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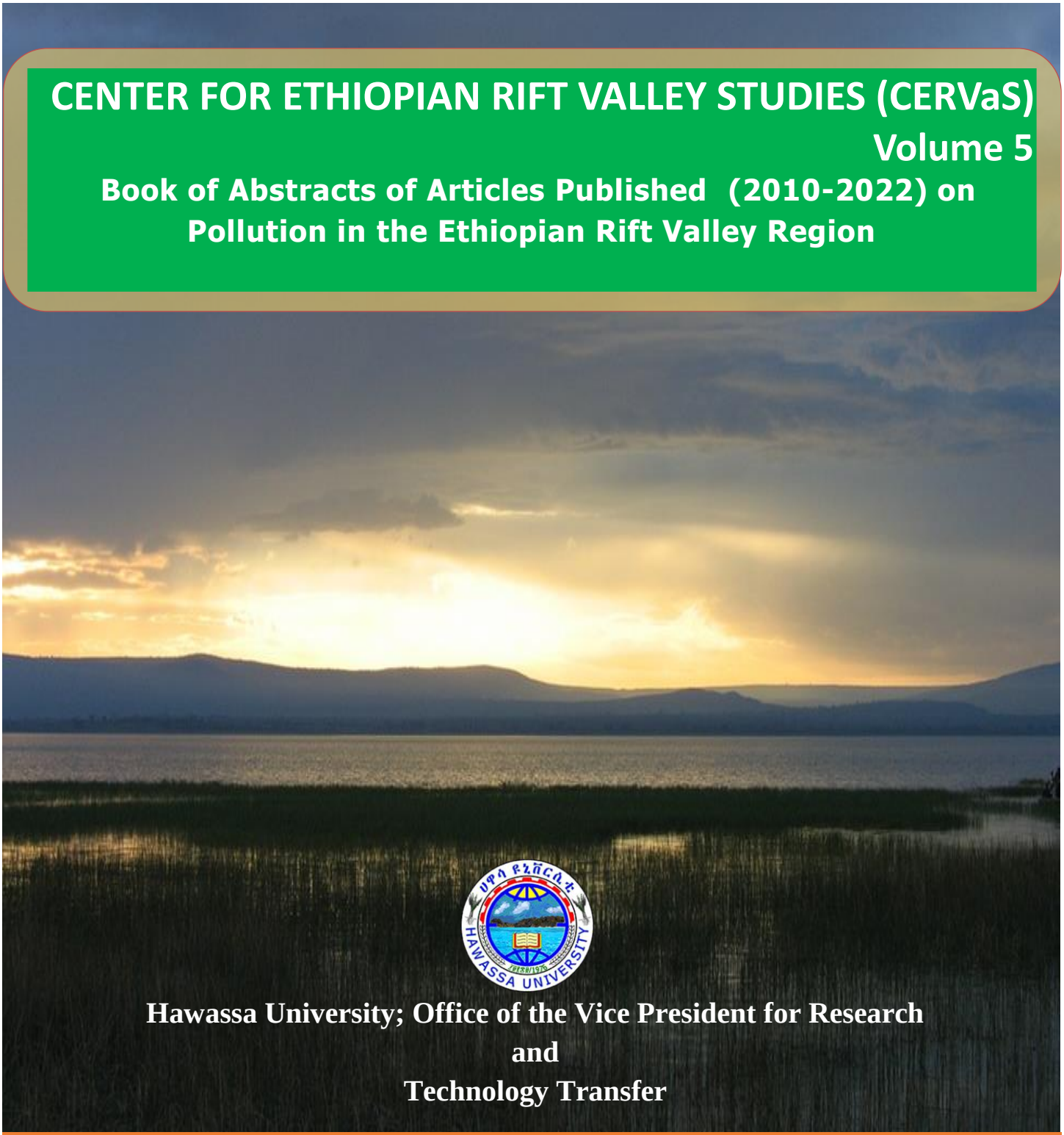

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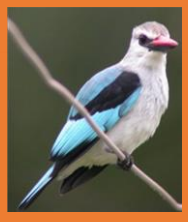

"Joining Hands to Reverse the Alarming Situations"

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Assessment of spatio-temporal variations of selected water quality parameters of Lake Ziway, Ethiopia using multivariate techniques

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Abstract

Excess agrochemicals input from agricultural activities and industrial effluent around Lake Ziway catchment can pose a serious threat on the lake ecosystem. Lake Ziway is a shallow freshwater lake found in the northern part of the Ethiopian Rift Valley. It is characterized as semi-arid to sub-humid type of climate. Expansions of the flower industry, widespread fisheries, intensive agricultural activities, fast population growth lead to deterioration of water quality and depletion of aquatic biota. The spatial and temporal variations of selected water quality parameters were evaluated using multivariate techniques. The data were collected from nine sampling stations during dry and wet seasonal basis for analysis of fifteen water quality parameters. The physicochemical parameters were measured in-situ with portable multimeter and nutrients were determined by following the standard procedures outlined in the American Public Health Association using UV/Visible spectrophotometer. Mean nutrient concentrations showed increasing trend in all seasons. These sites were also characterized by high electrical conductivity and total dissolved solid (TDS). All the nine sampling sites were categorized into three pollution levels according to their water quality features using cluster analysis (CA). Accordingly, sampling sites Fb and Ketar River (Kb) are highly and moderately polluted in both seasons, respectively. On the other hand, sampling sites at the center (C), Meki river mouth (Ma), Ketar river mouth (Ka), Meki River (Mb), Korekonch (K_o) and Fa in dry season and Ka, C, Ma, Ko, Bulbula river mouth (B) and Fa during wet season were less polluted. Principal component analysis (PCA) analysis also showed the pollutant sources were mainly from Fb during dry season Mb and Kb during wet season. The values of comprehensive pollution index illustrated the lake is moderately and slightly polluted in dry and wet seasons, respectively. Comparatively, the pollution status of the lake is high around floriculture effluent discharge site and at the two feeding rivers (Kb and Mb) due to increasing trends in agrochemical loads. In order to stop further deterioration of the lake water quality and to eventually restore the

beneficial uses of the lake, management of agrochemicals in the lake catchments should be given urgent priority.

Tibebe, D., Zewge, F., Lemma, B., & Kassa, Y. (2022). Assessment of spatio-temporal variations of selected water quality parameters of Lake Ziway, Ethiopia using multivariate techniques. *BMC chemistry*, *16*(1), 1-18.

Evaluation of water quality and eutrophication status of Hawassa Lake based on different water quality indices

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Abstract

Lake Hawassa is one of the major Ethiopian Rift Valley Lakes having an endorheic basin system. The surrounding community makes use of the lake water for the multiple purposes of irrigation, domestic water supply, recreation and fish harvesting. The aim of the present study was to ascertain the water quality of the lake in terms of water quality indices (WQI) and its health over a period of three months covering both dry and wet seasons. Overall, the water quality of Lake was unfit and bad as per the weighted arithmetic method (120.06–228.29) and modified Bascarón water quality index (MBWQI) methods (26.81–33.89), respectively. However, the quality was indicated as marginal, as per the Canadian Council of Ministers of the Environment (CCME) water quality index method (44.2–51.1). On average, the lake was under the hypertrophic stage as per the standard based on the results of Secchi depth and nutrient concentration. The current study showed the lake being unfit for all-purposes as per WAWQI range (> 100). According to the physicochemical and biological parameters, of the lake, it requires mitigation measures to control Eutrophication and pollutants inflow.

Menberu, Z., Mogesse, B., & Reddythota, D. (2021). Evaluation of water quality and eutrophication status of Hawassa Lake based on different water quality indices. *Applied Water Science*, *11*(3), 1-10.

Occurrence, distribution, and ecological risk assessment of DDTs and heavy metals in surface sediments from Lake Awassa—Ethiopian Rift Valley Lake

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Abstract

Dichlorodiphenyltrichloroethanes (DDTs) and heavy metals are ubiquitous contaminants with high bioaccumulation and persistence in the environment, which can have adverse effects on humans and animals. Although applications of DDTs have been banned in many countries, developing countries like Ethiopia are still using these for agricultural and medicinal purposes. In addition, heavy metals are naturally present in the aquatic environment and distributed globally. In this study, the occurrence, distribution, and ecological risk of DDTs and heavy metals in surface sediments from one of the Ethiopian rift valley lakes were studied. Twenty-five surface sediment samples from Lake Awassa, Ethiopia were collected and analyzed for DDTs and heavy metals. Results showed that concentrations of total DDTs ranged from 3.64 to 40.2 ng/g dry weight. High levels of DDTs were observed in the vicinity of inflow river side and coastal areas with agricultural activities. The heavy metals content were followed the order Zn > Ni > Pb > Cu > Cr > Co > As > Cd > Hg. Correlation analysis and principal components analysis demonstrated that heavy metals were originated from both natural and anthropogenic inputs. The levels of DDE and DDD in surface sediments exceeded the sediment quality guideline values, indicating that adverse effects may occur to the lake. A method based on toxic-response factor for heavy metals revealed that the calculated potential ecological risk indices showed low ecological risk for the water body.

Yohannes, Y. B., Ikenaka, Y., Saengtienchai, A., Watanabe, K. P., Nakayama, S. M., & Ishizuka, M. (2013). Occurrence, distribution, and ecological risk assessment of DDTs and heavy metals in surface sediments from Lake Awassa—Ethiopian Rift Valley Lake. *Environmental Science and Pollution Research*, *20*(12), 8663-8671.

