

An aerial photograph of a forest landscape, showing a mix of dark green forest and lighter green/brownish areas, possibly indicating different forest types or land use. A solid green horizontal line runs across the middle of the image.

# Forest inventories: principles, experiences and lessons for NWFP inventories

by  
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# 1. The talk

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- Present basic principles and considerations of forest inventories.
- Address the applicability of these concepts to NWFP inventories.

## 2. Why forest inventories ?

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- If we want to manage a natural renewable resource reasonably: the characteristics of the resource must be known.
- The information needs come up at the latest when the resources becomes scarce.

# Basic technical questions ...

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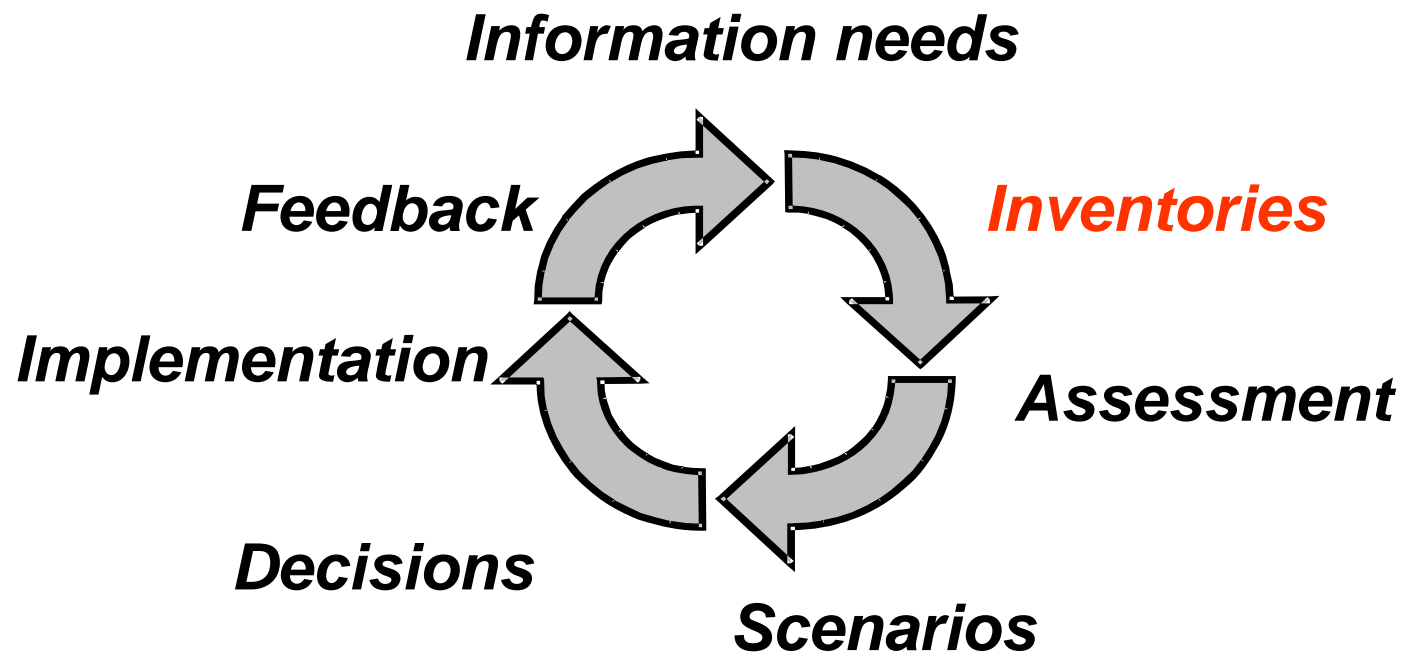
... to be answered by forest inventories to support SFM:

- how much is out there at a given point in time (growing stock) ?
- what is the quality ?
- where is it ?
- what is the growth (includes all components of dynamics like mortality and regeneration) ?
- how much can be harvested (accessibility, detectability, ownership restrictions) ?

... and it is the same questions that apply in principle to the management of NWFPs !

# Focus on planning processes

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Source:  
Dr. Peter  
Holmgren,  
FAO

In principle, we follow the principles that are expressed in this advertisement of a big bank:

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The WestLB principle:  
First we take measurements, then we take measures.

INDIVIDUAL FINANCIAL QUESTIONS DESERVE INDIVIDUAL ANSWERS. Our close partnership with customers combined with our international financial expertise generate the financial solutions that fit our clients' needs. Learn more about partnering with a leading German bank with outstanding competence in capital markets, structured finance and asset management at [www.new-answers.de](http://www.new-answers.de)



New Answers in Banking

### 3. Two basic assumptions:

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We believe (at least in principle) that

- it pays to spend money for data collection and Information procurement (*economic aspect*),

and ,

- better information leads to better decisions in planning and in policy formulation (*decision making aspect*).

