

Article

Health and Safety Issues in Romanian Forests: Findings from FSC Certification Audits

Aureliu Florin Hălălișan ^{1,*} , Bogdan Popa ¹ , Stelian Alexandru Borz ¹  and Ioan Vasile Abrudan ² 

¹ Department of Forest Engineering, Forest Management Planning and Terrestrial Measurements, Faculty of Silviculture and Forest Engineering, Transilvania University of Braşov, Sirul Beethoven 1, 500123 Braşov, Romania; popa.bogdan@unitbv.ro (B.P.); stelian.borz@unitbv.ro (S.A.B.)

² Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Braşov, Sirul Beethoven 1, 500123 Braşov, Romania; abrudan@unitbv.ro

* Correspondence: aureliu.halalisan@unitbv.ro; Tel.: +40-0752-099-328

Abstract: In a wider context of attempting to minimise forestry related occupational hazards, this paper aimed to evaluate the ability of FSC forest management certification to contribute to identifying, describing, and reducing health and safety issues in forest management in Romania. By extracting and analysing the health and safety related non-conformities from auditing reports issued for Romanian forest management operations between 2013 and 2018, the study reveals that the most important risk factors are organizational factors, followed by equipment-related factors. The correlation of the results with other findings in the forest operations literature indicates that forest management certification is a suitable tool to identify and describe the health and safety aspects of forest management related activities, especially for forest operations. The analysis also indicates some possible causes of the high rate of work accidents in Romanian forestry: obsolete and less mechanised technology, low concern for providing and using specific safety equipment, low wages in forest operations, lack of proper training etc. All these aspects point to the need for improving safe organisational culture.

Keywords: Romanian forestry sector; forest operations; health and safety; risk factors; accident factors; FSC; forest certification; non-conformities



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1. Introduction

Adopting voluntary certification standards is common practice, and is part of an increased effort by companies towards the implementation of a safety culture [1]. The main cause is the need to manage interacting factors, such as procedures and norms, employees' training and involvement, beliefs, attitudes, awareness, responsibilities, and measures adopted by employers to correct unsafe behaviours [2]. Safety culture, and its associated risk management, are among the main social responsibilities that should shape the strategy of a company [3], and constitute the essential ingredient of corporate social responsibility (CSR) [4]. Both prescriptive and proactive principles should be considered when designing and implementing measures aimed at improving health and safety (H&S), by eliminating unsafe practices, providing improved personal protective equipment, as well as introducing engineered controls and safer technologies, training, and improved organisational safety measures [5]. Fulfilment of the H&S legal requirements, as well as emphasising the beneficial role of CSR in preventive H&S culture, are the basis of improving the environmental and social issues in companies [6,7].

Working in forestry operations is among the most dangerous occupations [1,8], constantly having significantly higher accident rates when compared with many other industrial sectors [9,10]. Therefore, occupational hazards must be minimised in forestry operations by using safe work procedures, engineered designs and controls, personal protective equipment, and careful planning [2,8]. While these features of occupational H&S are a central part of CSR [3], the concept itself is becoming more common among the

forestry companies, as a response to their increasing interest in social matters, concerns for environmental impacts, and the need for efficient resource use [11]. As such, CSR is often characterised, in the forestry sector at least, as a voluntary approach by a company to include society and environment responsibilities in its portfolio [12]. In this context, the voluntary forest certification schemes promoting sustainable forest management had a significant impact on H&S issues in forestry. Often, forest certification is regarded as a CSR tool, since it is a voluntary integration of social and environmental issues, human rights, and consumer concerns into business operations and core strategies [13].

