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Forestry and Forest Operations in Turkey: Challenges and Developments

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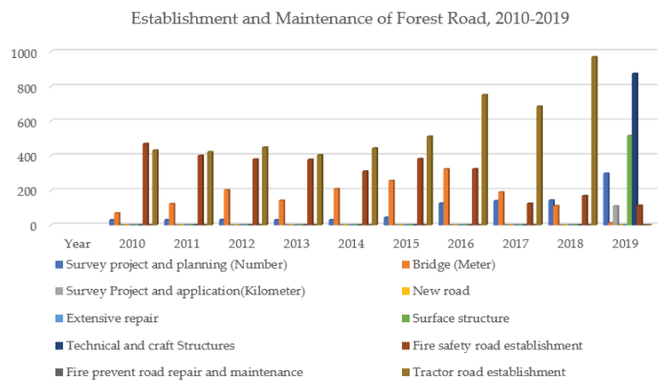
HIGHLIGHTS

- Comprehensive planning will help improving forest operations and all of activities.
- Increasing the integrated planning and programming capacity of the institutional structure is important for sustainable planning.
- Forest roads can be developed in such a way that ensures the continuous and regular supply of forest products to the market.

GRAPHICAL ABSTRACT



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ABSTRACT

There are damages or losses in natural resources due to many social-economic-ecological effects such as increasing demand for the use of forest resources over time, climate change and development needs. Therefore, there have been recent changes in management of forest resources in Turkey. Today, forest management plans are developed and implemented based on the principles of sustainable and functional forestry approaches. Up-to-date information on production of wood-based forest products and forestry activities in Turkey was presented. Besides, statistical information on forest road standards and quantities of existing and planned roads were revealed. As a result of the study, it was recognized that one of the important developments in forestry activities was the implementation of sustainable forest management approach with the new planning system. In addition, depending on the developing technology, the use of mechanization in forestry activities has increased in Turkey. Depending on the increasing demand on mechanization, improvements in forest road standards are considered and there are observations that they are being implemented in some areas.

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1. INTRODUCTION

Forests have important ecological and social functions besides being an important source of raw materials from which wood and non-wood forest products are produced. The management of forests in a way that is both suitable for environmental conditions and socially and economically beneficial to society constitutes the basis of today's forest management philosophy. For this purpose, various certification systems have been established to ensure good environmental and economic management [1]. By changing the former planning method of forests, based solely on wood production, sustainable forest management approach has been put into practice. Forestry activities have been directed according to ecosystem-based functional management plans that take into account the ecological, economic and social functions of forests.

Considering environmental problems, climate change, insufficiency of usable and healthy water resources, food security and social expectations, sustainable management of forests becomes even more important. Population growth rate, income level, urbanization, industrialization, increase in education level, improvements in infrastructure facilities are the main effects that cause societies to undergo economic, social, cultural, technological and political changes [2]. The basic approach of today's forestry understanding is to consider its biological and technical characteristics and ecological, economic, social, cultural and administrative dimensions within an ecosystem integrity. Nowadays, multi-purpose afforestation and soil conservation works have been carried out in Turkey. Thus, while increasing forest areas, it is aimed to prevent soil erosion and sediment transport to the water resources.

Turkey has 22.34 million ha of forest lands which means approximately one-quarter of Turkey's land are covered by forests. As in the world, environmental awareness, social developments, demands to wood raw material, and expectations from natural resources have been significantly increased in Turkey. Despite covering only 0.5% of the Earth's surface, Turkey has a very high species diversity especially in the forest lands [3].

Gümüş [4] defines forestry as activities carried out to meet the forest products and services demands of the society. The data used for forest operations in Turkey is composed of data obtained by the management plans and various measurement methods [5]. This study aimed to give information on the economic contribution of forest resources and forest management in Turkey. In addition, methods used in forest operations and forest roads are presented. In the study, the progress in forestry and forest engineering in Turkey were examined in 6 main sections. Thus, an assessment of the developments and challenges in forestry and forest engineering has been conducted.

2. MATERIAL AND METHODS

The literature synthesis about the current challenges in forestry and forest engineering in Turkey was provided based on the information collected from the scientific studies, academic researches, state documents, and institutional reports. The aspects of the study cover the relevant issues including forest resources, forest management plans, forest engineering, forest operations, forestry mechanization, and forest roads. The outcomes of the study were presented under Results and Discussion through following six sub-sections listed under: i) characterization of forest resources and their contribution to the economy, ii) description of forest management and of the use of forest resources, iii) characterization of mechanization in forest operations, iv) characterization of forest roads; v) current/critical challenges in forestry and forest engineering and vi) state of the art in relation to research done and developments to respond to those challenges.

