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TECHNODIVERSITY IN FOREST OPERATIONS

Jörn Erler, Raffaele Spinelli, Stelian Alexandru Borz, Piotr S. Mederski

A product of the ERASMUS+ project

Technodiversity: Harmonising European education in forest engineering by implementing an e-learning platform to support adaptation and evaluation of forest operations

project No. 2021-1-DE01-KA220-HED-000032038

The aim of the project is to show and explain the technological diversity in harvesting operations and to promote it through targeted training. For this purpose, a barrier free knowledge platform is built, containing:

- an e-learning course about decision-making to find the best technical solution for forest harvesting,
- scientific audiovisuals that show and explain forest operations with a common didactical standard,
- additional information about forest techniques of the partners.

The platform is aimed at forest students on master's level as well as for practitioners for life-long learning.

technodiversity-moodle.ibe.cnr.it

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A THE BASIC CONCEPTS OF TECHNODIVERSITY

A01 Do we need diversity in forest techniques?

Our thesis is:

Harvesting operations should optimally match

- the technical potential and personal capacities of the user
- the environmental and social conditions of the site
- the objectives of the forest owner.

Technodiversity explains how to select the most suitable harvesting technique for each given case, based on clear objective elements.

A02 What is the role of forests?

- For most people, nature is for free, and everybody can use it if they need. As a matter of fact, forest ecosystems offer to the human society a wide range of free **benefits**, which humans obtain without needing to make any efforts or invest any work. Among them, air and water quality, climate mitigation, soil protection etc.

What is the role of forestry?

Additional benefits can be obtained by investing work in the forest – i. e. cultivating it in order to obtain goods and services, like timber, game, non-wood products etc. But there is a limit to all uses: when people use more timber than the forest can grow, when they burn the bush and exploit the soil... the benefits are reduced over time and eventually lost.
That is why human society needs specialists, who take care of the woodlands and guarantee a permanent supply of forest products and services. That is the birth of forestry. Its main task is sustainable forest utilization through forest management.

What is the role of a forest company?

Within this context, the individual forest company has two tasks:

- 1st direct: To supply **goods and services** to society.
- 2nd indirect: To maintain and develop the woodland in a way that will improve its efficiency and maximize its benefits to society.

