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THE ENVIRONMENTAL IMPACT ASSESSMENT OF TIMBER EXTRACTION BY CABLE CRANES, MONORAIL AND CHUTE SYSTEMS IN TURKISH FORESTRY

Turkey has 20.7 million hectare forest area which makes up %26.6 of its total. Approximately %46 of the total forest area is on steep land with slopes greater than %40. Public awareness of environmental issues has increased constantly in the last few years. The construction of forest access structures was presented as one of the main forest activities responsible for destroying the environment forest professionals therefore have to look for improved procedures for planning, designing and constructing forest transportation network to improve public acceptance.

Recently, during forestry operations damage to the wood raw material and to the environment, gain importance. A multitude of wood extraction systems have been developed to transport wood from the felling area to the roadside, landing or river. This study deals with the effects of log chute systems, monorail system and cable yarding systems, which are the extraction techniques from compartment on environment, and compares these transportation systems with each other.

Keywords: Log Chute, Monorail, Cable yarding, Turkish Forestry, EIA, Timber Extraction

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Оцінка впливу на довкілля транспортування деревини ланцюговим обладнанням та монорейковими системами в лісовому господарстві Туреччини

Туреччина володіє 20,7 млн. га лісу, що становить 26,6 % її загальної площі. Близько 46 % лісових масивів сконцентровано в гірських регіонах з середнім ухилом місцевості понад 40 %. В останні роки постійно зростає увага суспільства до вирішення екологічних проблем. Лісотransпортні споруди розглядаються, як одне із найбільших джерел негативного впливу на довкілля. Тому ми повинні покращувати планування, проектування і будівництво лісотransпортної мережі.

Останнім часом було розроблено багато лісотransпортних засобів для транспортування деревини з лісосіки до навантажувального пункту, лісової дороги чи річки. В цьому дослідженні проаналізовані та порівняні між собою за показниками впливу на довкілля два лісотransпортні засоби – мобільне ланцюгове обладнання та монорейкова система.

Ключові слова: спускання колод, монорейкова система, мобільне ланцюгове обладнання, лісове господарство Туреччини, EIA, трелювання.

1. Introduction

Recently, the result of intensive interference to the forest areas on the earth resulted of drawing forests back to the mountainous areas. For that reason, in Turkey after the situation mentioned above generally forestry works have to be made on the mountainous and steep areas. Turkey has 20.7 million hectare forest area which makes up %26.6 of its total. Approximately %46 of the total forest area is

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on steep land with slopes greater than %40 (DPT, 2001). Due to this fact that, harvesting in mountainous regions has always played a significant role.

Public awareness of environmental questions has constantly increased in the last years. The construction of forest roads has been the main contentious issue in the discussion between foresters and environmentalists. The main criticism is that the construction of forest roads is destroying the environment causing soil erosion, habitat loss, scenic impacts, etc. Public acceptance of construction work has decreased significantly. In the context of sustainable development as stated by the UNCED (1992), the use of natural, renewable resources is a key element of environmentally sound development. Resource use depends on accessibility of the relevant areas. Therefore, it is impossible to give up the construction of forest road networks (UNCED, 1992). In the past, in Turkey approximately 4000 km road constructed. After the developments in the techniques of mechanization and the rise of environmental importance, the road length mentioned above was reduced to 1000 km. The another forestry operation, which is the damage appears on the stand, is the extraction from compartment.

Transportation stage of forest management involves rather difficult, expensive and time-consuming activity. As it is known during extracting compartment, lots of residual stands are damaged. The extent and degree of soil disturbance associated with bulldozer yarding are variable and appear to be related to slope (Stuart and Carr, 1991), soil texture, and soil moisture content at the time of logging (Jussuff, 1992). As soils are compacted from loads applied by bulldozers and logs skidded across the forest floor, soil porosity decreases often causing decreased water infiltration, soil moisture availability, aeration and rooting space (Greacen and Sands, 1980).

In order to carry out the activities of forestry at the point of technical, economical and ecological view for the regions where road construction is difficult and harmful, alternative transportation methods may be taken into consideration. Before opening up forest areas, technical, economical and ecological features of the area have to be researched for finding out appropriate methods. In order to achieve this aim, the system which will be used before the interference to the forest Environmental Impact Assessment has to be done.

