

## THE APPLICATION OF SATELLITE IMAGES TO THE FOREST ROADS NETWORK LAYOUT IN TURKISH FORESTRY

**Burak Arıcak; Selcuk Gumus; Hulusi Acar**

Faculty of Forestry  
Karadeniz Technical University  
61080 Trabzon, Turkey  
[baricak@ktu.edu.tr](mailto:baricak@ktu.edu.tr)

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**Abstract:** *The advanced technology has been extensively used in the majority study areas of forestry. The usage of satellite images is one of them and they are used for inventory, planning, controlling or another purpose in forestry. However, it is also known that the satellite images can serve to plan the forest road network.*

*All factors effecting the forest road planning should be collected in one stratum and taken into consideration with all together in order to plan, an efficient road layout. As traditional method, the terrestrial methods such as geological or geophysical have been still used to obtain data regard to road route space. On the other hand, the satellite images, as an alternative to terrestrial method, can provide to analyze of the planning elements all together, during road planning. Thus, it can be determined and mapped the landslide areas, wetland area, wet-ground areas, unstable areas, the sensitive areas to erosion on flood. In this way, the positive and negative cardinal points can be rationally fixed to preferable road route. The forest road network plans according to data obtained from satellite images can be drafted at least time as productive.*

*This study is a preliminary section of a comprehensive research. In this study, it was explained that the conceptual methodology of forest road network planning by means of satellite images and their superiorities were discussed according to traditional method applied in Turkish Forestry. As a result, the geological and geomorphologic data can be collected, combined with GIS, and manipulated for road layout or other aims. Particularly, with these aims, the environmentally friendly forest road layout can be planned. The satellite images usage has many superiority than 1/25 000 topographical maps, so using of it as a modern method will be very applicable in the future.*

### 1. Introduction

The satellite images, which are the one of remote sensing data sources, make the evaluation of area studied and the presentation of data belonging to this area possible (Arıcak, 2002).

Roads are a critical component of civilization. Developing and maintaining the economic activity that is vital for the quality of modern life would be difficult without roads. Roads provide access for people to study, enjoy or contemplate natural ecosystems (Lugo, 2003).

Opening forest to management makes the application of a rational forestry, which is more productive and suitable for aim, possible. Therefore, one of the most important tools needed is forestry roads. In our country, forestry works are realized in 20 million hectare of forest that is separate and in different relocations. Working in this forest lands having different climate and topographic condition needs a good road network. Additionally, forest villages also benefit from the road network for their needs. This provides economic, social and cultural benefits to all people (Erdaş et al., 1995; Acar et al., 2000).

## **2. Forest Roads**

Geographic Intelligent System (GIS) introduced into the planning of forest roads in the early 1990's. In the first studies, it was aimed to get the data which can be used as a criterion in the forest transport plans from geographic database and then to effectively and correctly. To use digital land models, which have used in the planning of superhighway in forest road plan our country for a few decades, in the plan and project works of forest roads in mountainous region decreases the costs and the time consumed. The studies that have been done so far have shown that the studying digital data in the computer media has been cheaper than classic method (Acar et al., 2001).

Forest road network planning have been effected by a lot of factors such as ecological conditions of region, forest type, settling area economical condition, market request for forest product, condition of forest transport vehicles, topographical attribute, forestry exploitations goals etc. The usage of computer and mathematic models has been required for successful planning processes which have a complex structure (Erdas et al., 1997).

As stated in the conference of UNCED (United Nations Conference on Environment and Development), usage of renewable resources of nature is the fundamental factor of improvement depending on environment. The transport is necessary for effectively benefiting from these resources. Therefore, the buildings of new roads that are accepted by public and are not dangerous for environment have become necessary (Heinimann, 1998).

Planning a road network begins with investigation of topographic and geologic conditions. The forest roads should be planned for passing on south slope, transport methods and tools should be taken into consideration, high slope should not be used, and the opening ratio of forest to management should be very high, building road on pipe, culvert, ford, bridge should be awaited, roads should not be pass though lands which have landslide danger and rocky forestland (Acar and Şentürk, 1996).

The determination of forest road route is the most important and the most difficult stage of forest road planning. There are a lot of routes among the mean control points in which a road have to pass. Thus, it is necessary to select the most suitable route by investigating all possible routes (Acar et al., 2001).

In Turkey, the investigation stage, the first projecting and the final projecting stages of road planning works should be realized together with land works (Ergin, 1986). It is necessary to go to lands to define lands whose road plan will be done and to control factories which are important for road network planning. During land works, topographic map, present road network plan, woods plan and air photos are used. Then, whether or not there is any discard is controlled by comparing maps with land.