3. RESULTS AND DICSUSSION

3.1. Characterization of Forest Resources and their Contribution to the Turkish Economy

In Turkey, 99.9 percent of the forest land are owned by the State, reflecting the nationalization of forests in 1945 (Law of Nationalization, Law 4785) in an attempt to safeguard resources and combat over-exploitation. The definition of forest in Turkey excludes areas of forest less than 3 ha and areas with species not found in natural forests [6]. Forest areas with a canopy cover of 10 percent or more are classed as "productive forests" and are required to have an allowable cut identified in the forest management plan. As of 2019, 94.72% of the forests are high forest while the rest is coppice forests in Turkey [7]. In the last fifteen years, the share of high forest area increased due to the decrease in the coppice forests, degraded forest areas, and establishment of new forests (**Figure 1**).

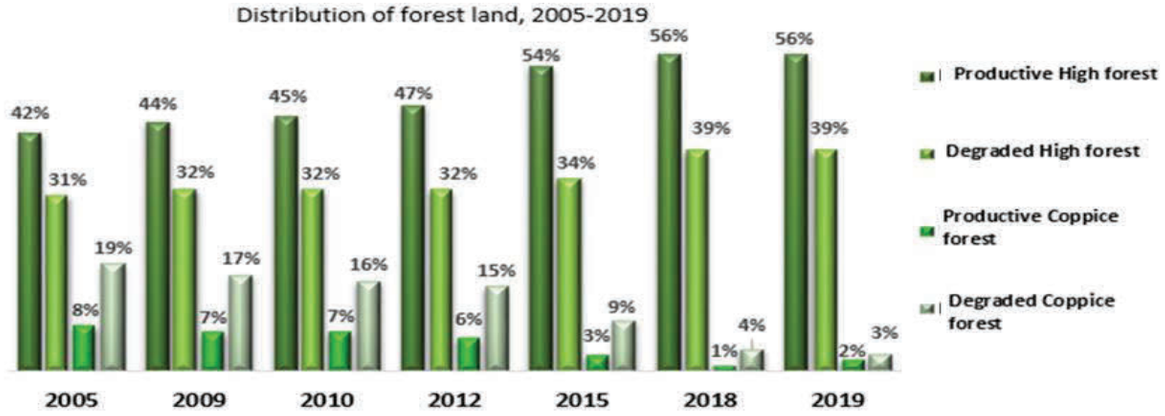

Figure 1: Distribution of forest land in Turkey between 2005 and 2019. Source: [7]

Table 1. Forest Area and Growing Stock in 2019

Forest Type	Area (million ha)			Growing Stock (million m^3)		
	Productive Forest	Degraded Forest	Total	Productive Forest	Degraded Forest	Total
High forest	12.73	8.81	21.54	1,595.83	64.79	1,660.62
Coppice forest	0.35	0.85	1.20	14.01	4.72	18.74
Total	**13.08**	**9.66**	**22.74**	**1,609.84**	**69.51**	**1,679.36**

The changes in forest area in recent years also affect the growing stock distribution. According to the statistics stated by the General Directorate of Forestry (GDF), the growing stock has increased in the last 10 years. In addition, according to the statistics of 2019, 95.9% of the growing stock was specific to productive forests, while 4.1% was that of degraded forests. The total growing stock was estimated at 1.66 billion m^3 in 2019 (**Table 1**). Approximately 50% of the forests are classified as having an economic function, mainly that related to the production of round wood, fire-wood, and non-wood forest products, 42% an ecological function with the purpose of watershed and erosion control and the remaining 8% have functions related to social and cultural aspects [8].

Natural resources are important for the local economy of Turkey [9]. Strategic planning for local economic development is in the duty of local or urban governments, which are considering the advantages of the region's humanitarian, social, economic, institutional and natural resources, as well as its geographic location, in a large-scale, long-term and future-oriented vision framework [10]. Strategic planning or management approach has been implemented by the private sector since the 1950s with the aim of increasing efficiency and effectiveness, and after 1980, this approach has been used by the public administration as the traditional public management approach has lost its effectiveness. Then, strategic planning started to have a place in the national planning system in the 2000s [11]. In public administrations, strategic plans are classified as long-term (five years or more), medium-term (one to five years) and short-term (less than one year) plans. In terms of functions fulfilled by the plans, it is seen that they are handled in the form of strategic action plans [12]. Strategic planning was considered in order to examine its contribution to the planning of forest resources.