2. Environmental impact assessment

2.1. Description and Proposal of Environmental Impact Assessment

Environmental Impact Assessment (EIA) may be defined as a formal process use to predict the environmental consequences of any development project. As a planning tool, it has both an information gathering and decision making component which provides the decision maker with an objective basis for granting or denying approval for a proposed development. Balanced assessment of effects on the environment should encompass a number of considerations. Depending on the nature, scope and significance of the project or proposal the assessment may include consideration of ecological, economical, cultural, aesthetical, health and safety, social impacts in relation to decisions on the sustainable management of natural and physical resources.

The purpose of the environmental assessment process is:

- to support the goals of environmental protection and sustainable development.
- to integrate environmental protection and economic decisions at the earliest stages of planning an activity.
- to predict environmental, social, economic, and cultural consequences of a proposed activity and to assess plans to mitigate any adverse impacts resulting from the proposed activity, (www.gdrc.org).

To make planning process transparent and to ensure public involvement, a project process model is needed that takes into account the whole project life cycle. A structured procedure identifies estimates and evaluates possible impacts on the environment systematically. Project milestones ensure decision-making and public involvement. The classical planning approach tried to optimize possible solutions by taking into account the following criteria:

- technical capability,
- economic efficiency,
- environmental integrity,
- social integrity (Heinimann, 1996).

The conception phase is the most important one because it commits about %70 of all effects. Thus, we have to improve planning processes to minimize potential impacts. "Impact means any effect caused by a proposed activity on the environment including human health and safety, flora, fauna, soil, air, water, climate, landscape and historical monuments or other physical effects on cultural heritage or socio-economic conditions resulting from alteration to those factors" (UNEP, 1991).

2.2. Environmental Impact Assessment in Turkey

In Turkey, first legal amendment related with EIA was begun in 1982. The environmental law, which went in to effect in 1983, was determined the framework of environmental management. According to the code related this law, it has to be done that a report (EIA) has to be prepared by the foundations and enterprises in order to take precautions. Environmental Impact Assessment Regulation, which went in to effect in 2002, is using presently.

It is necessary to determine and reduce the effects of the method which will be used while opening up forest in planning stage. Environmental Impact Assessment (EIA) is seen as a part of the process before the beginning of the project (OECD, 1994). However in Turkey EIA report preparation is compulsory, this duty has not become widespread.

Forest roads which are the tool of opening up forest areas in Turkey have only been partially produced. In this research it has been seen that during the construction of the %32.32 of the existing roads environment was extremely damaged. When the EIA criteria have taken in to consideration only %9.76 of the same roads affected negatively (Gümüş, 2003). The EIA criteria have not produced yet in order to determine the quantity of the effects and evaluate it for the other forestry operations.

3. The transportation systems in Turkish forestry

Recently, during forestry operations damage to the wood row material and to the environment, gain importance. The effects of chute, monorail and cable yar-

ding systems, which are the extraction techniques from compartment on environment, have been discussing. A multitude of wood extraction systems have been developed to transport wood from the felling area to the roadside, landing or river.

3.1. Monorail System

Monorail has got two parts as infrastructure and superstructure. The infrastructure is stable and formed metallic legs and rail. The superstructure is consisting of locomotive and railway car.

The wood material should be transported easily without the forest road on steep terrain by monorail system that is not cause land and money losses. In addition, monorail transports easily and safely the material workers and supplies to the working areas in forest. This system eliminates the negative features of the land and has the surface become artificially useful.

Main forestry studies, consists of rejuvenation, care, protection, production and evaluation. This system leads to less time and energy spent during these studies.

Advantages:

- Transportation of seedling to large afforest areas,
- Transportation workers and equipment to fire towers,
- Reducing work time span by transporting workers and operators who are working with forest cable yarding,
- Making tour arrangements to the natural areas where have visual values at the landscape point of view,
- Transportation short diameter log, fuel wood and non wood yield.
- Preventing road construction on the slope areas where the cost is high.
- Reducing work difficulties and energy loss to increase work efficiency.

The monorails railway width is decided by hall width which is 30 cm height from the ground depending on the locomotive and the railway car width. It is necessary to clean the trees, young trees and every kinds of material that is being on the minimum hall area.