## **3. The Usage of Satellite Images in Forest Roads Planning**

While forest road network is planning, forest borders, places that have difficulties for road building and slope classes are determined easily.

The main inquire stratum is formed by inputting information layer to satellite images and setting these layers together via overlay method.

When the forest road planning is done by using satellite images, the following land criteria should be taken into consideration:

- Drainage conditions,
- Soil properties,
- Hydrologic factors,
- The stability of land slope,
- Vegetation,
- The constructions built by human being,
- Land form.

The usage of satellite images in road planning provides the following advantages:

- The works of road route that is necessary for road project become easier,
- Road route is easily determined without bothering owners of properties in lands to be planned,
- It gives much more information than a map and other documents. Therefore, if there are hesitant situations in the later works, the information desired is achieved without going to lands,
- It is about 30-40 % more economic than traditional method,
- During and after road building, the suspicious measures and the calculations depending on them can be controlled and then corrected,
- The artistic places and other constructions can be detected most certainly from images without going to lands,
- Since fewer people work in the stages of exploration and application, the cost of the transport planning lessens to some extent,
- The measurement and the studies can be realized for both changing road route and projecting of other constructions in four seasons and also under all weather conditions (Erdaş, 1997).

The forest road route can be determined in the office by using data base achieved from satellite images. The most appropriate method of the determined alternatives is selected by comparing with land works.

After satellite images are digitized, the forest transportation planning is realized according to the properties of product on land and transport vehicles.

#### **4. Discussion**

The forest area in Turkey is about 20.7 million hectare. Remote sensing is necessary for truly, fast, and reliably achieving data about these lands and changing day by day. The techniques of remote sensing provide large perspective to different branches. The data collected by sensors can be easily shown and presented. The data is evaluated by computer and transformed to a map. The remote sensing data is directly analyzed. Additionally, the data groups can be evaluated in digital form or display form by using manual methods. After the data is used, it is easily stored and achieved. The circulation of data between all societies is easily realized in the coordinate system works. (Köse et al., 2001).

During planning and examining a forest road route, the technical fundamentals to be taken into consideration are following:

- A forest road to be built must not deteriorate the ecology and the natural appearance,
- Forest roads mustn't be built on slopes having landslide risk, lands which are not capable of carrying, places whose floor water are high and valuable agricultural lands,
- The forest roads mustn't be built also on southern exposure and dry lands.

The most of these technical fundamentals can be determined easily by using satellite images.

The first step in the transport planning is to examine carefully present natural and economic data. While the planning is preparing, the studied area is wanted to completely understand. However, the application of forest transporting plans should be controlled periodically. Shortly, remote sensing data makes comprehensive understanding possible.

The evaluation of air photos and satellite images together eliminate some disadvantages belonging to these two methods separately (Köse et al., 2001). The environmental effects of forest road network can be detected by comparing new and old images of area. Therefore, mistakes will not be repeated in other forest lands.

## 5. Conclusion

The forest road is never an installation connecting two points. This is a very important installation which provides benefiting from all compartments.

The planning of forest road network needs evolutions of a lot of data about area. This is difficulty realized by using classical method. However, data isn't also evaluated in these methods. Geographical Information System (GIS), as a result of the improvement in computer technology, has become effective tools, especially for planning works in large areas. GIS transforms the data collected from different sources to suitable form. Therefore a lot of analyzes can be realized directly via remote sensing data.

It is very important that the satellite images are convenient for evaluation in every respect and integrated information is conserved without losing its value to be reused in periodical researches (Ergin, 1986).

A lot of information can be collected on the same stratum. Thus, a lot of information not to be evaluated on classic map can be read and evaluated altogether. However the factors wanted can be calculated via data base already formed.

During planning a forest road, the most suitable road route needing less constructions, such as pipe, culvert, ford and bridge, can be preferred in present road routes by using GIS. Therefore, the most suitable road route from the point of view of technique, economic and ecology is formed (Acar et al., 2001).

The topographical shape, river network, vegetation type and its distribution, erosion condition of forest area whose forest road planning will be realized can be determined directly using satellite images. Moreover, tone variations, solid moisture, rock properties can be also detected.

The renewal of forest road network planning must be completed depending on current information to rationally manage forest. The determination of the criterions helping this aim and the usage of satellite images in the preparation of project according to these criteria are useful from the point of view of time and cost.

Finally, benefiting from new techniques which are easier and more economic for forest transport planning contributes to country economy positively.

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