RECONSTRUCTION OF THE FOREST ROAD NETWORK MODEL IN THE CONVERSION OF THE COPPICE COMPANIES TO HIGH FOREST ENTERPRISES

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ABSTRACT

In our country, forests cover an area of 21.2 million ha. 5.7 million ha of the forested area is covered by offshoot of coppice forests. 1.7 million ha of forested area is productive coppice and 4.0 million hectares of the forests is unproductive coppice. Forests are managed as two forest forms in terms of forest management: same age (regeneration area) and different age (selection, permanent forest). In terms of business forms, forests are divided into three categories as High Forest, Coppice, and High Forest Coppice. High forests grow or are grown from seed, coppice forests grow from the roots and shoots of log, and High Forest Coppices grow or are grown both from the seed and offshoot.

While these forests, scattered on a large area and located mainly on mountainous landscape, are opened to management, a good road network is absolutely needed to have intensive work, find practical solutions, transport every kind of forest product economically, and briefly, realize a rational forestry practice.

This study aims to reconstruct the forest road network during the conversion of coppice companies to high forest enterprises.

The research area covers the forest land, the roads and the road network, belonging to Yaylacık Forestry Unit of Tokat Forestry Management Department, lying within the boundaries of Amasya Regional Directorate of Forestry. The first thing to do was to collect preliminary information about Yaylacık Forestry Unit. The digital maps and management plans to be used in the study were obtained from this Unit. The study was carried out both in the office and in the field. 1/25000 scale maps of the study field were used. During the construction of road network of Yaylacık Forestry Unit, the forest road maps and road network plans obtained from the Unit were utilized. Information about stand maps of the study area, the existing forest roads, the planned forest roads, streams, hills and ridges was

transferred to the computer for database query. To create the digital maps, 1/25000 scale maps and digital maps of the region were superimposed in computer medium. An optimal road network map was created based on the field assessments and the GIS studies. The existing forest road network was involved in this total 332 km forest road network plan and an additional 90 km road was planned. As a result of this, the management rate was increased to 88 %. 390 km of the existing and planned roads go through the forest. Accordingly, the nominal road density and the overall road density were found 20.71 m/ha and 12.34 m/ha respectively. Consequently, the forest road density was increased to 20.71 m/ha with the optimal forest road network plan. This met the 20 m/ha forest road density ratio, which is the criterion for forest road density in our country.

Key words: Road Density, Coppice Company, High Forest Enterprise, GIS, Optimal Forest Road Network Model

1. Introduction

In our country, forestry activities are carried out over an area of about 21.2 million ha. Operating such large, scattered and mainly mountainous forest areas requires a good road network. 5.7 million ha of this forested area is covered by offshoot of coppice forests. 1.7 million ha of the forested area is made up of productive coppice forest and 4.0 million ha consists of unproductive coppice. Of the unproductive coppice forests, 625.000 ha has been converted to productive coppice since 1978 to create energy forests.

