COMPETITIVE STRATEGIES TO WOOD PRODUCTION IN EUROPE – A CONCEPTIONAL STUDY

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Abstract:
Wood is a raw material with multifaceted properties making it useful for a diversity of industrial products. However, its primary production is restricted by environmental conditions and alternative land use. Forestry, as the main supplier of wood as raw material, is assumed to act strategically with regard to the market situation and to try, therefore, to provide the most beneficial mix of different assortments of wood. Changes in the supply of different assortments and their current value on the market are assumed to be closely related. Fluctuations in stock and market value affect the wood-using industry depending on the different assortments as raw material.
The purpose of this study was to apply a concept of competitive strategies for market-driven goods to forest management in Europe, in order to derive information about the operational possibilities of forest management in specific market situations. For this purpose, Steinmann's and Schreyögg's concept of competitive strategies for market-driven goods was applied to forest management, in order to defining different competitive strategies for the production of different assortments of wood. The results show that different market strategies can be applied to forest management and that, even though the overall production is limited, forestry has quite a high flexibility regarding the competitive strategy used. The results also show possible impacts on the nature of forests due to changes in forest management.

Key words: assortment of wood; competitive strategy; forest management; forest production; market condition.

INTRODUCTION

Forests provide a multitude of products and services which have an ecological, socio-cultural or economic value (de Groot et al. 2002; Schmithüsen 2007). The mix of services available depends on biological characteristics and on the nature of the economic regime. The use of some goods is market-driven, others are used under a variety of agreements, and others are available to communities as free goods (Chopra and Kumar 2004; Schwarzbauer et al. 2015). Wood is one of those goods for which production is market-driven, see e.g. Vaux and Zivnuska (1952). Its supply includes different assortments suitable for diverse purposes in the wood-using industry, depending on different forest management strategies (Burschel and Huss 1987; Wagenführ 2007). The term "assortment" stands for a selection of roundwood characterized by a specific length, diameter and wood properties, such as saw logs or veneer logs, pulpwood, wood for energy conversion including small diameter trees or parts of trees such as tops or branches, of either softwood or hardwood.

Strategic planning is necessary for any business organisation and, for forestry in particular, strategic long-range planning goes back to the 18th and 19th centuries when concern about a continuous future wood supply in Central Europe came to the fore (Hoogstra and Schanz 2008). Historically, the different ways of using the forest in combination with the dynamics of the environmental parameters led to continuous changes in the nature of the forests (Farrell et al. 2000; Gamborg and Larsen 2003; McGrath et al. 2015). The complexity of forest management makes it difficult to investigate strategies for land availability, timber sustainability and harvest strategies, and this means that, for forest models for strategic management, a trade-off between their complexity and their usability for strategic planning must be found. Mostly, it has to be assumed that forest production does not change with forest management. Models used today also tend to ignore issues of prices and markets for forest products (Gunn 2007).

According to Porter (1980), the survival of an organisation in a competing environment lies in the creation of the best fit between environment and resources, which expresses itself in three core generic competitive strategies: cost leadership, differentiation and focus. Cost leadership is the cutting of costs to levels lower than those of competitors which gives an above-average cash-flow even with relative low prices for the products. Differentiation is achieved by innovation or customisation to its location and leads to lower user costs or an increase in the use value of a product. Limitation on key aspects means that a company focuses on different market niches or core markets regarding customers or regionalism (Schroeter 2013).

Steinmann and Schreyögg (2005) extended Porter's theory adding a third dimension to the place and focus of competition, viz.: the rule of competition. Therefore, their concept is more complex and in general illustrated graphically as a so-called strategic cube. To apply such a tool of strategic management to forestry has not yet been attempted, due perhaps to the complexity of forest management or to the fact that forests in general provide a mix of diverse goods.

OBJECTIVE
The purpose of this study was to apply "Steinmann's and Schreyögg's concept of competitive strategies" for market-driven goods to the common forest management practices in Europe, as a tool to evaluate changes in the assortments of wood supplied and the nature of forests in connection with changes in forest management strategies.

METHOD
Main parameters influencing the production and properties of wood
1) **The biometric aspect of wood production**
Under given climate conditions, some species show faster growth rates than others, especially in younger age classes, and this favours their use for biomass production (Burschel and Huss 1987). Species with faster growth rates in younger age classes are preferred because of the relationship between the total growth of a species, its current annual increment (CAI) and its mean annual increment (MAI). If the focus is on biomass production, a stand should be harvested when the MAI reaches its maximum. At this point, the growth curve has its second inflexion point and the CAI and MAI curves intersect each other. After that point, the increment decreases and the growth curve flattens out and approaches its maximum (Bachmann 2008). The gradient of the growth curve is steeper for fast growing species in young age classes than for species which reach their maximum later. This leads to earlier culmination points for the CAI and MAI and therefore shorter rotation cycles. This explains the benefit of such species when the focus is only on biomass production volumes regardless of the physical properties of the raw material.