Assessing the Water Quality of Lake Hawassa Ethiopia—Trophic State and Suitability for Anthropogenic Uses—Applying Common Water Quality Indices

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Abstract

The rapid growth of urbanization, industrialization and poor wastewater management practices have led to an intense water quality impediment in Lake Hawassa Watershed. This study has intended to engage the different water quality indices to categorize the suitability of the water quality of Lake Hawassa Watershed for anthropogenic uses and identify the trophic state of Lake Hawassa. Analysis of physicochemical water quality parameters at selected sites and periods was conducted throughout May 2020 to January 2021 to assess the present status of the Lake Watershed. In total, 19 monitoring sites and 21 physicochemical parameters were selected and analyzed in a laboratory. The Canadian council of ministries of the environment (CCME WQI) and weighted arithmetic (WA WQI) water quality indices have been used to cluster the water quality of Lake Hawassa Watershed and the Carlson trophic state index (TSI) has been employed to identify the trophic state of Lake Hawassa. The water quality is generally categorized as unsuitable for drinking, aquatic life and recreational purposes and it is excellent to unsuitable for irrigation depending on the sampling location and the applied indices. Specifically, in WA WQI, rivers were excellent for agricultural uses and Lake Hawassa was good for agricultural uses. However, the CCME WQI findings showed rivers were good for irrigation but lake Hawassa was marginal for agricultural use. Point sources were impaired for all envisioned purposes. The overall category of Lake Hawassa falls under a eutrophic state since the average TSI was 65.4 and the lake is phosphorous-deficient, having TN:TP of 31.1. The monitored point sources indicate that the city of Hawassa and its numerous industrial discharges are key polluters, requiring a fast and consequent set-up of an efficient wastewater infrastructure, accompanied by a rigorous monitoring of large point sources (e.g., industry, hospitals and hotels). In spite of the various efforts, the recovery of Lake Hawassa may take a long time as it is hydrologically closed. Therefore, to ensure safe drinking water supply, a central supply system according to World Health organization (WHO) standards also for the fringe inhabitants still using lake water is imperative. Introducing riparian buffer zones of vegetation and grasses can support the direct pollution alleviation measures and is helpful to reduce the dispersed pollution coming from the population using latrines. Additionally, integrating aeration systems like pumping atmospheric air into the bottom of the lake using solar energy panels or diffusers are effective mitigation

measures that will improve the water quality of the lake. In parallel, the implementation and efficiency control of measures requires coordinated environmental monitoring with dedicated development targets.

Keywords: water quality index; eutrophication; Lake Hawassa water quality; point sources; contaminants; monitoring and assessment

Lencha, S. M., Tränckner, J., & Dananto, M. (2021). Assessing the Water Quality of Lake Hawassa Ethiopia—Trophic State and Suitability for Anthropogenic Uses—Applying Common Water Quality Indices. *International Journal of Environmental Research and Public Health*, *18*(17), 8904.

Study on Physico-chemical Parameters in Relation to Species Composition and Abundance of Zooplankton and Water Quality of Rift Valley Lake Langano, Ethiopia

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Abstract

The study aimed to assess concentration of some heavy metals and physico-chemical parameters in relation to water quality and zooplankton Lake Langano. The lake was sampled at four stations from January to July, 2016 concurrently with physico-chemical parameters, heavy metals concentration and zooplankton. The data was analyzed using descriptive statistics, ANOVA, canonical correspondence and biological indices. 21 zooplankton species with eight species of cladocera and four species of cyclopoid copepods were identified from the lake. The diversity index narrowly ranged from 0.39-0.77 spatially. The abundance of zooplankton was maximum during April month at all sites with statistically significant variation both temporally and spatially ($p<0.05$). The abundance and species composition of zooplankton of the lake was negatively correlated Zn, Cu, Cd, PO43-, NO3-, conductivity and water temperature. A maximum (189. 05±32.05mg/l and 72.67±125.21mg/l) of concentration of Cd was measured temporally and spatially respectively and that exhibited temporal significant difference ($p < 0.05$). High (27.85 ± 4.970C) mean value of water temperature was measured at Simbo site that showed temporally significant variation ($p<0.05$). The maximum mean TDS, NO3- and PO43- of Simbo site (855.29±42.67mg/l, 29.44±32.74mg/l and 0.40±0.67mg/l) and no statistically significantly varied spatially ($p>0.05$). Most of the concentration of physico-chemical
parameters and heavy metal of the lake were above the permissible limits set by WHO and EPA. The study provided baseline information on some water chemistry and biota of the lake and their ecology of Lake Langano.

Key Words: Abundance, Concentration, Heavy metals, Lake Langano, Physico-chemical parameters, Zooplankton.

Emabye, E., & Alemayo, T. (2020). Study on Physico-Chemical Parameters in Relation to Species Composition and Abundance of Zooplankton and Water Quality of Rift Valley Lake Langano, Ethiopia. *International journal of innovation and applied studies*, *28*(2), 546-556.

Effects of untreated industrial effluents on water quality and benthic macroinvertebrate assemblages of Lake Hawassa and its tributaries, Southern Ethiopia

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Abstract

The present study investigates the impacts of industrial effluents on the macroinvertebrate assemblages and water quality of the Lake Hawassa watershed. The water quality and macroinvertebrate assemblages were assessed at 40 sampling sites. The chemical and ecological water quality was evaluated using the Basic Prati index and the Ethiopian Biological Score Index (ETHbios), respectively. Canonical Correspondence Analysis (CCA) was used to evaluate the relationship between abiotic factors and macroinvertebrate metrics. A total of 5 876 invertebrates belonging to twentyfive families were recorded. The Coleoptera was the most dominant order represented by four families with a relative abundance of 68%. According to the ETHbios scoring system the sites receiving industrial effluent had very poor water quality (ETHbios score <12), whereas the upstream sites had moderate to good water quality (ETHbios 53 to 76). Likewise, the Basic Prati Index of the sites receiving industrial effluent was considered as very heavily polluted (Index score >8). Overall, the industrial effluents had a significant negative impact on water quality and macroinvertebrate diversity. Therefore, proper management of industrial effluent is urgently needed to prevent further deterioration of water quality and loss of biodiversity in the Lake Hawassa and Shallo Wetland ecosystems.

Keywords: Basic Prati Index, Ethiopian Biological Score Index, macroinvertebrates wetlands

Mereta, S. T., Ambelu, A., Ermias, A., Abdie, Y., Moges, M., Haddis, A., ... & Mulat, W. L. (2020). Effects of untreated industrial effluents on water quality and benthic macroinvertebrate assemblages of Lake Hawassa and its tributaries, Southern Ethiopia. *African Journal of Aquatic Science*, *45*(3), 285-295.

Evaluation of Pollution Status and Detection of the Reason for the Death of Fish in Chamo Lake, Ethiopia

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Abstract

Chamo Lake is the third largest rift valley lake and one of the major economic sources for the communities in the Southern region, Ethiopia. The lake's quality is deteriorating due to the untreated wastewater, and sediment inflow resulting in the death of fish was observed during the dry season. The research aims to determine the water quality status using water quality indices, in addition to identifying the reason for the death of fish in the dry season in Chamo Lake. The water samples were drawn from 5 sampling points by composite sampling method during the dry and wet seasons of the year, and we analyzed 22 water quality parameters. Ammonia (14–23.6 mg/l), phosphates (0.30–1.10 mg/l), BOD (25.32–60 mg/l), COD (40–160 mg/l), and chlorophyll (19.64–31.87 μg/L) concentrations were above the permissible limits, and DO (5.20–6.70 mg/l) was below the acceptable limit in the lake as per EPA standards concerning temperature. The values of both the water quality indices of CCMEWQI (13.90–18.40) and NSFWQI (38.59–49.63) indicated that the water quality was "poor" and "bad," respectively. The death of fish might be due to high concentrations of ammonia and nutrients in the dry season.

Reddythota, D., & Teferi Timotewos, M. (2022). Evaluation of Pollution Status and Detection of the Reason for the Death of Fish in Chamo Lake, Ethiopia. *Journal of Environmental and Public Health*, *2022*.

Pesticides as water pollutants and level of risks to environment and people: an example from Central Rift Valley of Ethiopia

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Abstract

Sustainable agriculture focuses using agricultural resources with minimum possible negative environmental externality to produce more food. The present study reports the environmental and health risks associated with the use, management and handling of agrochemical in the Central Rift Valley, Ethiopia. Six Woredas (or districts) covering both upstream and downstream areas and major ecosystems were selected. Data were collected using focus group discussion, key informant interviews, field observation and literature review. Pesticide Risks in the Tropics for Man, Environment and Trade tool was used to analyse data. Results indicated that local community's awareness on use, handling and management of pesticides was low. Applications of insecticides, fungicides and herbicides polluted surface water systems and affected aquatic animals and plants with different level of risk (i.e. from no or insignificant risk to acute and chronic levels). The level of risks of using agrochemical on aquatic animals, human and the environment increased when the agricultural practices changed from good to non-good practices (i.e. increasing frequency of application). The types of agrochemicals determined the levels of risks on aquatic animals, human and the environment. For example, copper hydroxide and Lambda pose high risk, whereas Chlorpyrifos poses possible risk on fish under good agricultural practices. Also, the results indicated that the level of risks of using agrochemicals on fish and aquatic vertebrates was high for few pesticides (e.g. Chlorpyrifos) under both good and bad agricultural practices. The results of the present study support decision makers, practitioners and farmers to put corrective measures when importing agrochemicals, provide targeted risk management schemes including training on safety measures and screen agrochemicals on the market, respectively.

Teklu, B. M., Haileslassie, A., & Mekuria, W. (2022). Pesticides as water pollutants and level of risks to environment and people: An example from Central Rift Valley of Ethiopia. *Environment, Development and Sustainability*, *24*(4), 5275-5294.

Spatial and seasonal variation of lake water quality: Beseka in the Rift Valley of Oromia region, Ethiopia

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Abstract

Nowadays, freshwater pollution is an environmental crisis caused mainly by anthropogenic activities. The water quality deterioration of Lake Beseka which is located in the Ethiopian portion of the East African Rift Valley is associated with rapid expansion of that lake that is not fully understood yet. This water quality impairment is the major cause of severe shortage of water supply for human consumption, irrigation use, and public health problems in that area. Hence, this study aimed to investigate the physicochemical and metal concentrations of Lake Beseka and evaluate the impact of the spatio-temporal variation on the water quality. Water samples were collected from six sampling sites during the dry and wet seasons. The concentration ranges for physicochemical parameters evaluated were: temperature (25–40 °C), electrical conductivity (EC) (1407–3321 μs/cm), turbidity (28.5–63.0 NTU), total dissolved solids (TDS) (740–1598 mg/L), pH (7.47–10.86), NO_3^-–N (0.30–16.69 mg/L), PO_4^{3-}–P (0.03–13.00 mg/L), SO_4^{2-} (10.00–70.00 mg/L), Cl^- (0.00–200.00 mg/L), F^- (0.40–3.80 mg/L), K (0.30–2.40 mg/L), Mg (0.40–2.46 mg/L), Ca (0.40–3.80 mg/L) and Fe (0.40–3.80 mg/L). For several parameters investigated, the result showed some significant differences ($p < 0.05$) among the six water samples during both the rainy and dry seasons, except for turbidity, EC, NO_3^-–N, PO_4^{3-}–P, SO_4^{2-} and Cl^-. The values of many water quality parameters exceeded the WHO water quality guidelines for drinking water. Furthermore, the water is not suitable for irrigation due to extremely high values of pH (10) and other parameters dominating in salt lakes. This deteriorated water body has the potential to interfere with the natural function of the ecosystem by affecting human health in the area. Hence, to upgrade water quality to meet public health and environmental safety, implementation of suitable water treatment technologies is a crucial agenda to use Beseka lake water.

