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STUDY ON TYPES OF SOIL DEGRADATION CAUSED BY FOREST EXPLOITATION

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ABSTRACT. Sustainable management and development of forest sector should become an essential element in the strategy of prevention of the degradation of the land of each state. The forests play an important role in debts settlement of water courses, in ensuring the water quality, in maintaining land stability including the erosion control, landslides or avalanches.

Forest exploitation represents a main source on degradation on the soil, having a major impact on the environment. Accelerated erosion caused by forest exploitation and soil degradation has become the main factor which limits the sustainable use of the soil. Through irrational forest exploitation, the nature of damage that occurs is ecological, social and economic. Forests are sours of other goods and services for society, such as processed wood and non-wood products, space of recreation, landscaping etc. The large number of sites affected as a result of the forest exploitation, emphasizes massive environmental risks and their existence without urgent action has a negative impact on human health and the environment.

Key words: *soil degradation, forest exploitation, sustainable environment*

INTRODUCTION

The forests play an important role in water flows adjustment, ensuring water quality and the protection of water sources for local communities without alternative sources of water resources. It is the case of forests situated in protected parameters of groundwater resource or surface water, forests and natural lakes located on the flanks and accumulation (Haynes and Naidu, 1998).

In all the places where the exploitation and the processing of some mineral resources are made, that is in the industry of exploitation and processing of wood, there also occurs some environmental issues which can be seen through: soil degradation, water and air pollution, the negative effect over terrestrial and aquatic ecosystems, over health population, but also socio-economical effects (Moțoc, 1983).

For all human communities or for natural ecosystems from the industry of exploitation and processing of wood, pollution and the risk do not occur with the end of the exploitation and processing of the useful mineral substances, but they continue their activity and the grounds remain at risk and pollution sources (Kinnell and Risse, 1998).

As Dîrja and Pepine (2008) say, inside a forest ecosystem, as a result of the negative action of the physical agents from the environment, but also of the anthropic ones, the initial physical and chemical characteristics of the soil may suffer important changes which have as a result the partial reduction, in some cases even total reduction, of its fertility. These degradation processes are classified by the nature of the factors and by the manner the agents act, as it seems: erosion processes, slips of the land, salinization and swamped processes.

From the study published by FAO in 2013, we can notice that the situation of the grounds which are seriously damaged by the forest exploitation, excessive pasture and the bad administration of the grounds is worrying.

There is estimated that more that 34% from the soil degradation is due to excessive pasture, 29,5% because of forest exploitation and 35% because of the bad administration of the soils.

There is imposed the necessity of a suitable evaluation of the relations between the patterns of spatial landscapes (landscapes and the composition of some necessary elements for landscapes) and the human processes (cutting off the forests, the degradation of the forests, forest exploitation and deforestation) which was emphasized during the last decades, especially concerning the global changes of the environment (Ferrier and Drielsma, 2010; Holmes et al., 2010; Liu and Taylor, 2002).

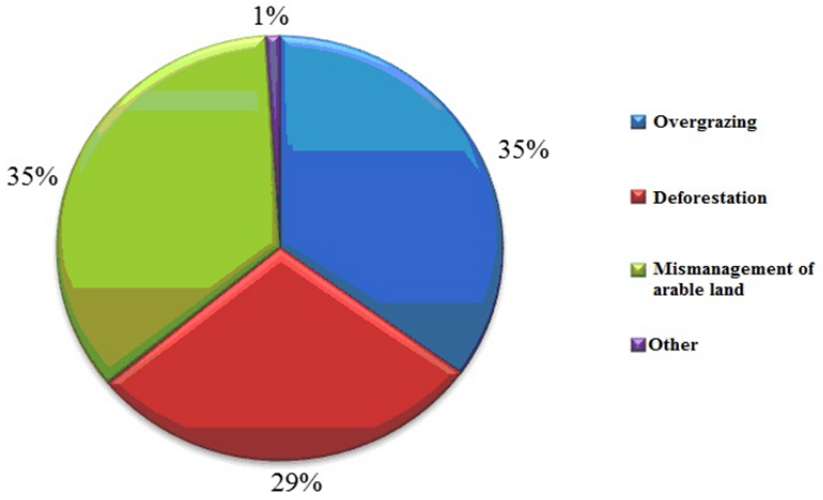

Fig. 1. *The major causes of soil degradation (http://ec.europa.eu/agriculture/envir/report/en/inter_en/report.htm#map3)*

Processes and forms of soil degradation in areas of forest exploitation

The main causes are deforestation, overgrazing, but also because of the inappropriate administration of the soil.

