Asia-Pacific
Economic Cooperation

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Agenda Item: 1

The Development of DNA Marker for Export-Controlled Timber and Domestic Forest Production Traceability System in Chinese Taipei

Submitted by: Chinese Taipei

APEC 2025
KOREA

Dialogues and Mini-Exhibition on Enhancing Enforcement and Legal Timber Trade through Stakeholder Collaboration and Innovation
Incheon, Korea
28 July 2025

The development of DNA marker for export-controlled timber and domestic forest production traceability system in Chinese Taipei

Dr. Chia-Chen Wu
Chinese Taipei
28th, July, 2025

About Me

- Dr. Chia-Chen Wu/
  - 2010-2024, Associate Researcher, Taiwan Forestry Research Institute
  - 2024- Assistant Professor, National Taiwan University
- Research areas: DNA markers and silviculture. Tree improvement, Genomic selection.
- Research experience:
  - 2011-2012 WFI visiting scholar, Oregon, USA (10 months)
  - 2017, APAFRI execute committee
  - 2018, EEAD visiting scholar, Zaragoza, Spain (3 months)
  - 2023, Forest genetics, Vernon, Canada; APEC EGILAT-SOM3, USA
  - 2024, APEC EGILAT workshop, Bogor, Indonesia

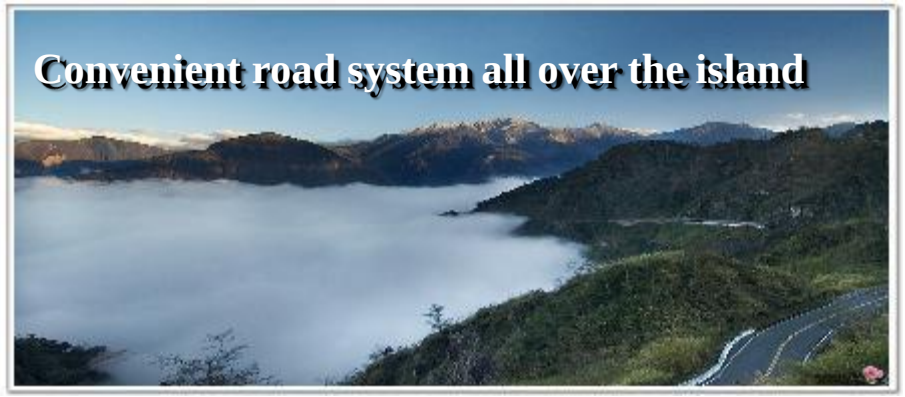



Outline

1. Forestry background of Chinese Taipei
2. DNA markers for export-controlled tree species identification
   - (Case studies: previous and recent applications)
3. Domestic forest production traceability system
4. Other application and combat the domestic illegal cutting
5. Conclusion

Forestry background of Taiwan island

- **60% of forestry area coverage and about 300 peaks (Mountains) are over 3,000 m (9,842 ft) in Chinese Taipei island.**
- Because of **the elevation and climate**, different forest types are found in Chinese Taipei island.



