



# FOREST MANAGEMENT and the C.A.F.E. CONCEPT

May 27<sup>th</sup>, 2020

Webinar

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Professor, R+D:

- Forest Ecology & Ecophysiology,
- Forest Hydrology & Watershed Management,
- Forest Fires,
- Forest Landscape Restoration



The project *LIFE RESILIENT FORESTS – Coupling water, fire and climate resilience with biomass production from forestry to adapt watersheds to climate change* is co-funded by the LIFE Programme of the European Union under contract number LIFE 17 CCA/ES/000063.



## Sketch

- 1.- Focusing Resilient Forests' **Narrative** about FOMA
- 2.- FOMA enhances **by-product G&S's** that can be quantified (P-B models)
- 3.- Traditional objectives in FOMA can be **broadened** by targeting selected G&S ☐ optimize among objectives
- 4.- Framework for developing a **DSS** to help on these aspects



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# 1.- Focusing Resilient Forests' Narrative about FOMA

## VERY different tree species ☐ VERY different forests

- Tolerant/Intolerant ☐ Light
- Hardwood/Softwood ☐ growth
- Iso/Anisohydric ☐ Water response
- *Even / Uneven-aged*
- *Coppice / High Forest*
- *Mono /multi-specific // Understorey*





# 1.- Focusing the Life's Narrative about FOMA

Tree sp. + Forest type + **Manag. goals** □

## Different Silvicultural systems

Clearcut with standards

Shelterwood

Selection systems

...

