Timber Extraction with a Modified Farm Tractor in Blacksea Region of Turkey

Tolga Ozturk*

Department of Forest Construction and Transportation, Faculty of Forestry,
Istanbul Univeristy, 34473 Bahcekoy/Istanbul, Turkey
tozturk@istanbul.edu.tr

Abstract:

In this study, productivity of Massey Ferguson farm tractor in calabrian pine stands was performed in the area of Taskopru Forest Office within the Izmit Forest Administration in Turkey. Timber was skidded uphill by farm tractor in felling area. The skidding operations were made on the skid roads. The length of skid roadsare changed between 80 and 130 meters. Time study of a cycle was carried out by using collected data and by statistical analysis. The research results implied that some working characteristics of the farm tractor such as skidding distance, load volume, time consumption of handling operations and fuel consumption had an important impact on productivity of the tractor. The results indicated that the average load volume is 0.500 m³/cycle. The volume of an average piece of timber was 0.250 m³ and it was 2.5 to 5 meters long. Hourly productivity is 6.160 m³/hour for skidding distance of 100 m. The daily fuel consumption was measured by the volume method. The average fuel consumption per operating hour was 5.5 liters/hr.

Keywords: Farm tractor, skidding, productivity, cost, time study, extraction

1 Introduction

The timber harvesting is stil one of the most important forestry operations in Turkey. The forests of Turkey are located in mountainous areas. This situation is very important because the extraction of forest products is a very difficult, expensive and time consumption activities.

Log skidding is probably the simplest task, and that requiring the lowest investment in specialised implements. At its simplest, skidding can be obtained by pulling directly off the tractor drawbar, but this technique is inefficient and causes much soil disturbance. More often, logs are pulled to the tractor with a winch, which is also used to lift the log ends off the ground during skidding (Spinelli and Magagnotti 2011).

Worldwide, agricultural tractors have been used in various forestry operations such as extraction, loading, transportation, road construction, site preparation and so on (Eker et.all. 2011). Mechanization started with the introduction of farm tractors modified by installation of additional equipment, which enabled, easier and safer work in the forest. Modified farm tractors play an important role in forest exploitation, even after the development of specialized forest articulated tractors (Zecic et. all 2005). Farm tractors have been used in forestry where the terrain conditions and the size of the forest operation are not limiting. On the other hand, farm tractors have very low initial costs and relatively low operating cost comparing with harvesting machine (Turk and Gumus 2010).

The aim of this research was to determine productivity in single-drum equipped Massey Ferguson skidding by analysing the load volume and time consumptions for different work circle.

2 Material and methods

2.1 Research area

The research area was located in northwestern Turkey. The research area is managed by Taskopru Forest Office within Izmit Forest Administration (Fig. 1). The total area of Taskopru Forest Office is 19572 ha.

The total tree volume of this area 700330 m³ and total growing stock is 52102 m³. The average road density is 12 m/ha for reasearch area. The most important commecial tree species in this region are *Pinus nigra*, *Pinus pinaster*, *Fagus orientalis* Lipsky., *Quercus* sp. The average slope in research area is betweenh 10 and 45%. Skidding operations was done on skid trails and used for a tractor. The length of skid trails were changed between 80 and 130 meters. The type of soil in research area are is clay-loam.
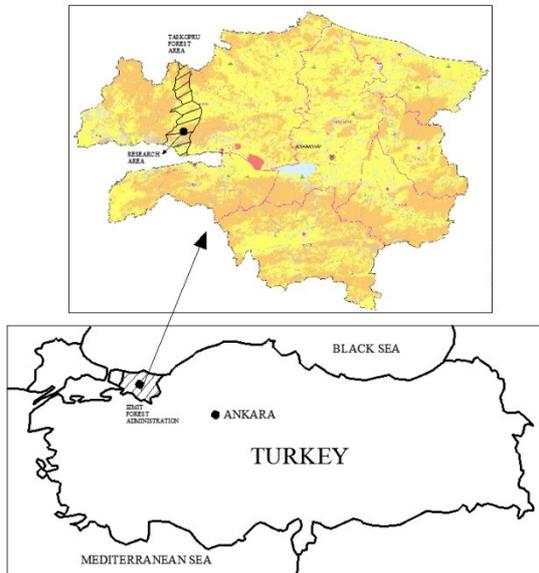

Figure 1: The research area in Turkey

2.2 Technical characteristics of farm tractor

The brand of farm tractor is Massey Ferguson and the tractor is a two wheel drive vehicle. It is modified for skidding operations on skid roads and skid trails which implies that one end of the dragged log is in touch with the ground. The tractor is eguipped with single drum winch. The main technical features of the Massey Ferguson tractor are follow:

⇒ Machine power is 60HP
⇒ Tractor weight is 2306 kg
⇒ Volume of cylinde is 2.3 lt
⇒ Numbe of cylinder is 4
⇒ Type of winch is special
⇒ Diameter of cable is 14 mm
⇒ Length of cable is 100 m.