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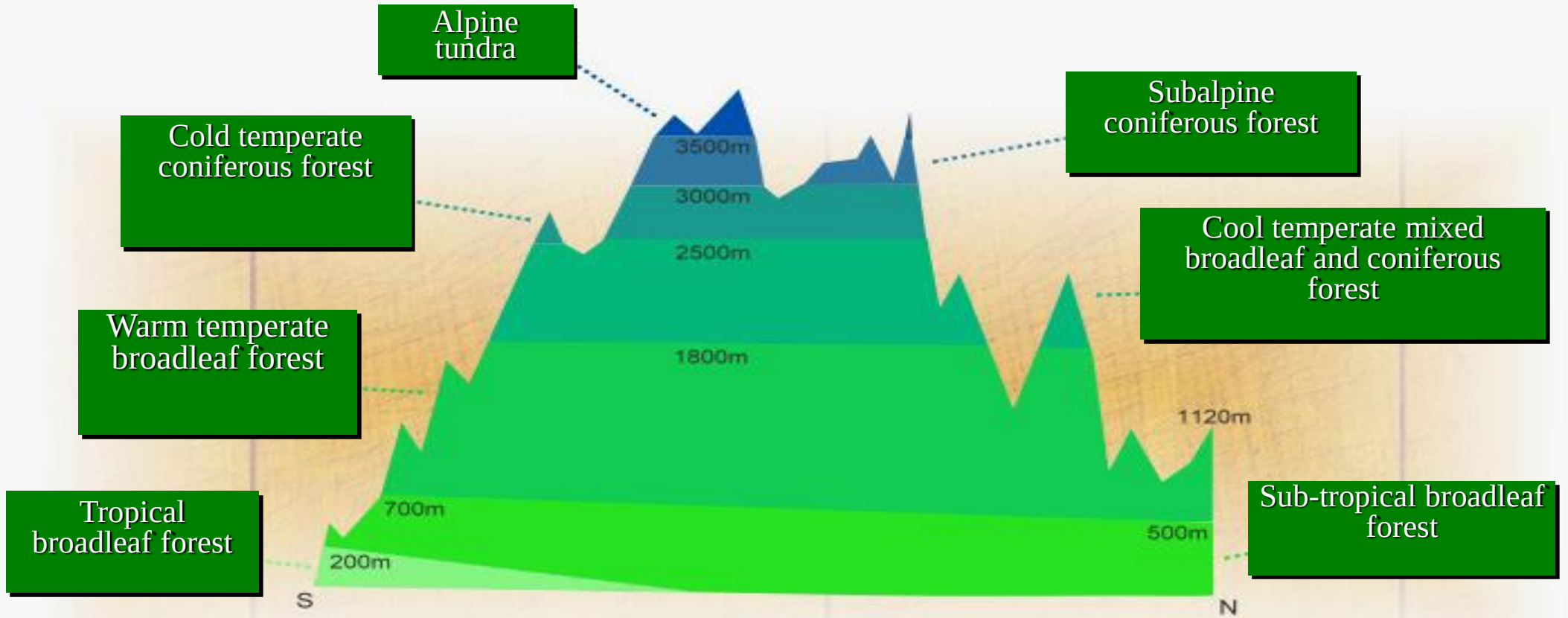
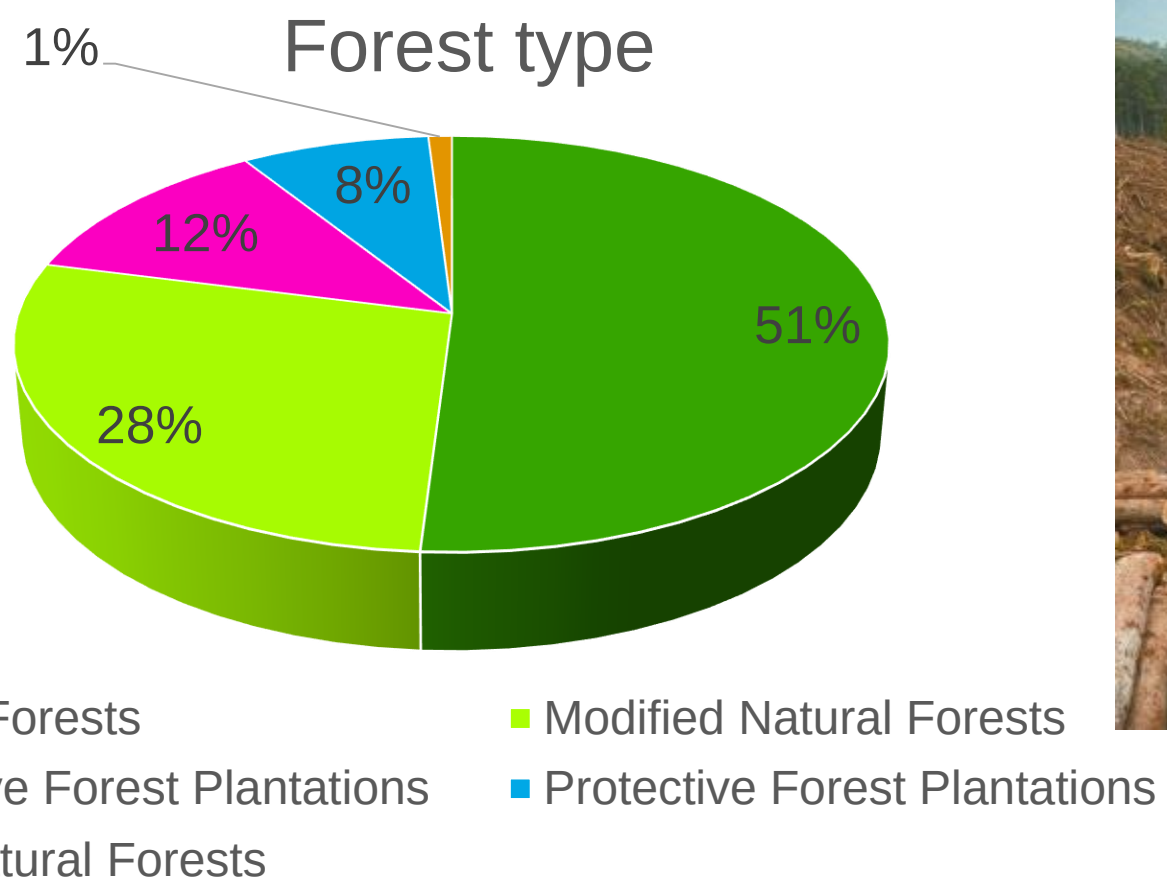


