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Research Paper: PM—Power and Machinery

Cable logging opportunities for firewood in Calabrian forests

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ARTICLE INFO

Article history:
Received 28 January 2008
Received in revised form
29 July 2008
Accepted 10 October 2008
Available online 28 November 2008

Cable cranes are among the most important means of yarding and transporting timber and they are being increasingly used in the mountainous regions of Europe. However, their in Southern Italy remains limited, particularly in forests used for firewood production, where they are hardly employed. Forests in Southern Italy are mainly located in steeply sloping mountainous areas where ground-based wood extraction is still the most common harvesting technique employed. The productivity of different cable cranes was assessed to establish if these machines could be recommended for efficient harvesting in the forest conditions in Southern Italy. The cable cranes tested were the Greifenberg TG 700, the Koller K300 and the Greifenberg VSG 2000; the tests were carried out in areas of Calabria (Southern Italy) where site features and forest management parameters differed. A time and motion study showed that the productivity of cable cranes tested was satisfactory although there are a number of organisational aspects that could be improved in order to fully exploit their potential.

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1. Introduction

Calabria is a region in Southern Italy with a forest cover of 31.8%. Calabrian forests are also highly productive since every year the average increase in wood volume (6–8 $m^3 ha^{-1}$), exceeds and is sometimes twice that of the increase estimated for other forests in Southern Italy (Ciancio, 1998).

Despite being such a conspicuous woodland resource, the most common working method in Calabria can be considered as being traditional and still at an early stage of mechanisation (Hippoliti, 1997). It is based mainly on the use of agricultural tractors, sometimes equipped with specific forest machines like winches, hydraulic cranes, log grapples but also, the use of animals for gathering and yarding is still widely used. Chainsaws are the most common machinery for timber cutting operations (Verani & Sperandio, 2003).

The low level of mechanisation in Calabrian forests can be attributed to their site features, the characteristics of the property, the small areas of many of the enterprises, the scant knowledge of modern machinery, and the scarcity of relevant studies relating to the use of modern machinery. Wood from Calabria is mainly destined for the production of energy or for building and packing materials. However some wood products are sent for processing firms in other regions, where they are converted into quality products. (Zimbalatti, 2005).

Thus, the use of cable cranes in Southern Italy remains limited, particularly in forests for firewood production. The problems associated with the introduction of cable cranes are common to many other forestry areas of the world and include the cost of the machinery, the productivity of work and the commercial value of the extracted material. Cable cranes are, however, among the most important means of yarding and transporting timber and their use in the

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1537-5110/$ – see front matter Published by Elsevier Ltd on behalf of IAgrE.
doi:10.1016/j.biosystemseng.2008.10.008

Table 1 – Test site characteristics for the Koller K300

	Work site A	Work site B
Place	Campodimanna	Diga Ampollino
Province – Area	Cosenza – South Italy	Cosenza – South Italy
Altitude (m a.s.l.)	820	1280
Forest		
• Species	Turkey oak	Turkey oak
• Silvicultural system	Coppice	High forest
• Treatment	Standard cutting	Clear-cutting with reserve
• Age (years)	20	>70
• Density (trees ha^{-1})	822	790
• Volume site ($m^3 ha^{-1}$)	115	150
• Extracted volume ($m^3 ha^{-1}$)	100	133
• Logging area (ha)	2.16	0.60
• Total extracted volume (m^3)	216	80
Average slope (%)	69	67
Maximum slope (%)	73	71
Lateral pull (m)	36	30
Yarding direction	Uphill	Uphill
Roughness	Highly	Average
Length of line (m)	330	100
Difference in height between the two ends of the line (m)	53	35
Average sag (m)	3.90	3.10

Table 2 – Test site characteristics for the Greifenberg VSG 2000

	Work site A	Work site B
Place	Crasti	Limina
Province – Area	Reggio Calabria – South Italy	Reggio Calabria – South Italy
Altitude (m a.s.l.)	929	978
Forest		
• Species	Holm oak	Holm oak
• Silvicultural system	Coppice	Coppice
• Treatment	Clear-cutting with reserve	Clear-cutting with reserve
• Age (years)	20	20
• Density (trees ha^{-1})	800	720
• Volume site ($m^3 ha^{-1}$)	112	108
• Extracted volume ($m^3 ha^{-1}$)	99	96
• Logging area (ha)	5	3.36
• Total extracted volume (m^3)	497	323
Average slope (%)	65	71
Maximum slope (%)	71	78
Lateral pull (m)	50	35
Yarding direction	Uphill	Uphill
Roughness	Average	Highly
Length of line (m)	500	480
Difference in height between the two ends of the line (m)	68	79
Average sag (m)	3.70	3.30

mountainous regions of Europe is more widespread. There are two main reasons for accelerating the spread of cableways; the substantial timber production associated with terrain difficulties and the growing need to safeguard the environment (Horek & Mauer, 2001; Košir, 2001)). Ninety-five percent of timber production in Southern Italy (2.3 million $m^3 year^{-1}$; 25% of the total in Italy) comes from terrain which is classified as having a very steep slope (Tiernan *et al.*, 2004). This limits the use of machines for ground-based extraction. In this context the use of cableways could represent one of the best methods from a technical and environmental point of view (Visser & Stampfer, 1998; Owende *et al.*, 2001; Rieger, 2001).

This experimental study, carried out in Calabria, was focused on a time motion study for the use of cable cranes with a mobile power supply for producing firewood, whose production is important over a wide area of study. The research presented aimed at improving the technical knowledge concerning the use of this machinery in Southern Italy and how advisable its extension to other areas would be.

2. Materials and methods

The experiments were carried out in three different timber-yards, situated in three Calabrian provinces, using three different models of single-span cable cranes with a mobile power supply. The times of the work phases were recorded separately for each timber-yard in two different test work sites, indicated with letters A and B and all having heterogeneous site features. As a result, all the data useful to describe the timber-yards were collected in the six test work sites by acquiring the necessary parameters for the forests concerned. Altitude was measured using a portable Global Positioning System (GPS), Magellan Triton™ 2000, and the slopes were assessed with a SUUNTO clinometer, PM-5/360 PC. Dendrometric data were recorded in order to obtain the total volume yarded in each area using volume table (double entry) and sample plot (Tables 1–3). The average sag calculation was carried out using a stadia.

In the first timber-yard, located in the Sila Massif, a Koller K300 cable crane was used (Tables 1, 4) and the Short Wood System (SWS) was applied. Timber was arranged into piles of approximately 1 m long logs. The volume of the single skidded logs was estimated using the Huber formula:

$$V = D^2 \cdot \pi \cdot L/4 \quad (1)$$

where D is the mid-height diameter, and L is the length of the log. In the second timber-yard, located in the Aspromonte Massif, a Greifenberg VSG 2000 cable crane was used (Tables 2, 4) and the Full Tree System (FTS) was adopted, which implies trimming and cutting at the timber-yard. In this case, the wood volume was determined using the Smalian formula:

$$V = \frac{S_b + S_s}{2} \cdot h \quad (2)$$

where S_b is the surface area calculated at the stem base, S_s is the surface area calculated at the stem top and h is the stem height. In the third timber-yard, located in the Serre Vibonesi Massif, the Greifenberg TG 700 cable crane was used (Tables 3, 4) and the Tree Length System (TLS) was adopted; the trimmed stems were cut at the timber-yard.

The timber was transported fully suspended in the three timber-yards.