E-ISSN: 1116 - 3240 P-ISSN: 3026-9334
MPRI-JAIMR | INTERNATIONAL JOURNAL OF AFRICAN INNOVATION & MULTIDSCIPLINARY RES.
VOL. 06 NO. 2 – OCTOBER, 2024

ASSESSMENT OF THE IMPACT OF DEFORESTATION ON SOIL EROSION IN WUKARI, TARABA STATE, NIGERIA

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DOI Unique ID: 10.70382/mejaimr.v6i2.005

Abstract

Many studies confirm the relationships between deforestation, agriculture and soil erosion. Deforestation was occurred about two or three decades ago in northern of Iran and replaced with pasture and cultivation. In the present study 7 hydrological stations were selected in deforestation lands. The field survey showed that different types of soil erosion features such as shallow gullies and sheet erosion were observed in deforestation lands in comparison to forest lands. Also, results showed that there is a significant relation between deforestation and the amount of runoff, sediment, TDS and EC. Land use change has a great influence on many soil quality attributes mostly through its effect on soil organic matter.

Keywords: Impact, Deforestation, Soil, Erosion, Degradation

Structural stability of soils is affected by land use, which in turn is positively associated with total organic C content (4). Six et al. (2000) report that cultivation has reduced soil C content and changed the distribution and stability of soil aggregates. Lemenih et al. (2005) demonstrate that soil C and total N contents in the 0–10 cm soil layer declined significantly in 53 years under cultivation compared to the natural forest. The MWD of soil

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aggregates is significantly greater in the forest and pasture than in the cultivated soils. Cultivation has caused significant decreases in MWD for the 0–10 cm layer (about 61 and 64%) and the 10– 20 cm layer (52 and 62%), respectively for the forest and pasture soils. Similarly, cultivation has resulted in, on an average, a 34% decrease in WSA (water stable aggregation). Soils become more susceptible to erosion as aggregates are disrupted.

Introduction

Land use and soil cover are considered the most important factors affecting the intensity and frequency of overland flow and surface wash erosion. Many studies confirm the relationships between deforestation, agriculture and soil erosion. Conversion of forest and grasslands into agricultural land is one of the main concerns worldwide in the context of environmental degradation and global climate change. Forest provides a good protection against surface runoff and soil erosion. Agriculture has caused a 7-fold increase in surface runoff and 21-fold increase in soil erosion. Many authors have demonstrated that in a wide range of environments both runoff and sediment loss decrease exponentially as the percentage of vegetation cover increases. Without exception, deforestation and substitution of forests by crops or meadows has led to a dramatic increase in soil erosion, resulting in gully development and shallow landslides that have increased the sediment load in rivers and ultimately contributed to the formation of new sedimentary structures including fluvial terraces, alluvial fans and deltas. Alluvialfans and deltas are clear evidence of the relationships among soil erosion, sediment transport and sedimentation. Grove and Rackham (2001) point outthat the mouth of the Andarax River (southeast Spain) originally was an estuary 8 km^2 in length. Deforestation and mining in the Andarax basin since the 18th century resulted in a delta of 6 km^2, where objects dated to 2600BP have been found under a layer of sediment 2.4 m thick. Surface waters are controlled by both the natural processes, i.e. precipitation inputs, erosion, weathering, and the anthropogenic activities via point sources, such as industrial effluents and

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wastewater treatment facilities, and diffuse, such as runoffs from urban area and farming land.

Land use change has a great influence on many soil quality attributes mostly through its effect on soil organic matter. Structural stability of soils is affected byland use, which in turn is positively associated with totalorganic C content (4). Six et al. (2000) report that cultivation has reduced soil C content and changed the distribution and stability of soil aggregates. Lemenih et al. (2005) demonstrate that soil C and total N contentsin the 0–10 cm soil layer declined significantly in 53 years under cultivation compared to the natural forest.

The MWD of soil aggregates is significantly greater in the forest and pasture than in the cultivated soils. Cultivation has caused significant decreases in MWD for the 0–10 cm layer (about 61 and 64%) and the 10– 20 cm layer (52 and 62%), respectively for the forestand pasture soils. Similarly, cultivation has resulted in, on an average, a 34% decrease in WSA (water stable aggregation). Soils become more susceptible to erosion as aggregates are disrupted.

Researchers have been paying more attentions to the effect of land use on water quality, in particular the key contributors of agricultural activities to nutrients andsuspended particulate matter.