THE VERTICAL ZONATION OF FOREST TYPES IN CHINESE TAIPEI ISLAND

Forest Type and Ownership

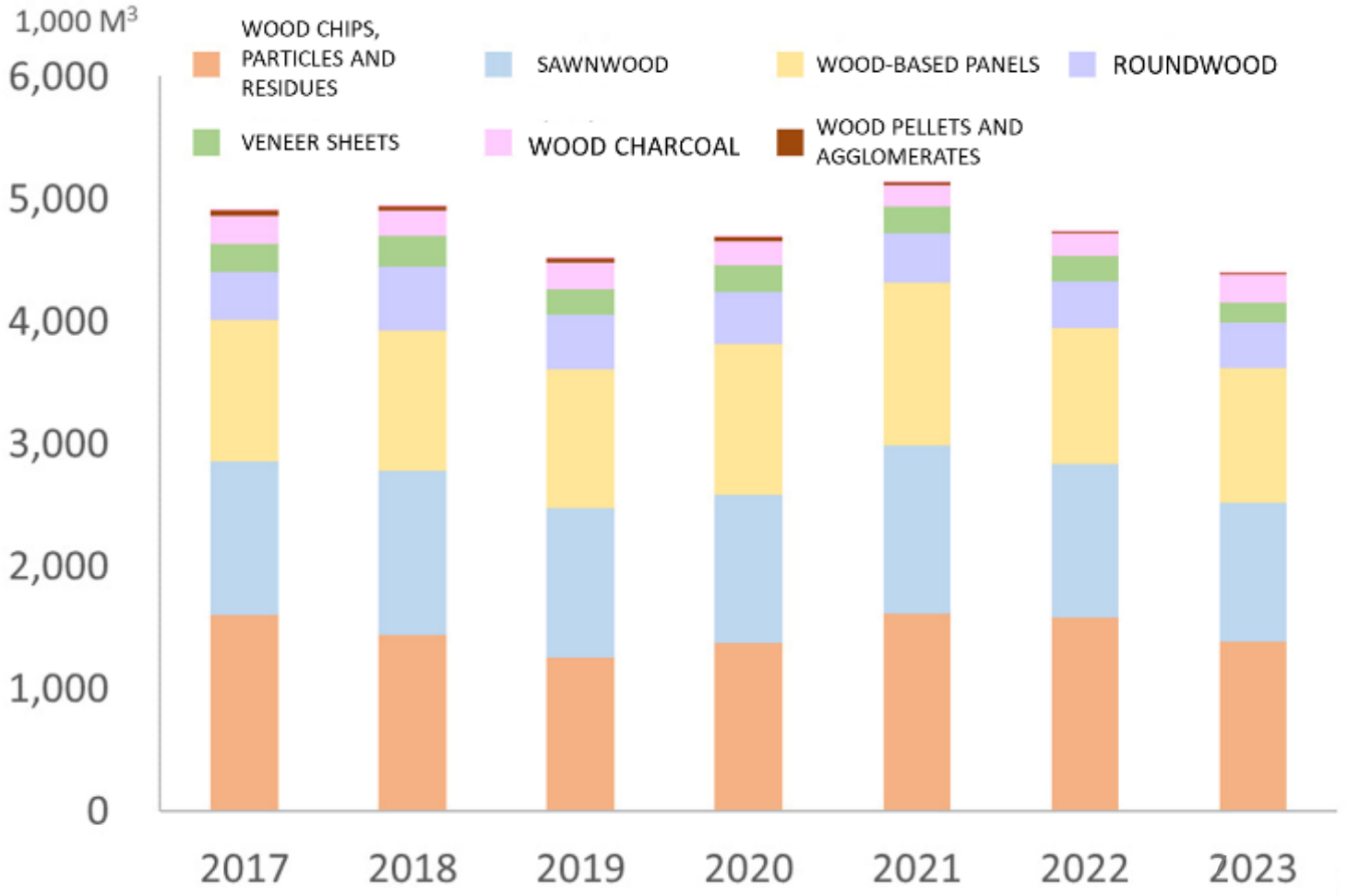
- Only 12% forest area is productive plantation.
- 7% forest land is private.
- 93% is state-owned forest.



