



UNFCCC COP24 ITTO/FFPRI Side Event
**“Restoring degraded tropical forests: reconciling carbon,
biodiversity and community resilience”**

How to evaluate forest degradation?

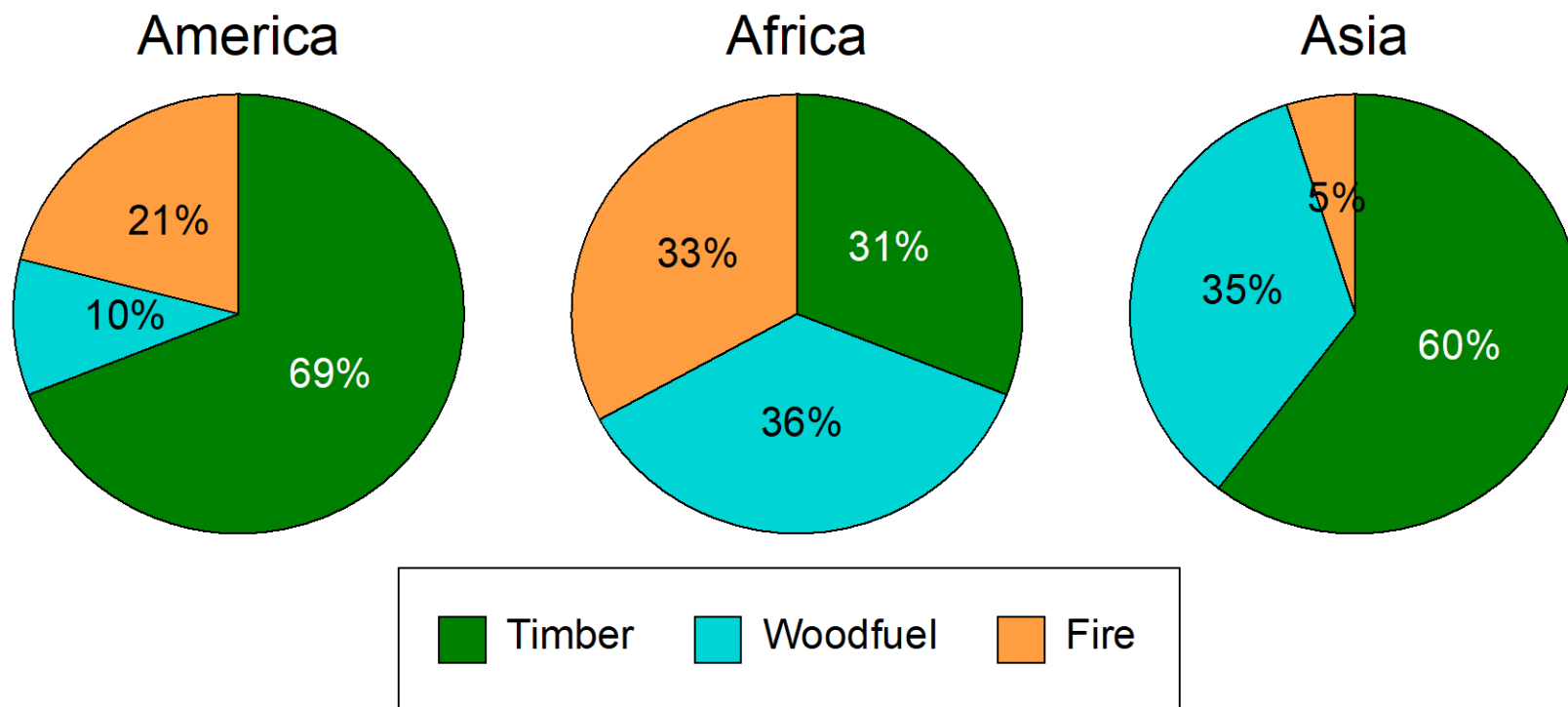
A forest ecologist’s view

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Why forest degradation is important?

- Although emission from forest degradation for 74 developing countries accounted for just a quarter of the total emission (deforestation and degradation), emission from forest degradation exceeded those from deforestation in 28 of 74 countries (Pearson et al. 2017).
- Compared to deforestation, forest degradation tends to be difficult to detect using remote sensing data.
- Although technical difficulties, accurate and precise carbon accounting for forest degradation is indispensable for REDD project under national and sub-national scale.

