Abstract:

The farm tractors used in four different ways for forestry operations. These are skidding, transporting, loading and for transporting of supplies and workers. The farm tractors are required to modify for use in forestry operations. Especially, tractors must be modified for skidding and loading works. In recent years, farm tractors are refurbished many of the features such as technical, body and tire size. Tire size enlargement and increase traction are a big advantage for skidding. The engine power increases, the timber is easier to skidding on the ground. Furthermore, tractors must comply with in terms of safety and environmental sensitivity. In this study, operating facilities of farm tractors for forest harvesting operations are explained inside Turkey forestry. The modified rules of farm tractors will be examined for forest operations. In this study will focus on the issues that should be considered modified of tractors.

Key Terms: Farm tractor, skidding, loading, hauling

Introduction:

The logs are extracted from the timber stand. There are several methods to accomplish this. The most common method is a skidding winch attachment on the farm tractor (also referred to as a skid plate). The skid plate is cheaper than other options, and it also allows for harvesting on steeper slopes because the tractor does not have to be driven to the stump area during removal of the log (Carbaugh, and Hensley 2013). Tractors are the most appropriate method to use for forestry operations in areas where the slope doesn’t exceed 35 to 40%. The skyliners and MB tract skidders used in our country is very old and productivities of these machines cannot be enough. At the same time, fuel consumption, repair and maintenance costs are very high. Many of these machines have been scrap and don’t use. Therefore, modify farm tractors are used instead of these old machines in recent years. Worldwide, farm tractors have been used in various forestry operations such as extraction, loading, transportation, site preparation so on (Eker et al. 2011). In Turkey, harvesting activities are generally performed by forest villagers or small-size contractor companies managed by forest villagers. In logging activities, whole-tree and tree-length systems cannot be implemented due to limited usage of technology, insufficient forest road standards, and inapplicability of running larger logging trucks. Therefore, qualities of the end-products decrease and size of the products cannot satisfy the market demand. Using man and animal power in harvesting activities is also one of the main causes of not being able to produce end-products with required sizes (Ozturk and Akay 2007).

The combination of the timber type and topography limit harvesting mechanization to perform transport operations. Rubber tired skidders are used on the more gentle slopes and on skid roads on steeper terrain (Gholami and Majnounian 2008). In many regions of the world, farm tractors have been used in forestry where the terrain conditions and the size of the forest operation are not limiting (Akay 2005). Modified farm tractor play an important role in forest exploitation even after the
The farm tractors can be efficiently and economically used in mechanized harvesting operations after receiving some modifications and additional hardware, by considering load and power limitations of the farm tractors. It is anticipated that loggers may prefer modified farm tractors since the initial purchasing cost and machine rate is less than that of other harvesting equipment. Various types of logging equipment with different functionalities have been used in forest harvesting operations. In Turkey, harvesting activities are generally performed by forest villagers or small-size contractor companies managed by forest villagers. In logging activities, whole-tree and tree-length systems cannot be implemented due to limited usage of technology, insufficient forest road standards, and inapplicability of running larger logging trucks. Therefore, qualities of the end-products decrease and size of the products can not satisfy the market demand. Using man and animal power in harvesting activities is also one of the main causes of not being able to produce end-products with required sizes (Ozturk and Akay 2007).

In this study, operating facilities of farm tractors for forest harvesting operations are explained inside Turkey forestry. The modified rules of farm tractors will be examined for forest operations. In this study will focus on the issues that should be considered modified of tractors.

Farm tractors: Farm tractor systems are generally best suited for level to moderately-sloping terrain. They do not work well in extremely wet or swampy conditions. Skidding distances should be 500 feet or less for the system to be profitable. Farm tractors are smaller and lighter than conventional harvesting equipment, which reduces the chance of soil disturbance and residual stand damage, but also reduces handling efficiency. Loaded farm tractors can be difficult to manage with a heavy load, making these systems better suited for operations that involve small to intermediate size trees such as thinning.

The system has four primary advantages. First, it is relatively inexpensive to establish. Second, it is a very versatile system that can effectively execute forest management regimes such as silvicultural clear-cuts, thinnings, group selection harvesting, and single-tree selection harvesting. Third, farm tractors can be adapted to a variety of tasks including cable logging (for steep terrain), cable skidding, and forwarding. Finally, soil compaction and damage to residual timber can be minimized, due to the light weight and small size of most farm tractors (Carbaugh,and Hensley 2013).

Disadvantages of this system include low productivity (relative to conventional systems), early equipment failures, limited range, and elevated safety risks. Farm tractors are not designed as logging machines; they are neither as powerful nor as durable as conventional logging machines, which results in smaller payloads and more frequent breakdowns. Their lighter frame, while reducing soil compaction, can make handling difficult when hauling a load (Carbaugh,and Hensley 2013).

In Turkish forestry a lot of farm tractors modified for forest operations are used. These tractors are various type and dimension. These models are such as New Holland, Massey Ferguson, Fiat, Universal, Tumosan etc. The engine powers of these tractors are changed to between 50 HP and 90 HP. The technical features of some tractors showed Table 1. There are factories in the agricultural tractor. Especially in recent years, these tractors are produced in a technically very modern. These machines enlarged tire sizes and it’s added to
the cabin. The cabins of tractors are modern and ergonomically designed. Farm tractors are produced as four-wheel drive tractors. Therefore, the force of gravity machines increased.

Table 1. The technical features of some farm tractors (Ozturk and Akay 2007).