The Forest Stewardship Council (FSC) is one of the most used forest certification schemes, based on developing, improving, and promoting sustainability standards in forestry. Forest certification aims at fostering responsible management through a voluntary certification scheme and a third-party (independent) assessment, specifically designed and implemented for the forest sector and forest-based products [14,15]. The FSC standards include H&S requirements viewed as important indicators of sustainable forest management. In the initial version of the FSC standard (Soil Association Woodmark Generic Standard and Checklist, adapted for Romania, v3.0, 2010) [16], Principle 4 (Community relations and worker's rights) described important H&S requirements for certified entities. In the latest version, these requirements gained even more importance, and they are included in Principle 2 (Workers' Rights and Employment Conditions), which fully focuses on requirements related to health and safety [17]. According to the current FSC policy, compliance with all the relevant conventions for forestry issued by the International Labour Organization (ILO) is required for receiving a FSC forest management certification. The FSC's policy for voluntary certification expects certified entities to comply with all the conventions listed in Annex 2 of the FSC-POL-30-401 FSC standard, and with the ILO conventions [18], irrespective of the country of operation. Two ILO codes of practice, which are not legally binding, namely, the 1998 "Safety and health in forestry work" and the 2006 "Guidelines for labour inspection in forestry", are currently used as the minimum requirements by the FSC standard [1].

The FSC certification process is based on standards compliance verified by third-party auditing teams assigned to identify minor or/and major non-conformities (NC) [19]. Minor NCs are those assumed to have temporally and spatially limited impacts, and do not result in a fundamental failure to achieve a relevant FSC criteria objective [20]. Major NCs refer to situations that result, or are likely to result, in fundamental failures to achieve the objectives of a relevant FSC criteria. Minor NCs should be fully corrected within one year, while major NCs should be fully addressed within three months [19]. The FSC audit teams need to evaluate a sufficient variety and number of records to allow them to make direct, independent, and factual observations that clearly reveal the conformity with indicators of the applicable standard [19,20]. Moreover, field visits and confidential stakeholder consultations are conducted to complement the above-mentioned information. In case of document evaluation, the FSC report on generic criteria, based on the principles of ILO conventions, mentions the documents that must be assessed [21]. Typically, payment records, archives of labour inspections, and/or risk assessments are the documents checked by auditors during the certification audit process [21]. Once issued, FSC forest management certification is valid for five years, with annual audits aimed at continuous verification of the compliance with FSC requirements. Previous studies on the FSC show that NCs under the FSC Principle related to H&S are very common, both in developed and less developed countries [22], while 75% of the FSC criteria under this principle are prescribed by the national laws [23].

Since 2002, the FSC is the only certification scheme used for forest management in Romania. To this day, this scheme and its concepts are well-known in the Romanian forestry industry, with more than 2.6 million ha of forest, and more than 800 companies being FSC certified [24]. Since 2019, Romanian audits have used the FSC Principles and Criteria for Forest Stewardship V5-2, which were released after the completion of the FSC International Generic Indicators and the transfer process of the FSC Romanian national standards.

Following the dramatic institutional and economic changes triggered by the transition to a market-oriented economy [25], the Romanian forest industry was gradually privatised, and is presently struggling to increase its economic efficiency, and environmental and social effectiveness [25]. Forest operations in the country rely on partly mechanised harvesting systems, such as those using motorised–manual felling and skidding [26,27], which also often integrate obsolete skidding technology. This situation was mainly caused by the predominance of small to medium-sized companies holding limited investment possibilities to purchase new technology. Tree felling and processing, as well as part of the operations performed at the landing of the tree, are based on the use of chainsaws [26]. This practice often causes severe accidents at work, many of them resulting in permanent invalidity, or death [28].

Some eastern European countries recorded a dramatic decline in the annual figures of forestry-related, non-fatal accidents between 2000–2005. Similar data for Romania show a national drop of over 50% in accident rates for the indicated period [9]. Still, when compared with other countries, Romania ranks in the top five European countries for fatal accidents in agriculture, forestry, and fishing (Table A1). In addition, at the national level, forestry holds the highest rate of accidents (Table A2), and it ranks in the top three industrial sectors when fatal accidents are considered, which is consistent with the findings of Wiatrowski and Janocha [29] comparing the United States and the European Union. Consequently, the Romanian specific legislation attempted to mitigate the risks related to work accidents through a complex body of laws aimed at regulating labour, with a special focus on forestry.

