

## **Survey on Mechanization and Safety Evolution in Forest Works in Italy**

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### **Abstract**

The work objectives were study the evolution from the 50s to 2009 of the forestry utilization companies in Italy, with particular attention to the level of mechanization and work safety in forest yards. The survey was conducted in the whole country, and implementing these data with research already carried out in the field whose results have been published in past. The study was based on responses given by forestry utilization companies as a result of questionnaires sending and taking into consideration a time period of about 60 years. Companies that answered were 292 on 3164 existing in Italy. In particular, this study has allowed to obtain a homogeneous vision of the Italian forestry utilization companies. The results of the survey show as the seasonal forestry work and then the low percentage of workers who can work continuously throughout the year represent a weakness of the sector thus requiring a scrupulous forest planning. The limited surfaces harvested annually highlights the difficulty for the forest firms to develop systems of work with high mechanization. Finally, most important, work safety, highlighted by the survey is a general lack of interest until at least 1990 for this important issue, from that time it will be clearly noted a growing commitment by firms in adapting to the safety laws, even though we are still far from complete transposition as required. However, our forestry work system is very weak as regards the level of training.

**Keywords:** forestry utilization, forest yards, work safety

### **Introduction**

Working in forests is primarily characterized and influenced by the environment in which the work takes place. The tasks undertaken are extremely varied and require the use of machinery and equipment which, if used incorrectly, can cause serious injury to operators. Although there are a number of existing regulations regarding safety in general and the health and safety of operators in the workplace, in the forestry works, there is greater resistance as regards accepting the applicable legislative provisions, regarding both the owners of businesses and the machinery. The law n.° 626/94 represented an evolution at national level in the field of occupational safety, improving quality of life as well as encouraging a reduction in the social cost that accidents and occupational diseases represent, now another decrees (81/2008) have amended this “old” law. A new definition of prevention was given therein: “the whole body of provisions or measures necessary, also in terms of the special nature of the work, experience and technique, in order to prevent or reduce occupational risks as regards public health and the integrity of the external environment...”. The aim of this study is to give an overview of the logging company throughout Italy, paying particular attention to the development of mechanization and especially to the field of risk prevention and safety work.

### **Material and methods**

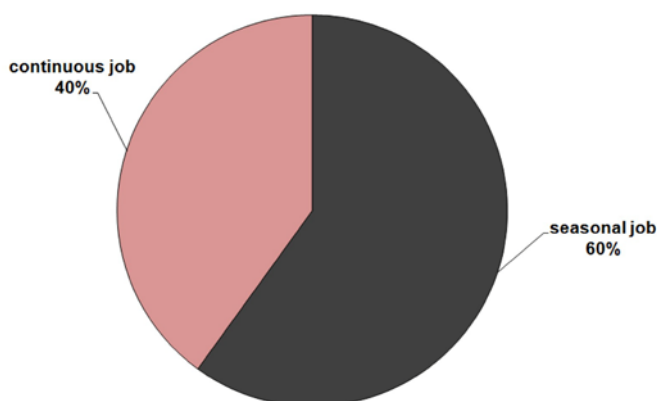
The investigation was conducted covering the whole country, and implementing the data with research already carried out in the forestry sector whose results have been published

(Baldini et al., 2002, Baldini et al., 2006; Picchio et al., 2008) The study was based on responses from logging companies as a result of sending out specially created questionnaires which examined a time period of about 50 years. 292 of the 3164 logging companies surveyed completed the questionnaire (ISTAT, 2008 a; ISTAT 2008 b), approximately 9.2%. In particular, this insight enabled us to provide a more uniform overview of Italy from a geographical point of view, with an equal distribution of companies in the south, centre and north.

## Data, results and discussion

### Temporal distribution of forestry work

60% of the sample of companies studied (Fig.1) have predominantly seasonal work, with an average of 186 working days (Fig.2) per year. Only 40% have the opportunity to work continuously throughout the year. This is another clear factor of weakness in the industry which requires serious forestry planning.



