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Controlled Sliding of Logs Through Plastic Chutes on the Forest Ground

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Abstract

In forestry, wood extracting activities which is a main stage between forest harvesting and transportation activities are very expensive, difficult and time consuming activities. Skidding of heavy and large-diameter logs on the ground from stump to the roadside landings is a complicated process. Besides, this activity brings up some environmental, economic and ergonomic problems. In this study, it is suggested to apply a new system which provides controlled sliding of logs through plastic chutes to overcome these problems. This system works both by yarding the heavy logs uphill using a drummed engine and by sliding them downhill with controlled brake system in plastic or fiberglass chutes located on forest ground. Such a system can be used within 300 m yarding distances by a portative drummed engine mechanism or by a drummed forest tractor operating from a roadside. In case of the necessity, the yarding distance of the system can be increased by installing additional consecutive chutes. It is expected some advantages from this system with respect to its economical viability, applicability, and efficiency in forestry activities. Furthermore, the system might decrease damages on residual trees and seedlings, and ensure workers' safety and enable to harvest forest products in the logging sites where installation of modern harvesting equipment is not economically feasible. Quality and quantity damages to carried logs and environmental damages to forest ecosystem can be minimized by using this semi-mechanical system. This system has also some operational advantages by establishing on any terrain conditions, by yarding uphill and downhill, and by decreasing work accidents.

Key Words: Forest ground, log yarding, plastic chutes, controlled sliding system, forestry activities in Turkey

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1. Introduction

Owing to increasing of public demand on the conservation of environment, the importance given to the environmentally friendly forestry activities have increased in recent years. This has brought environmental and ergonomic as well as economical issues into the agenda of today's forestry activities. Therefore, forest harvesting activities, which are the most important source of damages onto the forest ecosystem, can be performed with a minimum quality and quantity loss on forest products and with a minimum damage to the environment.

In the world, the total annual production of large size round wood without bark is about 3.5 billion m^3, in which the highest amount of industrial forest product are logs, which are followed by fiber chips and pulp woods (FAO, 2007). In Turkey, approximately 10 million m^3 industrial wood and 15 million stere, piled cubic meter and fuel wood have been produced each year. The amount of 65 % of industrial wood demand is satisfied by General Directorate of Forestry (GDF). This amount is the 90 % of the income of the forest industry. Approximately 50-55 % of annual wood production of GDF is industrial wood production and 48 % of it is logs (DPT, 2001).

Transportation of the wood products consists of two stages; the first one is the primary transportation which consists of felling, bucking, delimbing, and transporting to the landing and the second one is the secondary transportation which consists of hauling by logging trucks. The primary transportation is the most difficult and expensive stage which is also major cause of the environment damages in forest ecosystem.

The usage of cable logging methods and mechanized harvesting systems is limited in Turkey. Because of the fact that the majority of forest is located in mountainous areas, it is very difficult to extract timber by using traditional methods, which mainly include skidding by animal power and manpower, and partially winching by forest tractors. Skidding of logs on steep mountainous terrains causes serious damages on transported wood products, residual stands, and forest soil. The skidded logs can knock the remaining trees and then cracked, ruptured, and withered. In Turkey, since wood supply to market demand is inadequate and 9 % of industrial wood demand has been imported. Therefore, quality and quantity losses on transported wood material are very important problems (Ünver and Acar, 2006). For this reason, nowadays using advanced extraction systems is inevitable to prevent losses on the quality of the extracted wood in mountainous forests.

Due to wounds which take place on the residual trees during ground skidding, trees become vulnerable to insect and fungus attacks, which negatively affect the sustainability of forest. Also, soil compaction may occur during skidding based on the amount and weight of transported wood material. As a result of soil compaction, physical and chemical features of soil can be influenced negatively, which leads to reduction in forest productivity.

