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Hawassa University; Office of the Vice President for Research
and
Technology Transfer

"Joining Hands to Reverse the Alarming Situations"

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Abstract

For development of a comprehensive sediment management plan, it is crucial to categorize watersheds on the basis of soil erosion hotspot areas to extend the useful life of water bodies (e.g., Gidam reservoir). The goal of this study was to assess the surface water potential and identify erosion hotspot areas of the Gidabo watershed in Ethiopia using the Soil and Water Assessment Tool (SWAT) model. The SUFI-2 (Sequential Uncertainty Fitting Version 2) program was used to calibrate the model, and the model's performance was evaluated. According to the catchment prioritization analysis, some of the sub-basins with similar land use, land cover, and soil type but with higher slope would generate higher sediment yield. Furthermore, the soil conservation scenarios were developed in SWAT, and the model result showed that average annual sediment yield could be reduced by the application of grassed waterway, filter strips, terracing, and contouring by 49%, 37.53%, 62.32%, and 54.6% respectively. It was concluded that sediment yield reduction by applying terracing was more effective than other conservation measures for affected sub-basins. The surface water potential of the watershed varies spatially from sub-basin to sub-basin, and the mean monthly surface water potential of the watershed is 33 million cubic meters. These findings can help decision-makers to develop appropriate strategies to minimize the erosion rate from erosion hotspot areas and to allocate the watershed water potential for different types of water demands. Strip planting, terracing, or contour farming may be necessary on chosen hotspot erosion sites to reduce the effect of slopes on surface runoff flow velocity and sediment transport capacity.

Keywords: water balance; sediment yield; watershed prioritization; SWAT.

Dananto, M., Aga, A. O., Yohannes, P., & Shura, L. (2022). Assessing the Water-Resources Potential and Soil Erosion Hotspot Areas for Sustainable Land Management in the Gidabo Watershed, Rift Valley Lake Basin of Ethiopia. *Sustainability, 14*(9), 5262.

Estimation of runoff and sediment yield using SWAT model: the case of katar watershed, Rift Valley Lake basin of Ethiopia

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Abstract

Estimating runoff and sediment yield at watershed level is important for better understanding of hydrologic processes and identifying hotspot area by using Soil and Water Assessment Tool (SWAT) model for intervention strategies. From the result of Global sensitivity analysis, 12 highly sensitive parameters identified. The obtained results were satisfactory for the gauging station (coefficient of determination (R2)=0.8, Nash-Sutcliffe Efficiency (NSE)=0.6 and percent difference or percent bias (PBIAS)=0) from 1990 to 2005(16) years used calibration and (R2 =0.6, ENS=0.55and PBIAS=1.2) from 2006 to 2013(8 year) were used for validation period respectively. Among all sub-watersheds, nine sub watersheds were more vulnerable to soil loss and potentially prone to erosion risk, which was out of range of tolerable soil loss rate (18 tha-1yr-1). In conclusion, the SWAT model could be effectively used to estimate runoff and sediment yield; and identified hotspot area. In addition, the result could help different stakeholders to plan and implement appropriate interventions strategies in the Katar watershed.

Keywords: Runoff, Sediment Yield, SWAT, Calibration and Validation.

Husen, D., & Abate, B. (2020). Estimation of runoff and sediment yield using SWAT model: the case of katar watershed, Rift Valley Lake basin of Ethiopia. *International Journal of Mechanical Engineering and Applications*, *8*(6), 125.

An Alternative Empirical Model to Estimate Watershed Sediment Yield Based on Hydrology and Geomorphology of the Basin in Data-Scarce Rift Valley Lake Regions, Ethiopia

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Abstract

Physical-based soil erosion models are playing an important role in the assessment of soil erosion, transportation, and deposition in the watershed. Most of these models were developed for data-rich areas of the world and they need a measured data to calibrate and validate their results. To apply such physical-based models, the main factor hindering is the lack of measured sediment data. The amount of sediment in the fluvial systems is the result of hydro-geomorphological processes of a watershed and the nature of stream flows. Therefore, this study aims to develop an alternative empirical model that generates the observed sediment data based on the hydro-geomorphology and nature of stream flows for Ziway Lake basin in the rift Valley of Ethiopia. By applying Soil and water Assessment Tool (SWAT), the lake basin was divided in to two sub-basins (Maki and Katar) with 26 of the watersheds within Maki. The SWAT model was calibrated and validated for both stream and sediment flow by using SUFI-2 program and its performance was assessed by using model evaluation statistics. With calibrated sediment flow rates of 26 Maki sub basins, an empirical model was developed by using its respective drainage area, average sub-basins slope, surface runoff, soil erodibility factor, stream flow rate, and average rive slopes. The applicability of the newly developed alternative model was tested by using model evaluation statistics and validated inside of Katar sub-basin. It is recommended to test the developed model in other basins to incorporate with SWAT CUP program to calibrate and validate the sediment yield at data scared area.

Keywords: SWAT; hydro-geomorphology; alternative empirical model; Lake Ziway.

Aga, A. O., Melesse, A. M., & Chane, B. (2020). An alternative empirical model to estimate watershed sediment yield based on hydrology and geomorphology of the basin in data-scarce rift VALLEY lake regions, Ethiopia. *Geosciences*, *10*(1), 31.

Land use and land cover changes and the link to land degradation in Arsi Negele district, Central Rift Valley, Ethiopia.

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Abstract

Accurate information on land use and land cover change (LULCC) is critical for understanding the causes of change and for developing effective policies and strategies to slow and reverse land degradation. In Ethiopia, the speed and scale of LULCC has been accelerated in the last 3-4 decades of the 21st century. The objectives of this study were to assess: (i) the extent of LULCC and normalized difference vegetation index (NDVI) and the link to land degradation; (ii) the causes of LULCC and implication for climate change adaptation. Satellite images analysis was used to detect the change in area and vegetation index, and farmers' perception to see the magnitude of LULCC dynamics and causes of deforestation. Correlations were made between vegetation index with dry season rainfall and temperature. The analysis of confusion matrix of LULC classification showed 87% accuracy with Kappa coefficient of 0.84. In the period 1986-2016, agriculture and settlement areas have increased by 250% and 618%, respectively. On the other hand, forests and woodlands have decreased by 72% and 84%, respectively. These were also validated with the farmers' quantification results with similar trends. Different causes have played roles in the dynamics of LULCC. The results showed that vegetation dynamics vary both spatially and temporally against precipitation and temperature. This study informs the need to focus on halting deforestation and development of alternative energy sources. It further helps to design future land management directions, landscape based adaptation and rehabilitation strategies to be considered by policy makers.

Key words: Deforestation, NDVI, Land degradation, Landscape, LULCC, Perception.

Mekonnen, Z., Berie, H. T., Woldeamanuel, T., Asfaw, Z., & Kassa, H. (2018). Land use and land cover changes and the link to land degradation in Arsi Negele district, Central Rift Valley, Ethiopia. *Remote Sensing Applications: Society and Environment*, *12*, 1-9.