## 4. Brief remarks on the **history of forest inventories**

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- The first forest inventories were probably carried out in Europe as early as in the 14<sup>th</sup> and 15<sup>th</sup> century
  - not sample based (that was invented much later ...)
  - mainly based on a “general overview”; subsequent planning was done by simple *area subdivision* (“Flächenfachwerk”):

If one has an area of 100ha and the trees have a rotation period of 100 years, then every year 1 ha should be clearcut: Only (1) **total area** and (2) **rotation period** needs to be known.  
→ **Maps** are major planning tool.

This technique may also apply to NWFPs if information is available about spatial distribution and density.

# Example from 17th century

**W**ir Leopold von Gottes Gnaden / Erwählter Römischer Kayser / zu allen Seiten Mehrer des Reichs / in Bermanien / auch zu Hungarn vnd Böhheim zc. König / Erbs. Herzog zu Oesterreich / Herzog zu Burgund / Steyer / Kärnten / Crain vnd Württemberg in Ober- vnd Nieder-Schlesien / Marggraff zu Nahren / in Ober- vnd Nieder-Baunisch / Graf zu Habsburg / Tyrol vnd Görz / zc. Entbieten N. allen vnd jeden Geist / vnd Weltlichen / was Würden / Stands oder Wesens die seynd / so neben : vnd in Unserem Wiener-Wald / Gehölz / Waldung / Wiesen / Acker / Gerecht / Raumb vnd andere Grundstuck haben / Unser Gnad / vnd alles Guts / vnd thun dieselben insgesamdt : vnd jeden insonderheit / hiemit erinnern / was massen Wir auß allerhand vorkommnen Vntrew / Mißbrauch vnd Verwirrungen / allergnädigst resolvirt / zu mehrer Aufständigmachung solch sträflicher Excessen / Waldschäden vnd anderer Mißbrauch / auch der darauff gehöriigen Remedierung / bey Unserem Kayserl. Wald-Ambt eine rechte General-Waldbereitung / Visitation vnd Inquisition-Commission durch Unsere hernach benante Commissarien / als durch den Hoch- vnd Wohlgebornen Unsere liebe getreue Wilhelm Graffen von Oeting / Unseren Cammerer / vnd Obristen Hoff : vnd Land-Jägermeister in Unserem Erb-Herzogthumb Oesterreich vnter der Enns ; wie auch die Gestrenge / Unsere respectivve Hoff-Cammer : vnd Hoff-Räthe / Inner-Oesterreichischen Hoff-Secretarium vnd Referendarium / Johann Rascher von Weyerach / vnd Christophen Abeck von vnd zu Eitenberg / Edlen Herrn zu Hading / des Heil. Röm. Reichs Ritters ; dann Unseren N. S. Buchhalterey Rath Rath / vnd Unseren Rath-Schlüssel-Ambtmann zu Crems / vnd Inspektor der Wasser : vnd Brud. Daurh zu Stain / Johann Gremb / vnd Simon Wagner von Wagenheim vornehmen zu lassen. Empfehlen demnach allen vnd jeden / so wol Geist : als Weltlichen samdt vnd sonder / das ihre / auß zuschreiben / ersuchen oder begehren / vorgedacht Unserer Rät vnd Commissarien auß den / von ihnen bestimten Tag / entweder in Person / oder durch etwere abgeordnete Bevollmächtigte jedesmahl erscheinet / etwere Nachdrufften / Titulos vnd Legitimationes / zu denen in habenden Holz : vnd Waldungen produciret / vnd was man sonst nachrichtlich von euch vnd einem jeden insonderheit verlangen wird / an die Hand geben sollet. Vnd zumahlen auch vorkommen / das von vnterschiedlichen gewisse Grundstuck / Wiesen / Raumb / Gerecht vnd dergleichen / unverdient vnd ohne einige rechtmäßige Titul possedirt / innengehabt vnd genuzet werden / vnd Wir daher notwendig zu wissen / wie solche an sie kommen / allemassen von Uns deswegen noch hievor mehrmahlige Generalia vnd Patenta außgangen / vnd darinnen die Edier- vnd Vorweisung solchanger Titulorum begehret / so sonsten ein vnd anders mit mehrern allergnädigst anbefohlen worden. Als wollen Wir solche hiemit allerdings widerholt / vnd euch allen obberühret gemessen vnd mit ernst allergnädigst anbefohlen haben / das ein jeder / so decley Grundstuck innen hat / indifferenter seine Geröbren vnd Titulum Possessionis / obgedacht Unseren Rät vnd Commissarien / so gewis exhibire / als im wiederigen sie Rät vnd Commissarij schon befehlet seyn / solche Grundstuck zu Handen Unserer beselten Wald-Ambtleuth so lang einsehen / vnd behalten zu lassen / bis sie ihre Titulos ihnen vorgetwiefen / vnd sich darzu gnußsam legitimirt haben werden. Demnach sich dann ein jeder zu rüchten / vor Schaden zu hüten / vnd hiean Unsern gnädigsten Willen vnd Beymung gehorsambst zu vollziehen wissen würedet. Geben in Unserer Statt Wienn / den Fribstten Septembris / im Sechshundert Vier vnd Siebenzigsten / Unserer Reiche des Römischen im Sibenzehenden / des Hungarischen im *Dimuntzischen* / vnd des Böhmeischen im Neunzehenden Jahr.