Species

Site

Structure

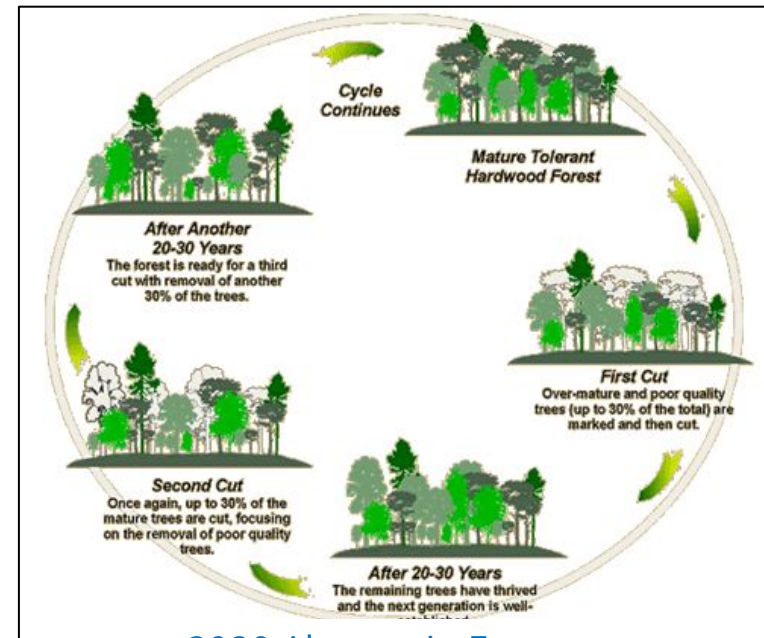
Spacing

Age

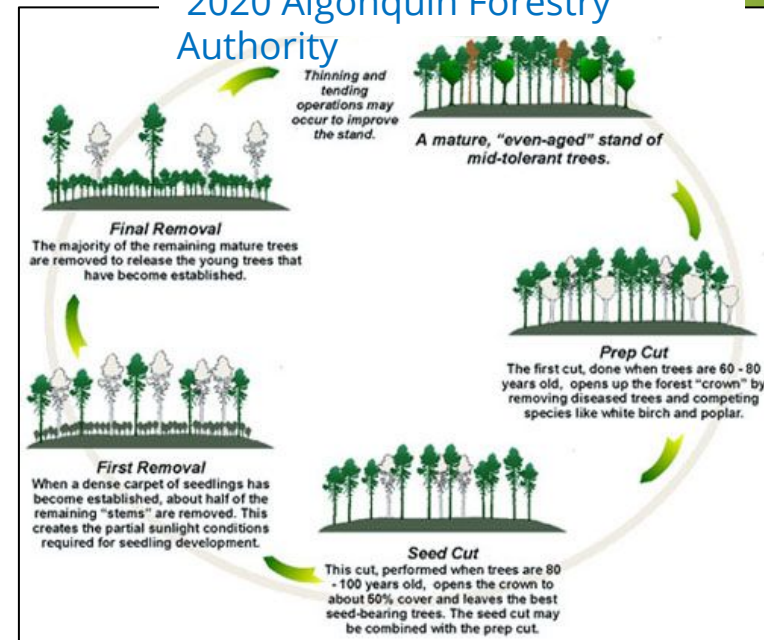
□ **Silvicultural treatments:**

## Regeneration / Improvement treatments

- Preparatory cuttings
- Sanitation cuttings
- Seedling cuttings
- First /... /Final Cuttings (including thinning)
- Brush-out / weeding
- Soil treatments, ....



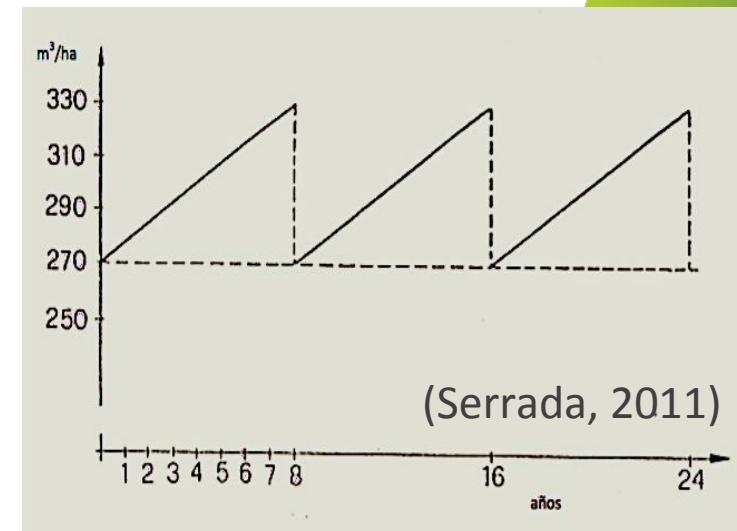
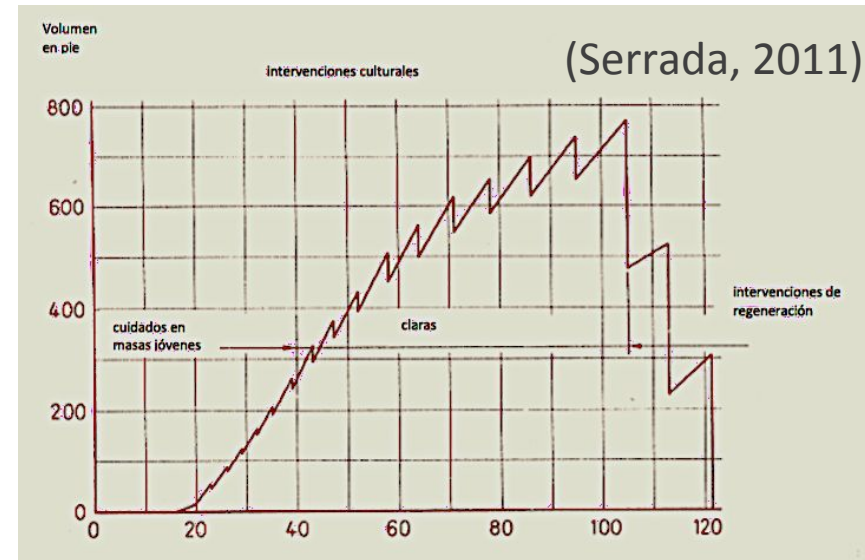
## 2020 Algonquin Forestry Authority



# 1.- Focusing Resilient Forests' Narrative about FOMA

## Regeneration / Improvement treatments

- Thinning regime and final felling cuttings in a shelterwood system
- Thinning cuttings rotation in an uneven-aged hardwood tolerant sp. in selection sys.