Romania was a founder, and is an active member, of the ILO. After the fall of the communist regime in 1989, the country's regulatory framework regarding working conditions and H&S passed reforms aimed at adapting and consolidating labour institutions and legislation with the new dynamics of the market-oriented economy [30]. The current Romanian labour H&S legislation, mostly based on the 2006 Occupational Health and Safety act, is rather specific to EU members, is in close compliance with all the ILO conventions and requirements, and adapted to the national conditions. Additionally, forest managers are committed to demonstrating their sustainable management by providing compliant working conditions in line with the FSC voluntary certification. The success of these attempts to improve H&S settings in the Romanian forestry industry has not yet been evaluated, and consequently, there is no clear analysis pointing to the most effective practices.

The purpose of this study was to evaluate if, and how, forest management certification contributed to identifying, describing, and reducing H&S issues in forest operations implemented by FSC-certified Romanian forest management entities. These companies adopted certification as a CSR practice.

2. Materials and Methods

The research was based on secondary information collection, processing, and discussing. Secondary information was procured by extracting the NCs from official FSC audit reports prepared by third-party auditing bodies between 2013 and 2018. The data collection was followed by analysis of the extracted NCs, based on certain criteria [22,31]. The study included analysis of all the official audit reports issued for certified Romanian forest management operations publicly available on the www.info.fsc.org platform. For the analysed period, forest management certification in Romania was only based on the FSC general forest management standard, adapted by the Soil Association [16] and Nepcon [32] certification bodies. The first round of research pulled out all the NCs identified by the FSC auditing bodies. All NCs related to Principle 4 (Community relations and worker's rights) were then selected, and their description, type, grade, and information sources (i.e., document verification, field checks, or stakeholder's interviews) were matched against the FSC standard, and later recorded in a Microsoft Office Excel database.

The second step further extracted, from Principle 4, the NCs only referring to H&S issues in the forest management FSC certification process. These NCs were then grouped by

FSC criteria, grade, and information sources. In order to assess the main H&S issues identified for forest management entities, and their causes, NCs descriptions were qualitatively analysed, and grouped according to the accident risk factors categories recommended in the literature by Melemez [33]: personal, equipment-related, job-related, environmental, and organisational. Table 1 presents the simplified pile of risk factors identified by Melemez [33], without presenting their hierarchy module.

Table 1. Risk factors used for qualitative analysis of H&S related NCs.

| Category of Risk Factors [33] | Factor |
|-------------------------------|---|
| Personal factors | Carelessness, inexperience, insufficient knowledge on the job, unsuitability to the work, fatigue, tendency to act quickly, disorderly behaviour, positioning in dangerous zones, lack of motivation |
| Equipment-related factors | Use of inappropriate tool/machine, use of non-standard tool/machine, use of old machine, insufficient maintenance and repair, absence of machinery protectors, high-level noise/vibration, use of non-ergonomic machine, not using personal protective equipment, not using communication tools |
| Job-related factors | Heavy physical workload, job structure spread over a large terrain, necessity of communication among workers, mobile objects (trees, logs), long and heavy objects, various phases of work in the same field, limited visibility, obligation to complete work in a short time, limiting the choice of workers |
| Environmental factors | High slope of terrain, rough terrain, slippery ground, stony/rocky terrain, density of trees, density of weeds, noisy environment, insufficient weather conditions, extreme heat/cold |
| Organisational factors | Incorrect working system, insufficient number of workers, unsuitable selection of workers, insufficient training of workers, inadequate control, lack of warning signs, overtime hours, insufficient rest breaks, difficulties in supplying protective equipment |

The distribution of NCs by risk factor categories and accident factors was used to identify the most important H&S issues describing forest operations in Romania.

3. Results

3.1. FSC Non-Conformities and Risk Factors

From a total of 326 NCs identified by the independent certification bodies in their reports, 72 are H&S related (22%), and are ranked second to the environmental-related NCs (Principle 6). After grouping the H&S related NCs by risk factors (Table 1), we find that H&S related NCs are related to seven risk factors. These risk factors are then grouped into three risk factors categories: equipment-related, personal, and organisational factors.

In terms of risk factors, more than half (59%) of the NCs are related to organisational, 26.4% correspond to equipment, and 13.9% are attributed to personal risk factors (Figure 1). There are no NCs for job-related or environmental risk factors.

Over half (53%) of the major NCs are related to equipment, 30% to organisational, and 17% to the personal category (Figure 2).