On the stand level, the increment of a species is related not to the single tree but to a defined area, which means that the increment is in general that of a community of trees. To achieve high yields in biomass production, there must be a trade-off between the increment of the single tree and the stand density or number of trees, as single trees with larger crowns show a larger increment than smaller trees, whereas the stand growth of larger trees generally decreases with increasing age of the trees (Utschig 2002). Pretzsch (2006) has shown that the growing area efficiency increases with increasing stand density but that the stand growth decreases because of the large number of small, inefficient trees. If the number of trees is relatively small, the growing area efficiency is low but the stand growth is high because of the larger number of average-sized trees which have a higher efficiency. This means that dense stands have a high growing area efficiency, whereas sparsely stocked stands a have high stand growth. Not only the position of the single tree within the stand but the mixture of species also influences the production per area. It has been shown, based on modelled data, that in the temperate zone the increment of a stand can vary between -30% and +40% depending on the mixture of species (Pretzsch 2012).
2) **Site factors influencing the wood properties**
Water has a strong impact on the growth rate in temperate regions, especially in the form of precipitation. If water is not the limiting factor for growth, nutrients are becoming the limiting factor. The effects of water and nutrients as limiting factors have been shown for species like Norway spruce grown in Sweden (Bergh et al. 1999) and Maritime pine grown in south-western France (Trichet et al. 2008).

Temperature is also important for the growth rate and is one reason why the ratio of broad-leafed trees to conifers in the sub-boreal and temporal climate zones differs from that in the tropical climate zone. The larger proportion of conifers in the cooler zones suggests that conifers have a faster growth rate under cooler conditions (Way and Oren 2010). The strong effect of temperature in combination with precipitation on the growth of a tree has been shown in stands of Norway spruce (Larson 1969; Šoškić et al. 2003). Taking into consideration the results reported by Nylinder and Hägglund (1954) and by Bergh et al. (1999), the conclusion is that temperature has not only a direct but also an indirect effect on the growth rate. A low temperature leads to a slower mineralisation process, and the lack of nutrients can have a negative impact on wood properties, as the Swedish expression "starvation wood" testifies (Nylinder and Hägglund 1954). It has been found that with increasing latitude not only the width of the annual rings but also the amount of latewood and the mean fibre length have decreased. It has also been shown that not only very wide but also very narrow annual rings lead to a decrease in density (Nylinder and Hägglund 1954; Larson 1969; Thörnqvist 1987) which indicates that the climate has a strong impact on wood properties. The density of softwoods is determined by the proportion of earlywood to latewood and this proportion depends to some extent on the width of the annual rings (Brazier 1970). A larger proportion of latewood with its thicker cell

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walls (Grahn et al. 1995) leads to a larger amount of S2-layers which amount to 70 vol.% of the fibre wall (Forsberg 1997) and the highest cellulose content (Sandberg et al. 2011).

Fertilisation and thinnings in Douglas fir, Norway spruce and Scots pine stands showed differences in wood properties between the wood of treated trees and the references (Ericson 1966; Jozsa and Brix 1989; Barbour and Kellogg 1990). Kyrkjeeide et al. (1994) showed that the smaller proportion of intermediate and mature wood in fast-grown than in slow-grown Norway spruce lead to a lower quality classification at a given diameter when sorted after sawing-drying-ripping. Wood of fast-grown Norway spruce had a lower bending strength than slowly grown Norway spruce (Eikenes and Lackner 1990). The relationships between juvenile wood, mature wood and density differ not only with the age of the tree within the tree diameter but also within the height (Ericson 1966; Larson 1969; Jozsa and Brix 1989; Jozsa and Sen 1992; Thörnqvist 1993; Kennedy 1995). In Sitka spruce stands, it has been demonstrated that the wood properties can be influenced by silvicultural operations such as spacing, pruning, fertilizing and irrigation which have an impact on the frequency of knot incidence (Brazier 1977; Brazier et al. 1985; Macdonald and Hubert 2002).

