A Methodological Approach to the Determination and Mapping of Forest Roads' Technical Competence

Çiğdem ÖZER, Burak ARICAK, Arif Oğuz ALTUNEL, Korhan ENEZ

cozer@kastamonu.edu.tr, baricak@kastamonu.edu.tr, aoaltunel@kastamonu.edu.tr, korhanenez@kastamonu.edu.tr

*Kastamonu University, Faculty of Forestry, Forest Operations

Summary

Necessary measures are required to effectively fulfill the functions of forest roads for a long time, determining conditions of their technical competences. By determining the technical competence variables of the forest roads and the criterions affecting these variables, the status of technical competence of forest routes serving their respectable forest will be mapped in a GIS database, which is outlined in this study.

In determining the technical competence of forest roads, statuses of thirteen different variables were taken into consideration. These variables were the platform width, ditches, curves in the road expansion, pavements, retaining walls, concrete pipe, shadow due to cut trees, excavation slope stabilization, embankment slope stabilization, continuous transport, platform deformation in the vertical slope and platform plant growth. With the method to be proposed, it will spatially be possible to determine the technical competence of the forest road so their adequacies / deficiencies will be identified at a relatively accurate spatial level. The results of this study will be useful in the decision making of road maintenance priorities.

1.Introduction

The objectives of forest roads can be specified as providing access to intensive forestry activities, i. e. silvicultural, conservation, administrative, intervening the forest fires, meeting the needs of communities living in or around the forests, etc. Typically, forest roads have geometric standards lower than those of highways. Besides the benefits forest road provide, they are the reasons of some damages in the form of ecologic and economic perspectives. If a quality concept is to be defined for forest roads, the first thing to do is to identify the functions of them. In spite of being considered as a kind of highway, they differ from other road types in technical, administrative, economic and forestry relates senses.

To effectively and efficiently manage forests, they must be equipped with well planned and executed road networks, which must have a sufficient technical competence. Besides, like in any other engineering work, that providing suitability to site conditions and satisfying the necessity of providing a required level of safety and economic conditions will ensure the users that the facility will adequately function. Thus, that a forest road is effectively providing for what it was previously intended can be viewed as a quality indicator so occasional audits can be carried out to inspect the initial competencies. Gumus has developed a method in 2009 for the evaluation of existing roads. A criteria has been determined that can represent the technical, economical, ecological and social aspects of roads. A field technician administered a multiple selection questioner which was previously been weighed accordingly, then analytic hierarchal evaluation process was used to elaborate the field

results. The outcome from this particular study was not implemented on a forest road and no additional explanation was generated as to how the values that will represent the indicators, will be administered.

Tunay ve Melemez (2004a) presented the fact that in order for the forest road to function properly year round, they must be topped with a decent surfacing. Acar and Unver evaluated existing forest roads in terms of economic, ecological and visual perspectives .They have developed a scoring system for road classification, taking the technical specifications of road, disturbances on road surface, being economic in the construction and the site conditions into consideration . According to Balci , if road width is kept narrow, drying of the road surface becomes problematic due to residents trees shades. Hruz and Vyskat stated that increasing the technical, economic and environmental quality forest roads will contribute the lifespan of the road in the long run.

Although in Turkish forestry, the theoretical work has been done concerning the evaluation of economic, ecological and visual aspects of forest roads by Acar and ünver(2007) and Gümüş (2009), the features of forest roads haven't been evaluated in the field. In determining the effect of forestry practices on forest ecosystems, GIS that is a good support tool also can be used as a positional control mechanism.

The objective of the method to be performed is to determine the technical competence of each road, depending on factors specified in GIS. Situation of elements that include technical competence of the roads are determined by a scoring system, mapping of spatial situations will be provided. With the method to be applied, maintenance priorities of existing forest roads along with the positions will be possible. Extension of the life span of forest road will thus be provided.

2. Material and Method

To establish a GIS database that will fit in the purposes of the study, the existing road network plan, the standard topographic maps and public domain google earth will be used. Google earth image will cross check and verify the availability of the existing road network that is not in the plan. 13 variables will be used in the determination of technical competence of roads. These variables are platform width, ditches, curves in the road expansion, superstructure, retaining walls, concrete pipe, the status of shadowing trees, cut slope stabilization, fill slope stabilization, continuous access, deformation situations on platform, longitudinal slope and plant growth situations on platform. On the field, a hand-held GPS for determining the coordinates, laser range finder for measuring distance and steel measuring tapes will be used. Study reports cards to save the field measurements and observations made while checking the statuses of the roads in the field, will be used (Table 1).

