DNA Barcoding for Valuable Tree Species in Indonesia

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Introduction: Illegal Timber

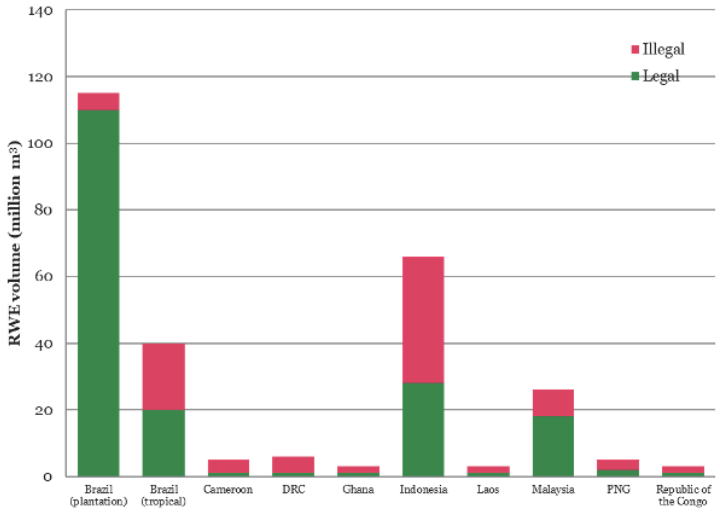
Violations in the Timber Trade

- Document falsification
- Misdeclaration of timber origin and/or species
- Customs fraud
- Logging outside concession boundaries

WRI (2026)

Status of Illegal Timber

The State of Illegal Logging Enforcement in Indonesia



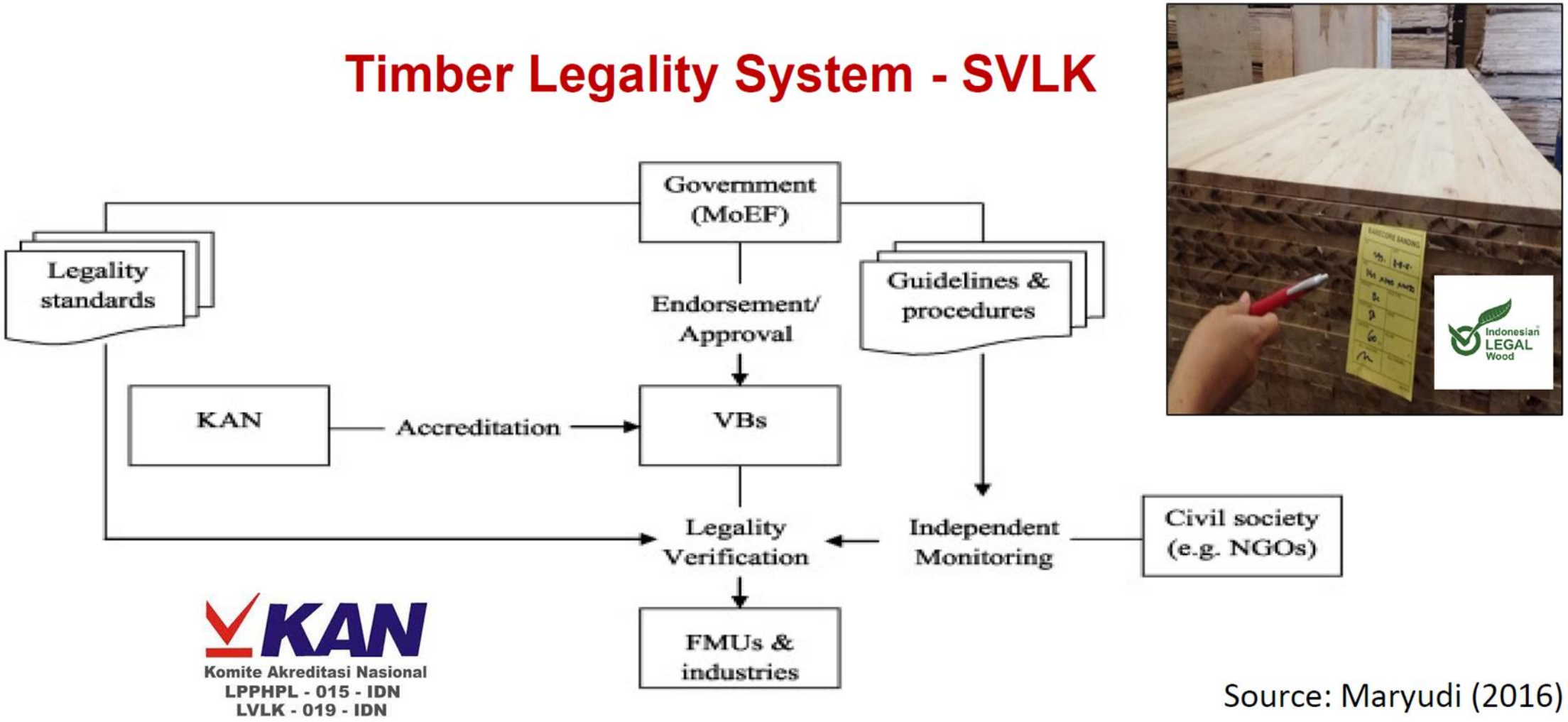
In 2013, Indonesia was among the world's three largest producers of illegal timber, with approximately 50% of its timber production estimated to originate from illegal sources

