Research article

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Analysis of a long-term Forest Accountancy Network to Support Management and Controlling

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Abstract: Multifunctional forestry in Germany is characterized by long production periods and complex biological-technical processes. Private forest enterprises are complex systems which are closely interwoven with the economic environment. To ensure their economic success, forest landowners need to take the economic development into consideration and adapt their management strategies. Management accounting is an important source for information needed to fulfil main tasks of accounting that help to manage forest enterprises: ‘description’, ‘explanation’ and ‘decision making’. To get general data, long time series data, taken from Forest Accountancy Networks (FAN), can be analysed. For more than 45 years, data from the FAN Westfalen-Lippe in Germany has been collected and analysed by the department of Forest Economics and Forest Management at the University of Göttingen. The long-term development and adaptation strategies of defined groups of private forest enterprises can be illustrated using this data. These valuable time series can support decision-making processes for private forest landowners and provide tools for forest policy. The data shows that private forest enterprises, with spruce as the dominating tree species, have performed above average in terms of operating revenues and profit margins, but are also more susceptible to calamities resulting in higher involuntary timber harvests.

Keywords: management accounting, tasks of accounting, forest accountancy network

1 Introduction

Forests in Germany are the result of intergenerational economic activity. With almost 50% of total forest area (BMEL 2014), private forests are the dominant form of forest land ownership (33% is state owned and 19% is owned by municipalities). Private forests are generally managed by forest enterprises. Private forest enterprises are complex businesses typically operating at local level to offer goods and services on various markets for forest produce (see also Brandl 2002). Management strategies are under constant development to safeguard overall economic success and financial stability of the enterprise (Selchert 1997). A possible approach to develop new management strategies is in analyzing long term accounting data (Möhring et al. 2016; Bürgi et al. 2016a). This data can be obtained from so called Forest Accountancy Networks (in the following referred to as FAN), which comprise a number of forest enterprises (Brandl 2011, Wense 1990). Generally speaking, accounting monitors financial processes and tracks the flow of goods and funds. It is commonly divided into external financial reporting, which includes annual financial statements, and internal management accounting, which deals with cost-revenue analysis, company statistics and budgeting. It is of high importance that financial reporting is always in compliance with legal requirements. For management accounting, a business management perspective is necessary (Möhring et al. 2017).

The following article will deal with a total of three tasks associated with the concept of accounting:

Task 1: Description: What is the situation?

Task 2: Explanation: Why is the situation like that? What will it be?

Task 3: Decision making: What should be done? What are the factors of success?

The results of FANs, like that of Westfalen-Lippe in Germany, support the tasks of management and controlling (cf. Sekot 2017). Brabänder et al. (2001) describes a FAN as an instrument for monitoring economic efficiency of a

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forest enterprise. It can be used for objective evaluation of economic decision making. A FAN not only provides means of operational control but is also an important tool for future planning (see BMEL 2018; Lohner et al. 2016; Toscani and Sekot 2018). The following will demonstrate how this can be done in a scientific manner.

2 FAN Westfalen-Lippe

For more than 45 years, data from the FAN Westfalen-Lippe in Germany has been collected and analysed by the department of Forest Economics and Forest Management at the Georg-August-Universität Göttingen. The FAN was established in 1969 in cooperation between the federal state of Northrhine-Westfalia, the *Landesbetrieb Wald u. Holz NRW*, the *Forest Farmers Association NRW* and the *University of Göttingen*. It is one of the oldest and most extensive data sets for private forests in Germany. Now it consists of about 30 middle-sized and large private forest enterprises from North Rhine-Westphalia and bordering areas of Hesse and Lower-Saxony located in North-West-Germany. Ever since its establishment it has collected key financial indicators and tracked the growing stock of the participating forest enterprises. The average size of the enterprises is 1,600 ha. Most of the enterprises deliver annual reports to the network resulting in a nearly gapless set of data, which makes long term comparisons possible.

Regionally induced differences amongst enterprises are taken into account as the FAN is divided into different groups referred to as ‘consultancy circles’. These groups are categorized by the enterprises’ dominant tree species, which is either spruce (*Picea abies*), broad-leaved tree species (especially beech, *Fagus sylvatica*) or pine (*Pinus sylvestris*). The long-term management development and adaptation strategies of these groups can be derived from the collected data. These valuable time series can support decision-making processes for private forest landowners and provides tools for forest policy.

2.1 Task 1: Description

The current economic state of a forest enterprise can be described using different operating results (see Bürgi et al. 2016b; Bürgi and Pauli 2012). The following results of the FAN Westfalen-Lippe are averages of the various consultancy circles (with defined properties and sets of tree species) and therefore allow comparisons at operational level.