Quantitative evaluation of watershed attributes for water resources management in the Rift Valley Lakes Basin, Ethiopia: a case from Tikur Wuha river watershed

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Abstract

Characterization of watershed hydrological process is vital for sustainable water resource management. The principal goal of this study was to investigate the inference of drainage attributes on basic hydrological processes using spatial-based morphometric analysis on Tikur Wuha river watershed. The result obtained indicated that the area was characterized with ffth-order stream. Drainage area with higher stream order has lower infltration capacity, and the shorter stream lengths were associated with the steepness of the area which afects water fow. Based on Nu value, sub-watersheds were categorized in the active erosion stage (SW7) and matured topography development (SW6). The interpretation from watershed geometry identifed circular areas most susceptible to rapid hydrological response (SW11). Hydrological process and underlying materials are mainly correlated with the drainage texture parameter, and the lower the values indicated less rocky terrain and very high infltration capacity which contributes toward less erosion (SW11). Relief parameters such as Rr value indicate the rate of stream fow and are well used in sediment yield estimation. The fndings of this investigation will provide core information for water resource planning and further studies like identifcation of groundwater potential zones; food risk assessment; erosion-prone area prioritization; and to select suitable sites for the construction of water harvesting structures.

Keywords: Water resource · Hydrology · Morphometric analysis · Tikur Wuha

Girma, R., Abraham, T., & Muluneh, A. (2020). Quantitative evaluation of watershed attributes for water resources management in the Rift Valley Lakes Basin, Ethiopia: a case from Tikur Wuha river watershed. *Applied Water Science*, *10*(8), 1-15.

Developing a DEM and Elucidating through SWAT to Conserve Soil in Kulfo Watershed of Rift Valley Basin, Ethiopia

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Abstract

Due to uninterrupted erosion and transportation, huge volume of sediments carried away by streams and rivers are finally deposited on the meanders, lakes, and reservoirs when the velocity of the surface water flow decreases. Kulfo River in the southern part of Ethiopia faces a challenge due to massive deposit of sediments. Hydrometeorological and spatial data of Kulfo watershed from the observed stream flow data series near Kulfo bridge and four meteorological station data were used to assess the depositional environment of Kulfo watershed. 'e data length covers the period from 2000 to 2019. Geomorphic parameters of the watershed were developed by using a 30m × 30m digital elevation model (DEM). 'e spatial distribution of sediment yield of the study area was estimated using SWAT, the soil and water assessment tool. Scenarios were developed to assess the effectiveness of watershed management interventions provided at the watershed and critical subwatershed level. 'e model genuinely replicated the observed discharge and sediment with an overall performance of 0.75 as measured by NSE. Twenty-one subbasins were created, and the observed average sediment yield was calculated as 11.9 ton/ha/y. 'e observed average sediment yield reduction at the hotspot subwatershed level postapplication of contouring, filter strip, terracing, and strip cropping were 40.79%, 57.94%, 66.02%, and 62.93%, respectively. By intricately analyzing, it can be referred that terracing is the best conservation measure to be incorporated into the affected subbasins.

Keywords : Kulfo River , DEM, Soil loss ,SWAT

Ayana, M. T., Bizuneh, Y. K., Koshuma, A. E., Workneh, A. C., Ali, B. M., & Lohani, T. K. (2022). Developing a DEM and Elucidating through SWAT to Conserve Soil in Kulfo Watershed of Rift Valley Basin, Ethiopia. *Applied and Environmental Soil Science, 2022*.

Assessment of rainfall-induced soil erosion rate and severity analysis for prioritization of conservation measures using RUSLE and Multi-Criteria Evaluations Technique at Gidabo watershed, Rift Valley Basin, Ethiopia

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Abstract

Soil erosion due to rainfall is the most dominant form of land resources deterioration in many parts of the world, including Ethiopia. Hence, assessing soil rate and understanding its major drivers are vital to implementing management interventions. This study intended to assess soil erosion rate, severity analysis of hotspot areas and prioritize it using Geographic Information System (GIS) based Revised Universal Soil Loss Equation (RUSLE) and multi-criteria Evaluation analysis Methods for Gidabo watershed, Rift Valley basin, Ethiopia. The Rainfall, Soil, land use/cover, Digital Elevation Model (DEM), and support practice data were used as input parameters of this study. The result revealed that the mean annual soil loss of the watershed was 44.2 t ha^{-1} $yr^{-1,}$ and it was found to be above the tolerable soil erosion rate. The outcome indicated that 6.8% (21909.6 ha) of the watershed categorized under high to severe (>10 t ha^{-1} yr^{-1}) and need urgent mitigation measures. The study also demonstrated that the upstream parts of the watershed were more threatened by soil erosion risk due to the area's steep slope and rugged landforms. Therefore, mapping erosion hotspot areas would be helpful to watershed management planner and decision makers for prioritization of watershed management plan. It is too early to say that the finding would help policymakers plan and implement erosion mitigation measures to curb land degradation and support sustainable development in the Gidabo watershed and the Rift Valley basin in general.

Keywords : Gidabo watershed ,RUSLE ,MCDA pair-wise comparison , Soil loss.

Guduru, J. U., & Jilo, N. B. (2022). Assessment of rainfall-induced soil erosion rate and severity analysis for prioritization of conservation measures using RUSLE and Multi-Criteria Evaluations Technique at Gidabo watershed, Rift Valley Basin, Ethiopia. *Ecohydrology & Hydrobiology*.

Land use land covers dynamics, its drivers and environmental implications in Lake Hawassa Watershed of Ethiopia.

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Abstract

Lake Hawassa watershed is characterized by decades of deterioration with mismanagement of natural resources. Hence, the current study was aimed at assessing the magnitude and transformation patterns of land use land cover categories over the last 45 years, the major drivers of land use land cover changes and the environmental implications of land use land cover dynamics in Lake Hawassa Watershed. The study triangulated data from Landsat images (1972, 1992 and 2017), focus group discussions, interviews and farmers' lived experiences through household survey to evaluate the change and examine the underlying factors and its implications. The land use land cover change detection results revealed significant conversion from shrubland, woodland, and forest to built-up, bare land cultivated land and agroforestry. The proportion of cultivated land and agroforestry increased from 24.2% of the watershed in 1972 to 62% in 2017.These two land uses have gained large parcel of land from naturally vegetated land covers. Overall, about 74.34% of the watershed experienced changes in land cover in 45 years. The changes were driven by proximate and underlying drivers. The identified drivers were expansion of agricultural activities, urban and infrastructure expansion, wood extraction, biophysical factors, demographic factors and land tenure policy. Consequently, the natural resource base of the watershed is degrading. We concluded that unmanaged conversions of land covers were affecting the natural vegetation base and hydrology of the watershed. Hence, it was suggested that integrated lake watershed planning and management has a paramount importance in maintaining economic benefits and ecological.

Keywords: Watershed; Agroforestry; Perception; Drivers

Degife, A., Worku, H., Gizaw, S., & Legesse, A. (2019). Land use land cover dynamics, its drivers and environmental implications in Lake Hawassa Watershed of Ethiopia. *Remote sensing applications: society and environment*, *14*, 178-190.