The concept of competitive strategy in the context to forestry

For an organisation, a competitive strategy regarding market-driven goods has to include: cost leadership, differentiation and limitation on key aspects (Porter 1980; Schroeter 2013). Steinmann and Schreyögg (2005) extended Porter's theory with one more dimension, leading to three dimensions which can be illustrated as a strategic cube, Fig. 1. Each form of competition is defined by two characteristic variables which allow eight different combinations of the characteristic variables and therefore eight different competitive strategies for market-driven goods.
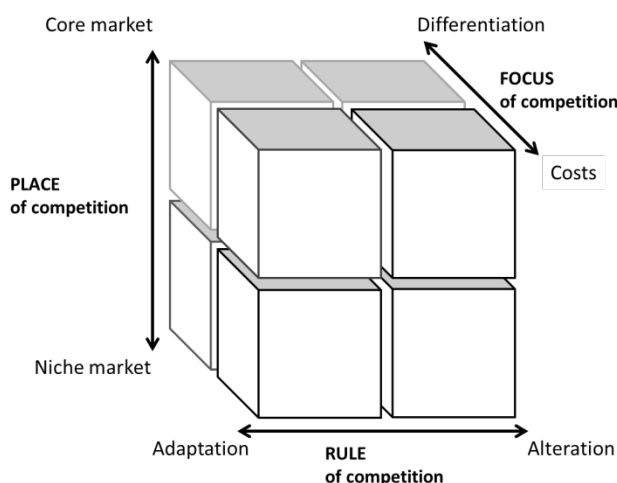

Fig. 1.
The principle of Steinmann's and Schreyögg's strategic cube after showing the three forms of competition with their two characteristic variables, the combination of which give eight different competitive strategies for market-driven goods.

A company will choose a strategy which ensures its current profit or a profit maximisation which is acceptable and realizable. Monetarily, such a selection of strategy can be interpreted as an investment, which means that the strategy with the highest capitalised value or rate-of-return should be chosen (Schroeter 2013).

In forestry, the specific site conditions in combination with diverse management strategies and intensities lead to the production of different volumes and assortments of wood (Burschel and Huss 1987). The management strategy with regard to market-driven goods such as different assortments of wood is strongly related to the market situation which reflects the current trend of use (see e.g. Mason 2007; Schwarzbauer and Stern 2010; Trømborg and Solberg 2010). This has an impact on the nature of forests (see e.g. Mason 2007; McGrath et al. 2015). Therefore, the environmental conditions can be seen as the limiting factors for the production capacities and the forest management strategies to decide which assortments (goods) out of a possible mix are produced or promoted.

Since forest management strategies have the potential to influence the output of different assortments, and since it can be assumed that wood is a market-driven good, it is possible to impute a competitive strategy to forest management. The challenge is, however, that forestry often provides a mix of different assortments. To apply the concept of Steinmann and Schreyögg, the three forms of competition – place, focus, and rule – have to be put in context with forestry. In this study, the interpretation made with

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regard to the current market-driven production of different assortments of wood is shown in Fig. 2 and was as follows:

(a) Place of competition
- Core market   Relatively long rotation times leading to high stands, timber forests
- Niche market   Relatively short rotation times, coppice and short rotation coppice

(b) Focus of competition
- Differentiation   Focusing on assortments of wood with beneficial properties
- Costs   Focusing on productivity, assortments of low to average wood properties (bulk goods)

(c) Rules of competition
- Adaptation   Tendency to follow current market trends, specialisation
- Alteration   Conservative performance, traditional forest management, variation

RESULTS AND DISCUSSION

If considering wood as market-driven goods of which the volumes and properties can be influenced by forest management strategies leading to different amounts of different assortments of wood, the concept of competitive strategies according to Steinmann and Schreyögg (2005) can also be applied to forest management. The results interpreted according to Steinmann's and Schreyögg's concept are presented in Fig. 2, showing the competitive strategies for the different assortments and different types of forest.
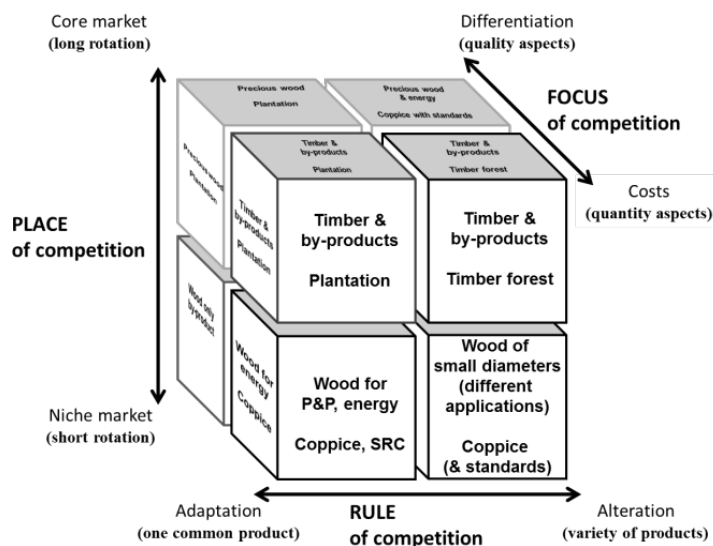

Fig. 2.
The strategic cube showing the competitive strategies for the different assortments of wood and different types of forest defined by: length of rotation time (place of competition), specialisation vs. diversification (rule of competition), and productivity vs. wood properties (focus of competition).

