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THE EFFECTS OF FOREST ROADS ON SEDIMENT TRANSPORT

Erhan ÇALIŞKAN[1*+]

[1]Department of Forest Engineering, Faculty of Forestry, Karadeniz Technical University, 61080, Trabzon-Turkey
[*]Corresponding Author and [+]Speaker: caliskan@ktu.edu.tr
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Abstract **–** Sediment can be composed of all road elements. On soil roads, road surface erosion is generally the predominant source of sediment. The multifaceted impact of forest road construction on the environment is always a serious issue in terms of watershed management. Water quality of surface erosion caused by road construction and neglect, flow regime of streams, floods, formation of marshes, reduction of soil fertility and similar negative effects cause great economic losses and degradation of the landscape. The fact that the road routes travel along the valley floor or slope or pass through the ridges affects the sediment transport. The aim of this study was to investigate the road erosion and sediment models and the factors affecting them.

Keywords*: Forest road,sediment,transport,model*

INTRODUCTION

Forest roads serve the maintenance of forestry works and services and economic transportation of all kinds of forest products. Forest road construction works should be carried out in such a way as to cause minimal damage to the stand, soil and natural landscape.

One of the most important issues in the construction and maintenance of forest roads is the problem of draining rainwater accumulated on the forest road surface. While the forest road that does not have good drainage provides sediment to the environment at any time, the damage to the environment by the good drainage is at the lowest level (Ryan et.al. 2004). Jones et al. (2000) stated that the sediment production that occurs on the road surface immediately after the construction of forest roads is quite high and this amount decreases gradually over time.

Görcelioğlu (2004) states that the construction of a forest road is an intervention to the ecological system. If the necessary protective measures are not taken and the forest roads are not treated carefully, erosion, flood, flood, landslide and sedimentation etc. negative results.

The importance of dirt roads in reducing water quality has been widely accepted, especially in forest basins (Anderson and MacDonald, 1998; Croke et al., 1999b; Forsyth et al., 2006; Grayson et al., 1993; Ramos-Scharro´n and MacDonald, 2007c). The rate of erosion on soil roads is higher than adjacent slope areas. For example, Ramos-Scharro´n and MacDonald (2007b) and Croke et al. (1999) U.S. Pat. He observed sequentially in pristine hillside areas on the Virgin Islands and the southeast coast of Australia and found the erosion rate on the raw roads four and six times higher.

Road construction removes vegetation from road cutting slope, fill slope, pit and ridge, making these areas susceptible to surface erosion. Over time, cut slope and fill slope reappear and erosion from these areas is reduced, but road rope and trench continue to be sources of sediment as long as the road is used.

Road construction is considered to be the largest source of sediment production during forest operations (Megahan 1980). Soil losses during and after soil construction are the highest (Swift 1984). However, water quality effects may persist during the active life of a road and even after road closure and decommissioning. Primary water quality impacts associated with the presence of forest roads include sedimentation, buffer removal and high temperature and habitat degradation from sediment deposition.

Soil roads lack surface protection provided by tar or cement based materials. Features including the whole or a subset of the typical soil road section are shown in Figure 1.

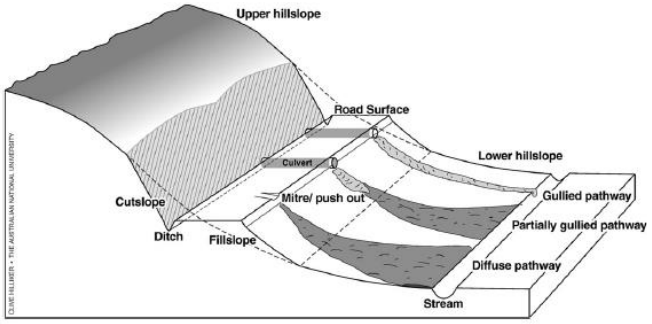

Figure 1: Road cross section and characteristi.(Baihua et al.,2010)

