

Investigation and Situation of Timber Harvesting Mechanization of Turkey and the Usage of Tractors in Timber Extraction

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Abstract: In this study is to summarize usage of tractors in timber extraction and major problems of mechanized timber harvesting in Turkey. Timber harvesting in Turkey is still carried out by manual methods due to economical, social and environmental constraints. Almost 80% of harvesting activities are mechanized in many developed countries while this value is only 5% in Turkey. Overall ratio of mechanization is relatively low. Approximately percentage of man power, animal power, machine power and skyline harvesting are 72, 15, 8 and 5%, respectively. Turkish General Directorate of Forestry's mechanical park total amount is 457 in 2004. Mechanical park amount has been reduced to 19 tractors (4x4 and assembled shovel), 169 skidding winches, 6 tractors with equipment of snow cleaner, 46 forklifts, 26 loaders, 32 skylines, 65 agricultural tractors, 88 trucks, 4 agricultural tractors with shovel, 2 barking machines as of 2004. Approximate percentages of skidders, trucks, 4x2 tractors, forklifts, skylines, loaders, 4x4 tractors and barking machines are 36.9, 19.3, 16.4, 10, 7, 5.7, 4.2 and 0.5% in 2004. 4x2 and 4x4 tractors total amount has been reached to 41.7% in 1982, but this percentage has been reduced to 20.6% in 2004. Total machine park amount has been reduced 41.4% between years 1998-2004 in Turkey. In spite of existence of substantial number of harvesters, the amount of modern harvesting processor in Turkey is not sufficient. Different type and marked machine hasn't taken into consideration to improve mechanization and a poor standardization in harvesting is another problem in Turkey.

Keywords: Timber extraction, Tractor, Timber harvesting mechanization, Turkey

INTRODUCTION

Forests, which are renewable natural assets, are formed by gathering of a large number of living and non-living creatures. However, this formation is not random mass, but whole, a system. When making use of the forest ecosystem for various purposes, care must be taken not to spoil the forest structure [1]. In forestry, like every kind of production, production works require a productive power. This productive power can be provided by both human power or animal and machines which are used by human beings. The production of wood raw material are formed various stages that continues from the productive place to market centre. These work stages depend on each other like rings of a chain. Success and failures in each stage effect the next stage [2]. Until recently, the forests in Turkey have encountered excessive interventions at diverse levels and densities in order to meet the country's needs for firewood. These detrimental interventions started generally in forest lands which provided easy access or transportation and continued for long causing damage to some parts of the natural structure of our forests. Thus, only those forests located on rough lands could

conserve their natural forms. This situation made it clear that these forests should be developed and improved with a view to continuously benefit from them economically. The term "*mechanization*" which is defined in the dictionaries as "all of the activities that help to create a new good or service" correspond in forestry transportation to activities such as cutting the raw material of wood, hauling, transporting and stacking it. In order to perform this harvesting rationally, requirements such as conformance to rules, safety and affordability, which make up the basis of engineering discipline, must be met. In order to make full use of modern technology, forest trees which, for long years carry along the efforts of nature and human beings to reach the time for being cut, must be transported from the place they have been cut to the main transportation near the forest road keeping its original volume and quality intact and without harming the other trees, youth, the forest soil, in short the forest ecosystem. At that stage, with each step towards mechanization, labor loss shall be prevented, hauling costs will be reduced, natural balance and forest soil will be preserved, while obtained more products with higher quality.

MATERIALS AND METHODS

Materials: Turkey, with 97% of its land in Asia and 3% in Europe continents, is located between 42° 06'-35° 51' N latitude and 25° 40'-44° 48' E longitudes. Turkey is surrounded with the Mediterranean, the Black Sea, the Marmara and the Aegean Sea, has an area of 77945200 hectares and coasts of 8333 km long. This width along with large distances of over 1600 km in East-West and changing 475-650 km between North-South directions, as well properties such as location, relief and climate have caused the formation of different geographical regions within the country boundaries. As of the end of 2004, the total forest area in Turkey is 20703122 hectares. This figure is 26.6% of Turkey's area. High quality forests and coppice forests spread over 10547987 hectares account for 50.9% of the total forest area, coppice forests spread over 10155135 hectares account for 49.1% of the total forest area. According to 2004 figures, the percent of coniferous forest in the total forest area is 53.9 and that of deciduous forest is 46.1. Production capacities are approximately 12039718 m³/year in high quality forests and 8837705 m³/year in coppice forests, respectively.