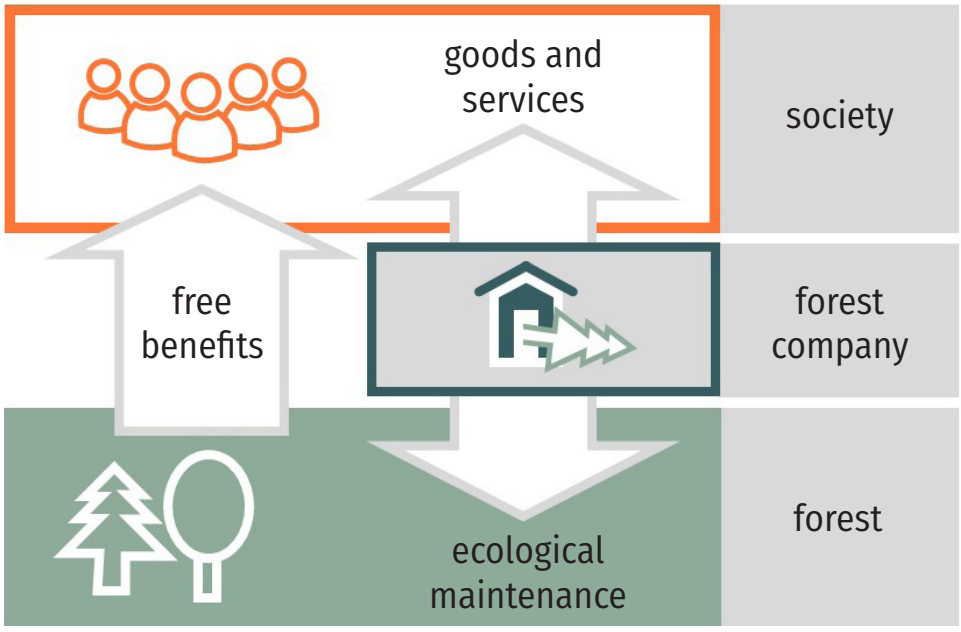

Figure 1: The role of a forest company

A comment on the role of a forest company

But from the point of view of the forest company? Isn't it that the overarching task of every company is to **maximize the income** of the owner? Yes and no. Because we must make a difference between the material objective and the formal objective:
The material objective of any forest and herewith also for every forest owner is to care for the forest and to deliver services and goods in a sustainable way. This defines the typical character of this branch of forestry, its restrictions, and limitations.
The manager of the forest must regard all these restrictions and limitations. There is no leeway; if he fails, he can be punished. But inside these restrictions and natural limitations, different options are given to optimize the success. Choosing the best option is the original job of the manager. But what is the best? Here the overarching task may be to maximize the income of the owner, but in some cases, there are diverging priorities. The success of the manager is measured on the background of this formal objective.

What is the role of forest techniques?

Inside this frame, techniques have the task to implement what the company needs. So, a technique is good as far as it achieves the intended effects while minimizing undesirable side-effects and risks.
Now, we see that the intended effects have three directions:

- towards society to deliver those goods and services that are demanded **> social efforts**
- towards woodlands to maintain them and to improve their health, if needed **> ecological efforts**
- towards the forest company itself to keep its value and to fulfill the needs of its owners **> economic efforts** as well.

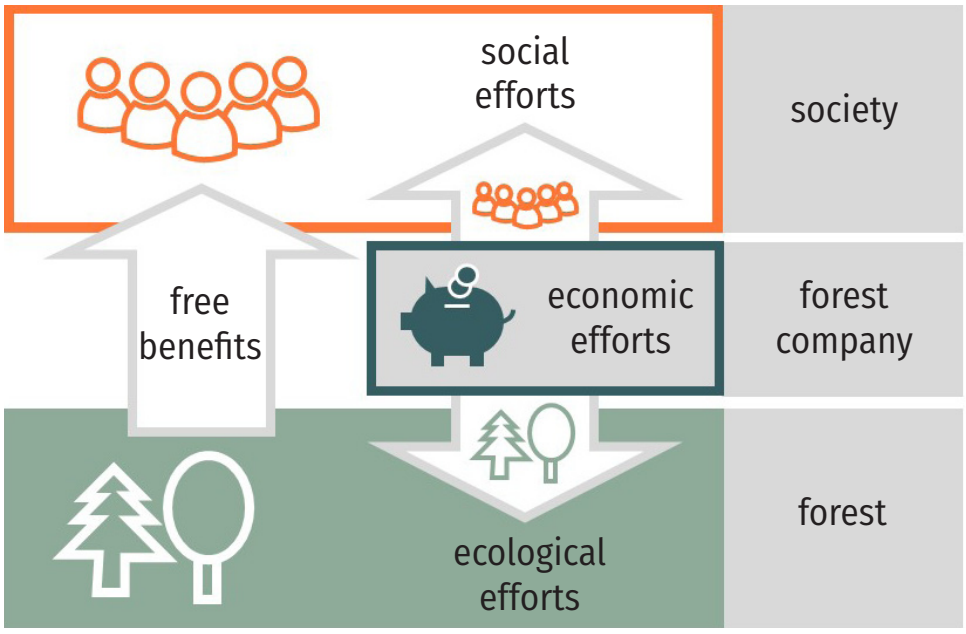

Figure 2: The role of forest techniques

A03 Assessment criteria

The goals of a company

The objectives of a forest company can be divided into three groups: economic, ecological and social objectives.
All actions are to be assessed based on how these three objectives are met. Here very often we find cause-and-effect logics that can be assessed with scientific methods. Consequently, we call this process **assessment**.
The ultimate goal of the company determines which objective is the most important (priority) and how the objectives are weighted against each other (preference). This depends on the individual wishes and sometimes the political aims of the decision maker... and is far away from scientific routines and methods. But very often, the ultimate goal influences the decision making process more than the scientific cause-and-effect logics. Therefore, we would make a mistake not to take into account this individual "color" of decision making. We call it "evaluation".

