Indicators of sustainable forest management: application and assessment
One of the main challenges for forest policies and planning is to conciliate many different interests, finding a balance in order to satisfy the economical requests without compromising the integrity of forests ecological functions (e.g. MacDicken et al. 2015). Sustainable forest management is defined as “stewardship and use of forests and forest land in a way, and at a rate, that maintains their biodiversity, productivity, generation capacity, vitality, and their potential to fulfil now and in the future, relevant ecological, economic, and social functions at local, national, and global levels [. . .]” (MCPFE 1993).
Indicators of sustainable forest management: application and assessment

Criterion 1: Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles;

Criterion 2: Maintenance of forest ecosystem health and vitality;

Criterion 3: Maintenance and encouragement of productive functions of forests (wood and non-wood);

Criterion 4: Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems;

Criterion 5: Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water);

Criterion 6: Maintenance of other socioeconomic functions and conditions.
The criteria and indicators for Sustainable Forest Management (SFM) of MCPFE have a great significance at Regional and National level. However, their ability to describe phenomena that influence the forest ecosystem at the forest management forest management scale should be tested. Furthermore this indicators are not able to describe important ecosystem processes.

The Life project ManFor C.BD. can offer to stakeholders and practitioners a practical account of the effect of management on carbon cycle, biodiversity and landscape.

Forest management cannot be evaluated using a single indicator because sustainability is connected to several factors related to production, carbon cycle, biodiversity and landscape → all the different criteria and scales should be taken into account, as a network of processes, to assess the sustainability of different management options.
Indicators of sustainable forest management: application and assessment

Project objectives:

Objective 2. Collect, compare and disseminate updated data related to the Pan-European indicators for Sustainable Forest Management, with a particular emphasis on those indicators related to carbon cycle/sequestration and biodiversity.

Objective 3. Define, test and evaluate additional quantitative indicators related to forest management in order to fulfill the needs of International Conventions and European Action Plans (UNFCCC, UNCBD, EU Forest Action Plan, Halting the loss of biodiversity by 2010 –and beyond, etc.).

"Indicators of sustainable forest management: application and assessment"

- present and disseminate the data on indicators collected during the project.
- it is a technical report that describes indicators of SFM and the method to assess them, showing the results of ManFor C.BD.
- It is not a research paper but the base for discussion.
Indicators of sustainable forest management: application and assessment

1. Indicators of sustainable forest management: a European overview

2. The life project ManFor C.BD.: Managing forests for multiple purposes: carbon, biodiversity and socio-economic wellbeing

3. Implementing forest management options for the life project ManFor C.BD.: Description of the test areas

4. Data collection and new indicators of sustainable forest management: the life project ManFor C.BD.

5. Assessing the maintenance of forest resources and their contribution to carbon cycles

6. Assessing indicators of forest ecosystem health

7. Assessing indicators of forest productive functions

8. Assessing indicators of forest vegetation diversity

9. Assessing indicators of deadwood and microhabitats

10. Assessing indicators of animal diversity

11. Applying indicators of vegetation diversity
Indicators of sustainable forest management: application and assessment

Indicator name

Full text: brief description of the indicator

Rationale: description and justification

Methods: how it may be measured

Measurement units

Measurement time: Before [Y/N] - After [Y/N] – During [Y/N]

Feasibility:

<table>
<thead>
<tr>
<th>Scale of application</th>
<th>Specific knowledge</th>
<th>Costs</th>
<th>Interaction with other indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>plot, stand, compartment, landscape, regional</td>
<td>1 (no specific background)- 5 (specialized technician)</td>
<td>Costs: 1-5 (min.-max.)</td>
<td>The potential interaction with other indicators (proxies)</td>
</tr>
</tbody>
</table>

Results from ManFor C.BD.:

<table>
<thead>
<tr>
<th>Indicator name</th>
<th>Site</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. Basal area (m² ha⁻¹)</td>
<td>Cansiglio Innovative</td>
<td>41.9</td>
<td>26.6</td>
</tr>
</tbody>
</table>
ASSESSING THE MAINTENANCE OF FOREST RESOURCES AND THEIR CONTRIBUTION TO CARBON CYCLES

1. Growing stock (1.2)
2. Diameter distribution (1.3)
3. Forest carbon stock (1.4)
4. Basal area
5. Fast response of stem growth
6. Soil efflux
7. Land use

The first criterion supports SFM considering the expansion and evolution of European forests and their contribution to carbon cycles.
Indicators of sustainable forest management: application and assessment

ASSESSING INDICATORS OF FOREST ECOSYSTEM HEALTH

1. C/N ratio in soil
2. Humus form
3. GHG emissions 2.1
4. Tree wounds 2.4
5. QBS-ar variation

Both biotic and abiotic factors influence the health and vitality, and thus the resistance and resilience of forest to disturbance. This criterion includes the issues that may affect forests (e.g. air pollution, soil acidification), the factors that allow to evaluate forest health (e.g. defoliation) and an account of the damaging events that may occur (e.g. diseases, storms).

ASSESSING INDICATORS OF FOREST PRODUCTIVE FUNCTIONS

1. Roundwood 3.2

Forests provide socio-economic resources to nations and stakeholders: this criterion lists different parameters which monitoring should support the maintenance of forest products and services for present and future generations.
Indicators of sustainable forest management: application and assessment

A fundamental goal of sustainable forest management is the maintenance of forest biodiversity. This criterion includes all forest life forms, the ecological roles they perform and the genetic diversity they hold.

Criterion 4: Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems:

✓ DEADWOOD
✓ FAUNA
✓ FLORA

ASSESSING INDICATORS OF DEADWOOD AND MICROHABITATS

1. Deadwood 4.5
2. Microhabitats
Indicators of sustainable forest management: application and assessment

ASSESSING INDICATORS OF FOREST VEGETATION DIVERSITY

1. Diversity of tree species/ Tree species composition
2. Naturalness
3. Plant species richness
4. Vertical vegetation structure
5. Plant diversity indexes
6. Stand structural complexity
7. Gaps texture
8. Novel silvicultural and management practices
ASSESSING INDICATORS OF ANIMAL DIVERSITY

1. Threatened forest species 4.8
   a. Threatened bat species
   b. Threatened bird species
   c. Threatened amphibian and reptile species
   d. Threatened beetle species
   e. Threatened insect forest species

2. Guild related indicators
   a. Bird insectivorous cavity nester guild
   b. Forest birds
   c. Amphibian guild index
   d. Hoverfly obligate forest species
   e. Hoverflies diversity and ecology

3. Species activity indicators
   a. Bat activity index
In the “Indicators of sustainable forest management: application and assessment”:

✓ we present 28 Indicators of SFM (9 of MCPFE and 17 proposed by project specialists).

✓ we answer to the objectives 2 and 3 of the project.

✓ the technical report offers data at management scale (stand, compartment) useful for stakeholders and practitioners.

✓ these data can be used as a base for future research on the interaction between forest management, biodiversity and carbon cycle.
Indicators of sustainable forest management: application and assessment

Thank you for your attention!