*Leopold*



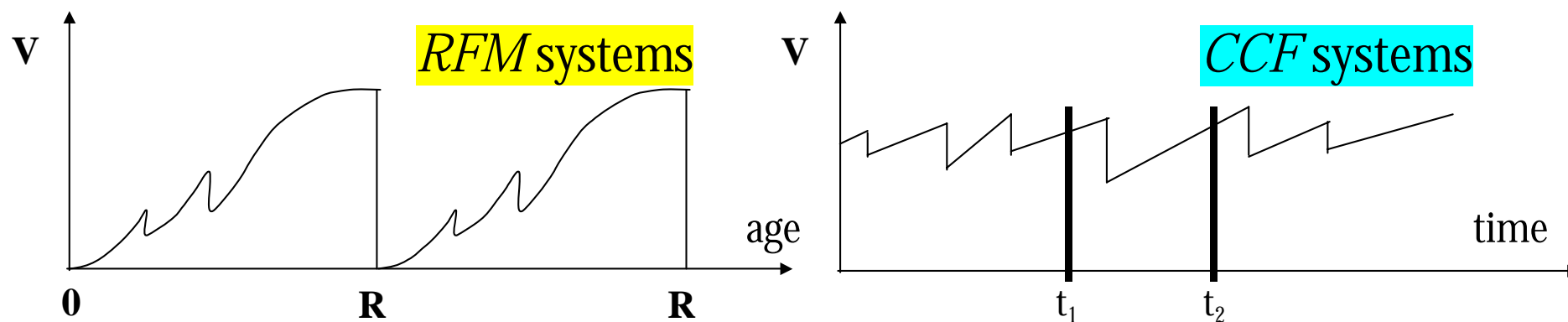
Ad Mandatum Electi Domini  
Imperatoris proprium.

*Leopold*

Urkunde zur Wienerwald-  
Bereitung 1674-1678  
(document on „riding through the  
forest of Vienna 1674-1678“)

## 5. Two basic approaches to forest management for timber production

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RFM: Rotation Forest Management  
Production-oriented  
well established methodology

CCF: Continuous Cover Forest  
Complex decisions

Both systems, as depicted here, are sustainable in terms of timber production. It is exactly the increment which is harvested.

For plant NWFP, some system close to the CCF system might be appropriate – however, with many open questions ...!