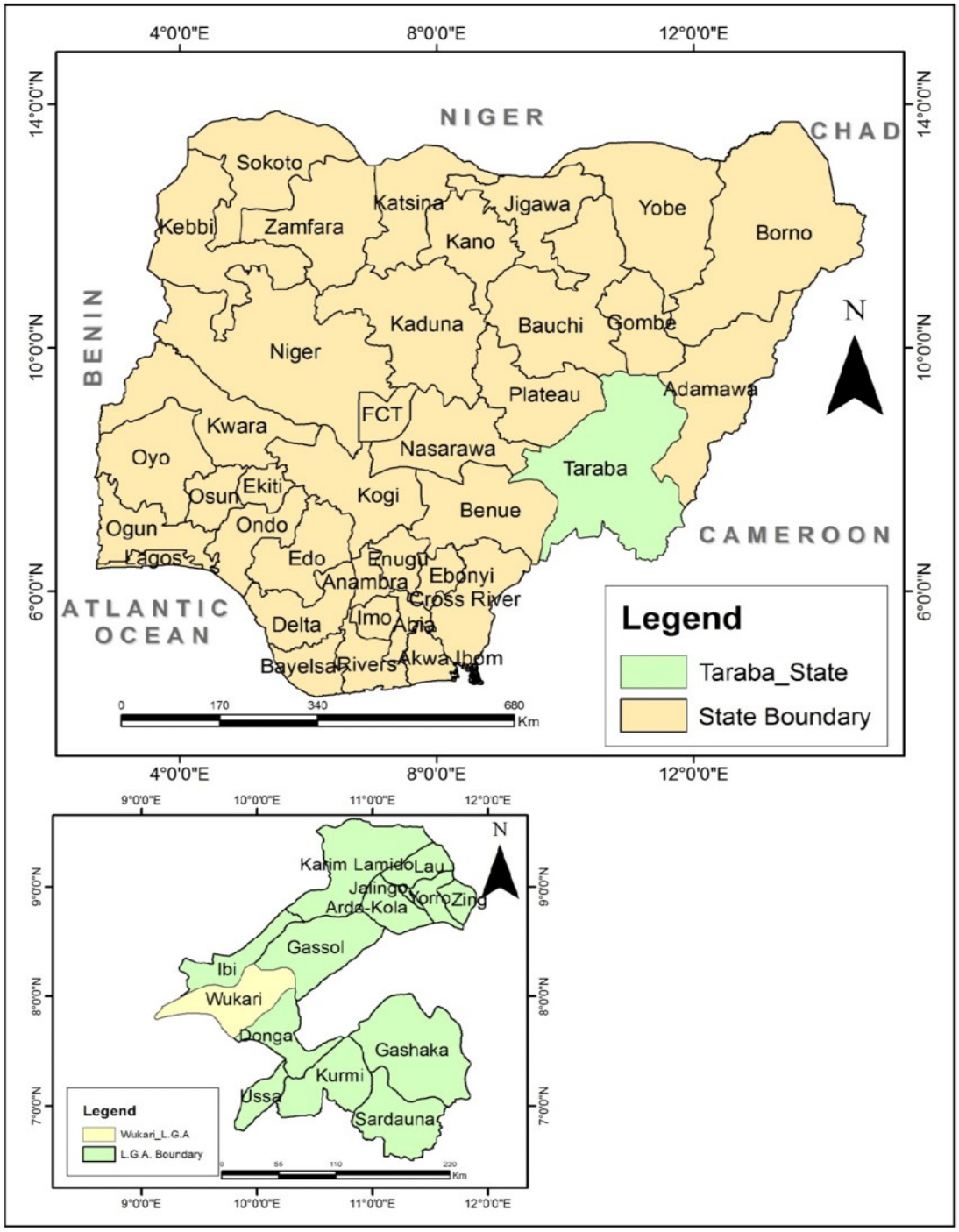
Studies demonstrate that surface water quality hasdeteriorated noticeably in many countries in the pastdecades due to poor land use practices (e.g. Carpenter,1998), indicating by the strong relationships betweendeclining water quality and increasing agriculturaldevelopment at catchment scale (e.g. Carpenter, 1998) Loess soils are among the most fertile in the world.They often contain little clay, which leads to loss of organic matter under cultivation; the resulting structural instability of the surface soil causes problems ofcrusting, poor germination of crops and erosion (Catt,2001).