Currently, a very important thing that should be taken into consideration is the fact that if deforestations from the tropical areas still continue (with a broadcasting of carbon estimates to approximately 1.5 Pg/ a year), other positive flows from 1.8 to 2 PG C/ a year will be sequestered in terrestrial ecosystems.

The forms of soil degradation through forest exploitation are large enough and different, but they can be grouped with different criterions taken into consideration. In relation with the human activities, there are two big groups of processes:

- natural degradation processes where man is a conditional factor (pluvial erosion, wind erosion, slipping, swamping),
- anthropic degradation processes where man is accidental factor (compaction, repeated disturbing of grounds and pollution).

Inside of soil degradation process caused by forest exploitation takes place the destruction of soil and deterioration of its characteristics, presented in detail in table 1.

Table 1. *Processes of soil degradation in areas of forest exploitation (Forest magazine, no 2/2010)*

Processes of soil degradation in areas of forest exploitation	**Deterioration of soil characteristics**	*Physical*	➢ Destructuration ➢ Compaction ➢ Crusting; strengthening
		Chemical	➢ Soil acidification, acid drops ➢ Pollution (chemical) with fuel or emissions of machinery
		Biological	➢ Reduce the population of microorganisms ➢ Reducing population macro organisms and mezzo fauna ➢ Pollution pathogens (agents)
		Complex	➢ Excess water, swamped processes, salinization and alkaline of soil ➢ Desertification ➢ The exhaustion of fertility
	Soil destruction	*Dislocation*	➢ Water erosion ➢ Wind erosion ➢ Landslides ➢ Excavation
		Covering	➢ Soil coverage (soil clogging) with infertile sediments ➢ Soil coverage with waste wood
		Loss of land	➢ forest road construction induce land degradation

Cerdà et al. (2010) and García-Orenes et al. (2009, 2012) observed that Mediterranean areas had suffered changes in the land use which caused deforestations, exhaustion of organically material, erosion, soil degradation, salinization and crusting.

Many studies (Haines and Naidu, 1998, Kladivko et al., 2001; Kocyigit and Demirci, 2012) have showed that the administration of lands have a crucial influence upon chemical, physical and biological properties of the soil, mentioning that deforestations are not a reason for the scalping of a forest area with the purpose of obtaining an agricultural area.

Soil erosion is classified according to the climate, torrential degree, the equation of good classification of erosion which takes into account the determination of active, general and specified factors (climate agresivity, topographical factor, vegetation factor and the use of the soil and also the lithological factor) (Morgan and Quinton, 2001).

The factors which have an influence upon soil erosion can be grouped into two big categories: natural factors(climate factors- rains, temperature, winds/ soil factors- length, shape of the slopes, exhibition etc/ lithological factors- the nature of mother rock, the mixture of different rocks/ edaphic factors- texture, structure skelet composition) and anthropical or social-economical factors. Dîrja and Budiu, 2006; Toiy et al., 2002; Gobin et al., 2004; Eckelmann et al., 2006).

Mathematical modelling and determining the degree of soil erosion

Universal equation of soil erosion (Wischmeier and Smith, 1978; Patriche et al., 2006) estimated the amount of eroded soil based on six factors, according to the formula:

$$\mathbf{A=R \cdot K \cdot L \cdot S \cdot C \cdot P}$$

A = average annual soil loss
R = rainfall-runoff erosivity factor
K = soil erodibility factor
LS = slope length and steepness factor
C = cover management factor
P = support practice factor

USLE method tends to give higher results for the erosion in small measured values and low values for soil erosion with higher real values. In this case (Risse et al., 1993) the Initial USLE equation has changed, introducing new evidences for the account of soil erosion, so we have a new method of calculation, RUSLE.