Indonesia is the only country authorized to issue FLEGT licenses and has implemented the Timber Legality Assurance System (SVLK) through mandatory certification

Most illegal timber trade cases are prosecuted under the Forestry Law (Law No. 41/1999) and the Law on the Prevention and Eradication of Forest Destruction (Law No. 18/2013)

WRI (2026)

Timber Legality System in Indonesia



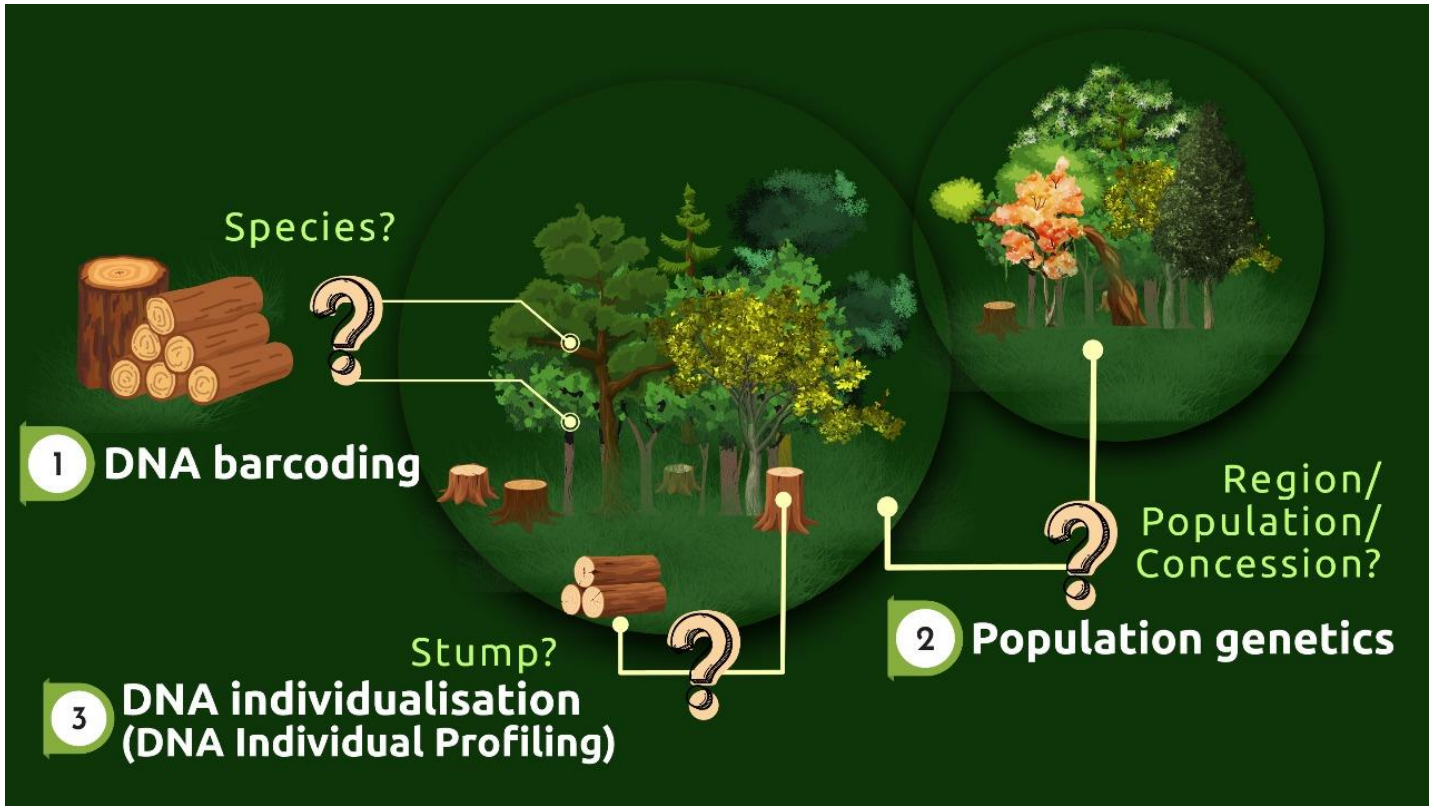
Source: Maryudi (2016)