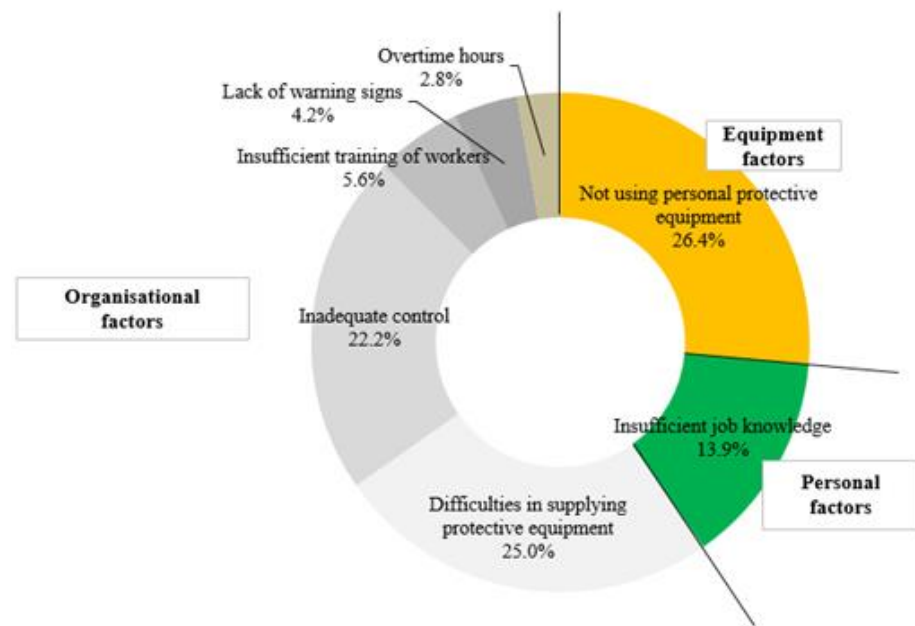


Figure 1. Risk factors influencing the H&S related NCs (% of all H&S related NCs) from FSC audit reports (2013–2018) in Romania.

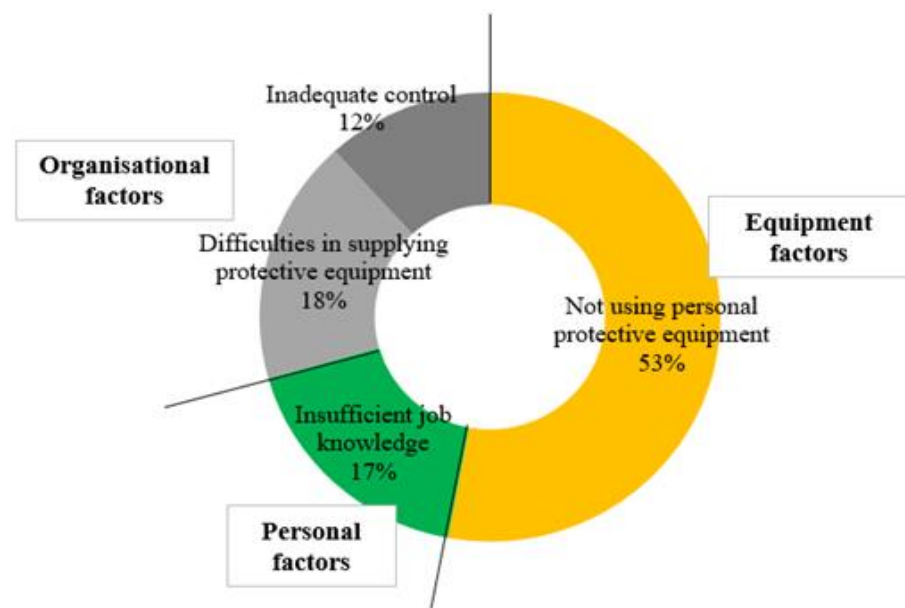


Figure 2. Categories of risk factors influencing the H&S related major NCs (% of all H&S related major NCs).

3.1.1. Equipment Factors

Under the equipment risk factors category, we find that all NCs mention lack of use of the entire personal protective equipment (Figures 1 and 2). Even if it is stipulated by national laws that protective equipment should be used properly, the auditors report that workers do not always use it once it is provided by their organization. Analysing the NCs criteria distribution (Table 2), it is shown that most of the NCs related to the equipment are grouped by the auditors under criteria 4.2.5 and 4.2.4 (84.2%).