Umer, A., Assefa, B., & Fito, J. (2020). Spatial and seasonal variation of lake water quality: Beseka in the Rift Valley of Oromia region, Ethiopia. International Journal of Energy and Water Resources, 4(1), 47-54.

Analysing the temporal water quality dynamics of Lake Basaka, Central Rift Valley of Ethiopia

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Abstract

This study presents the general water quality status and temporal quality dynamics of Lake Basaka water in the past about 5 decades. Water samples were collected and analysed for important physico-chemical quality parameters following standard procedures. The result showed that Lake Basaka water is highly saline and alkaline and experiencing a general reducing trends in ionic concentrations of quality parameters due to the dilution effect. About 10-fold reduction of total ionic concentration occurred in the Lake over the period of 2 decades (1960-1980). There was a sharp and fast decline in EC, Cl, SO_4, Na, and K ions from early 1960s up to the late 1980s, and then became relatively stable. Some ions (eg. Na, Ca, Mg, Cl, SO_4) are showing increment in recent years. This characteristics of the lake water is terrible in relation to its potential to inundate the nearby areas in the near future. The expansion of such quality water has negative effects on the water resources of the region, especially soil quality, drainage and groundwater, in terms of salinity, sodicity and specific ion toxicity. The regimes of soil moisture, solute and groundwater could be affected, concurrently affecting the productivity and sustainability of the sugar estate. Thus, there is an urgent need to identify the potential sources of water and chemicals to the lake and devise an appropriate mitigation and/or remedial measures.

Dinka, M. O. (2017). Analysing the temporal water quality dynamics of Lake Basaka, Central Rift Valley of Ethiopia. In *IOP Conference Series: Earth and Environmental Science* (Vol. 52, No. 1, p. 012057). IOP Publishing.

Estimating Point and Nonpoint Source Pollutant Flux by Integrating Various Models, a Case Study of the Lake Hawassa Watershed in Ethiopia's Rift Valley Basin

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Abstract

Increasing pollutant emissions in the Lake Hawassa watershed (LHW) has led to a severe water quality deterioration. Allocation and quantification of responsible pollutant fluxes are suffering from scarce data. In this study, a combination of various models with monitoring data has been applied to determine the fluxes for Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD_5), Total Dissolved Solid (TDS), Total Nitrogen (TN), Nitrate and Nitrite-nitrogen (NOx-N), Total Phosphorous (TP) and phosphate (PO_4-P). Water, wastewater and stormwater samples were collected and analyzed at eight monitoring stations from rivers and point sources and six monitoring stations of stormwater samples. The flow simulated with soil and water assessment tool (SWAT) could be very well calibrated and validated with gauge data. This flow from SWAT model, measured flow during monitoring and pollutant concentrations were used in FLUX32 to estimate pollutant fluxes of main rivers and point sources in LHW. The formulas provided by Ethiopian Roads Authority and Gumbel's theory of rainfall frequency analysis was employed to determine the 2-years return period rainfall depth for the City of Hawassa. The integration of HEC-GeoHMS and SCS-CN with the catchment area enabled to determine stormwater pollution load of Hawassa City. The estimated pollutant flux at each monitoring stations showed that the pollutant contribution from the point and nonpoint sources prevailing in the study area, where the maximum fluxes were observed at Tikur-Wuha sub-catchments. This station was located downstream of the two point sources and received flow from the upper streams where agricultural use is predominant. Furthermore, Hawassa city has been identified as a key pollutant load driver, owing to increased impacts from clearly identified point sources and stormwater pollutant flux from major outfalls. Agricultural activities, on the other hand, covers a large portion of the catchment and contributes significant amount to the overall load that reaches the lake. Thus, mitigation measures that are focused on pollutant flux reduction to the lake Hawassa have to target on the urban and agricultural activities.

Keywords: pollutant loading estimator (PLOAD); FLUX32; water quality; pollutant export coefficients; point and non-point source pollutant flux

Lencha, S. M., Ulsido, M. D., & Tränckner, J. (2022). Estimating Point and Nonpoint Source Pollutant Flux by Integrating Various Models, a Case Study of the Lake Hawassa Watershed in Ethiopia's Rift Valley Basin. Water, 14(10), 1569.

Aquatic macrophytes in Ethiopian Rift Valley lakes; Their trace elements concentration and use as pollution indicators

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Abstract

Trace elements (TEs) uptake from water and sediments to 10 aquatic macrophytes in the Ethiopia Rift Valley lakes Koka, Ziway and Awassa was investigated to evaluate pollution of these lakes. Concentrations of Cr, Co, Ni, Cu, Zn, As, Se, Cd, Pb and Mn have been determined in leaves of macrophytes, water and sediment, using ICP-MS (Inductively Coupled Plasma–Mass Spectrometry). Principal component analysis showed an existing variation in TEs concentration in leaves of aquatic macrophytes. High concentration of Mn (1.6×10^3 and 1.2×10^3 mg kg^{-1} dw) was found in *Aeschynomene elaphroxylon* of Lake Ziway and *Eichhornia crassipes* of Lake Koka, respectively. Cr concentration in low molecular mass (LMM) fraction of water and total sediment (4.9 μg L^{-1} and 95 ± 4 mg kg^{-1} dw, respectively) was higher in Lake Koka compared to lakes Ziway and Awassa. Some of the studied macrophytes can accumulate high level of trace elements concentration compared to the surrounding, showing their potential to be utilized as pollution indicators. Most TEs in macrophytes used as animal feed, such as *Echinochloa stagnina* (Retz.) P. Beauv, were sufficiently low.

Keywords: Macrophytes**,** Ethiopian Rift Valley lakes**,** Trace elements Pollution.

Kassaye, Y. A., Skipperud, L., Einset, J., & Salbu, B. (2016). Aquatic macrophytes in Ethiopian Rift Valley lakes; Their trace elements concentration and use as pollution indicators. *Aquatic Botany*, *134*, 18-25.

Evaluation of the water quality status of Lake Hawassa by using water quality index, Southern Ethiopia

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Abstract

Lake Hawassa is one of the eight Major Ethiopian Rift Valley Lakes and the smallest among them which is situated in southern regional state; it is a closed basin system and receives water from only perennial Tikurwuha River and runoff from the catchment areas. It is an important source of water for surrounding rural communities for various uses like domestic, irrigation, livestock watering, fishing and recreation. Quality of the lake water is vital for the surrounding rural and urban communities for proper and safe use of the lake. The present study was designed to determine the water quality status of the lake for multiple designated water uses by employing the water quality index. To assess the status water samples were collected in monthly intervals for a period of three months from December to February (dry period), 2011/12. From all water quality parameters analyzed turbidity, Mn, Na+, K+, F-, PO43-, total coliform and fecal coliform were higher than the recommended limits of national and international standards for designated water uses. Based on the water quality index calculation the lake water is categorized under marginal category which reveals the water is frequently threatened and impaired and as well departs from natural condition. Accordingly the lake water is under fair category for irrigation and aquatic life; however, it needs great care on selection of crops and soil condition. The lake is under higher risk by deleterious anthropogenic activities on watershed and it needs mitigation measures to prevent it from further deterioration.

Key words: Water quality index, Lake Hawassa, water quality status, designated water use.

Adimasu, W. W. (2015). Evaluation of the water quality status of Lake Hawassa by using water quality index, Southern Ethiopia. *International Journal of Water Resources and Environmental Engineering*, *7*(4), 58-65.

Trends in chemical pollution and ecological status of Lake Ziway, Ethiopia: a review focussing on nutrients, metals and pesticides

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Abstract

Aquatic ecosystems contribute to human well-being by delivering ecosystem services, but their protection has been given low priority in Africa. Lake Ziway in the Ethiopian Rift Valley basin provides services including irrigation, drinking water and fish food in the region. This paper reviews the biological resources and spatio- temporal variation of water quality of the lake focussing on nutrients, metals and pesticides. Lake Ziway is under increasing agricultural and urban pressure and is exhibiting deteriorating trends in several water quality and ecological parameters. Nutrients and trace metals, including PO_4^{3-}, NO_3-, NH_4^+, Ca^{2+}, Cu and Ni of the lake have shown increasing temporal trends in concentration. Spatially, higher values of major parameters (e.g. NO_3^-, NH_4^+, K, Na and electrical conductivity) were observed at shoreline sites near floriculture farming. The water quality of the lake exceeded guideline values for drinking water (alkalinity and Fe) and for aquatic life (NH^+, Fe, Cr, Cu and Se). The recently reported pesticides in the lake possibly cause ecological and human health effect. Accordingly, agriculture and urbanisation are affecting water quality of Lake Ziway, with likely negative effects on human health and the lake ecosystem function unless appropriate interventions are taken. Our results may be useful in assessing other African lakes subject to similar anthropogenic pressures in their catchments.

Keywords: African lakes, agriculture,, ecological effect, ecosystem services, spatio-temporal variation, urbanisation, water quality.

Merga, L. B., Mengistie, A. A., Faber, J. H., & Van den Brink, P. J. (2020). Trends in chemical pollution and ecological status of Lake Ziway, Ethiopia: a review focussing on nutrients, metals and pesticides. *African Journal of Aquatic Science*, *45*(4), 386-400.

Natural and anthropogenic sources of salinity in the Awash River and Lake Beseka (Ethiopia): Modelling impacts of climate change and lake-river interactions

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Abstract

Study region: Awash River Basin, Ethiopia: Study focus

Many river basins in sub-Saharan Africa have become vulnerable due to the impact from climate change, weak governance and high levels of poverty. One of the primary concerns is the elevated salinity and the degradation of water quality in the Awash River. Located in the Great Rift Valley in Ethiopia, the Awash River has unique hydrochemistry due to water-rock interactions. However, in recent years, increasing anthropogenic activities including the discharge from saline Lake Beseka into the Awash River has caused some concern. This study used an Integrated Catchment Model to simulate chloride concentration in the Awash River Basin by taking both natural and anthropogenic sources of salinity into consideration. Future scenarios of climate change and Lake Beseka discharge were examined to assess the impact to the river water quality.

New hydrologic insights

Results show that Lake Beseka has made significant contribution to the rise of the salinity in the Awash River. If the trend of human interference (e.g. increased irrigation and unregulated water transfer) continues, the river downstream of Lake Beseka could see Cl increases up to 200 % in the near future (2006–2030). The modeling results are essential for generating long term plans for proper utilization of water resources especially in the region where the resources and the economic capacity to meet the water demand is lacking.