Hydrological Impacts Due To Land-Use And Land-Cover Changes Of Ketar Watershed, Lake Ziway Catchment, Ethiopia.

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ABSTRACT

Human health and welfare, food security and industrial developments are dependent on adequate supplies of suitable water; however, water resources are finite in space and time and affected by many parameters. One of the parameters that affect the volume of water flowing in a watershed is land-use and land-cover of the watershed area. Having investigated the influence of human induced abstractions and its impact on the hydrology of the basin, it is also important to investigate of land-use/land-cover changes within the basin and their impacts on the hydrological regime. Based on this the main objectives of this study is to assess the temporal impacts of land-use and landcover changes on stream flow of Ketar river which is located at south east central part of Ethiopia. The study also evaluated land-use and land-cover changes between 1986 and 2010 years and its impact on watershed hydrology. Classifications of historical land-use and land-cover changes occurred in the watershed were performed using 1986 and 2010 years satellite images with the help of ERDAS and GIS software. To investigate the impacts of land-use and land-cover change on stream flow, Semi-distributed hydrological model, Soil and Water Assessment Tool (SWAT) was applied. Following to model sensitivity analysis, calibration and validation was performed using historical recorded river flow data. The analysis result of land-use and land-cover change show that, an outspread of agricultural land and settlement and reduction of forest land and grass land in the study area. The evaluation of the SWAT model response to the land-use/land-cover change indicate that, the mean wet monthly flow for 2010 land cover increased by 3.8% compared to the 1986 land cover. On the other hand, average monthly flow in dry season is decreased by 12.3% in 2010 compared to 1986 land-cover. It is concluded that because of increasing number of population in alarming rates, it is expected that, the existing marginal lands at present will changed to agricultural lands which can affect health of hydrological process within the watershed and thereby threatens the livelihoods of the inhabitants.

Key words: Water resource, Ketar watershed, land-use/land-cover and SWAT

Tufa, D. F., Abbulu, Y., & Rao, G. V. R. (2015). Hydrological impacts due to land-use and land-cover changes of Ketar watershed, Lake Ziway catchment, Ethiopia. *Int. J. Civ. Eng Tech, 6*, 36-45.

Estimating the extent of soil degradation of Weito Watershed in lower Rift Valley Basin: Southern Ethiopia

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Abstract

In this study, Revised Soil Loss Equation (RUSLE) was used to quantify the potential soil erosion in Weito Watershed. Rainfall data, soil data, DEM data and land use-land cover data were used as input data sets to generate RUSLE factor values. RUSLE factors such as R_ the erosivity factor, K_the soil erodibility factor, LS_ the topographic factor, C_ the crop management factor, and P_ the conservation support practice was analyzed and superimposed using raster calculator in ArcGIS10.1 to estimate and map the annual soil loss. The results showed annual soil loss ranging from 0 to 210 tons/ha and mean annual soil loss rate of 110ton/ha/yr. The annual soil loss rate in the western and south western part of the watershed was mainly identified as high and severe and hence, requires special attention with an immediate soil conservation practice. Key words: conservation support practice; erodibility; erosivity; RUSLE; Soil erosion.

Key words: conservation support practice; erodibility; erosivity; RUSLE; Soil erosion

Ayana, M. T., Workineh, A. C., Mohammed, A. K., & Hatiye, S. D. Estimating the extent of soil degradation of Weito Watershed in lower Rift Valley Basin: Southern Ethiopia.

Soil Loss Mapping and Severity Analysis by Using Revised Universal Soil Loss Equation (RUSLE) Modeling: A Case Study of Dijo River Watershed, Central Rift Valley Basin of Ethiopia.

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Abstract

Background: Soil loss is one of the main forms of soil and environmental degradation. Soil degradation due to erosion contributes to loss of ecological and aesthetic values of environment, socioeconomic local community, and agricultural land productivity. The study aimed to evaluate the spatial variability of erosion occurring at Dijo river watershed in central rift valley basin of Ethiopia RUSLE model. Methodology: 30 m by 30 m DEM, thirty four years' rainfall data measured at 5 rain gauge stations across the watershed, soil and land use maps, published literature review were used as inputs to analyze the model. Results: The computed mean annual soil loss rate of the watershed was found to be 48.4 ton ha-1 yr -1 , which is more than three times higher as compared to the maximum tolerable soil loss value (16 ton ha-1 yr -1) and the annual erosion rates range from 0 to above 947 ton ha-1 yr -1 . The mean annual soil loss values below 5 ton ha-1 yr -1 were rated as very slight, while those above 50 ton ha-1 yr -1 were categorized as very severe soil erosion risk. About 25% of the areas (35533.96 ha) in the watershed were identified with moderate to high severity erosion class (>50 ton ha-1 yr -1) which needs immediate measures to reclaim soil erosion. Conclusions: The quantitative soil loss computation results indicated that soil loss has still continued substantial problems in the watershed. The results underline the urgent need for appropriate land use management practices in the watershed.

Keywords: Dijo river watershed, Erodibility factor, Erosivity factor, RUSLE, Soil loss

Nigusie, A., & Dananto, M. Soil Loss Mapping and Severity Analysis by Using Revised Universal Soil Loss Equation (RUSLE) Modeling: A Case Study of Dijo River Watershed, Central Rift Valley Basin of Ethiopia.

Effects of Long-Term Land Use and Land Cover Changes on Ecosystem Service Values: An Example from the Central Rift Valley, Ethiopia.

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Abstract

Changes in land use and land cover (LULC) are the leading contributors to the decline and loss of ecosystem services in the world. The present study covered the Central Rift Valley lakes basin in Ethiopia, focusing on the valley floor and the East and West escarpments, to analyze changes in LULC and to estimate associated losses in ecosystem service values (ESVs). Covering both upstream and downstream areas in the basin, the study addressed major gaps in existing studies by connecting the sources and sinks of material (e.g., sediment and water) in source-to-lake systems. Additionally, the study facilitated the identification of critical areas for conserving natural resources and reversing the decline of associated ESVs in the Central Rift Valley. A post-classification comparison approach was used to detect LULC changes between 1973 and 2020 using four Landsat images from 1973, 1990, 2005 and 2020. The value transfer valuation method was used to estimate the changes in ESVs due to LULC changes. Among the seven major identified LULC classes, farmlands, settlements, and bare lands showed positive changes, while forestlands, grasslands, shrublands and waterbodies showed negative changes over the last 47 years. The expansion of farmlands, for example, has occurred at the expense of grasslands, forestlands and shrublands. The changes in LULC over a period of 47 years resulted in a total loss of US $62,110.4 × 106 in ESVs. The contributors to the overall loss of ESVs in decreasing order are provisioning services (US $33,795.1 × 106), cultural services (US $28,981.5 × 106) and regulating services (US $652.9 × 106). The results imply that addressing the degradation of land and water resources is crucial to reversing the loss of ecosystem services and achieving the national Sustainable Development Goals (SDGs) related to food and water security (SDGs 2 and 6) and life on land (SDG 15).