## 6. A typical forest inventory

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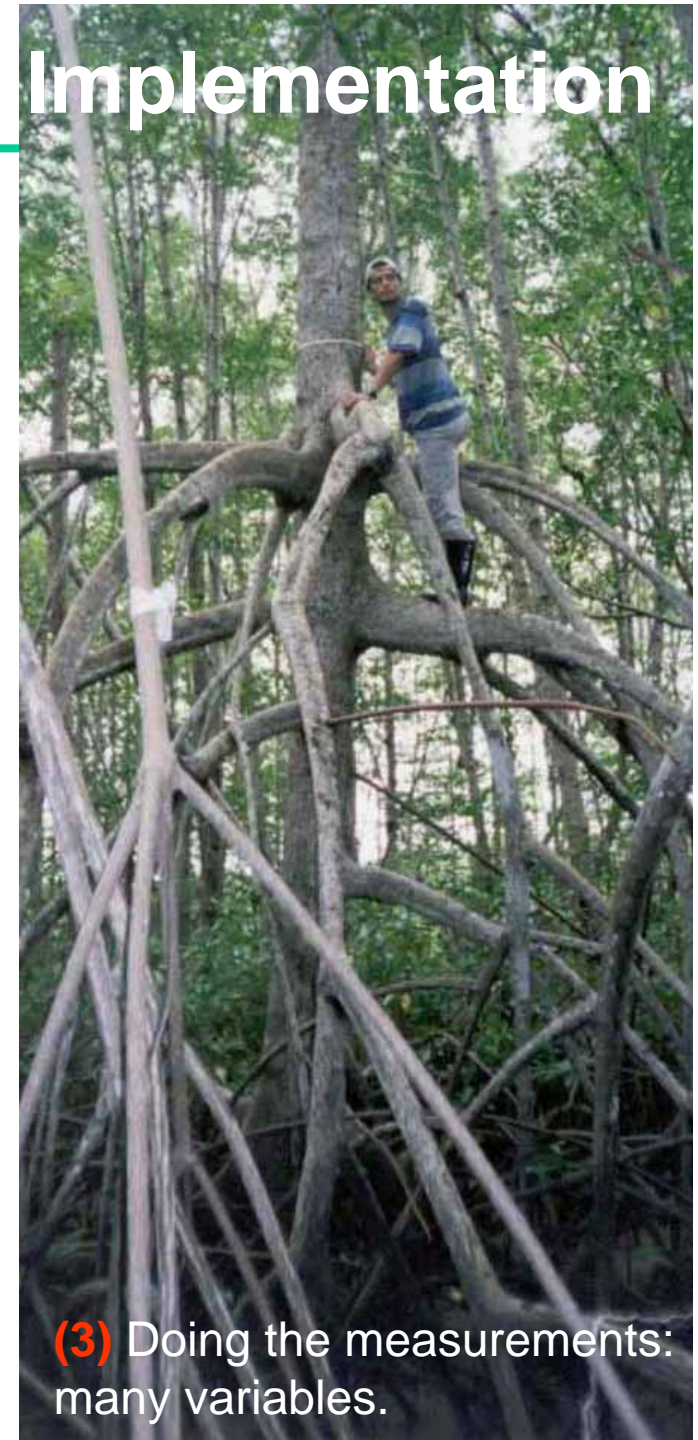
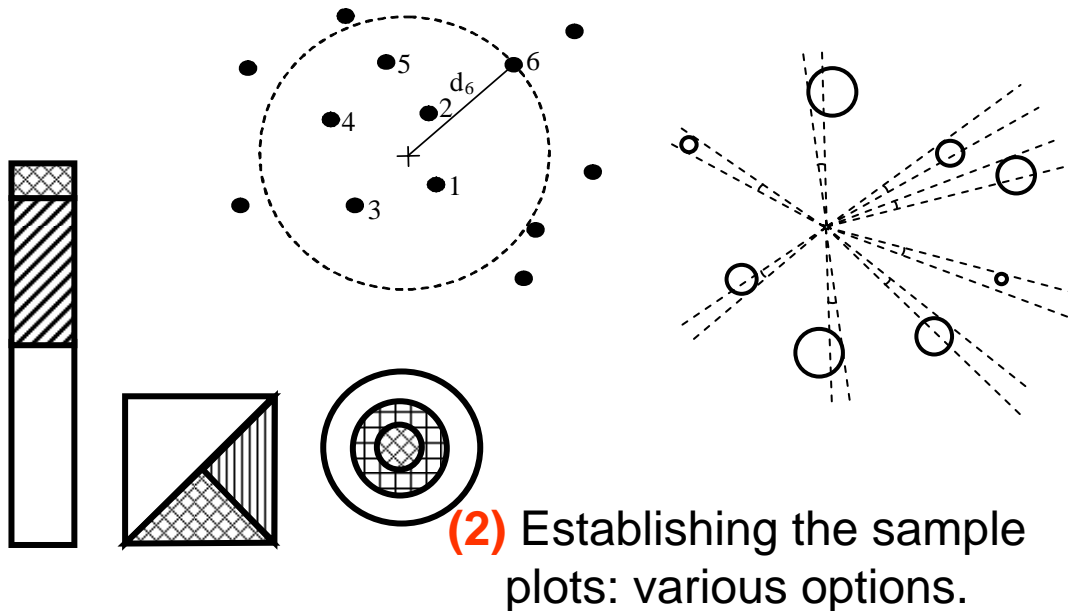
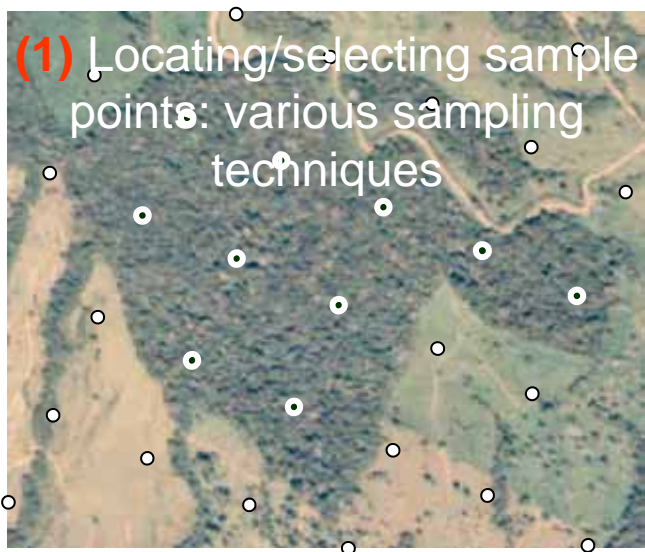
- Planning
- Implementation
- Analysis
- Reporting