Keywords: Salinity, Chloride, Lake Beseka, Climate change.

Jin, L., Whitehead, P. G., Bussi, G., Hirpa, F., Taye, M. T., Abebe, Y., & Charles, K. (2021). Natural and anthropogenic sources of salinity in the Awash River and Lake Beseka (Ethiopia): modelling impacts of climate change and lake-river interactions. *Journal of Hydrology: Regional Studies*, *36*, 100865.

Assessment of heavy metals in water samples and tissues of edible fish species from Awassa and Koka Rift Valley Lakes, Ethiopia

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Abstract

The Ethiopian Rift Valley Lakes host populations of edible fish species including *Oreochromis niloticus*, *Labeobarbus intermedius* and *Clarias gariepinus*, which are harvested also in other tropical countries. We investigated the occurrence of six heavy metals in tissues of these fish species as well as in the waters of Lake Koka and Lake Awassa. Both lakes are affected by industrial effluents in their catchments, making them ideal study sites. Mercury concentrations were very low in the water samples, but concentrations in the fish samples were relatively high, suggesting a particularly high bioaccumulation tendency as compared with the other investigated metals. Mercury was preferentially accumulated in the fish liver or muscle. It was the only metal with species-specific accumulation with highest levels found in the predatory species *L. intermedius*. Lower mercury concentrations in *O. niloticus* could be attributed to the lower trophic level, whereas mercury values in the predatory *C. gariepinus* were unexpectedly low. This probably relates to the high growth rate of this species resulting in biodilution of mercury. Accumulation of lead, selenium, chromium, arsenic and cadmium did not differ between species, indicating that these elements are not biomagnified in the food chain. Values of cadmium, selenium and arsenic were highest in fish livers, while lead and chromium levels were highest in the gills, which could be related to the uptake pathway. A significant impact of the industrial discharges on the occurrence of metals in the lakes could not be detected, and the respective concentrations in fish do not pose a public health hazard.

Dsikowitzky, L., Mengesha, M., Dadebo, E., de Carvalho, C. E. V., & Sindern, S. (2013). Assessment of heavy metals in water samples and tissues of edible fish species from Awassa and Koka Rift Valley Lakes, Ethiopia. *Environmental monitoring and assessment*, *185*(4), 3117-3131.

Evaluation of the current water quality of Lake Hawassa, Ethiopia

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Abstract

The research aimed to evaluate the current wáter quality of Lake Hawassa in order to identify potential pollution sources and suggest appropriate measures. Physico-chemical water quality parameters have been determined by taking duplicate samples from seven sampling sites and the results were compared with WHO and FAO standards. The findings of the study revealed that the concentration of metals such as manganese (0.83 mg/L), zinc (5.75 mg/L), chromium (0.22 mg/L), phosphate (1.31 mg/L), and biochemical oxygen demand 5 (BOD5, 68.7 mg/L) exceeded WHO standard that could be due to point sources pollution from ceramics, textile, plastics, leather tanning and food processing industries located near the rivers and streams that end up into the lake. Moreover, the study indicated that the lake has also been polluted by non-point source pollution caused by urban stormwater, agricultural runoff, over grazing, deforestation, soil erosion and land development as it was shown with elevated levels of total dissolved solids (TDS, 928.3 mg/L), electrical conductivity (EC, 1851.4 μS/cm), turbidity (47.9 NTUs), fluoride (15.3 mg/L) and potassium (74.2 mg/L). Therefore, intervention measures should be put in place to prevent pollution of the lake.

Key words: Ethiopian Rift Valley Lakes, surface water pollution, water quality parameters, nutrients, metals.

Haile, M. Z., & Mohammed, E. T. (2019). Evaluation of the current water quality of Lake Hawassa, Ethiopia. *International Journal of Water Resources and Environmental Engineering*, *11*(7), 120-128.

Estimating the Sediment Flux and Budget for a Data Limited Rift Valley Lake in Ethiopia

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Abstract

Information on sediment concentration in rivers is important for the design and management of reservoirs. In this paper, river sediment flux and siltation rate of a rift valley lake basin (Lake Ziway, Ethiopia) was modeled using suspended sediment concentration (SSC) samples from four rivers and lake outlet stations. Both linear and non-linear least squares log–log regression methods were used to develop the model. The best-fit model was tested and evaluated qualitatively by time-series plots, quantitatively by using watershed model evaluation statistics, and validated by calculating the prediction error. The contribution of the ungauged basin was estimated by developing a model that included the terrain attributes and measured sediment yield (SY). The bedload of the rivers was estimated and the total amount of sediment transposed into the lake was calculated as 2.081 Mton/year. Annually, 0.178 Mton/year of sediment is deposited in floodplains with a sediment trapping rate of 20.6%, and 41,340 ton/year of sediment leaves the lake through the Bulbula River. As a result, the net sediment deposition rate of the lake was estimated as 2.039 Mton/year and its trapping efficiency was 98%. Accordingly, the lake is losing its volume by 0.106% annually and the half-life of the lake is estimated as 474 years. The results show that the approach used can be replicated at other similar ungauged watersheds. As one of the most important sources of water for irrigation in the country, the results can be used for planning and implementing a lake basin management program targeting upstream soil erosion control.

Keywords: sediment fluxes; rating curve; lake sedimentation; floodplain deposition; sediment budget; Lake Ziway

Aga, A. O., Melesse, A. M., & Chane, B. (2018). Estimating the sediment flux and budget for a data limited rift valley lake in Ethiopia. *Hydrology*, *6*(1), 1.

Eutrophication of Ethiopian water bodies: a serious threat to water quality, biodiversity and public health

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Abstract

Freshwater ecosystems provide several ecological and economic services. However, these ecosystems in Ethiopia are deteriorating, because of economic growth, unwise use and pollution (eutrophication). This paper reviews existing trends of eutrophication in Ethiopian water bodies, identifies principal sources of nutrient pollution, highlights major consequences, and proposes measures to control eutrophication. The trophic state of all major Ethiopian lakes considered in the current assessment ranges from eutrophic to hypereutrophic. A major cause of eutrophication is the use of chemical fertilisers that has grown > 186 times between the 1970s and 2012. Similarly, the large livestock population has contributed to the increase in nitrogen and phosphorus accumulated in the soil, which is often washed into aquatic ecosystems. Urbanisation and industrial effluents and associated wastewaters are the other causes of eutrophication. The major consequences include shifts to bloom-forming cyanobacteria, prolific growth of water hyacinth, hypoxia, fish kills and health risks. To control eutrophication and avoid its devastating consequences, raising public awareness, creating buffer strips, development of chemical fertiliser use guidelines based on plant removal rates and soil types, wastewater treatments, issuance of policy on Water Quality Guidelines, and the establishment of a National Aquatic Ecosystem Monitoring Program are recommended.

Keywords: algal blooms, bloom-forming cyanobacteria. chemical fertilisers, economic growth, industrialisation, urbanisation, water hyacinth

Fetahi, T. (2019). Eutrophication of Ethiopian water bodies: a serious threat to water quality, biodiversity and public health. *African Journal of Aquatic Science*, *44*(4), 303-312.

Bioaccumulation of trace elements in liver and kidney of fish species from three freshwater lakes in the Ethiopian Rift Valley

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Abstract

The objective of the present work was to obtain scientific information on the ecological health of three freshwater lakes (Awassa, Koka, and Ziway) situated in the Ethiopian Rift Valley by investigating possible trace element contamination accumulated in fish. Accordingly, fish liver and kidney samples were collected from three commercially important fish species (*Barbus intermedius*, *Clarias gariepinus*, and *Oreochromis niloticus*) in the lakes to determine the concentrations of chromium (Cr), manganese (Mn), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), arsenic (As), selenium (Se), cadmium (Cd), and lead (Pb), using ICP-MS. Trace element concentrations were generally higher in *O. niloticus* compared with concentrations in *B. intermedius* and *C. gariepinus*. Compared to background values of most freshwater fish species, higher liver concentrations of Cu in *C. gariepinus* and *O. niloticus*, Mn in *O. niloticus*, Co in all except *B. intermedius*, and Zn in *C. gariepinus* from Lakes Ziway and Awassa were found. Cr, Co, Ni, Cd, and Pb were enriched in kidney, while Mn, Cu, Zn, As, and Se seems retained in the liver tissues. Assessment of transfer factors indicated that bioaccumulation from water and diet occurred, while uptake from sediments was low. Furthermore, the transfer factor values were generally higher for essential elements compared to the non-essential elements. Multivariate statistical analyses showed that the differences between the trace element levels were generally not significant among the lakes ($p = 0.672$), while significant differences were found between the fish species ($p = 0.042$), and between accumulation in kidney and liver ($p = 0.002$).

Masresha, A. E., Skipperud, L., Rosseland, B. O., GM, Z., Meland, S., & Salbu, B. (2021). Bioaccumulation of trace elements in liver and kidney of fish species from three freshwater lakes in the Ethiopian Rift Valley. *Environmental Monitoring and Assessment*, *193*(6), 1-19.

Water Quality and Productivity Assessment of LakeTinishu Abaya for Multiple Designated Water Uses, Ethiopia

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Abstract

Lake Tinishu Abaya, which is also known as Small Abya, is a shallow and small-sized inland water body in the rift valley lakes basin of Ethiopian. The lake is a source of livelihood and supports many socioeconomic activities of which fishing, small-scale irrigation, and domestic water uses are among others. However, the lake has not given attention predominantly due to its remote location and having a small size compared to other rift valley lakes of Ethiopia. The purpose of this research was, therefore, to determine the water quality and productivity of Lake Tinishu Abaya with respect to the changes in various physicochemical factors to give a long-term information for multidimensional use of the Lake water. Water samples collection was carried out for a year on a monthly basis between January and December 2016 from two predefined sampling stations (open and shore). In-situ and Laboratory measurements of the various physicochemical parameters (Temperature, pH, DO, conductivity, TDS, TSS, water transparency, euphotic depth, NH4, NO2, NO3, SiO2, SRP, TP) were performed using the standardized method. The trophic state was determined using Carlson's trophic state determination of an inland water body. The results of the study generalized that the lake water is well oxygenated, slightly warm, alkaline; and contained more TSS, TDS, and Electrical conductivity. The lake water was very turbid, low transparency, and fresh water. The major inorganic nutrients were relatively high. The study also revealed that the trophic nature of the lake was a eutrophic system which shows the lake water is productive. Most of the physicochemical parameters and major inorganic nutrients analyzed indicated that the water quality and productivity of the Lake Tinishu Abaya is suitable for the survival of most of aquatic life, fishing, irrigation and many other related multidimensional uses.