This study assumes that wood, like other resources, is available only in limited amounts, so that a change within the wood-using industry affects not only the competitors within the industry but also forestry which is the supplier. Abt et al. (2012) showed that an increasing demand for a particular assortment (wood for bioenergy) has an impact on the traditional wood-using industries such as saw-log processing industry and on the use of land. The magnitude of the impact depends on the shift in the levels of demand and on the supply response. The important role of forestry and agriculture as a producer of raw material is also obvious in the review presented by Berndes et al. (2003), who state that the greatest uncertainties in energy-crop production are the availability of land and the level of biomass production. Trømborg and Solberg (2010) were able to show in a case study for Norway that an increase in the price of wood for energy purposes can affect other sectors of the wood-using industry. Similar results were reached by Schwarzbauer and Stern (2010) when simulating a rising demand for wood for energy purposes in Austria. According to their study, forestry and sawmills would profit from the greater demand and higher prices, while the wood-based panel and the pulp and paper industries would suffer.

Depending on the focus of the raw material production, silvicultural management leads to different types of forests. If the focus is on timber production, the longer rotation cycles lead to the typical "timber forests" with trees with large heights and diameters. On the other hand coppice forests with maximum

rotation cycles of 10 to 30 years show completely different characteristics. A special form of coppice providing raw material for energy purposes is the short rotation coppice, which has a rotation time of even less than 10 years. Coppices with standards are a combination of these two main forest types, the timber forest and the coppice forest, with two crown layers. The upper layer is composed of trees for timber production and the lower layer of trees mainly for energy production (Burschel and Huss 1987; Bürgi 1999).

It has been assumed that forest management operates strategically regarding the production of different assortments of wood. However, regarding the production of the different assortments, it is difficult to argue that a specific forest management strategy is focusing on a single main assortment as often a mix of different assortments is provided. Nevertheless, the results also give space for more wider interpretation:

Firstly, the nature of forests and forest management is dynamic and this is important to consider when modelling (future) availability and accessibility of different assortments. It is critical to take the status quo and assume a change in available quantities without considering possible changes in forest management or in the nature of the forest. From a market-driven point of view, different trends on the market lead to changes in forest management affecting the composition of the assortments and the types of forest by a shift in the focus of production towards a new competitive strategy.

Secondly, the most critical parameters for the production of wood are the limited land area and the climate. As the production area is limited, a trade-off regarding accessibility between the different assortments has to be made. Therefore, only one single assortment can be produced as the main assortment on a given site at a given time when the production is maximized, which can be interpreted as a direct competition for the available land for production. Increasing demand requires a higher production capacity on the available land area and this leads to a shift in the direction of homogeneity. This would lead to monocultures or plantations of either soft- or hardwoods, depending on the range of assortments needed.

Thirdly, with regard to the production of different assortments, increasing market orientation leads primarily to an increase in harvest pressure (Nabuurs et al. 2006) and further to a shift towards more efficient production such as plantations, see e.g. (Bowyer 1995; Carle et al. 2002; Payn et al. 2015). Timber forests can theoretically change into coppices or coppices with standards if, for example, it becomes more profitable to be produce wood for energy purposes than wood for timber or vice versa. However, this theoretical assumption also clarifies that there is still a high potential for increasing the volume of production for different assortments, since production efficiency can be increased by concentrating on a single assortment per area. This would relativize the arguments regarding the shortage of wood and is supported by the literature in the context of forest plantations. Even if the facts are obvious, regionally forest must not change at all as global trade and intense production in climatically favourable regions can compensate high volumes of demand (Jonsson 2011; Buongiorno and Zhu 2014). However, there is still a research gap regarding econometric studies considering the multi-country market aspect (Toppinen and Kuuluvainen 2010).

CONCLUSIONS

Wood is an important raw material for many products. The future development of the supply and demand for different assortments of wood is therefore of great interest. The aim of this study was to apply "Steinmann's and Schreyögg's concept of competitive strategies" for market-driven goods on the common forest management practices in Europe with regard to the production of different assortments of wood. If the production of different assortments is market-driven, it can be assumed that forest management will follow competitive strategies in the production of different assortments. Forest management, the nature of the forest and the accessible volumes of the different assortments are changing depending on the market situation. Moreover, the results show that the production of different assortments per area is limited. Maximising the production per area is possible only for a single assortment at the expense of other assortments. Overall, the findings of this study are a useful base and provide constructive support for diverse types of forest models with regard to the future development of wood accessibility.

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