Table 2. Analysis of the NCs related to equipment risk-factor category and their relation to the FSC requirements.

| FSC Criteria | Description | Equipment Factors | |
|--------------|---|-------------------|------|
| | | No. of NC | % |
| 4.2.2 | Managers assess the risks to workers for particular tasks and equipment, and take measures to reduce or eliminate such risks. | 2 | 10.5 |
| 4.2.3 | Safety training is carried out, relevant to the tasks of workers and the equipment is used. | 1 | 5.3 |
| 4.2.4 | Workers are provided with safety equipment, relevant to the tasks of workers and the equipment is used. | 8 | 42.1 |
| 4.2.5 | Managers take measures to ensure that workers use any safety equipment that is provided. | 8 | 42.1 |
| | TOTAL | 19 | 100 |

Related to criterion 4.2.4 (Table 2), auditors report that, in many cases, the workers are provided with safety equipment relevant to their tasks by the employing contractor but the equipment is not used. For example, the following NCs are raised by auditors through field observations:

Example 1: During the filed visit in active logging site, logging team members were not wearing high visibility vests while performing logging operations. One logger helper was seen wearing rubber boots instead of steel toe boots while working in the logging site.

Example 2: Contractors were observed not wearing entire protective equipment during audit.

In both cases, the auditors indicated that the non-conformity refers to workers' behaviour, as the organizations' obligation to offer the protective equipment had been fulfilled.

In both cases, the auditors indicate that the non-conformity refers to workers' behaviour, as the organizations' obligation to offer the protective equipment was fulfilled.

3.1.2. Organisational Factors

Within this category of risk factors, difficulties in supplying the protective equipment (25%), and inadequate control of equipment use (22.2%) are the most frequently identified issues (Figure 1).

The provision and control of the use of safety equipment are legal requirements under the Romanian regulatory framework. With regards to the FSC requirements and criteria, 23.3% of the analysed NCs are related to measures taken by organisations to ensure that workers use safety equipment (criterion 4.2.5), and 18.6% to the H&S measures complying with the national minimum requirements (criterion 4.2.8.) (Table 3). Related to measures taken for the workers to use the safety equipment provided by their employers (criterion 4.2.5), the FSC standards are also applicable to wood harvesting contractors [19], even if they are not FSC certified. Other criteria with frequent NCs pertain to criterion 4.2.4, regarding the provision of safety equipment relevant for workers' tasks and the effective use of equipment (14%), and criterion 4.2.2., dealing with risk assessment (and reducing or eliminating risks) for particular tasks and equipment (14%) (Table 3).

Table 3. Analysis of the organisational risk factors category related NCs and their relation to the FSC requirements.

| FSC Criteria | Description | Organisational Factors | |
|--------------|---|------------------------|------|
| | | No. of NC | % |
| 4.2.2 | Managers assess the risks to workers for particular tasks and equipment, and take measures to reduce or eliminate such risks. | 6 | 14.0 |
| 4.2.3 | Safety training is carried out, relevant to the tasks of workers and the equipment used. | 1 | 2.3 |
| 4.2.4 | Workers are provided with safety equipment, relevant to the tasks of workers and the equipment is used. | 6 | 14.0 |
| 4.2.5 | Managers take measures to ensure that workers use any safety equipment that is provided. | 10 | 23.3 |
| 4.2.6 | Managers implement an accident reporting system that includes all work-related accidents and deaths of employees, their causes, and corrective action taken to prevent similar accidents in future. | 2 | 4.7 |
| 4.2.7 | There are assured compensation benefits in case of accidents. | 1 | 2.3 |
| 4.2.8 | Health and safety measures comply with national minimum requirements. | 8 | 18.6 |
| 4.2.9 | Warning displays are positioned on the access ways to wood harvesting areas | 5 | 11.6 |
| 4.2.10 | The organisation keeps working accidents records, including the measures for reducing the risks for working accidents. | 2 | 4.7 |
| 4.2.11 | The organisation is implementing a policy and a management system for work health and safety. | 1 | 2.3 |
| 4.2.13 | Where workers stay in camps, conditions for accommodation and nutrition comply at least with ILO Code of Practice on Safety and Health in Forestry. | 1 | 2.3 |
| 4.2.2 | Managers assess the risks to workers for particular tasks and equipment, and take measures to reduce or eliminate such risks. | 6 | 14.0 |
| 4.2.3 | Safety training is carried out, relevant to the tasks of workers and the equipment is used. | 1 | 2.3 |
| TOTAL | | 43 | 100 |