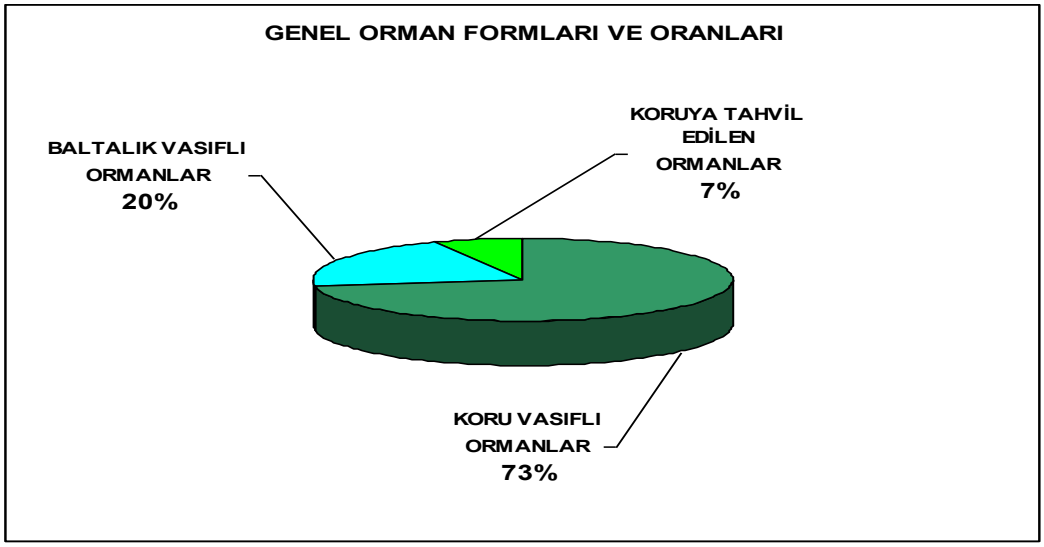

Figure 1. General Forest Forms and Rates
(Coppice Forests 20 % - Allocated for High Forests 7 %, Already High Forests 73 %)

During and after the conversion process of coppice companies to high forest enterprises, it was found that the inadequate existing road network had to be reorganized and modeled. When the amount of targeted forest roads in our country is reached, the road density in forests with more than 250 m^3/ha asset will be 20 m/ha. On the other hand, the road density in Austria, whose forests show similarity with our forests, is 30-35 m/ha. Today, the coppice forests have not got adequate forest road network meeting the criteria of this regulation except for tractor paths and skidding tracks. It seems inevitable to create a new road network model while 5.7 million ha coppice forest is being converted to high forest.

1.2. Forest Roads

Forest roads are high-cost infrastructures. They make up one of the most important infrastructures in forestry activities; however their construction and maintenance costs are relatively high, too. Approximately TL 50 million is spent each year on works of art on the forest roads, construction and maintenance. This amount covers as much as 20 – 25 % of the annual budget of General Directorate of Forestry.

The first forest road construction in Turkey began in 1937. The general outline of the forest road network construction was completed in 1979. In recent years, 1000 km/year forest road construction and 1000 km/year forest road major maintenance was planned (OÖİKR, 2001). When the total amount of targeted forest roads in our country is reached, the road density in forests with over 250 m^3/ha asset will be 20 m/ha. However, the road density per ha is expected to be more when the conversion of coppice companies to high forest enterprises have been achieved. Considering the state of forest road construction in recent years, it can be said that about 50000 km forest road construction is required in the coming years to achieve the desired road length.

As of 2010, the total length of forest roads reached 163072 km. 143005 of this total is production route; 17474 km fire emergency path; 832 km watchtower path; and 1761 km store path. 77.6 % of the planned forest roads have already been completed. Relating to the degree of compliance of forest roads with existing standards, it has been reported that 9 % of the roads is poor, 25 % good, and 66 % moderate (OGM, 2010). The upper structure of about 17 % of the forest roads in our country has been completed (Acar and Eker, 2001). Almost all of the remaining forest roads are earth road (dirt road). Besides, national parks, recreation areas, and some rural roads have asphalt pavement.

Forest roads combine to make up forest road network and road system. Primary and secondary interconnected roads, such as stream paths, hillside roads and link roads, appropriate for transporting any product obtained from forests, implementing forestry activities and realizing the multi-faceted benefits, are all called forest road network (OGM, 2008). Forests should have roads of enough length and density so that forest products can be transported (skidding, transportation, etc.) to forest roadside from cutting area and then to main stores with minimum cost.

2. Things Done So far

The study area was limited to Yaylacık Forestry Planning Unit of Tokat Forestry Management Department, situated within the boundaries of Amasya Regional Directorate of Forestry

Table 1. Yaylacık Forestry Unit Area Distribution Table

Normal Forest Area	11573,5 ha
Degraded Forest Area	8799,5 ha
Forested Area	20373,5 ha
Deforestation Area	15435,0 ha
Total Area	**35808,5 ha**

The study area consists of several tree species such as larch, pine, birch, juniper, beech, poplar and oak. Completed in 1992, the new road network project was planned multifaceted to make every kind of forestry activities possible. The 1992 planning included 322+4 km of road. 158+8 km of the total was existing roads. 163+6 km was planned as new construction.