Keywords: ecosystem service; ecosystem service values; forestland; SDGs; waterbodies

Mekuria, W., Diyasa, M., Tengberg, A., & Haileslassie, A. (2021). Effects of long-term land use and land cover changes on ecosystem service values: An example from the central rift valley, Ethiopia. Land, 10(12), 1373

Soil Erosion Modelling and Risk Assessment in Data Scarce Rift Valley Lake Regions, Ethiopia

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Abstract

To prolong the useful life of lakes and reservoirs, prioritizing watersheds by severity and risk of soil erosion is an essential index to develop sound sediment management plans. This study aims to predict soil erosion risk and sediment yield using Soil and Water Assessment Tool (SWAT) model in Lake Ziway basin, Ethiopia, and the model result is validated with lake bathymetric changes. The SUFI-2 program was applied for a model calibration and the performance of the model was assessed. The catchment prioritization study indicated that some sub-basins having the same soil type and land use but a higher slope gives higher sediment yield. This confirms that, in the basin, the upland is the main source of sediment for the lake, hence the variation of sediment yield is more sensitive to terrain slope. Furthermore, the soil conservation scenarios demonstrated in SWAT that reduce the slope length of the watershed by 50% for a slope greater than 5% are decreasing the sediment yield of the basin by 55%. The bathymetric differencing of the lake indicates that the sediment was accumulating at a rate of 3.13 t/ha/year while a calibrated SWAT model resulted in 5.85 t/ha/year. The identified reasons for these variations are the existence of outlet for the lake, floodplain depositions and abstraction of sediment (sand mining) from the tributary rivers before flowing to the lake.

Keywords: SWAT; watershed prioritization; sediment yield; reservoir sedimentation; bathymetry; Lake Ziway

Aga, A. O., Chane, B., & Melesse, A. M. (2018). Soil erosion modelling and risk assessment in data scarce rift valley lake regions, Ethiopia. Water, 10(11), 1684.

Environmental implications of soil erosion and sediment yield in Lake Hawassa watershed, south-central Ethiopia.

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Abstract

Background: Assessing soil erosion, sediment yield and sediment retention capacity of watersheds is one of the under-researched areas in watersheds of developing countries like Lake Hawassa watershed. The study examined soil erosion and sediment yield and their environmental implications in the Lake Hawassa watershed. The quantifcation and mapping were carried out using the Integrated Valuation of Ecosystem Services and Tradeofs (InVEST) model. Data such as Land Use Land Cover (LULC), Digital Elevation Model (DEM), rainfall, soil, and management practice were used as input parameters. Results: The empirical analysis confrmed that the watershed has a total soil loss of about 5.27 Mt annually. The mean annual erosion rate from the watershed was estimated to be 37 t ha−1 year−1 . The estimated erosion rate was greater than the maximum tolerable erosion limit in Ethiopia (2–18 t ha−1 year−1). The total amount of sediment which was exported to the nearby streams and lakes in the watershed was estimated to be 1.6 t ha−1 year−1 . The water bodies receive a total of 226,690.3 t of sediment annually. Although higher soil loss and sediment export per unit of area were estimated from the highest slope gradients, greater contributions to the total soil loss and sediment export were computed from slopes with 5–30% gradients. In terms of LULC, the highest contribution to the total soil loss was computed from cultivated land while the highest rate of soil loss per hectare was observed from bare land. Due to the existing vegetative cover, a total of 18.65 Mt (130.7 t ha−1 year−1) of sediment was retained. Vegetation-covered LULCs such as forest, woodland, shrubland, and agroforestry revealed the highest sediment retention capacity. As a result of the increased soil erosion and sediment yield in the watershed, the drying-out of a small lake and the rise in the water level of Lake Hawassa were identifed. Conclusion: Most of the soil loss and sediment yield were contributed by a small part of the watershed. Thus, the results underscore the urgent need for targeted soil and water conservation measures of various types to ensure the sustainability of the watershed resources.

Keywords: Lake Hawassa, Sediment yield, Soil erosion, Sediment retention.

Degife, A., Worku, H., & Gizaw, S. (2021). Environmental implications of soil erosion and sediment yield in Lake Hawassa watershed, south-central Ethiopia. Environmental Systems Research, 10(1), 1-24.

Mapping of soil erosion-prone sub-watersheds through drainage morphometric analysis and weighted sum approach: a case study of the Kulfo River basin, Rift valley, Arba Minch, Southern Ethiopia.

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Abstract

In the present study, soil erosion prioritization of sub-watersheds of the Kulfo River basin was conducted by adopting a drainage morphometric analysis along with a statistical correlation matrix-based weighted sum approach. The drainage network extracted and sub-watershed boundaries were demarcated through GIS techniques using advanced space-borne thermal emission and refection–digital elevation model (ASTER–DEM). The Kulfo River basin was separated into six sub-watersheds (SW-1 to SW-6), and diferent morphometric criteria were calculated using the standard formula. And, morphometric parameters like drainage frequency, bifurcation ratio, drainage density, form factor, circulatory ratio, drainage texture, elongation ratio, compact coefcient, and length of overland fow have been considered for sub-watershed prioritization. Based on the results, the Kulfo River basin's sub-watersheds were categorized into fve priority classes: very low, low, medium, high, and very high. The results illustrate the sub-watersheds (SW-1, SW-2, SW-3, and SW-6) that approximately 65% of the Kulfo River basin's total area fall under the very high, high, and medium soil erosion-prone areas, respectively. Therefore, the above-mentioned four sub-watersheds can be a value for the consideration of the soil protection plan. The outcomes derived from this study will be valuable information for several partners like agriculturists, surface and groundwater wealth administrators, and decision-makers for improving the soil management process. The current research shows that ASTER–DEM data, GIS approach, and a statistical correlation matrix-based weighted sum approach are vibrant tools for watershed prioritization in data-scarce regions.

Keywords : Drainage morphometry, Statistical correlation analysis, Watershed prioritization · Kulfo River basin , Rift valley , Ethiopia

Jothimani, M., Abebe, A., & Dawit, Z. (2020). Mapping of soil erosion-prone sub-watersheds through drainage morphometric analysis and weighted sum approach: a case study of the Kulfo River basin, Rift valley, Arba Minch, Southern Ethiopia. Modeling Earth Systems and Environment, 6(4), 2377-2389.

Assessment on Farmers' Practices on Soil Erosion Control and Soil Fertility Improvement in Rift Valley Areas of East Shoa and West Arsi Zones of Oromia, Ethiopia.

