

CHANGES OF FORESTS AND FOREST MANAGEMENT IN A CHANGING WORLD

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Unprecedented demands towards forests, which reflect also in changes of forest stands, challenge many fields of forest management. It is often highlighted that forest policy needs to change, that new financial instruments are needed, new planning tools, maps of forest services etc. However, silviculture seems to be rarely exposed as one of the fields important for multi-objective forest management. Silviculture may have different role for providing forest services regarding the general approach to multi-objective forest management. In the segregation approach, where forest lands are divided according to the single management objectives, silviculture commonly has a side role, whereas in the integration approach it is one of the main tools to provide forest services. Integration forestry has been common in Central Europe, where the concept of forest functions has been typically applied to practice multi-objective forest management. Integration forestry has based itself on the 'close-to-nature' silviculture, which has been considered as the most appropriate for providing forest functions (services). However, many questions arise regarding the usefulness and effectiveness of the current silviculture systems for providing different benefits in very divergent natural and social conditions. This paper will try to expose some of them and highlight the role that silviculture plays in the framework of multi-objective forest management.

Keywords: multiple objective forest management, silviculture, segregation vs. integration, societal values.

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1. Introduction

Forest stands change considerably in time, and it seems that frame conditions of forest management, earmarked by social-economic background, change even faster.

The aim of the paper is to highlight some reflections on changes of forest stands and possible driving forces for them. New demands towards forests and higher societal value of forest ecosystems require changes in forest management; therefore the main part of the paper is aimed to conceptual framework of multi-objective forest management, and the role that silviculture plays in it.

2. Changes of forest stands

Great changes in stand structure and tree species composition of forest stands in the period of past decades/centuries occurred in many countries. Different approaches exist how to study long-term changes of forest stands. Using archival data is one of them. Experiences from Slovenia show that old forest management plans, old forest inventories and other forestry archival data serve as a source of data to reconstruct the development of forest stands for the period of a few decades or even a few centuries for the certain forest area (Klopčič *et al.*, 2010). We found dramatic changes of forest stands occurred in the periods of a few decades or a century (e.g. Poljanec *et al.*, 2010); forest area noticeably enlarged, average growing stock increased, and stand and age structure of forest stands

changed considerably. The mentioned changes that express dynamics in forest resources at the landscape/country level were somehow expected – since we experienced great changes in social conditions.

However, for some areas changes were dramatic and unexpected – for example alterations in the tree species compositions of forest stands, or huge shifts in demographic structure of certain tree species populations. Among them, silver fir (*Abies alba* Mill.) faced the most dramatic changes; we revealed intensive ageing of population or even the decline of silver fir (Klopčič *et al.*, 2010; Klopčič and Boncina, 2011). What were the driving forces behind these changes? And what role silviculture played in these processes? It seems that many other factors besides silviculture influence forest stand dynamic (Fig. 1). Across longer time spans, social and economic conditions (e.g. wars, economic crisis, changes in the objectives of forest owners) reflected also in silviculture; modifications of silviculture systems, intensity of forest management or amount of cut were some typical consequences. In some areas oscillations in deer population influenced regeneration patterns of forest stands (Klopčič *et al.*, 2010); because of heavy and selective browsing, silver fir and valuable broadleaved tree species have been unsuccessful in the regeneration and recruitment and thus excluded from future tree species composition. Similarly other factors - like medium size disturbances (Klopčič *et al.*, 2009), climate changes and air pollution (Ficko *et al.*, 2011), and other forces caused significant changes in stand dynamics at a land-

scape or country level. Some of them (e.g. changes in environment) had direct impact on forest stand dynamic, while many of them indirectly through modifications of silviculture activities. Among the latter social-economic conditions seem to be crucial. Changes in economy and social values often reflect in new demands of society for forest good and services, therefore development or modifications of multi-objective forest management were needed.

3. Shift to multi-objective forest management

From the beginning of 'regular forest management', forest management objectives have changed considerably. Demands for new services or an increased importance of existing ones are apparent.

The crucial question of the forest management concept is how to effectively provide various services. Experiences from the globe (e.g. Angelstam *et al.*, 2005; Nitschke and Innes, 2005) show that spatially-based approach to forest management is needed, which means classification of forest areas according to priority management objectives. Management objectives define the type of services to be provided by forestry activities in a given area. There are three main arguments for such spatially based approach (Simončič *et al.*, 2013):

- public or owners' demands for goods and services are not equally distributed throughout the forest land;
- natural potential (e.g. site conditions) for delivery of desired goods and services is not uniform throughout the forest area;
- spatially based approach increases management possibilities for providing the desired goods and services.

