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Risk Analysis of Agricultural, Forestry and Green Maintenance Working Sites

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Abstract

This work is focused on serious and fatal accidents which occur at forestry, agricultural and green maintenance working sites. In these sites are performed operations related to tree cutting or felling with continuous use of chainsaws.
During this study we investigated 123 professional as well as non-professional working sites. We considered all characteristics necessary to determine the operating conditions and to identify possible steps for an effective protection. The work highlights a very serious situation in both investigated working environments where all measures of job safety are systematically ignored.
In conclusion, we recommend that for a significant reduction of serious and fatal accidents, a mandatory training should be extended to all chainsaws users. Passive and active safety systems which interrupt the operation of the saw when it does not comply with all obligatory safety rules (i.e. human vicinity to cutting chain, falling down of the operator and others) should be defined.

Keywords: safety, chainsaw, accident

1 Introduction

The operations on working sites in forestry or agriculture represent an activity with high risk of accidents [1]. Two major causes of serious injury or death are mainly tree falling or improper use of the chainsaw [2]. In the professional world legal obligations and national guidelines for forest workers identify the correct procedures for the safe use of the chainsaw. However, these types of information are often ignored and consequently a large number of chainsaws users perform unsafe operations during forest green management with no awareness of possible risks. The scientific and medical literature overview shows that even a short contact with the cutting chain or blade of the saw may cause fatal injuries [3]. During professional activities in the field or in the forest all operations should be always carried out by a team of experienced and skilled operators. In this context, it is forbidden to work alone, although this rule is almost never respected [4]. For a correct analysis of the working dynamics in the woods or in open fields a set of observational methods with experienced staff should be defined. The correct identification of specific problems can be obtained only with checklists and rigid methods because unlike in other areas of work this area (i.e. agricultural, forestry and park maintenance and hobby activities) are characterized by a multitude of factors and variables which are independent of the operator himself [5]. Indeed the normal agricultural and forestry activities are affected by environmental, geo-morphological or phyto-pathological parameters or conditions. In specific, if we consider the aspects related to the operator activity it is important to mention also the following specific risk factors such as noise vibration and chemical risk (use of the chainsaw) with elements such as physical fatigue, demanding activities and movements as well as difficult postures. Therefore, starting from this complex

scenario and possible accident scenarios this work investigated the risk factors and operating conditions on different working sites to establish appropriate technical, legislative and operational solutions

2 Materials and methods

This work describes a sample of 123 working sites in the province of Udine and Pordenone in North-East Italy (surveyed in the period October 2012-March 2014).

The working sites were selected randomly and the samplings were mainly made on weekdays or during holidays (this element allowed us to identify more sites of non-professional type). All analyzed aspects are enclosed in the following categories:

- **section 1- Descriptive data:** all information related to the working site (10 survey points);
- **section 2- Activity:** analysis of the types of actions or operations carried out in the site (in this section we included 5 macro categories and each has been observed for at least 30 minutes. The 5 macro categories were: 1) sawing, 2) reduction, 3) pruning, 4) cargo/transport and 5) supply;
- **section 3- Organization and working site logistics;**
- **section 4- Vehicles and equipment;**
- **section 5- Managing of safety devices.**

Each element of the sections was analyzed according to the evaluation scheme presented in Table 1.

Section 1	Descriptive data		
	Number of operators		
	Age		
	Job/Occupation		
	Experience with chainsaw use	Present	Absent
	Gender		
Section 2	Activity section		
	Activity	Identified risk factors	Working period
	1) sawing		
	2) felling		
	3) pruning		
	4) cargo/transport		
	5) supplying		

Section 3	Organization and working site logistics		
	Roads/Viability	Present	Absent
	Evacuation routes		
	Compliance with the safety distances (operator)		
	Compliance with the safety distances (streets/roads)		
	Signalling and signs		
	Signalling and principals emergency		
Section 4	Vehicles and equipment		
	Type		
	Age		
	Presence of user manual and instructions		
	Definition of a maintenance protocol		
Section 5	Managing of safety devices		
	Type		
	Use		
	Expiry date		
	Efficiency		

Table 1 – Summary of the surveying system used during sampling

The used analysis tool comprised a total of 118 points of specific survey.