Methods: The production of wood raw material are formed various stages that continues from the productive place to market centre. The transport of forestry products is realized in two stages. The first one is the primary transport stage which involves the haulage of timbers, while the second one is the secondary transport stage involving the main stage of transport of timbers, generally realized by trucks on forest roads. Primary transportation is moving timber from the harvesting site to the landing area. Cutting, bucking, skidding, landing and unloading are some of the major activities of primary transportation. Based on the results of several studies, non-mechanized (manual) cutting and skidding are relatively inefficient and more expensive than that of mechanized techniques. Primary transportation is generally 25-50 percent of total cost of the harvesting activities [3-4]. These work stages depend on each other like rings of a chain. However the increasing of forest products need that is formed in our country recently, now hauling has been still made with old patterns, such as sliding, throwing, circling, transport with human, skidding with animals on ground. Besides special forest tractors and skylines are used in some areas.

The level of harvesting mechanization in developed countries is higher than Turkey. While mechanical harvesting is about 86% in Austria that is

similar to Turkey, this ratio is about 9% in Turkey. Timber haulage studies are usually practiced with tractor winches that have double or single drums. Timbers are skidded directly on surface with the shape of cable harvesting by tractor winches. Another way of timber harvesting is to benefit from skylines. Tractors are used in areas that have 30-35% slope gradient. But skylines are used in areas that have 55-75% slope gradient [1-5].

Productive forests are generally found in mountainous areas which have 40-80% gradient in Turkey. In Turkish forestry, the timber logging expenditures capture the majority of the total forestry expenditures after general administrative expenditures. Taken into consideration the timber production per unit costs (with current price); 16% of total unit costs is harvesting costs (cutting/felling etc.), 31% of them is extraction cost (bunching/skidding etc.) and 30% of them is transportation cost (loading/hauling etc.) [6-7]. Therefore, application of mechanization of skidding such as introduction of grapple skidder or using feller-buncher in cutting phase of harvesting will not only reduce total cost but also increase productivity. Besides, forest products are hauled by short, middle and long skylines types. These skyline types are Koller K300, URUS MIII and Gantner. These skylines are using especially East Blacksea Region in Turkey. Forest tractors are used in different region of Turkey and forest tractors types are MB Trac 800/900/1000/1100 and farm tractors types are Steyr 768, Ford, M.Ferguson, Tumosan and Universal in Turkey (Fig. 1). These tractors go into the yarder side with skidding roads and strips. Tractors are used in two ways in these areas. The first way is; while tractors are staying on the road, to draw the timber up to the road, which is found under road or on the road, with the help of winch line. The second way is; to timber haulage directly on the surface, with skidding, while tractor in entering up to yarder side. MB Trac 800/900/1000/1100 tractor types are being used especially at mountainous areas in Turkey. Technical features of these tractors are given in Table 1.

In areas which has 30-35% gradient, MB Trac forest tractors can work comfortably. But farm tractors can work generally in areas which has a gradient until 30%. The movement capacity of forest tractors is higher than the movement capacity of farm tractors. Forest tractors have many axle heights. Because of this they move more comfortably in skidding strips and roads. Yield values of work which had done with tractors and the study information of machines are given in Table 2.

Table 1: Technical features of MB Trac tractors [8].

| Features | | MB Trac 800 | MB Trac 900 | MB Trac 1000 | MB Trac 1100 |
|-------------------|-----------|---------------------------|---------------------------|---------------------------|---------------------------|
| Machine power | | 75 HP (55 kW) | 85 HP (63 kW) | 95 HP (70 kW) | 110 HP (81 kW) |
| Weight | | 6000 kg | 6000 kg | 7000 kg | 9000 kg |
| Drawing power | | 60 HP (44,2 kW) | 72,9 HP (53,7 kW) | 76 HP (56 kW) | 89 HP (66 kW) |
| Speed | | 30-40 km/hour | 30-40 km/hour | 30-40 km/hour | 30-40 km/hour |
| Cylinder | | 4 cylinder | 4 cylinder | 6 cylinder | 6 cylinder |
| Cylinder capacity | | 3780 cm ³ | 3780 cm ³ | 5675 cm ³ | 5675 cm ³ |
| Cooling system | | Water cooling | Water cooling | Water cooling | Water cooling |
| Speed | Front | 25-40 km/hour | 25-40 km/hour | 25-40 km/hour | 25-40 km/hour |
| | Back | 20 km/hour | 20 km/hour | 20 km/hour | 20 km/hour |
| Winch mark | | CG2M2ZD | CG2M2ZD | CG2M2ZD | CG2M2ZD |
| Cable diameter | | 12 mm | 12 mm | 12 mm | 12 mm |
| Cable length | | 100 m | 100 m | 100 m | 100 m |
| Cable speed | 540 tour | 33-61 m min ⁻¹ | 33-61 m min ⁻¹ | 33-61 m min ⁻¹ | 33-61 m min ⁻¹ |
| | 1000 tour | 19-35 m min ⁻¹ | 19-35 m min ⁻¹ | 19-35 m min ⁻¹ | 19-35 m min ⁻¹ |
| Lift up power | | 2000 daN | 2000 daN | 5000 daN | 5000 daN |
| Depot capacity | | 120 lt | 120 lt | 170 lt | 170 lt |
| Machine type | | OM 314 | OM 314 | OM 352 | OM 352 |