Figure 2: Massey Ferguson tractor

2.3 Data collection

The productivity Works of forestry machines are used time measurements and time study techniques (Klepac and Rummer 2000). Time consumptions of the duration of working components were researched by repetition method and records were taken throughout the whole working day (Ozturk 2010). In this study, the distance of skidding was measured by use of a measurşng type, the slope gradient of the terrain and skid roads was measured by clinometer and the load data were collected by measuring the diameter and length of each piece of timber under bark was measured by caliper.

The measurement data were entered into computer files from the record into computer files from the record sheets so as to market them available for data processing. Data processing covered the control and selection of data classification of recorded times and calculation of the achieved work productivity (Ozturk 2010).Statistical data processing was carried out by use of a computer with the application of the software package Microsoft Excel 2010 and SPSS 16.00.

In this study, dependent variable is total cycle time (Total time for time measurements) and independent variables are skidding distance, load volume, and load number. The definitions of both dependent and independent variables and how to neasure them are summarized below:

Dependent variable:

T: Total time, which is measured as time at scale level variable and the measurement unit is minute.

Independent variables:

SD: skidding distance which is described as distance between loading point and destination. The distance is measured by meter and market at regular intervals and recorder.

LV: load volume is a variable that represents the volume of all transported logs at the destination. This variable is measured as cubic meters.

LN: load number is variable that number of skidding logs.

2.4 Time measurement phases

A skidding cycle of farm tractor is arisen from five phases. These phases are below:

A: unloaded tractor travel, this phase is started when the tractor is ready to move the loading area. Then, ends of this phase when tractor arrive the loading area.

B: hookup of load, it begins at the end of lateral out and ends when the choke seter has completed hooking.

C: winching, begins at the end of hookup period and it ends when the operator is skidding timber through tractor side.

D: loaded tractor travel, begins at the end of latural in and ends when the tractor has reached to the ramp.

E: unhook of load, begins at the end of in haul nwhen the tractor passes over to the trip block and ends when the hook is pulled back to the loading point.

3 Results

A regression model was developed for the statistical analyses. Initially a 95% significance level was set to test the null and alternative hypothesis presented above. F-test and statistically based on 0.05 significance level. The data were consistent with the alternative hypothesis that the proportion of variance in total time, explained by the set of independent variables included in the regression model, was greater than 0.0

in the population from which this sample was selected. It also implied that at least one of these independent variables had a statistically significant effect on total cycle time and this relationship was linear. The regrassion model was calculated as follows:

$$T = -4{,}074 + 0.080 \cdot SD + 1.697 \cdot LV - 0.214 \cdot LN \quad (R^2 = 0.745)$$

The tractor performance was being observed at the feeling area for 10 working days. The number of time measurements are 35 recorded cycles. Timber extraction was carried out at three different distances. These distances are 90, 100 and 110 meters. Average results of measurements are shown Table 1.

Table 1: Average results of time measurements

Skidding distance	Load volume	Load number	Unloaded tractor travel	Hookup of load	Winching	Loaded tractor travel	Unhook of load	Total time
SD	LV	LN	A	B	C	D	E	T
m	m³	number			min			
90	0.590	2	0.34	0.32	1.16	0.47	0.17	3.26
100	0.500	2	0.54	0.46	1.37	1.14	0.17	4.48
110	0.420	2	1.18	1.14	2.10	1.36	0.24	6.42
Average	0.500	2	0.55	0.51	1.41	1.12	0.19	4.59

The total cycle time of tractor at the different distances of 90, 100 and 110 meters are 3.26, 4.48 and 6.42 minutes, respectively. The average load volume for 90, 100 and 110 meters skidding distances are 0.590 m³/cycle, 0.500 m³/cycle and 0.420 m³/cycle, respectively. The average productivities for different skidding distance at the felling area were 10.310 m³/hours (for 90 meters), 6.25 m³/hours (for 100 meters) and 3.76 m³/hours (for 110 meters). The timber skidding was carried out uphill for one skid road with the slopes between 5 and 15%. The relationship between total time and skidding distance is shown in Figure 3 and the relationship between total time and productivity is shown in Figure 4. As shown in Figure 3 and 4, when the skidding distance increases, the total time of a cycle is increasing. In addition, when the skidding distance increases, the productivity of tractor is decreasing. The distribution of time consumption is shown in Figure 5.
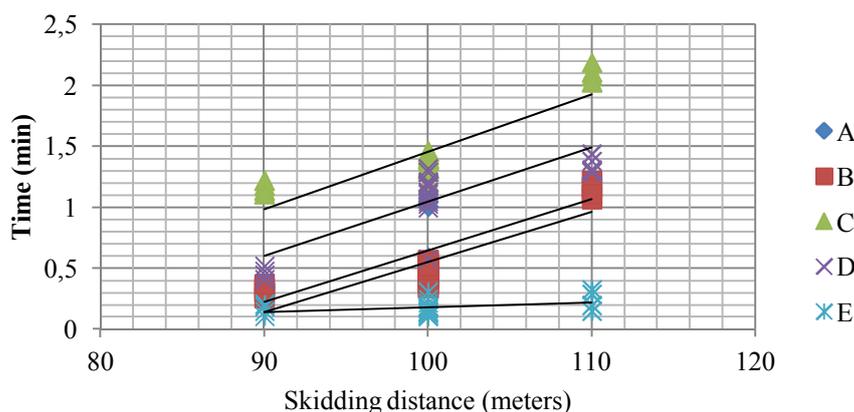

