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The Comparison of Logging Techniques for Productivity and Ecological Aspects in Artvin, Turkey

¹Habip Eroglu and ²H. Hulusi Acar

¹Department of Forest Engineering, Faculty of Forestry, Kafkas University, 08000 Artvin, Turkey

²Department of Forest Engineering, Faculty of Forestry, Karadeniz Technical University, 61080 Trabzon, Turkey

Abstract: Harvesting and transportation of woods from forest is extremely difficult, expensive and time-consuming issue. Forests are usually found in Artvin region in high and steep slopes of mountainous areas and this increases the cost of harvesting. For logging operations, Koller K 300 and URUS M III mobile skylines, MB Trac 900 forest tractor and AcarOLUKPeF50/600 polyethylene chute are used commonly in Artvin region. In this study, three logging techniques (two models skyline system, plastic chute, forest tractors) have been compared for productive and ecological aspects. The productivity of Koller K 300, URUS M III, MB Trac 900 and AcarOLUKPeF50/600 plastic chute were determined as 4.791, 6.734, 6.328 m³/h and 42.86 stere/h (29.00 m³/h), respectively. It was concluded that AcarOLUKPeF50/600 can be used efficiently to extract small logs and/or short pieces of wood in Artvin forestry, Turkey.

Key words: Logging, plastic chute, skidder, skyline

INTRODUCTION

In the worldwide, the natural resources like forest acting as source of life have gradually and tragically tended to disappear. Mankind, users and consumer of the natural resources, comprehended the risk and they took a precaution to reduce the destroying of nature.

The necessity of the raw wood material in Turkey has been increasing, but on the contrary the forest area has been rapidly decreasing. In forest management, transportation stage involves a rather difficult, expensive and time consuming activity. Transport of forest yield from forest to the landing has been practiced in various forms. Forest transportation with minimum loss in quality and quantity and with minimum damage to itself and the environment is an important problem (Acar, 1997).

Over 80% of extraction operations in Turkish forest are practiced with manpower as skidding or sliding and these methods have technical, ergonomic and environmental problems. The wood harvesting and transport operations are the mechanical dimension of the wood production facilities depending on various efficient factors. These operations are costly actions and capture 25-35% of the total expenditure in forestry operations of Turkey (Acar *et al.*, 2003).

The committee of FAO came to Turkey for a research in 1960 and this committee suggested the skylines for

Turkey's mountainously areas. Thus, German Swiss and Austrian Firms had to come to Turkey and The Forestry Ministry of Turkey had bought the skylines from Baco, Wyssen and Hinteregger firms. Today Koller K 300 as short distanced forest skyline, URUS M III as middle distanced forest skyline and Gantner as long distanced sledge forest skylines are used on forest areas of Turkey (Acar *et al.*, 1999).

The harvesting method in Turkish forestry is cut-to-length. The trees are cut, felled, delimited, topped and bucked to various assortments by chainsaw directly in the stump area. Debarking is handled by hand tools such as axe. The cut limbs and tops can be left in stand. The wood extraction from stump to landing site is mostly realized on step terrain by manual by means of gravity, rolling, throwing and sliding/skidding on the ground. On the flat grounds, firstly animal force and rarely agricultural tractors have been used. Forest tractors or skidder have been used on the pulling from slope stands and skidding. The forest skylines, various distanced, have been used on step terrains. Recently, plastic chutes are used in Turkey for transportation of small size wood.

The plastic chute systems represent a new dimension in modern harvesting technology in Turkish forestry. They represent an important improvement in ergonomics compared to the traditional hand-rolling method and are safer and faster than traditional hand-rolling method.

Table 1: Properties of experimental areas for Koller K 300 and URUS M III skyline

Type of skyline	Study area	Compartment No.	Ground slope (%)	Type of product	Line slope (%)	Transport dist.- Line dist.(m)	Tour No.	Worker No.
Koller K 300	Artvin/Taslica	104	50	Softwood	33	175-250	41	4
	Artvin/Taslica	271	60	Softwood	51	190-275	32	4
	Artvin/Sacinka	51	47	Hardwood	22	100-250	33	4
	Artvin/Ortakoy	422	58	Softwood	53	200-300	32	4
	Artvin/Ortakoy	445	59	Firewood	45	205-300	37	4
URUS M III	Artvin/Taslica	71	65	Softwood	30	128-300	30	5
	Borcka/Karsikoy	266	60	Hardwood	35	250-400	19	5

The damage to seedlings, standing trees, extracted woods and environment were in minimum level during the extraction with plastic chutes in the present study (Eroglu *et al.*, 2007).