Hsinchu county

Policy: Banned logging in primary forest Since 1990

- Imported 500-600 cubic meter wood-related products in Chinese Taipei, yearly
- 99% timber / wood-related products are imported.



DNA markers for export-controlled tree species identification

- Background for developing species /individual identification DNA markers
  - Announcement of Precious Wood Products Export Control (Since Dec, 2022).
  - Exportation of wood products made by these species should get permit from MoA, Chinese Taipei.
  - These four species are easily confused with related-species.

Cinnamomum kanehirae

Chamaecyparis formosensis

C. obtusa var. *formosana*

Calocedrus formosana

Potential criminal behavior

✓ Fraud with false species/hybrid
Related species: *Cinnamomum micranthum*

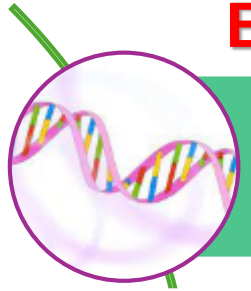
✓ High risk illegal cutting for medical use

✓ Fraud with false species/forma
Forma species: *C. obtusa* var. *obtusa* (Japanese cypress from Japan)

✓ Very high risk illegal cutting for art/ craft

✓ Fraud with false species
Related species: *C. macrolepis* from China & *C. rupestris* from Viet Nam

✓ High risk illegal cutting for art/ craft



Basic requirement for DNA marker

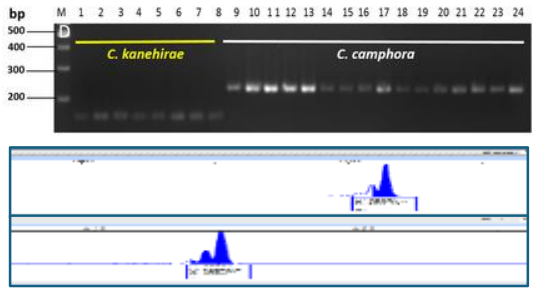
DNA database establishment

- Database is essential for DNA fingerprinting.
  1. Primer/marker sequencing database is necessary.
  2. We need basic genotyping database (enough plant samples)for further identification analysis.

polymorphic

1. DNA sequence (specific regions): i.e. DNA barcode

2. DNA size



DNA markers for export-controlled tree species identification


Cinnamomum kanehirae


Chamaecyparis formosensis
C. obtusa var. formosana


Calocedrus formosana

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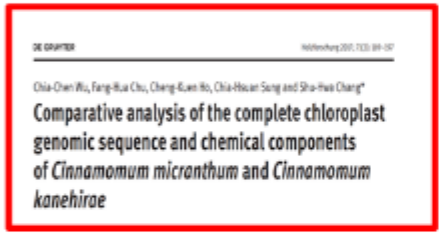
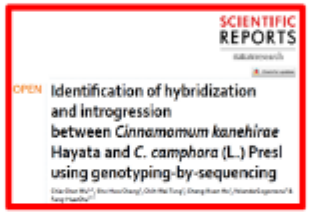
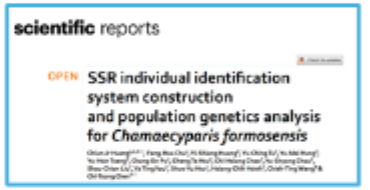
We developed different DNA markers for identification