The revised equation of calculation of soil erosion is composed of five factors according to equation.

$$\mathbf{A\ (t/ha/y) = R \cdot K \cdot LS \cdot C \cdot P}$$

Also there were achieved studies for calibrating these coefficients and their adaptation to local and regional environmental conditions for different areas of the world.

In Romania, this process was conducted by Research Institute for Soil (Moţoc et al., 1975), (ICPA, 1986).

The effects of soil degradation caused by forest exploitation

The importance of soil vegetation cover is particularly important to combat the degradation processes. The loss values of soil are decreasing from 28 to 2 t / ha * year, depending on the covered surface with vegetation, 90% of the absorbed water is oozed, representing 20-50 m^3 / ha / day for productive species, hardwood and softwood (Oroian, 2010).

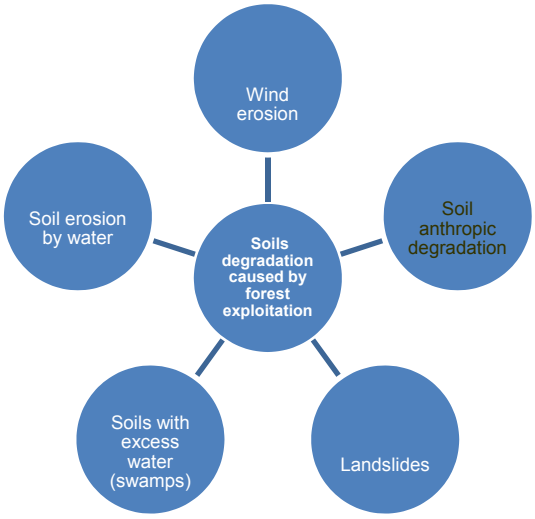

Fig. 2. *The main forms of soil degradation caused by forest exploitation*

Following this classification (Figure 2) we can say that the first four categories are concomitant after forestry in a certain area has been finished and the last and the worst that trains other types of soil degradation is where the soil has suffered major changes due to human action, namely land degraded by human activities.

The areas eroded by water can be: areas with surface erosion, revenant areas (revenant), torrential storehouses (river deposits).

The researches made in U.S.A show that the turbidity of water in the mountains from the west side of Virginia state has risen from 0.025 g / litter in the case of selective cutting to 56 g / litter in the case of the cutting on large surfaces.

The areas eroded by wind can be those areas with wind erosion of surface or wind storehouses, less met in the case of forest exploitation.

By rolling are transported bigger particles and laboratory researches have showed that the majority of soil particles (62-97%) are transported in the air up to 1 m height, by slaps like wind. In this way, the particles of 0.05-0.5 mm are transported. Big particles (0.5-2.0 mm), the heavier ones, are transported by rolling them to the surface of the ground without obstacles (vegetation, strictness's of the ground (Chepil, 1954).

The areas with too much water can be: with permanent access or prolonged and with periodic access, having to mention the fact that these areas can be seen in high places (bogs) but also in low places.

Degraded soil through the humidity excess are characterized by content at the surface but also in their water table which stop the normal functioning of plants and make the soil in an inappropriate condition to be working and cropped. (Kosmenko, 1956)

The excess moisture is more pronounced doubly so as the ratio of precipitation (P) and evapo-exudation (ETP), meaning the index of aridity - P / ETP is bigger than 1 (Dirja and Budiu, 2006) or it is met like notation the rate of soil wetting (Apetroaiei, 1977). High quantities of carbon are found in soils, especially in peat, wetland referred to permafrost compared with the atmosphere, by Davidson et al., 2006.

Displacement field (landslides) can be found in different forms: slippery soils, warehouses collapses, mudflows and rock deposits, deposits of debris (Lee and Lee, 2006).