According to the Turkey Export Council's 2023 Export Strategy Report, exports of forest products in 2023 is predicted to be 16 billion US dollars with an annual average growth rate of 13.7% [13]. The forestry sector, which has an economic size of 12 billion dollars and exports of 2.4 billion dollars in 2013, targets an economic size of 25 billion dollars and an export figure of 8 billion dollars in 2023 [14]. In 2018, exports of 571 million dollars versus 624 million dollars of imports were recorded considering wood product types [15].

In Turkey, the economic contribution of the forest sector is about 0.8% according to the calculations of Turkey Statistical Institute which was made based on the monetary value of primary and secondary forest products and services. Considering the subsidies arising from inputs given free of charge or with low cost to other sectors, this ratio reaches up to 2% [16]. According to GDF

data for 2018, the contribution of wood-based product sales to the national economy was 4.263.569.558 TL. A total of 140,994 people, 72,174 of which are forest cooperative members and 68,820 non-cooperative employees, were employed in forest operations, and 36,106 personnel were employed in GDF organizations [17].

According to Development Plan for 2019-2023, the contribution of forests to the economy will be increased through sustainable forest management. The support provided for forest villagers will be maintained within certain programs, and professionalization will be raised through training activities in order to increase quality of production and labor productivity in forestry.

3.2. Description of Forest Management and of the Use of Forest Resources

Forest planning in Turkey has begun with the first management plan developed in 1917-1918 [18]. Today, management plans are developed according to ecosystem-based functional planning (ETFOP) approach [19]. Within the frame of Sustainable Development Goals, Turkey's forest resources are managed according the international conventions and processes to which Turkey is a party, national forestry strategic plans, forestry master plans, forestry programs, and regional and local action plans designed with a participatory approach. The main strategies aim and plan to protect forest and forest resources, develop a close understanding of nature, manage in sustainable ecosystem integrity and provide multidimensional benefits to the society, and vision [20].

In line with forestry policies and strategies, the objectives of sustainable forest management are as follows:

- Improving institutional, administrative and human capacity and information infrastructure;
- Ensuring effective coordination between forestry organizations;
- Ensuring supply guarantee in production based on forest products;
- Increasing the life quality of forest villagers, strengthening the economic and social infrastructure;
- Capacity building for Ecosystem Services;
- Increasing the integrated planning and programming capacity of the institutional structure.

Sustainable forest management has been applied in Turkey, which faces many challenges for an efficient utilization of forest ecosystem services [21]. The General Directorate of Forestry (GDF) is the main institution in the sector, responsible for the integration policy and supervision of the protection and sustainable forestry management of forest resources in Turkey, and it is part of the Ministry of Agriculture and Forestry (MAF). The majority (over 99%) of forest land is state owned and managed by GDF. Decision making and forest operations have been planned, organized, guided, managed, and controlled through the Chief Office of the Forest District (COFD), the Directorate of the Forest District (DFD), the Regional Directorate of Forestry (RDF), and also GDF [21], as respectively and hierarchically [22]. Most of the wood raw material demand is met by GDF. Within the admission of GDF, there are 28 Regional Directorates of Forestry and 12 Forestry Research Institutes [23].

Planning production in forestry is a relatively complicated problem that requires the harmonious implementation of issues such as primary (logging) and secondary (hauling) transport [24]. During the forest operations, the decision maker should consider various factors: weather conditions, climate, vegetation, topography, social structure, logging techniques, harvesting methods, amount of production, existing forest road network [25, 26].

The most effective way to improve especially forest operations is through comprehensive planning of all activities. At the tactical level, multifunctional forest management plans have been prepared for each planning units in COFD. In addition to other decisions, these plans provide the harvestable compartments (blocks) in each year within a planning horizon. Harvest decisions are based on 10–20-year forest management plans and silvicultural prescriptions for a mid-time horizon [21]. The harvesting decisions from COFDs to GDF have been executed by governmental legislation the name of which is "Official Communique about Harvesting of Wood-based Forest Products No: 310" [27].

Nowadays, by the use of forest resources, products such as logs, telephone poles, mining poles, other industrial wood, pulpwood, fiber-chip wood, fuelwood are produced as wood raw materials. Non-wood forest products are typically the resin, resinous wood, *Buxus*, *Laurus nobilis*, *Thymus*, *Salvia* sp., *Tilia* sp., natural mushrooms, flower bulbs, etc. In **Table 2**, wood raw material production values are indicated based on the statistics provided by the GDF.

