REDD+における
森林炭素モニタリングの意味

What is the point of forest carbon monitoring in REDD+?

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はじめに/ Contents

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   What is “forest carbon monitoring”?

2. モニタリングの対象は炭素だけではない
   Carbon is not only target

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   Forest degradation is indispensable component

4. より継続的なモニタリングを目指して
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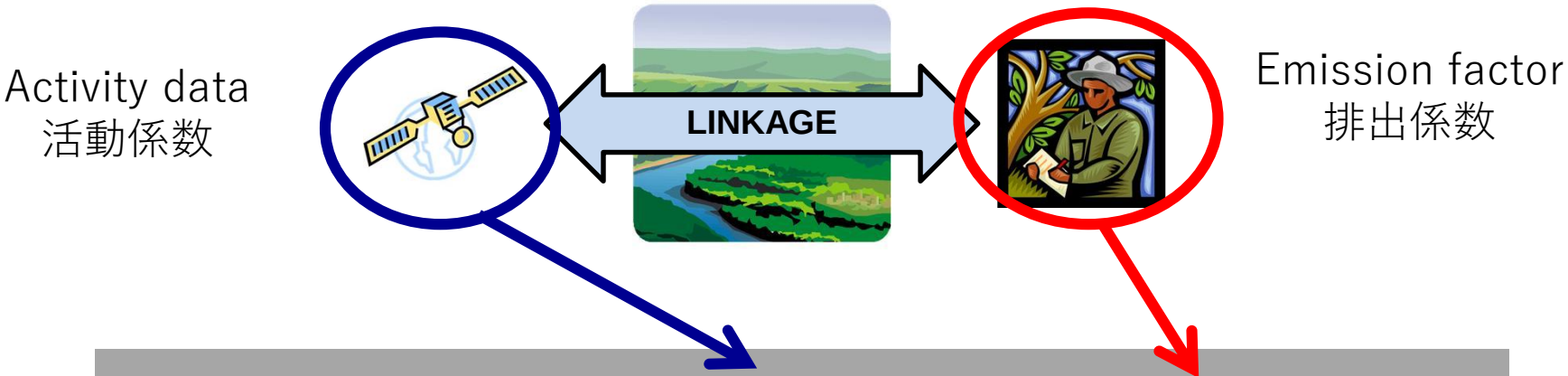
❶ 炭素モニタリング/ Carbon monitoring