Golestan province of Iran is one of the most important agricultural areas well known for its loess deposits and loess derived fertile soils. Land use change and deforestation on loess hill slopes (even up to 45%) are considered as the main causes of the dramatic floodings (e.g. August 2001 and 2002) resulted in loss of

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the lives of many people. The main objective of this study isto determine the effects of deforestation on soil erosion, sediment and some water quality.

Materials and Methods



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Wukari is a Local Government Area in Taraba State, Nigeria. Its headquarters is in the town of Wukari on the A4 highway. The Donga River flows through the area and the Benue River forms a boundary with Nasarawa State to the northwest. It has an area of 4,308 km^2 and a population of 241,546 at the 2006 census The postal code of the area is 670. The town is the base of the Wukari Federation, a traditional state. It is the home to Jukun people (West Africa)|Jukun people. The local languages are Jukun (Wapan, Jibu, Nyifon etc),ICHEN and Tiv. The dry season is humid and partly cloudy, resulting in hot temperatures all year round, while the rainy season is oppressive and overcast, rarely falling below 55°F or over 98°F.

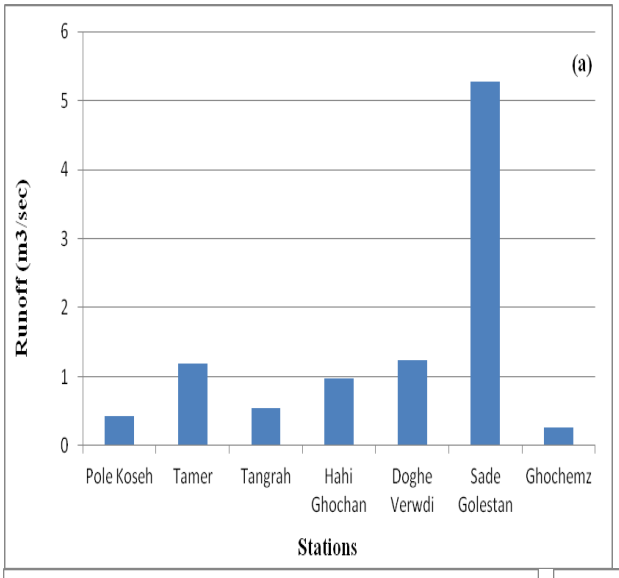
Results and Discussions

According to the field survey, deforestation occurred in the last two or three decades ago and replace with cultivation and pasture. On the hillslopes and somewhere that abandoned for some years natural plants were grown rapidly and replace with pasture.This situation obviously observed near the boundary of forest and somewhere that land change was occurred (Fig. 1). The field surveys showed that in the deforestation lands different types of soil erosion features were occurred. In general, shallow gullies and sheet erosion were observed (Fig. 2). Foster et al. (1983) found that shallow gullies were formed by concentrated- flow erosion and plough activity. In the study area, cultivation activity and plough on hillslopes along slopes were the major cause of soil erosion in the deforestation lands. Zheng (2006) expressed that on the Loess Plateau, generally, shallow gully erosion occurred on the cultivated steep slopes of greater than 15°.