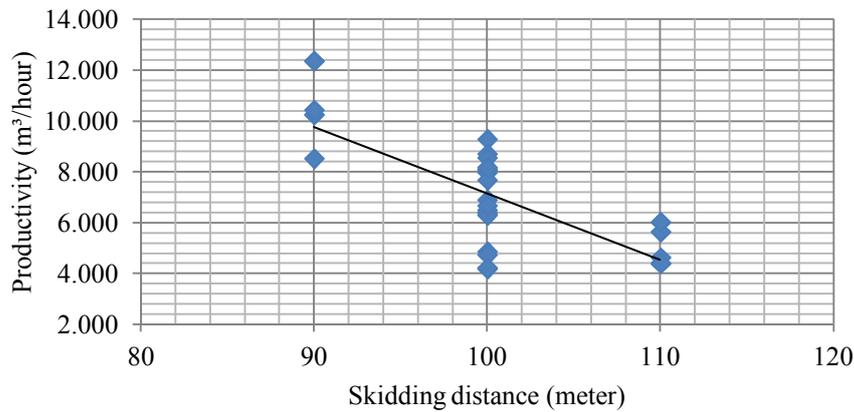**Figure 3: Relationship of skidding distance vs. total time**

Figure 4: Relationship of skidding distance vs. productivity
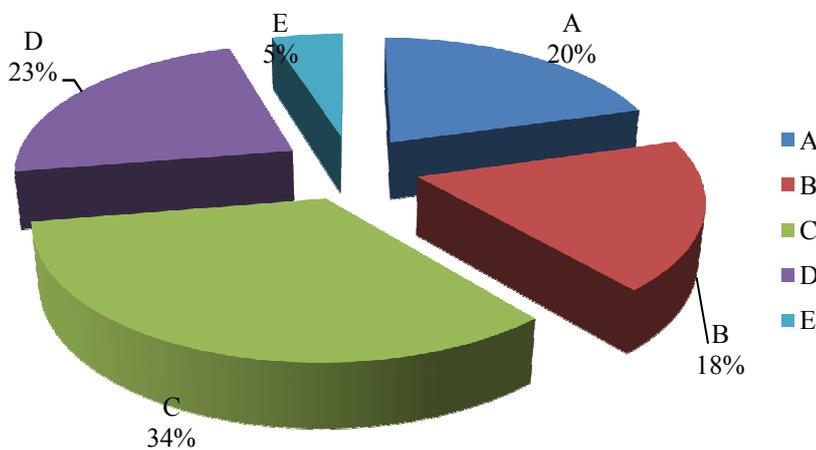

Figure 5: Percent of work phases

When the skidding distance increases, the total time of a cycle is increasing. In addition, when the skidding distance increases, the productivity of tractor is decreasing.Increasing the average skidding distance during the forest operations decreases the efficiency of machines. At the same time, the cost of skidding increases in felling area. Therefore, in the felling areas forest engineers should use shorter the skidding distances. Besides, the skid roads should be coated in the form of a network in production areas.

Acknowledgements

5 References

Eker, M., Çoban, H.O., Onal, Y.E., 2011: Using of Agricultural Tractors for Harvesting Operations in Turkish Forestry. FORMEC, Austria 2011, p..

Klepec, J., Rummer, B., 2000: Productivity and Cost Compar,son of two different sized Skidders. ASAE Annual International Meeting, Paper No:00-5015:1-9.

Ozturk, T., 2010: Productivity of MB Trac 900 tractor at beech stands on mountainous areas in Blacksea region. African Journal of Agricultural Research 5(1): 28-33.

Ozturk, T., 2010: Productivity of New Holand farm tractor at beech stands on mountainous areas in Blacksea region. Forestry Ideas, 1(39): 1-6.

Spinelli, R., Magagnotti, N., 2011: Wood extraction with farm tractor and sulky: estimating productivity, cost and energy consumption. Small-scale Forestry, DOI 10.1007/s11842-011-9169-8.

Turk, Y., Gumus, S., 2010: Log Skidding with Farm Tractors. Forest Engineering: Meeting the Needs of the Society and the Environment, Padova-Italy 2010.

Zecic, Z., Krpan, A.P.B., Vukusic, S., 2005: Productivity of C Holder 870 F tractor with double drum winch Igland 4002 in thinning beech stands. Croatian Journal of Forest Engineering, 26(2): 49-56.