より広域にわたる地域の森林炭素モニタリングには、地上調査データと衛星データの組み合わせによって求められる

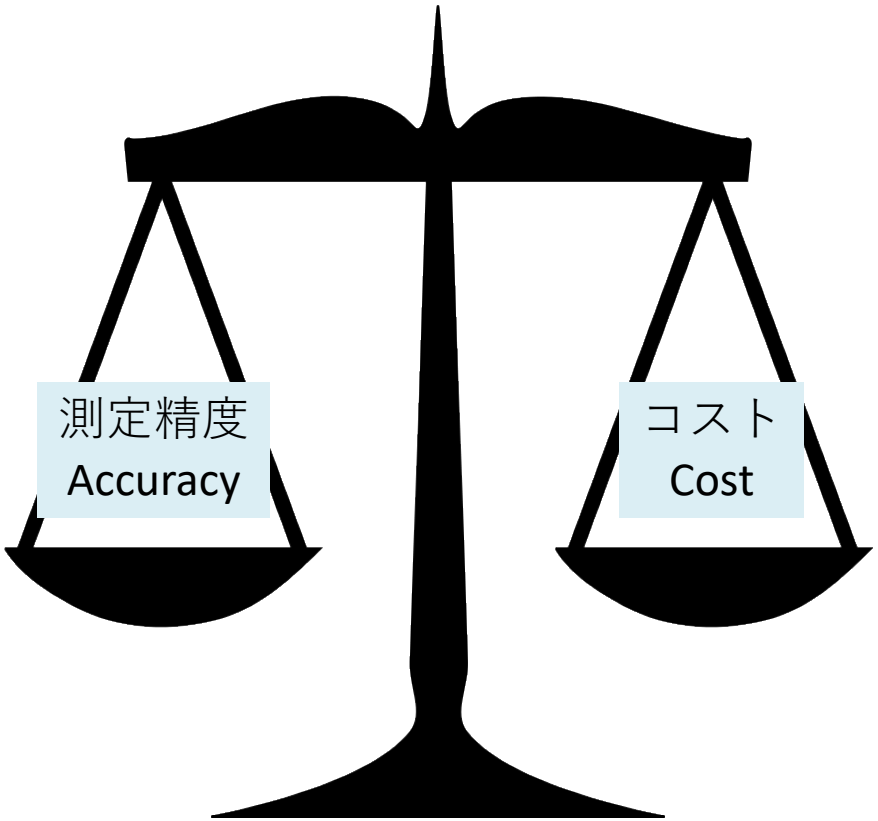


To establish national forest monitoring systems, use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating forest carbon stocks and forest area changes.