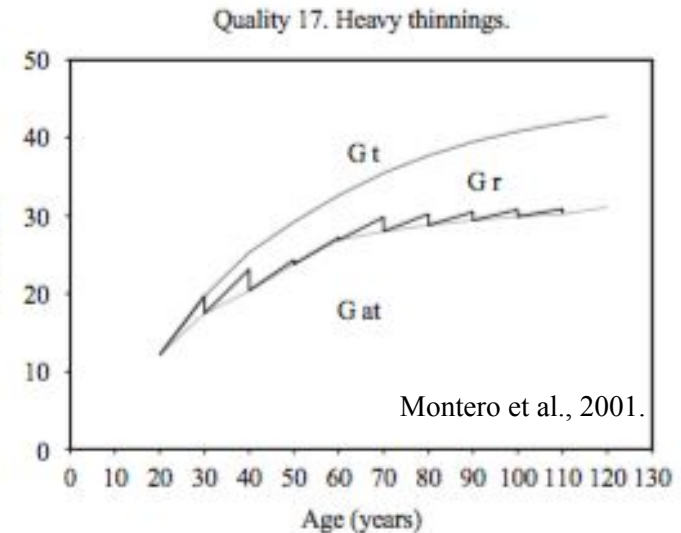
# 1.- Focusing Resilient Forests' Narrative about FOMA

- E.g. Intolerant-isohydric-softwood sp.

- Even-aged high forest ☐  
Clearcut / Shelterwood system ☐

Site Qlty.  
Structure  
Spacing  
Age

→ Regeneration  
/ Improvement cuttings



-Basal area ( $\text{m}^2 \cdot \text{ha}^{-1}$ ) of main stand after thinning, basal area remove with thinning and total basal area for site quality and thinning regimes for *Pinus halepensis*  
(Basal area: GT: total; Gr: removed; Gat: after thinning.)



Photo: Hernández, D.

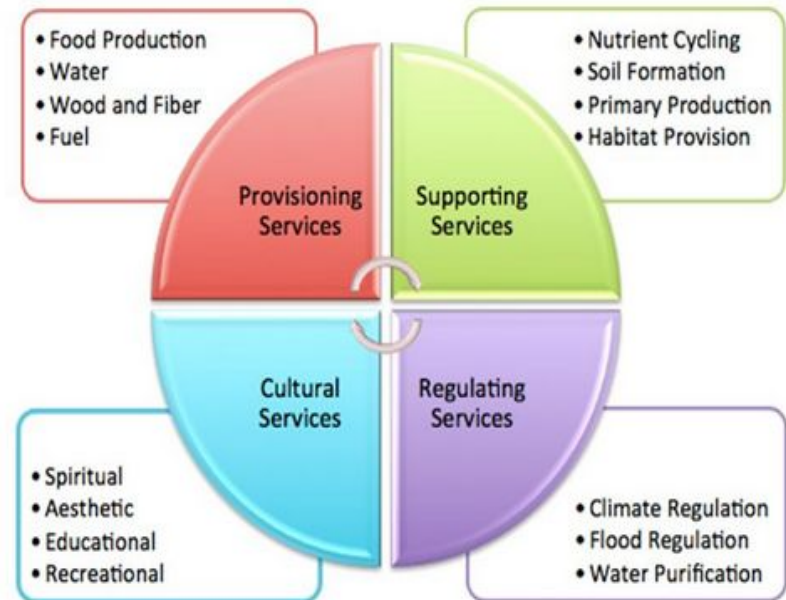
2004

## 2.- FOMA enhances by-product G&S's that can be quantified

FOMA ☐ **Timber + other G&S**



### Forests provide ecosystem services



Source: Millenium Ecosystem Assessment, 2005.

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## • EU forest strategy (2021) encourages and promotes:

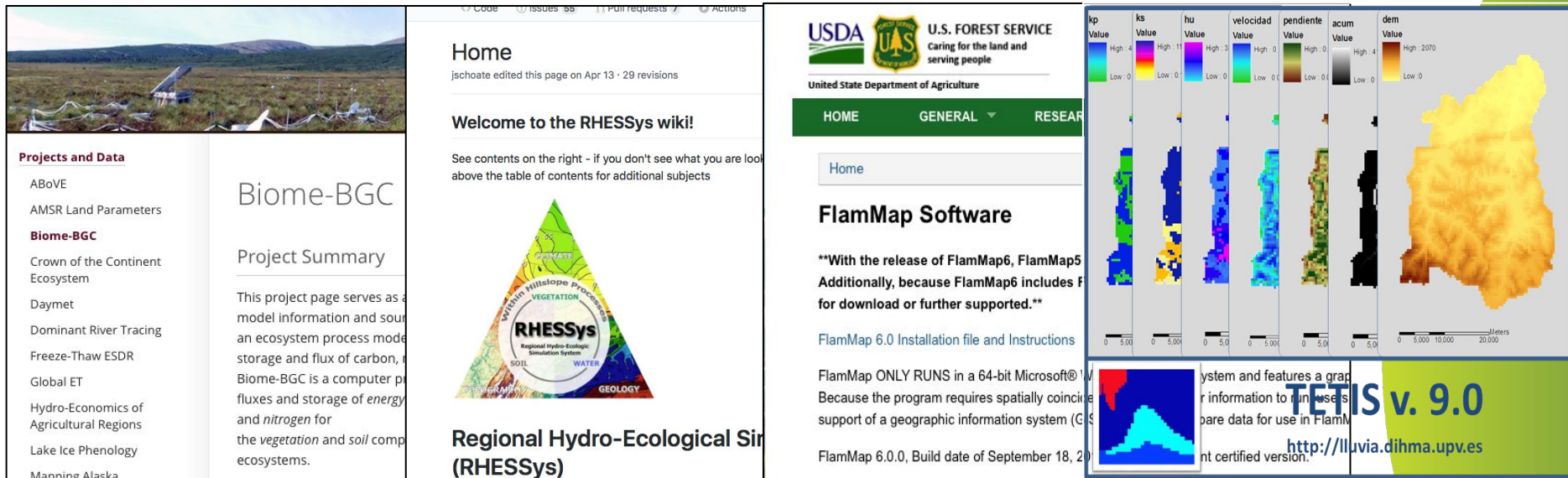
- The multifunctional role of forests
- Sequestering carbon
- Enhance resilience of ecosystems
- Protect and preserve biodiversity and other ecosystem services

☐ **Demonstrate the added value of FOMA to the society**

## 2.- FOMA enhances by-product G&S's that can be quantified (P-B models)

Need to quantify ecosystem processes: Carbon, water, fire, eco-resilience,...

Tree species + Forest type + Management goals ☐ Silvicultural systems ☐ General silviculture ☐ Functional silviculture ☐ Processes-based silviculture ☐ Process-based models:





## 2.- FOMA enhances by-product G&S's that can be quantified (P-B models)

### Process-based silviculture ☐

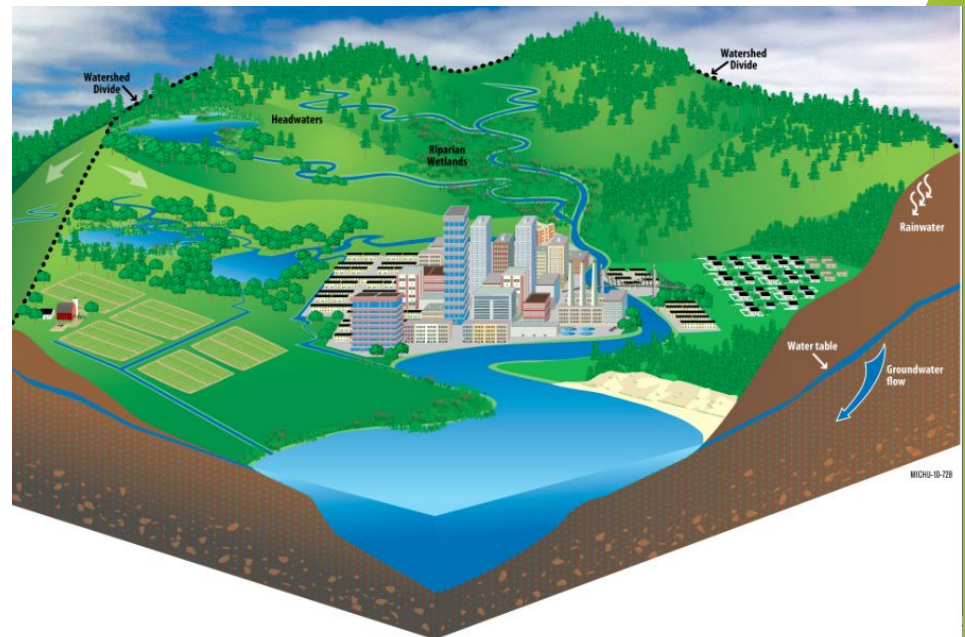
Carbon cycles

Water cycles

Fire ecology & fire regimes

Climate change issues

Eco-hydrological modeling of the broader watershed



<http://www.miseagrant.umich.edu/lessons/files/2013/05/10-728-How-A-Watershed-Works.jpg>