Wood Identification Technologies Supports Law Enforcement

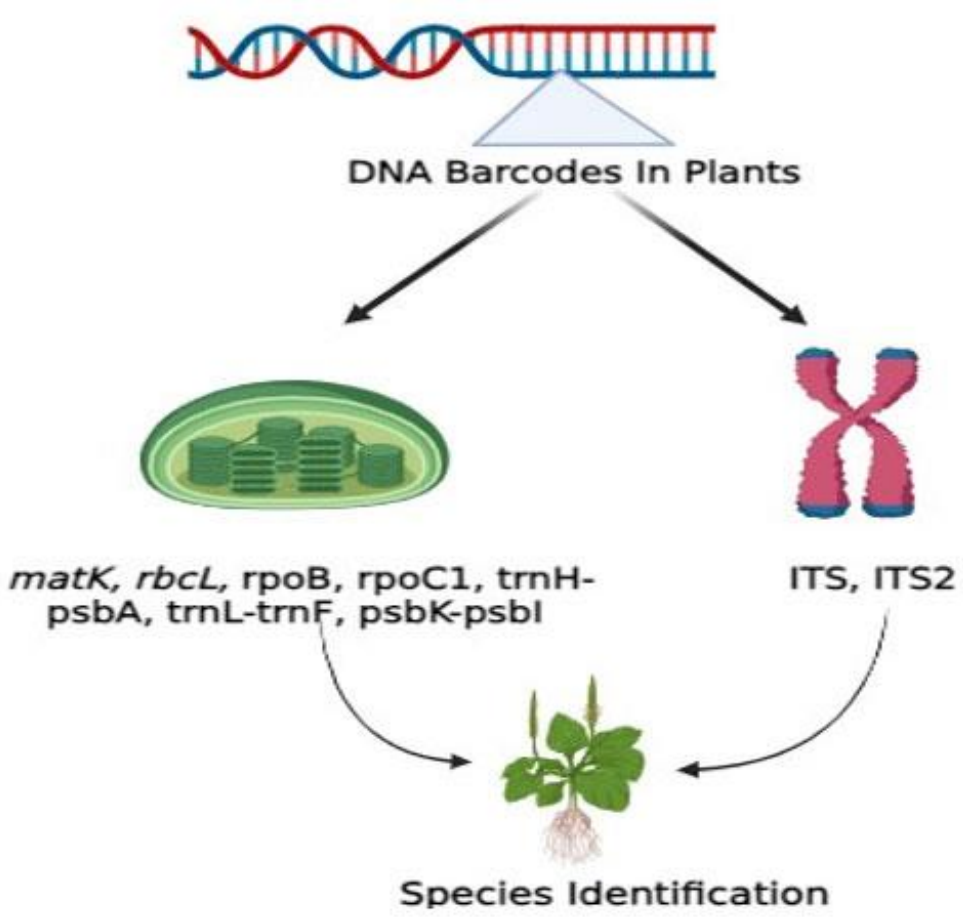
- Provides scientific evidence as recognized under Supreme Court Regulation (PerMA) No. 1/2023 on Guidelines for Adjudicating Environmental Cases
- Supports investigations that are subject to a 90-day time limit under Article 39 of the Forest Destruction Prevention and Eradication Law (P3H Law)
- Enables prosecutors to pursue additional or cumulative criminal sanctions
- Forestry non-tax state revenues (PNBP), particularly PSDH and Reforestation Funds (DR), are assessed based on timber origin (island) and species.