**Figure 1. Job typology of the forestry companies (year 2009, 100% of the sample have given an answer)**

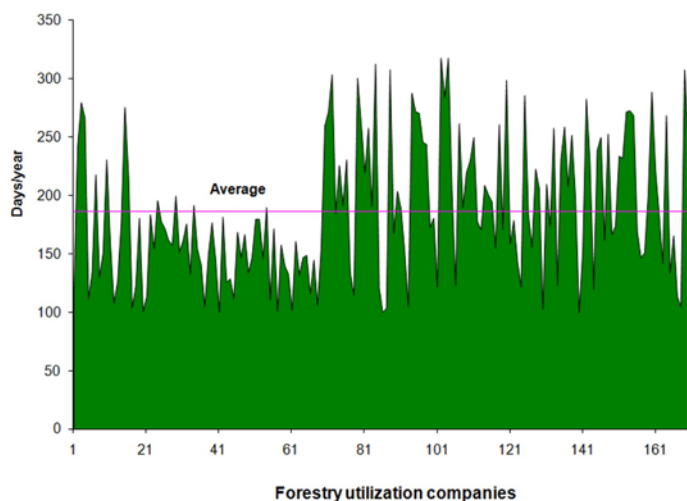
### Wood harvested annually

According to the investigation conducted, the average felling area for coppices is approximately 20.5 ha (Fig.3), while for the high forests, it is only possible to provide the average removal value of approximately 632 m<sup>3</sup>/year (Fig.4). These values indicate that it is impossible for most logging companies to develop work systems with a high level of mechanization, as the volumes and working areas would not ensure adequate amortization of the expenses incurred.

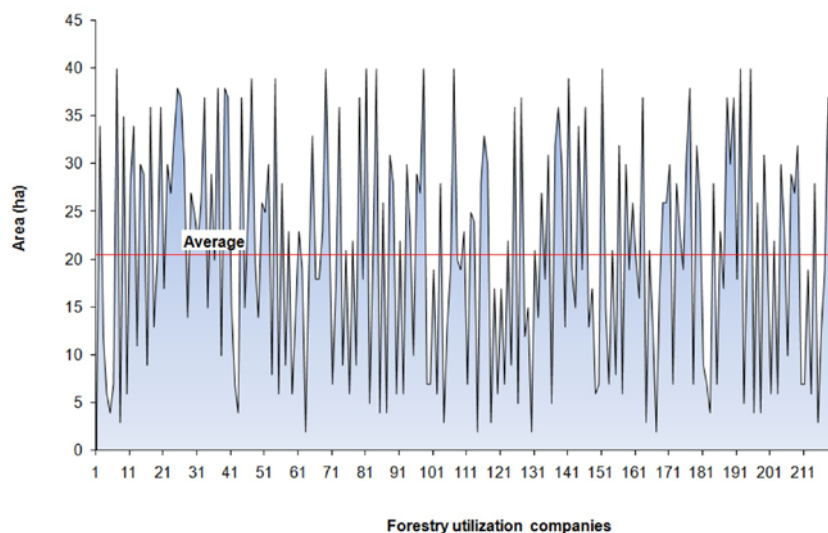
### Logging systems

The graph on the system for wood harvesting in the forest (Fig.5), shows how the tree length system accounts for 44% of the total, thanks to significant development over the last decade. The short wood system, with 38%, still holds a significant share of the sector. Furthermore, as much as 18% said they work equally with one system or the other depending on operational or market needs. This is a good adaptation index of company capacities.

Nevertheless, with the current need to maximize stumpage, increase working productivity and prevent fire hazards, the tree length system appears to be a good opportunity, which we will gradually have to make more use of even in coppices. The waste material, consisting of branchwood and top end logs, will not be easy to place, but the current trend, the considerable use of biomass for energy purposes, seem able to find a useful place in the market for even this type of product.



