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Evaluation of Timber Extraction Machines in Turkey

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Abstract: 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 center. These work stages depend on each other like rings of a chain. Success and failures in each stage effect the next stage. However the increasing of forest product 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 direct ground. Besides special forest tractors and skylines are used in some areas. In this study researched technical features and work performances of MB Trac tractors and skylines in Turkey.

Key words: Tractor, Skyline, Logging, Hauling, Forest Operation, Turkey

INTRODUCTION

The production of wood raw material are formed various stages that continues from the productive place to market center. These work stages depend on each other like rings of a chain. Success and failures in each stage effect the next stage. 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 [1].

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 direct 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 percent 86 in Austria that is similar to Turkey, this ratio is about percent 9 in Turkey [2].

Protuctive forest are generally, found in mountainous areas which have %40 - 80 gradient in Turkey. Timber haulage studies are usually practised with tractor winches that have double or single drums. Timbers are skidded directly on the surface with the shape of cable hauling by tractor winches. Another way of timber haulage is to benefit from skylines. Tractors are used in areas wich have % 30-55 slope gradient. But skylines are used in areas that have % 55-75 slope gradient [3].

Koller K300, URUS MIII and Gantner skylines are used in East Blacksea forest areas. Special forest tractors like MB Trac 800-900-1000-1100 and farm tractors. Like steyr 768, Ferguson are used in almost whole forest areas in Turkey.

MATERIALS AND METHODS

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 77 945 200 hectares [4].

As of the end of 2003, the total forest area in Turkey is 20 703 122 hectares. This figure is 26.6% of Turkey's area. High quality forests and coppice forests spread over 10 547 987 hectares account for 50.9% of the total forest area, coppice forests spread over 10 155 135 hectares account for 49.1% of the total forest area. According to 2003 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 12 039 718 m³/year in high quality forests and 8 837 705 m³/year in coppice forests, respectively [5-6].

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. The need for forest roads in total in Turkey was 201810 km and that 133693 km portion on which, corresponding to 66.25% constructed by end of 2002.

Mechanical park at Forestry General Directorate in Turkey has been improved 187 MB Trac tractors, 68 farm tractors (adapted), 19 Koller K300 skyline, 15 URUS MIII skyline and 3 Gantner skyline machines as of 2004 as illustrated in Table 1.

Table 1: Amount of Extraction Machines Used in Turkey (2004 Year)

							4X4 Tractors						Skylines				
Administration of forest	MB Trac 800	MB Trac 900	MB Trac 1000	MB Trac 1100	Flat 1180	Unimog	Steyr	Ford	Fordson	M. Ferguson	Tumosan	Universal	Urus MIII	Gantner	Koller K300	Romork K300	Total
Adana		3															3
Adapazari	1	5					2										8
Amasya	2	10	1				6	1									20
Ankara		6	1	2	2		4	2									17
Antalya	6	10	1				3	3				1	1		1		26
Artvin	2	3											4	3	3	1	16
Balikesir		7													2		9
Bolu	1	12				1	3	1			1						19
Bursa	2	5					3	1							2	2	15
Canakkale	3	8	2				5	1							1		20
Denizli		1					1										2
Elazig							3										3
Erzurum		1					1	3		2							7
Eskisehir		1		2			1										4
Giresun	6	9			1								2		1		19
Isparta		5					1										6
Istanbul		2					2										4
Izmir	1	6	1				3	3									14
K.Maras		3															3
Kastamonu	5	11					2	2					5		1		26
Konya		1															1
Kutahya		2														1	3
Mersin	1	2		1			1	1									6
Mugla		7					1						1		2		11
Sinop	1	5					2	1					1		1		11
Trabzon	2	5											1				8
Zonguldak		9					1								1		11
Total	33	139	6	5	3	1	45	19		2	1	1	15	3	15	4	292
Gen. Total			187							68			37				292

Table 2: 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)	95HP (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 cm³	3780 cm³	5675 cm³	5675 cm³
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
Vinch 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	OM352

Technical Features and Work Performance of Tractors: These tractors go into the yarder side with skidding roads and strips. In this areas tractors are used in two ways. The first way is; while tractors is staying on the road, to draw the product up to the road, which is found under the road or on the road, with the help of winch line. The second way is; to timber haulage the product directly on the surface, with skidding, while tractor is entering up to the yarder side. MB Trac 800-900-1000-1100 tractor types are being used especially at mountain areas in Turkey. These tractors are showed technical features Table 2.

In areas which has %30-55 gradient, MB Trac forest tractors can work comfortably. But farm tractors can work generally in areas which has a gradient until %30. Weight and dimension of the product that is skidded by forest tractors, is more than the weight and dimension of the product that is skidded by farm tractors. And also the movement capacity of forest tractors is higher than the movement capacity of farm tractors. Forest tractors

Table 3: Data of the MB Trac and Farm Tractors in Turkey

Machines	Average distance(m)	Average output ($m^3\ h^{-1}$)	Average output (m^3/day)	Average Fuel consume ($lt\ h^{-1}$)	Average slope (%)
Pulling with cable					
MB Trac 800	50	8,336	66,688	3-4	48
MB Trac 900	50	6,328	50,624	3-4	53
MB Trac 900	30	8,813	70,504	3-4	35
Steyr 768	50	4,382	35,056	3-4	42
Skidding on roads with tractors					
MB Trac 900	100	3,813	30,504	4-5	10
M Ferguson	400	6,360	50,880	5-6	15