Species/forma level	Hybrid	Individual level
Chloroplast indel	SNP	SSR
1. $Cinnamomum kanehirae 2. *Chamaecyparis* spp 3. *Calocedrus* spp	1. *Cinnamomum kanehirae	1. #*Chamaecyparis* spp


Comparative analysis of the complete chloroplast genomic sequence and chemical components of *Cinnamomum micranthum* and *Cinnamomum kanehirae*


SCIENTIFIC REPORTS
Identification of hybridization and introgression between *Cinnamomum kanehirae* Hayata and *C. camphora* (L.) Presl using genotyping-by-sequencing


scientific reports
SSR individual identification system construction and population genetics analysis for *Chamaecyparis formosensis*

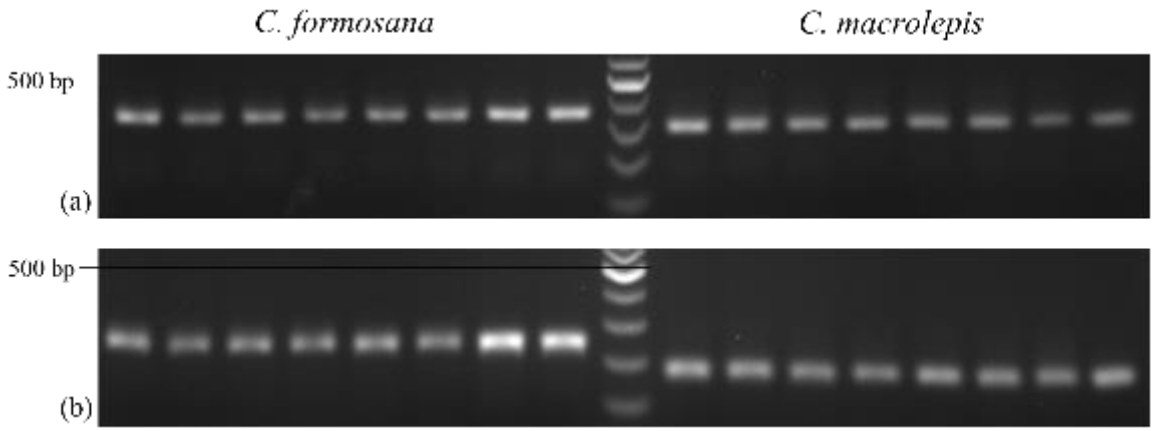

scientific reports
Development and technical application of SSR-based individual identification system for *Chamaecyparis taiwanensis* against illegal logging convictions

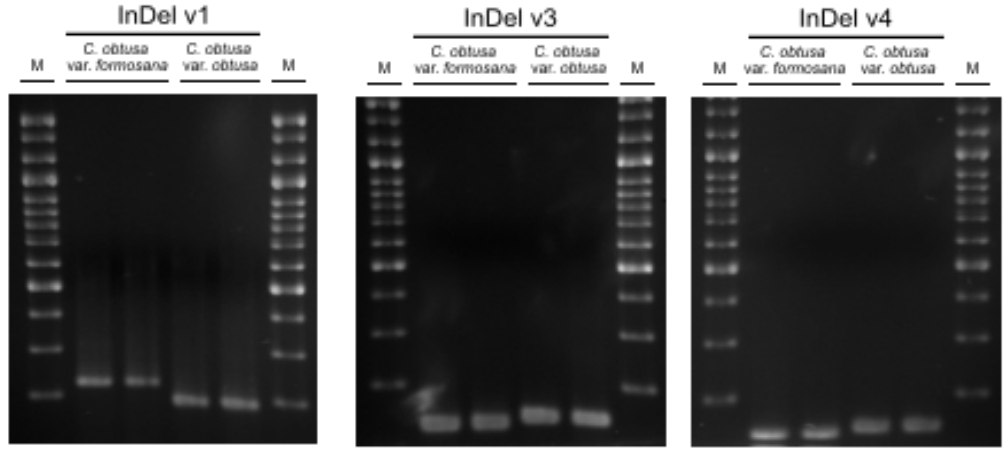
Labeled ($*#)were published
$ used in wild filed identification
# Forensic identification in court