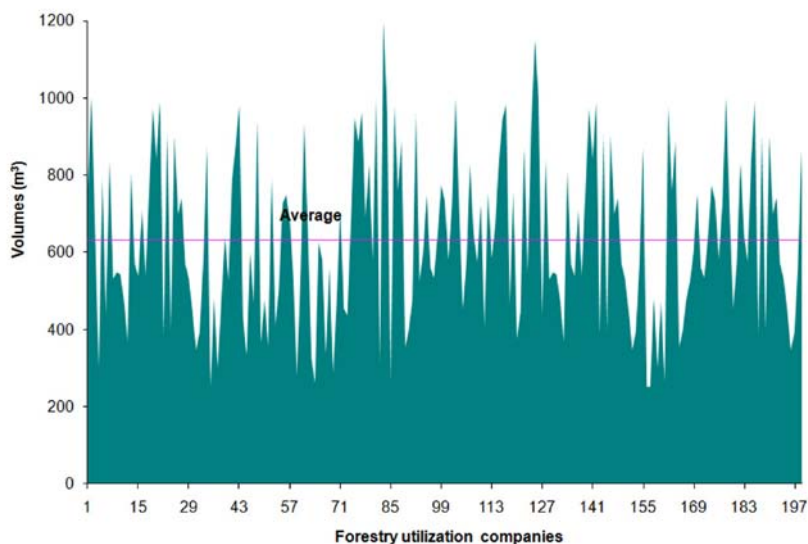
**Figure 2. Annual average number of working days for every company (year 2009, 97% of the sample have given an answer)**



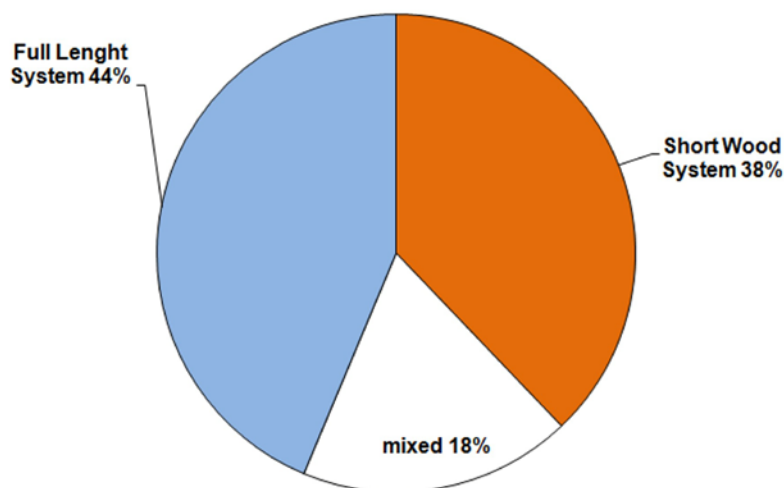
**Figure 3. Average area of coppice wood harvested annually for every company (year 2009, 94,5% of the sample have given an answer)**

Entering the mechanization sector, starting from the felling operation, in relation to the seven historical periods considered and as our investigation sample shows on the graph (Fig.6), we see that until 1970, manual systems, mainly manual saws and axes, were undoubtedly the most commonly used. The advent of the chainsaw in our country and, as a result, of semi-mechanical felling, began in 1960, leading to the demise of manual felling between 1980 and

1990. In 2000, the first harvesters began to be used and purchased and, confirming their targeted validity of use, within a decade, their presence doubled (from 4% in 2000 to 7% in 2009), still, though, leaving a 93% share for the chainsaw. A clear symptom of how the Italian forestry sector is still a long way off other European standards, due to orographic, technical and economic restraints.