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Abstract

Farmers' perception and indigenous knowledge to conserve natural resources in general and soil and water conservation in particular have received little emphasis in Ethiopia. This study aimed to understand farmers' perception on prevalence of soil erosion and their indigenous mechanism in soil erosion control and soil fertility management. The study was conducted in March, 2011 in purposively selected districts of East Showa Zone (Adama and Lume districts) and West Arsi zones (Shashemene and Kofele) of Oromia, Ethiopia. Data was collected using household interviews where a total of 160 farmers were randomly selected and interviewed. It was identified that the land allocated for the agricultural land and forest land showed an increasing trends since five years back in all study districts while the land allocated for grazing was degreasing. This was due to conversion of grazing land and other marginal lands in to cropland to satisfy an increased food demand. Water and wind erosions are the two major types of soil erosion identified in this particular study. Heavy and erratic rain fall, topography and deforestation are the major causes of soil erosion in all study area. To tackle the soil erosion problem, framers are using different physical structures such as soil bund, cutoff drains and micro basins. In addition, crop rotation, compost, animal manure and intercropping are also the major biological soil and water conservation activities practiced by the farmers. In their decisions for fertilization or production farmers use yield response, soil color, vegetation cover, soil type and topography as soil fertility indicators. Chemical fertilizers, though perceived expensive, are still the dominant strategy used by farmers to increase production. In addition, farmers' perception and training on use of other alternative organic fertilizer is very low in all study areas.

Keywords: Farmers' practice; Soil erosion; Soil; Water conservation

Gemechu, T., & Hunde, K. K. (2015). Assessment on farmers' practices on soil erosion control and soil fertility improvement in Rift Valley Areas of East Shoa and West Arsi Zones of Oromia, Ethiopia. EC Agriculture, 2, 391-400.

Evaluating spatial and temporal variations of rainfall erosivity, case of Central Rift Valley of Ethiopia.

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Abstract

Land degradation in many Ethiopian highlands occurs mainly due to high rainfall erosivity and poor soil conservation practices. Rainfall erosivity is an indicator of the precipitation energy and ability to cause soil erosion. In Central Rift Valley (CRV) of Ethiopia, where the climate is characterized as arid and semiarid, rainfall is the main driver of soil erosion that in turn causes a serious expansion in land degradation. In order to evaluate the spatial and temporal variability of rainfall erosivity and its impact on soil erosion, long-term rainfall data (1980–2010) was used, and the monthly Fournier index (FI) and the annual modified Fournier index (MFI) were applied. Student's t test analysis was performed particularly to examine statistical significances of differences in average monthly and annual erosivity values. The result indicated that, in a similar spatial pattern with elevation and rainfall amount, average annual erosivity is also found being higher in western highlands of the valley and gradually decreased towards the east. The long-term average annual erosivity (MFI) showed a general decreasing trend in recent 10 years (2000–2010) as compared to previous 20 years (1980–1999). In most of the stations, average erosivity of main rainy months (May, June, July, and August) showed a decreasing trend, whereby some of them (about 33.3 %) are statically significant at 90 and 95 % confidence intervals but with high variation in spatial pattern of changes. The overall result of the study showed that rainfall aggression (erosivity) in the region has a general decreasing trend in the recent decade as compared to previous decades, especially in the western highlands of the valley. Hence, it implies that anthropogenic factors such as land use change being coupled with topography (steep slope) have largely contributed to increased soil erosion rate in the region.

Keywords: Central Rift Valley, erosivity

Meshesha, D. T., Tsunekawa, A., Tsubo, M., Haregeweyn, N., & Adgo, E. (2015). Evaluating spatial and temporal variations of rainfall erosivity, case of Central Rift Valley of Ethiopia. *Theoretical and Applied Climatology*, *119*(3), 515-522.

Land-use and land-cover change in Lake Ziway watershed of the Ethiopian Central Rift Valley Region and its environmental impacts.

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Abstract

Assessing land use and land cover (LULC) change in Lake Ziway watershed is important to evaluate the degradation of ecosystems and their environmental processes caused by the ongoing increase in human pressures. The present study analyzed the long-term LULC dynamics in the Lake Ziway watershed, which covers 7300 km^2 in the Ethiopian Central Rift Valley region. Three Landsat Satellite Image Series - Landsat MSS (1973), Landsat TM (1989) and Landsat Enhanced ETM+ (2018) - were the main input data from which three LULC maps were produced by employing Remote Sensing Techniques and Geographical Information Systems. The satellite data were supported by Google Earth and information gathered from informal discussions from local elderly people who are knowledgeable about the area. The results over the last 45 years show that the major LULC changes in the study watershed have been the expansion of cultivated, agroforestry and settlement areas and the corresponding reduction in woodlands. Cultivation, agroforestry, and settlement LULC categories increased by 45%, 10.9%, and 141.4%, respectively. These changes are attributable to a combination of the ever increasing human population and the subsequent demands on environmental resources like agricultural lands, commercial and domestic fuelwood and charcoal. Other factors include poorly defined ownership arrangements and weak enforcement strategies on the existing land use policy. This has created open access mentalities among communities and intensified LULC changes in the watershed. Awareness raising and provision of technical training about conservation interventions should be provided to communities in the watershed.This study provides information for corrective measures to protect further degradation and irreversible losses that might happen to the biotic and abiotic resources in Lake Ziway watershed.

Keywords: Landsat LULC change Lake Ziway Watershed Ethiopia

Desta, H., & Fetene, A. (2020). Land-use and land-cover change in Lake Ziway watershed of the Ethiopian Central Rift Valley Region and its environmental impacts. *Land use policy*, *96*, 104682.

Identifying sustainability challenges on land and water uses: The case of Lake Ziway watershed, Ethiopia.

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Abstract

This paper firstly analyzes the land use - land cover (LULC) in Lake Ziway watershed (Ethiopia) and quantifies the changing patterns from 1973 to 2014 using Landsat images. Secondly, the paper estimates sediment yields using the Soil and Water Assessment Tool (SWAT model). It also assesses and estimates water abstraction from Lake Ziway using survey data. The study shows that the conversions from woodlands into agricultural lands and settlement areas are the major detected LULC changes. Of the total area of the watershed, agricultural lands and settlement areas together increased from 57% in 1973 to 75% in 2014 at the expense of woodlands whose areas decreased from 26.16% to 6.63% in the study periods. The study also shows that water abstraction and sediment loads are increasing at Lake Ziway watershed. The major driving forces behind these LULC changes and the impacts on the lake natural condition are anthropogenic factors such as population growth, land policy changes and deforestation. Increasing demands for more land and water resources, i.e., land for settlements and cultivation, wood for fuel and charcoals, and water for irrigation and municipal water supply, are the underlying causes for the observed changes on the watershed resources. Thus, if the existing scenarios of human pressures are left neglected without management interventions, severe watershed degradations will continue to further affect the watershed's resources including the hydrology. Therefore, responsible government institutions should start mobilizing the local communities along with providing financial and material supports for watershed rehabilitation through afforestation and soil and water conservation activities. Additionally, the free-access practices for water use should be replaced by user-charge policy to regulate water abstractions in order to adequately sustain the water level of Lake Ziway and its feeder rivers. In this respect, this study provides firsthand information to policy makers and planners to put in place a comprehensive land and water use plan and regulations against the unruly human actions in the watershed before irreversible losses might happen to Lake Ziway and its watershed resources.