Table 2. Annual production amount of the main forest-related products in Turkey (2012-2019). Source: [3]

Annual production amount									
Description	**Unit**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Log	m^3	5,027,738	4,629,829	5,001,861	5,904,015	5,786,106	5,474,260	7,152,776	**8,514,026**
Telephone pole	m^3	59,613	32,641	37,527	54,257	57,574	60,610	71,147	58,333
Mining pole	m^3	692,944	541,771	570,156	663,689	632,168	561,967	731,604	929,259
Other industrial wood	m^3	874,793	701,688	728,971	764,010	835,157	752,253	875,403	1,008,952
Pulpwood	m^3	2,333,651	2,196,434	1,966,963	2,375,172	2,486,595	2,169,059	2,874,882	3,175,505
Fibre-chip wood	m^3	5,424,794	5,551,397	6,608,416	6,866,356	7,201,462	6,494,372	7,361,714	**8,417,096**
Fuel wood	m^3	4,824,506	4,486,277	3,943,496	3,767,240	3,657,801	3,269,734	3,667,841	4,201,807
Total	**m^3**	**19,238,039**	**18,140,037**	**18,857,390**	**20,394,740**	**20,656,862**	**18,782,255**	**22 735,367**	**26,304,977**

The forest products with the highest amounts were the log and fiber-chip wood production between 2012-2019. In the last 8 years, average quantities of 6,740,700.924 m^3 of fiber-chip wood and 5,936,326.391 m^3 of logs have been produced. In the case of non-wood forest products, which is another area of use of forest resources, in the last eight years, an average of 21,916,726 kg of *Laurus nobilis* and an average of 11,563,283 kg of resinous wood were produced. About 72% of Turkey's wood supply is provided by GDF while 17% and 11% of it is given by the private sector and through import, respectively. When we look at the distribution of wood raw material usage in Turkey, the board sector is at the top with 55%, while the timber industry comes next with 25%, being followed by pallet-packaging with 15%, plywood-coating with 2%, paper with 2%, and pole sector with 1% [27].

Turkey has a great capacity on non-wood forest products due to the advantage provided by high biodiversity. Additionally, people in Turkey have a wide range of experience on the utilization of wild plants and there is a significant diversity of use of non-wood forest products as a result of geographical location and historical heritage. Despite these advantages, it is difficult to mention that sustainable management of non-wood forest products is totally guaranteed in Turkey, as is the case in many other countries [28]. When the production amounts of non-wood are examined according to GDF statistics, the annual average proportional increase of non-wood forest products sales income between 2003 and 2017 is 15.8%, and the production amount of non-wood produced in state forests will exceed 1 million tons in 2022, and GDF's 12.5 Million TL sales revenue is estimated [29].

3.3. Characterization of Mechanization in Forest Operations

The development of the technology level used in wood harvest operations is classified according to its historical course; it is known that basic technology was used until the 19th century, semi-mechanized intermediate technology in the 19-20th century, machine-advanced technology in the 20-21th century, and highly-automated technology with artificial intelligence and smart machines after the 21st century, have been used in the world forestry [30]. The characteristics of Turkish State Forestry may be characterized as holding and using a basic to moderate forest operations technology [22].

As stated by [31], mechanized harvesting began in Turkey in 1949 by using long distance winch skylines. Wyssen, Bako and Hintereger model skylines (21 sets) were widely used in the northeast forests of Turkey. The most used equipment in the Turkish timber harvesting operations is based on human-animal power and partly mechanical systems. In recent years, mechanical methods have been used more frequently, especially in areas with intensive forestry practices [32].

According to the legal obligation, forest acts and regulations in Turkey, all of the forest operations must be accomplished by villagers who live in the forest villages nearest to the workplace. Forest work is the main income for those villagers also called as “forest villagers” and around 6.97 million people live over 22,941 forest villages [7]. In Turkey, forest harvesting activities are performed by forest villagers and/or their cooperatives that have 190,000-300,000 members. On

the other hand, the forestry workers do not receive adequate training and professional education [21].