❶ 炭素モニタリング/ Carbon monitoring

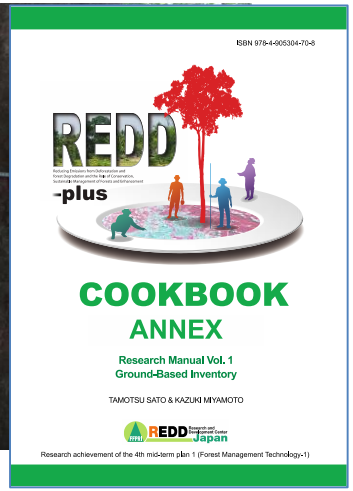
測定精度を低減させず、コストを抑えたモニタリングが重要

Need monitoring method with low cost and low uncertainty

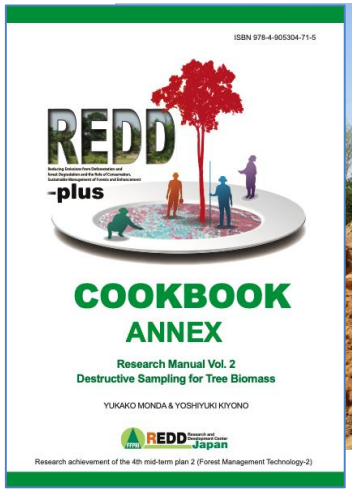


❶ 調査マニュアル/ Research manual

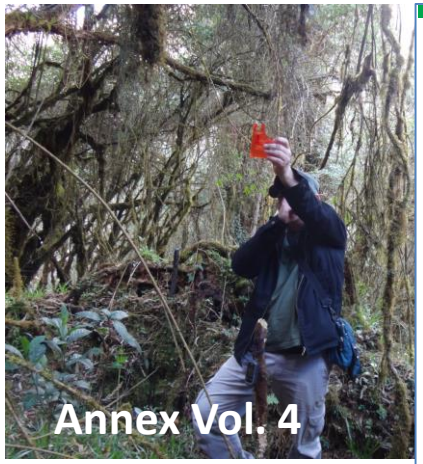
地上調査　Ground-based inventory

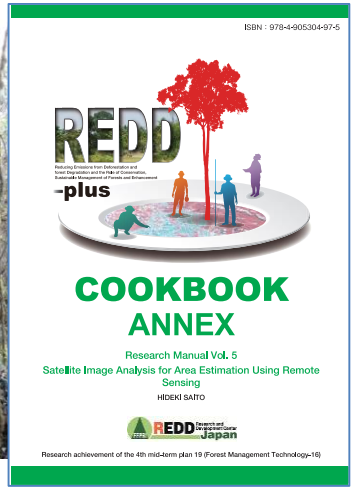


破壊調査　Destructive sampling

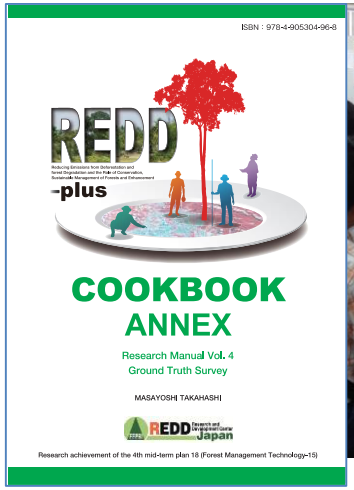


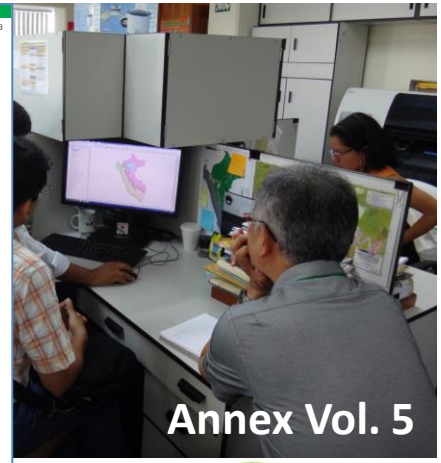
GT調査　Ground-truth survey





衛星画像解析　RS image analysis





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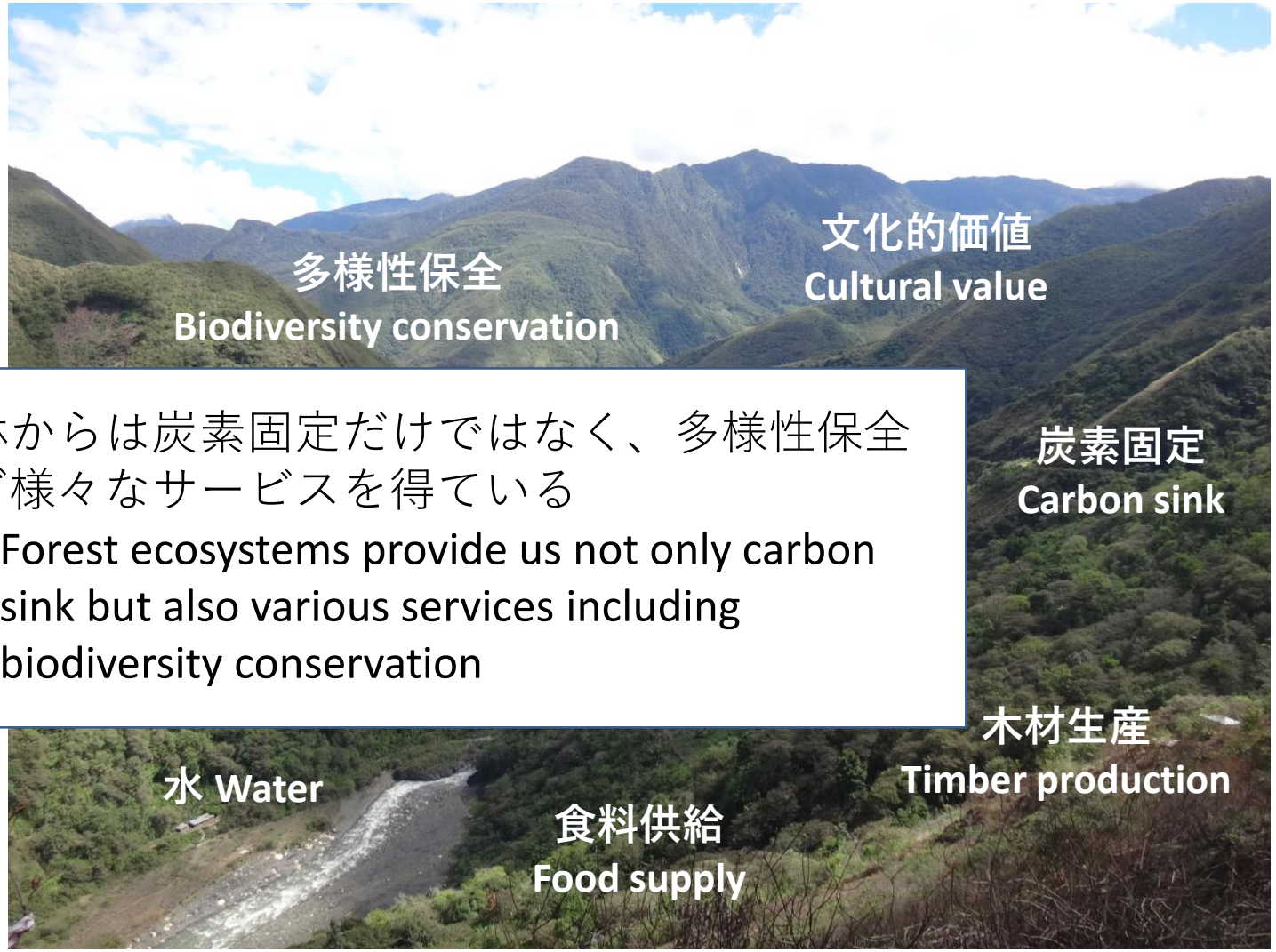
❷ 生態系サービス / Ecosystem services