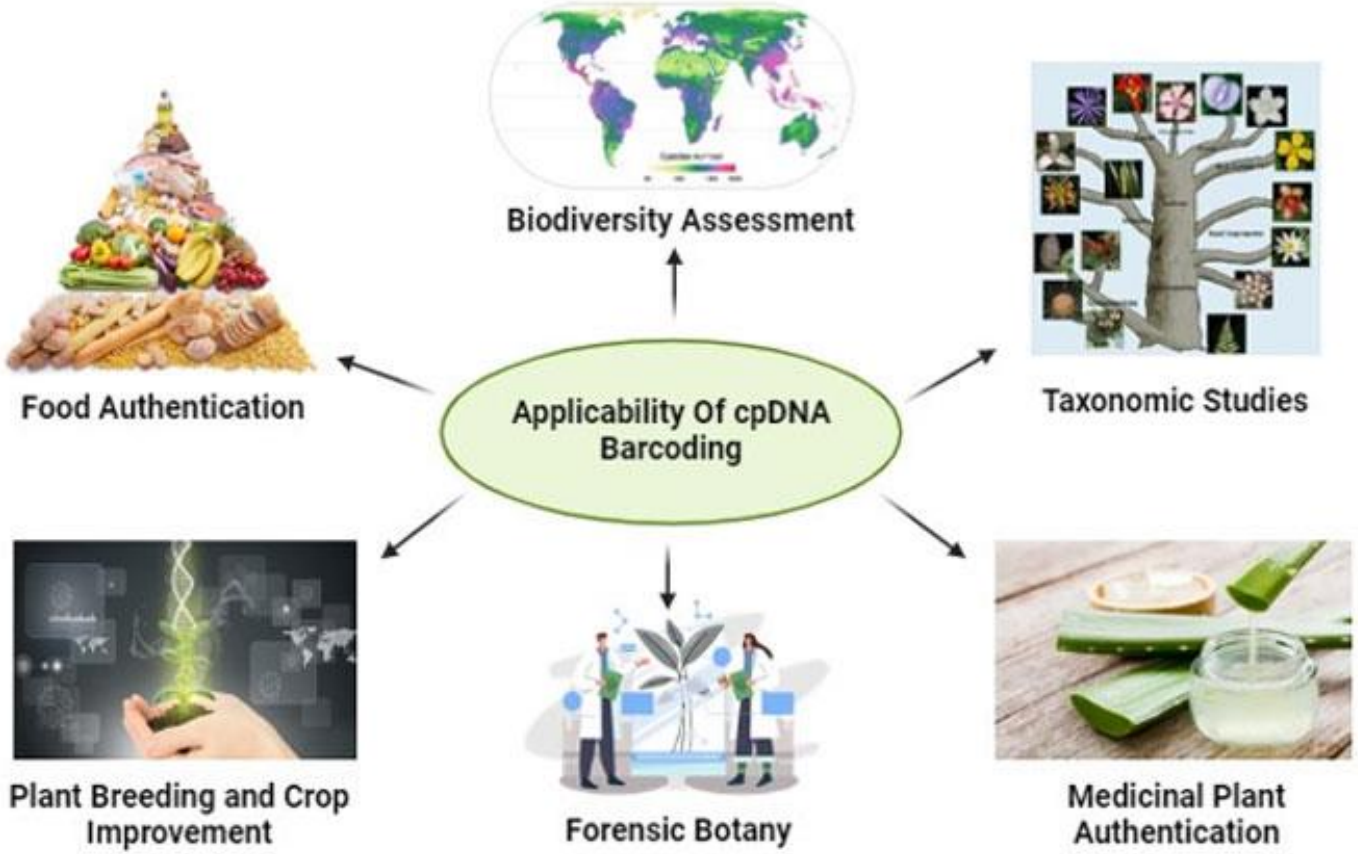
Molecular Wood Identification :

- Conventional DNA markers
- DNA Barcoding
- SNP: abundant and more specific markers



