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# The role of capacity building in context of MRV for REDD+

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# Background

- International processes like REDD+ require clear commitments on international level – and the possibility to objectively monitor them.

- Such monitoring needs to happen along **variables and indicators** that can objectively be analyzed and evaluated.

- Assuming that such policy processes have sufficient rational and/or scientific elements, these variables and indicators need to be

***Measurable, Reportable and Verifiable***

"You can't manage (sustainably) what you can't measure"

# Background

- In the Marrakesh Accords of COP7 (2001), forest related carbon projects were admitted for **reforestation and afforestation only**,

- An agreement on forest carbon enhancement was not considered feasible also because a **reliable and verifiable monitoring was not considered possible**,

- Also “Avoided deforestation” projects were excluded from the Kyoto Protocol because of different **concerns and missing methods to measure emission reductions** (Gibbs et al. 2007, Gullison et al. 2007).

# COP16 Cancún

Some of the forest monitoring related statements in the Cancún Agreements from COP16 in Cancún 2010:

- 70. Encourages developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities, …:
  a) Reducing emissions from **deforestation**;
  b) Reducing emissions from forest **degradation**;
  c) **Conservation** of forest carbon stocks;
  d) **Sustainable management** of forests;
  e) **Enhancement** of forest carbon stocks;

# COP16 Cancún

- 71. Requests developing country Parties aiming to undertake the activities referred to in paragraph 70 above, … , to develop the following elements:

  a) A national strategy or action plan;
  b) A national forest reference emission level and/or forest reference;
  c) A robust and transparent national forest monitoring system …. , with, if appropriate, subnational monitoring and reporting as an interim measure.

# MRV

- Consequently, **Measuring**, **Reporting** and **Verification** (**MRV)** has developed to a standard in context of REDD+ and various international conventions.

**Measurement:** Observation, producing data

↓

**Reporting:** Translating the data into information

↓

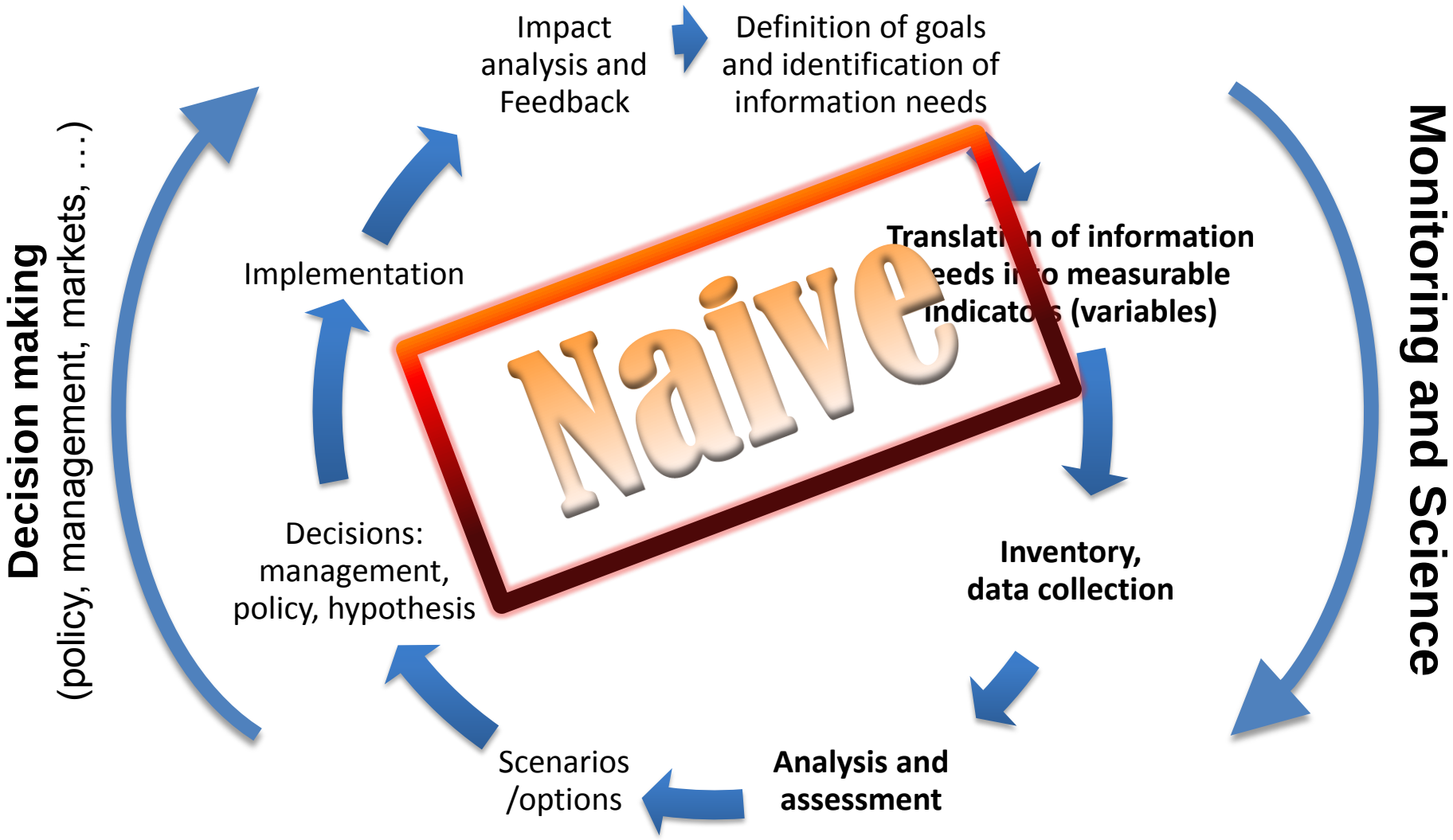
**Verification:** Independently (!) check both measurement and reporting

Requires mainly **technical expertise** (plus knowledge about the processes)