Murpy et al. (1985) stated that damages to wood material during harvesting activities decreased the productivity by amount of 40 %. Similarly, Gürtan (1975) reported that 15 % to 17 % of wood production loosed after harvesting activities in Artvin and Trabzon regions in Turkey. Also, it was estimated that 10 % value loss may occur because of the quality reduction on the transported wood (Gürtan, 1975). Fjeld and Granhus (1998) determined that the average injury rate was 11.4 % after applying

single tree selection harvesting method in Norway spruce (*Picea abies*). It was found that although only less than 2 % of trees in harvesting unit were cut, 26 % of residual trees died or got damaged. Bettinger and Kellogg (1993) found that 39.8 % of total stand were damaged after harvesting in a mixed conifer stand. Similarly, Pinard and Putz (1996) reported that uncontrolled logging damaged more than 50 % of the original stand.

In last few years, the problem of transporting small-diameter wood materials from stand to the landing in mountainous regions has been solved by using plastic chute system (Acar et al., 2005). However, extraction of large-diameter wood material is very difficult because of the difficulties in work conditions, time consumption, safety risks and high costs, as well as ergonomic and environmental difficulties.

At present, it is thought that cable yarding, balloon logging, and helicopter loggings are the most suitable methods in extraction of large-diameter wood materials. Cable yarding systems are practiced in specific corridors with the yarding distance of 300 - 2000m. Because these systems are expensive and established in the areas where there are less than 300 m^3/ha materials, they are not preferred in Turkey. On the other hand, balloon logging and helicopter logging are very expensive (Blakeney, 1992).. Because of this fact, they are not uşed in Turkey

The amount of the damage to residual stand after harvesting activities is important because it can affect sustainability of forest ecosystems and the wood material which can be obtained from forest in the future (Acar and Ünver, 2006). Therefore, new systems must be developed to extract the large-diameter wood material in such a way that both forest sustainability and contribution to the country's economy can be ensured. In this study, it is aimed to improve a new semi-mechanic system of plastic chute to perform an economic, environmentally friendly, and ergonomic wood extraction process.

2. Controlled Log Sliding in Plastic Chutes System

The system of controlled log sliding plastic chute is composed of two main parts, one is the artificial route made in plastic chutes and the other one is motor mechanism performing sliding or pulling. Subparts of the system are 10 HP motor, brake drum, steel bearing cable which has 6 - 8 mm diameter, at least two holds, direction mechanism, break device, harness, control handle, and a redactor. The motor which performs controlled sliding or pulling can be electrically operated. The power of the motor has to be 120 volt and the dimensions of it must be at least 40x40 cm. A redactor is installed on the motor to improve electric and gravitational power. The total mechanism is approximately the amount of 80 kg and it can be separated into two parts and carried by two workers to be reinstalled in the forest. The redactor which decreases the cycling of the motor from 1200 to 30 in a minute is installed on the system. Construction of motor mechanism is very important because the average weight of the product to be carried by this system is about 600kg. Fixing of the mechanism on the forest area should be carefully planned and done. The mechanism should be replaced on a flat ground with its feet as strongly standing on the floor. Then, to prevent the

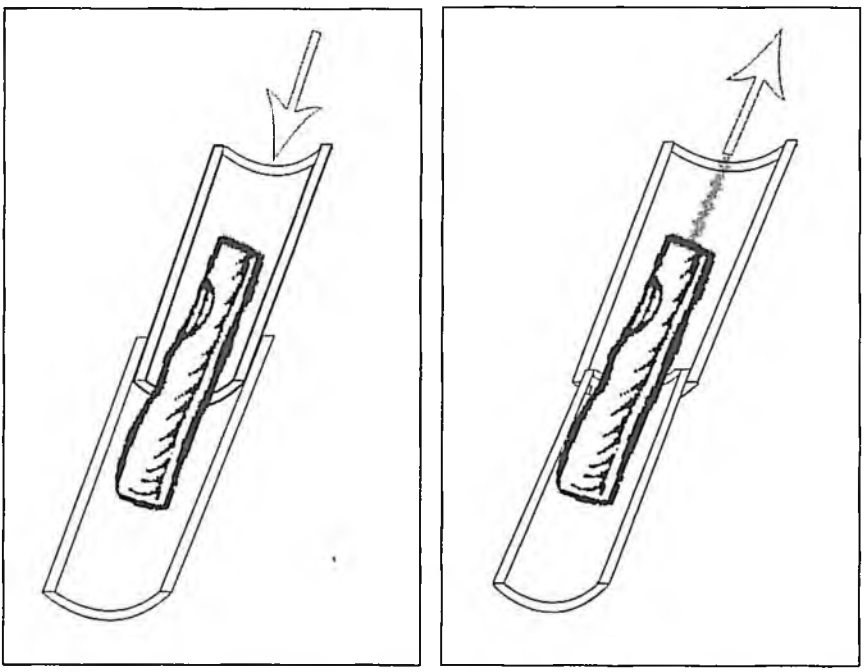
movement of the mechanism during transportation, it should be strongly tied to trees with security ropes.