### 3.- Traditional objectives in FOMA can be broadened by incorporating selected G&S

The **C.A.F.E. concept** (carbon, aqua, fire and eco-resilience) is a multifunctional approach that quantifies key by-product G&S's enhanced with FOMA



- C.A.F.E. approach **stimulates** silviculture, as coffee does



# Water

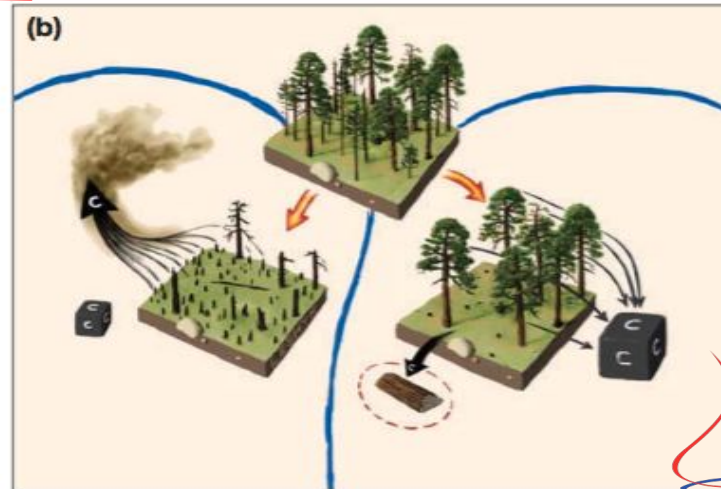
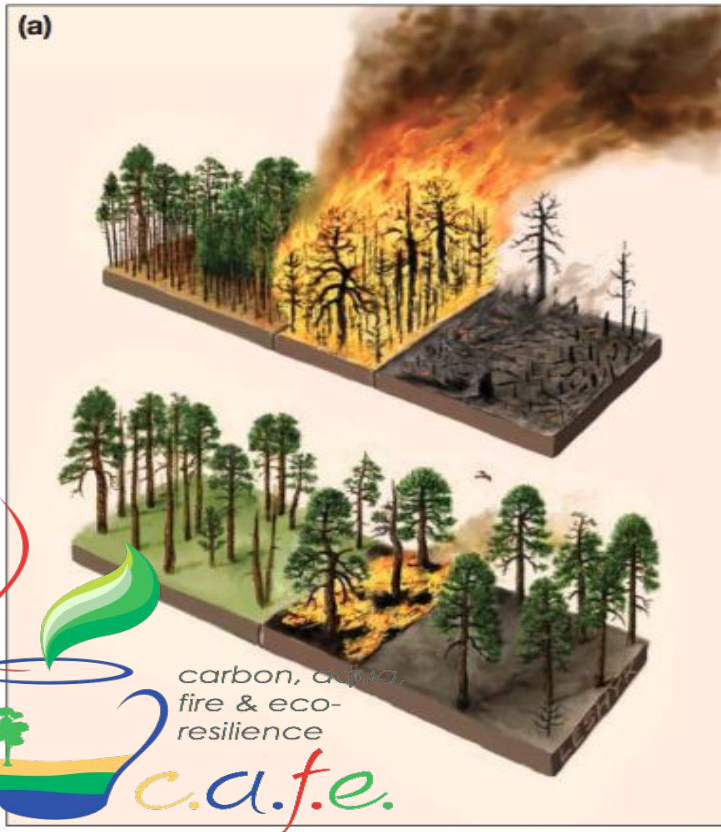






## Carbon protection & fire risk reduction

Carbon protection and fire risk reduction



**Figure 1.** (a) Two options for a given forest stand and the resultant tree survivorship following a wildfire event. (b) The carbon accounting consequences of two possible options for a given forest stand and the results following a wildfire event. The cubes represent the amount of carbon remaining in the ecosystem after wildfire.

Hurteau et al., 2008 (Front Ecol Environ, 6(9),493-498, doi:10.1890/070187)

carbon, aqua,  
fire & eco-  
resilience

c.a.f.e.