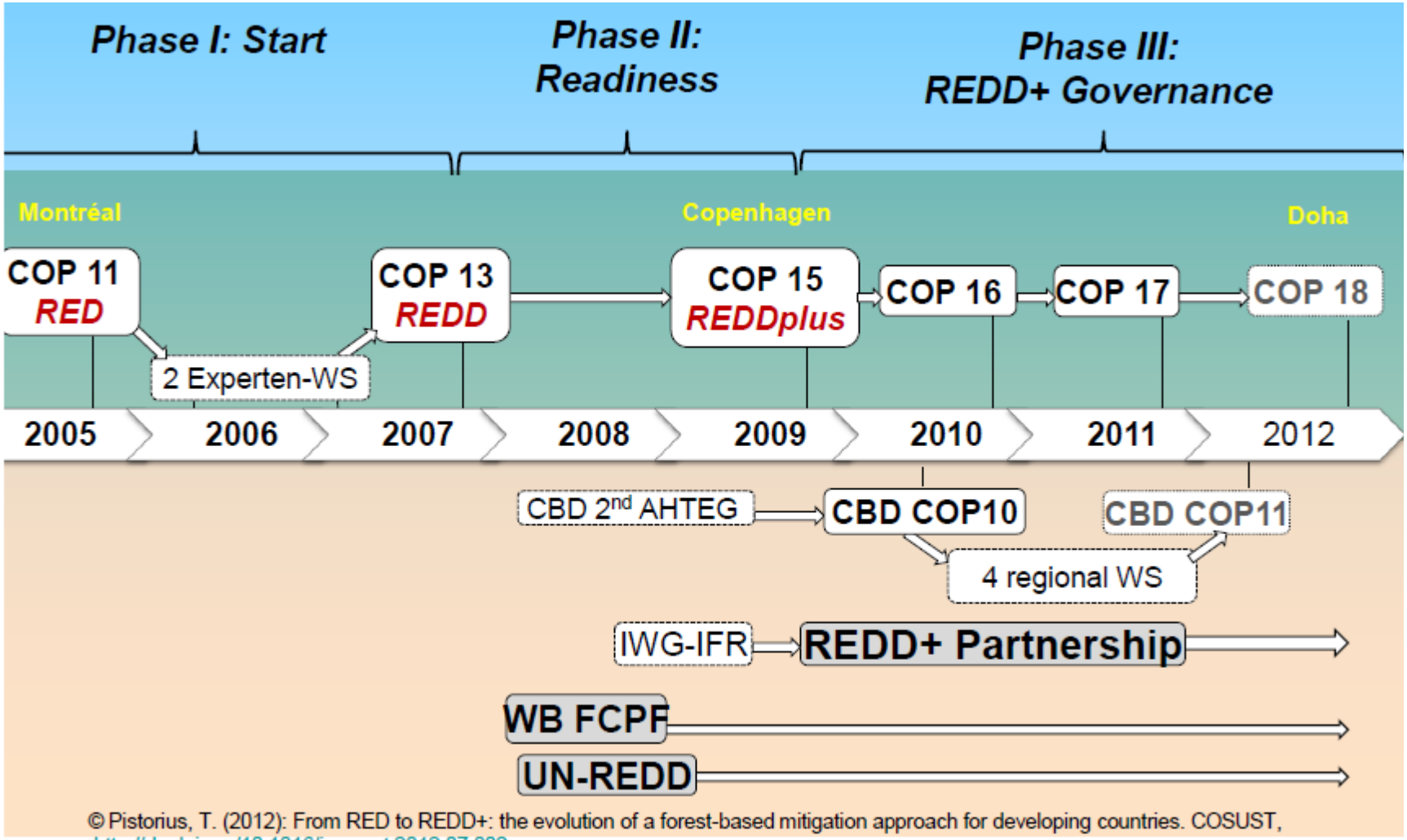
Requires mainly **knowledge about the processes** (plus technical expertise)

# Science-policy interface (naïve view)

## Sound information as basis for decision making?



# Increasing complexity of the process




© Pistorius, T. (2012): From RED to REDD+: the evolution of a forest-based mitigation approach for developing countries. COSUST, http://dx.doi.org/10.1016/j.cosust.2012.07.002

# Measuring

- for all land use categories and for all carbon pools, if relevant **human induced changes** in the carbon pools are to be expected.

- "Activity data" and "emission factors" need to be determined and reported.

  - Activity data refers to **area and area changes** of forest land or types of forest land,
  - Emission factors refer to the **carbon density per unit area** of forest.

# Reporting

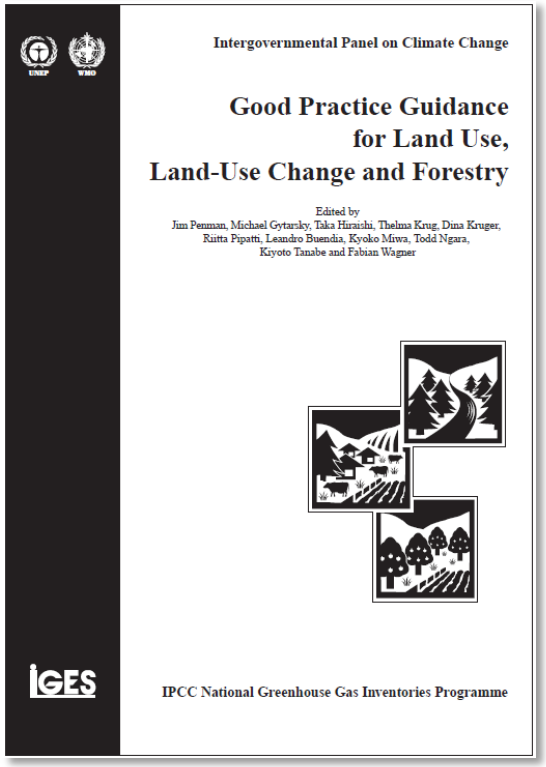
Reporting principles according to UNFCCC:

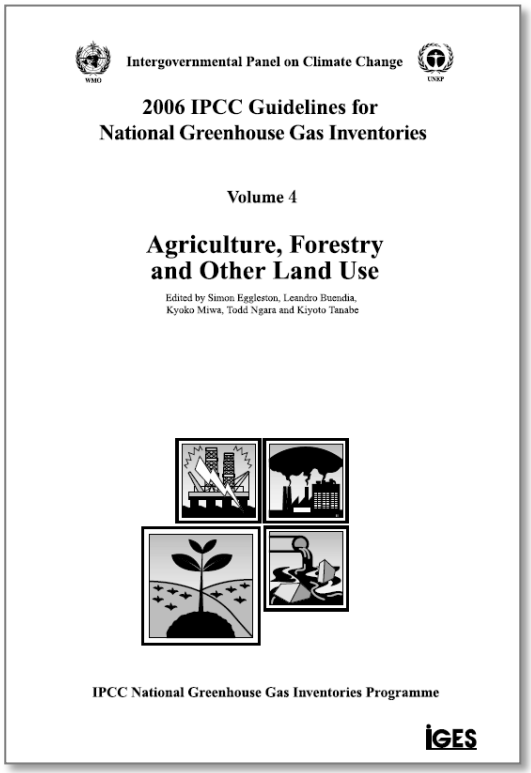
1. **Transparency**: methodology must be clearly stated so that anybody may verify the correctness.
2. **Consistency**: same definitions and methodologies shall be used over time.
3. **Comparability**: across countries.
4. **Completeness**: all relevant information shall be given; gaps explicitly documented.
5. **Accuracy**: estimates shall not systematically over- or underestimate.