Table 4: Technical Features of Gantner, URUS MIII and Koller K300 Skylines [8-9]

Technical features	KOLLER K300	URUS MIII	GANTNER
Base Machine	Ford 1180 DTH	Mercedes 1500T trucks	-
Power of machine	50 HP	70 HP	45 HP
Maximum cable speed	-	6 m sec^{-1}	7,5 m sec^{-1}
Maximum skyline length	300 m	600 m	2000 m
Total weight	1600 kg	8500 kg	1420 kg
Height of tower	7 m	8,7 m	-
Brake type	Mechanic	Mechanic	Mechanic
Maximum number of drums	2	4	1
Carriage	Koller SKA 1	Koller SKA 2,5	Koller SKA 2,5
Cables (thickness x length)			
-Skyline	16 mm/300 m	22 mm/600 m	24 mm/2000 m
-Main line	16 mm/300 m	12 mm/600 m	16 mm/2000 m
-Guyline	15 mm/3 X 30 m	16 mm/50 m	15 mm/3 X 30 m
-Haulback line	-	12 mm/1200 m	-
-Auxiliary line	-	10 mm/600 m	-

Fig. 1: Tractor and Gantner Skyline

have many axle height. Because of this they move more comfortably in skidding strips and roads. Yield vaules of work which had done with tractors and the study informations of machines are given in Table 3.

Technical Features and Work Performance of Skylines: In Turkey, forest skylines are various types such as 1) Koller K300 skylines, 2) URUS MIII skylines, 3) Gantner skylines. Also, MB Trac 800-900-1000-1100 tractor types are being used especially at mountain areas. If the distance of maximum 300 m, Koller K300 skyline makes a transport. If the distance is max. 600 m, we use URUS MIII skyline and if the distance is between 1500 and 2000 m, Gantner skyline is used for transport. Koller K300 skyline and Gantner skyline which is assembles to trailer, transport from below to above also above to below. Skylines types are being used especially at mountain areas in Turkey. These skylines are showed technical features Table 4.

Table 5: Data of the Different Skylines in Turkey

Skylines	Average Distance (m)	Average Output ($m^3 h^{-1}$)	Average Output (m^3/day)	Average Fuel Consume (lt h^{-1})	Average transporting time(min)	Costs ($\$ m^{-2}$)
Koller K300	225	2,889	23,114	2,5	11,58	4,49
Koller K300	150	10,012	80,096	2,5	6,10	3,48
URUS MIII	250	12,931	103,448	3,5	5,30	4,13
URUS MIII	350	7,906	63,248	3,0	17,13	5,24
Gantner	300	6,423	51,384	3,0	12,12	4,10
Gantner	800	2,234	37,032	3,0	15,28	5,06

Fig. 2: Koller K300 and URUS MIII Skyline

Koller and URUS MIII skyline are mobile. Installation and uninstallation periods of these skylines are short. And also they are transported from a yarder side another very quickly. Assembly and dissembly periods of Gantner skylines are so long because of long institution and condition of lands. Koller and URUS skylines generally transport the product which is in the timber condition like this: One of the tip of product is transported surface and the other is in hook by these skylines. But Gantner skyline transports the timber completely in hook. In to posations, average times of timber haulage works and yields of machines are shown in Table 5.

As it is show in the Tablo 5, URUS MIII skyline's hour product was found as 7,9 and 12,9 m^3 when the distance is 250 and 350 m. Koller K300 skyline's hour product was found as 2,8 and 10,0 m^3 when the distance is between 150 and 225 m. Gantner skyline's hour product was found as between 2,2-6,4 m^3 when the distance is between 300-800 m. Under these conditions, the fuel consumption of skylines change between 3 and 4 liters per hour. In skylines, average of 3-4 workers are worked according to land conditions of loading area, species of product which is timber haulaged and the intensity of work in the ramp.

CONCLUSION

Mechanical park at Forestry General Directorate in Turkey has been improved 187 MB Trac tractors (4X4 and assembled shovel) and skidding vinches, 68 farm tractors (adapted), 19 Koller K300 skyline, 15 URUS MIII skyline and 3 Gantner skyline machines at 2004.

During the construction of forest roads, with the dependence of the length of road, the land between 1,0-2,0 ha is lost trees and plants. During the studies of road constructions in rocky lands and mountainous lands like the region of Turkey, big damages occur in stands which are remained under the road. During the construction studies, stones and rocks which roll to the bottom, damage to trees and plants that are under the road. Because of this, it is suitable that these lands are possibly opened with skylines and tractors, instead of being opened roads for only production.

During the skidding of product with the help of tractors, treees and sapling which are found in the environment and also soil of forest can be damaged. Because of this, skidding strips and road must be opened in a place where the tractors are used. So, the roading in forest is increased but the drawing distance of tractors is decreased.

Skidding roads and strips must be done in a definite plan. These plans must be definetly suitable for an area and also practices must be put in order according to these plans. A wrong way, which is followed in the stage of timber hauling, causes spending more power and more money and also spending more time in timber hauling. It also causes less amount and quality of

product. In addition, it will be damaged the soil of forest and youth.

In respect of this study, the skylines' and tractors' unit volume transport expenses are more less than the other hauling methods (hauling with human and animal power). If we produce forest product cheaper and high quality, the profit of Forest Districts will be too much.

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