Figure 1. Acar-T 750 Monorail System

In Turkey, in Maçka region, 750 kg fuel wood has been transported along the line of which length is 200 m and the maximum slope is %70 by the prototype

monorail, Acar-T 750. This study shows that average efficiency is 10 m³/hour (Acar et. al, 2002). The effects on environment of this system run have not been researched yet.

3.2. Log Chutes

In Turkey, 4 kinds of chute which are wooden, plastic, sheed and polietilen are using. A log chute can be used effectively for extracting timber from first thinning in environmentally sensitive areas.

A slope of at least 15–20 % is required for the chute to be successful. If the chute is wet, the speed of descent is increased, even on slopes of below 20 %. The chute has performed safely on slopes up to 45 %. Timber tends to slide more freely if the chute is a little damp. In dry conditions it may be helpful to throw a bucket-full of water into the top of the chute.



Figure 2. The Plastic Chute System

The system advantages are:

- minimal ground disturbance during the extraction process,
- no extraction racks are required,
- Safe pulling, lifting and carrying techniques should be adopted at all times and lifting aids,
- This method of extraction, which avoids the need for racks, may reduce the likelihood of wind throw following first thinning in areas of high wind throw risk. However, the effect of racking at second thinning on stability may then become a constraint,
- The system allows a range of products to be cut without the provision of crosscutting space at roadside,
- This would normally be required for a wide product range from cableway or skidder extracting whole poles.

The system disadvantages are;

- To restrict imposed by cost, slope, terrain, crop, produce size and the high proportion of manual handling,
- Joints between the sections become vulnerable,
- Loading of the chute becomes more difficult because the pulpwood has to be lifted higher.

The planning of roadside landing is as important as the position of the chute in the wood. The layout of the chute at the landing area in relation to roadside banks and ditches and the road itself is important. Steep final descents may cause the timber to leave the chute and are to be avoided. The mouth of the chute should be positioned so that produce slides smoothly out. To keep road damage to a minimum 1-2 m piece of 'conveyor belt' should be placed under the mouth of the chute extending along the road. Manual lifting is part of the system.

According to a wooden chute study, productivity was found as 5.9 m³/hour at the slope of 37 % and the transport of softwood from 300 meters in Rize, İkizdere region (Acar et.al., 2001).

According to a study carried out in Turkey, sheed chute has been settled on to the slope ranging from %5 to %40 and 770 ster fuel wood has been carried along a line of which length is 364m. It was calculated that according to the transportation distance, efficiency is 14.2 ster/hour, 2.14 ster/hour for full work and cost efficiency is 4.63 \$/hour for this study (Acar, 1995).

3.3. Cable yarding

Applying of skyline, short, medium-long distance started after end of 1970's in Turkey. Forest skylines are used to transport the forest products between 300 and 2000 meters distances. According to yarding distances, these are called as short up to 300 m, middle between 300 and 800 meter distance and long more 800 meters distances for skylines. Koller K 300 as short distanced forest skyline, Urus M III as middle distanced forest skyline, Gantner and Baco as long distanced sledge forest skyline are used.



Figure 3. Urus M III Cable yarding System

A study carried out in Turkey, productivity values were determined for Koller K 300 4.52 m³/hour, 3.83 m³/hour for Urus M III, 4.04 m³/hour for Gantner forest skyline yarder in transportation of softwood, and 4.181 m³/hour for Baco (Çağlar, 2002).

The forest yield can be transported by suspending completely or partly (one side of the material rubs) by using cable yarding. Generally cable yarding system

where downhill transportation is done, it is seen that one side of the material rubs. Also, one side material rub is seen where the cable yarding transportation cable is low from ground. On the other hand, uphill transportation is accomplished by suspending the material completely.

4. Conclusions and recommendations

Nowadays, despite the rising demand for raw wood material, forests are drawing back to the mountainous areas. Because of the reaching difficulties to these slope areas considerable amount of short diameter material were left over in the forest. As every kinds of raw wood material can be utilized, these materials importance is increasing. In Turkey, afterwards the cutting, the amount of the short diameter wood, which is left over in the forest, is approximately 8 million ster fuel wood and 2 million ster fiber particle wood. Remaining of this large amount of yield in forest causes both economical loss and living environment for bark harming insects. This situation leads to hazard for surrounding trees and young trees. Due to this fact that, extracting yield from compartment is getting importance. Due to the technological developments, extracting short diameter yield from compartment is getting easier.

