

## Note

# Forestry between land use intensification and sustainable development: Improving landscape functions with forests and trees

Jørgen Bo Larsen

### Key words

*Forests, trees, landscapes, multifunctionality, global change.*

*Jørgen Bo Larsen*

*Forest & Landscape, University of Copenhagen, Denmark*

*E-mail: jbl@life.ku.dk*

### Introduction

Landscapes are open, complex systems in which ecological, economic, social and cultural processes interact. The values of landscapes are correspondingly manifold. The economic or instrumental values are not just related to agriculture, forestry or fisheries, landscapes also deliver raw materials as well as different renewable resources (water, bio-energy). The natural or intrinsic values of landscapes are mainly related to the biological diversity, whereas the social values are connected to human habitation, recreational use as well as its cultural and artistic information. With regard to landscape functions, the complexity of functions is expressed by the term multifunctionality and the landscapes are addressed as multifunctional landscapes.

The identification of sustainable pathways for land use development will play a crucial role in future management of urban, peri-urban, and rural landscapes. Facing the multiple demands and understanding the complexity with which landscape functions interact, the identification of these pathways must depart clearly from a multifunctional point of view.

Multifunctionality on the landscape level can be achieved by functional segregation (spatial combination of separate land units with different functions) or by func-

tional integration (different functions on the same unit of land). As shown in Figure 1 landscapes can be fully segregated into different mono-uses (natural forests, intensive agro- and ligni-culture, and cities). They can be fully integrated with crops, trees, forest patches, meadows, human habitations intensively intermingled or, most commonly, exhibit a mosaic structure with a prearranged integration of different functions.

When multifunctionality is achieved through a mixture of mono-functional parcels, however, the question remains if we are dealing with real multifunctionality and to which extend the notion of sustainability is achieved. By managing forests and landscapes for future generations we are in essence dealing with uncertainties in terms of altered future perceptions, modified requirements and changed climate. The mono-functional use is in general hampering the functional flexibility and thereby the adaptive capacity – an imperative issue when dealing with future generations' needs and expectations. Hence, the challenge for planning and management should be to develop landscapes with a robust functionality despite changes in ecological as well as social-economic settings. More emphasis needs to be given to the need of developing locally appropriate solutions for forests as components of multi-functional landscapes (Sayer et al., 2003).

The increasing call for multifunctionality has emphasized the need for flexibility in landscape management with respect to future outputs. The importance of adaptability of forests and trees is underlined by their long production periods. Trees and forests we plant today must be able to stay alive in the climate of the 22<sup>nd</sup> century in order to deliver goods and services to our great grand children!

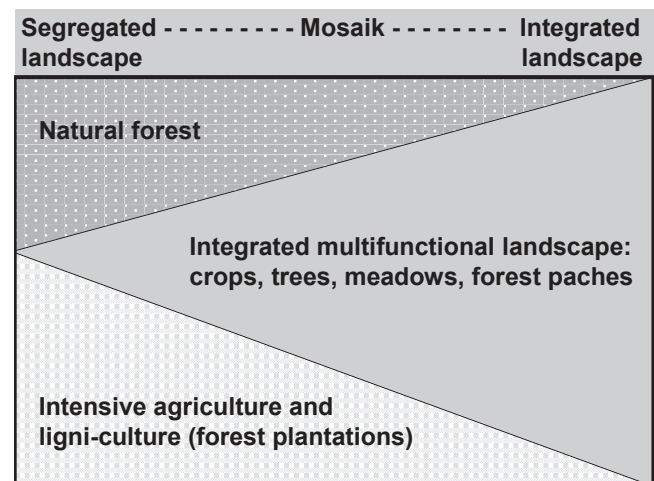


Figure 1: Landscape segregation and integration – a continuum.

## Land use in Europe in a temporal perspective

In Europe the use of the landscape has undertaken huge changes in respect to multifunctionality. The starting point was an integrated multiple use by local people with traditional, experienced based knowledge – as in most landscapes where small populations are struggling for life. Due to population growth the land-use developed into an uncontrolled ‘over’-use followed by resource depletion and loss of natural values and production potentials.