# Climate change Resilience



Photo: Botella, A. 2015

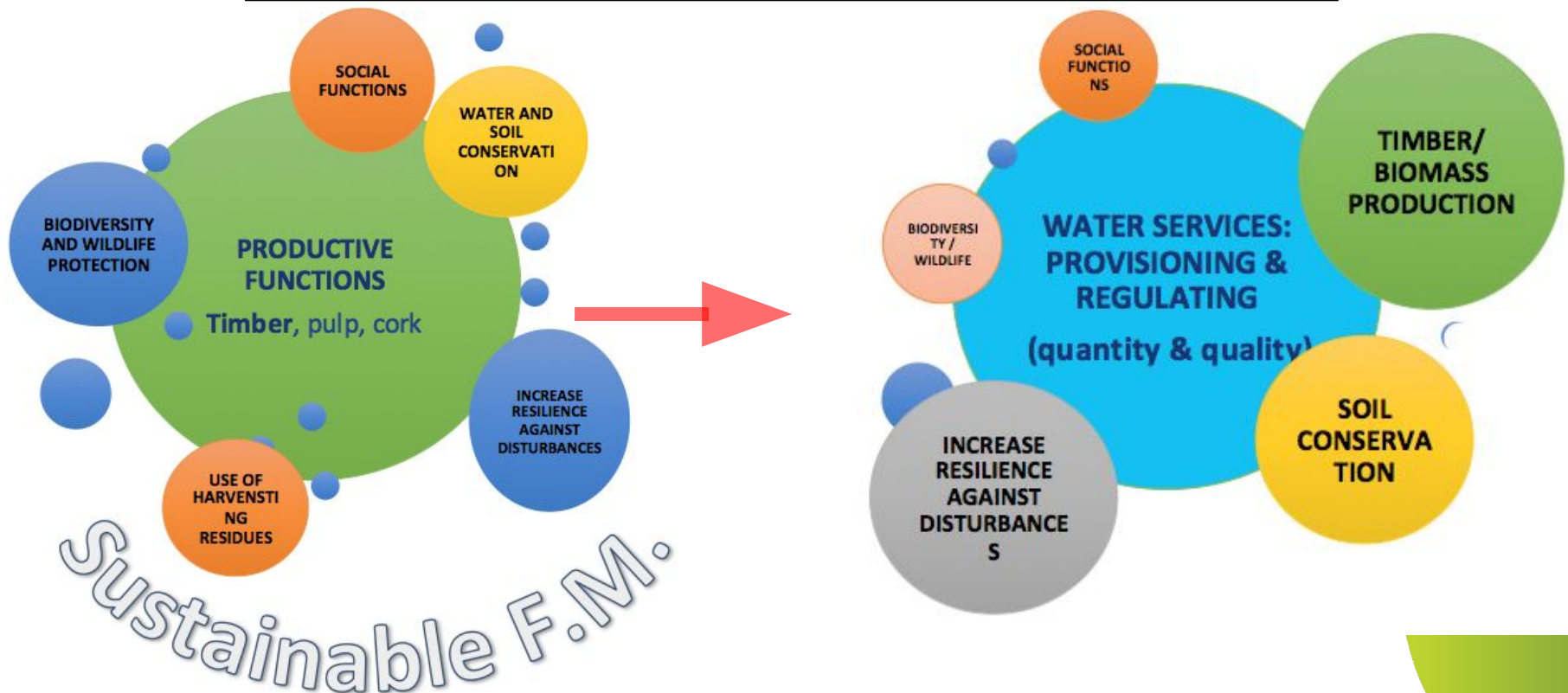




### 3.- Traditional objectives in FOMA can be broadened by incorporating selected G&S □ optimize among objectives

**Processes silviculture □ identify critical processes and vulnerability of the forests □ Change management objectives**

Several objectives (multifunctional forestry)  
E.g., piro-hydro-ecological silviculture





## 4.- Framework for developing a DSS

### Life Resilient Forests

#### Process-based silviculture □

Carbon cycles  
Water cycles  
Fire ecology & fire regimes  
Climate change issues  
....