For example, the following NCs are raised by auditors related to inadequate control, and difficulties in providing the equipment (criteria 4.2.5, 4.2.4, or 4.2.2 as reference):

Example 1: Managers do not take sufficient measures to ensure that the provided protective equipment is used.

Example 2: Internal mechanisms for ensuring that contractors wear equipment do not appear to be working.

Example 3: The logger did not have safety trousers to protect from the chainsaw cuts, he was not wearing chainsaw gloves and the logger helpers did not have good fitting helmets (helmets without the adjustable inner are unstable and can fall easily during movement and bending).

Example 4: The company shall ensure that the risk to workers of particular tasks and equipment were assessed, and measures to reduce or eliminate such risks taken.

The share of NCs falling under the criterion 4.2.8. (health and safety measures comply with national minimum requirements) is 18.6% (Table 3). The identified NCs are related to the compliance of H&S issues against the national legislation. Here are some examples of NCs grouped under organizational factors as per criterion 4.2.8.

Example 1: Health and safety measures are not complying with national minimum legislation requirements.

Example 2: During site visits it was seen that accommodations of the contractor's workers in camps were not fully in compliance with standard requirements (ILO code of Practice on Safety 1998) in terms of presence of facilities. Managers didn't check whether the camp conditions comply with the ILO provisions.

3.1.3. Personal Risk Factors

The NCs found in the Romanian forest management certification process under the personal risk factors are related only to an insufficient knowledge on the job (Figure 1), encompassing 13.9% of NCs. All major NCs (17%) correspond to personal risk factors.

With regards to the FSC requirements and criteria, 60% of the analysed NCs relate to H&S measures complying with the national minimum requirements (criterion 4.2.8.), and 20% relate to managers' knowledge of relevant health and safety guidelines and regulations (criteria 4.2.1) (Table 4).

Table 4. Analysis of the personal risk factors category related NCs and their relation to the FSC requirements.

| FSC Criteria | Description | Organisational Factors | |
|--------------|---|------------------------|-------|
| | | No. of NC | % |
| 4.2.1 | Managers are familiar with relevant health and safety guidelines and regulations. | 2 | 20 |
| 4.2.2 | Managers assess the risks to workers for particular tasks and equipment, and take measures to reduce or eliminate such risks. | 1 | 10 |
| 4.2.3 | Safety training is carried out, relevant to the tasks of workers and the equipment is used. | 1 | 10 |
| 4.2.8 | Health and safety measures comply with national minimum requirements. | 6 | 60 |
| TOTAL | | 10 | 100.0 |

For example, one NC linked to personal risk factor refers to an ongoing harvesting operation in a Norway spruce stand (criteria 4.2.8): 70% of the stumps show evidence of unsafe felling techniques, and forest workers are not aware of, or interested in, these unsafe felling techniques.

3.2. Sources of NCs Identification

The sources of information for NC identification by auditors are as follows: field observations, document review, and stakeholders interviews. In the investigated sample, 78% of all H&S related NCs are identified through field observations, and 12% are detected by checking documents and procedures (Figure 3). Ten percent of the analysed NCs are identified using interviews and determining workers' perceptions. Major NCs are identified only through field observation.