Over the last two to three centuries this adverse development has been counteracted through landscape segregation followed by mono-functional use. The forests were separated from the landscape and developed exclusively to produce timber. Trees on farm-land were cut in order to intensify agricultural production, and human habitation was concentrated in cities isolated from nature and the production landscape. The fine-grained and heterogeneous land-use mosaic that had developed over centuries became more and more coarse-grained and homogeneous. This development, motivated by the ambition to gain control of the landscape and its resources, efficiently increased the productivity. However, it was followed by decoupling of ecological and social processes and by losses of natural capital and cultural/social values leading to an unsustainable development.

The present challenge is to facilitate a landscape development where ecological, social and economic goals are better integrated – both in the physical landscape and in the social context. In the process of realizing a higher degree of functional integration at the landscape level, forests and trees can play an important role. How can forests be developed not only for their own values, but also be an added value to the landscape and its inhabitants?

### Forest restoration: What kind of forests?

Forests are in general multifunctional. They have significantly economic and productive functions. In addition they encompass a number of regulation and protection functions (biological diversity maintenance, nutrient and water cycling, CO<sub>2</sub>-storage, climate regulation, and soil protection) as well as carrier of information functions (human habitation and recreation, energy conversion, aesthetic/cultural/historic information). However, not all forests are multifunctional: the natural (non interventional) forests are functionally production deprived and the intensive managed plantations (lingo-cellulose cultures) are limited adaptable

to climate change, they possess little functional flexibility, and encompass only limited ecological and social values. This raises the question: what forest types are suitable in relation to functional integration in order to improve adaptability on the landscape level?

From a forest restoration viewpoint, silvicultural strategies are required to transform plantations and monocultures of the past. By incorporating structural and functional features of natural forest ecosystems this transformation should lead to more diverse forests with a high potential for biodiversity protection and contributions to environmental and social values. This approach can be summarised by the term *nature-based silviculture* (Gamborg & Larsen, 2005; Larsen & Nielsen 2007).

As a basis for nature-based silviculture, it is relevant to study the temporal dynamics and spatial interactions among tree species in forests close to the natural state (Hahn et al., 2007). The disturbances and processes in natural forest ecosystems, which cause structural heterogeneity at both large and small scale are linked to regional characteristics of climate, soil, and species compositions. It is expressed as e.g. infrequent, large-scale storm disturbances, small and large-scale fire-driven disturbances in boreal ecosystems, and frequent, small-scale disturbances in Central European forests. Hence, models describing the region specific disturbance patterns in such natural ecosystems should be used in the development of applied silvicultural methods. At present, coniferous plantations are being converted into mixed-species and broadleaved dominated forests in most European countries.

However, the debate on changing silvicultural practices not only deals with technical, scientific and managerial matters. It indicates the need for a continued discussion – within and between forestry ranks and other stakeholders (local people, conservationist etc.) – about the ‘proper’ use of forests and what constitutes a ‘true’ forest. Further, it underlines, that forest management must be able to adapt to changes in nature perception and its underlying ethics. This implies that at the socio-political level forest management will call for improved transparency and participation.

Hence, common denominators for these new approaches would be: Closer to nature and closer to people.

### Forest expansion or reduction: How much forest?

Foresters in general find forests valuable and the more the better. There are, however, many landscape functions – first of all food production – where forests barely contribute, and

several protection and social functions are only realized in an open landscape. Hence, forests should not only be seen as a value in it self, but as supplementary together with other land-use forms as an added value to the landscape.

At the end of the 18<sup>th</sup> century there was a wide-ranging need of forests in Europe leading to a long lasting wood-crisis. During the following centuries huge forest restoration activities have consequently been conducted in most countries both through afforesting abandoned farm land and by rehabilitating degraded forests. Most regions in Europe have thereby increased the forest cover, and in many countries the forested area is still growing.