Keywords: LULC Watershed Water abstraction Human impacts Sediment yield Lake Ziway

Desta, H., Lemma, B., & Gebremariam, E. (2017). Identifying sustainability challenges on land and water uses: The case of Lake Ziway watershed, Ethiopia. *Applied Geography, 88,* 130-143.

Enset-based land use land cover change detection and its impact on soil erosion in Meki river watershed, Western Lake Ziway Sub-Basin, Central Rift Valley of Ethiopia

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Abstract

Background: Water erosion, upland degradation and deforestation are key environmental problems in the Meki river watershed. The study assessed the land use land cover change (LULCC) for 30 years and it examined the contribution of indigenous Enset-based land use system (EBLUS) to reduce soil erosion and prevent water bodies including Lake Ziway from sedimentation which was not considered in the former studies. GPS based data collected and satellite based LULC analysis using ERDAS Imagine 2014 performed to investigate existing farm management practices and land cover respectively. HEC-GEOHMS, Geo-statistical interpolation and RUSLE were applied to model watershed characteristics, spatial climate parameters and soil loss respectively. Result: Meki river watershed (2110.4 km2 of area) is dominantly covered by cultivated LUS (41.5%), EBLUS (10.65%), Bush and Chat LUS (25.6%), Forest and plantations LUS (14.14%), built-up (7.4%) and water bodies (0.75%). Soil loss is increasing from 1987 to 2017 and a larger part of the watershed sufers a moderately severe to very severe risk (18 t ha−1 year−1 to>80 t ha−1 year−1) in all sub-watersheds irrespective of the land use systems which shows the watershed is facing sever degradation problem. The mean soil loss of 30.5 t ha−1 year−1 3 and 31.905 t ha−1 year−1 are verifed from Enset growing zones and non-Enset growing zones of the watershed respectively. Conclusion: EBLUS saves signifcant amount of soil despite the steepness of the slopes of the Enset growing zones of the watershed. Hence, expansion of EBLUS can contribute in sustaining water bodies, including Lake Ziway by reducing soil loss rate and sedimentation problem for the ecological sustainability of the watershed. Therefore, separate land use policy and awareness creation are mandatory for such EBLUS expansion, sustainable watershed management interventions and conservation of the natural environment in the watershed based on its suitability and severity of erosion risk mapping.

Keywords: Enset, Soil-loss, Geostatistics, RUSLE, Land use policy, Meki-river-watershed

Woldesenbet, A. B., Wudmatas, S. D., Denboba, M. A., & Gebremariam, A. G. (2020). Enset-based land use land cover change detection and its impact on soil erosion in Meki river watershed, Western Lake Ziway Sub-Basin, Central Rift Valley of Ethiopia. Environmental Systems Research, 9(1), 1-23.

Effect of Land Use/Cover Changes on Ecological Landscapes of the Four Lakes of Central Rift Valley Ethiopia

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Abstract

The objective of this study was to analyze land use land cover (LULC) changes in the landscape of Central Rift Valley over a period of 30 years (1985–2015). Satellite images of Landsat5 TM (1985), (1995) and Landsat8 OLI (2015) were used. All images were classified using supervised classification technique with ERDAS-13. Change analysis was carried out using post classification comparison in GIS-10.3.1. Twelve LULCCs were successfully captured and the classification result revealed that intensive cultivated land (44.52%), mixed cultivation (18.31%), and woodlands (11.13%), open water (7.99%), large scale farming (7.50%) was dominant LULC types in 1985. In 2015, mixed cultivation (35.90%), large scale farming (14.87%), intensive cultivation (13.99%), open woodland (8.37%) and irrigated land (6.94 %) were the major LULC types followed by others. The change result shows that a rapid increase in irrigable land, large scale farming, and mixed cultivation 8.37%, 14.87%, and 35.90 % occurred between the 1985 and 2015 study period, respectively. Similarly, open water/lake decreased by 2.31%, during the 1985 and 2015 study periods. More specifically, Lake Abijata showed a progressive decline by 25.6%. Analysis of the 30-year change revealed that about 80.79% of the land showed major changes in LULC. Based on the DPSIR framework of analysis, an integrated land use and development planning and policy reform are suggested to encourage the ongoing and planned ecosystem restoration, degraded land rehabilitation, and biodiversity conservation intervention in the Ethiopia Central Rift Valley areas. However, further detailed investigation may be need prior to any recommendation to address the drivers and consequences of land use and land cover changes in the area.

Keywords: CRV, ERDAS, GIS; Image; Landsat TM /Oli, Lake, LULC, RS

Girmay, W., Tesfaye, B., Seifu, W., & Elias, E. (2017). Effect of Land Use/Cover Changes on Ecological Landscapes of the Four Lakes of Central Rift Valley Ethiopia. Journal of Environment and Earth Science.

Land Use Land Cover Changes and their impact on the lake ecosystem of the Central Rift Valley of Ethiopia

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Abstract

LULC changes are major environmental challenges in many parts of the world which are adversely affecting ecosystem services. This study was aimed to analyse LULC changes on the ecological landscape of Ethiopia CRV areas from 1985 to 2015. Satellite images were accessed and pre-processing and classification is done. Major LULC types were detected and change analysis was executed. Nine LULC changes were successfully evaluated. The classification result revealed that in 1985, 44.34% of the land was covered with small scale farming followed by mixed cultivated/acacia (21.89%), open woodland (11.96%), and water bodies (9.77%). Whereas for the same study year open grazing land, forest, degraded savannah and settlements accounted the smallest proportion. Though the area varied among land use classes, the trend of share occupied by the LULC types in the study area remained same in 1995 and 2015. Increase in small and large scale farming, settlements and mixed cultivation/acacia while a decrease in water bodies, forest and open woodlands is noted. About 86.11% of the land showed major changes in land use/cover. Lastly, DPSIR framework analysis was done and an integrated land use and development planning and policy reform are suggested for sustainable land use planning and management.

Keywords: Central Rift Valley, Ethiopia, Landsat images, Lake, land use/land cover

Elias, E., Gessesew, W. S., Tesfaye, B., & Girmay, W. (2018). Land Use Land Cover Changes and their impact on the lake ecosystem of the Central Rift Valley of Ethiopia.

Runoff and Sediment Yield Modeling of Meki River Watershed Using SWAT Model in Rift Valley Lakes Basin, Ethiopia

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Abstract

Loss of soil fertility in agricultural lands and sedimentation in lakes of central rift valley of Ethiopia are major watershed problem threatening the agro economy in the area. To develop effective erosion control plans through implementing appropriate soil conservation practices, runoff and sediment yield in Meki watershed was estimated and analyzed using the SWAT model. The model showed the simulated mean annual surface runoff was 114.03mm and the mean annual streamflow was 9.41m3 /s. Similarly, mean annual sediment load of 13.12 t/ha enters to Lake Ziway. The model was calibrated and validated on daily and monthly time step for flow and on monthly time step for sediment yield. The results of Nash Sutcliff Efficiency of 0.71 on daily and 0.89 on monthly time steps for streamflow and its value of 0.80 on monthly time step for sediment yield during calibration showed that there is a good match between measured and simulated data for both variables on daily basis and very good match on monthly basis. The potential erosion source areas were identified. Likewise, 51.34% of the watershed area was found to be potential erosion sources and priorized for erosion control plans.