In Turkey, tree felling, delimbing, topping, bucking, and debarking operations are mostly performed in the woods. In some cases, debarking is done at the roadside. The motor-manual method with chainsaw is used in felling, delimbing and topping, bucking, and partly in debarking by means of equipment attachments [33]. On the other hand, debarking is mostly done by using axe and hand tools. In recent operations, debarking stage is omitted from the harvesting system depending on the sale type. Timber extraction from stump to landing area or roadside is mostly (over 60%) conducted by rolling, throwing, and sliding/skidding methods on the steep ground depending on gravity and by using manpower techniques [34]. In recent years, animal-powered techniques have not been used very often and their proportions are decreasing gradually. The use of farm tractors in logging operations however has an uptrend [35]. The cable logging methods with various distances have been used on mountainous region in Turkey.

The old cable yarders, purchased by the GDF in 1980s, have been replaced as all of them had fulfilled the economic lifetime. In addition, log chute systems are available for extraction of small diameter wood products [36]. Mechanized harvesting equipment with advanced technologies such as harvester, forwarder, and skidder have been implemented by few private forestry companies [32,37,38]. In Turkey, the most common harvesting method is cut-to-length, generally facilitating the use of chainsaws and farm tractors. During loading and unloading operations, grapple loaders or hydraulic cranes are used on roadside or landing areas. Transportation of wood-based forest products is done by logging trucks and trailers on forest and main roads [22].

In addition, leading domestic companies in the production of wood-based panels meet their wood raw material needs in large quantities through supplier companies that can produce wood raw materials in a short time and in large areas by using mechanical harvesting systems [39]. Thus, the forest industry is witnessing an increase of interest in mechanized harvesting systems. The configurations of these systems typically consist of harvesters, feller bunchers, and grapple skidders [40].

The legal obligations in Turkey make it compulsory and necessary to employ forest villagers or to offer the job to the forestry cooperatives mostly established by the villagers. However, local people and cooperatives cannot afford the advanced mechanized forestry equipment due to their high purchase prices and operating costs. In order to make this equipment available for local people, GDF owns equipment that can be rented to them with an acceptable price range [37].

3.4. Characterization of Forest Roads

Forest roads are the basic facilities that enable safe and effective access to the forest for the purpose of carrying out main forestry activities such as timber extraction, forest transportation, forest protection, afforestation, and wildlife management [41], recreation and firefighting [42] activities throughout the year. In Turkey, the forest roads are classified as primary or secondary (types A or B) roads, with type B secondary roads predominating. The main regulation for forest road planning and construction is presented in Communication 292 (**Table 3**). Road density is a

significant factor in the accessibility of forest stands and in the environmental impact of forest harvesting. Forest roads have been planned and constructed according to road density (m/ha) and yield/forest area (m^3/ha) criteria to meet the needs of Turkish forestry. However, forest road density should be determined according to all aspects of forestry operations [31].

Table 3. Forest road standards in Turkey

Road Features	Unit	Main forest road	Secondary Forest Roads				Tractor roads
			A-Type	B-Type			
				HBT	NBT	EBT	
Platform width	**m**	7	6	5	4	3	3,5
Number of lanes	**-**	2	1	1	1	1	1
Maximum slope	**%**	8	10	9	12	12	20
Minimum radius	**m**	50	35	20	12	8	8
Lane width	**m**	3	3	3	3	3	3
Shoulder width	**m**	0.50	0,50	0,50	0,50	0,50	
Ditch width	**m**	1	1	1	1	0,50	
Pavement width	**m**	6	5	4	3	3	
Bridge width	**m**	7+(2x0.6)	6+(2x0.6)	5+(2x0.6)		4+(2x0.6)	

Note: HBT: High standard B type forest road, NBT: Normal B type forest road, EBT: Extreme B type forest road.

In previous studies, it was stated that the target road density is to be 20 m/ha. However, this value can change depending on the technique used during harvesting, the number of skidding roads and also other functions of road use (i.e., firefighting etc.). It was reported that 17,651 new roads were build, 17,538 roads were repaired, and 1,637 bridges were built in last 10 years. The information about the planned and implemented road projects is shown in **Table 4**.

Table 4. Establishment and maintenance of forest roads, 2010-2019 [7].