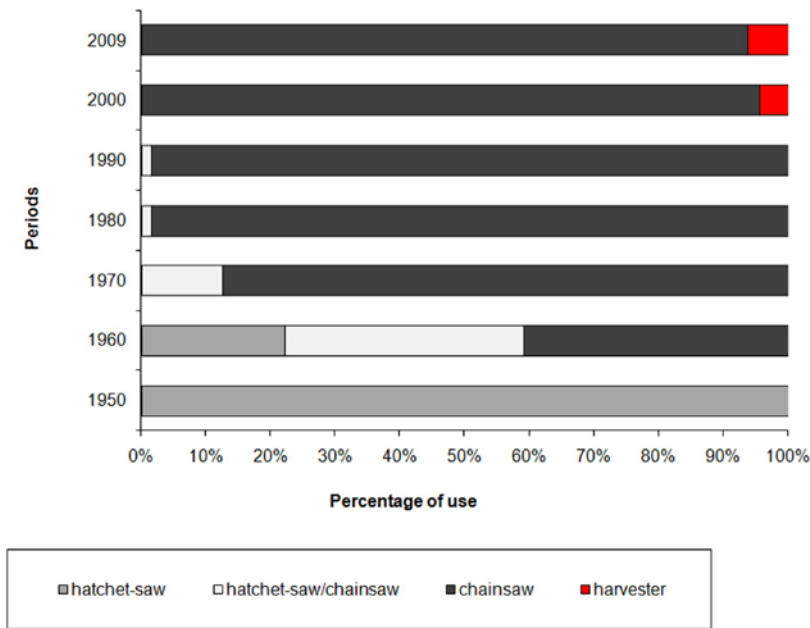
**Figure 4. Average volume annually harvested for every company (year 2009, 63% of the sample have given an answer)**



**Figure 5. Forestry utilization systems. The full length system includes the full tree system and the full length system (year 2009, 91% of the sample have given an answer)**  
**Forestry mechanization evolution**

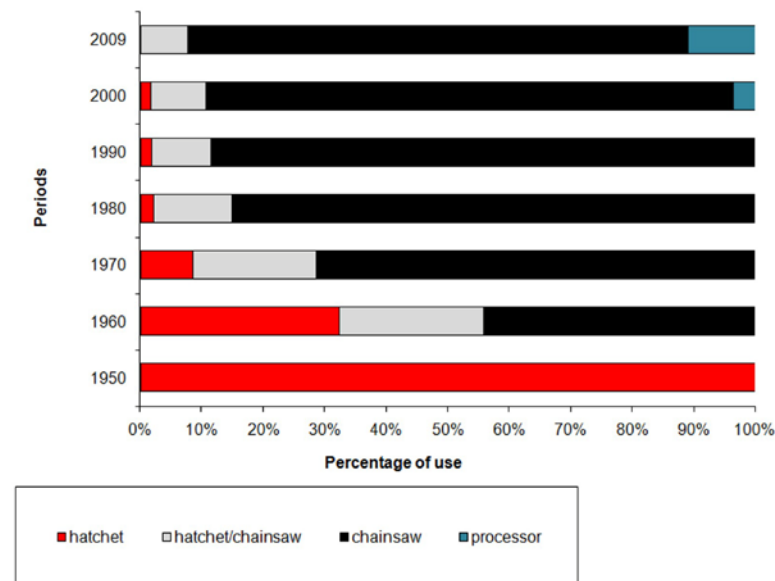
In the case of the processing operation (Fig.7), greater persistence is shown compared with felling in the use of manual systems. This should not be interpreted as a lack of evolution in this sector, but as proof of the actual usefulness of these systems. Furthermore, the use of advanced mechanization in this operation, especially in recent years, seems to be more

marked compared with felling, above all on construction sites where processing at the landing is envisaged.



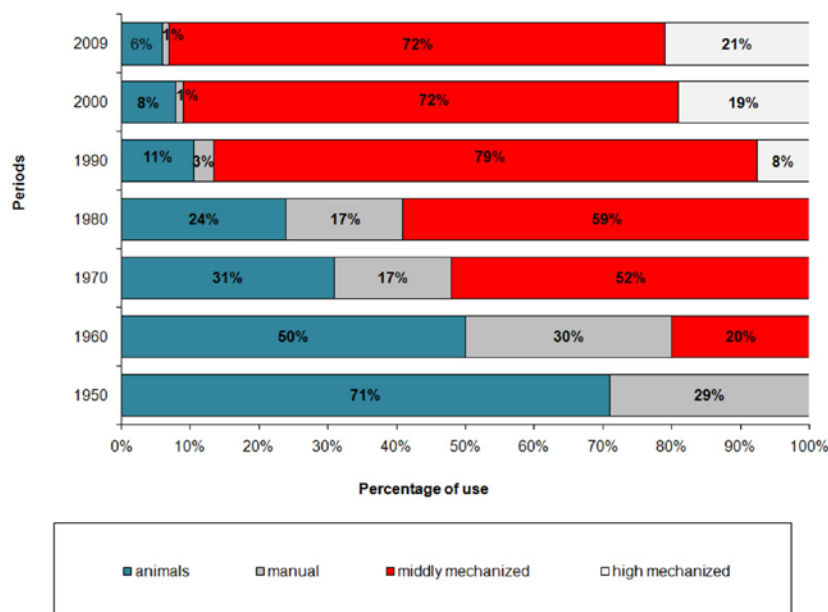
**Figure 6. Felling methodologies used from 1950 to 2009. (97% of the sample have given an answer)**