Denmark has, as an example, launched a plan to double the forest area from 11 to 22% within this century. This plan will without doubt create more forest functions, but whether it leads to a more functional and flexible landscape is highly questionable. The agricultural decline especially in mountain areas in Europe is often followed by invasion of forest. This unintended increase in forest cover has huge consequences for biodiversity, landscape scenery, and landscape functions. Another emerging issue is the increasing use of land for bio-energy plantations. How will other landscape values respond to transforming open space into monocultures of fast growing tree species?

This leads to the question: how much forest is needed to support the general landscape functionality? During the past centuries the goal in Europe was to enlarge the forest area. Now the question of forest cover and landscape functionality is getting much more complex, adding the option of dramatically increasing the forest cover in some regions for bio energy production and even reducing forest in other regions in order to make space for other landscape values including food production.

### **Forests in the landscape: Where?**

The contribution of forests to landscape functionality is not only an issue of how much forest, and what kind of forests, but also a question of where the forests should be located in the landscape.

### **Urban forestry and urban greening**

Hitherto, most activities aiming at increasing the forest cover have focussed upon production issues in relation to alternative use of marginal agricultural land. The rapid increase of the world's urban population has led to a major

redistribution of people world-wide. By 2008 the proportion of urban dwellers passed 50% across the globe and is expected to reach 60% by 2030. In Europe, the percentage of the population living in urban areas is expected to rise from 73% in 2000 to 80% in 2030 (United Nations, 2004).

Consequently, in our forest restoration strategies we have to focus more upon forests and trees in relation to human settlements in order to build up nature where people live. The importance of urban forests as green infrastructure has been widely overlooked from a forestry perspective and, as a result, undervalued. The capacity of forests and trees in populated areas are increasingly being accepted to limit energy use, improve air quality, reduce noise, increase water storage, maintain fragmented ecosystems, and positively affect the societal sense of well-being. Thus, more communities are recognizing that vegetation, especially trees, make up a green infrastructure with a potential to improve the urban landscape functionality including the quality of life.

Most urban forests have developed from 'commercial' forests seeking to incorporate recreational and ecological functions in a basic wood production oriented management system while focussing upon the stand as the functional unit. When dealing with urban forests the higher functional level – the forest landscape – is much more in focus in order to develop the intended recreational and ecological functions.

From a forest restoration viewpoint, silvicultural strategies are required in order to develop forests with a high potential for biodiversity protection and contributions to environmental and social values. In this context, keeping as close to nature as possible and using natural processes as the base for design and management generally are claimed to be one of the most promising approaches (Bell et al., 2005). This can be achieved by incorporating structural and functional features of natural forest ecosystems. This approach can be summarised by the term '*nature-based silviculture*' – as mentioned above.

From a landscape restoration viewpoint diverse forest ecosystems can be introduced as an integral part of the urban landscape, bringing the special qualities of nature into peoples' daily lives. A key element in the provision of these new forests is the integration of forested areas, openings and other nature types into spatially diverse and visual attractive forest landscapes. Combining different forest types with other nature types i.e. meadows, wetlands and water bodies etc., the urban forest landscape can be designed with a range of site-adapted rich ecosystems and recreational experiences.

## Trees in the landscape and agroforestry

Trees in the landscape play a predominant role for many landscape services including natural and cultural values. Agroforestry provides an alternative land use option which for the last two centuries has been widely neglected in Europe, although trees on farms and in the landscape are contributing to multifunctionality by enhancing many landscape values. Agroforestry makes use of the synergy between trees and crops, so that the available resources can be more effectively utilized. It is environmental benign (climate regulating, soil and water protecting, biodiversity enhancing, carbon storing), it delivers wood for multiple purposes as well as a large amount of non timber forest products, and it can create original landscapes that are attractive, open and favour recreational activities (Nair et al., 2004). Thus, trees in the landscape (boundary planting, live fences, farm woodlots, riparian forest buffers, shelterbelts, home gardens and agroforestry plots have a really innovative landscaping potential (ITTO & IUCN, 2005; Garrity, 2004).