Recently, we develop the DNA marker for cypress and *Calocedrus*

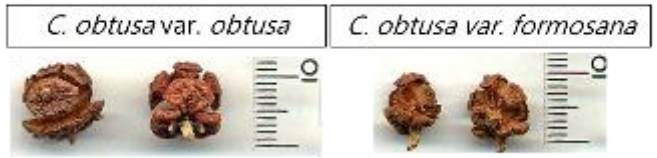
DNA markers for export-controlled tree species identification

We designed the suitable and specific DNA markers for wood sample identification in cypress and *Calocedrus* spp





	C. obtusa var. *obtusa*	*C. obtusa* var. *formosana*
Leaf	blunt apex	with a more acute apex
Cone	spherical cone, slightly larger than C. obtusa var. formosana	spherical cone
Wood	light, earthy aroma	pungent odor



DNA markers for identifying *C. obtusa* forma (Japan cypress and Chinese Taipei cypress).

Domestic forest production traceability system

- We use QR code and independent third-party verification system to track the domestic timber and bamboo products.
- The wood products of exported-controlled species under these categories should acquire domestic traceability system.

Regulated Products

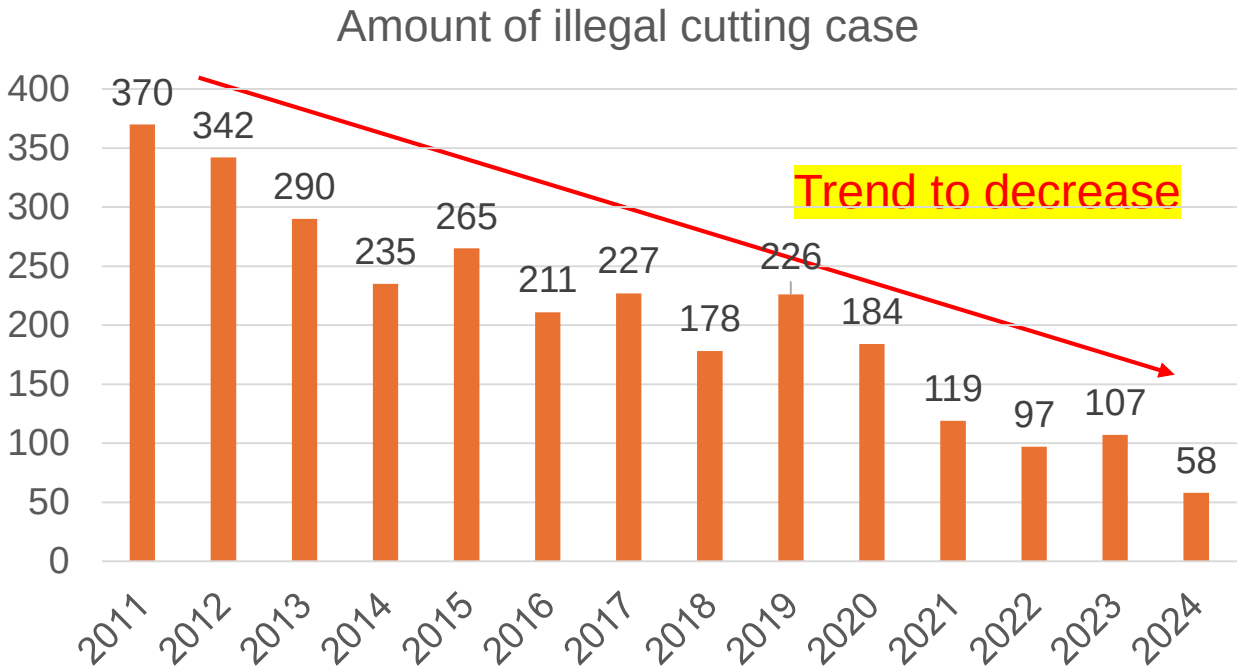
- Roundwood 4403
- Sawn wood 4407
- Shape wood4409
- Wood marquetry 4420
- Wood sculpture 9703