- These definitions are from UNFCCC. In other fields, other definitions of these terms exist.

# IPCC Guidelines

- It is likely that a REDD mechanism would draw on established IPCC guidelines for national reporting on greenhouse gas emissions and land use change



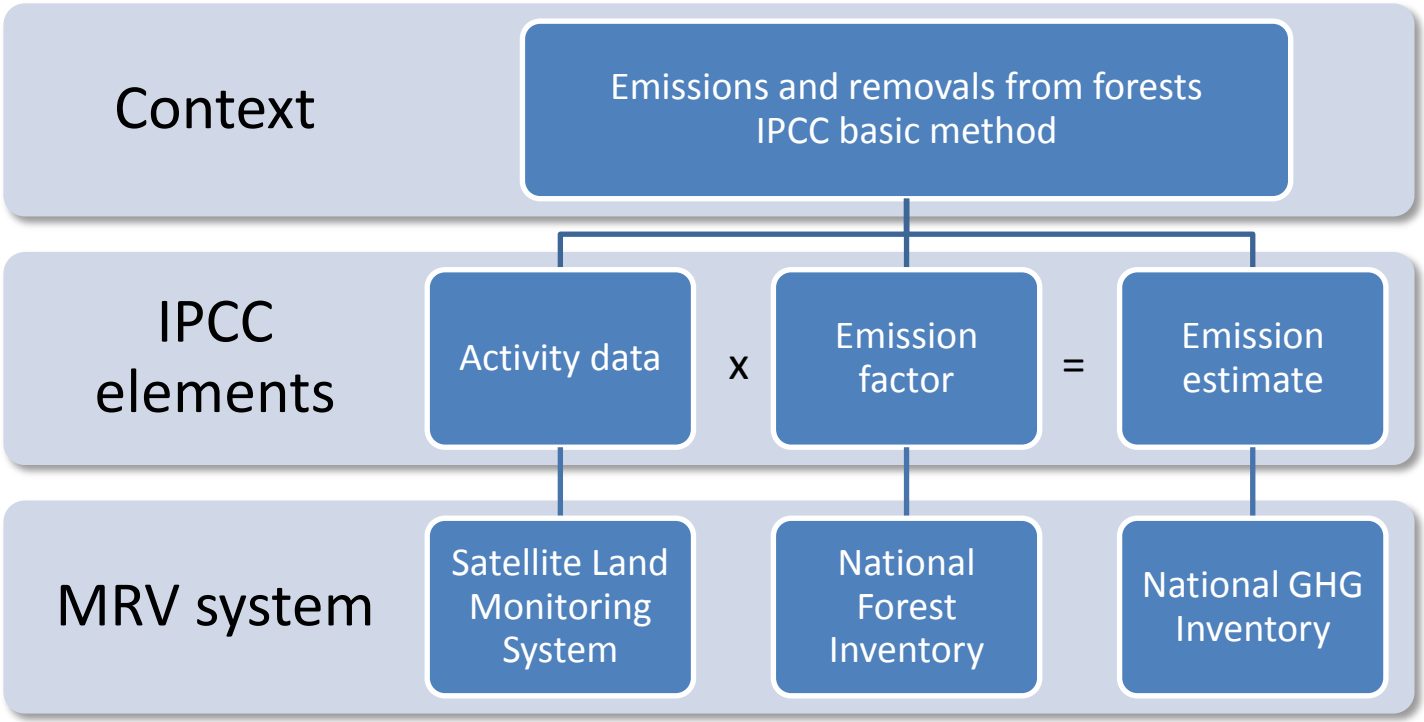
# IPCC Guidelines

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (vol.1, Chap.3) provides general information on how to deal with “uncertainties” and describe statistical terminology.
- GPG 2000 (and GPG LULUCF 2003, SR LULUCF) addresses further issues regarding the quantification and reporting of errors.

- Nevertheless, there is **less guidance on how to influence uncertainty of estimates and/or how to implement / optimize inventories (for good reason?)**.

# IPCC Guidelines

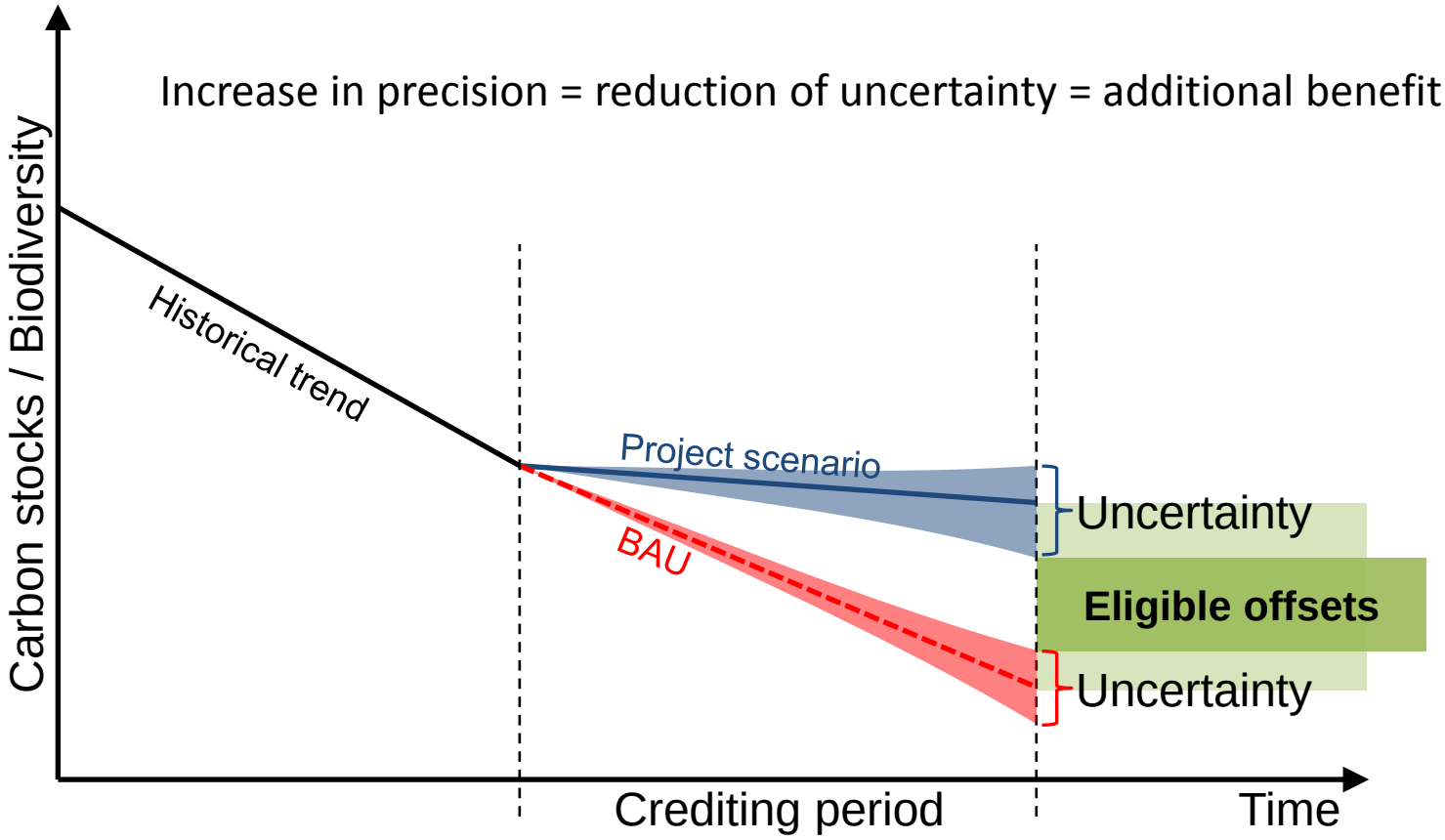
- It is further likely that additional standards are necessary as reference for remote sensing integration and planning of forest inventories (e.g. attempts like GOFC-GOLD)