## 6.1 A typical forest inventory: Planning

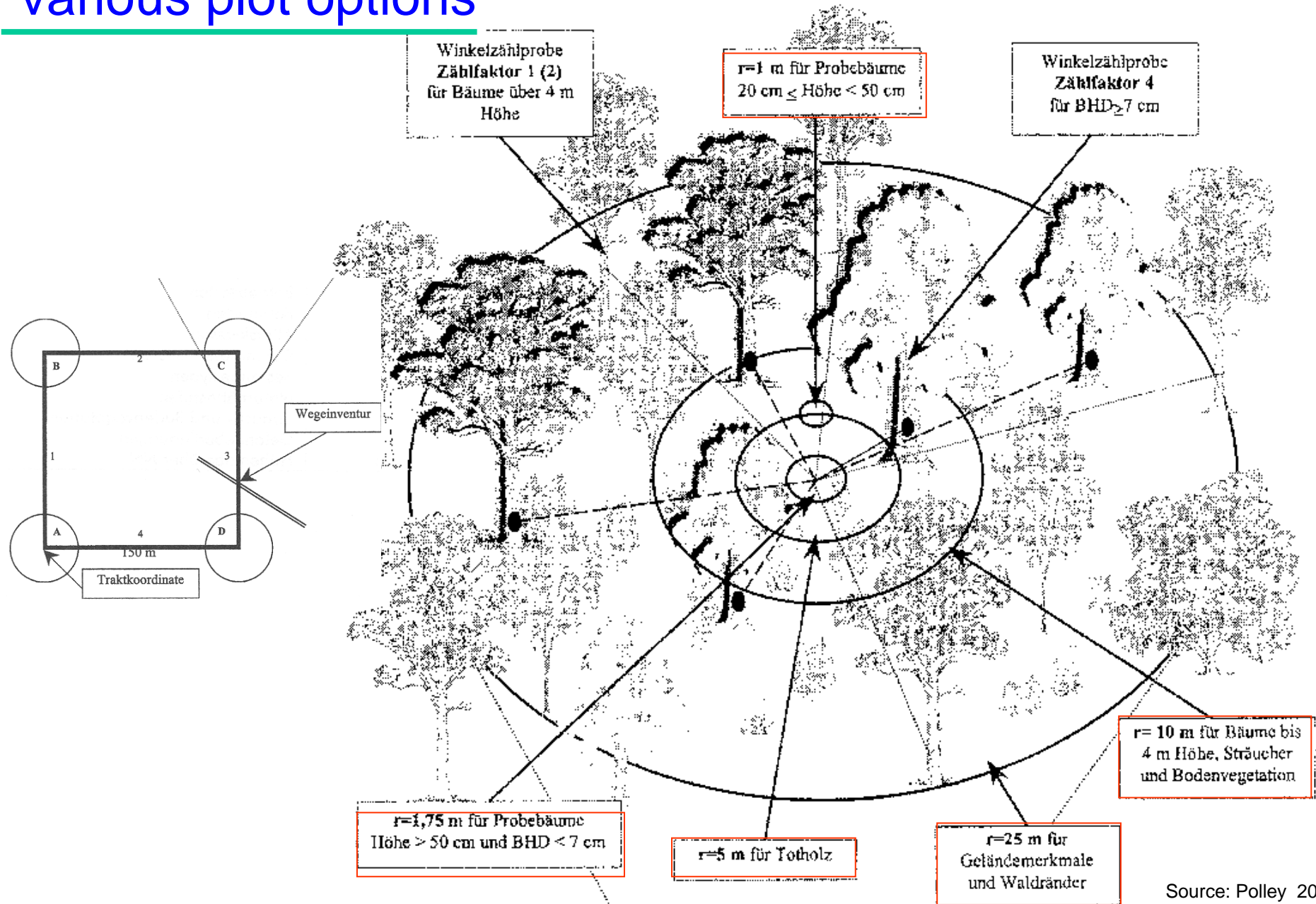
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- Defining objectives and scope.
- Defining target attributes to be observed.
- Defining data sources to be used.
- Field data are crucial, and field sampling is an essential component of all forest inventories; where three design elements need to be planned for:
  - (i) Sampling design
  - (ii) Response design
  - (iii) Estimation design

## 6.2 A typical forest inventory: Implementation



# Cluster plot design in the German NFI: combination of various plot options



## 6.3 A typical forest inventory: Analysis

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Issues in data analysis:

- Data quality check (begins with check cruising ...)
- Models: many attributes can not directly be observed and need to be modelled (timber volume, wood volume, biomass, carbon).

Many models exist – but not so for NWFPs!