In the 1950s, the extraction operation (Fig.8) was done primarily using the strength of men and animals. In particular, sliding was carried out on "routes" which were both equipped (chutes) and non-equipped, while as regards animals, mules were mainly used in coppices, while horses and oxen were more commonly used in high forests.



**Figure 7. Processing methodologies used from 1950 to 2009. (97% of the sample have given an answer)**

From 1960 onwards, the situation changed gradually. Extraction systems using animals or manual labour were increasingly integrated until they were replaced with mechanical equipment. The first mechanical use was mainly tractors for skidding and sporadic cases of recovery winch usage.



**Figure 8. Bunching and extraction methodologies used from 1950 to 2009. (94% of the sample have given an answer)**

From 1970 to 1990, the trend towards the replacement of human and animal strength with that of mechanical equipment became increasingly pronounced. Sliding was carried out less and less, unless on specially equipped routes using PVC or sheet metal (log-line) chutes. As regards animals, the use of oxen and horses was decreasing, while mules were still used in the most difficult and inaccessible areas. Tractors were most commonly used for skidding, although the first forestry winches were starting to be used.

From 1990 to the present day, the use of mechanical equipment has become paramount. Sliding now takes place using PVC or sheet chutes and the animals used are mules. Two types of mechanization are becoming more popular. One is less specialized, of rural origin, and is known as medium while the other, with a marked forestry specialization, is called advanced. Agricultural tractors, forestry-version agricultural tractors and forestry tractors are among the mechanical equipment used, with numerous accessories that enhance the usefulness of these machines, among them forestry winches, reverse hydraulic forestry grapples and cages located on the front and rear hydraulic lift on tractors.

Transport (Fig.9) during the 1950s and 1960s was mainly based on cable systems and to lesser extent on overland systems. The cable systems were made up of gravity cables and "Valtellina" model cable ways, while the overland systems were based on the use of animals, especially oxen and horses, tractors with trailers and, to a much lesser extent, lorries.

From 1970 onwards, up to the present day, cable systems have increasingly been overtaken by overland systems, and the use of animals is disappearing.

Over time, cable systems have undergone numerous modifications and changes. Gravity cables and cable ways have been entirely replaced by so-called yarders, supported by various

types of stations, pylons, engines and log carriages. Overland transport is only carried out by tractors with trailers or, to a very small extent, by lorries or forwarders.