# Capacity has direct economic impact on the REDD business

IPCC: Eligible carbon offsets are directly reduced by the uncertainty of information

→ Systems of MRV have the goal to reduce uncertainty



# The role of MRV

- REDD+ is a market mechanism that is for the moment based on carbon alone,

- If quantifying the actual amount of a traded commodity is related to uncertainty, it reduces trust between market partners (Donor countries, voluntary carbon markets),

- However, other REDD+ coponents like biodiversity or social aspects are even more difficult to monitor!

# Tiers (emission factors)

***Table 1.*** *Data needs for meeting the requirements of the three IPCC Tiers (from: GOFC-GOLD 2009).*

| Tier | Data needs / examples of appropiate biomass data |
|---|---|
| **Tier 1 (basic)** | Default MAI* (for degradation) and/or forest biomass stock (for deforestation) values for broad continental forest types – includes six classes for each continental area to encompass differences in elevation and general climatic zone; default values given for all vegetation-based pools |
| **Tier 2 (intermediate)** | MAI* and/or forest biomass values from existing forest inventories and/or ecological studies.<br>Default values provided for all non-tree pools<br>Newly collected forest biomass data. |
| **Tier 3 (most demanding)** | Repeated measurements of trees from permanent plots and/or calibrated process models. Can use default data for other pools stratified by in-country regions and for-est type, or estimates from process models. |

*MAI=Mean annual increment of tree growth

# Activity data

- A land use change matrix for all relevant land use classes or geographic explecit data are needed **for the IPCC approach**,
- In context of Tier 1 and 2 the whole story could be reduced to a mapping exercise.

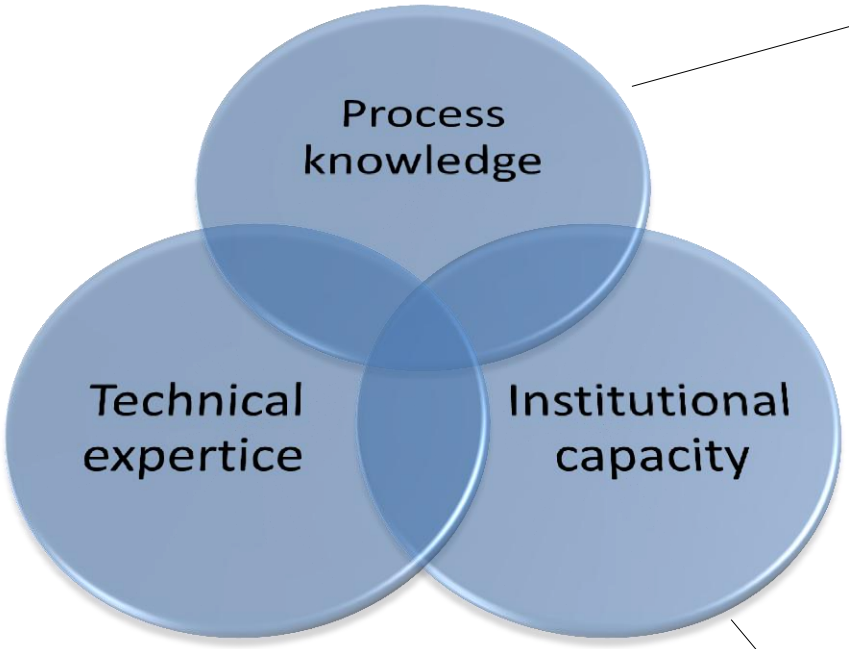
**TABLE 2.3.5**
**SIMPLIFIED LAND-USE CHANGE MATRIX FOR EXAMPLE APPROACH 2**

**Land-Use Change Matrix**

| Final \ Initial | F | G | C | W | S | O | *Final sum* |
|---|---|---|---|---|---|---|---|
| **F** | **15** | 3 | 1 | | | | *19* |
| **G** | 2 | **80** | | | | | *82* |
| **C** | | | **29** | | | | *29* |
| **W** | | | | | | | |
| **S** | 1 | 1 | 1 | | **5** | | *8* |
| **O** | | | | | | **2** | *2* |
| *Initial sum* | *18* | *84* | *31* | | *5* | *2* | *140* |

Note:
F = Forest land, G = Grassland, C = Cropland, W = Wetlands,
S = Settlements, O = Other land
Numbers represent area units (Mha in this example).
There is no Wetlands in this example. Blank entry indicates no land use change.