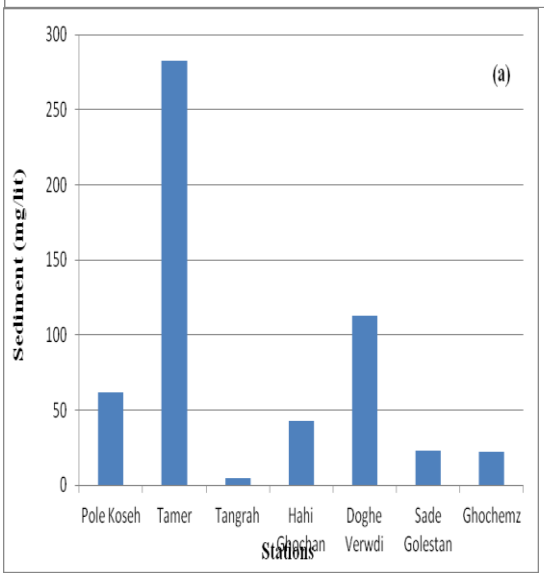
Runoff and Sediment

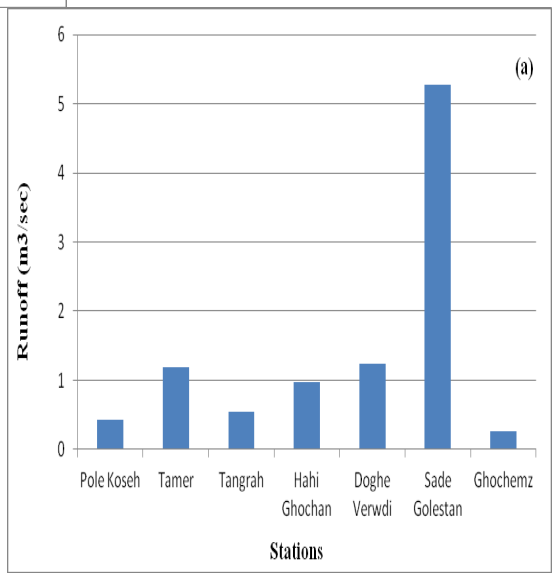
As expected, runoff increased in deforestation lands. Results showed that Sade Golestan's station had thelargest amount of runoff; on the other hand, Tamer's station had the largest amount of sediment. The difference between the volume of runoff and total sediment had effected by many factors such as erodibility coefficient of soil, total precipitation, vegetation cover, total area of the catchment and the capacity of pothole in catchment. Comparison runoff and amount of sediment in Tamer's station showed that there is no correlation between the amount of runoff and sediment (Fig. 3b), soil in the Tamer's station is very sustainable to erosion and soil eroded with the low flow of runoff. Figure 3 (a and b) reveal that the no correlation between volume of runoff and total sediment. Merzer (2007) expressed in addition to the current season's growth, the presence of sparse deadvegetation from the previous season is sufficient to decrease runoff generation during the early stages of the rainy season. Casermeeiro et al. (2004) noted that runoffand soil erosion are significantly lower under shrub land as a result of the high infiltration rate afforded by the addition of organic matter to the soil. In the conditions under which the research was carried out, cultivation and pasture replaced natural forest plants. This event was lead to increase in sediment. Al-Seikh (2006) reported that the amount of sedimentation was higher in cultivated land in comparison to natural vegetation due to the loss of vegetative cover and the detachment ofsoil particles.



Total Dissolved Solids (TDS) and Electrical Conductivity (EC)

The amounts of TDS and EC in Haji Ghochan's station have the highest amount of TDS and EC between seven selected stations (Fig. 4 a and b).





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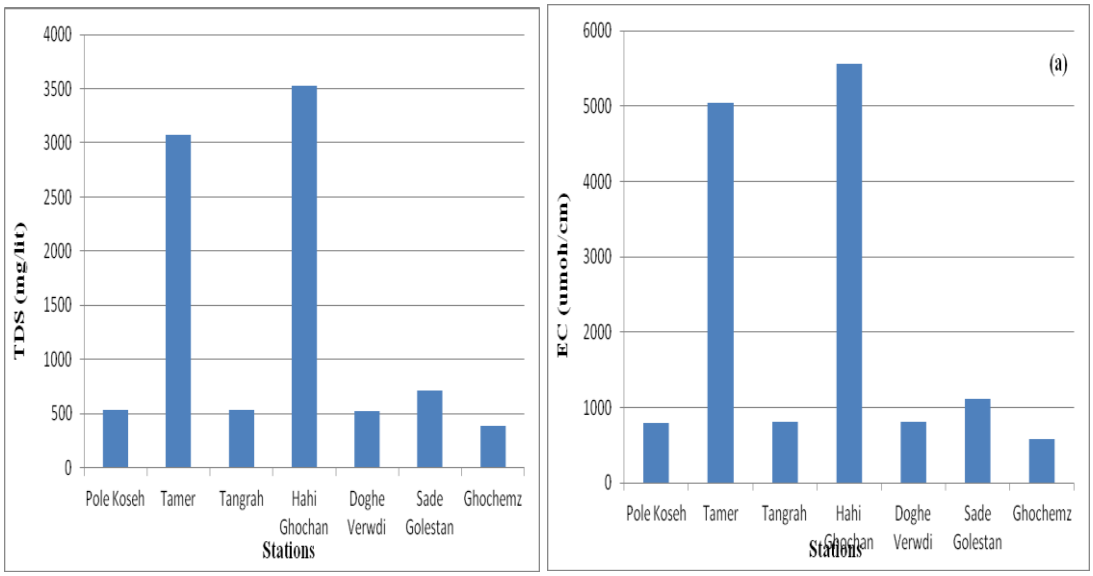


Figure 4. Amount of TDS (a) and EC (b) in different stations.

