ANALySIS OF THE MEANS OF FOREST HARVESTING IN THE FEDERATION OF BOSNIA AND HERZEGOVINA

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Abstract: The development of technology and the means of labour in the technological process of forest harvesting in FBiH mainly depends on the factors related to the specific manner of forest management. The dominant share of mixed tall forests with natural regeneration, the selective manner of management and rather difficult natural conditions have resulted in the application of the cut-to-length method and to a lesser extent, the tree-length and semi-tree-length methods. On the basis of expert classification of the development phases in forest harvesting, it can be noted that wood assortment production in FBiH is currently partially mechanised. With the aim of defining measures for increasing productivity, lowering the costs and a greater humanisation of work, there has been an analysis of the current state of the means of work in all three phases of forest harvesting. The analysis included the following parameters: number of means in different phases, the type, the average age, ownership and technical planned obsolescence. All the data were collected through a survey which included all stakeholders (cantonal forest companies and private contractors). The results showed a satisfactory state only when chainsaws are concerned, i.e. the rather cheap tools. Other equipment (adapted tractors, skidders, trucks, etc.) has largely reached planned obsolescence. Their old age results in a low level of utilisation, i.e. an insufficient amount of working hours per year which eventually leads to a decrease in productivity and increase in expenses. Based on the data, it can be concluded that it is necessary to begin the process of new mechanisation procurement and the replacement of existing, time-worn and technologically obsolete machines with new ones. At the same time, it is clear that, in the conditions of low availability of investment capital and cheap labour force, this has to be a gradual process. In relation with this, the process should start in the most expensive phase – timber extraction, i.e. the phase in which the economic efficiency is unquestionable.

Key words: forest harvesting, chainsaws, skidder, truck, public and private sectors, FBiH

INTRODUCTION

Forests have always been one of the most important resources of the planet. With responsible forest management and harvesting, forests transform into a renewable source of unfailing economic worth; thus it is rather lucrative to manage forests wisely.

Nowadays, forest harvesting in BiH is mainly done by human-machine work. Cutting and production is done by chainsaws and the extraction is done with larger machines. The choice of labour technology presents a significant issue in the overall process.
The use of machines in forestry demands knowledge about the machines, be they new, obtained through adjustment, remodelling or upgrade. In assessing their environmental suitability, it is necessary to know their technical details as basis for defining the corresponding environmental criteria system (Danilović 2001, Horvat and Šušnjar 2005., Poršinsky et al. 2005, Horvat et al. 2007).

Due to the difficulty of forestry work, as well as the immense load on the workers, and with the purpose of humanising work; it is important to consider the ergonomic features of machines, especially the load on man and environment due to noise and vibrations in the working place (Čomić 1985, 1997, Lipoglavšek 2005, Lipoglavšek and Staudt 2005, Bergman 2005).

The optimal usage of wood mass in forest harvesting is one of the key elements for successful forestry company management, and also very important for the wood industry as was stated by Nikolić et al. 1993, and Musić et al. 2013.

Forest harvesting should be based on the environment, a greater humanisation of work and the lowest costs of carefully selected optimal working method. One method in achieving this is the application of cutting-edge technology in forest exploitation which meets all the ever-demanding environmental standards and conditions (Kulušić 1977, Gurdas et al. 2010, Halilović et al. 2013).

The production process mechanisation level in forest harvesting significantly influences the production costs. By selecting the working method and utilising the corresponding working medium, it is possible to achieve auspicious production effects (Bajić et al. 2005). The mechanisation issue in the surrounding countries was the topic for a number of scientists (Tarnaj and Dundović 2005, Bajić et al. 2005).

The aim of the research was to analyse and ascertain the quantity and quality structure of the means of work currently being used in forest harvesting in the Federation of BiH.

**RESEARCH RESULTS AND DISCUSSION**

**Current state of means of work in forest harvesting**

Forest harvesting in the Federation of BiH is in its partially mechanised development phase, and the analysis of the current state of means of work encompasses the mechanisation of all three phases of the technological forest harvesting process: the aspect of number and type of means of work, the ownership and average age, i.e. technical planned obsolescence.

**Cutting and production – chainsaws**

The means of work in the cutting and production phase are divided according to work operations; and they are: chainsaws, debranching...
machines, log debarking machines, timber cutting machines, wood cutting machines, wood chipping machines and machines for multiple operations in cutting and production i.e. cutting, production and extraction of wood assortments.

Regarding forest harvesting in FBiH, the survey presents data for chainsaws in forest companies and private contractors (Chart 1).

Analysing the chart, it is ascertained that:
• the total number of analysed chainsaws 506 (forest companies 328 and private sector 178),
• The public sector’s 45% of chainsaws is between 1–2 years old, and the average age is 2.5 years;
• The private contractors own half the number of chainsaws the age between 1–2 years with the average age of 2.25 years;
• The partaking of 3-4 year-old chainsaws was 13% with public companies and 17% with private contractors, while it was lesser with chainsaws of over 4 years,
• the average age of all analysed chainsaws is 2.35 years.

### Wood cutting machines

Data related to wood cutting machines is presented in chart 2.