There are many possible ways to spatially allocate forest lands to provide forest services, but two main approaches to multi-objective forest management can be exposed (Borchers, 2010; Bončina, 2011) – integration and segregation approach. In the integration approach, multiple management objectives are considered in the same forest area, and thus more services are delivered from the same forest land. Still, the importance of particular management objectives can be different regarding the demands of forest owners, public, or natural conditions. In the segregation approach, forest area is separated according to a single management objective, whereas multiple services are provided from separated lands on a larger scale. In reality mixes of both approaches are used. At the globe, there are more forest management approaches with prevalingly segregation elements, although there are significant differences in how forest services are provided on regional or local scales (e.g. Koch and Skovsgaard, 1999; Angelstam *et al.*, 2005). Segregation approach is especially common in countries with vast forest areas and large share of publicly owned forests. In Central Europe, characterized by limited forest lands, large share of scattered private lands and high density of population, forest management is based mainly on the integration elements. There is a specific historical background in regulating forest use in Central European countries, characterized by long-term tradition in administrative and planning regulations, and

early awareness of high public value in all forests. Such regulations were partly a reflection of catastrophic events in the end of 19th century that strengthened the public importance of private lands (Kräuchi *et al.*, 2000). These processes imply that previous development of forest management considerably traces its future development. In both approaches to multi-objective forest management, 'priority areas' are an important tool for providing desired services. Priority areas are an umbrella term for different kinds of forest areas with special importance for multi-objective forest management which have explicit legal commitments either by national acts, forest plans or by some other legal means (Simončič *et al.*, 2013). The types of priority areas and processes for their designation differ significantly among countries in regard to the type of services considered, spatial scale of designation, designation and management authorities, and the types of management activities allowed/practiced. Divergent characteristics on how management objectives (forest services) are considered under both - integration and segregation approach to multi-objective forest management lead to a very different role of silviculture in each of the approaches. In the segregation model, forest services are often provided by restrictions of forest management (e.g. Zhang, 2005); therefore silviculture may be less important. Whereas in the integration model, activities to provide forest services commonly include different activities of forest management, from silviculture, infrastructure etc.

4. The integration forestry, forest functions and ecosystem services

In Slovenia, and in Central Europe in general, two types of priority areas have been typically used: 1) protected forest areas and 2) forest function areas.

The most common example of the first are protection forests in the Alps, which are declared by federal or municipal regulations due to their outstanding public importance for protecting settlements and infrastructure against natural hazards. Other important examples of protected forests include national forest reserves, forests in national parks and other. The majority of priority areas are so called 'forest function areas'. The concept of forest functions is based on the designation of areas with important forest functions that are of relatively higher importance for the selected forest services (functions) than the surrounding forest area (Blum *et al.*, 1996).

The concept of forest functions has been common in Central Europe, especially in Switzerland, Germany, Austria and Slovenia, where the forest function maps have been one of the main tools to practice multi-objective forest management. Forest function areas are important for many reasons: they provide an overview of the public importance of forests, they are a tool for forest policy, a tool to collaborate with public and other institutions in forest areas, a tool for collaboration in spatial planning, a basis for forest valuation, frame for financial instruments, and for planning multiple forest land-use and strategic management objectives (identification of conflicts etc.). The term forest function has been typical in Central Europe. In other countries, the term 'ecosystem

services' has recently been brought up (e.g. MEA, 2005). It seems that the concept of ecosystem services is gaining quite high support also in Europe (EUSTAFOR and Patterson, 2011; Pistorius *et al.*, 2011). In the integration model, silviculture is one of the main tools to provide the desired ecosystem services. Silviculture activities influence the structure and composition of forest communities and thus also the on-going processes, all of which are the basis for provision of forest services (Fig. 3). The integration approach to multi-objective forest management has largely relied on the principles of 'close-to-nature silviculture', which has been considered as appropriate for providing ecological, economic and social forest functions. It is described in different ways; it efforts to maintain 'natural' biodiversity of forest ecosystems, management activities should be adapted to site conditions, it follows natural stand dynamics, and it should avoid clichés in forest management.

The latter seems to be crucial for multi-objective forest management. However, given the changing societal values, climatic changes and frame conditions, it is questionable whether the current 'close-to-nature' silviculture systems are able to provide the desired services to society. Close-to-nature silviculture is often simplified as to use only one of traditional silviculture systems (e.g. the selection system or irregular shelter-wood systems) across the landscape. Close-to-nature silviculture should be understood more broadly, encompassing combination of different systems and practices applied across the regions that vary due to site conditions, but also due to societal values etc. This approach is known as 'a free silviculture' (Mlinšek, 1968). Providing desired services should be one of the main reasons for diversification of silvicultural activities across the forest land (besides the site conditions). Therefore spatial designation of forest services, such as a map of forest functions, might be a helpful tool for searching the most efficient silvicultural activities. However, the forest function map has often been criticized due to weak relation with the management activities aimed at providing the desired services (e.g. Weiss *et al.*, 2002; Simončič *et al.*, 2013).

Therefore, the relevant questions arise: are forest function areas really needed to practice multi-objective silviculture or can management activities be adapted to forest services without any spatial designations? Probably for some services, e.g. for recreation, a designation of forest functions is useful to show where additional activities are needed. But for some services, like nature conservation, societal values can be considered in silviculture without being spatially exactly designated.

Increasing societal forest values are a new big challenge for silviculture; the important question is how silviculture can be useful and more efficient for providing different benefits in very divergent natural and social conditions.