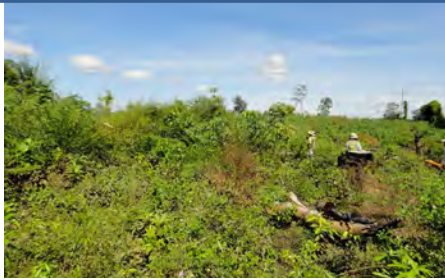
Forest degradation emissions by degrading activity



Pearson et al. 2017

Detect or not using RS data

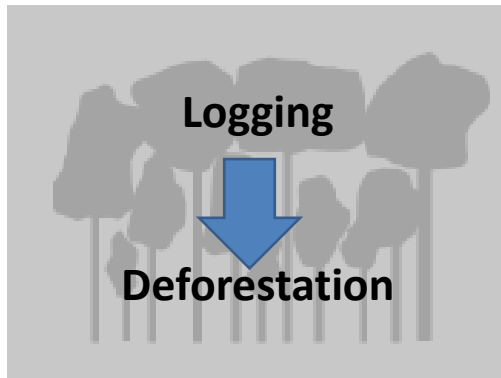
**Detectable
deforestation by
remote sensing imagery**



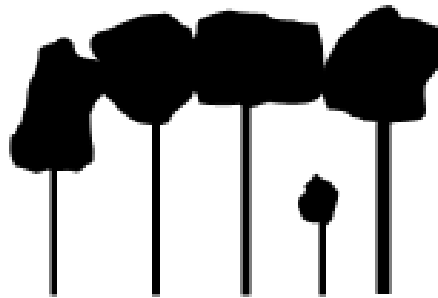
**Not detectable
degradation by remote
sensing imagery**



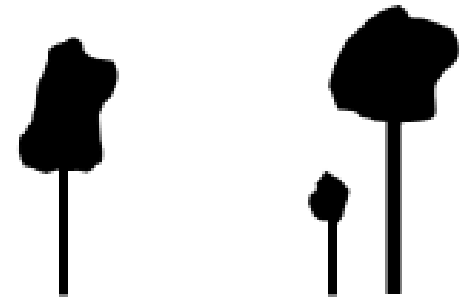
**Detectable degradation
by remote sensing
imagery**



Biomass stock time 1



Biomass stock time 2



Biomass stock time 3

Low



High

Magnitude of degradation

Referred from Köhl et al. (2009)

Degraded by forest fires



Palangkaraya, Indonesia



Kampong Thom, Cambodia

Degraded by forest fires

Table 1. Tree species and genera from the 10–20 cm DBH size class (and shrubs and saplings below 10 cm in DBH) which were most abundant in each burn treatment, showing a high degree of turnover in community composition with each additional burn. (All species (or genera) with a density greater than 10 trees ha⁻¹ are shown for trees 10 cm and above in DBH, and the most abundant species in once-, twice- and thrice-burned forest plots are shown for saplings.)

species	family	forest type where most abundant	trees (10–20 cm in DBH) ha ⁻¹			
			unburned	once-burned	twice-burned	thrice-burned
<i>Protium</i> and <i>Tetragastris</i> spp.	Burseraceae	unburned	69	15	2	2
<i>Pouteria</i> and others	Sapotaceae	unburned	17	13	0	0
<i>Sclerolobium</i> and <i>Tachigali</i> spp.	Fabaceae	unburned	17	4	0	0
<i>Rinorea</i> spp.	Violaceae	unburned	14	0	0	0
various genera	Lauraceae	unburned	12	2	4	0
<i>Cecropia</i> spp.	Cecropiaceae	once-burned	0	69	22	8
<i>Jacaranda copaia</i>	Bignoniaceae	once-burned	0	18	0	0
<i>Pseudobombax</i> sp.	Malvaceae	twice-burned	0	0	88	14
<i>Inga</i> spp.	Fabaceae	twice-burned	8	0	22	10
<i>Tapirira</i> sp.	Anacardiaceae	twice-burned	0	0	14	0
<i>Cordia</i> sp.	Boraginaceae	thrice-burned	1	2	0	30
			saplings (< 10 cm in DBH) per 200 m ²			
<i>Palicourea guianensis</i>	Rubiaceae	once-burned	—	38	0	5
<i>Aparisthium cordatum</i>	Euphorbiaceae	twice-burned	—	13	79	12
<i>Cordia</i> sp.	Boraginaceae	thrice-burned	—	4	5	30