- Estimation

## 7. Technical challenges for NWFP inventories

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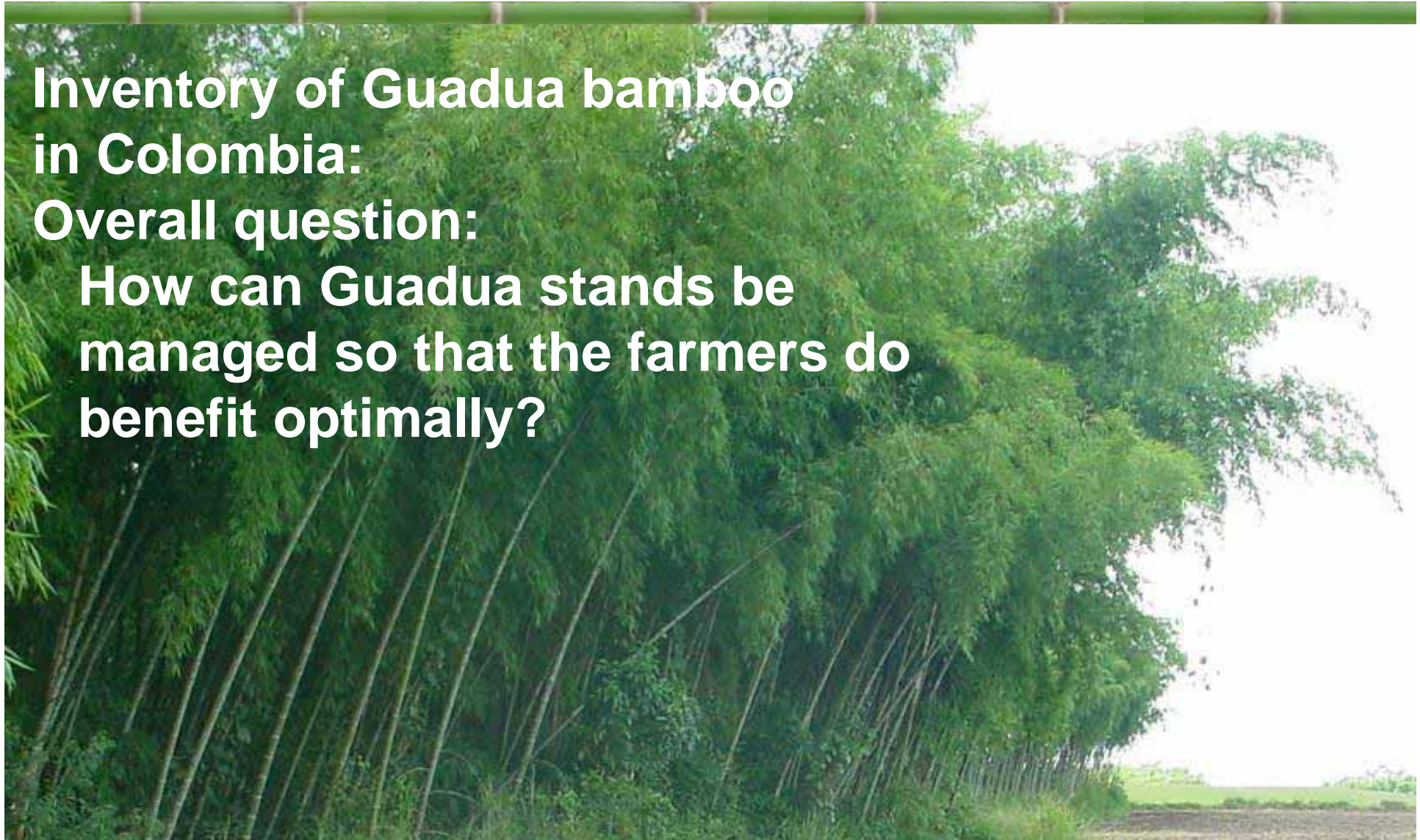
- Many obvious commonalities with forest inventories.
- The diverse range of NWFPs requires a diverse range of inventory approaches.
- Some substantial differences, such as:
  - seasonality, annual vs. perennial plants;
  - rare and clustered pattern of distribution ;
  - specific knowledge required for detection and identification;
  - growth pattern;
  - ...

## 8. Examples of our NWFP inventory related projects.

**Inventory of Guadua bamboo  
in Colombia:**

**Overall question:**

**How can Guadua stands be  
managed so that the farmers do  
benefit optimally?**



Sustainable bark harvesting in Southern Africa for medicinal purposes (Jenny Wong project leader):