Year	Projects	Bridges (m)	Projects (km)	New roads (km)	Extensive repair (km)	Surface structure (km)	Technical and craft structure (km)	Fire safety road establishment (km)	Fire prevention road repair and maintenance	Tractor road Establishment (km)
2010	30	69	3,600	1,400	1,000	1,179	1,832	469	18,459	431
2011	30	123	3,644	1,468	1,064	1,162	1,817	401	18,509	422
2012	31	202	4,618	1,518	1,022	1,860	1,959	379	19,440	448
2013	30	142	4,728	1,479	1,421	1,532	1,881	378	18,306	404
2014	30	209	5,394	1,542	1,661	2,094	2,387	310	20 481	443
2015	44	256	5,717	1,624	1,753	2,261	2,823	382	19,871	511
2016	126	323	6,188	1,852	2,276	2,142	3,131	324	23,675	751
2017	140	190	7,721	2,542	2,768	2,520	3,210	125	23,765	684
2018	143	111	8,826	2,902	3,184	2,843	3,696	169	24,584	969
2019	298	12	109	1,324	1,389	515	873	113	24,911	1,025
Total	**902**	**1,637**	**50,545**	**17,651**	**17,538**	**18,108**	**23,609**	**3 050**	**212,001**	**6,088**

At the end of 2020, the length of the planned roads for proving sufficient access to the forests was updated at 320,000 km in Turkey. The current total length of the roads (including the highway, rural roads and other roads) that pass through the forest is about 265,000 km. Approximately 200,000 km of this roads are forest logging roads. Most of the forest roads in Turkey are classified as type B secondary forest roads with standard size (i.e. platform width of 4 m, ditch width of 1 m, gradient less than 12%, minimum curve radius of 12-20 m). However, in the last decade, the forest road standards have been improved and the platform width increased to 5 m. In addition, routine and major repairs are being carried out on forest roads built in the last 50 years.

In 2019, the amount of forest roads planned for all forestry activities was 302,000 km which has been revised since 194,000 km of it has been completed. 66,092 km of village roads are passing through the forest and the total length of roads that can be used in forestry, including highways is 260,092 km. As of 2019, the total forested area has been determined as 22,740,297 hectares [7]. According to these values, road density is 11,45 m/ha. New road planning continues within the scope of development and strategic planning.

In recent years, 2,500 to 3,000 km of new roads have been constructed annually, depending on the economic situation of GDF and the general forestry sector. With these roads, both the overall road density and the actual road density increase. In forests managed for their production function, the road density can exceed 20 m/ha and the road spacing can be reduced below 500 m. Moreover, the skidding distances can be reduced by increasing the road density [43]. Most of the forest roads in Turkey are developed on slopes. Especially the middle and upper hill roads undertake an important function in the management of mountainous forest lands. Valley roads are generally collector roads and their standards are relatively higher. In mountainous forest with steep slopes (particularly in northeast of Turkey), the use of ridge roads and valley roads are an effective way for implementing cable logging methods.

3.5. Challenges in Forestry and Forest Engineering

Sustainability of forestry depends on the dynamics in the use of forest resources. However, factors such as climate change and air pollution direct forestry work to a more detailed planning. Problems may arise in the planning stage of natural resources due to different effects. One of them is the decrease in forest resources as a result of the increase in natural disasters. Extraordinary situations can create problems during planning. The increase in other diseases and harmful organisms in the world disrupts this balance. In addition to the problems mentioned above, the use of highly-mechanized equipment is a problem in Turkey because it is economically expensive for the forest villagers. In addition, the decrease in the young population in forest villages, the increase in labor and production costs, are already challenges in forestry. As mentioned earlier, 99% of the forests are managed by the state in Turkey. Accordingly, besides the facilities provided by the institutional structure, there can be also difficulties. As stated by [6], one of the challenges for the GDF is that of how to mobilize its annual timber harvest in a cost-efficient and sustainable fashion, thereby facilitating the development of a competitive domestic timber processing sector by reducing costs and reconfiguring the timber supply chain.

3.6. Main Research Done to Support Turkish Forestry

Another important aspect of the Turkish forestry is that related to the research and development. With the application of the findings obtained from studies, positive developments occurred, by enabling the continuity in the flow of product and services. As a result of the rapid developments in the forest products industry, new solutions and approaches are available.

One of the current developments is that related to increasing the possibilities of using the LIDAR data supply systems. LiDAR technology has an important potential to enable many forestry activities to be carried out effectively [44]. Advanced tools such as satellite images contribute significantly to the planning and implementation stages in forestry. This type of technology can be provided with the supporting logistics (e.g. recording, analysis and reporting software, training). Especially when LIDAR technology provides uninterrupted and high-resolution data for large areas, it will make great contributions to forest inventory studies conducted to organize forest management plans [45]. As stated by [46], the use of LIDAR data has also a great potential in determining the amount of fuel load in forest areas.