Table 2: Data of the MB Trac and farm tractors in Turkey [8].

| Machines Types | Average Distance (m) | Average Output (m ³ /day) | Average Output (m ³ /day) | Average Fuel Consume (lt/hour) | Average Slope(%) |
|---------------------------------|----------------------|--------------------------------------|--------------------------------------|--------------------------------|------------------|
| Pulling with cable | | | | | |
| MB Trac 800 | 50 | 8.34 | 66.69 | 3-4 | 48 |
| MB Trac 900 | 50 | 6.33 | 50.62 | 3-4 | 53 |
| MB Trac 900 | 30 | 8.81 | 70.51 | 3-4 | 35 |
| Steyr 768 | 50 | 4.38 | 35.06 | 3-4 | 42 |
| Skidding on roads with tractors | | | | | |
| MB Trac 900 | 100 | 3.82 | 30.51 | 3-4 | 10 |
| M.Ferguson | 400 | 6.36 | 50.88 | 3-4 | 15 |



a) MB Trac 900



b) MB Trac 900

Fig. 1: Primary transportation with 4x2 tractors in Turkey

RESULTS AND DISCUSSION

Mechanization on harvesting has begun with use long distance winch skylines in Turkey in 1949. Wyssen, Baco and Hintereger marked 21 set skylines widely used in the northeast forests of Turkey. Furthermore, attain to standard of production in developed countries has been going on in Turkey. It is believed that mechanization of timber harvesting will be improving in near future in Turkey [9-10]. The

average slope of Turkey's forests is 50-60% and overall ratio of mechanization is relatively low. Approximate percentages of man power, animal power, machine power and skyline harvesting are 72, 15, 8 and 5%, respectively (Fig. 2) [11].

Mechanical park has been improved from the point of view type and amount. These amounts has reached to 27 mobile skylines, 43 skidding winches, 85 forklifts, 55 loaders 152 tractors and 71 trucks as of 1982. Park at the production machinery has also improved having