**Overall question:**

**How can bark be harvested sustainably when the demand is growing towards an international market?**

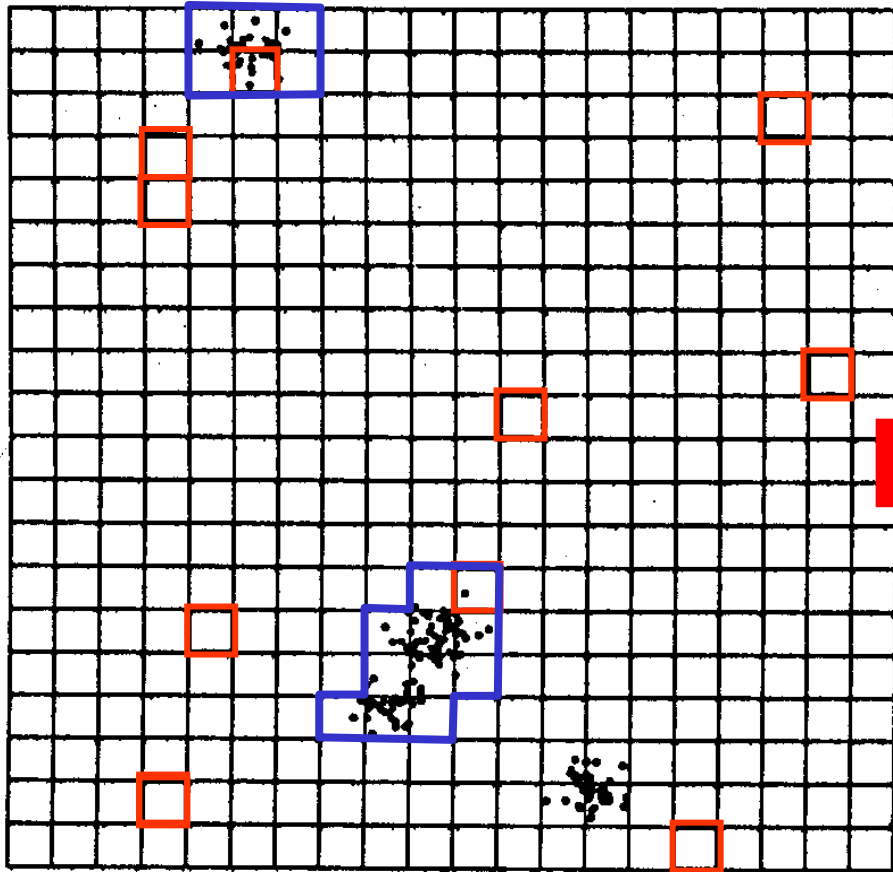


# “Adapting“ Adaptive Cluster Sampling (ACS)

Overall question:

How can *rare events* be sampled efficiently (such as NWFP and TOF)?

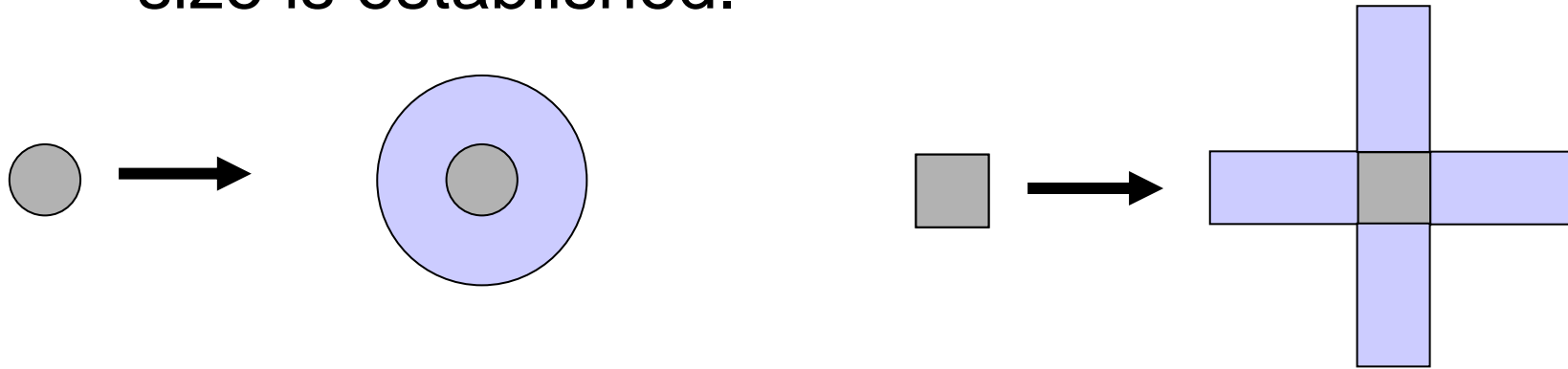
ACS → further development.



# “Adapting“ Adaptive Cluster Sampling (ACS)

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Idea: Simplification of ACS with only two different plot sizes: If the defined condition is fulfilled in the seed plot, then a larger plot of a defined size is established.