The expert system was built through the use of technical standards, application of national guidelines and best practices. The assessment was performed according to the diagram shown in the Table 2.

Risk factors	**Definition of critical issue level**	**Color**
Moderate	Risk factor present or moderate. Irrelevant to for health	Green
Significative	Risk factor whose consequences may affect the health and protection of the operator	Yellow
Critical	Element of risk that is constantly present in the working activity that exposes the operator to serious and life-threatening situations.	Red

Table 2 – Identification and categorization of risk factors

In the final stage of this work we correlated the dynamics and the types of serious and fatal accidents which have occurred in the overall region with the findings and results from this study.

3 Results

The analysis of collected data has shown a heterogeneous sample with high variability. For example, 40 working sites had a single operator and only two sites had 8 operators. Overall, the mean number of operators per working sites was of 2.7. A total of 361 operators were evaluated and the prevalence of males was of 93%. In addition, it was observed also a high variability among age distribution, going from sites with an average age above 70 to sites with presence of minors (Fig.3) (15).

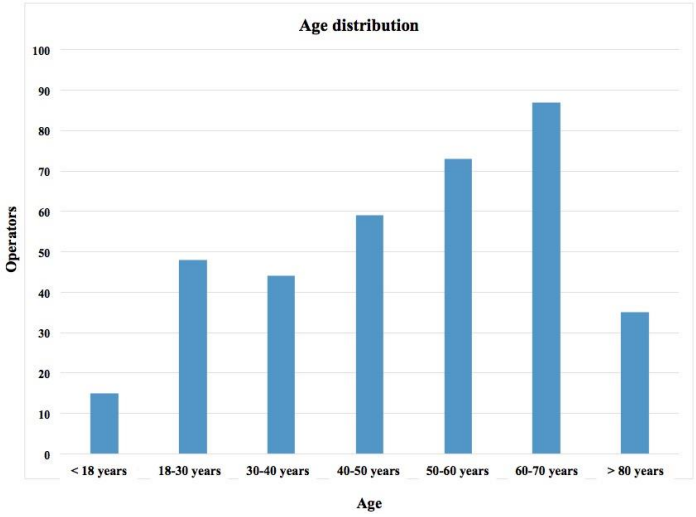

Figure 3 – Classification of operators based on their age

The 65% of working sites were in fact for domestic use, in which the operators used the wood for personal requirement. In Figure 4 can be observed that the distribution relative to job/occupation or activities involved significantly retired persons and farmers. At the working sites were present also professionals connect to other working fields and not solely to agricultural or forestry areas.