While establishing an artificial route consisting of chutes, it is not necessary to open any corridor. The chute route can be easily established vertically in the slopes between 10 % and 70 %, whereas the route can be established in the way that the route is angled to the contour lines more than 70 % slopes. Inventory parameters relating to system are presented in Table 1.

Table 1. Inventory Tables of the Chute System.

Features of Chute	
The number	
Type and model	
Diameter	
Thickness	
Length	
Length of route	
Route slope	
Boundary of transportation	
Features of Mechanism (Motor)	
Type	
Power	
Weight	
Width of drum	
Cycle of redactor	
Weight of redactor	
Features of the chute system	
Total weight of system	
The number of pieces in system	
The number of laborers	
Productivity of system	

While downhill transportation of logs in plastic chutes is performed by controlled brake system without using motor, uphill transportation of logs is performed by a portative drummed motor mechanism or a forest tractor with drum. Plastic chutes are connected to each other by using tips with screws. The tips of the upper chute which we called as male must be installed in the lower chute during downhill sliding, so the obstructing of sliding logs in the chutes is prevented. On the other hand, when pulling the logs uphill, the lower chute which we called female is located on the upper chute (Figure 1).



(a) Controlled sliding to downhill (b) Pulling by motor power to uphill

Figure 1. Position of chutes in setting of transportation direction.

After connecting the chutes, sliding of logs tied to a steel cable is performed by a control handle without starting the motor during controlled sliding to downhill. Establishing of the route, carrying and installing of the chute system are generally done by two laborers, and the system runs by an operator and one or two laborers. The sliding distance should be ideally about 300m, but it can be expanded to the flat areas. Sliding of logs trough downhill can only be done after discharging the retrograde cable in a controlled way when the motor is off. After that, the motor is started to draw an empty retrograde cable and to roll on the drum (Figure 2).

If there is a forest road near the harvesting area, the system can be installed to a forest tractor to pull logs uphill. If there is no forest road, a drummed mechanism having a motor is installed in the harvesting area. The logs are pulled trough uphill with the power of this motor on a flat or a slopped route (Figure 3).

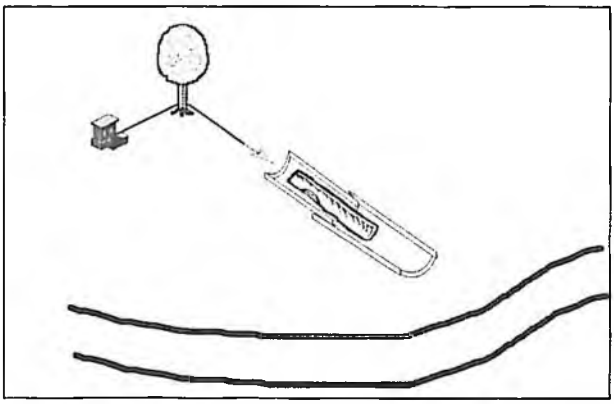


Figure 2. Controlled sliding of logs to downhill direction in plastic chute route.