Today, the available plan for the study area is still the 1992 forest road network plan. According to this forest roads network plan, a total of 756 km road was schemed. 322+4 km of the total was forest road, 135+0 rural road, and 3+0 motorway. Of the planned total road, 420+650 km forest road, 42+250 km rural road and 66+550 km motorway was expected to pass through the forested area. The road density was determined to be 15.6 m/ha.

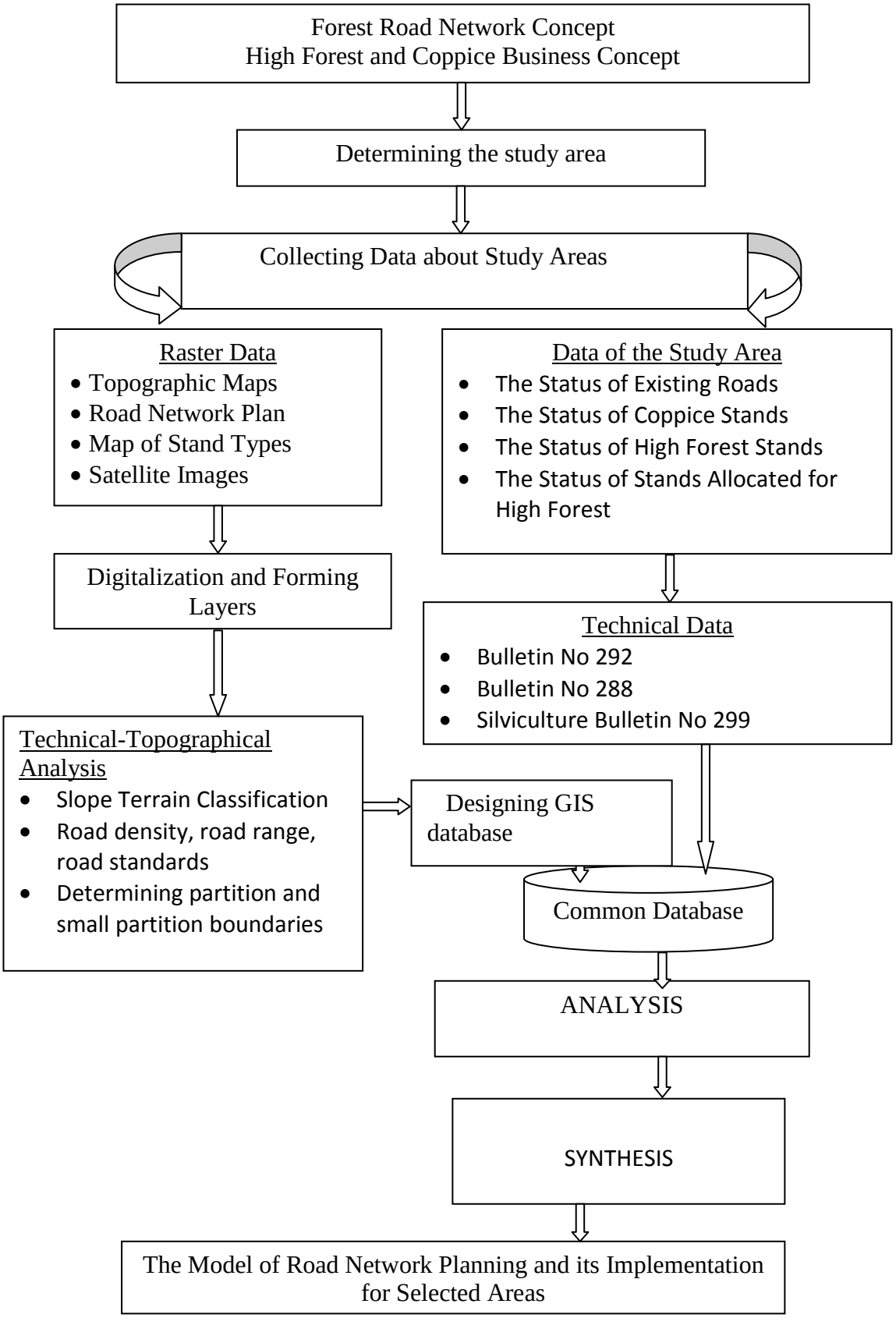
Forest Road Network Concept
High Forest and Coppice Business Concept
Determining the study area
Collecting Data about Study Areas
Raster Data
Topographic Maps
Road Network Plan
Map of Stand Types
Satellite Images
Data of the Study Area
The Status of Existing Roads
The Status of Coppice Stands
The Status of High Forest Stands
The Status of Stands Allocated for High Forest
Digitalization and Forming Layers
Technical Data
Bulletin No 292
Bulletin No 288
Silviculture Bulletin No 299
Technical-Topographical Analysis
Slope Terrain Classification
Road density, road range, road standards
Determining partition and small partition boundaries
Designing GIS database
Common Database
ANALYSIS
SYNTHESIS
The Model of Road Network Planning and its Implementation for Selected Areas