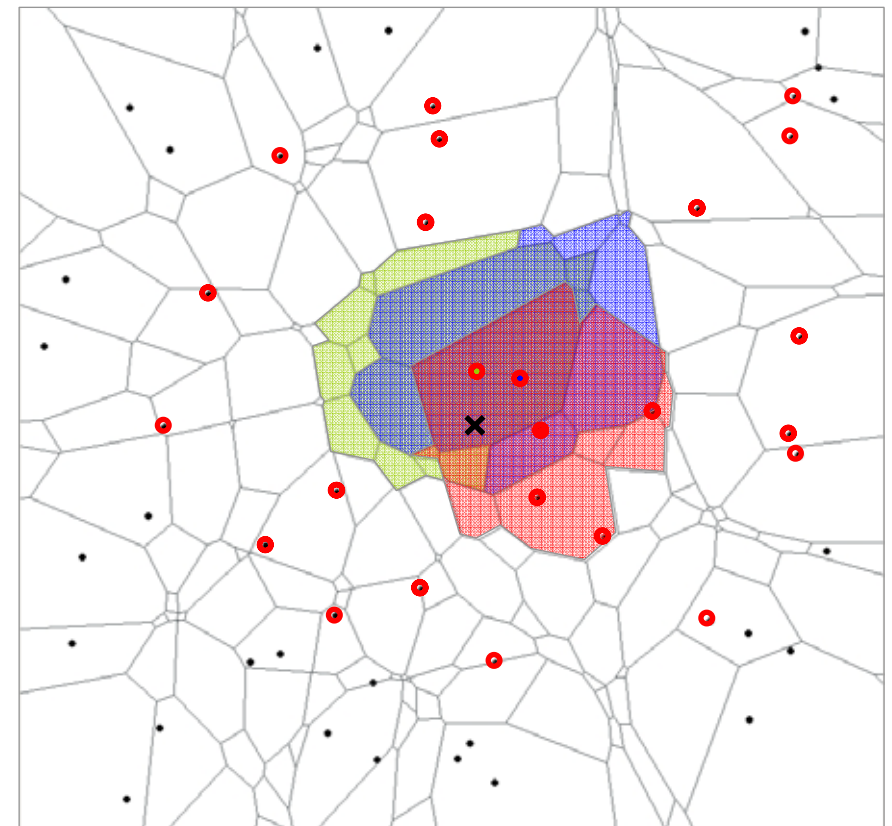
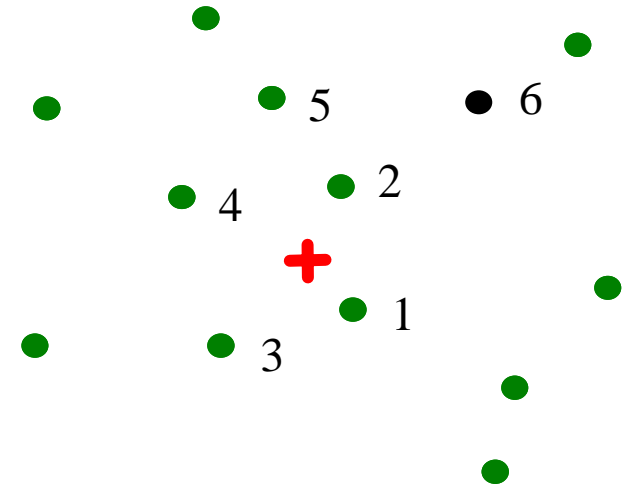


Problem: This *conditional* adjustment of plot size makes estimation a challenge, because selection probabilities change in a “strange” manner ...

# Unbiased estimation in $k$ -tree sampling

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- $k$ -tree plots: A response design in which, from each sample point, the  $k$  nearest trees are taken as sample trees.
- Frequently applied in ecology, and potentially of interest also in plant NWFP sampling.
- Strength: easy to apply (if  $k$  isn't too large).
- Weakness: **unbiased estimator ?**



## 9. Guiding criteria for forest inventory planning (probably directly applicable to NWFP inventories)

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There is no formal “good practice” guide for forest inventories,  
but there are some criteria commonly accepted  
in the “forest inventory expert community”:

- **Conformity with objectives.**
  - **Methodological soundness.**
  - **Comprehensive reporting and documentation.**
  - **Overall transparency and high data quality.**
- **Overall credibility.**

## 10. Wrap-up

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It is important to generate sound data and make them available as up-to-date information.

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- That means: forest inventory is eventually not only an “**information issue**” but also a “**communication issue**”.  
( Forest inventory research should not only focus on information *generation* but also on information *utilization* )
- And: forest inventory (in particular large area forest inventory) has not only the **technical dimension** of statistics and information generation, but also a **political dimension**.

## 11. Conclusion:

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Information is probably required in all fields of natural resources management, including conservation.

Forest inventory offers a comprehensive toolbox for data and information provision and interpretation.

Many forestry inventory techniques and approaches are directly applicable to other fields – such as NWFP inventories.

Still, there are manifold issues waiting to be solved – this holds in particular also for the inventory of NWFPs.



**Thanks**