The amount of TDS and EC showed significantdifferences in seven selected stations. Table 1 presents the analysis of variance of TDS in the studied stations. Results showed that there is a significant difference between different stations ($p<0.05$) but there is not any significant difference between different years.

Table 3and 4 present comparison of the mean values for the TDS and EC studied stations. The results of TDS and EC amount in different stations and years showed that there is a significant relationship in these years and stations ($P < 0.05$) (Table 3,4). The major reason for these alterations is because of intensive land use changing in the area.

References

Al-Seikh, S., 2006. The Effect of different water harvesting techniques on Runoff,Sedimentation, and soil characteristics. M.Sc thesis, Hebron University

Beguería, S., López-Moreno, J.I., Gómez-Villar, A., Rubio, V., Lana-Renault, N., and García-Ruiz, J.M., 2006. Fluvial adjustmentsto soil erosion and plant cover changes in the Central Spanish Pyrenees.*Geografiska AnnalerA,* 88 (3), pp. 177–186.

Buck, O., Niyogi, D.K., and Townsend, C.R., 2004. Scale-dependence of land use effects on water quality of streams in agricultural catchments. *Environmental Pollution,* 130, pp. 287–299.

Caravaca, F., Lax, A., and Albaladejo, J., 2004. Aggregate stability and carboncharacteristics of particle-size fractions in cultivated and forested soils of semiarid Spain.*Soil Tillage Research*, 78, pp. 83–90.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Carpenter, S.R., Caraco, N.F., Correll, D.L., Howarth, R.W., Sharpley, A.N., and Smith, V.H., 1998. Non-point pollution of surface waters with phosphorus and nitrogen. *Ecological Applications*, 8, pp. 559–568.

Casermeeiro, M.A., Molina, J.A., Cravaca, M.T., Costa, J., Massanet, M.I., Moreno, P.S., 2004. Influence of scrubs on runoff andsediment loss in soils of Mediterranean climate. *Catena,* 57, pp. 91–107.

Catt, J.A., 2001. The agricultural importance of loess. *Earth-Science Review*. Pp. 213–229.

Celik, I., 2005. Land-use effects on organicmatter and physical properties of soil in a southern Mediterranean highland of Turkey.*Soil Tillage Research*, 83, pp. 270–277. Foster, G.R., Lane, L.J., and Milder, W.F., 1983. Seasonally ephemeral cropland gully erosion. In Proceedings of Natural Resources Modeling Symposium. Pingree Park, CO.,USA, Oct. 16-21, 1983. pp. 263-365.

Francis, C., and Thornes, J.B., 1990.*Runoff hydrographs from three Mediterranean vegetation cover types*. In J. B. Thornes (Ed.), Vegetation and erosion (pp. 363-384). Chischester: Wiley.

García-Ruiz, J.M., 2010. The effects of land uses on soil erosion in Spain: a review. *Catena*, 81, pp. 1-11.

Grove, A.T., and Rackham, O., 2001. *The Nature of Mediterranean Europe*. AnEcological History. Yale University Press, London. 384 pp.

Hadiani, M.O., 2007. Role of land use change on the local floods volume (a case study in Madar Su watershed, Golestan Province, Iran). *Environmentology*, 33, pp. 9– 16 (in Farsi)

Khormali, F., Ajami, M., Ayoubi, S.,Srinivasarao, Ch., and Wani, S.P., 2009. Role of deforestation and hillslope position on soil quality attributes of loess-derived soils in Golestan province, Iran. *Agriculture, Ecosystems and Environment*, 134, pp.178– 189

Lemenih, M., Karltun, E., and Olsson, M., 2005. Assessing soil chemical and physical property responses to deforestation and subsequent cultivation in smallholders farming system in Ethiopia. *Agriculture Ecosystem Environment*, 105, pp. 373–386.

Li, S., and Zhang, Q., 2008. Geochemistry of the upper Han River basin, China. 1. Spatial distribution of major ion compositions and their controlling factors. *Applied Geochemistry*, 23, pp. 3535–3544.

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