Keywords: Meki Watershed, Runoff, Sediment Yield, SWAT, SWAT-CUP

Bunta, A., & Abate, B. (2021). Runoff and Sediment Yield Modeling of Meki River Watershed Using SWAT Model in Rift Valley Lakes Basin, Ethiopia. *American Journal of Civil Engineering*, *9*(5), 155-166.

Estimation of Soil Erosion using USLE and GIS in Awassa Catchment, Rift valley, Central Ethiopia

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Abstract

In central part of the Main Ethiopian Rift, population increase is forcing farmers to expand their land by clearing forests, bushes and scrubs for crop cultivation, construction purposes and for fuel as energy source. Thus, loss of agricultural lands is increasing in the catchment. Therefore, estimation of soil erosion in Awassa catchment, Ethiopia is very important to make sound environmental management strategies and land use planning. In this context, Universal Soil Loss Equation (USLE) has been adopted to estimate soil erosion for sheet, rill and inter-rill. All these thematic layers were prepared in a Geographical Information System (GIS) using various data sources and data preparation methods. The soil erosion map was prepared by GIS layers over lapping method which ultimately estimated soil erosion rate of study area. The study revealed that 97% of the study area is characterized by 0-10t ha-1yr-1 soil erosion rate, whereas 3% of the study area is characterized by 10-202 t ha-1yr-1 soil erosion rates. When estimated for soil erosion, it was found that out of the whole catchment, 30 km2 was under high to extremely high soil erosion rate (91-202t ha-1yr-1). The outcome of research also showed that the study areas having six ordinal classes of soil erosion risk zone, e,g., extremely high risk (91-202), extreme risk (55-91), very high risk (30-55), high risk (10-30), moderate risk (5–10) and low risk (0-5) with corresponding percentage of area falling,0.18, 0.26, 0.43, 1.62, 2.68, and 94.83, respectively. From the level of soil tolerance limits, it appears that the amount of soil loss is tolerable at its current situation.

Keywords: Soil Erosion; USLE; Remote Sensing; GIS; Ethiopia

Ali, S. A., & Hagos, H. (2016). Estimation of soil erosion using USLE and GIS in Awassa Catchment, Rift valley, Central Ethiopia. *Geoderma Regional*, *7*(2), 159-166.

Impact of land use/land cover change on hydrologic processes in Dijo watershed, central rift valley, Ethiopia.

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Abstract

The aim of this study was to assess the impact of land use / land cover changes on the hydrological process in the central valley basin of Ethiopia, from 1985 to 2018 and evaluate historical land use/land cover change using satellite image. Satellite images were classified by supervised classification technique with maximum likelihood. SWAT model were used to simulate hydrological processes in the watershed. The result of the study shows that barren lands, agricultural and settlement lands were expanded by 7 and 64%; whereas, forestlands, water bodies, shrub and grasslands were declined by 13, 57 and 41% respectively over the past three decades. The calibrated and validated SWAT model used also showed that there has been good agreement between simulated and observed streamflow on monthly basis. Streamflow evaluation due to LULC change influence showed that mean monthly simulated streamflow was increased by 10.84% between the years 1985 and 2003, also increased from the year 2003 to 2018 by 9.3% in wet months; whereas, decreased by 8.23 and 11.4% between 1985-2003 and 2003-2018 in dry months. Therefore, hydrological process of the watershed was highly influenced by LULC changes and it requires integrated watershed management techniques.

Key words: Digital image processing, Gis, hydrologic process, landsat image.

Ashenafi, N., & Mihret, D. (2021). Impact of land use/land cover change on hydrologic processes in Dijo watershed, central rift valley, Ethiopia. International Journal of Water Resources and Environmental Engineering, 13(1), 37-48.

Prioritization of sub-watersheds for conservation measures based on soil loss rate in Tikur Wuha watershed, Ethiopia.

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Abstract

Soil erosion is unquestionably the trickiest land degradation that adversely agricultural productivity. Since resources are scarce, in developing countries like Ethiopia, implementing soil and water conservation practice at a time on the entire watershed is not feasible. Therefore, recognizing erosion-prone areas (the priority watersheds) based on the magnitude of soil loss rate is indispensable. The purpose of this study is to delineate priority sub-watersheds of the Tikur Wuha watershed in Ethiopia based upon the soil loss rate. A universal soil loss equation under the geographic information system environment was employed to estimate the soil loss rate. The result revealed that the average soil loss rate from the watershed is 14.13. It is resulting in a gross soil loss of 962,083 from the entire watershed. A small portion of the watershed (9.22%) is suffering from severe and very severe soil loss rate (> 25). A total of 14.41% of the watershed have soil loss rates above the maximum soil loss tolerance of the area (> 12). Among the seven sub-watersheds in the watershed, four sub-watersheds (SW_3, SW_1, SW_2, and SW_4) are falling under the top priority zone. Soil and water conservation measures should be executed rapidly in the Tikur Wuha watershed, consistent with the rank of the priority watersheds.

Keywords: Ethiopia. Prioritization, Soil and water conservation, Soil loss rate, Sub-watershed

Ketema, A., & Dwarakish, G. S. (2020). Prioritization of sub-watersheds for conservation measures based on soil loss rate in Tikur Wuha watershed, Ethiopia. Arabian Journal of Geosciences, 13(19), 1-16.

Ecological succession and land use changes in a lake retreat area (Main Ethiopian Rift Valley)

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Abstract

In the semi-arid Main Ethiopian Rift Valley, ecological succession is related to continuous lake retreat. Human activity, through its impact on land use and cover, affects this ecological succession at various degrees. Through a remote sensing study, we explored how the drivers for land use and cover changes (LUCC) have changed over the last decades and which impact this has on ecological succession. Remote sensing data used include a Landsat MSS from 1973, a Landsat TM from 1986 and Landsat ETMþ from 2000; a conventional type of classification was used whereby supervised classification of the 2000 image was supplemented by unsupervised classification of the older images. Due to decreased rainfall and water abstraction for intense irrigated agriculture in its catchment, Lake Abijata lost 46% of its area between 2000 and 2006. On the emerged land, an ecological succession was observed along the environmental gradient of the retreating lake: emerged bare land, grassland, land with few scattered Acacia shrubs and open woodlands. Between 1986 and 2000, LUCC tendencies were totally reversed and woody vegetation decreased strongly, indicating increased human impact. This land degradation took place in a context of instable political situation, fuelwood extraction, higher population density and better communications.

Keywords: Deforestation Ethiopia Lake Abijata Lake retreat Landsat imagery Remote sensing Successional trend

Temesgen, H., Nyssen, J., Zenebe, A., Haregeweyn, N., Kindu, M., Lemenih, M., & Haile, M. (2013). Ecological succession and land use changes in a lake retreat area (Main Ethiopian Rift Valley). Journal of Arid Environments, 91, 53-60.