A key indicator for economic activity is the annual felling amount within a forest enterprise. As shown in Figure 1 (Dög et al. 2017) the amount of timber felled in spruce dominated enterprises was almost always at a higher level, compared with the other enterprises (aprox.

Figure 1: Felling amount per hectare forest land according to consultancy circles

2.5 m³/ha higher). Even though the most recent years show a decrease in the amount of timber harvested, spruce enterprises remain well within the total average of all participating enterprises. The peak in 2007 was caused by the storm 'Kyrill' which primarily affected the spruce dominated enterprises.

Not only is the amount of timber harvested important, but the costs and revenues of felling are of particular interest in regard to the operating results of the enterprises. Revenues result in multiplying the timber price with the harvested amount. Naturally, long-term revenues follow a similar trend to the harvested amounts with peaks in times of calamities (such as windstorms). Revenues (nominal values) over time were stable over the last years since 2009 and accumulated to approx. 350 €/ha in the year 2016 (see Figure 2). Figure 2 (Dög et al. 2016) also shows that spruce enterprises (especially compared to pine enterprises) show a more volatile trend. The reason being that spruce was more affected by storms in the years since 1990. The costs follow a smoother path with a slight increase over time. Costs increase during calamity years like 2007, where the spruce enterprises were greatly affected by the storm "Kyrill".

To demonstrate the relation between income and expenses (nominal values), the chart shown in Figure 3 can be applied. It shows the relation between operating costs and revenues for the year 2015. In 2015 only four of the participating enterprises had higher costs than returns so that they are located in the so-called loss zone. There are however some really profitable enterprises (primarily spruce enterprises) as well.

2.2 Task 2: Explanation

Interpreting the results provided by the FAN and deriving prognoses for the future is the second task of accounting. An example of this is given in Figure 4, which shows the working hours of the employed forest workers in an enterprise that can be financed by the revenues per cubic meter of sold timber (financeable working hours). The financeable working hours do not consider timber which was harvested and sold in self-logging contracts. The development can be described as asymptotic and demonstrates the effect of how increased mechanization, rising labor costs (in addition to outsourcing of labor to

Figure 2: Costs and revenues per hectare forest land according to consultancy circles

Figure 3: Income and expenses of the enterprises according to consultancy circles in 2015

Figure 4: Financeable working hours according to consultancy circles

contractors) and varying timber prices, results in fewer financeable working hours. While in 1969 a total of eight hours could be financed with the revenues of one cubic meter of timber (equivalent to labor costs of one working day), only two hours could be financed in the early 2000s. Nowadays one cubic meter of timber is able to finance three working hours on average. That means despite outsourcing and receding numbers of employed forest workers, financeable working hours are declining because of higher wages, increased qualification of employees (mechanization) and a proportionally lower increase in timber prices. Following this trend, it can be expected that the value of 2 h/m³ demonstrates a lower bound so that in the future about 2 to 3 working hours can be financed by the revenues of a cubic meter of timber. For operational planning with an employed workforce, the minimum amount of timber to be harvested, to compensate personnel expenses, can be derived from this information.

2.3 Task 3: Decision Making

From the enterprises' point of view, the third task of accounting is of high relevance as it provides indicators for decision making. The question which will be answered exemplarily here is: what are the factors of success? Therefore, the financial contribution of the dominating tree species to the operating results needs to be identified. This

requires shifting the focus from comparing whole enterprises to comparing the results of different tree species. In Germany (and as well in FAN Westfalen-Lippe), results for the 4 main tree species 'oak', 'beech', 'spruce' and 'pine' are reported regularly. The financial return per hectare species-area of a harvest depends primarily on the felling quantity and secondly on the net timber revenue per cubic meter. These two figures are shown for the four main tree species below. Figure 5 shows the amount of timber harvested in relation to the amount of forest land area each species occupied. Since the figures are based on the area occupied by the trees it is not possible to derive the sum of the total harvest amount (like in Figure 1). That is why the harvested amount (m³) is set in relation to land occupied (ha) by the species (species-area). It becomes apparent that the spruce harvest decreases significantly on the spruce land. The slight peak in 2014 in beech harvest can be attributed to a summer storm event that heavily hit broadleaf enterprises.

The net timber revenue per cubic meter after deducting harvesting costs is one of the most relevant economic ratios for forest enterprises. Figure 6 depicts the net timber revenue per cubic meter for the four main tree species over the last years. It becomes apparent that the revenues of oak wood (m³) are comparatively high, though not constant over time. The revenues of spruce are on a constant high value only decreasing slightly during the last years. The revenues of beech are continuously on a low level.