DNA Barcoding

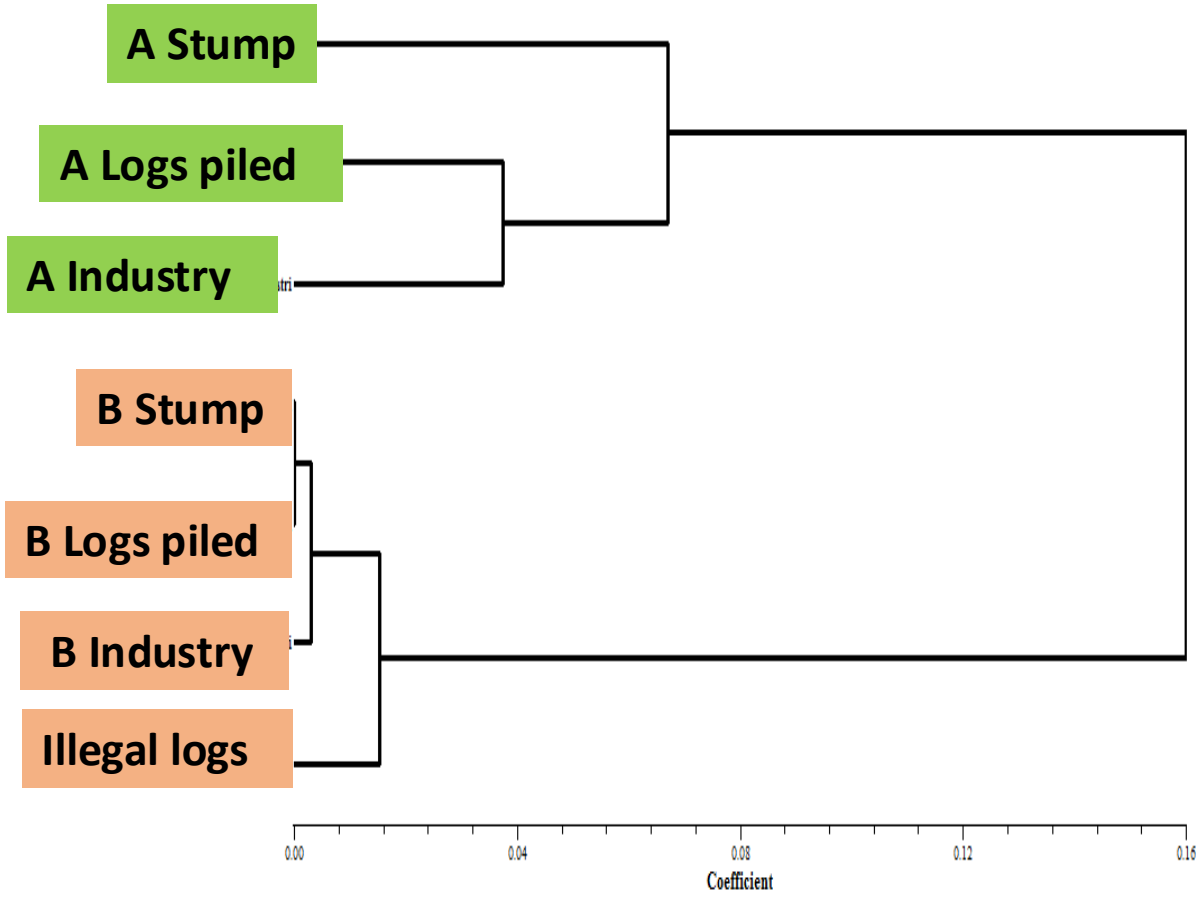




Behura et al. 2024

CASE STUDY: Concession Companies in Kalimantan

Dipterocarp: Assessed using Microsatellite markers

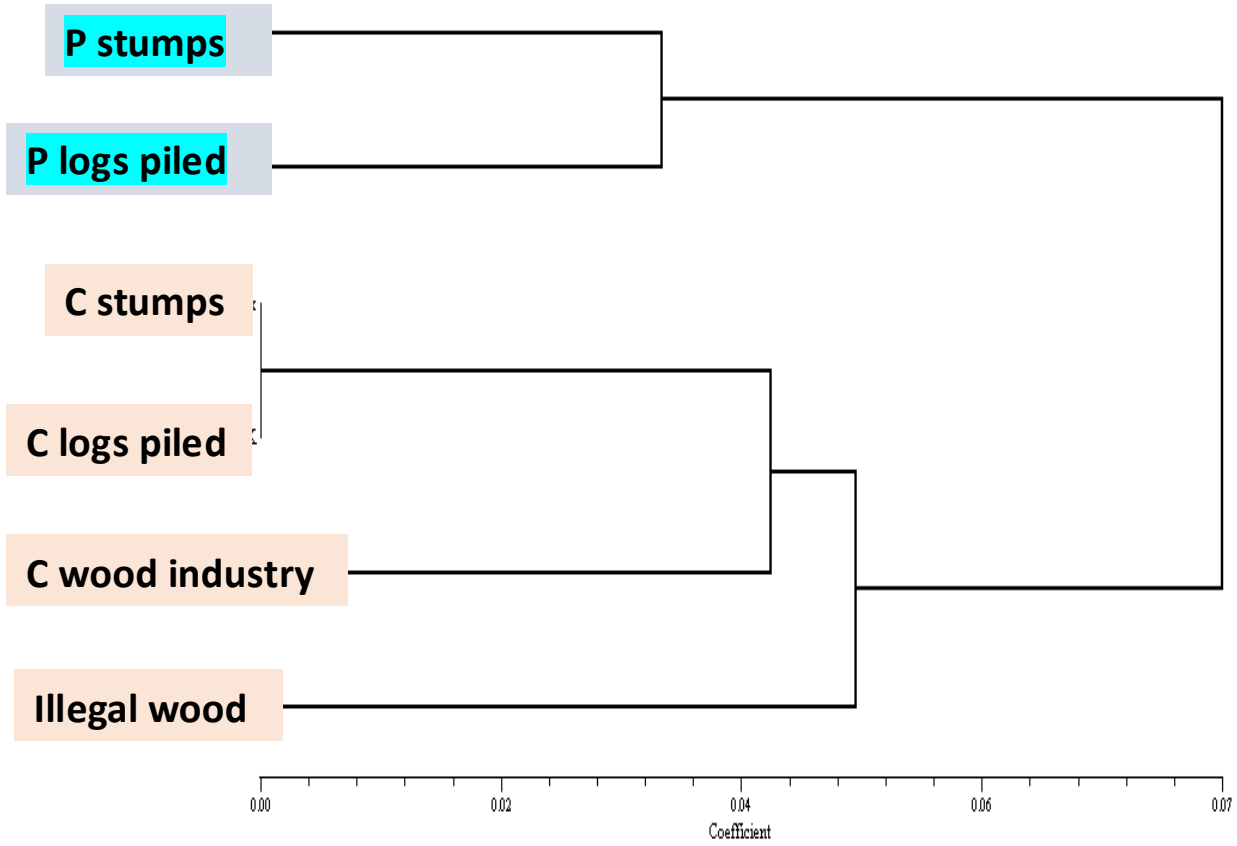


No	Location	Sample No.				Total
		Stump	Logs piled	Wood Industry	Illegal Wood	
1	Company A	20	20	20	40 (Jakarta – different island)	160
2	Company B	20	20	20		

Yunanto 2010

CASE STUDY: TEAK Plantation

Teak: Assessed using RAPD



No	Location	Age	Sample No.				Elevation (asl)
			Stump	Piled logs	Illegal	Industry	
1	FMU C	(30-40 yr)	11	11	7	12	69 m
2	FMU P	(50-60 yr)	20	20	-	-	96 m

Siregar et al. 2008)

Fingerprinting and Profiling: Most advance techniques

- **Rely on high-throughput technology powered by next-generation sequencing platforms**