Local perceptions of ecosystem services and human-induced degradation of lake Ziway in the Rift Valley region of Ethiopia

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Abstract

Ecosystems supply beneficial contributions to people's quality of life and well-being. Freshwater lakes provide diverse consumptive and non-consumptive ecosystem services (ESs) to people. This study examined ecosystem goods and services that Lake Ziway in the Rift valley region of Ethiopia supply and identified the anthropogenic pressures that impact the lake and its services. The lake currently supports investment projects and livelihoods of the local communities. It contributes to the local and national economy from the export of cut flowers. The biggest commercial floriculture investment in the country is located on the shore of this lake, depending mainly on its water. Assessing the views and knowledge of local communities towards the contributions of ESs to human life, well-being, and livelihoods is important to protect and prolong the long-term benefits of ESs. A total of 41 experts, 137 households, and 20 discussants from two districts were selected for interviews and focus group discussions (FGDs). Pearson's Chi-square tests were used to test the association between dependent and independent variables. Multiple regression models were developed to examine the ESs of the lake and human impacts. The result showed that respondents prioritize the ESs of the lake as provisioning > supporting > cultural > regulating services. The Chi-square results revealed a strong association among ESs with respondents' type and residence locations. The multiple regression results revealed that respondents' types and residence locations were significant determinants in prioritizing the importance of ESs of Lake Ziway ($p < .01$). The degradation of Lake Ziway is increasing along with the increasing human population and increasing demands for provisioning services. The major anthropogenic activities are intensive water abstraction, pollution, overharvesting of resources, wetland conversion, and the introduction of invasive species. Such human activities are degrading the capacities of the lake ecosystem and its ecosystem service provisions. Our results indicate that understanding the links between these human pressures on Lake Ziway and its ES provisions is crucial for the sustainable management of the lake. The study could serve as a reference for decision-making for prioritizing the conservation measures needed towards ensuring the sustainable use of the various ecosystem services of the lake. Conservation interventions by involving local communities as major actors are needed to minimize human pressures and ensure the sustainability of the lake and its ESs.

Keywords: Ecosystem services anthropogenic pressures Lake Ziway Lake management Ethiopia Eastern Africa.

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PREDICTING SOIL EROSION BY WATER: RUSLE APPLICATION FOR SOIL CONSERVATION PLANNING IN CENTRAL RIFT VALLEY OF ETHIOPIA

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Abstract

In Ethiopia, research on soil erosion hazard assessment has largely focused in its cereal crop dominated subtropical and temperate highlands. This study has been carried out in the semiarid and arid lowland areas of pastoral and agro-pastoral economic belts of Ethiopia where little research attention has been given. The RUSLE model is employed to estimate soil loss erosion rates in this present study area, Ethiopia. The RUSLE parameters were acquired from meteorological, available soil and satellite image data, key informant interviews, focus group discussions and field observations. The result showed that mean annual soil loss rates varied from 0.5 t on flatter slopes to slightly over 20 t ha-1 yr-1 on poorly vegetated areas. The study area was classified into very high (>20 t ha-1 yr-1), high (10- 20 t ha-1 yr-1), medium (1 –10 t ha-1 yr-1), low (0.5 – 1 t ha-1 yr-1) and very low (0-0.5) erosion risk categories. Areas with high (10 to 20 t ha-1 yr-1) and very high (>20 t ha-1 yr-1) erosion risk parts of the study site need to be prioritized for land management interventions. Areas which require immediate land management account about 22.06% (473.9km2) of the study area. The severity of soil erosion was largely linked to high soil erodibility, poor vegetation cover and lack of conservation practices. Therefore, improving soil erodibility, vegetation cover and implementing locally suitable soil and water conservation technologies are commendable.

Key words: Agro-pastoral economies, Erosion risk, Hotspots, Pastoral area, RUSLE, Semiarid

Asmamaw, L., Mohammed, A., & Mathias, T. (2021). Predicting soil erosion by water: rusle application for soil conservation planning in central rift valley of ethiopia. *Environmental Engineering and Management Journal*, *20*(9), 1521-1534.

Soil erosion risk and sediment yield assessment with universal soil loss equation and GIS: in Dijo watershed, Rift valley Basin of Ethiopia

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Abstract

Soil erosion is the main drivers in the world and Ethiopia in particular. This study has been conducted at Dijo watersheds in the Rift valley Basins of Ethiopia to estimate soil erosion rate and identify erosion hotspot areas for proper planning using Geographic Information System and Universal Soil Loss Equation adapted to Ethiopian condition. 64 years mean annual rainfall data for estimating erosivity factor, digital soil map for estimating soil erodibility factor, Digital Elevation Model for estimating topographic (LS) factor, Land use land cover for cover factor detection from Ethiopian ministry of water resources. The result reveals that the soil loss ranges from 0 ton/ha/year in fat slope to 38.09 ton/ha/year from steep slopes. The average soil loss rate is 2.2 tons per hectare per year and has been classifed into three erosion severity classes as very low, low and moderate. The result also reveals that most of the watershed erosion severity evaluated under very low and low soil erosion severity classes covering 97.3% of the watershed areas which is due to the efect of mixed plantation of various tree and terraces. However, moderate soil erosion in the upper parts of the watershed could be due to the inherent characteristics of vertisols, lack of vegetation cover and terraces which should be given frst priority for conservation interventions. From the gross soil erosion, 43,762 ton/year sediment yields have been estimated at watershed outlet. Policy aim at keeping land productivity will need to focus to reduce low and moderate soil erosion through terracing, inter-cropping, contour farming, strip cropping, conservation tillage, mulching and biological stabilizers based on their slope range, soil type and land use type. The current fnding on erosion was evaluated based on the past 10 years land use land cover scenario; therefore, soil erosion might be reduced if the current land use land cover scenario considered. Finally, the integration of USLE and GIS is an efective tool in mapping the spatial distribution of soil erosion from the entire watershed. The moderate and low soil erosion severity areas should be managed through terracing, inter-cropping, contour farming, strip cropping, conservation tillage, mulching and biological stabilizers based on their slope range, soil type and land use type. Free grazing and cultivation of steep slope(Northern parts) contributed for moderate soil erosion in the watershed should be managed by cut–carry system, limiting the number of cattle units to be grazed in the specifc plot of land and leaving the marginal steep slope areas with no ground covers for natural

regeneration. Finally, the current fnding on erosion was evaluated based on the past 10-year land use land cover scenario. Therefore, the soil erosion could be reduced if the current land use land cover scenario is considered.

Keywords: Conservation priority , Dijo watershed, Sediment yield ,Soil erosion · Sub watersheds · GIS · USLE , SLMP.

Bekele, B., & Gemi, Y. (2021). Soil erosion risk and sediment yield assessment with universal soil loss equation and GIS: in Dijo watershed, Rift valley Basin of Ethiopia. Modeling Earth Systems and Environment, 7(1), 273-291.