Keywords: Lake Tinishu abaya; Physicochemical; Rift valley lake; Trophic state; Water quality

Enawgaw, Y., & Lemma, B. (2018). Water Quality and Productivity Assessment of Lake Tinishu Abaya for Multiple Designated Water Uses, Ethiopia. *J Environ Anal Toxicol*, *8*(570), 2161-0525.

Water Quality Analysis of Lake Ziway

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Abstract

The water quality of Lake Ziway is deteriorating due to human intervention. The objective of this research was to analyze the water quality of the lake. Analysis was done for color, odor, pH, EC, TDS, turbidity, ammonia, total hardness, sodium, potassium, total iron, manganese, calcium, magnesium, alkalinity, bicarbonate, chloride, Sulphate, nitrate, nitrite,fluoride, phosphate, DO, BOD and COD at seven sites from February to March in 21 runs. This research utilized international and national drinking water quality guidelines and standards for the statistical evaluation of experimental results. The mean values of turbidity, manganese, BOD, and COD levels exceed the WHO standards. All water quality parameters have significance values of $P \leq 0.05$ for spatial variation except BOD and COD that have P- values of 0.196 and 0.143, respectively. Whereas significant temporal variations were only observed for potassium (0.03), BOD (0.001), and COD (0.002). The cluster analysis showed two significant clusters for both water and sediment samples. This study indicated that the major causes of water quality deterioration are the inflow of effluents from the floriculture industry, domestics, agricultural practices, saline seeps, and other uncontrolled human interventions as observed in sites one, two, three, four, and five. The other cause results from people's activities in boats and islands. Run-off, silt, waste effluents, etc. probably were the causes of the lakes' pollutions as shown in cluster one.

Keywords: Lake Ziway, Water quality, water pollution, floriculture farms, statistical analysis, physicochemical parameters

Tegegne, D. F. (2022). Water Quality Analysis of Lake Ziway.

Assessment of Cyanobacterial Blooms Associated with Water Quality Status of Lake Chamo, South Ethiopia

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Abstract

Cyanobacterial blooms are group of phytoplankton called blue green algal blooms which are occurred commonly and naturally in many aquatic systems. In this paper, assessment of groups of different phytoplankton community and physicochemical water quality properties (pH, DO, TDS, temperature, total hardness, chloride, Chlorophyll a, nutrient level of PO4 3--P, NO3-N, NO2 --N, TP, TN) were analyzed and discussed using both original and literature data from the lake Chamo-known by its fish potential and fresh water in Ethiopia. Samples of water were taken from three different sites within the lake (from Inlet, Center and out let sites) during the dry season of 2014/15. Average Physicochemical properties of lake water were determined for each of the sites and cyanobacterial algae bloom was assessed by taking the composite sample of water biologically. The overall water quality parameters and phytoplankton biomass results have been observed as Turbidity (7.10-20.42 NTU), a maximum pH 9.02, TDS (622-651 mg/l), electric conductivity (720- 782 μS/cm), DO (10.26-17.61 mg/l), nitrate-nitrogen (3.12-5.35 mg/l), nitrite-nitrogen (0.03-0.11 mg/l), Total nitrogen (3.18-5.39 mg/l), phosphate (1.08-1.47 mg/l), Total phosphorus (0.43-0.55 mg/l), Chlorophyll a (23.85-28.87 μg/l) and total of 54 species from 9 classes of phytoplankton, dominated by large colonial forms of Microcystis and Anabaena species. The values of the whole analyzed parameters have shown significant variation in site ($P<0.05$). Finally, these results were compared with previous studies and concluded that the lake is getting worse and worst time to time and needs better follow up to protect and make it suitable for multiple purposes.

Keywords: Cyanobacteria; Physicochemical property; Nutrients; Algal toxins; Lake Chamo

Fenta, A. D., & Kidanemariam, A. A. (2016). Assessment of cyanobactrial blooms associated with water quality status of lake Chamo, south Ethiopia. *Journal of Environmental & Analytical Toxicology*, *6*(1), 1-6.

Physicochemical Analysis of Water Collected from Lake Chamo

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Abstract

Water collected from Lake Chamo was examined and its physicochemical properties were studied. This study was conducted between July 2014 and April 2015. This period covered four succeeding seasons. October and April were considered as the rainy season, whereas July and January were considered as the dry season. Water samples were collected from the lake from three random sites for every season. Totally, collections were made four times, one for every season. The collected water samples were subjected to physicochemical analyses to check its properties such as pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA), and total hardness (TH). In addition, levels of certain ions such as chloride (Cl-), nitrite (NO2-), nitrate (NO3-), phosphate (PO43-) and sulphate (SO42-) were also quantified. Physicochemical properties varied with every season. High salinity was reported from the waters of the lake. This could be the cause for the deteriorating environmental conditions in the lake, as well as the reduction in fish production. The quantity of nitrite ions was also several-fold higher than the admissible limits. To conclude, the waters of Lake Chamo did not show much variation in its physicochemical properties for different seasons, except in its salinity and nitrite levels

Key Words: Lake Chamo, Water Quality, Physicochemical Properties

OBA, B. T. ASSESSMENT OF PHYSICOCHEMICAL PROPERTIES OF WATER FROM LAKE CHAMO.

Biological and chemical monitoring of the ecological risks of pesticides in Lake Ziway, Ethiopia

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Abstract

Lake Ziway, a freshwater lake located in Ethiopia, is under the pressure of pesticide and nutrient pollution due to agricultural activity and urbanization. This study has analysed concentrations of insecticides, fungicides and nutrients in water and sediment samples of Lake Ziway taken in the wet and dry season at 13 sites expected to be under different environmental stress and assessed their expected ecological impacts. Malathion, dimethoate, metalaxyl, diazinon, chlorpyrifos, fenitrothion and endosulfan were detected in more than half of the water samples, while diazinon, α-cypermethrin and endosulfan were frequently detected (>25%) in sediment samples. Higher levels of physicochemical parameters were observed at sample locations proximate to agricultural and urban activities. Risk quotients (RQ) and multi-substance Potentially Affected Fraction ($msPAF_{RA}$) were calculated to assess the ecological risk of individual and mixture of pesticides, respectively. The majority of the pesticides detected in the water of the lake showed a potential acute risk (RQ > 1), specifically the insecticides chlorpyrifos, λ-cyhalothrin and α-cypermethrin for which high potential acute risks were calculated using a 2nd tier risk assessment. Levels of pesticides in sediment showed low ecological risks. Arthropods and fishes are expected to be highly affected by mixtures of pesticides ($msPAF_{RA}$ = < 1–80%) detected at locations that are proximate to smallholders' farms, and receive largescale farms' wastewater and at sites where inflow rivers join the lake. Macroinvertebrates based redundancy analysis showed the effectiveness of EPT richness to assess ecological status of the lake. Training for smallholder farmers on pesticides safety and usage, and implementation of improved effluent management mechanisms by floriculture farms are urgently needed intervention measures to reduce the pollution.

Keywords: Agricultural activity; Fungicides; Insecticides; Mixture toxicity

Merga, L. B., Mengistie, A. A., Alemu, M. T., & Van den Brink, P. J. (2021). Biological and chemical monitoring of the ecological risks of pesticides in Lake Ziway, Ethiopia. *Chemosphere*, *266*, 129214.

Spatial and Temporal Dynamics of Irrigation Water Quality in Zeway, Ketar, and Bulbula sub-Watersheds, Central Rift Valley of Ethiopia

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Abstract

Scarcity of information apprehending the current situation and spatial variation of water quality has limited our understanding on to what extent the current intensive human activities in the Central Rift Valley are affecting the natural resource base. This study investigated hydrochemistry, spatial and temporal quality variation of water from different sources, and their implications for agricultural uses. Water samples from rivers (Meki, Ketar, and Bulbula), Lake Zeway, and borehole or hand-dug (BH/HD) wells were analyzed for selected quality parameters following standard procedures. Historical data and current analysis results were used to analyze temporal changes using Mann-Kendall test statistics, while analysis of variance was used to detect spatial variation. The hydrochemistry analysis result showed that Na^+ followed by Ca^{2+}, except for Ketar River where Ca^{2+} followed by Na^+, dominates among cations. Bicarbonate dominated among anions in all water samples. In Lake Zeway, no statistically significant spatial variations were evident for sampling locations, while electrical conductivity (EC) and iron showed a statistically significant increasing trend from 2005 to 2016. Iron in Lake Zeway; total dissolved solids, EC and Na^+ in BH/HD wells, and K^+ in all water sources were partly beyond the maximum permissible limit for drinking. Considering salinity effect on crop water availability, at least 60% of the water samples from rivers and Lake Zeway were in "none" restriction, while it was in "slight to moderate" restriction category in about 50% of water samples from BH/HD wells. Over 37% of the water samples from BH/HD wells in Zeway and Bulbula sub-watersheds showed high to very high alkali hazard. The RSC > 2.5 meq L^{-1} in most water samples of Lake Zeway, and BH/HD wells in Zeway and Bulbula sub-watersheds hastens sodium hazard rate. The study results suggest the need to adapt compatible management options on use and emplace strong water quality monitoring program to reduce risks.

Abera, D., Kibret, K., Beyene, S., & Kebede, F. (2018). Spatial and Temporal Dynamics of Irrigation Water Quality in Zeway, Ketar, and Bulbula sub-Watersheds, Central Rift Valley of Ethiopia. *Ethiopian Journal of Agricultural Sciences*, *28*(3), 55-77.

Geochemistry and water quality assessment of central Main Ethiopian Rift natural waters with emphasis on source and occurrence of fluoride and arsenic

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Abstract

Drinking water supply for the Main Ethiopian Rift (MER) area principally relies on groundwater wells and springs and is characterized by natural source of elevated fluoride concentration. New analyses reveal that the F− geochemical anomaly is associated with other potentially toxic elements such as As, U, Mo and B. Particularly, 35% of the 23 investigated groundwater wells and 70% of the 14 hot springs (and geothermal wells) show arsenic concentrations above the recommended limit of 10 μg/L (WHO, 2006). Arsenic in groundwater wells has a positive correlation with Na+ (R2 = 0.63) and alkalinity (; R2 = 0.70) as well as with trace elements such as U (R2 = 0.70), Mo (R2 = 0.79) and V (R2 = 0.68). PHREEQC speciation modelling indicates that Fe oxides and hydroxides are stable in water systems, suggesting their role as potential adsorbents that could influence the mobility of arsenic.Chemical analyses of leachates from MER rhyolitic rocks and their weathered and re-worked fluvio-lacustrine sediments were performed to evaluate their contribution as a source of the mentioned geochemical anomalies. These leachates were obtained from a 1-year leaching experiment on powdered rocks and sediments mixed with distilled water (10 g:50 ml). They contain as much as 220 μg/L of As, 7.6 mg/L of F−, 181 μg/L of Mo, 64 μg/L of U and 254 μg/L of V suggesting that the local sediments represent the main source and reservoir of toxic elements. These elements, originally present in the glassy portion of the MER rhyolitic rocks were progressively concentrated in weathered and re-deposited products. Therefore, together with the renowned F− problem, the possible presence of further geochemical anomalies have to be considered in water quality issues and future work has to investigate their possible health impact on the population of MER and other sectors of the East African Rift.