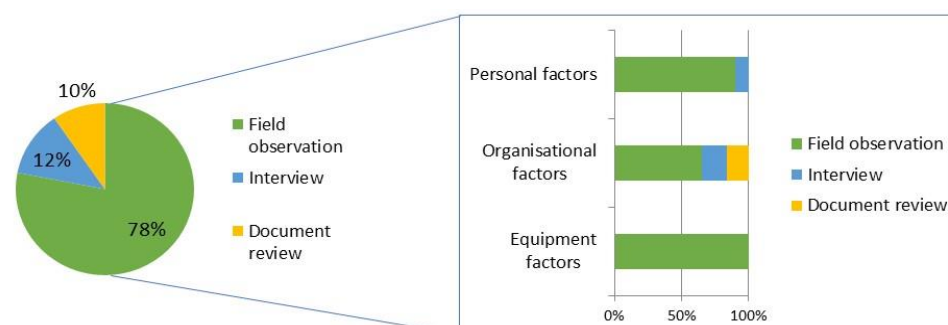


Figure 3. Sources for NCs identification.

4. Discussion

The results of this study indicate shortcomings of a managerial nature regarding the H&S equipment provision and use, particularly in the case of wood harvesting companies. Therefore, our results are consistent with those reported by many studies on the topic, repeatedly indicating that the most relevant problems of the forestry sector are typically

those related to logging operations [34]. Although many European countries share a similar situation, related to the seemingly obsolete and inadequate equipment and technology used in harvesting practices [26], the findings reported herein could also relate to these failures. Therefore, the results of this study should be analysed in the specific context of the Romanian wood harvesting sector, mainly because most of the harvesting companies are small and medium enterprises, and have low production capacities and, in most cases, obsolete equipment. Given their economic context, these companies cannot afford high investment in state-of-the-art machines, which leads them to purchase, for example, cheaper, Romanian-made skidders [27]. In addition, tree-felling and processing operations are performed, in most cases, using chainsaws. Both chainsaws and cable skidders require a high degree awareness from their operators, and the adoption of safety precautions during their operation [35].

The current state of mechanisation in forest operations is also the effect of the highly regulated silvicultural restrictions by the national government [36], low extraction intensities, and a highly competitive business environment [37,38]. For many companies, this context limits the sources for investing in machines that require substantial amounts of wood, and the possibilities to rely on contractual predictability to cover the investments. In addition, there is a low institutional acceptance of the use of highly mechanised equipment, such as timber harvesters, which in many cases are only used on rather small sites where clearfelling operations are performed. All together, these common factors discourage, in most cases, the use of highly mechanised equipment.

Some new equipment was introduced but seldom used in operations [39,40], and labour intensive, less productive and safety challenging options (such as the motor-manual tree felling and processing, animal traction, and tractor skidding) still dominate the scene of Romanian forest operations [26]. Moreover, safety regulations and procedures are often disregarded by the workers, particularly by those using chainsaws in tree felling and processing operations [41,42]. The reasons behind these behaviours are unknown, but may include a low knowledge on how to do their jobs appropriately/correctly, distrust, and a high perceived difficulty of the specific task. As reported elsewhere, wearing personal protective equipment seems to be a problem of the Romanian timber-harvesting sector [40]. Some related research points out that the size of a company is indirectly proportional to the accident rates, even if the general perception on the importance of using protective equipment is positive [43,44], which may give some indications for the possible causes for the high rate of work-related accidents (i.e., the ratio between the number of injured personnel and the total number of employees.)

One important requirement of the FSC standards that determined numerous NCs is the risk management evaluation for particular tasks (criterion 4.2.2.). Also, many of the NCs related to H&S are found to describe inadequate felling techniques, results that are consistent with the findings of other studies, such as those of Bordas et al. [45]. For instance, Bordas et al. [45] reveal that 30% of the forest workers do not use adequate felling procedures. Other studies on the topic focus on the importance of training on these issues [46]. The descriptive statistics of the study, as well as the fact that many of the findings confirm other studies in the area, prove that forest management certification is a performant instrument in identifying, describing, and reducing H&S issues in forest operations performed by FSC-certified companies. However, the study methodology has certain limitations, the most important of which is that the research presented only analyses the Romanian case. The analysis is based only on the information recorded in public official FSC assessment reports. It is obvious that every assessment has numerous particularities that depend on the decision power of the auditing team over the audit itself. An explanation for the absence of NCs related to job and environmental risk factors may be that the evaluation of auditors is based on punctual observations in the field and, in most of cases, it is focused only on protective equipment, knowledge, and experience of the workers, or on the tree felling technique. The FSC standard focused more on aspects such as protective equipment, and less on the environmental working conditions [21], which

already included a sample bias on the information to be gathered by auditors and, thus, was included in audit reports.