Figure 2. The flow chart of forest road network planning model to be implemented in conversion of coppice forest to high forest

To create the topographic structure and digital terrain model of the area, 1/25000 scale curved contour maps covering the Yaylacık Forestry Unit boundaries were used. Then slope and aspect analysis maps were created using 3D Analyst module of ArcGIS software. The spatial distribution of forest functions belonging to Yaylacık Forestry Unit was estimated by analyzing and evaluating the function map of the study area in NetCAD medium.

The existing forest roads were digitalized by controlling them from road network plan of Yaylacık Forestry Unit and utilizing satellite images. The road information in areas where there is excess stand cover was transferred to electronic medium by means of GPS and satellite images. The map of forest roads was created out of these maps and made available for inspection. For topographic analysis, slope, aspect and elevation classification was made using digital terrain model.

Following the land planning and preliminary assessment studies, the geometric elements of the forest road were measured in the field, and the road type was determined. The data were recorded through measurement and observation on forest roads. The geometric features of the road were determined by measuring, and other features were established by observation. Road survey report was used to record the land data. The related measurements and observations were implemented by driving between the start and end point of the all existing forest roads based on full counting method.

2.1 Establishment of Optimal Forest Road Network Plan

After the road network plan and the current situation was incorporated into the map, low and high road slope values, reverse slopes, various road density values, the areas opened to management and the technical details in existing and planned roads were presented. After the existing forest road network plan and completed forest roads were studied technically and with respect to forest transportation, a nearly 100 % conversion rate was targeted (20 m/ha optimum road density and 500 m optimum road spacing). With this aim, apart from the existing forest road network, the optimal forest road network plan was established by giving new road codes.

3. FINDINGS AND DISCUSSION

46 % of the study area was determined to be flat and gently sloping, and 45.9 % moderately sloping. The forest roads looked appropriate for setting up facilities with respect to slope. Regarding the spatial distribution of aspect groups of study area, it was determined that 24.03 % of the area is in the north aspect and 52.78 % in the south aspect. 14249.8 ha of Yaylacık Forestry Unit was production area, 7069.4 ha soil conservation, 24.2 ha fresh water conservation, 15.8 ha recreation, 13314.4 ha open space, 47.9 ha water, and 581.ha housing-cemetery.

The forest road density in today's conditions should be at least 20 m/ha. Accordingly, considering the rate of management in existing roads (average road spacing 500 m), the nominal road density in the areas of Yaylacık Forestry Unit was determined to be 15.71 m/ha as of today.

An optimal road network map was created considering the assessments in the field and the studies carried out in GIS medium (figure 2). The current forest road network in this forest road network plan having a total of 332 km road was evaluated and an additional 90 km road was planned. As a result of this, the management rate was increased to 88 %. 390 km of the existing and planned roads go through the forest. Accordingly, the nominal road density and the overall road density were found 20.71 m/ha and 12.34 m/ha respectively (Table 10). Consequently, the forest road density was increased to 20.71 m/ha with the optimal forest road network plan. As a result, this met the 20 m/ha forest road density rate, which is the criterion for forest road density in our country.