Referred from Barlow & Peres 2008

- Species composition were changed after fires
- Difficult to recovery after repeated fires
- Forest carbon stock decreased simultaneously

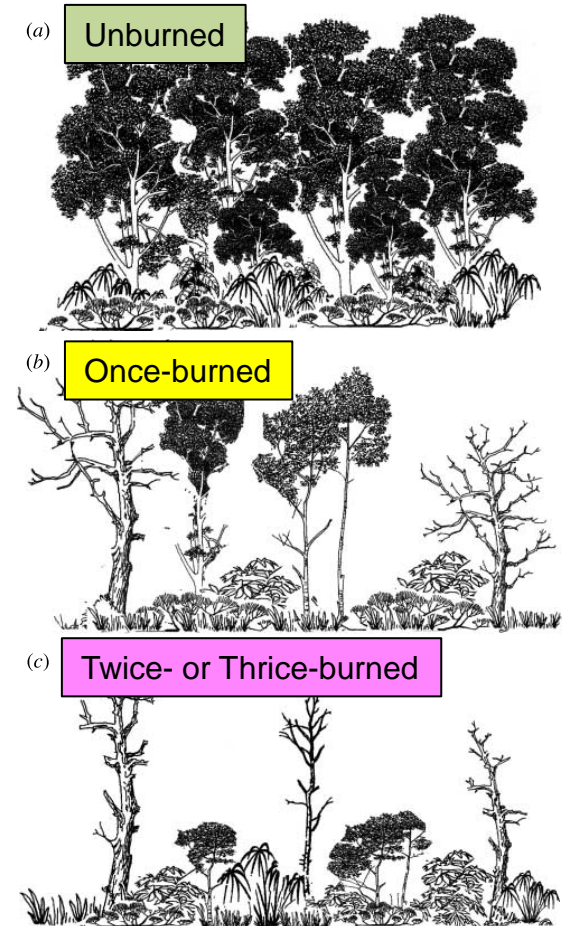


Figure 2. X-ray of forest degradation after fires

Forest fires facilitate bamboo dominance

Case study in Myanmar

Open forest



Plot #3

Canopy coverage: 16%
(**Bamboo coverage: 8%**)
Tree biomass: 77.2 Mg/ha
Bamboo biomass: 58.6 Mg/ha

Closed forest
(bamboo dominated)



Plot #14

Canopy coverage: 64%
(**Bamboo coverage: 56%**)
Tree biomass: 44.0 Mg/ha
Bamboo biomass: 37.6 Mg/ha

Closed forest
(tree dominated)



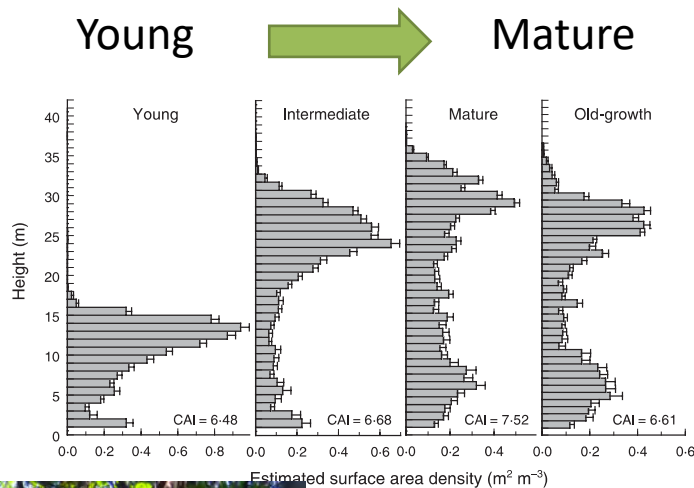
Plot #5

Canopy coverage: 60%
(**Bamboo coverage: 0%**)
Tree biomass: 299.3 Mg/ha
Bamboo biomass: 3.8 Mg/ha

Aerial photos were taken by Asian Air Survey Co, Ltd

Forest structure reflects plant biodiversity

Species diversity correlated to heterogeneity of vertical forest structure.