Other Actions already being taken to combat illegal cutting

- **Collaborating platform**
  - cooperation of forestry agencies, police department, prosecutor office, sometimes with immigration agency.
  - Meeting and action together, be a tightly enforcement platform (2010-)
- **Community patrol**
  - collaborate with communities and aboriginal villages around the forest to patrol the forest. (2012-)

Joint meeting for combating illegal cutting
(Photo from: Taichung Branch, Forestry and Nature Conservation Agency)

Other Actions already being taken to combat illegal cutting

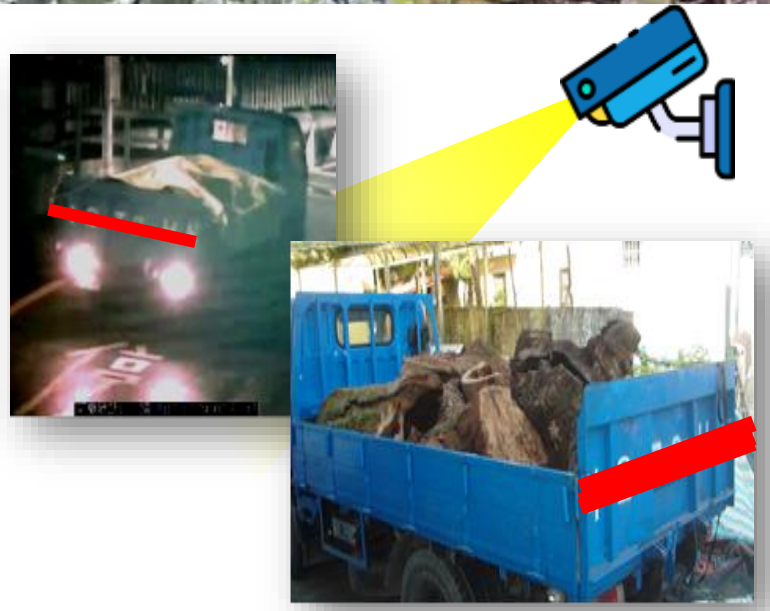


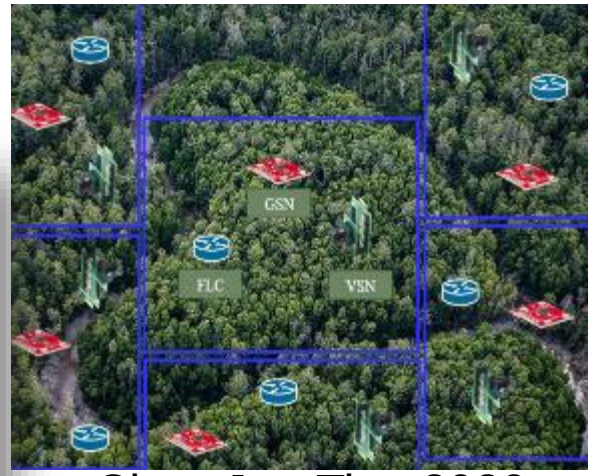
Whistle-blowing system

Blacklist of car plates

Other technologies

- In site device:
  - Blacklist of car plates, and recognize them on major forest roads in advance.
  - Infrared sensor for motion, then turn on the **hidden camera** and inform to the ranger, right away.
- Other technologies undergoing:
  - In-site inform/sensor system (Vibration and audio detector)
  - Wood image identification by machine learning (AI)





Chen Jen-Ting 2020

Conclusion

1. Multiple- and cooperation- innovation methods we applied in Chinese Taipei for combating illegal cutting.
2. Besides morphological identification, DNA marker is a well-known and reliable tool for woody species identification.
3. For different purposes, different DNA markers should be considered and selected to use.
4. More technologies (i.e.: machine learning) are also important in the future.

Acknowledgement

- Forestry and Nature Conservation Agency, Ministry of Agriculture
- Taiwan Forestry Research Institute, Ministry of Agriculture
- Investigation Bureau, Ministry of Justice

農業部
林業及自然保育署
Forestry and Nature Conservation Agency,
Ministry of Agriculture