Models for forest management from research to sustainable forest practices

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Forestry

- Forestry is the science, art, business, and practice of conserving and managing forests and forest lands to provide a sustained supply of forest products, forest conditions, or other forest values desired by the forest owner and the society in general

  (Ford-Robertson, 1971)

Forest management

- Forest activities imply decisions about the relationship between man and the forest, in particular about the way man modifies the forest in order to achieve its objectives - forest management

Forest management occurs at different scales of spatial resolution:

- stand
  homogeneous forest area
- management unit
  set of stands with a common management plan
- watershed
- region
- country
- continent
- globe

Foresters and private owners

Politicians and public administrators

Growth models and decision support systems

- To support decision-making forest resources administrators (politicians, public and private land administrators, foresters, etc) require sound predictions on the evolution of the forest under alternative management actions
- Growth models and decision support systems help the users to define the set of actions that optimise their objective goals and criteria

Stand	→	Growth models
Management area	→	Decision support systems
Landscape	→	Decision support systems

EVOLUTION OF FORESTRY

Development of forestry (Kimmins, 1997)

	Stage of development	Result
Preforestry	Exploitation	→ Resource depletion
Forestry stage 1	Administrative forestry	→ Failure to achieve conservation and sustainability goals
Forestry stage 2	Ecologically based forestry	→ Sustained production of timber and other conventional products
Forestry stage 3	Social forestry	→ Ecologically based forestry that sustains a wide range of forest conditions and values desired by society

Increasing information needs (Lund & Smith, 1997)

- The information requirements of the forest resources administrators increased in parallel with the development of forestry

1950's	1960's	1970's	1980's	1990's	2000's
Timber	Timber	Timber	Timber	Timber	Timber
	Multiple resources	Multiple resources	Multiple resources	Multiple resources	Multiple resources
		Biomass	Biomass	Biomass	Biomass
			Global warming	Global warming	Global warming
				Ecosystems, biodiversity, non-wood products	Ecosystems, biodiversity, non-wood products
					Other´s lands?

Sustainable forest management:

- The stewardship and use of forests in a way, and at a rate, that maintain their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems

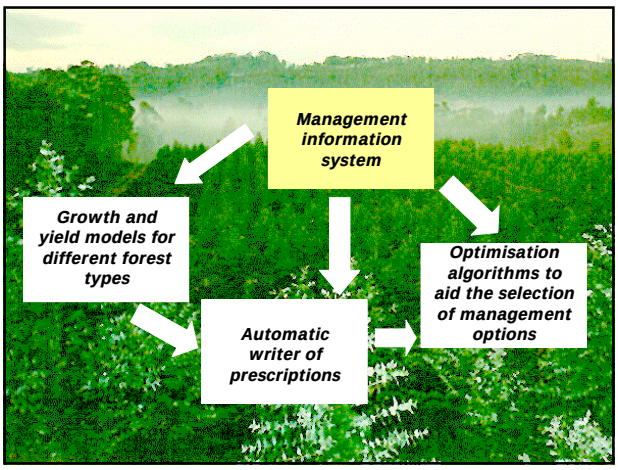
source: MCPFE, 2000

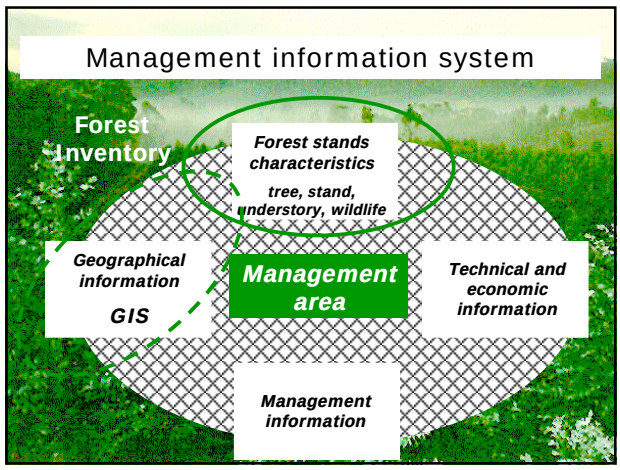
Pan-European criteria and guidelines for sustainable forest management (Lisbon Conference, 1998):

Maintenance and enhancement of …

1. Forest resources and their contribution to global carbon cycles
2. Forest ecosystem health and vitality
3. Productive functions of forests (wood and non-wood)
4. Biological diversity in forest ecosystems
5. Protective functions in forest management (soil and water)
6. Socio-economic functions and conditions

DECISION SUPPORT SYSTEMS

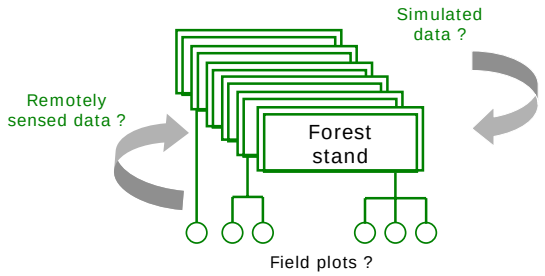




THE NEEDS OF FOREST MANAGEMENT UNDER CHANGING CONTEXT

- Problems with Forest Inventory methodologies used at present:
  - Information is usually not available for every stand in the management area

Information for each stand – how?



- Problems with Forest Inventory methodologies used at present:
  - Information is usually not available for every stand in the management area
  - Present forest inventories focus mainly on the production functions of forest
    - Can multiple functions of forest functions – biodiversity, recreation, carbon sequestration, species mixtures, etc – be assessed on the basis of the sampling scheme that is used for volume assessment?
    - NO!

- The need for more intensive data collection on Forest Inventory methodologies used at present:
  - Other information than just on trees
  - Vertical structure of the stand
  - Herbal plants, bushes
  - Soil information (essential for carbon sequestration assessment)
  - Data to be used for modelling

- The need for new approaches for multi-resource inventory
  - Adaptive cluster sampling for assessment of rare species
  - Ranked set sampling for point-to-plant distances assessment
  - The use of modelling (e.g. habitat modelling, site productivity modelling)
  - The use of hyperspectral data for classifying tree species
  - Landscape indices (area metrics, patch density metrics, edge metrics, etc)

see *e.g.* (Köhl, 2001)

- Problems with growth models used at present:
  - Presently used models (empirical models)
    - do not allow for the simulation of forest growth under a changing environment
    - concentrate output on the development of trees (do not give output on the impact of forests and forest management on soils and water use, on biodiversity, etc)
    - Do not simulate the impact of genetic improvement
  - Process based models
    - do need too much input data, usually not available from forest inventory
    - do not give all the output needed for forest management

- What do we then need?
  - We need a “mariage” between empirical and process based models in order to obtain hybrid models that
    - can work using forest inventory data as input, even if forest inventory data is slightly intensified
    - simulate the effect of global change on tree and stand growth
    - provide information of the effect of different silvicultural alternatives not only on tree growth but also on other forest uses
  - The question that remains:
- Is that possible?