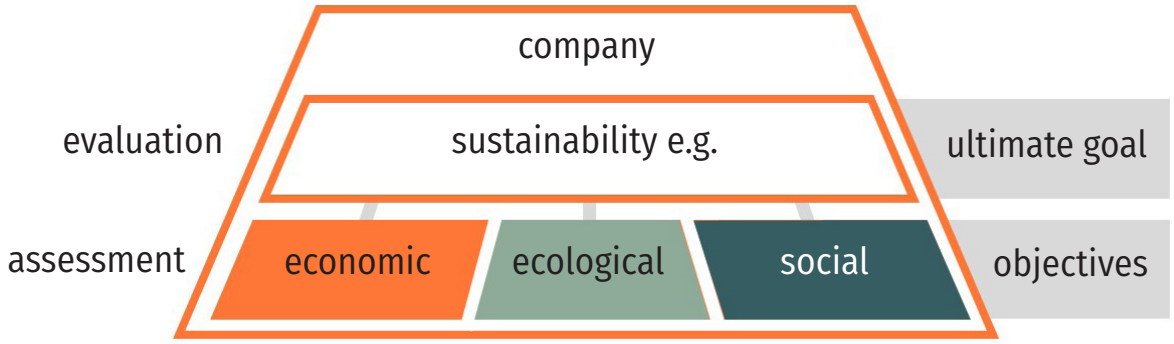

Figure 3: Basic model for decision-making: The company has a common system of competing objectives that together form the ultimate goal (here as example sustainability). For each objective, options can be assessed against the objective. Combining all assessments to one common value is called evaluation.

The concept of breaking down

This system of objectives remains on an abstract level and is not concrete enough for certain decision-making tasks. To solve this problem, we can break this system of objectives down to a subsystem, which is specially designed for making decisions about forest techniques.
The relationship between an objective and its corresponding sub-objective is functional: Does the means achieve the objective? Is it suitable?

The sub-objectives: to be suitable

Concerning the forest technology, the technical means should be:
- Economically suitable > **meeting the needs of the company**
- Ecologically suitable > **meeting the needs of the environment**
- Socially suitable > **careful and acceptable for the local society**

Optimality, a combination of effectiveness and efficiency

To be suitable means that we are looking for the optimal solution; **"optimal"** in a way that we look for that means that achieves best the objective. But unfortunately, we seldom recognize, which solution is optimal, because it is less obvious than we wish. So, we need to make a detour.

First, we should ask, whether we will be able to reach the effect that we aim for. Or, more academic, what will be the effect of using these two options on the background of our objective? Is there an option, by which we will not be able to reach it? If so, it is clear that the other option will be the winner. But if both options come to a comparable end, the effect of both options is identical. Thus, when we ask whether the effect fulfills the objective, we call it **"effectiveness"**.

Let's assume that both options lead to a comparable effect. Then we feel the need to take the option, which demands for the lowest input. In general, looking for that means that reaches the same effect with the lowest input is called **"efficiency"**.

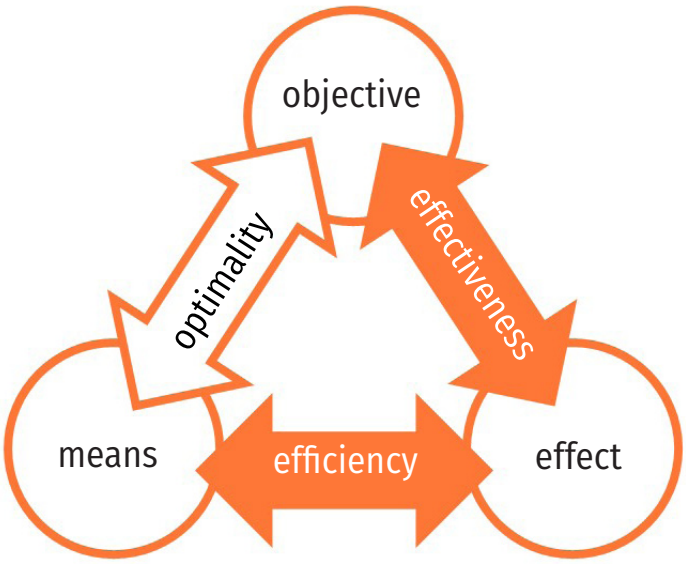

Figure 4: Optimality, a combination of effectiveness and efficiency