Rango, Tewodros, Gianluca Bianchini, Luigi Beccaluva, and Renzo Tassinari. “Geochemistry and Water Quality Assessment of Central Main Ethiopian Rift Natural Waters with Emphasis on Source and Occurrence of Fluoride and Arsenic.” *Journal of African Earth Sciences* 57, no. 5 (2010): 479–91.

Anthropogenic impacts on Rift Valley water bodies: The case of Lakes Ziway, Langano and Abijata

Mathewos Hailu, G Senbete, M Endebu

ABSTRACT

The Ethiopian central rift valley encompasses a series of lakes, rivers and wetlands with high socioeconomic importance to the country. This study focused on the central rift valley which encompasses Lake Zeway, Langanoo and Abijata located 38o 00'-39o 30' E and 7o 00'-8o 30' concentrating on the districts around the lakes. Community perception and users attitude was assessed regarding the lakeside environment including vegetation cover (past and present), water utilization, economic benefit, type of agrochemical utilization and fisheries management, etc. The economic benefit from Lake Zeway was mainly from fishing and water extraction for irrigation with the irrigated farms' production of horticulture including flower farming covering 500 ha. Lake Abijata was mainly used for soda ash production and mineral salt for livestock as means of income as revelealed by 12.5 % households.. In Lake Langanoo, the water was used by the local community for fishing and livestock as well as home consumption. However the areas surrounding the lakes are fragile ecosystem, which are facing threat from irrigated agriculture, improper water abstraction in line with population increment. Expansion of farmland by 50 % around Lake Langanoo has aggravated the deforestation activity. Absence of regional fisheries policy has encouraged the involvement of 27.7% and 7.7%, illegal fishermen in Lake Zeway and Lake Langanoo respectively. The existing cooperatives do not have clear cooperative structure.96 % of the beach seine in Lake Zeway is below the recommended mesh size. Overall problems in fishery production were indicated as illegal fishery (58.6%), followed by inappropriate mesh size of 31.0%. The absence of soil conservation practice accelerated siltation process in Lake Abijata. Lack of regulation has aggravated the use of extremely toxic pesticides including endosulfan that is used in proximity of Lake Zeway. Despite the existence of institutional environment regarding water and environment, government rules are hardly implemented at local level. This paper reviews some of the adverse socioeconomic activities that exert pressure around the lakeside environment.

Key words: Abijata, Anthropogenic impact, environmental degradation, Zeway, Langanoo, Rift valley, water abstraction.

Hailu, M., Senbete, G., & Endebu, M. (2010, February). Anthropogenic impacts on Rift Valley water bodies: The case of Lakes Ziway, Langano and Abijata. In *EFASA sec. national conf. proceed, Bahir Dar, Ethiopia* (pp. 210-216).

Application of a semi-distributed swat model to estimate groundwater recharge in the lake Ziway watershed, Ethiopian rift

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Abstract

Ethiopia, like many other developing countries, is faced with escalating challenges of water supply. Abstraction of groundwater for water supply, especially for rural communities, requires an understanding of the spatial and temporal variability of ground water recharge. In this study, a semi-distributed hydrological model, SWAT (Soil-Water Assessment Tool) was applied to estimate spatial and temporal variability of recharge in Ziway watershed, Ethiopian rift. The model was calibrated and validated against observed river discharge over the period 1981–2000 and 2000-2010 using SWAT-CUP (Calibration and Uncertainty Program). The long-term (1981-2010) water balance of the SWAT model reveals that the annual precipitation of 878 mm was distributed as: surface runoff of 70 mm (7.8%), evapotranspiration of 710 mm (81.8%), and groundwater recharge of 98 mm (11.2%). From the water balance analysis, evapotranspiration is the most consuming parameter for precipitation in the area. The average annual groundwater recharge shows that a general decreasing trend from the highland (160 mm/year) towards the rift floor (34 mm/year). Both the seasonal and annual variability of groundwater recharge shows similar trend with precipitation throughout the basin. In general, the spatial and temporal groundwater recharge variability is mainly controlled by the variability of precipitation. Finally, observational data sets over longer periods with higher resolution are required to constrain model parameterization and thereby reduce uncertainty in future simulations of groundwater recharge in the area. Keywords: Groundwater recharge variability, SWAT model, Ziway Lake watershed, Ethiopian Rift

Keywords: Groundwater recharge variability, SWAT model, Ziway Lake watershed,

FIRDISA, M. (2019). *APPLICATION OF A SEMI-DISTRIBUTED SWAT MODEL TO ESTIMATE GROUNDWATER RECHARGE IN THE LAKE ZIWAY WATERSHED, ETHIOPIAN RIFT* (Doctoral dissertation, ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY)

Application of multi-hydrochemical indices for spatial groundwater quality assessment: Ziway Lake Basin of the Ethiopian Rift Valley

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Abstract

The Ethiopian Rift Valley (ERV) is characterized by arid and semi-arid climate with groundwater as the most important water resource used for drinking and irrigation purposes. However, in the region, people are suffering from severe water scarcity exacerbated by climate effect. Besides water availability, endemic water quality issues are critical and affect the suitability of the water and human health risks. The present study evaluates the suitability of groundwater for drinking and agricultural purposes in the Ziway Lake Basin (ZLB) of the ERV. Groundwater used for drinking contains multiple inorganic contaminants in levels that surpass the World Health Organization recommended limits. The most frequent of these violations were for Na+, K+, HCO3−, F− and few samples for Mn, As, U, Pb and Mo. The modeled Drinking Water Quality Index (DWQI) values of the groundwater show wide variation ranging from 12.7 (Excellent category) to 714 (Unsuitable category) with mean value of 94. Likewise, Irrigation Water Quality Index (IWQI) computed by considering EC, SAR, Na%, RSC and PI of the groundwater varies from 13.2 to 520 with a mean value of 106. Both DWQI and IWQI values suggest that groundwater is generally of Excellent quality for drinking and irrigation use in the headwater regions of the ZLB and progressively becomes extremely Unsuitable toward the rift floor. The exceptionally high DWQI values to the west of Lake Ziway is mainly associated with the co-occurrence of multiple toxic elements from a groundwater from the Quaternary sediments and rhyolitic volcanic aquifers.

Mechal, A., Shube, H., Godebo, T. R., Walraevens, K., & Birk, S. (2022). Application of multi-hydrochemical indices for spatial groundwater quality assessment: Ziway Lake Basin of the Ethiopian Rift Valley. *Environmental Earth Sciences*, *81*(1), 1-22.

Aquatic macrophytes in Ethiopian Rift Valley Lake Koka: Biological management option to reduce sediment loading

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Abstract

Nowadays, due to deforestation, poor soil management and improper farming techniques, reservoir and lake sedimentation is a serious problem in Ethiopia. Despite the severity of the problem, there is no documented study on the use of macrophytes as a biological management option for sediment loading. A sediment trap field experiment was conducted from July to September 2017 to assess the efficiency of macrophytes in reducing sedimentation problem in Lake Koka. During the study period (90 days) on average a total of 1140 g DW m−2 sediment was deposited at the vegetated stations and 336 g DW m−2 at the open water site. The corresponding values for resuspension were 906 g DW m−2 and 1680 g DW m−2, respectively. Compared with the non-vegetated area, all macrophytes significantly facilitated sedimentation and reduced resuspension ($P < 0.05$). The order of the macrophytes in their sediment trapping efficiency was Echinochloa stagnina> Typha angustifolia > Eichhornia crassipes = Leptochloa caerulescens and the corresponding order for restraining resuspension was T. angustifolia > E. stagnina > E. crassipes = L. caerulescens. Generally, E. stagnina and T. angustifolia were better in trapping sediment and preventing resuspension. Development and maintenance of wetlands with these aquatic macrophytes may be an effective management tool for reducing the sediment load on Lake Koka, but would need further studies on the effect of wind velocity and direction on their efficiency.

Keywords: MacrophyteSediment trapSediment dynamicsOrganic fraction

Wosnie, A., Mengistou, S., & Alvarez, M. (2020). Aquatic macrophytes in Ethiopian Rift Valley Lake Koka: Biological management option to reduce sediment loading. *Aquatic botany*, *165*, 103242.

Aquatic macrophytes in Ethiopian Rift Valley lakes; their trace elements concentration and use as pollution indicators

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Abstract

Trace elements (TEs) uptake from water and sediments to 10 aquatic macrophytes in the Ethiopia Rift Valley lakes Koka, Ziway and Awassa was investigated to evaluate pollution of these lakes. Concentrations of Cr, Co, Ni, Cu, Zn, As, Se, Cd, Pb and Mn have been determined in leaves of macrophytes, water and sediment, using ICP-MS (Inductively Coupled Plasma–Mass Spectrometry). Principal component analysis showed an existing variation in TEs concentration in leaves of aquatic macrophytes. High concentration of Mn (1.6 × 103 and 1.2 × 103 mg kg−1 dw) was found in Aeschynomene elaphroxylon of Lake Ziway and Eichhornia crassipes of Lake Koka, respectively. Cr concentration in low molecular mass (LMM) fraction of water and total sediment (4.9 μg L−1 and 95 ± 4 mg kg−1 dw, respectively) was higher in Lake Koka compared to lakes Ziway and Awassa. Some of the studied macrophytes can accumulate high level of trace elements concentration compared to the surrounding, showing their potential to be utilized as pollution indicators. Most TEs in macrophytes used as animal feed, such as Echinochloa stagnina (Retz.) P. Beauv, were sufficiently low.

Keywords: Macrophytes, Ethiopian Rift Valley lakes, Trace elementsm Pollution

Kassaye, Y. A., Skipperud, L., Einset, J., & Salbu, B. (2016). Aquatic macrophytes in Ethiopian Rift Valley lakes; Their trace elements concentration and use as pollution indicators. *Aquatic Botany, 134*, 18-25.

