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Annual use, economic life and residual value of cut-to-length harvesting machines

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ABSTRACT

Recognizing the absence of up-to-date empirical data on the economic life, the annual use and the residual value of dedicated cut-to-length (CTL) harvesting machinery, the authors gathered a large database of second-hand machine sale offers containing over 1000 records, coming from Europe and North America. The statistical analysis of these data pointed at an economic life in the vicinity of 18,000 h for both harvesters and forwarders, which confirms previous assumptions. The average annual use for the machines in the database is 1424 and 1581 h year⁻¹, respectively for the harvesters and the forwarders. Nordic users achieve a higher annual use than central European users, and the difference is statistically significant. Nevertheless, the average annual use recorded for both groups falls below the levels commonly adopted in current estimates, which may therefore represent ideal reference figures rather than actual averages. Residual value is strongly related to machine age, and the authors calculated some simple functions for estimating it. The study points at a better retention of the original value, compared to the figures reported in previous literature. At 5 years of age the harvesters and forwarders in the study keep respectively 38% and 44% of the new value. The information contained in the study is crucial to machine rate calculation, which has often been based on rule-of-thumb assumptions, in the absence of empirical data.

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Introduction

Mechanized cut-to-length (CTL) harvesting is performed by specialised machines that fell the trees, process them into commercial assortments, and extract such assortments to a landing. Mechanized CTL harvesting has revolutionised forest operations, with strong impacts on value recovery and labour productivity (Chiorescu and Grönlund, 2001). Normally, the whole system is based on two machines only: the harvester for felling and processing, and the forwarder for extraction.

Such machines are now common in all industrialized countries (Gellerstedt and Dahlin, 1999), far beyond the borders of the Nordic regions where they were first developed and thoroughly studied (Brunberg, 1997; Nurminen et al., 2006). Today, their use is no longer limited to gentle terrain and softwood trees, as demonstrated by their growing popularity in the Austrian mountain forests (Stampfer, 1999), in the French hardwood stands (Martin et al., 1996; Cuchet and Morel, 2001) and in the Iberian eucalypt plantations (Spinelli et al., 2001).

Despite such widespread diffusion, very little data are available on the annual use, economic life and residual value of CTL machinery. Several studies have addressed other cost centres, such as fuel consumption (Athanassiadis et al., 1999; Nordfjell et al., 2003) and spare parts utilization (Athanassiadis et al., 2000), but no studies have been specifically devoted to annual use, economic life and residual value. In fact, Bright (2001) did develop a formula to estimate the residual value of CTL machinery, but such formula was based on relatively old data, produced by Fairley (1993) over 15 years ago. Published figures for machine annual use are only available for Austria (Pröll, 2005), Italy (Spinelli et al., 2009) and some regions of Germany (Forbrig, 2000; Denninger, 2002; Findeisen, 2002; Nick and Forbrig, 2002; Drewes and Jacke, 2005), but the reports are often in the national languages and are not readily available to the larger scientific community. The summary tables published by Brinker et al. (2002) actually contain estimates for the economic life and residual value of CTL machinery, but the Authors did not indicate any empirical data source for these figures. Furthermore, Cubbage et al. (1991) did conduct an empirical study for the same figures and showed a consistent underestimate in the residual values presented by Brinker et al. in their previous version of the tables (1989). Unfortunately, Cubbage and his co-authors only tested the data for whole-tree harvesting machinery, while leaving out CTL equipment.

The acquisition of modern CTL technology involves a significant capital investment, much higher than that required by traditional small-scale equipment: that makes the formulation of a correct machine rate even more dependent on a reliable estimate of economic life, annual use and residual value. Such figures play a crucial role in all costing methods, from the basic system codified by Miyata for the USDA Forest Service (1980), to the more sophisticated approaches offered by Bright (2004), Koger and Dubois (1999), and Price (1997). Due to the large capital investment, the assumptions taken for economic life, annual use and residual value also have a significant impact on the accounting of interest charges (Howard, 1991).

Therefore, the goal of this study is to produce reliable figures for the annual use, economic life and residual value of CTL machinery, based on the analysis of documented, empirical data coming from a large sample of machines on sale on the European and North American markets. A further goal of the study was to determine the relationship between residual value, machine age and machine total use (in terms of total hours worked), which can aid the cross-sectional estimate of cost streams all along the economic life of a machine.

The study only concerned dedicated CTL machinery, and excluded all harvesters and forwarders built on a general-purpose prime mover, such as excavators and farm tractors. Exclusion was justified by the inherent larger variability of the general-purpose equipment category, which risked to generate an unacceptable level of background noise. Furthermore, both the agricultural (Johansson, 1996) and the earthmoving machinery (Jingxin and Haarla, 2002) used as a base for forestry equipment have been the object of many studies, and figures for their annual use, economic life and residual value are already available (Cross and Perry, 1996; Gullberg and Johansson, 1998; Hanninen, 1997). Finally, the versatile character of general-purpose prime movers makes them the ideal solution for part-time loggers (Väätäinen et al., 2004), with the risk of introducing a significant bias in the results, if part-time and professional loggers were pooled together.

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