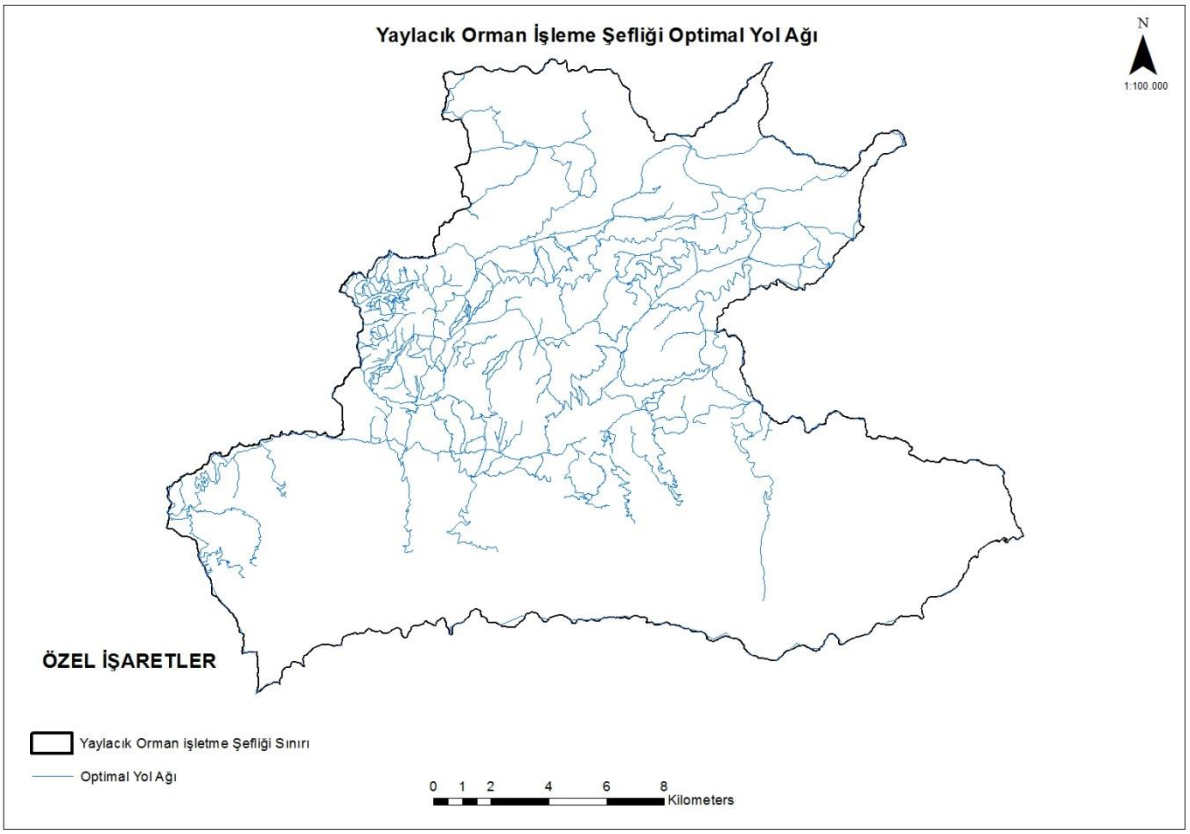

Figure 3. The Optimal Road Network Plan of Yaylacık Forestry Unit.

4. CONCLUSION

An optimal road network was created in the study area in accordance with principles specified in the regulations regarding forest road network planning.

As a result of the study, it was determined that there were totally 52 forest roads in the study area, including the existing and planned ones. It was also found that all of these roads were in class B type forest road standards. The existing forest road network in Yaylacık Forestry Unit is 332 km, and an additional 90 km road was planned.

An optimal road network map was created by considering the field assessments and GIS studies. The existing 332 km road network in this network plan was assessed and an additional 90 km road was planned. As a result of this, the management rate was increased to 88 %. 390 km of the existing and planned roads go through the forest. Accordingly, the nominal road density and the overall road density were determined to be 20.71 m/ha and 12.34 m/ha respectively.

Today, the coppice forests have not got adequate forest road network meeting the criteria of this regulation except for tractor paths and skidding tracks. It seems inevitable to

create a new road network model during the conversion of 5.7 million ha coppice forest to high forest. Based on their function, forests will need a forest road network of various density and standards. Determining the amount and distribution of forest road needed by each function is extremely important in the optimization of forest roads. While planning the road network in forested areas, it is necessary that accurate and updated information should be obtained, and that this information should be evaluated and used in the planning

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