In this study, three logging techniques, skyline (Koller K 300 and URUS M III), forest tractor (MB Trac 900) and plastic chute (AcarOLUKPeF50/600) were compared for productive and ecological aspect.

MATERIALS AND METHODS

The study was carried out in 2004 in north-eastern part of Turkey, Artvin (41°10' N, 41°48' E). The climate in Artvin is mild with humid summers. Annual precipitation averages approximately 700 mm and the temperatures averages 13°C (Akman, 1990).

The forests in this region are mostly in mountains and extraction of logs and small-sized wood is very hard and expensive. Besides, many small size woods could not be extracted and left in forest.

Studies on Koller K 300 in different ground slope (47-60 %) have been carried out on type of Koller K 300 attached tractor. This skyline takes its power from tractor's engine by axle and it is used as combined farmer tractor which power is 50 HP (Erdas and Eroglu, 1999). URUS M III forest skylines generally are used on uphill transportation. It is combined to Mercedes Benz Unimog U1500 truck and it can be set up between 500-600 m. distances (Table 1).

Studies on MB Trac 900 forest tractor were carried out on type of MB Trac 900 with double drum winch forest tractor. This machine was used in two study areas for hauling on the ground.

AcarOLUKPeF 50/600 plastic chutes made on polyethylene (PE) were obtained from Firat Plastic Firm in Istanbul, Turkey. PE plastic chute has 6 m length, 50 cm diameter, 6 mm thickness and 25 kg weight.

Tolls such as electronic chronometer, steel tape and clinometers were used during the studies. To measure the time consumption, digital chronometer (1 min =100 unit) was used. Digital photograph and video camera were used for image and record during the process.

For the AcarOLUKPeF 50/600 plastic chutes measurements were done from suitable visible points to see extraction operations with plastic chutes. All productivity values found for different transportation distances (42-258 m) were calculated for 100 m transportation distance to compare the productivity of the three chute systems.

Study cards were prepared firstly in time analyses to determine the productivity level of logging techniques. Cumulative time measurement technique was used for time measure at study areas. Measurements were done from suitable visible points to see all systems.

Data obtained from time researches on different harvesting areas were entered the computer according to kinds of wood (hardwood, softwood and firewood) and tables prepared as to work phases. Then data obtained from statistical analysis were investigated comparatively.

RESULTS AND DISCUSSION

Productivity values for logging by Koller K 300 and URUS M III were determined as shown on Table 2.

As a result, it was determined that extraction the softwood, hardwood and firewood from forest by URUS M III was more productive than extraction by Koller K 300. Extraction of softwood by Koller K 300 was more productive than hardwood and firewood. Also, softwood extraction by URUS M III was the most productive and firewood was the least.

As the transportation distance increased, productivity decreased in the two skylines (Koller K 300 and URUS M III) and URUS M III was more productive than Koller K 300 (Fig. 1).

Table 2: Productivity values for Koller K 300 and URUS M III on harvesting areas

Type of skyline	Harvesting area	Type of product	Productivity (m³/h)
Koller K 300	Taslica	Softwood	5.529
	Taslica	Softwood	4.852
	Sacinka	Hardwood	4.775
	Ortakoy-1	Softwood	4.614
	Ortakoy-2	Firewood	4.620
URUS M III	Taslica	Softwood	7.944
	Dereli	Firewood	4.944
	Karsikoy	Hardwood	5.525

Table 3: The efficiency of MB Trac 900 forest tractor with different distance and slope

Study area	Compartment No.	Type of product	Transportation distance (m)	Slope (%)	Number of tour	Number of workers	Productivity value (m ³ /h)	Average productivity value (m ³ /h)
Artvin/Tütüncüler	67	Softwood	53.64	50	11	3	6.540	6.328
Artvin	26	Softwood	68.37	70	46	3	6.116	

Table 4: The efficiency of the chute with different length and slope

Type of chute	Study area	Length (m)	Slope (%)	Set up duration (h)	Pull up duration (h)	Transportation time for 1 piece (s)	Productivity value (stere/h)	Productivity value for 100 m distance (stere/h)
AcarOLUK	Cukur-1	42	36	1	0.5	6.09	47.61	42.86
PeF50/600	Cukur-2	60	34	1.2	0.6	8.09	45.11	
	Hatila-1	258	29	48	24	24.12	38.71	
	Ardanuc	84	31	3	1	12.66	43.48	