Figure 5: Felling amount per hectare according to main tree species

The profit margin (revenue per hectare) is the mathematical product of timber harvest and net timber revenue. To determine the importance of the individual species, the graph in Figure 7 was created (Dög et al. 2016). It shows the profit margin of the dominating tree species in relation to the share of total forest land occupied by that species. Therefore, the width of the bars indicate the share of the forest land, whereas the bar height indicates the profit margin. Because of this the surface under the graph

(profit multiplied with area) corresponds to the share of the total operating revenue. The black line shows the mean profit margin over all species and total forest land (in this case all forest enterprises). It becomes apparent that spruce is the most relevant species within the FAN Westfalen-Lippe.

Using this knowledge for operational decision making can aid for instance in tree species selection (task: 'decision making'). The beech for example is highly

Figure 6: Net timber revenue per cubic meter according to main tree species

Figure 7: Profit margin per hectare according to main tree species (average 2010-2016)

praised in central Europe and specifically in Germany in regard to both nature conservation and silviculture. The results of the FAN Westfalen-Lippe suggest however, that over time and on average of all enterprises, the beech can only mildly contribute to a positive operating income. On average, the spruce generated by far the highest operating income per hectare of species-area and contributed over-proportionally to the overall economic success. Comparable results can be found in Ermisch et al. (2013). They determined that the spruce contributed the highest to the total timber revenue in Germany between 2003 and 2011. Griess and Knoke modelled comparable results for mixed spruce-beech-stands with more than 50 % beech. Regarding climatic change however, it may be necessary to replace the spruce in the long term and establish a broad-leaved species like beech (Bolte 2016; Bolte et al. 2010; Panferov et al. 2009; Kölling et al. 2007). From an economic perspective it would be advisable to resort to tree species, which can produce an equivalent operating income (see also Neuner and Knoke 2017; Knoke 2009). Griess and Knoke (2013) modelled comparable results for mixed spruce-beech-stands with more than 50% beech.

3 Conclusions

Data from forest accountancy networks provide varied information of the past and can deliver valuable insights for future management. Participating forest enterprises, forest economic research as well as forest politics can therefore benefit from this data (see Sekot 2017; Sekot et al. 2010; Filbrandt 2005). There are however several possibilities for evaluation and interpretation. Firstly, a classical comparison of different enterprises must be mentioned. Secondly, a type of operating branch settlement (like those known in agriculture) seems to be appropriate. A suitable basis for this could be main tree species with reference to the species-area. With the data from the FAN Westfalen-Lippe such an analysis was shown. In result of this analysis the most important tree species for the participating enterprises could be identified. On average the species spruce achieved the highest revenues (per hectare). From a business point of view, however, tree species that can sustainably provide adequate contribution margins should always be preferred. Such information can be used in decision making for managing individual enterprises as well as political consultation.