5. Conclusions

By analysing the results of FSC certification-related audit reports, this research shows that the most important risk factors for H&S in forest operations in Romania are the organisational and equipment factors.

Forest certification, as a voluntary tool for implementing and demonstrating sustainable forest management, had a significant influence on increasing the concern for H&S matters. It brought some new voluntary requirements, and tried to improve workers' conditions, by creating an additional greater concern of forest management structures (e.g., law enforcement, and measures for better use of adequate safety equipment and procedures). The analysis of NCs identified during forest management certification audits focused on the risk factors related to H&S. The correlation of these results with other findings in the forest operations and H&S literature helps us draw the conclusion that forest management certification is a suitable tool to identify and describe the H&S aspects of forest management related activities, especially for forest operations. The identified NCs in the FSC certification process indicate the probable causes of the high rate of work accidents in the Romanian forestry industry: obsolete and less mechanised technology, low concern for providing and using specific safety equipment, low wages in forest operations, lack of proper training, etc. All these aspects point to the need for improving safe organisational culture. Consequently, despite recent developments in safety techniques, and the adoption of more stringent legislative constraints on H&S, higher consideration should still be paid to the human factor, and training regarding safe culture. The research proves that FSC certification, especially for forestry operation, is an enabling factor for identifying, describing, and reducing H&S issues in the Romanian forestry industry.

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Appendix A

Table A1. Fatal accidents (number of accidents per 100,000 workers) in agriculture, forestry, and fishing in Europe.

| Country/Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------|------|------|------|------|------|------|------|------|------|------|
| European Union | - | 549 | 509 | 485 | 442 | 507 | 477 | 482 | 408 | - |
| Germany | 83 | 94 | 91 | 95 | 89 | 96 | 73 | 76 | 67 | 76 |
| Italy | 108 | 103 | 107 | 97 | 94 | 94 | 95 | 76 | 62 | 73 |
| Austria | 67 | 86 | 53 | 50 | 58 | 69 | 63 | 54 | 27 | 58 |
| Spain | 37 | 36 | 42 | 37 | 38 | 55 | 41 | 45 | 40 | 46 |
| United Kingdom | 39 | 34 | 43 | 42 | 38 | 35 | 36 | 29 | 45 | 44 |
| Romania | 31 | 46 | 35 | 38 | 25 | 32 | 37 | 45 | 43 | 32 |

Data from: [47].

Table A2. Accidents in Romania related to different sectors.

| Accidents | SECTOR | Unit | Year | | | | | | | | | | |
|---------------|------------------------|-----------------------------------|------|------|------|------|------|------|------|------|------|------|------|
| | | | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| Fatal | Manufacturing industry | No. of accidents | 78 | 80 | 72 | 76 | 63 | 48 | 41 | 35 | 34 | 33 | 38 |
| | Construction | | 111 | 102 | 84 | 57 | 61 | 46 | 56 | 39 | 46 | 46 | 26 |
| | Forestry | | 45 | 42 | 47 | 34 | 35 | 25 | 30 | 25 | 35 | 24 | 25 |
| | Mining industry | | 22 | 13 | 6 | 12 | 6 | 4 | 5 | 8 | 1 | 5 | 3 |
| Accident rate | Forestry | No. of accidents per 1000 workers | 1.6 | 1.17 | 1.63 | 1.58 | 3.17 | 2.26 | 2.52 | 2.73 | 2.93 | 2.71 | 2.64 |
| | Manufacturing industry | | 0.96 | 0.95 | 1.1 | 1.06 | 1.37 | 1.16 | 1.04 | 1.2 | 1.26 | 1.22 | 1.31 |
| | Construction | | 2.01 | 1.33 | 1.82 | 1.48 | 1.25 | 1.18 | 1.21 | 1.3 | 1.3 | 1.3 | 1.1 |
| | Mining industry | | 2.99 | 3.62 | 3.57 | 2.98 | 3.28 | 2.59 | 1.61 | 1.53 | 0.93 | 1.35 | 0.81 |

Data from: [48].

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