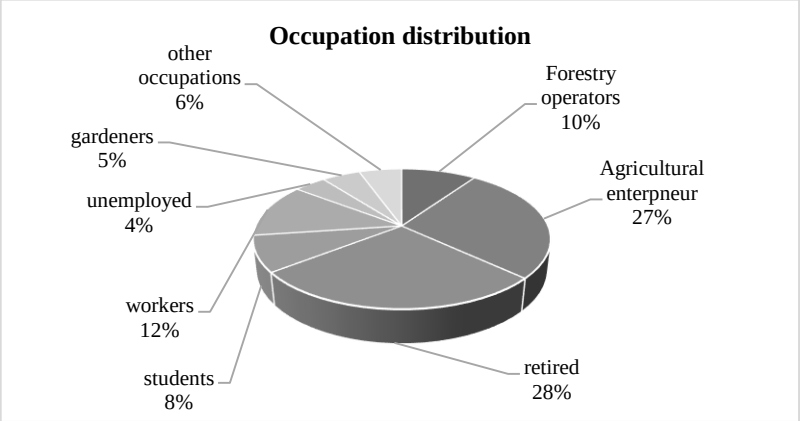

Figure 4 – Classification of operators by occupation

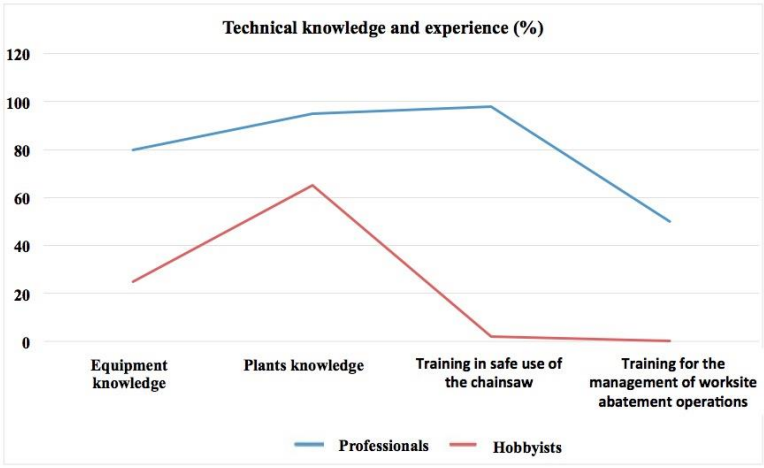

Figure 5 – Technical knowledge and experience

Figure 5 shows the clear distinction between experience and knowledge of professional vs. non-professional operators in the management of operations at the working sites. However, several lacks in the management activities performed by professional operators were also noticed and especially during the management of complex working sites near the roadside. In the case of occasional operators it was shown an average technical knowledge of the chainsaws (especially for farmers) with completely absent knowledge regarding safe handling of the equipment. In 29 cases out of 123 modalities of tree felling were completely random, without any planning of the cutting or the planning of the area of possible tree falling.

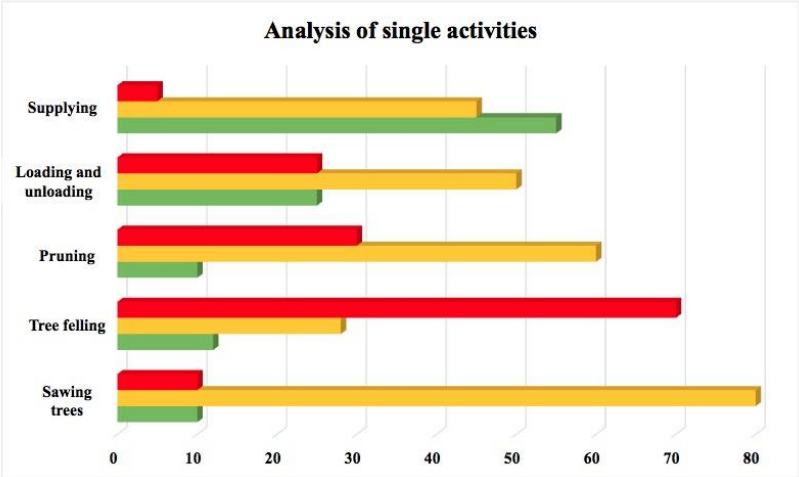

Figure 6 – Analysis of safety levels for all operations

Analysis of performed activities/operations within a working site had shown the tree felling as the operation with the highest risk rate. This element denotes

two types of critical issues; firstly the lack of compliance with the safety distances, the activities of operators are always in the area or in the hypothetical radius of the tree, and secondly the working height (operators were found working on scales with the chainsaw; 75 cases out of 123, Figure 6).

Also, during the activities of pruning were found the following scenarios: lack of planning stages of pruning, random stacking and lighting of fires in potentially dangerous areas.

The sawing had denoted the greater danger related to the machines and also in this case to the safety distances (e.g. two operators in the cutting zone with hands positioned close to the saw during wood handling).

Loading and transport were performed with unsuitable equipment, self-built trailer and no use of fastener (in 60 cases of 123).

In the stages of supplying no particularly prominent factors were found, except in situations where the technical time for the cooling of the machine was not respected before filling with wood or non-compliant tanks were used for transport. The machinery used within professional and non-professional working sites was similar, with an average presence of two chainsaws per operator. It was noticed a high usage rate of non-compliant equipment in working sites with sawing activities (45 of 123). In fact, 18 log splitter of 32 tested were built in-house or self-made.