- **Bypass traditional gel-based limitations to provide dense, genome-wide single nucleotide polymorphism (SNP) profiles**
- **There are several types:**

- High-Throughput Sequencing & Reduced Representation:

1. **Genotyping-by-Sequencing (GBS)**
2. **Restriction site-Associated DNA sequencing (RAD-seq)**

- High-Precision SNP Genotyping:

1. **KASP (Kompetitive Allele Specific PCR)**
2. **DNA microarrays (SNP Chips)**

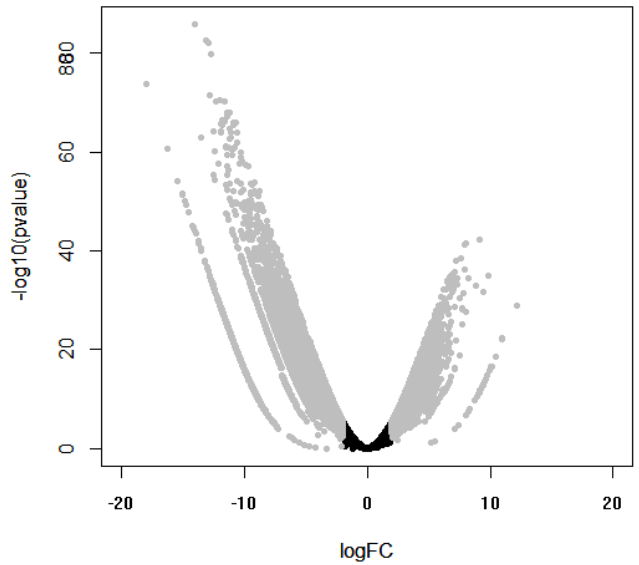
- Functional and Targeted Fingerprinting:

1. **Start Codon Targeted (SCoT) Polymorphism**
2. **Targeted Region Amplified Polymorphism (TRAP)**

Development of *SNP* markers: for tree resistance

Analysis of *transcriptomics:*

Resistant and susceptible trees have different set of expressed genes (both up-regulated and down-regulated) related to resistance to pest and disease