References

- BMEL, Der Wald in Deutschland. Ausgewählte Ergebnisse der dritten Bundeswaldinventur, 2014, https://www.bmel-statistik.de/fileadmin/user_upload/017_Holz-und_Forstwirtschaft/Bundeswaldinventur3.pdf, (in German)
- BMEL, Die wirtschaftliche Lage der forstwirtschaftlichen Betriebe. Buchführungsergebnisse des Forstwirtschaftsjahres 2016, 2018, https://www.bmel-statistik.de/fileadmin/user_upload/monatsberichte/BFB-0113002-2016.pdf, (in German)
- Bolte A., Hilbrig L., Grundmann B., Kampf F., Brunet J., Roloff A., Climate change impacts on stand structure and competitive interactions in a southern Swedish spruce-beech forest, *European Journal of Forest Research*, 2010, 129(3), 261-276
- Bolte A., Chancen und Risiken der Buche im Klimawandel, *AFZ Der Wald*, 2016, 71(12), 17-19, (in German)
- Brandl H., The Economic Situation of Family-farm Enterprises in the Southern Black Forest, *Small-scale Forest Economics, Management and Policy*, 2002, 1(1), 13–24
- Brandl H., Experiences in Collecting Data on Farm Forest Enterprises over More than Three Decades, *Small-scale Forestry*, 2011, 10, 135
- Brabänder H.D., Kaul R., Freiherr von dem Bussche-Kessel A., Leefken G., Freiherr von Fürstenberg H., Grünert S., Hoffmann S., Graf von Nesselrode D., 30 Jahre forstlicher Betriebsvergleich, Druck- und Verlagshaus Bitter GmbH & Co, Recklinghausen, 2001, (in German)
- Bürgi P., Pauli B., Schweizer Waldwirtschaft vor großen Herausforderungen, *Wald und Holz*, 2012, 93(5), 19-21, (in German)
- Bürgi P., Sekot W., Ermisch N., Pauli B., Möhring B., Toscani P., Forstbetrieblicher Kennzahlenvergleich Deutschland – Österreich – Schweiz. *Schweizerische Zeitschrift für Forstwesen*, 2016, 167(2), 73–81, (in German)
- Dög M., Möhring B., Wrede E., Der Privatwald-Betriebsvergleich Westfalen-Lippe im WJ 2015, *AFZ-Der Wald*, 2016, 71(23), 32-34, (in German)
- Dög M., Möhring B., Wrede E., Der Privatwald-Betriebsvergleich Westfalen-Lippe im WJ 2015, *AFZ-Der Wald*, 2016, 71(23), 32-34, (in German)
- Dög M., Möhring B., Wrede E., Ellermann W., Der Privatwald-Betriebsvergleich Westfalen-Lippe im Jahr 2016, *AFZ-Der Wald*, 2017, 72(23), 31-33, (in German)
- Ermisch N., Seintsch B., Dieter M., Holzartengruppe Fichte 2003 bis 2011 konstant mit höchstem Erlösbeitrag, *AFZ Der Wald*, 2013, 68(23), 6-9, (in German)
- Fillbrandt T., Das Testbetriebsnetz Forstwirtschaft als Instrument der Politik und der Betriebsführung, <http://www.waldwissen.net>, 2005, (in German)
- Griess V.C., Knoke T., Bioeconomic modeling of mixed Norway spruce - European beech stands: economic consequences of considering ecological effects, *European Journal of Forest Research*, 2013, 132(3), 511-522
- Knoke T., Die ökonomische Zukunft der Fichte, *LWF Wissen: Fichtenwälder im Klimawandel*, 2009, 63, 16-21, (in German)
- Kölling C., Zimmermann L., Walentowski H., Klimawandel: Was geschieht mit Buche und Fichte?, *AFZ Der Wald*, 2007, 62(11), 584-588, (in German)

- Lohner P., Appel V., Dieter M., Seintsch B., Das TBN-Forst: Ein Datenschatz für die deutsche Forstwirtschaft, *AFZ Der Wald*, 2016, 71(17), 10-11, (in German)
- Möhring B., Wilhelm S., Dög M., The Relevance of Economic Data from Forest Accountancy Networks for Forest Management, *Research and Politics Consultation, Small-scale Forestry*, 2018, 17, 25-40
- Möhring B., Wilhelm S., Dög M., TBN-Daten für Betriebssteuerung, *Forschung und Politikberatung, AFZ Der Wald*, 2016, 71(17), 12-15, (in German)
- Neuner S., Knoke T., Economic consequences of altered survival of mixed or pure Norway spruce under a dryer and warmer climate, *Climatic Change*, 2017, 140(3-4), 519-531
- Panferov O., Kreilein H., Meesenburg H., Eichhorn J., Gravenhorst G., Climatic Condition at Three Beech Forest Sites in Central Germany, In: Brumme R., Khanna P.K. (eds) *Functioning and Management of European Beech Ecosystems. Ecological Studies*, 2009, 208
- Sekot W., Fillbrandt T., Zesiger A., Improving the International Compatibility of Accountancy Data: The 'DACH-Initiative', *Small-scale Forestry*, 2010, 10, 255-269
- Sekot W., Forest Accountancy Data Networks as a Means for Investigating Small-Scale Forestry: A European Perspective, *Small-scale Forestry*, 2017, 16, 435-449
- Selchert F. W., Einführung in die Betriebswirtschaftslehre in Übersichtsdarstellungen, 6th ed., Oldenbourg, München, Wien, 1997, (in German)
- Toscani P., Sekot W., Forest Accountancy Data Networks—A European Approach of Empirical Research, Its Achievements, and Potentials in Regard to Sustainable Multiple Use Forestry, *Forests*, 2018, 9(4), 220, doi:10.3390/f9040220
- Wense W.-H., Der Betriebsvergleich in der Forstwirtschaft: Methoden zur Analyse forstwirtschaftlicher Kennziffern am Beispiel des Privatwaldvergleichs Westfalen-Lippe, PhD thesis, Georg-August-Universität Göttingen, Göttingen, Germany, 1990, (in German)