Review of the natural conditions and anthropogenic threats to the Ethiopian Rift Valley Rivers and Lakes

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Abstract

This review article considers the lakes found within the Ethiopian Rift Valley system and the rivers draining from the highlands towards them. The Ethiopian Rift Valley system extends in a north-east–south-west direction, bisecting the Ethiopian highlands. They differ in sizes and hydrological and hydrogeological settings. The lakes support a variety of flora and fauna, mainly fishes, reptiles, birds and mammals. The lakes and their feeder rivers, however, are currently being subjected to more human use pressure than previously experienced, attributable mainly to water abstractions for irrigation, household water supply and industrial activities in the catchments. Soil erosion, primarily attributable to the lack of soil conservation practices on farm lands, overgrazing and deforestation, along with unregulated irrigation practices, are generating large quantities of silt reaching the lakes. Improper utilization of water and land resources in the catchments, along with population growth and climate change impacts, is escalating the threats to the health of the lake and river ecosystems. As a result, some of the lakes exhibited reduced water levels and increased salinity. This article reviews the major environmental changes happening to these lakes and their feeder rivers. Visits were made to the area to update previous information while also consolidating the trends of change in the aquatic systems and the watersheds attributed to intense development practices

Lemma, B., & Desta, H. (2016). Review of the natural conditions and anthropogenic threats to the Ethiopian Rift Valley Rivers and Lakes. *Lakes & Reservoirs: Research & Management*, *21*(2), 133-151.

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 9.41m^3/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.

Keyword Meki Watershed, Runoff, Sediment Yield, SWAT, SWAT-CUP, 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.

Satellite Imageries and Field Data of Macrophytes Reveal a Regime Shift of a Tropical Lake (Lake Ziway, Ethiopia)

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Abstract

Lake Ziway is one of the largest freshwater lakes located in the central Ethiopian rift valley. The lake shoreline is dominated by macrophytes which play an important role in immobilizing run-off pollution, stabilize sediments and support biodiversity. Monitoring the spatio-temporal changes of great lakes requires standardized methods. The aim of this study was to assess the current and long-term trends of macrophyte distribution, surface water area and the water level of Lake Ziway using remote sensing images from 1986 to 2016 with additional hydro-meteorological data. A supervised image classification with classification enhancement using Normalized Difference Aquatic Vegetation Index (NDAVI) and Normalized Difference Vegetation Index (NDVI) was applied. The classification based on NDAVI revealed eight target classes which were identified with an overall producer's accuracy of 79.6%. Contemporary open water and macrophyte fringes occupied most of the study area with a total area of 407.4 km^2 and 60.1 km^2, respectively. The findings also revealed a regime shift in the mean water level of the lake and a decline in macrophyte distribution. The long-term water surface area of Lake Ziway also decreased between 1986 and 2016. The changes in water level could be explained by climate variability in the region and strong anthropogenic disturbance. A decline in water level was also associated with lowered surface water area, lakeward retreated macrophyte fringes and enhanced landward encroachment of mudflats, and resulted in a succession of macrophytes with semi-terrestrial vegetations.

Keywords: Lake Ziway; macrophytes; water level change; image classification; land cover change

Damtew, Y. T., Verbeiren, B., Awoke, A., & Triest, L. (2021). Satellite Imageries and Field Data of Macrophytes Reveal a Regime Shift of a Tropical Lake (Lake Ziway, Ethiopia). *Water*, *13*(4), 396.

Seasonal variations in phytoplankton biomass and primary production in the Ethiopian Rift Valley lakes Ziway, Awassa and Chamo – The basis for fish production

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Abstract

Seasonal variations in the biomass (Chl *a*) and primary production (14C-method) of phytoplankton were studied during 12 months of 2005 in the three Ethiopian Rift Valley Lakes (ERVL) Ziway, Awassa and Chamo. Chl *a* showed an average value of 40, 20, and 30 mg m−3 for the three lakes, respectively. Integrated areal primary production for the total phytoplankton (g C m−2 d−1) varied 2-fold in the three lakes but on different levels, from 0.67–1.8 in L. Ziway, 1.8–4.6 in L. Awassa, and 1.0–2.6 in L. Chamo. The overall photosynthetic efficiency of utilizing photosynthetically active radiation by the phytoplankton on molar basis (mmol C mol of photons−1) resulted in an average value of 1.4 for L. Ziway, 3.5 for L. Awassa and 1.6 for L. Chamo. Among the different factors regulating phytoplankton primary productivity, light penetration and nutrients were the most important in the three lakes. The seasonal variations of incident radiation (most values between 5 and 7 E m−2 h−1) and water temperature (most values between 22 and 24 °C) were small and unlikely to result in the marked differences in phytoplankton primary production. Although relative increase in nutrient concentrations occurred following the rainy periods, the major algal nutrients were either consistently low (nitrate and/or silicate) or high (phosphate and/or ammonium) and remained within a narrow range for most of the study period in all the three lakes. Consequently, phytoplankton biomass and primary production seem to be maintained more by nutrient regeneration or turnover (facilitated by high temperature) than by allochthonous nutrient input. This would be coupled with wind-induced mixing that would play an important role in determining hydrographic characteristics (water column structure) and the associated redistribution of nutrients and phytoplankton, the availability of light and subsequently the spatial (vertical) and temporal patterns of phytoplankton production in these three ERVL. Phytoplankton production (PP) is regarded as a good predictor of fish yield in lakes and seasonal measurements of PP is a prerequisite for good such estimates.

Keywords: Tropical lakes,Primary production,Chlorophyll,Physical data,Chemical data,Fish production

Tilahun, G., & Ahlgren, G. (2010). Seasonal variations in phytoplankton biomass and primary production in the Ethiopian Rift Valley lakes Ziway, Awassa and Chamo–The basis for fish production. *Limnologica, 40*(4), 330-342.

Review on the natural conditions and anthropogenic threats of Wetlands in Ethiopian

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Abstract

Wetlands are one of the most multifunctional ecosystems of the world that provide a range of economical, biological, ecological, social, and cultural functions and services to human beings. In Ethiopia all types of wetlands except coastal and marine-related wetlands and extensive swamp-forest complexes are found and they are estimated to cover more than 2% of its total surface area coverage. Wetlands deliver a wide range of ecosystem services that contribute to human well-being such as food and feed, construction materials, water supply, water purification, climate regulation, flood regulation and eco-tourism. Wetlands have played a significant role in the growth of human civilizations and cultural development. However, the degradation and loss of wetlands is a worldwide phenomenon and seems to progress faster than in other ecosystems. Despite all those and other indispensable values, these wetlands are under severe pressure and degradation. Due to improper extraction of uses and misconceptions forwarded to wetlands, the health of the wetlands is continuously decreasing from time to time that in doubt their existence in the near future. In order to reverse these emerging problems and conserve these fragile but crucial wetlands, integrated problem solving approach through realizing the collaboration of relevant stakeholders from policy level down to grassroots community is indispensable opportunity to Ethiopian wetlands.

Keywords: Anthropogenic; Management; Natural; Threats and Wetland

Mengesha, T. A. (2017). Review on the natural conditions and anthropogenic threats of Wetlands in Ethiopian. Global Journal of Ecology, 2(1), 006-014.

Groundwaters of the Central Ethiopian Rift: diagnostic trends in trace elements, $\delta^{18}O$ and major elements

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Abstract

The Ethiopian Rift (a major portion of the Great East African Rift) is characterized by a narrow elongated depression bounded by highlands from both sides. This topographic configuration leads to a monsoon redistribution which resulted in an arid rift floor and humid high rainfall highlands. The rifting and associated volcanism also caused a thinning of the crust and facilitates influx of CO_2 and other mantle gases as diffuse sources or along faults from deeper sources. Groundwaters in the rift floor are usually of high mineral content (high F, U, As and salinity) while those on the plateau are of low mineral content. Among many factors, groundwater availability and quality in the rift floor aquifers is the function of their connection to the aquifers in the high rainfall plateau and the residence time of groundwater prior to reaching the rift floor. This entails the need for addressing one basic hydrologic question in such a setting: at what depth and rate does recharge from the high rainfall highland reach the lowland rift aquifers? This study uses spatial variations in trace elements and relates them to ^{14}C variations, thereby investigating the suitability of using trace elements as proxies for residence time estimation of groundwaters of relatively short (1,000–2,000 years) residence time. This work also investigates the behavior of trace element trends along the groundwater flow path in a rifted setting and compares them with such trends in sedimentary aquifers elsewhere. The comparison shows a clear difference in behavior of trace elements along the groundwater flow path when compared with such variations in big sedimentary basins with no prominent rifting and volcanism, suggesting the need of calibrating the relation between trace elements and any direct residence time indicators. An integrated use of major elements, trace elements, and environmental isotopes reveals that the main recharge of the aquifers originates from mountain blocks and that recharge takes place via fractures with no evidence of evaporation prior to recharge. Redox processes appear to play a limited role in trace element geochemistry of groundwaters in the region. Progressive trends in trace element composition along the groundwater flow path suggest continuous groundwater flow from the plateau.

Keywords: Groundwater, Trace elements, Groundwater flow, Ethiopian rift

Kebede, S., Travi, Y., & Stadler, S. (2010). Groundwaters of the Central Ethiopian Rift: diagnostic trends in trace elements, δ18O and major elements. Environmental Earth Sciences, 61(8), 1641-1655.

Investigating the Current Level of Heavy Metals and Physico-Chemical Parameters in Water of Lake Ziway, Oromia Region – Ethiopia

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Abstract

Background: Pollution from a single, easily identifiable source, such as an industrial facility or sewage treatment plant, is referred to as point-source pollution. Nonpoint-Source pollution is contamination that originates from multiple sources rather than just one. Lake Ziway is one of the Ethiopian Rift Valley lakes that have been impacted by both anthropogenic and natural activities. Large-scale projects, domestic waste influents, pesticide use that wasn't foreseen, industrial and domestic wastes, etc. are a few of the factors contributing to the pollution. Objective: The goal of this study was to determine the current concentrations of a few specific heavy metals and physicochemical components in the water of Lake Ziway (Ethiopia) as a result of point and nonpoint influent discharges. Method: The physico-chemical parameters including electrical conductivity, total dissolved solids, pH, turbidity, ammonia, nitrites, nitrates, phosphates, sulfates, and total hardness were investigated using the Palin test photometer, while the Cr, Pb, and Ni concentrations in collected water samples were determined using the Flame Atomic Absorption Spectroscopy (FAAS). Result: Phosphorus, turbidity, chemical oxygen demand, biochemical oxygen demand, magnesium, calcium, chromium, lead, and nickel are just a few of the parameters that were over the standard limit values at location "A", and they are also revealed to be above the standard limit values at site "B" and site "C" chromium, nickel, and zinc requirements are higher than recommended by WHO standards. Conclusion: In this article we investigated the levels of some heavy metals, i.e. chromium, lead, nickel, Zinc and physicochemical paramters including BOD, COD, PH, total dissolved solids, turbidity, nitrates, phosphates, and total hardness. The expansion of large-scale investment projects, such as irrigation-based agricultural development activities, floriculture industries, unplanned use of agrochemicals, domestic waste influents from Ziway/Batu town, and rivers like the Meki Rivers in Meki town (about 30 km far from Ziway) that flow into Lake Ziway carry contaminated discharge from industrial and domestic sources, are currently putting pressure on Lake Ziway.