Eco-hydrological modeling

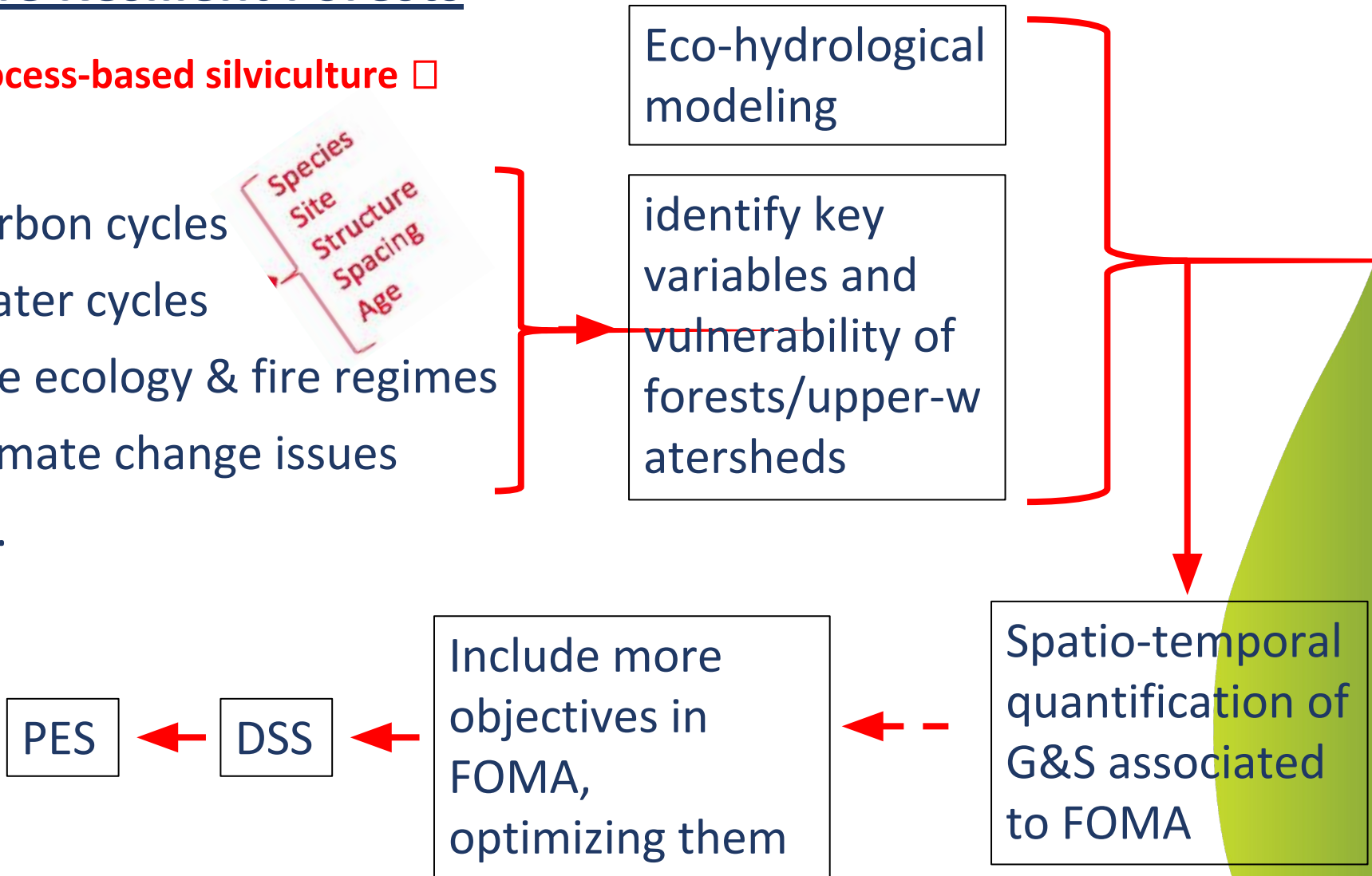
identify key variables and vulnerability of forests/upper-watersheds

Spatio-temporal quantification of G&S associated to FOMA

Include more objectives in FOMA, optimizing them

PES

DSS



## CAUTION (we are from the Academy...!!):

Heinrich Cotta [1816, Anweisung zum Waldbau, in DANIEL (1982) & Serrada (2011)],

“Forest engineering is still so far behind:

- first, the **long period** necessary for the development of forests;
- second, the great **variety of sites** on which they grow;
- third, the fact that the technician who practices a lot writes very little, and the **one who writes almost does not practice»**.

.....Thanks, Antonio del  
Campo