No	Sequence ID	logFC	Gene name
	Up-regulated		
1	FalSK.97594.1.T.79583.c4.g2.i2	12.17	Transcription factor CPC
2	FalSK.82701.1.T.79466.c1.g1.i4	10.96	Serine carboxypeptidase-like 18
3	FalSK.95586.66090.T.88690.c1.g1.i13	10.40	Serine carboxypeptidase-like 18
4	FalSK.95586.109491.T.81468.c3.g4.i2	10.10	Universal stress protein A-like protein
5	FalSK.61811.0.T.83289.c6.g2.i1	10.07	Cytochrome P450 78A5
6	FalSK.95586.84704.T.84126.c0.g1.i4	9.86	Ubiquitin carboxyl-terminal hydrolase 13
7	FalSK.95586.114481.T.84961.c0.g3.i6	9.78	NAD(P)H-dependent 6-deoxychalcone synthase
8	FalSK.95586.114551.T.84150.c0.g3.i2	9.78	UPF0057 membrane protein At2g24040
9	FalSK.110044.1.T.78909.c1.g1.i2	9.62	Retrovirus-related Pol polyprotein from transposon RE1
10	FalSK.110044.0.T.78909.c1.g1.i1	9.54	Retrovirus-related Pol polyprotein from transposon RE1
	Down-regulated		
1	FalSK.95586.47482.T.84387.c9.g3.i1	-16.27	Fasciclin-like arabinogalactan protein 12
2	FalSK.95586.51624.T.88608.c2.g2.i11	-15.41	ATP synthase protein MI25
3	FalSK.95586.43003.C22450	-14.55	Cytochrome c oxidase subunit 1 (Fragment)
4	FalSK.95586.51538.T.89133.c2.g2.i2	-14.21	Cytochrome c oxidase subunit 1
5	FalSK.95586.73299.C24188	-14.19	RNA-directed DNA polymerase homolog
6	FalSK.95586.35682.T.89651.c2.g1.i5	-14.12	NADH-ubiquinone oxidoreductase chain 5
7	FalSK.95586.60006.T.89651.c2.g1.i8	-14.04	NADH-ubiquinone oxidoreductase chain 5
8	FalSK.95586.39961.T.80573.c3.g1.i8	-13.97	COBRA-like protein 4
9	FalSK.95586.49425.T.89133.c2.g1.i6	-13.53	Cytochrome c oxidase subunit 1
10	FalSK.95586.58752.T.88479.c6.g3.i6	-13.03	Photosystem II CP47 reaction center protein

Alleles related to resistance

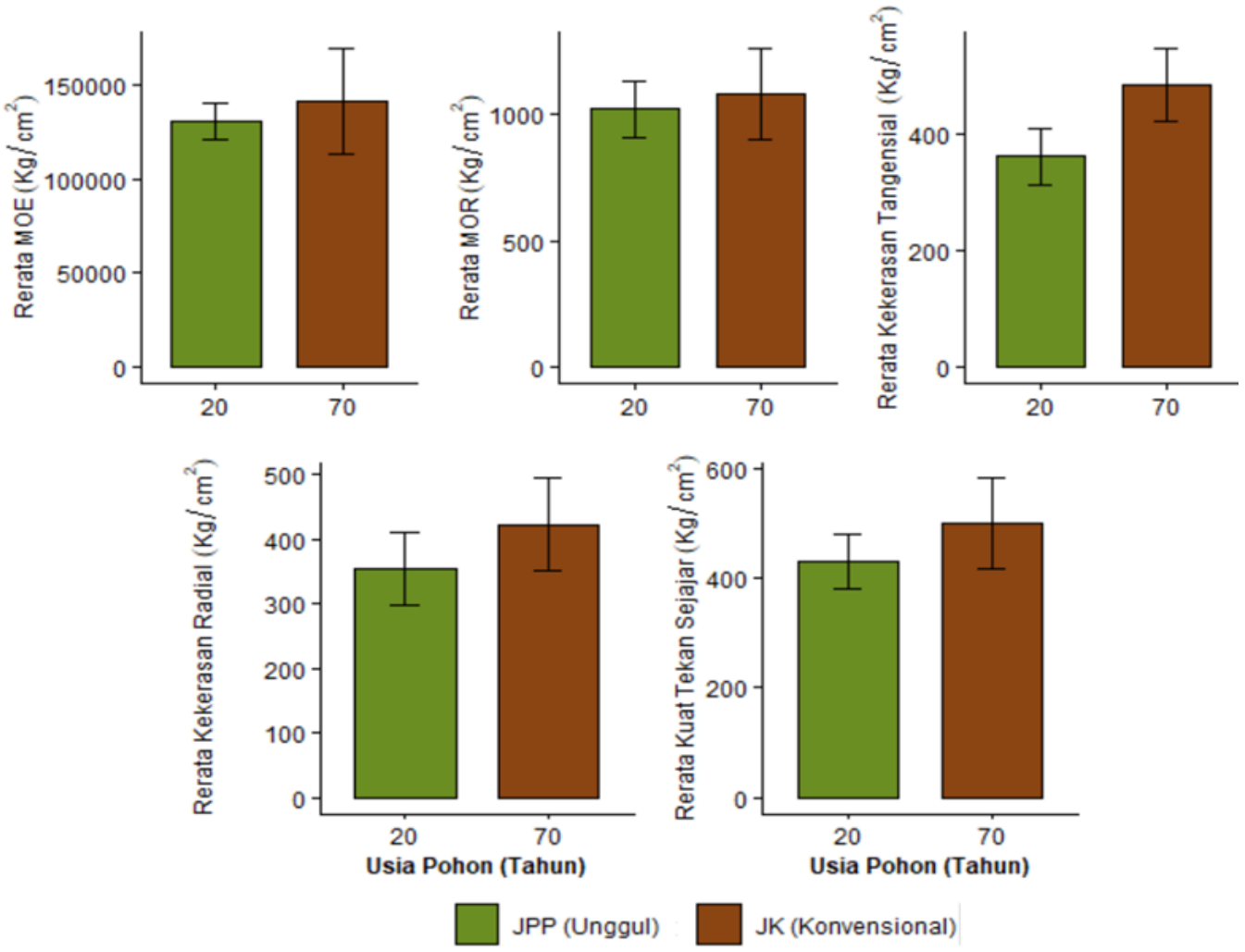
Parameter (%)	WRKY 40			IAA 1			IAA 2		
	AA	AT	TT	CC	CA	AA	CC	CA	AA
Disease insidence	100	100	-	100	100	100	100	100	100
Severity	52.66	88.61	-	74.87	53.33	54.45	69.52	47.22	55.96
Mortality	31.40	47.22	-	41.88	25.92	33.33	42.06	27.78	29.29
	A ← T			C → A			C → A		