# Capacity needs




-REDD Financing
-IPCC Guidelines
-Terminology
-Carbon ownership
-Benefit sharing
-national carbon accounting systems

-Designing a MRV system
-RS analysis and field inventory
-Training and Data collection
-Data analysis and statistics

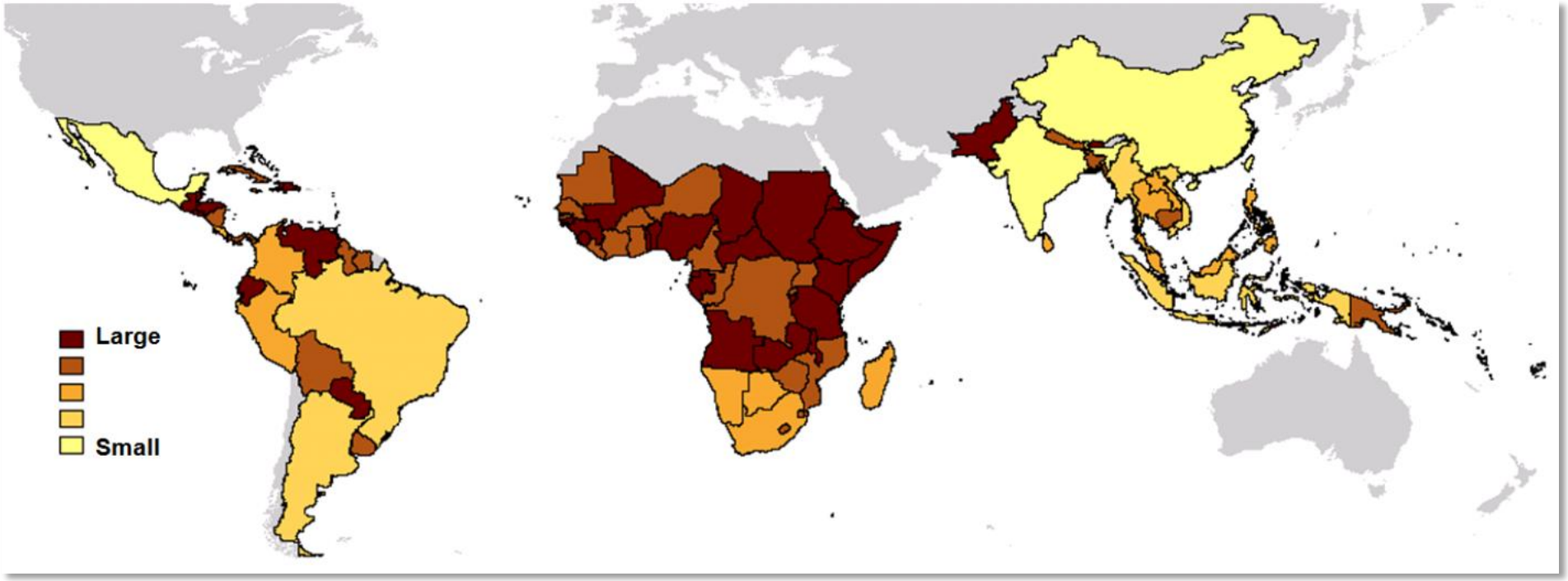
-Sub-national REDD strategy
-Integrating institutions
-Data management and Reporting
-Sustainability

# Capacity needs

- Some of the needed capacities are typical reserach tasks (and not yet completely solved!):
  - development of allometric biomass models,
  - optimazation of sampling and plot design,
  - integration of remote sensing data and field observations,
  - combining model based approaches and design based sampling,
  - Sample based assessment of biodiversity ,
  - …
- The capacities needed would in many cases go beyond what is required for running advanced NFI's!

# Capacity gaps

- An assessment of national forest monitoring “capabilities” in tropical non-Annex I countries (Herold 2009):



# Capacity gaps?

- Some criteria mentioned in this report are not about capacity alone:
  - "…limited experience in estimation and reporting of national GHG inventories…"
  - "…low existing capabilities to continuously measure forest area changes and changes in forest carbon stocks…"
  - "…particular challenges for REDD implementation require investments to observe more IPCC key categories and move towards Tier 3 level measurements"
  - "…availability of useful data sources for REDD monitoring is constrained (cloud cover, data access, …)"

# Is capacity the only problem?

Some typical statements on the need for capacity building:

- ***"Massive Capacity building is needed!"***
- ***"The number of national experts is insufficient"***
  - Or: REDD is very much a policy- and technology driven process that became to complex because of national and institutional interests?
- ***"Often, support comes from independent consultants and external qualified technical experts"***
  - Or: Donor countries are very much interested to allocate their funding (tax money) based on own economical interest instead of giving it away?
- ***"Capacity-building mostly focus on individuals and not institutional capacity"***
  - Or: Results are expected to be delivered very fast and there is no interest in long term and sustainable actions?

# Other relevant gaps

**Communication:**

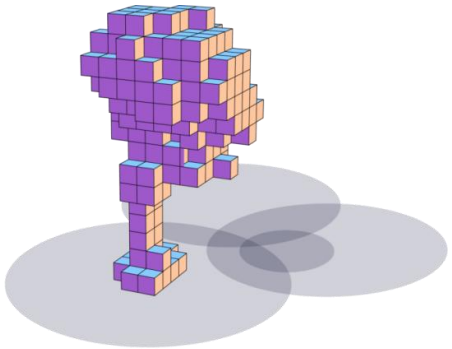
- Even if there are experts in the political process, in forest inventory and in remote sensing they are talking a different language!
  - Examples: what do you think is a „R-package“ or „activity data“ or „emission factors“?

**Integration of existing capacity:**

- A lot of standards are „re-invented“ by people from different sectors or disciplines (while at the same time available experts are ignored).
  - Example: in many countries remote sensing experts explain how forest inventories should be conducted

# How to build capacity?

- Integration into the curricula of tailor made curricula at BSc, MSc and PhD level is much more sustainable (and cheaper) than recruiting  consultants!?
- NFIs implemented with REDD funding are a long term effort!
- „The only constant is change!“
- Sharing knowledge:



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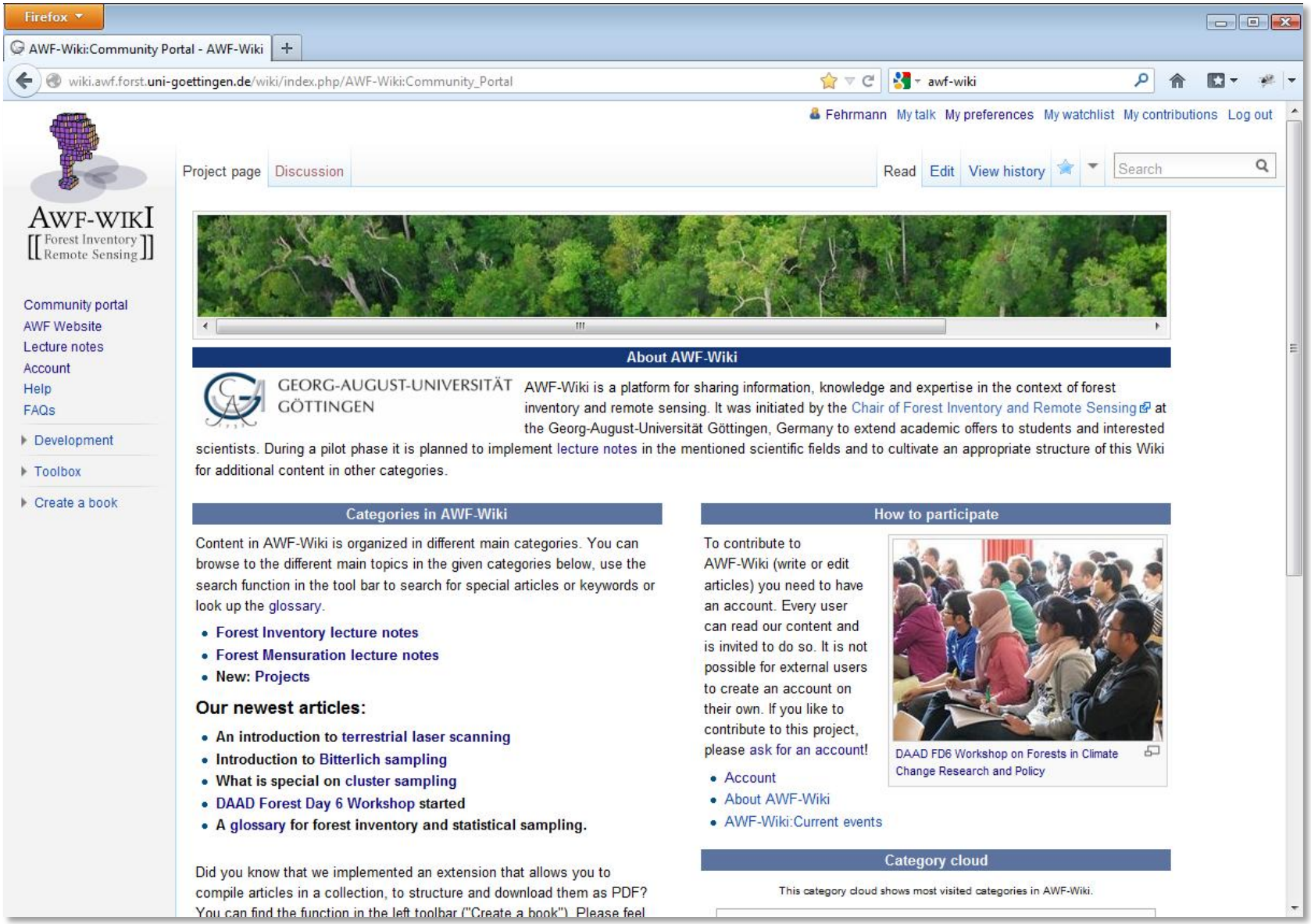
[[ Forest Inventory
Remote Sensing ]]

# AWF-Wiki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About AWF-Wiki
GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN
AWF-Wiki is a platform for sharing information, knowledge and expertise in the context of forest inventory and remote sensing. It was initiated by the Chair of Forest Inventory and Remote Sensing at the Georg-August-Universität Göttingen, Germany to extend academic offers to students and interested scientists. During a pilot phase it is planned to implement lecture notes in the mentioned scientific fields and to cultivate an appropriate structure of this Wiki for additional content in other categories.
Categories in AWF-Wiki
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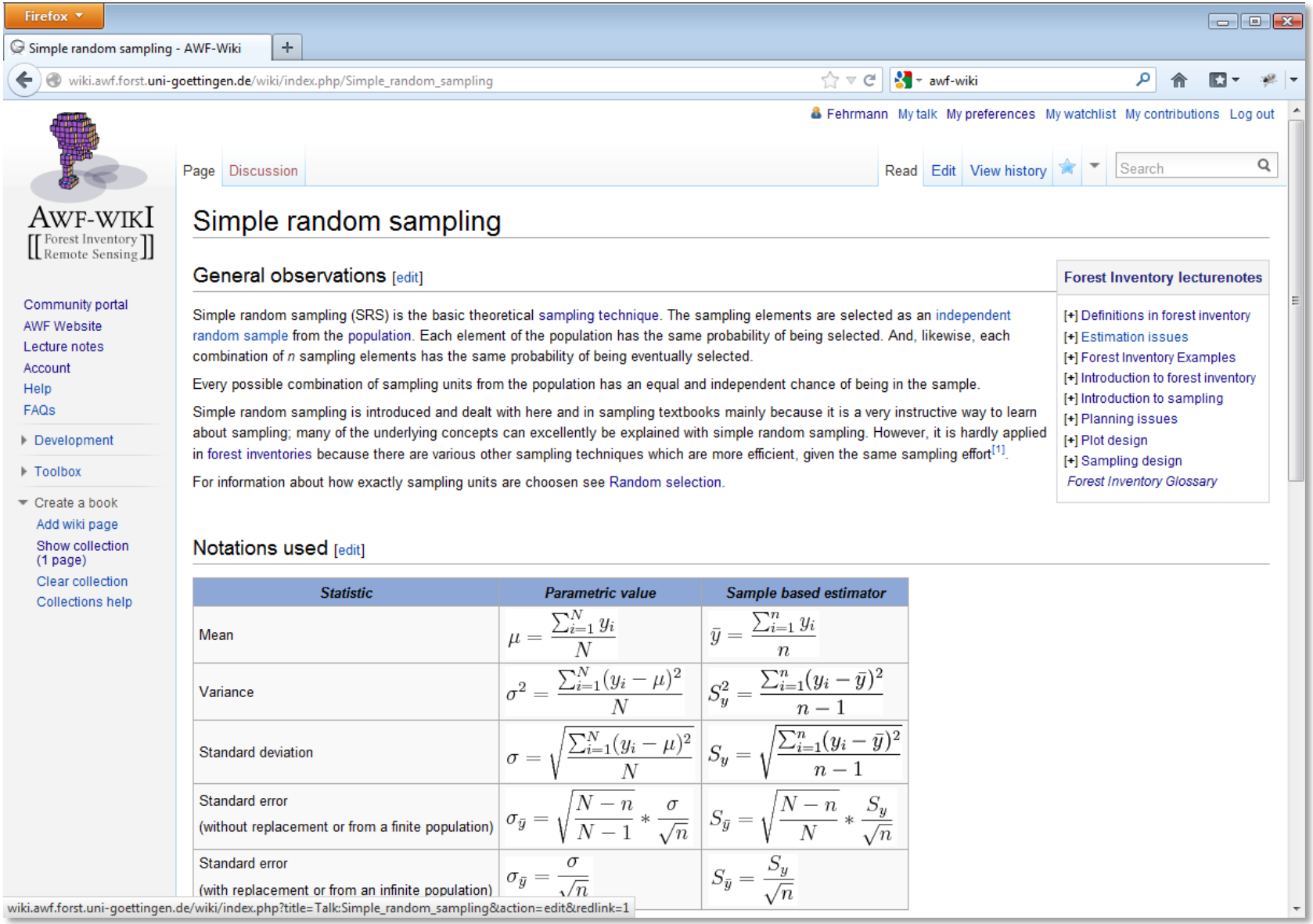
# AWF-WIKI