Keywords: Biochemical Demand, Meki River, Heavy Metals, Lake Ziway, Palint Test, East Shoa

Wakuma, T., Estifanos, A., & Zigde, M. Investigating the Current Level of Heavy Metals and Physico-Chemical Parameters in Water of Lake Ziway, Oromia Region-Ethiopia.

Evaluation of Seasonal and Spatial Variations in Water Quality and Identification of Potential Sources of Pollution Using Multivariate Statistical Techniques for Lake Hawassa Watershed, Ethiopia

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Abstract

The magnitude of pollution in Lake Hawassa has been exacerbated by population growth and economic development in the city of Hawassa, which is hydrologically closed and retains pollutants entering it. This study was therefore aimed at examining seasonal and spatial variations in the water quality of Lake Hawassa Watershed (LHW) and identifying possible sources of pollution using multivariate statistical techniques. Water and effluent samples from LHW were collected monthly for analysis of 19 physicochemical parameters during dry and wet seasons at 19 monitoring stations. Multivariate statistical techniques (MVST) were used to investigate the influences of an anthropogenic intervention on the physicochemical characteristics of water quality at monitoring stations. Through cluster analysis (CA), all 19 monitoring stations were spatially grouped into two statistically significant clusters for the dry and wet seasons based on pollution index, which were designated as moderately polluted (MP) and highly polluted (HP). According to the study results, rivers and Lake Hawassa were moderately polluted (MP), while point sources (industry, hospitals and hotels) were found to be highly polluted (HP). Discriminant analysis (DA) was used to identify the most critical parameters to study the spatial variations, and seven significant parameters were extracted (electrical conductivity (EC), dissolved oxygen (DO), chemical oxygen demand (COD), total nitrogen (TN), total phosphorous (TP), sodium ion (Na+), and potassium ion (K+) with the spatial variance to distinguish the pollution condition of the groups obtained using CA. Principal component analysis (PCA) was used to qualitatively determine the potential sources contributing to LHW pollution. In addition, three factors determining pollution levels during the dry and wet season were identified to explain 70.5% and 72.5% of the total variance, respectively. Various sources of pollution are prevalent in the LHW, including urban runoff, industrial discharges, diffused sources from agricultural land use, and livestock. A correlation matrix with seasonal variations was prepared for both seasons using physicochemical parameters. In conclusion, effective management of point and non-point source pollution is imperative to improve domestic, industrial, livestock, and agricultural runoff to reduce pollutants entering the Lake. In this regard, proper municipal and industrial wastewater treatment should be complemented, especially, by stringent management that requires a comprehensive application of technologies such as

fertilizer management, ecological ditches, constructed wetlands, and buffer strips. Furthermore, application of indigenous aeration practices such as the use of drop structures at critical locations would help improve water quality in the lake watershed.

Keywords: monitoring; mitigations; spatial and temporal variabilities; principal component analysis; cluster analysis; discriminant analysis; water quality; pollution; correlation

Lencha, S. M., Ulsido, M. D., & Muluneh, A. (2021). Evaluation of Seasonal and Spatial Variations in Water Quality and Identification of Potential Sources of Pollution Using Multivariate Statistical Techniques for Lake Hawassa Watershed, Ethiopia. Applied Sciences, 11(19), 8991.

Cyanotoxin production in seven Ethiopian Rift Valley lakes

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Abstract

We hypothesized that unusual deaths and illnesses in wild and domestic animals in lake areas of the Rift Valley south of Addis Ababa were caused by toxic cyanobacteria. In the first cyanotoxic analyses conducted in samples from Ethiopia, we found lakes Chamo, Abaya, Awassa, Chitu, Langano, Ziway, and Koka all had concentrations of microcystins (MC) ranging from trace to hazardous, whereas only traces less than limits of detection (LOD) of cylindrospermopsin (CYN) were found. In the December 2006 dry season we sampled the lakes for analyses of MC, CYN, species structures, and calculations of cyanobacteria biomass. We used the Utermöhl technique to analyse cyanobacterial biomass and monitored MC toxins using HPLC-DAD, LC-ESI-MS-MRM, and ELISA-test and CYN with HPLC-DAD and ELISA. The various toxicity tests coincided well. In 4 of the lakes (Chamo, Langano, Ziway, and Koka), the inter-lake range of total MC concentration was 1.3–48 μg L−1; in 3 (Abaya, Awassa, and Chitu), we found only traces of MC. Microcystis aeruginosawas the dominant species, with Microcystis panniformis, Anabaena spiroides, and Cylindrospermopsisspp. as subdominants. The MC concentration, especially in Lake Koka, exceeded levels for serious health hazards for humans, cattle, and wildlife.

Keywords:: CyanoHAB, cylindrospermosin, ELISA, Ethiopian Rift Valley lakes, HPLC, mass spectrometry, microcystins, Microcystis, Previous article View issue table of contents

Willén, E., Ahlgren, G., Tilahun, G., Spoof, L., Neffling, M. R., & Meriluoto, J. (2011). Cyanotoxin production in seven Ethiopian Rift Valley lakes. *Inland Waters*, *1*(2), 81-91.

Water Quality Monitoring in Lake Abaya and Lake Chamo Region

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Abstract

This study is based on water quality monitoring work of water resources within the Abaya Chamo basin. The methods, method validation and analysis results have been presented and discussed. Seasonal variation and trends as well as associated water quality management issues are discussed. A water quality monitoring system based on an integrated partial physical orthogonal model has been designed based on data generated within the water resources of the Abaya – Chamo drainage basin. Abstract common factors were extracted by the application of principal component and factor analysis. By overlaying real factors with abstract common factors the underlying causes for the water quality variations have been explained. Surface flow factors, sub surface flow factors, leaching flow factors, effects of soil matrix, rainfall magnitude and intensity, discharge, catchment area and slope, in stream pollution and point sources of pollution, evaporative storage and precipitation chemistry all showed up in such integrated model. This model can be extended by including further physical factors as well as natural and anthropogenic pollution sources and factors. This model can be extended to lakes and ground water sources as well. Design of water quality monitoring intervals was accomplished with the help of spectral analysis. Spatial monitoring spacing for lake water quality was determined after hierarchical cluster analysis. The possibility of modelling the various water quality parameters was investigated. Auto regressive modelling fits well variables that have seasonally evened variation. Variables with short-term fluctuation were modelled with spectral level regression. State-space method was satisfactorily applied for relating the time series between two sampling points located on different rivers. Discharge- base contaminant modelling was modified to compensate for error by establishing a pattern of relationship between calculated and observed contaminant loads.

Key Words: Water Quality Monitoring, Water Quality modelling, Water Quality management.

Tiruneh, A. T. (2005). Water quality monitoring in Lake Abaya and Lake Chamo region. *Chemistry-Biology University of Siegen, University of Siegen*.

Exploring future global change-induced water imbalances in the Central Rift Valley Basin, Ethiopia

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Abstract

Lake Ziway, the only freshwater lake in Ethiopia's Central Rift Valley basin, has been the source for irrigation, floriculture, fish farming and domestic water supply in the region for the last few decades. This study examined the impacts of the planned future agricultural developments and climate change on the lake water balance by an integrated application of the Soil Water Assessment Tool and Water Evaluation and Planning models. The future projections of precipitation and temperature from the Coordinated Regional Downscaling Experiment, CORDEX-AFRICA, under the Representative Concentration Pathways 4.5 and 8.5 were used for the climate change impact assessment. Nine irrigation development and climate change scenarios were developed and simulated to examine the separate and combined impacts on the lake water balance and supply coverages. The study showed that the planned future agricultural developments could result in a mean annual lake water level decline by about 0.15 m, with a considerable reduction (27% to 32%) in the outflow to the downstream Bulbula River. Climate change could increase evaporation losses from the shallow lake resulting in a drastic decrease in the lake water level, especially during the dry season. It could also significantly reduce (by about 74%) the amount of water flowing out of the lake. The combined impacts of future development and climate change are likely to reduce the supply coverages of most of the competing demands. Approaches need to be studied to minimize the lake water evaporation losses and explore water demand/supply management options.

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Environmental Impacts of Small Scale Irrigation Schemes: Evidence from Ethiopian Rift Valley Lake Basins

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Abstract

This research has been carried out in the Rift Valley Lakes Basin (RVLB), which is one of the twelve major river basins in Ethiopia. The RVLB has been considered in this research due to its high priority that comes from the significant ecological and environmental interest from different sectors. The research has tried to compare the relative environmental impact of Bedene Alemtena, Eballa, Argeda and Gedemso irrigation projects. Impact assessment at the community level has been collected on a base of key informant interviews and ad- hock technique. For the study, a summary of two sets of structured questioners are also used. Check lists, matrices, and rule based analysis are used to aggregate a scaled value of the individual parameters collected through the interviews and physical observations at the four sites. Deforestation, overgrazing, poor watershed management, soil salinity, soil acidity, communicable and non communicable diseases, and water logging are the major problems of all schemes. Specifically, about 34% of respondents have encountered soil fertility deterioration in Argeda, Gedemso and Bedene Alemtena irrigation projects with high significant variation (X2, 97.7). Land degradation scenario after the implementation of the projects is also reported in Argeda (19.9%), Gedemso (10.4%), Ebala (23.8%), Bedene Alemtena (33.3%) (X2, 86.3). About 76.2 % of farmers in Argeda irrigation project have perceived that soil erosion in their plot is significantly more severe than other schemes (X2, 198.3). The comparison based on aggregated values shows that the Argeda 01 and Gedemso 01 irrigation projects have environmentally performed better than the Eballa and Bedene Alemtena irrigation projects.

Keywords: Check list, Matrices, Rule based analysis, Environmental Impact

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