森林からは炭素固定だけではなく、多様性保全など様々なサービスを得ている

Forest ecosystems provide us not only carbon sink but also various services including biodiversity conservation

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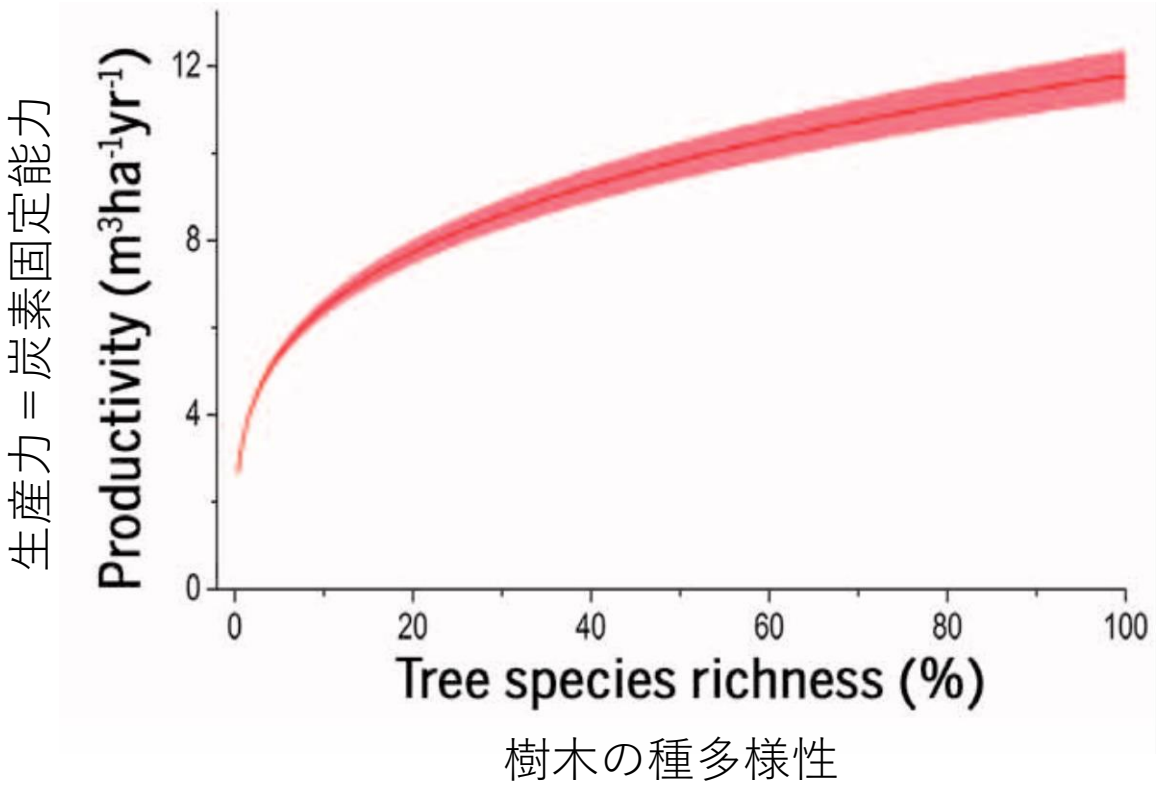
❷ High diversity – High productivity

樹木の種多様性の高い林分では、炭素固定できる量も大きい

High diversity forest tends to show high carbon sequestration capacity



Source: Liang et al. 2016

❷ 小径木の貢献 / Small tree contribution

樹木の種多様性の把握のためには、小径木の測定も必須

Measurement of small trees are indispensable to evaluate tree species diversity

最大到達直径のクラスごとの種数

Species number based on the maximum DBH class

最大直径 Maximum DBH class	種数 Species #	相対% Relative %
10cm未満／Less than 10cm	111	22.9
10 - 29.9 cm	193	39.8
30 - 49.9 cm	116	23.9
50 - 69.9 cm	35	7.2
70 – 89.9 cm	15	3.1
90cm以上／Larger than 90 cm	15	3.1

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❸ 森林劣化 / Forest degradation

途上国７４カ国の森林劣化によるGHGの排出量は、森林劣化を加えた排出量の約１/４ほどであるが、２８カ国では森林劣化による排出量の方が森林減少起因の量よりも多くなっている。

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).