The cutting slope is the soil surface area above the road where the back slope was excavated. Without proper stabilization, the cutting slopes can erode and transfer sediment to the road. Elliot et al. (2009) found that slopes less than three meters experienced primarily erosion while longer slopes were exposed to erosion. The authors also found that they frequently spend mass waste on slopes, road trenches or road surfaces that accumulate on hilly terrain and cut during high rainy seasons. Luce and Black (1999)

The multi-faceted impact of road construction on the environment is always a serious issue in terms of watershed management. Water quality of surface erosion caused by road construction and neglect, flow regime of streams, floods, formation of marshes, reduction of soil fertility and similar negative effects cause great economic losses and degradation of the landscape. Erosion related to road construction and repair is also related to the following factors. These:

Road Density

The total path length available in the unit area in a watershed is called “road density.. The severity of erosion is directly related to the total road length in a basin and increases with road density.

Road Route, Slope and Width

The slope of the land, creek beds, look and erosion tendency of the road route determined by factors such as the amount of sediment reaching the rivers has a direct relationship with the erosion. The slope of the road is also an important factor in the formation of erosion. The most desirable slopes on forest roads are slopes which are moderately 3-5%. In general, the slope should not exceed 8-10%. However, in case of excessive excavation and filling works, the maximum slope should not exceed 15-20%, only at short distances. The continuation of the same road slope over long distances in the determination and application of the road route causes the surface runoff to increase and condense both on the road surface and the road drainage ditches. This is like the effect of slope length on erosion on a slope. Likewise, it is necessary to avoid long and inclined, ie straight roads, because in this case the drainage of the water can create a problem.

Topography

Topographic parameters are generally important factors in determining the route. The route is determined by following three main terrain types in a rugged forest area. These are: (1) The roads following the valley floor have advantages such as low slope, smooth route and less excavation. On the other hand, their disadvantages include being exposed to floods and floods, requiring bridge crossings and proximity to the creek bed. (2) Slope roads also have the advantage of being away from flood and flood damages due to their distance from the creek floor. On the other hand, their disadvantages are higher slopes, more excavation and filling, a bad route that has to comply with the topography, and the newly formed and eroded slopes. (3) Road routes on the ridge have advantages such as good drainage, less excavation and filling, moderate road slope and smooth route.

Geology and Soil

In the road planning, the rocky points, unstable areas, old landslides, soil leaks and high erodicity soils should be determined and avoided by the geology and soil map of the area. A forest road passing through landslide areas leads to the formation of new landslides

River Protection

One of the drawbacks of passing the roads very close to the stream beds is the deterioration of the stream water quality due to erosion and sedimentation. For this reason, the passage of the roads at a certain distance from the creek bed and leaving an uncut forest strip between the creek and the road will slow down the surface flow, increase the possibility of infiltration and protect the creek water by effecting the filter in sediment transport.

In order to prevent erosion and sediment transport after forest sections from reaching the creeks, it is possible to place some protective barriers on the lower slopes of the road route.

Excavation and Filling

Filling and excavation slopes caused by road constructions are generally the places where there are major erosion problems. If the total surface exposed to

erosion can be reduced, the carving of some steep inclined slopes is also acceptable. In fact, the slope of the slopes in terms of erosion depends on the erodiability characteristics of the soil, the wetness of the slope and the stability of a slope surface.

CONLUSION

Forest roads as a potential source of sediment in the forest environment. Sediment is formed by processes such as land flow, gill and full erosion and landslides from forest road surfaces, ditches, cut slopes and fill slopes. Sediment production is highest during and immediately after road construction, but sediment production can occur over the life of a road, even when they are no longer in use. Forest roads can also transmit sediment by increasing the flow path of stormwater flow.Forest roads should be planned and constructed in such a way as to minimize the damage to soil and river beds, and measures should be taken immediately to protect the land surfaces that are susceptible to erosion by road construction.

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