Comparison of Fast-growing (FT) vs. Conventional Teak (CT)

38 cm (FT 20 yrs)

38 cm (CT 70 yrs)

22 cm (CT 20 yrs)



- **Differences in several wood properties between FT 20 yrs and CT 70 yrs were not significant**

- **Clonal forestry in teak plantation made it possible and easier to fingerprint the clones**

Lessons Learned:

- Molecular genetic markers showed consistency in timber forest products throughout timber chain of custody
- Success of DNA isolation from wood is a precondition for feasible application of technologies
- Requirements for full application of molecular markers and fingerprinting in forensic genetics in forestry depend on:

    - establishment of complete data base on genetic variations of important timber species

    - cheap and easy methods for DNA analysis

Siregar et al. BMC Res Notes (2021) 14:261
https://doi.org/10.1186/s13104-021-05675-9

DATA NOTE

De novo transcriptome for sengon (*Falcataria* displaying resistance a to *boktor* stem borers (

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Deden D. Matra[4]

BMC Research Notes

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Data in Brief
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CONTRIBUTED PAPERS

Conservation Biology

Tropical and subtropical Asia's valued tree species under threat

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Article

e novo transcriptome datasets of *Shorea langeran* leaves and basal stem in

Policy and Economics
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DOI: 10.13057/biodiv/d220534

Trypsin inhibitor activities as defense m (*Falcataria moluccana*) against pest attac

BIODIVERSITAS
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Fingerprinting sengon (*Falcatria moluccana*) accessions resistant to boktor pest and gall rust disease using microsatellite markers

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Plant M
ISPMB © 2006

Commentary

of heritability in a sengon Kediri, East Java, Indonesia

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s of sengon (*Paraserianthes* nity forest plantation, a ies in East Java, Indonesia

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BMC Research Notes

Extraction, Amplification and Characterization of Wood DNA from Dipterocarpaceae

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Abstract. A successful DNA extraction from wood yielding appropriate DNA quality for PCR amplification allows molecular genetic investigations of wood tissue. Genotypes, the origin of sampled material, and species can be identified based on an investigation of wood if suitable information on genetic variation patterns within and among species is available. Potential applications are in forensics and in the control of the timber and wood

sts in Southeast Asia and n Japan based on alysis of 16S rRNA

Charles[2], Bibian Diway[2], John Sabang[2],
amiya[4], Shawn Lum[5], Ulfah J. Siregar[6],
hiko T. Miyashita[1*]

DATA NOTE Open Access

De novo assembly of transcriptome dataset from leaves of *Dryobalanops aromatica* (Syn. *Dryobalanops sumatrensis*) seedlings grown in two contrasting potting media

Iskandar Zulkarnaen Siregar[1*], Fifi Gus Dwiyanti[1], Ulfah Juniarti Siregar[1] and Deden Derajat Matra[2]

Reasearch Team - Acknowledgement

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Rahadian Pratama
Others

IPB University
Bogor Indonesia

Kampus Merdeka
INDONESIA JAYA

Thank You