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Young fo
vertical

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High

RTS

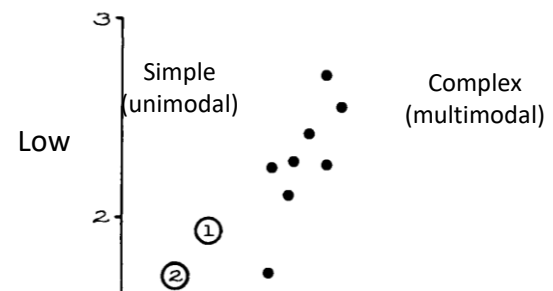
Ecology, Vol. 42, No. 3

diversity and bird species diversities are shown as well as plant species diversity and latitude. These are plotted as a graph in Figure 2, showing a close fit to the line:

$$\text{bird species diversity} = 2.01 \text{ foliage height diversity} + .46,$$

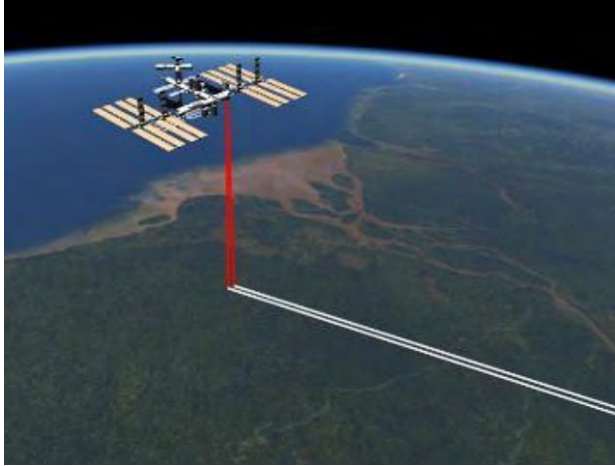
calculated by least squares. Various other subdivisions of the profile into horizontal layers were tried, and the layers 0-2', 2'-25' and >25' were chosen as those layers which made the collection of points on the graph most orderly. It is of interest that this subdivision was chosen after the Vermont censuses were taken in 1959 and that it continued to be appropriate for the censuses in 1960, elsewhere. Such subdivisions as 0-3', 3-30' and >30' were nearly as good, but more nearly equal subdivision (e.g. 0-15', 15-30', >30') made a very scattered

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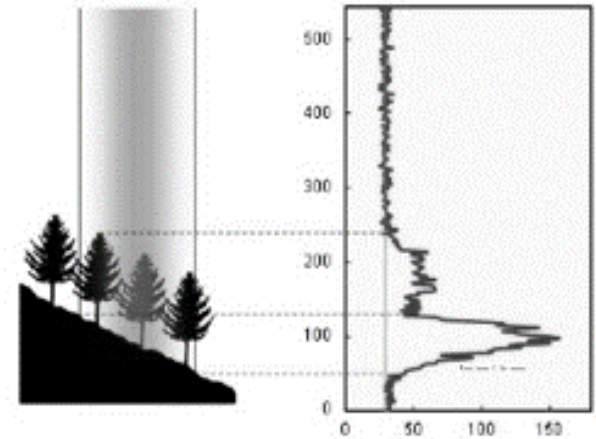
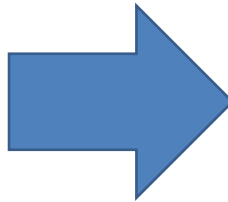


MacArthur & MacArthur (1961)

Reconciling carbon and biodiversity



Satellite-borne LiDAR
(Source from JAXA)



Canopy height and vertical structure
would detect using LiDAR data.

Canopy height



Forest carbon stock

Vertical structure



Tree species diversity

The latest device would provide useful information to
evaluate forest degradation including biodiversity.

Conclusions

- Changes in species composition occur through degradation progress. Evaluation of species compositions is also important as well as carbon stock estimation in degraded forests.
- The latest device (e.g. UAV and satellite-borne LiDAR) would provide useful information to evaluate forest degradation under various spatial scales.
- Ground-based inventory is indispensable to understand forest degradation and develop measures against degradation.