Table1. Study report card

Measurement Date:										
ROAD NAME	ROAD CODE	STARTING COORDINATE			LAST COORDINATE			ROAD LENGHT		
Road ranges (m)		0-100	100-200	200-300	300-400	400-500	600-700	700-800	800-900	900-1000
Platform Width (m)										
Ditches										
Curves in The Road Expansion										
Superstructure										
Retaining Walls										
Concrete Pipe										
The Status of Shadowing Trees										
Cut Slope Stabilization										
Fill Slope Stabilization										
Continuous Access										
Deformation Situations on Platform										
Longitudinal Slope										
Plant Growth Situations on Platform										

The above card in table 1 will be formed for each road. Start and end point coordinates of each road will be determined by GPS. Variables given in table 1 will be graded for each 100-meter section of the road.

Thus, for each 100 meter part of the road, 13 technical specification variables given in table 1 the will be determined. In ArcGIS forest road will be broken down to 100 meters segments in length from the starting point. Variable scores saved in survey reports for every 100-foot piece of road will be recorded in the ArcGIS database. This medium that will be compiled numerically, will be evaluated to determine the technical competence of roads. Assessment scores for variables determined will be made according to the values given in Table 2. Values for each variable will be graded in 0, 1 and 2. “0” for out of standard for that variable and adverse effects; “1” for exact suitability showing accordance with the standards and it should be; “2” for above the standards, environmental damage to a minimum, no cause of any visual impairment.

Table2. Indicator and points of variables determined

Evaluation Factors	Indicator	Indicator Points
Platform Width (m)	4,5<	2
	4-4,5	1
	<4	0
Ditches	Usable and width is above the standard	2
	Present and Usable	1
	Clogged or not	0
Curves in The Road Expansion	Width is above the standard	2
	Standard width and without curve	1
	Width is below standard	0
Superstructure	Rigid stable superstructure	2
	Soil structure	1
	Damaged and no superstructure	0
Retaining Walls	Usable and width is above the standard	2
	Structurally sound, no retaining wall	1
	Unavailable or does not exist	0
Concrete Pipe	Usable and width is above the standard	2
	Usable or unnecessary	1
	Clogged or broken	0
The Status of Shadowing Trees	Not necessary	2
	No	1
	Yes	0
Cut Slope Stabilization	If there is dense vegetation or retaining walls on cut slopes	2
	Necessary stabilization can be provided on cut slopes	1
	Stabilization is necessary on cut slope but not present	0
Fill Slope Stabilization	If there is dense vegetation or retaining walls on fill slopes	2
	Necessary stabilization can be provided on fill slopes	1
	Stabilization is necessary on fill slope but not present	0
Continuous access	8-12 month	2
	6-8 month	1
	Less than 5 month	0
Deformation Situations on Platform	There is no possibility of pothole formation resulting from superstructure	2
	There is no pothole or the formation is very unlikely	1
	Being lots of potholes	0
Longitudinal Slope	% 0-5	2
	%5,01-12	1
	%12.01< and adverse slope	0
Plant Growth Situations on Platform	There is no possibility of plant growth on superstructure	2
	There is no plant growth or very unlikely	1
	Dense plan formation on the platform	0

Each road will be divided into 4 classes ranging from Class I, to Class IV. Classes will take shape according to the total scores coming from 13 variables.

By evaluating a combination of specified variables, technical quality class of each road route will be determined. Roads fall into Class I will form the ideal case from every angle and provide a long lasting service. In Class II, the roads are in good condition and in a short time without the need for urgent intervention. Roads that fall into Class III are in poor condition and in need of intervention roads. Class IV roads are in poor condition, immediate major repairs will be prescribed and they are rated as dysfunctional.

Technical quality class for each route will be mapped in ArcGIS and thus technical competence of forest road will be created. In addition, each 100 m of road segment that make up the forest road network will be mapped according to its rating, thus required maintenance and repair jobs will be able to be extracted from the database according to technical parameters.

3. Results

The state of technical competence of the forest roads according to identified variables and mapped ratings will determine how the method described and evaluated with the field results of the study will be presented. Furthermore, this study will show how to provide support as a means of rapid measurements in GIS assessment of the quality of existing forest roads. With work to be done, it will be possible to reduce the negative effects caused by technical deficiencies of forest roads in the field, allowing the utilization of roads for longer periods and describing what needs to be done technically by means of scientific analysis.

With the results from work to be done;

Locations of the road segments which will be given priority in maintenance and repair can be identified,

Quality class of forest road can be used as a multiplier for unit shipping cost in the calculation of hauling costs in the transportation of forest products.

According to the quality of the forest road, length and tonnage limits of vehicles transporting forest products can be determined.

It will be possible to determine from which aspect each road segment will have the highest quality so the functions of the roads can be identified and designed depending on the indicators of the quality measures.

Using methodology presented in the study, forest road quality control charts can be prepared and used.

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