The total number of analysed wood cutting machines was 9 and all of these machines are owned by private contractors. Five machines out of the total number are 1-2 years old (56%), one machine is 2–3 years old (11%), while the remaining wood cutting machines are over 4 years old (33%).
Timber extraction vehicle

The basic wood assortment extraction methods include land skidding, skidding with cable yarders and areal timber extraction. The means of work in the extraction phase (including the sub-phase of skidding) are animal power, plastic log chute, tractors, cable yarders, winches and helicopters.

Animal transport (horses and oxen) is often used for pulling of wood assortments in FBiH. This kind of research has not been studied much in past.

Cable yarding system is very poorly represented in the forestry of FBiH. Chute (made from plastic) for extracting logs from a thinning operation and helicopters are not in use at all.

In this study we present only tractors used in thinning operations.

The survey ascertained that tractors represent the main means of work in the wood assortments extraction phase.

The survey results show that the total number of analyzed tractors for extracting wood is 195 (forest companies 93, private contractors 102).

The most common tractors are specialised forest tractors (skidders) 85%, 98% of which are owned by the state and 74% are owned by private contractors.

Specialized forest tractors owned by public companies are mainly tractors older than 10 years (76%) with an average age of 13 years. Private contractors own 57% tractors over the age of ten, with an average age of 11 years.

Only 3% of tractors are slightly adapted for skidding, and those are mainly older tractors, they are owned by private contractors and their share in the total number is around 12%.

The largest number of adapted tractors reach the threshold of technical obsolescence (50% of the tractors is older than 10 years) or are over it. The average age of forest tractors is approximately 11 years.

The total number of tractors by age in the public and private sectors is presented in the chart.

Transport trucks – trucks with or without hydraulic jacks

The survey presented data for the transport of wood assortments using truck with or without hydraulic jacks; and the analysis of the data leads to the following:

The total number of trucks analysed 40 (forestry companies 19 and private contractors 21). Trucks without hydraulic jacks partake with 14.6%

![Diagram 3. Wood extraction machine age in FBiH](image-url)
and belong to the category of old vehicles (83% of the vehicles are older than 10 years), with an average age of 13.5 years.

Trucks with hydraulic jacks partake with 83.4% and also belong to the category of old vehicles with the average age of 11.9 years.

In the case of distance transport operated by the public sector, all the trucks are older than 10 years (including the ones with hydraulic jacks).

In the case of transport using trucks with hydraulic jacks operated by the private contractors, 62% of such transport is operated by trucks not older than 10 years (52% trucks of all the surveyed private contractors).

The percentage partaking of trucks older than 10 years in the total number of vehicles, used in distance transport, included in the survey is 70%, and the average age of all vehicles included in the analysis is 12.4 years.

Chart 4 Presents the age of trucks used for distance transport in FBiH.

CONCLUSION

The following important conclusions can be drawn from the analysis of the conditions of means of work in forest harvesting in FBiH for the year 2010:

- utilised chainsaws did not reach technical obsolescence; considering the development of chainsaws, it is to be expected that they meet all ergonomic, environmental and other requirements (the utilisation of chainsaws older than three years is questionable due to their work features - especially the ergonomic ones),
- choppers have mostly not reached technical obsolescence,
- forest adapted tractors (the application of which is mostly linked to the assortment method and skidding of a prepared load and is limited by the terrain conditions) have reached the threshold of technical obsolescence, as have the tractors with minor adaptations for skidding (the newer ones have limited application conditions),
- a somewhat greater average age of specialized tractors owned by public companies can be explained by being the tractors remaining from previous production, but as is the case with private contractors, these tractors need replacement with new ones,
- although private contractors have somewhat younger trucks (approximately half of them are not older than 10 years), it can be stated that most of the trucks have passed the threshold of technical obsolescence.

Improvement measures in the area of forest harvesting in FBiH have to be founded on the basic principles and numerous activities have to be conducted to ensure meeting production, efficiency, ergonomic and environmental requirements towards techniques and technologies of forest harvesting in FBiH, i.e. to ensure their optimal compromise.

Certain measures have a wider scope, while others are specific to an area, work phase and work operations of technological processes in forest harvesting.

The following actions are suggested:

- planning and completing activities in field classification and technological standardisation of forest areas in FBiH (choosing and planning the technology and means of work for middle-term and operational forest management plans and forest harvesting works),
• decrease of the amount of manual work in the cutting, production and skidding phase, either by changing the work method, introducing mechanisation while respecting the terrain and stand conditions,
• transferring a number of operations from the felling area to the forest depot with the aim of using specialised production machines (especially machines for stacked wood and chipping),
• replacement of means used in forest harvesting which have passed the threshold of technical obsolescence (currently means for skidding – skidders and trucks),
• introducing technologies of a greater level of wood mass utilisation, especially regarding raw materials for renewable energy resources,
• introducing the processor technology for the purpose of utilising wood energy plantations,
• introducing technologies and means of work for the utilisation of the forest biomass from the cutting and production remains, i.e. forests intended for conversion etc.
• forming a unique information system (for public companies and private contractors) with the aim of collecting data in the domain of technology and technological processes.

The above mentioned measures present an objective complex solution and they are intended to be the criteria while choosing the technology and means of work.

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