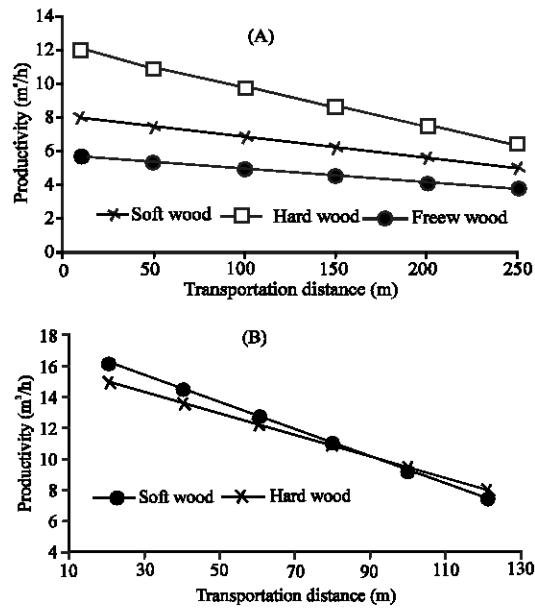


Fig. 1: Relation between transportation distance and productivity for Koller K 300 (a) and URUS M III (b)

MB Trac 900 forest tractor was used on two study areas. Obtained data from these study areas were shown at Table 3.

Skidding distance and log diameter-length and volume have been affected to productivity of skidding on the ground by MB Trac 900 forest tractor (Fig. 2). Type of product and slope has not been affected to productivity.

Productivity value of AcarOLUKPeF50/600 for 100 m distance was showed differences between experimental areas when firewood was carried. The productivity value was found as 42.86 stere/h averaged over four study areas at Acar OLUKPeF 50/600 chute (Table 4).

The length of the chute and slope of the system affected the productivity value of the chute. The productivity was the highest in the study area of Cukur-1 on slope with the highest gradient (36%). Increasing in the slope increased the productivity of the plastic chute.

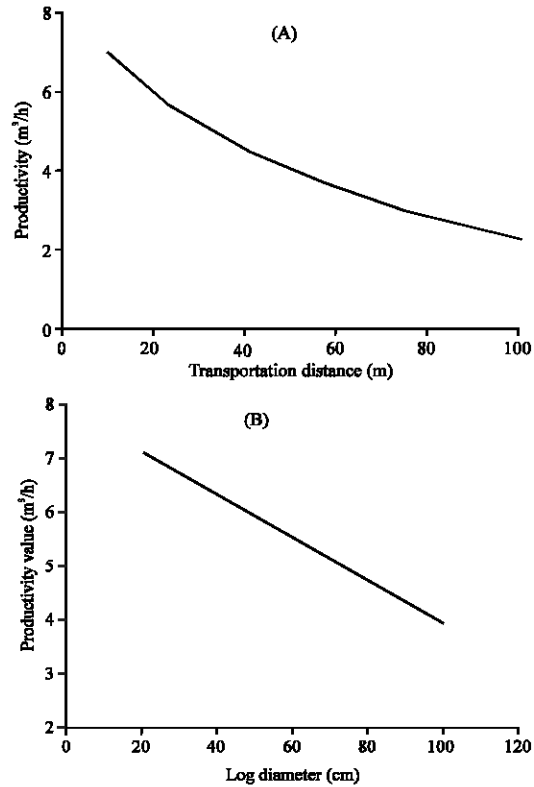


Fig. 2: The relationship of transportation distance (a) and log diameter (b) with productivity

As a result of the regression analysis in all 4 experimental areas, the variations of the length and diameter of the wood material did not affect the transportation time ($R^2 < 0.0002$).

Transportation distance was not important for worker during extraction with chutes, because manpower was just needed at the beginning of extraction process. However, in the skidding with manpower, transportation distance affects manpower and long distance results in more manpower. Wood extraction with chute systems was easier and speedier than extraction with man and animal power (Anders and Wiksten, 1984; Hart, 1991).

Koller K 300 and URUS M III mobile skylines can be used where road construction costs are expensive, products quality and quantity loss are occurred and forest soil and stand trees are damaged because of long skidding distance.

Acar OLUKPeF 50/600 plastic chute was found the most efficient to extract firewoods compared to the others. Chute systems should be set up from uphill to downhill. For the safety of chutes systems, all chutes should be fixed on ground and each other carefully. Chutes systems should be controlled continuously by a worker during the extraction period. Extraction operations are not safe during rain and well organized work is necessary for increasing productivity of the chute systems.

The chutes represent a new dimension in modern harvesting technology in Turkish forestry. It represents an important improvement in ergonomics compared to the traditional hand-rolling method. It is also a practical extraction method. Wood extraction with plastic chute systems is found to be easier, safer and faster. The damage to young and standing trees, products and environment were in minimum level during the extraction with chutes in this study.

Use of plastic chute is very important especially for firewood during the extraction from forest. Extraction with plastic chute also decreases in losing quality and quantity of wood and increases work safety. Also this system save time and needs less labor compared to other logging systems.

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