- AWF-Wiki is a platform for sharing information, knowledge and expertise in the context of forest inventory, natural resources assessment and remote sensing.

- The vision behind this initiative is to create a new and more interactive form of knowledge reference for our students

- However, AWF-Wiki is open for everyone

# AWF-Wiki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[[Forest Inventory Remote Sensing]]
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Lecture notes
Account
Help
FAQs
Development
Toolbox
Create a book
Add wiki page
Show collection (1 page)
Clear collection
Collections help
Simple random sampling
General observations [edit]
Simple random sampling (SRS) is the basic theoretical sampling technique. The sampling elements are selected as an independent random sample from the population. Each element of the population has the same probability of being selected. And, likewise, each combination of n sampling elements has the same probability of being eventually selected.
Every possible combination of sampling units from the population has an equal and independent chance of being in the sample.
Simple random sampling is introduced and dealt with here and in sampling textbooks mainly because it is a very instructive way to learn about sampling; many of the underlying concepts can excellently be explained with simple random sampling. However, it is hardly applied in forest inventories because there are various other sampling techniques which are more efficient, given the same sampling effort[1].
For information about how exactly sampling units are choosen see Random selection.
Forest Inventory lecturenotes
[+] Definitions in forest inventory
[+] Estimation issues
[+] Forest Inventory Examples
[+] Introduction to forest inventory
[+] Introduction to sampling
[+] Planning issues
[+] Plot design
[+] Sampling design
Forest Inventory Glossary
Notations used [edit]
Statistic
Parametric value
Sample based estimator
Mean
$\mu = \frac{\sum_{i=1}^{N} y_i}{N}$
$\bar{y} = \frac{\sum_{i=1}^{n} y_i}{n}$
Variance
$\sigma^2 = \frac{\sum_{i=1}^{N} (y_i - \mu)^2}{N}$
$S_y^2 = \frac{\sum_{i=1}^{n} (y_i - \bar{y})^2}{n-1}$
Standard deviation
$\sigma = \sqrt{\frac{\sum_{i=1}^{N} (y_i - \mu)^2}{N}}$
$S_y = \sqrt{\frac{\sum_{i=1}^{n} (y_i - \bar{y})^2}{n-1}}$
Standard error (without replacement or from a finite population)
$\sigma_{\bar{y}} = \sqrt{\frac{N-n}{N-1}} * \frac{\sigma}{\sqrt{n}}$
$S_{\bar{y}} = \sqrt{\frac{N-n}{N}} * \frac{S_y}{\sqrt{n}}$
Standard error (with replacement or from an infinite population)
$\sigma_{\bar{y}} = \frac{\sigma}{\sqrt{n}}$
$S_{\bar{y}} = \frac{S_y}{\sqrt{n}}$
wiki.awf.forst.uni-goettingen.de/wiki/index.php?title=Talk:Simple_random_sampling&action=edit&redlink=1

# AWF-Wiki

Special page

cluster

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cluster Search

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Showing below up to **20** results starting with **#1**.

**Search in namespaces:**

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| User | User talk | Template | Template talk | Internals | Internals talk |
| AWF-Wiki | AWF-Wiki talk | Help | Help talk | Layer | Layer talk |
| File | File talk | Category | Category talk | | |

List redirects

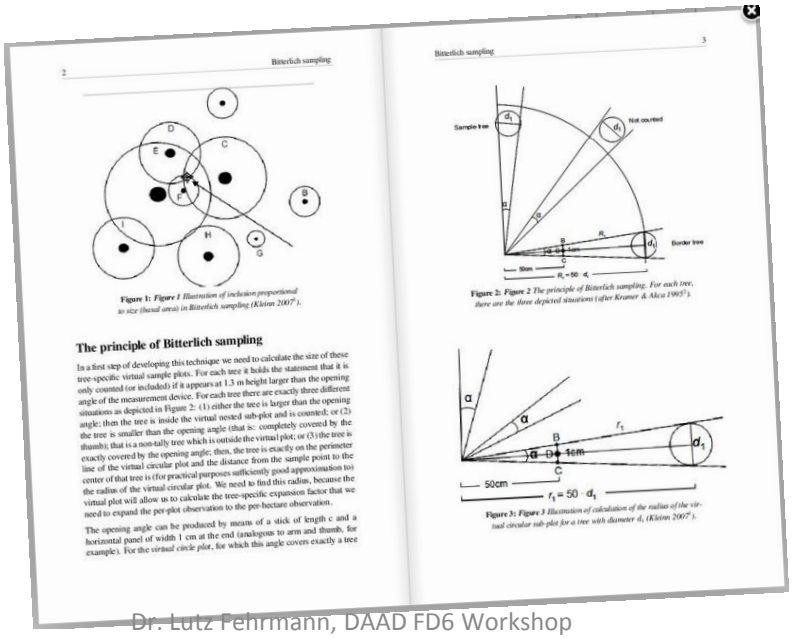
**Create the page "Cluster" on this wiki!**

### Page title matches

Cluster sampling examples

...refore, be very instructive for the optimization of the [[**cluster** sampling|**cluster** plot design]] – but it does not help reducing the error variance (Kleinn [[File:5.3.4-fig81.png|right|thumb|300px|"Figure 1" **Cluster** plot design as used in a regional forest inventory in the Northern Zone of

6 KB (973 words) - 11:00, 24 September 2011



**The principle of Bitterlich sampling**

In a first step of developing this technique we need to calculate the size of these tree-specific virtual sample plots. For each tree it holds the statement that it is only counted (or included) if it appears at 1.3 m height larger than the opening angle of the measurement device. For each tree there are exactly three different situations as depicted in Figure 2: (1) either the tree is larger than the opening angle; then the tree is inside the virtual nested sub-plot and is counted; or (2) the tree is smaller than the opening angle (that is: completely covered by the thumb); that is a non-tally tree which is outside the virtual plot; or (3) the tree is exactly covered by the opening angle; then, the tree is exactly on the perimeter line of the virtual circular plot and the distance from the sample point to the center of that tree is (for practical purposes sufficiently good approximation to) the radius of the virtual circular plot. We need to find this radius, because the virtual plot will allow us to calculate the tree-specific expansion factor that we need to expand the per-plot observation to the per-hectare observation.