Agroforestry concepts have, hitherto, mainly been introduced in developing countries. Therefore, there is a need for re-thinking this option in Europe since mixed land use systems combining trees and crops are not considered by current regulations in the EU and trees are generally considered as not compatible with cropping or grazing.

Additionally it is important to reconsider the use of short-rotation cropping of woody species (willows and poplars) for CO<sub>2</sub>-neutral energy production as part of the agricultural production landscape taking economic as well as biological and landscape aesthetical aspects into consideration.

## Conclusion

Forests and trees play a significant role in improving the multifunctionality of landscapes by contributing to the functional integration in general and through specific functions in a landscape mosaic. The contribution of forests and trees to landscape multifunctionality can be enhanced by:

- integrating nature into silviculture (nature based forest management)
- integrating forests and trees into human settlements (urban forestry – urban greening)
- integrating trees in the landscape (agro-silviculture)

- identifying and valuating landscape functions, goods and services for rational decision among competing and conflicting demands
- involving practitioners and experts from natural as well as social sciences in development and planning (adaptive planning and management)
- integrating people in the planning process (collaborative management and planning)

The policy implications would be:

- abolish traditional ‘sectoral’ laws (forestry, agriculture), basically aiming at landscape segregation in order to build an integrated landscape legislation based upon the concept of multifunctionality and sustainable development
- generate incentives to enhance the values of landscapes across ownership boundaries
- develop incentives to promote nature based forest management
- promote participatory planning approaches and develop partnerships between stakeholders
- build local institutional capacity for improved knowledge sharing and lesson learning

We are confronted with a two-fold task: (1) to analyse and comprehend how to reorganize land use in order to improve the functionality and adaptive capacity of landscapes including how to make use of trees and to restore forests, and (2) to develop tools and methodologies required to deliberate on and achieve ownership of the goals and their consequences among the stakeholders.

## References

- Bell, S., Blom, D., Rautamäki, M., Castel-Branco, C., Simson, A. & Olsen, I.A. (2005): Design of Urban Forests. Pp. 149-186 in: Konijnendijk, C.C., Nilsson, K., Randerup, T.B. & Schipperijn, J. (eds.): Urban Forests and Trees. Berlin, Springer.
- Gamborg, C. & Larsen, J.B. (2003): ‘Back to nature’: A sustainable future for forestry? *Forest Ecology and Management* 179: 559-571.
- Garrity, D. (2004): Agroforestry and the achievement of the Millennium Development Goals. *Agroforestry Systems* 61: 5-17.
- Hahn, K., Emborg J., Vesterdal L., Christensen S., Bradshaw R.H.W, Raulund-Rasmussen, K. & Larsen, J.B.

- (2007): Natural forest stand dynamics in time and space – synthesis of research in Suserup Skov, Denmark and perspectives for forest management. *Ecological Bulletins* 52: 183-194.
- ITTO & IUCN (2005): *Restoring Forest Landscapes: An introduction to the art and science of forest landscape restoration*. ITTO Technical Series No. 23: 1-145.
- Larsen, J.B. & Nielsen, A.B. (2007): Nature-based forest management – where are we going? Elaboration forest development types in and with practice. *Forest Ecology and Management* 238: 107-117.
- Sayer, J., Elliott, C. & Maginnis, S. (2003): Protect, manage and restore: Conserving forests in multi-functional landscapes. Pp. 199-205 in: *Proc. XII World Forestry Congress, Quebec, Canada, September 2003*.
- Nair, P., Rao, M. & Buck, L. (eds.) (2004): *New Vistas in Agroforestry: A Compendium for the 1<sup>st</sup> World Congress of Agroforestry, 2004*. Series: *Advances in Agroforestry*, Vol. 1. New York, Springer.
- United Nations (2004): *World Urbanization Prospects: The 2003 Revision*. United Nations Publications.