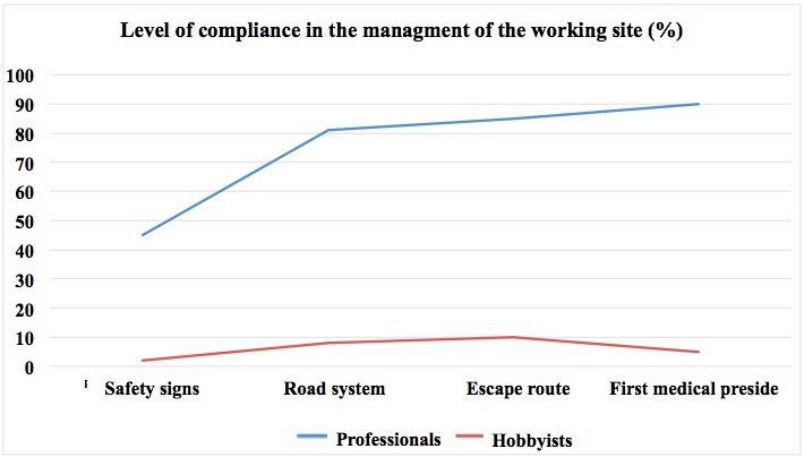

Figure 7 – Level of compliance (difference between professional and non-professional operators)

Analyzing the data presented in Figure 7, it is possible to notice two types of different distribution. In non-professional working sites (with same characteristics and complexity as professional ones), it was present a complete absence of safety approaches or specific guidelines with an average compliance of only 7%). In addition, if the both types of working sites are analyzed it can be observed a similar unsafe approach and complete absence of personal protection equipment (Figure 8).

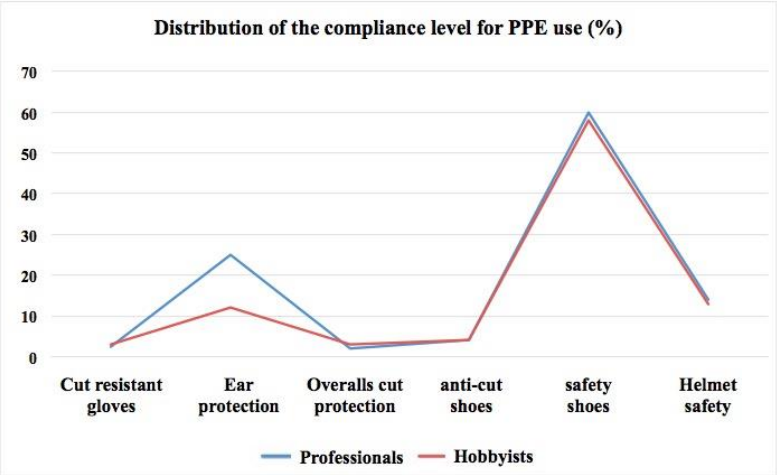

Figure 8 – Levels of compliance for the use of PPE (comparison between professional and non- professional operators)

Ultimately the work carried out a comparison between the identified factors and the accident dynamics recognized in the period of study in the FVG region. We observed the following relationships:

- three serious and fatal injuries per week in the sampled area
- 60% of injuries related to trees falling on the operator (3 fatal cases in 6 months, Figure 9)
- 30% of injuries related to the contact with the cutting chain or blade
- 10% of injuries related to falling from height during work

Figure 9 – Signs of fatal injuries of injuries from due to tree falling on the operator (on the left an ecchymotic mask and on the right parts of the stump

4 Conclusions

The work showed that the levels of safety in agricultural or forestry working sites in FVG region in North-East Italy are unacceptable. In general, a fatal accident

is a moral damage to the whole community as well as a social cost even if takes place in private areas and not only at professional working sites.

The research demonstrated a general underestimation of the risks and complete absence of minimum safety rules and no use of personal protective equipment. The starting point for the reduction of accidents must be implemented based on the following priorities:

1. compulsory training related to the use of the saw for non-professional operators;
2. increase of the control at the working site;
3. improvement of the comfort level of PPE;
4. development of specific sensors connected to the chainsaw;
5. development of sensors, displays, procedures which make inaccessible the working zone to unauthorized operators;
6. implementation of specific courses for proper felling and analysis of the dynamics of tree falling and the feedback stability of the same.

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