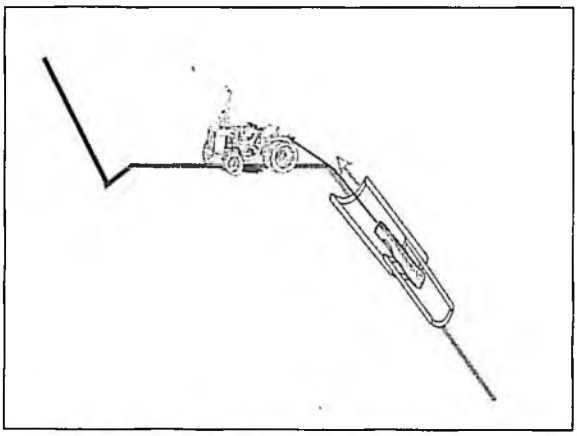


Figure 3. Pulling of logs to upward in plastic chute rout.

3. Evaluation of the System

Extraction with plastic chute has more advantages than other yarding methods in terms of environmental, ergonomic, and economical issues. Its damages on environment, standing and young trees, and quality and quantity of woods are in a minimum level (Acar, 2005). Installation process can be carried out at most one day without using any equipment. The route can be installed both vertically and a defined angle to the area. The friction coefficient between the logs and chutes is less than that of between the log and soil, so the applied power to logs will be less than that to ground based skidding. Chutes should be installed to the area taking the transportation direction into consideration. Otherwise, logs can be blocked at the connection points of the chutes.

The system of controlled sliding in the chute saves time and work power and needs less labor when compared with other extracting methods. In Turkey, harvesting activities are performed by forest villagers or logging crew assigned by forest cooperatives. Also, the difference between this system and the other extracting systems is that qualified laborers are only required in the establishing stage. Establishing the route which consists of chutes can be done without giving any damages to the forest. Thus, any damages to the residual trees and the wood material in the future can be minimized. The damages on the transported woods, residual stands, sapling and soil during logging with plastic log chutes are less than those of the other logging techniques (Acar et al., 2005).

Because laborers do not pull or push the logs during the operation, the transporting distance in the controlled skidding and pulling technique will not be important (Acar et al., 2005). However, they work only where the motor mechanism and braking mechanism is established. When it is necessary, they control the system in the motorway near the forest without walking in the forest, so any work accidents might be avoided.

The cost of this chute system is approximately 10 thousand dollars. This portable system is less expensive and more productive than the other mechanized extracting techniques.

The logs away from the forest roads are generally left in the area because they cannot be reached and carried to the roadside. These abandoned materials will be able to be contributed to the economy by using chute system. Furthermore, small-diameter wood material can be carried on the chute route by manpower, without using any motor mechanism.

4. Conclusions and Recommendations

Improving current extraction methods of large-diameter wood material is one of the most important subjects in the forest management. 143 565 000 TRL was spent on extraction of wood material in 2006, which was approximately % 36 of the whole budget declared by the GDF (OGM, 2006).

Controlled sliding of logs by motor mechanism decrease the amount and severity of wounds on the residual trees, which is important to diminish the natural habitat for bark insect and fungus. Semi-mechanic system minimizing the residual stand damage should be considered for the forest areas as important risks of insects and fungus. For example, the East Black Sea Region in the North East of Turkey is at risk of bark insect such as *Dentroctanus micans* and *Ips sexdendatus* (Alkan et al, 2005).

Consequently, this above mentioned system, used for the first time in Turkish forestry to extract wood material, is a practical, economical, productive, and simple system. It can be seen that the system is portable and sensitive to the environment, and it gives also minimum damage to the ecosystem and transported products. Therefore, it can be an alternative to the expensive systems such as aerial systems. The system is semi- mechanized form of the chute system which gives successful results in carrying small-diameter wood materials and most preferable in the future in terms of

Environmental Impact Assessment (EIA). Thus, more studies should be conducted on this system for future improvements.

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