Depending on the developed technology, the possibilities of using computer programs such as In road, NetCAD, Netpro Platea, Geomedia have emerged in the planning of forest roads in Turkey. In recent years, forest road planning has been improved with the use of these programs and besides, forest road planning became more cost efficient [47-49]. In terms road standards, recent studies conducted on improving standards of forest roads have suggested that the total discounted costs of forest roads can be reduced by about 5% in the case of improved road standards [50]. Even though improving road standards may cause extra costs in road construction, but total road costs decrease since maintenance and repair costs decrease considerably in the long run.

In recent years, there is an interest in utilizing logging residues for renewable energy generation in Turkey. The forests have great potential to supply large amount of biomass as there is an annual increment of 46 million m^3 in forest lands [51]. In fact, logging residues can be considered as the most readily available source of biofuel [52]. Thus, logging residues from the industrial forests consisting of fast-growing trees should be used as biofuels to provide renewable resources for energy generation in Turkey [51].

In Turkey the tree cutting stage is mostly carried out by using a chainsaw, while the stage of extracting the wood raw materials is carried out by using human-animal power and partly machine power. In recent years, mechanical production methods have started to be preferred more frequently, especially in areas with intensive forestry [32]. In addition, domestic organizations, which are at the top of the Europe in the wood-based panel industry, supply a significant part of their high wood raw material demands from domestic forest resources. In order to produce wood raw materials in large areas in a short time, contractors purchase alternative machinery and use mechanical systems intensively. In this context, they are willing to invest in modern harvesting equipment which includes harvesters, feller-bunchers, and skidders [39]. In addition, there are ongoing studies on developing own mechanized harvesting equipment in Turkey [53].

Another important development was that related to forest products, taking into account national conditions and international markets. It is aimed at increasing the area of certified forests by developing standardization and certification systems. By GDF, certification studies are considered as one of the most important auxiliary tools; they started in 2010, within the scope of sustainable forest management principles.

4. CONCLUSIONS

Considering the demands of the society and the structure of the country's forests, forest management aims at ecosystem integrity, balancing ecological, economic, social, cultural and administrative dimensions. It is known that there are significant developments in terms of taking into account the versatile services offered in the planning and management of forest resources and in the protection, development and expansion of forests within the framework of sustainable management approach. It is important that forest roads are developed in a way that ensures the continuous and regular supply of forest products to the market. For this purpose, improvements in forest road standards and new road planning continue in Turkey.

In Turkey, the use of mechanization follows an increasing trend. This contributes to the increase of industrial production and to the country's overall economy. In addition, various support opportunities are provided to forest villagers in order to strengthen practices in the production, processing and marketing of non-wood forest products and to exchange and evaluate experiences in this field.

There are large forest lands with high fire risk due to the climate zone in which Turkey is located in. It is clear that firefighting activities will become even more important in the future due to the effects of global warming on wildfire incidents. In this context, various projects and action plans have been implemented by GDF in the subject of fire extinguishing.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

EXTENDED ABSTRACT – REZUMAT EXTINS

Titlu în Română: *Silvicultura şi exploatarea lemnului în Turcia: Provocări şi realizări*

Introducere: *Schimbările climatice, nevoile de dezvoltare şi cererea crescândă cu privire la resurse ameninţă resursele naturale, inclusiv pădurile. Din acest punct de vedere managementul pădurilor trebuie să urmeze filozofia conform căreia beneficiile oferite societăţii nu trebuie să compromită valorile pădurilor relaţionate cu mediul. În acest scop s-au adoptat diferite sisteme de certificare care să echilibreze toate valorile oferite de păduri. Prezenta lucrare insistă pe*

problemele actuale legate de silvicultura şi utilizarea lemnului în Turcia, descriind resursele forestiere, contribuțiile economice şi de mediu precum şi logistica aprovizionării cu lemn.

Materiale şi metode: *Lucrarea are la bază informaţii culese din studii ştiinţifice, cercetări, documente de stat şi rapoarte ale diferitelor instituții din Turcia. Studiul a fost sintetizat în cinci capitole principale, dintre care primul caracterizează resursele forestiere şi contribuția lor în economie, al doilea descrie tipul de management forestier şi modul de utilizare a resurselor, al treilea face referire la nivelul mecanizării în operaţii forestiere, al patrulea caracterizează rețeaua de transport forestier iar ultima parte prezintă provocările actuale şi realizările relaţionate cu silvicultura din Turcia.*