Thanks to the chute and monorail systems short diameter materials can be extracted from compartment without any damage. During the application of chute system horizontal curve can be formed. Because of this, chute system can be built without any damage to surrounding trees and young trees. Also, contrary to the direct rub, this system does not bring permanent damage in the forest. Furthermore the chute system is a much more simple structure than monorail and the cable yarding. The system set up is not required qualified personnel. Applicable and low cost solutions without any damage for forests can be achieved by this system so as to extract short diameter materials from compartment. This method of extraction meets the needs of the forest first thinning program on sensitive sites. Conventional cableway or tractor systems involve the creation of racks, which increase the risk of wind throw.

Monorail is a rail transportation system, which is settled on the legs from the ground. Owing to the location of the system, which is not settled directly on the ground, prevents the forest soil from compression and slide. It does not need large way to open up. This feature prevents from losing large forest area. Also the workers can be transported to the working area easily without using too much time and energy, so that performance of the workers can be increased and the loss of time can be prevented.

Cable yarding is used when the logs are extracting from compartment. While transporting these heavy yields, some damages may be come in to being on the transportation way and on the surrounding area. The probability of recovering transportation way is low. For that reason the opening up way of cable yarding should not be large. Cable yarding way has to be taken in to consideration while carrying out the process of cutting and felling the trees. So, side rub distance can be minimized in order to increase the efficiency of cable yarding and reduced the damage to the soil.

The mentioned systems not only put the forest road cost out of sight but also prevent the forest from forest way construction effect area of 20m so environmental damages and ecological balance can be protected. Also, minimum forest way construction leads to the decrease of forest area loss. But a disadvantage of cable yarding needs qualified personnel.

As a result of this study, some crucial suggestions are shown below:

- Road network distribution should be re-examined in the scope of EIA,
- EIA should be done for the techniques of extraction from compartment,
- Stand and forest soil should be prevented by preparing forest transportation plans,
- When determining the transportation tools and the usage of them, environment should be taken in to consideration and workers should be informed well,
- Chute system should be settled in the areas of thinning stands and copse areas where too much short diameter raw wood material is being.
- When forest management and road network plans are preparing, transportation possibilities should be taken in to consideration and analyzed at the EIA point of view.
- Transportation by cable yardings should use completely hang carry.
- New arrangements should be done in Forestry Law concerning the operations of forestry in the scope of EIA.

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THE EVALUATION OF ENVIRONMENTAL EFFECTS IN FOREST ROAD CONSTRUCTION

In the developed country, forest activity required by GIS (Geographic Information System) data base. A lot of country using by remote sensing techniques were prepare country maps, land classification maps and location maps. The advanced technology has been extensively used in the majority study areas of forestry. The usage of remote sensing data 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.

Keywords: Environmental effects, Forest road, GIS, Remote sensing data, Turkish forestry.

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Оцінка впливу на довкілля будівництва лісових доріг

У розвинутих країнах питання лісогосподарської діяльності вирішуються з використанням GIS (географічних інформаційних систем). У багатьох країнах, де застосовується обладнання дистанційного зондування, отримані цифрові карти місцевості. Передова геоінформаційна технологія широко використовується в наукових дослідженнях, пов'язаних з лісовим господарством. Дані дистанційного зондування та супутникові знімки є одним із інформаційних джерел для виконання лісовпорядкувальних робіт, планування та управління лісовим господарством.

Ключові слова: вплив на довкілля, лісова дорога, GIS, дані дистанційного зондування, лісове господарство Туреччини.

Introduction

Engineering practices on forest road building are challenged by the task of minimizing the impact on forest environment. In some studies, there is evidence that improvements in planning and locating forest roads reduce the negative effects on the forest environment. Poorly placed access road can affect forest productivity by taking forest area out of production, damaging residual trees and seedlings, removing nutrients from the site, and by compacting, rutting, and eroding the soil. Adjacent areas can be affected by associated changes in the hydrology condition of the site. Water can run in the ruts, loosening and transporting soil particles, which may eventually drain into local streams, potentially increasing the stream turbidity and affecting the water resources. Even though these impacts are unavoidable but their frequency and extent can be significantly reduced by a stable forest road network.

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