One cycle of water erosion according to the definition has three phases (Dîrja and Budiu, 2006): detachment (dislocation), transport and deposition. During an extreme event, more than 100 $t \cdot ha^{-1}$ soil can be detached and transported, even if the loss of quantities of 2 to 40 $t \cdot ha^{-1}$ soil, indicates the beginning of erosion (Eckelman et al., 2006).

Fig. 3. *Deforestation causes landslide (http://scienceheathen.com/)*

Despite of technological improvements introduced in the 20th Century, the agricultural fields converted from forest land are the source with the most sediment in direct run-off waters (Cerda et al., 2007b).

According to a report by FAO in 2012 regarding forests and landslides, it was found that: the main cause of landslides in the mountains areas are logging with negative impact on soil and forest tree planting on susceptible down-grades can also reduce the risk of landslide, but it is not enough, because the fast-growing of tree planting and shrubs is more indicated, due to the fact of time of taking effect of retaining soil but also in terms of socio–economical problems.

Anthropic degraded lands are lands uncovered by layer of soil, land disturbed or dirt, artificial embankments, soil compaction, formation of ruts, roads etc.

Studies made by Jandal in 2007, Johnson in 1992 and Post and Kwon in 2003, concluded that the conversion of forest land that have been changed by compaction or production of ruts situations encountered in forestry, supposing that there were implemented ecological reconstruction measures, specifically afforestation, has noted an increase C storage in soil.

Fig. 4 . *Production of ruts (Forest magazine no. 3/2013)*

Soil degradation induces changes in the amount of organic carbon in forest topsoil, the estimated loss are 22% of soil organic carbon over 50 years, establishing through this aspect that arable land is a dynamic ecosystem that changes very quickly (Doetterl et al., 2012).

Based on the results from the current study and considering the fact that:

● According to some studies made by ICAS in 2014, water reservations are constantly supplied through infiltration. It is said that one ha of forest can retain at a soil level, in the first 50 cm, 1 450 m^3 of water (the equivalent of 145 mm of rain).

● Afforestation surfaces have the role of absorbing water (Untaru, 2010).

●The importance of soil vegetation cover is particularly important to combat the degradation processes. The loss values of soil are decreasing from 28 to 2 t / ha * year, depending on the covered surface with vegetation. 90% of the absorbed water is oozed, representing 20-50 m^3 / ha / day for productive species, hardwood and softwood (Coe et al., 2009, 2013; Costa et al., 2003; D'almeida et al., 2007; De Moraes et al., 2006; Lathuillière et al., 2012; Nepstad et al., 1994; Pongratz et al., 2011; Scanlon et al., 2007; Silvério, submitted, Oroian, 2010), therefore necessary to prevent the occurrence forms of degradation and remediation of degraded soils in areas forestry.

●The researches made in S.U.A show that the turbidity of water in the mountains from the west side of Virginia state has risen from 0.025 g / l in the case of selective cutting to 56 g / l in the case of the cutting on large surfaces (Harbek and Reinhart, 1964).

CONCLUSIONS

Analyzing the effects and degradation processes can be said that the impact of forest exploitation on the ground is a complex systemic phenomenon, lengthy, which manifests itself extensively on the landscapes in the area of forest exploitation requiring an extensive research of all the elements which contribute to appearance.

The main processes and forms of soil degradation after forest exploitation sometimes grows observe without being visible just after a few years. Mainly, the causes that favour these processes and the development of soil erosion are related to human activity - abusive exploitation, deforestation, destruction of grass carpet, forming roads, along favours the action of water and wind to destroy and remove large quantities of topsoil.

Knowing the consequences of enlargement for the protection of forest soils erosion processes is very important human activity, in terms of systematization of forest cultures, choosing exploitation area of forest use technological system of forest resources management and sustainable development.

It requires ecological restoration of degraded lands by forest exploitation or affected by various factors natural restrictive (climate, topography, edaphically conditions) or human, due to wasteful use of land or under the influence industry of exploitation and wood processing through processes degradation.

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