<table>
<thead>
<tr>
<th>Features</th>
<th>Fiat 1180 DTH</th>
<th>MF 276 G</th>
<th>NH 70-66</th>
<th>Universal DT</th>
<th>Tumosan 643 DT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>2400</td>
<td>3450</td>
<td>2650</td>
<td>2800</td>
<td>3450</td>
</tr>
<tr>
<td>Track width (mm)</td>
<td>1350</td>
<td>1422-2134</td>
<td>1410-1910</td>
<td>1400-1900</td>
<td>1400-2100</td>
</tr>
<tr>
<td>Distance between axles (mm)</td>
<td>2130</td>
<td>2140</td>
<td>2305</td>
<td>2270</td>
<td>2295</td>
</tr>
<tr>
<td>Cylinder number</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Speed (km/hours)</td>
<td>35</td>
<td>32.4</td>
<td>27.2</td>
<td>25.1</td>
<td>28.2</td>
</tr>
<tr>
<td>Engine power (HP)</td>
<td>50</td>
<td>51</td>
<td>51</td>
<td>52</td>
<td>54</td>
</tr>
<tr>
<td>Fuel depot (lt)</td>
<td>80</td>
<td>60</td>
<td>61</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td>Front dimensions (inch)</td>
<td>7.5x16</td>
<td>7.5-16</td>
<td>7.5-16</td>
<td>11.2-10-24</td>
<td>7.5-16</td>
</tr>
<tr>
<td>Back dimensions</td>
<td>16,9-14-30</td>
<td>16,9-14-30</td>
<td>16,9-14-30</td>
<td>16,9-14-30</td>
<td>16,9-14-30</td>
</tr>
</tbody>
</table>

MF: Massey Ferguson
NH: New Holland
Modified rules of farm tractors

Various types of modification have been implemented on the farm tractors. In the state of Virginia in the US, farm tractors are equipped with five different attachments: (1) pulling winch, (2) cutting head, (3) skidding winch, (4) loading grapple, and (5) cable logging tower. These types of modified farm tractors have been widely used in small and medium size harvesting operations in Scandinavians and Canada.

Some of the specifications in the modified farm tractors are similar to mechanized harvesting equipment:

- Front and rear axles with the same load rate (50%)
- Four-wheel drive
- Articulated steering system
- Three-point hitch to anchor the winch on the ground and to raise the ends up
- Large size and high pressured tires with chain
- Adjustable ground clearance
- Advanced hydraulic capacity
- Protective cab or roll bars for operator’s safety
- Two-ways operator seat
- Differential locks

The modification of the farm tractors can be performed by national manufacturers. When adequate modifications are implemented, it is highly anticipated that farm tractors can be efficiently and economically used in harvesting operations in Turkey (Ozturk and Akay 2007). Some of the modifications applied to tractors, are as follows;

- Large volumes tires
- Protected cab
- Improved maneuverability
- Drum
- Differential locks
- High-capacity hydraulic pump system
- Cold-weather starter

Use of farm tractor as skidder: The drum is mounted on the back of the tractor that used as skidders. Power is obtained from the tractor shaft. Tractor is done skidding work on the skid road or skid trail. Furthermore, tractor has been attracting with a crane standing on the road (Figure 1). The environmental damage may occur during the skidding operations. Especially, environmental damages may occur on the forest soil.
Use of farm tractor as loader: The farm tractors can be used as a loader. A load arm is added to the rear of the tractor. Besides, a weight is added to the front side of the tractor. This arm is used to as either loading or stacking (Figure 2).

Use of farm tractor as transporter: Farm tractors are used to a transporter. Tractor trailer is carried forest products such as timber or firewood. Besides, these tractors are used to transport of worker and supplies for forest operations (Figure 3).

Use of farm tractor as skyline: The skyline tower is mounted on the back of the tractor that used as skidders. Power of skyline is obtained from the tractor shaft. The tower height of skyline is 8 meter and the length of skyline is 100 meter (Figure 4).

Productivity of modified farm tractors: Many studies were carried out that were aimed at productivity and cost of felling and skidding operations and effective factors influencing the machine performance (Glanipoor et al. 2012). There are several studies on the efficiency of tractors. In these studies, time measurements have been done and hour’s productivity of farm tractors has been found in different regions of Turkish forestry. At the same time, fuel consumption of farm tractors has been calculated in these studies. In these study areas, environmental damages has been investigated to caused by tractors and skidding operations. According to Ozturk; in a study conducted in the Izmit region, the total cycle time of tractor at the average 100 meters are found 4,48 minutes and the average load volume is found 0,500 m³/cycle. In this study, productivity of tractor is calculated 6,25 m³/hours (Ozturk 2012). In another study, in a study conducted in the Ordu region, the average load volume for 140 and 320 meters skidding distance are 2,150 m³/cycle and 1,620 m³/cycle, respectively. In this study, productivity of tractor for same distances are
calculated 11,350 m³/hours and 7,700 m³/hours, respectively. (Ozturk 2010).

The skidding operations with the modified farm tractor are very important at skidding distance. Increasing the average skidding distance during the forest operations decreases the productivity of tractors. Also, the cost of skidding increases in felling area. For to be effective of tractors, skid roads and skid trails should be coated in the form of a network in working areas.

References


Ozturk, T. 2012. Timber extraction with a modified farm tractor in black sea region of Turkey, FORMEC, October 8-12, 2012, Croatia.