New demands somehow change the current tasks and focus of silviculture; it used to be oriented to wood production, from the 1990' nature conservation became an important issue, and with society development societal values became more important. One of the priority topics of the silviculture should be to bridge the gap between these three directions. These dilemmas will be crucial for further development of integration forestry.

5. Prospects

There are unprecedented changes in the frame conditions of forest management – social and economic conditions, and consequently management objectives, which, together with environmental impacts, especially climate change, strongly influence current and future development of forest stands. Progress in wood processing industry is evident, and new ways of timber use can be expected. What consequences do the changes of frame conditions mentioned above bring for silviculture and forest management in general?

Probably a shift from a rather rigid to much more flexible silviculture strategies is needed to provide desired outcomes in progressively changeable and uncertain social, economic, and environmental conditions.

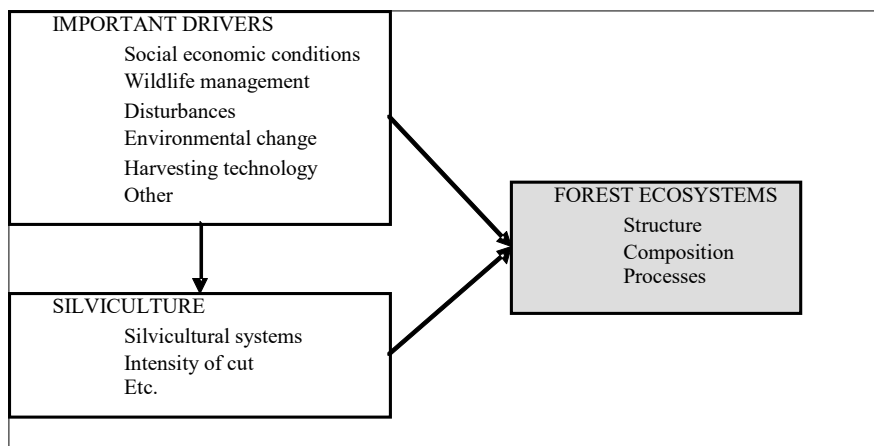


Figure 1. Driving forces of changes of forest stands.

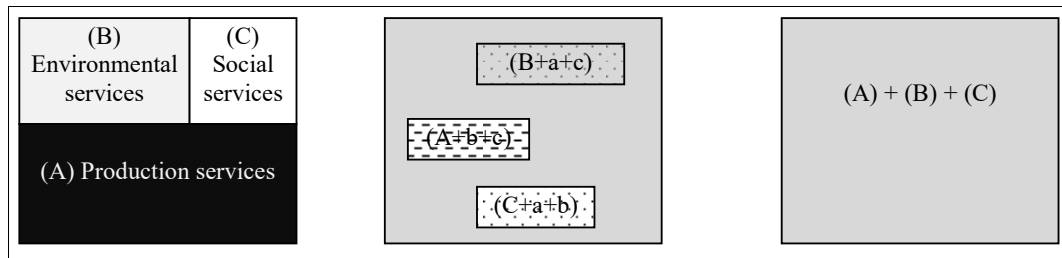


Figure 2. Illustration of the main approaches to multi-objective forest management (left: segregation; right: integration, in the middle: a combination of both approaches).

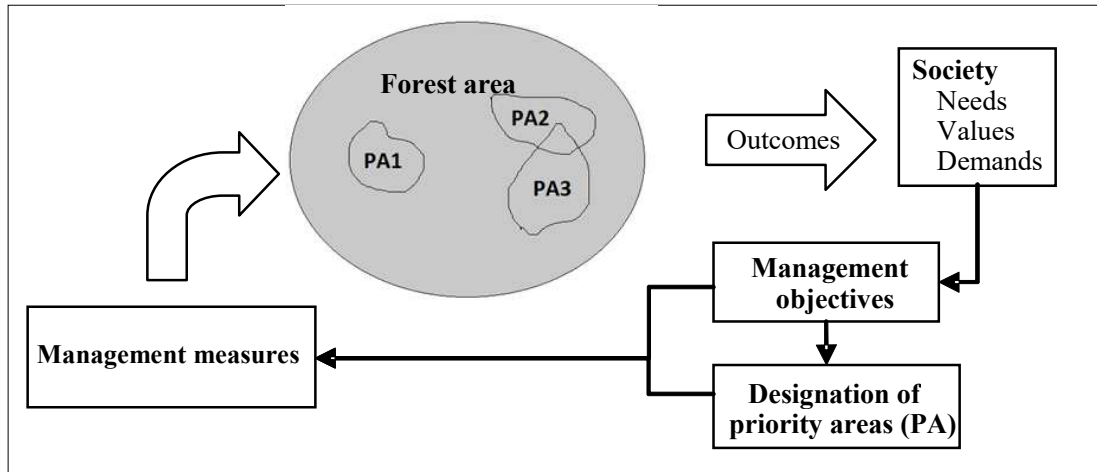


Figure 3. Forest management for multi-objective forest management (modified after Bončina, 2011). (PA–priority area).

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