The opening angle can be produced by means of a stick of length c and a horizontal panel of width 1 cm at the end (analogous to arm and thumb, for example). For the *virtual circle plot*, for which this angle covers exactly a tree

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Page | Discussion

## Diameter tape

Tree diameter can also be determined from the measurement of the stems cross section at the height of measurement, the diam

$$d = \frac{C}{\pi}.$$

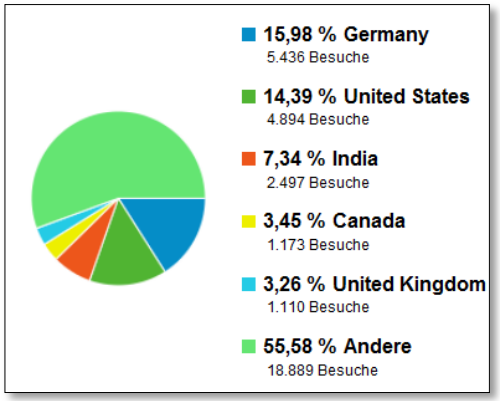
There are also diameter tapes from which the tree diameter can sides, on one side with linear centimeter scale for reading circur important, not to confuse the readings!

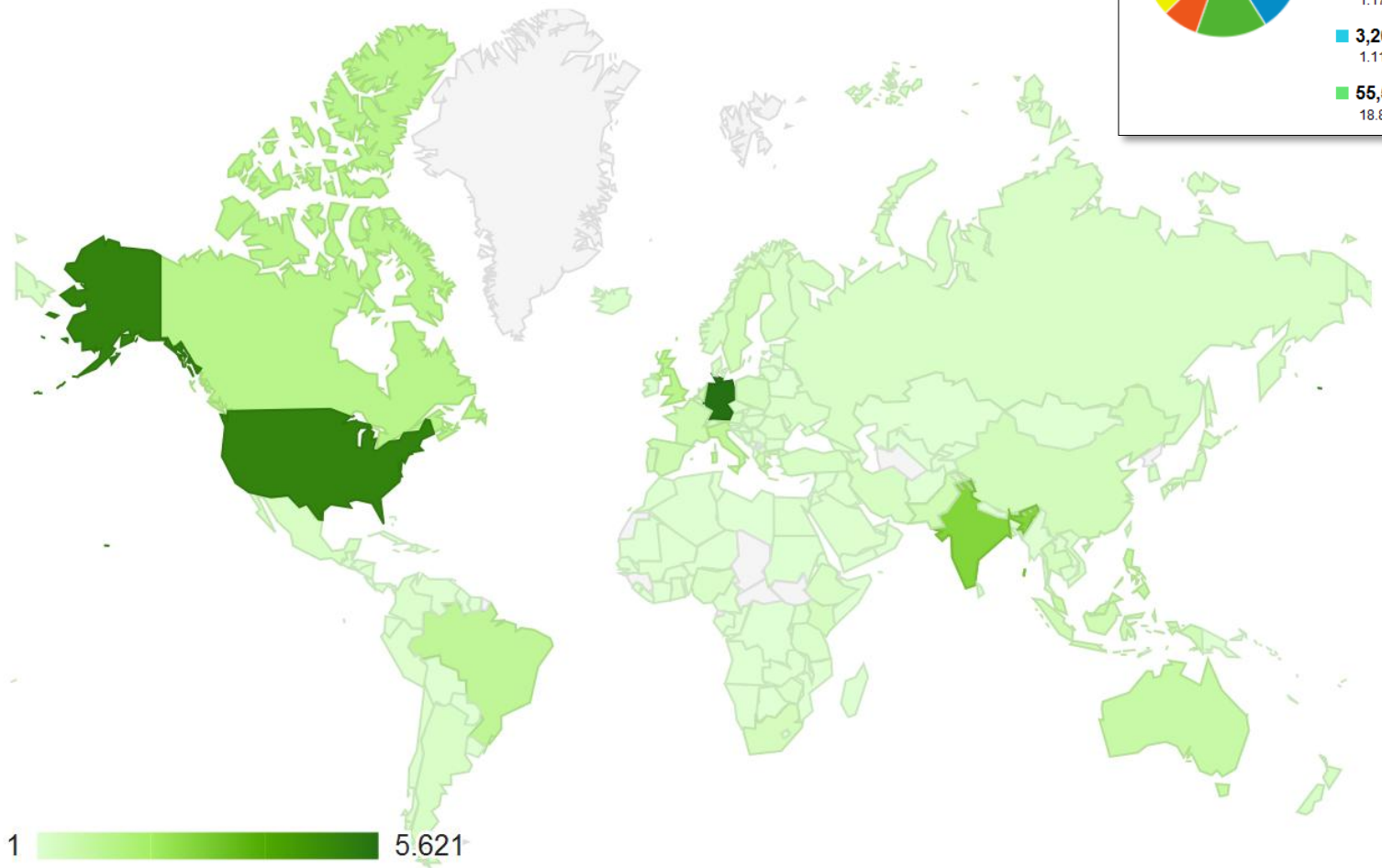
Circular shape is assumed when inferring from circumference to circular cross section; there are always irregularities. If we then with the shortest perimeter for a given cross-sectional area, then cross-sectional area and also of the diameter which is derived fr

Table 1 illustrates that with a simple and theoretic example: we but different elliptic shapes of their cross-sections. We are now i perimeter and then infer to basal area of dbh assuming a circular area $f_c = \pi r$. The shape of an ellipse is defined by the two r calculated by $f_e = \pi ab$; there is no formula to calculate the approximated by

$$p_e \approx \pi\,(a * b)\left(1 + \frac{3t}{10 + \left(\sqrt{4 - 3t}\right)}\right),$$

- Dissimination



# Thank you!

# References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Gullison RE, PC Frumhoff, JG Canadell, CB Field, DC Nepstad, K Hayhoe, R Avissar, LM Curran, P Friedlingstein, CD Jones, C Nobre. 2007. Tropical forests and climate policy. Science 316: 885-986.