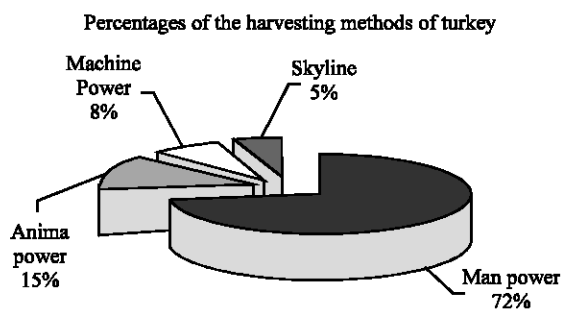


Fig. 2: Approximate percentages of the harvesting methods in Turkey

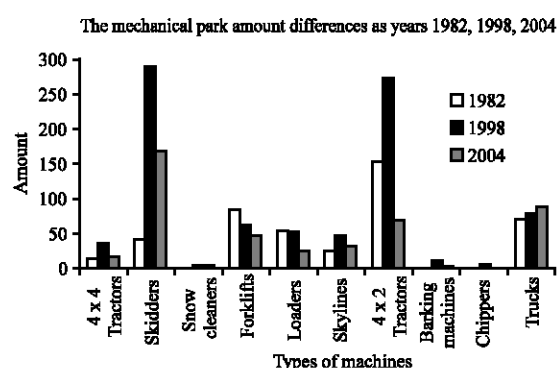
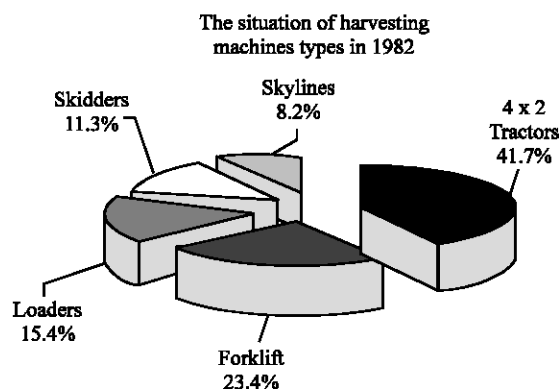
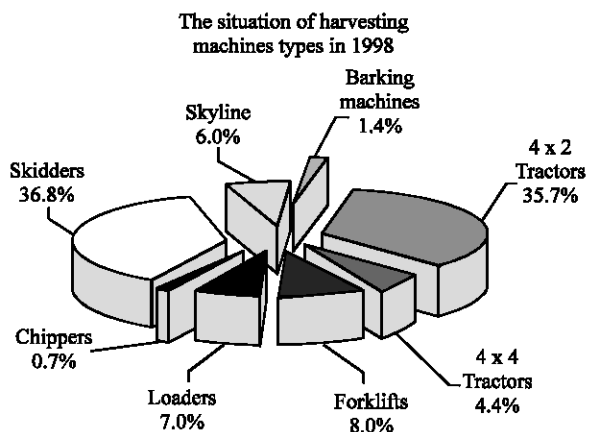
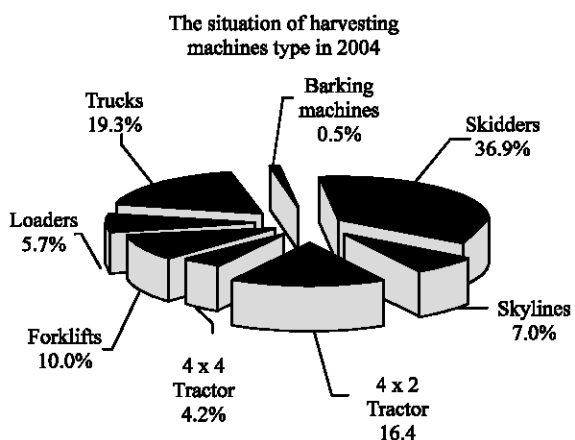


Fig. 3: The mechanical park amount differences as years of Turkey



35 tractors (4x4 and assembled shovel), 286 skidding winches, 6 tractors with equipment of snow cleaner, 63 forklifts, 53 loaders, 47 skylines, 260 agricultural tractors, 12 agricultural tractors with shovel, 11 barking machines and 7 chippers as of 1998. Mechanical park amount has been reduced to 19 tractors (4x4 and assembled shovel), 169 skidding winches, 6 tractors with equipment of snow cleaner, 46 forklifts, 26 loaders, 32 skylines, 65 agricultural tractors, 4 agricultural tractors with shovel, 2 barking machines as of 2004 as illustrated in Fig. 3,4.



In spite of existence of substantial number of harvesters, the amount of modern harvesting processor in Turkey is not sufficient. Different type and marked machine hasn't taken into consideration to improve mechanization and a poor standardization in harvesting is another problem in Turkey. Besides, these production machine generally uses subjective and out of aim because of technical inexperience. Also closing of repair shops due to suffer harm effected situation of production machine. To repair, to maintenance and to obtain spare part of these machine are forced [12].

Fig. 4: The situation of harvesting machines types differences as years 1982, 1998, 2004

Within the scope of this brief study, the following remarks can be concluded about applications of mechanized timber harvesting techniques in Turkey. First of all, harvesting plans should be analyzed based on today's forest conditions before any solid decisions

are made. Turkey is a developing country; it may look as efficient way to use manual harvesting methods at the time. However, it is important that consider long term-harvesting plans which will require mechanization so that total harvesting cost will be reduced in long term. Therefore, initial investments should be considered for mechanization. Road conditions must be improved with regard topographic and silvicultural factors. Slope of primary and secondary roads should be clearly analyzed and combined with harvesting area

and final destinations. Total machine park amount has been reduced 41.4% between years 1998-2004. In 1998, the decision made to close down the Directorates of Main Forest Repair Shops should be reconsidered and possibilities to make these Directorates function more effectively should be researched. Forest main repair shops should be opened over again in Turkey. Level of mechanization should be determined for all of the country and then machines park should be standardized. Forest villagers should be included in logging plan and their involvement may play important in long form in mechanized harvesting. Government should arrange credit to finance initial cost of mechanized harvest equipment owned by local forest villagers. Training of villager should be achieved in the form of short workshop [12].

ACKNOWLEDGEMENTS

This work was supported by the Research Fund of the University of Istanbul. Project number: UDP-458/13042005.

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