時間

非森林

Morales-Barquero et al. 2014

❸ 森林劣化の要因 / Drivers of degradation

伐採　Logging

火災　Fire

燃料材採集・炭生産
Fuelwood collection / Charcoal production

林内放牧　Livestock grazing

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❸ 火災による劣化 / Degradation by fires

Palangkaraya, Indonesia

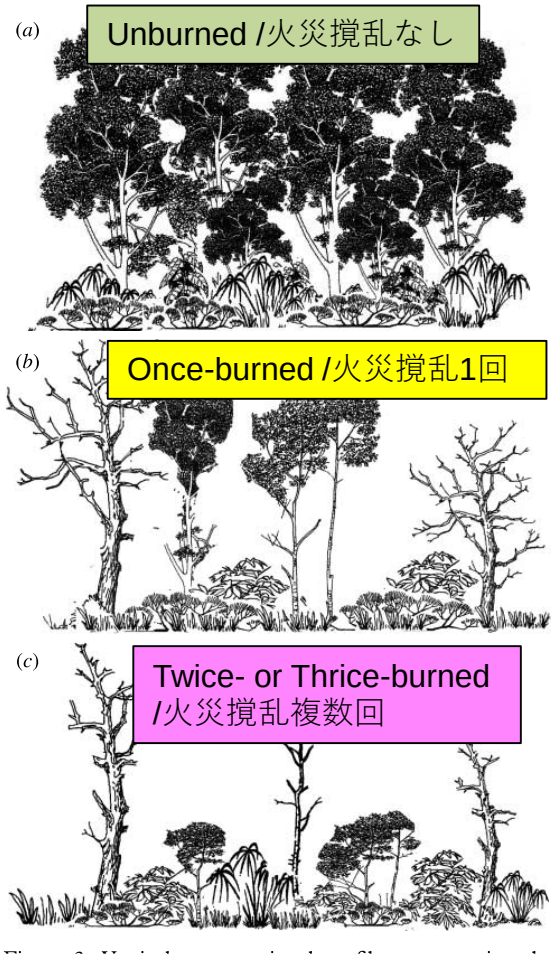
Kampong Thom, Cambodia

❸ 火災による影響 / Fire impacts

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
Protium and Tetragastris spp.	Burseraceae	unburned	69	15	2	2
Pouteria and others	Sapotaceae	unburned	17	13	0	0
Sclerolobium and Tachigali spp.	Fabaceae	unburned	17	4	0	0
Rinorea spp.	Violaceae	unburned	14	0	0	0
various genera	Lauraceae	unburned	12	2	4	0
Cecropia spp.	Cecropiaceae	once-burned	0	69	22	8
Jacaranda copaia	Bignoniaceae	once-burned	0	18	0	0
Pseudobombax sp.	Malvaceae	twice-burned	0	0	88	14
Inga spp.	Fabaceae	twice-burned	8	0	22	10
Tapirira sp.	Anacardiaceae	twice-burned	0	0	14	0
Cordia sp.	Boraginaceae	thrice-burned	1	2	0	30
			saplings (<10 cm in DBH) per 200 m^2			
Palicourea guianensis	Rubiaceae	once-burned	—	38	0	5
Aparisthmium cordatum	Euphorbiaceae	twice-burned	—	13	79	12
Cordia sp.	Boraginaceae	thrice-burned	—	4	5	30

Referred from Barlow & Peres 2008



- 火災撹乱後に種組成は変化
  Species composition were changed after fires
- 火災撹乱を重ねるごとに回復は困難に
  Difficult to recovery after repeated fires
- 炭素量も減少していく
  Forest carbon stock decreased simultaneously