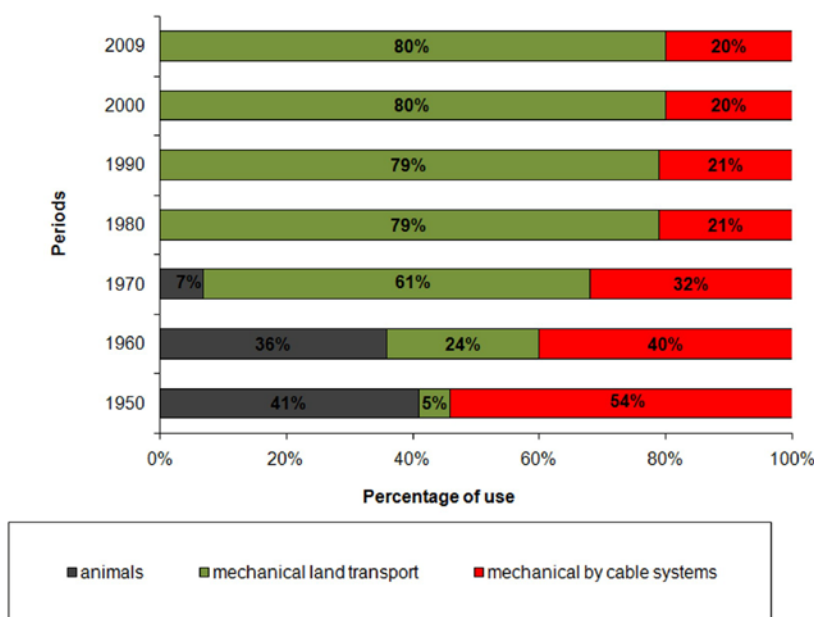


Figure 9. Extraction and transport methodologies used from 1950 to 2009. (95% of the sample have given an answer)

### Work safety

Work safety (Fig.10) and the active and passive protection of operators is a fundamental issue.

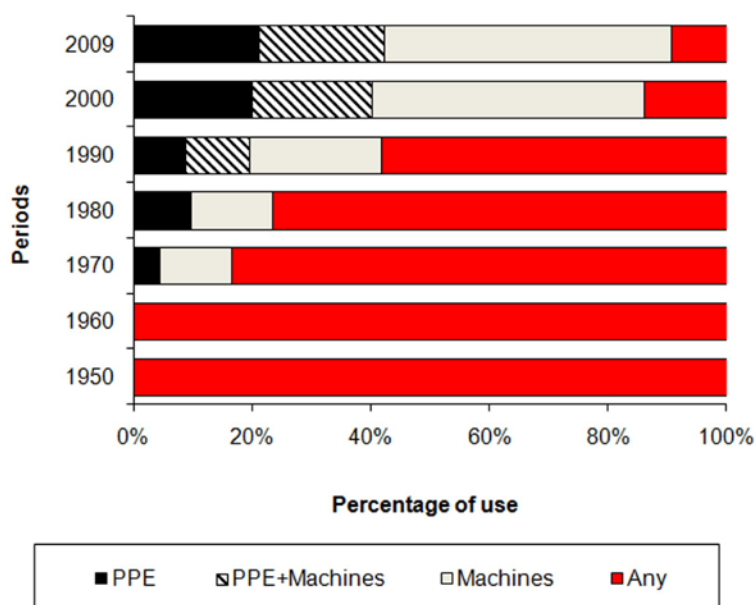


Figure 10. Use of the individual devices of protection and the safety machines devices in the forest yards from 1950 to 2009. (82% of the sample have given an answer)

Current industry regulations stipulate that when the risks can not be avoided or sufficiently reduced by technical prevention measures, collective protection, or by measures, methods or procedures for reorganizing work, a series of personal protective equipment must be used, where personal protective equipment refers to any equipment designed to be worn by workers in order to protect them from one or more risks which could threaten health or safety while at work. Nevertheless, upon examination of the results obtained from the investigation sample, it can be seen that only since the late 1990s has there been an active commitment by companies, but unfortunately even today, there are still instances of neglect regarding this important issue. It is particularly interesting to note that, in the face of increasing safety as regards the machinery used, personnel are still very reluctant to make use of personal protective equipment. As regards professional training, working in forests is primarily characterized and influenced by the environment in which the work takes place. The tasks undertaken are extremely varied and require the use of machinery and equipment which, if used incorrectly, can cause serious injury to operators. In order to work correctly and safely, proper theoretical training is therefore necessary, helping achieve the theoretical bases alongside practical training that involves the acquisition of manual skills and the ability to use vehicles and equipment safely. Combining theory and practice is essential, since theoretical training alone is not sufficient because forestry work requires a practical, manual ability. Training should not only be occasional, but must be continuous in order to go over topics already covered, providing information and refreshing skills. Once again, only in recent years (from the late 1990s onwards) has training registered its presence with a slight increase. The forestry sector still has serious shortcomings. In 2009 only operators from 20% of the sample of companies interviewed had participated actively in professional training courses for the forestry sector.

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