Rezultate şi discuții: *În Turcia, 99.9% din suprafața pădurii este deținută de stat, reflectând naționalizarea acestei resurse care a avut loc în 1945. Aproximativ 95% din suprafața pădurii este gestionată în regimul codru, iar restul în regimul crâng. S-a constatat o creştere semnificativă a suprafețelor gestionate în regimul codru în ultimii 15 ani, în principal datorită plantării de noi păduri. Aproximativ 50% din păduri sunt încadrate în grupa funcțională de producţie, 42% au rolul de a proteja bazinetele împotriva eroziunii, iar restul au roluri socio-culturale. Potrivit Raportului Strategic de Export al Consiliului Turciei pentru Export, exportul de produse forestiere în 2023 este previzionat a fi în valoare de 16 miliarde de dolari SUA, cu o rată de creştere anuală de 13.7%. Sectorul forestier vizează o participare economică de 25 de miliarde de dolari şi o valoare a exportului de 8 miliarde de dolari în 2023. Contribuția silviculturii la economia ţării este de circa 0.8%, bazat pe calculele Institutului de Statistică al Turciei. În prezent amenajamentele silvice sunt realizate pe baza planificării funcționale, iar resursele forestiere sunt gestionate în acord cu convențiile internaționale şi procesele în care este implicată Turcia, planurile strategice naționale cu privire la păduri, master planuri, programe forestiere şi planuri de acțiune regionale şi locale. Direcţia Generală pentru Păduri este principala instituție responsabilă pentru integrarea politicilor, supervizare, protecție şi management sustenabil al pădurilor în Turcia. În prezent, principalele produse generate de sector includ bușteni, stâlpi, lemn de mină, lemn industrial, lemn pentru industria celulozei, tocătură şi lemn de foc. Principalele produse forestiere nelemnoase sunt rășina, lemn cu rășini şi alte specii de interes ornamental sau farmaceutic, ciupercile şi florile. Planificarea producției de lemn este o problemă complexă care necesită luarea în considerare a transportului primar şi secundar. În Turcia, exploatarea lemnului se bazează, în principal, pe efortul uman şi sisteme parțial mecanizate, dar s-au introdus şi utilaje moderne în ultimii ani, mai ales în zonele caracterizate de practici forestiere mai intensive. Utilaje precum mașinile multifuncționale de recoltare, tractoarele forwarder şi skidder sunt utilizate în prezent de câteva companii private. În conformitate cu sistemul legal din Turcia, este necesară angajarea cu prioritate a localnicilor în activitatea forestieră. Cu toate acestea, localnicii şi cooperativele pe care aceştia le-au dezvoltat nu pot să își permită achiziționarea de echipament forestier mecanizat datorită costurilor mari de achiziție şi operare. Ca răspuns, Direcţia Generală pentru Păduri a achiziționat astfel de utilaje pe care le închiriază localnicilor la prețuri acceptabile pentru utilizarea în operaţii forestiere. Drumurile forestiere se proiectează şi se construiesc pe baza densității țintă şi a volumului de masă lemnoasă la hectar, în acord cu necesitățile Turciei. În prezent, densitatea drumurilor este de 11,45 m/ha iar densitatea țintă este de 20 m/ha. La finalul anului 2020, lungimea planificată a drumurilor a fost actualizată la valoarea de 320,000 km. Problemele actuale, cum sunt cele relaționate cu schimbările climatice şi poluarea aerului direcționează silvicultura către o planificare mult mai detaliată şi pot să apară probleme de planificare în diferite stadii ale acesteia. Cercetarea de profil încearcă să rezolve problemele curente ale sectorului prin studii ale căror rezultate conduc la dezvoltarea sustenabilă şi asigurarea continuității de produse şi servicii forestiere. Problemele care apar în industria de profil sunt rezolvate prin noi soluții şi abordări oferite prin cercetare.*

Concluzii: *Există un progres semnificativ legat de serviciile oferite în planificarea şi managementul resurselor forestiere, precum şi de protecția, dezvoltarea şi extinderea pădurilor printr-o abordare sustenabilă în managementul acestora. În Turcia, mecanizarea operațiilor forestiere urmărește un trend crescător, înlocuind metodele şi munca manuală. Statul furnizează oportunități şi suport localnicilor pentru a întări producția, procesarea şi comercializarea produselor pădurii şi pentru schimbul de experiență în domeniu. Este de o mare importanță ca dezvoltarea drumurilor forestiere să se realizeze astfel încât să se asigure continuitatea aprovizionării cu produse forestiere şi, ca atare, îmbunătățirea standardelor şi a modalităților de planificare a drumurilor forestiere continuă în Turcia.*

Cuvinte cheie: *resurse forestiere, amenajament forestier, inginerie forestieră, operaţii forestiere, mecanizare forestieră, drumuri forestiere*

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