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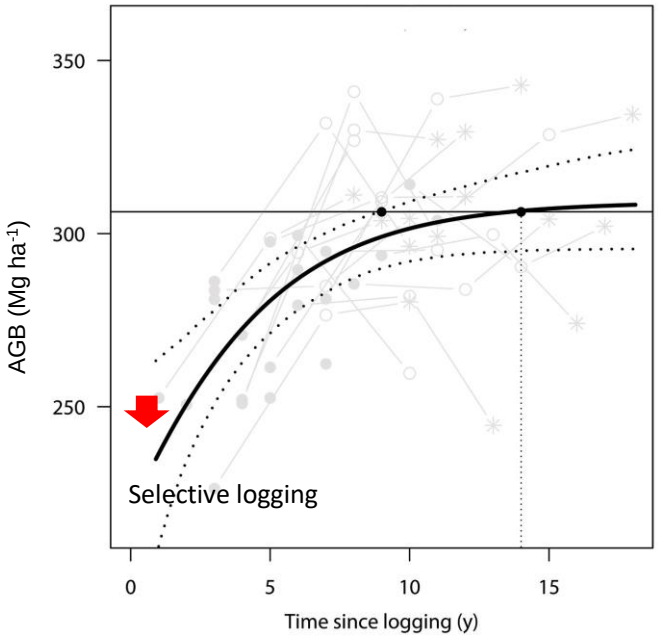
❸ ミャンマーでの事例 / Case study in Myanmar


- 森林火災はタケの優占を促進する
  Forest fires facilitate bamboo dominance
- 種同定と樹木以外の種（タケやヤシなど）の測定は炭素蓄積量と森林劣化の評価に重要
  Species identification and measurement of non-tree species are important to evaluate forest carbon stock and forest degradation
- 森林劣化を衛星データなどを活用して、いかに広範囲に把握できるかが今後の課題
  Next step: To develop methodology for evaluation forest degradation using remote sensing data

❹ 継続的なモニタリング/ Monitoring continuously

なぜ長期のモニタリングが必要なのか？
Why do we need long-term monitoring systems?

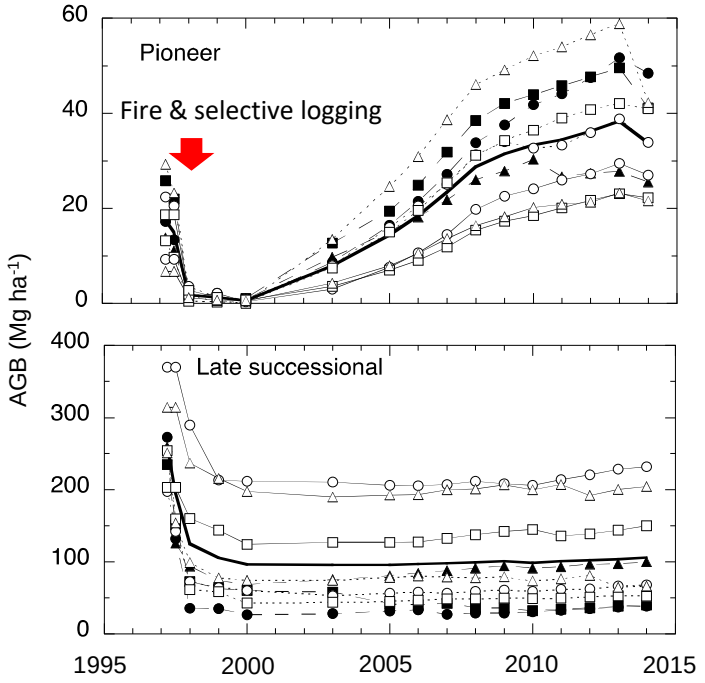
Central Amazon (Brazil)



伐採後の経過年数

Source: Otani et al. (2018)

Bukit Soeharto (Indonesia)



Source: Toma et al. (2016)

❹ 継続的なモニタリング/ Monitoring continuously

より長期のモニタリング体制構築のために

For establishment of long-term monitoring systems

測定誤差を少なくするための計測のルール作り

Clear rule for continuous measurement with reducing uncertainty

トレーニングによる能力向上

Training for capacity building

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❹ 継続的なモニタリング/ Monitoring continuously

より長期のモニタリング体制構築のために

For establishment of long-term monitoring systems

科学者・技術者だけでは無く　Need act from not only scientists

地元住民の協力も必要　But also local people!

"What we do for ourselves dies with us. What we do for others and the world remains and is immortal."

–Albert Pine

自らのための行いは死と共に消えるが、人や世界のための行いは永遠に生き続ける。

–アルバート・パイン