1. **Arba Minch institute of water Technology**

**Faculty:** Water resources and irrigation engineering

**PhD program**: Irrigation and drainage engineering

**Agricultural Water Management under Smallholder Irrigated Farms and Its Impact on Soil Quality and Nutrient Management**

**DEMELASH WENDEMENEH**

Principal Supervisor: Mekonen Ayana, Adama Science and Technology University

Co-supervisors: Partap Singh, Arba Minch University

Amare Haileslassie**:** International Water Management Institute, East Africa and

Nile Basin Office

**Abstract**

*The rift valley areas of Ethiopia are well known for vegetable crop production using furrow irrigation methods. This type of farming practices in most of the cases favors excessive use of agricultural inputs including fertilizer and irrigation water that in turn could negatively influence soil fertility and crop yield. This research, therefore, attempted to investigate the influences of irrigation management practices on soil fertility, nutrient management, and crop productivity under smallholder irrigated farms at Bochessa catchment in central Ethiopia. This study started with the assessment of the spatiotemporal variability of the irrigation water quality and evaluating its suitability for agricultural uses across the sources. About 72 water samples were collected from 12 extensively used boreholes and 2 abstraction points from the Bulublla River during 2015 and 2017. About 14 parameters of water quality were analyzed following standard laboratory procedures. The general linear model of two ways analysis of variance was used to evaluate the variability of water quality parameters across the seasons, locations, and sources. The suitability of the water source quality for irrigation was assessed as per FAO guidelines. The results indicated that the variation of quality of irrigation water was relatively more pronounced across time and source than space (P<0.05). Moreover, 93% of the quality parameters were higher in groundwater as compared to surface water. This suggests that the continuous use of groundwater for irrigation may adversely affect soil property in the area. Hence, the use of improved management practices along with groundwater is very important to maintain the fertility of irrigated lands. The change and trends of salinity build-up in irrigated fields was conducted on 24 irrigated and 6 rain-fed farmers' fields for three consecutive years (2015-2017). One hundred eighty soil samples were collected during the investigation period at the beginning and end of each cropping season. Fifteen physicochemical properties of the soil were analyzed following standard laboratory procedures. The two ways analysis of variance was employed to evaluate the changes and trends of soil salinity across the irrigated fields. The results revealed that the majority of studied soil properties varied significantly across the fields and seasons (P<0.05). This implies that both time and farming practices have a pronounced effect on soil salinity build-up in the area. Hence, the use of salt-tolerant crops, improving field management, and in certain time interval use of fallowing may help the farmers to maintain the fertility of irrigated fields. The third objective of this study was more focused on the evaluation of the effects of management of irrigation practices and irrigation water sources used on soil quality in the area. This investigation was carried out on 16 selected farmers irrigated plots (8 each from surface and groundwater source) for two consecutive years (2016-2017). A large number of soil and water samples were collected from selected farmers' fields and analyzed for different parameters following standard laboratory procedures. The results revealed that the majority of studied soil properties varied significantly across the treatments (P<0.05). This implies that irrigation management and water source influenced soil quality. It is also important to consider these issues whenever farmers choose irrigation as a means of crop production. The effect of irrigation management practices on soil nutrient balances, leaching and water productivity of leafy cabbage in the area were also analyzed using the above selected 16 farmers irrigated fields. Totally 64 soil, 24 water, and 32 plant samples were collected besides other agronomic data's' during the investigation period and analyzed following standard laboratory procedures. The results revealed that the highest nutrient balance and relatively less leaching loss of nutrients were observed under monitored irrigated fields as compared to farmers' practiced fields. Similarly, a high average fresh yield of leafy cabbage was also observed in managed irrigated fields as compared to unmanaged irrigated fields. These all implies that irrigation management practices have a noticeable impact on soil fertility and yield of leafy cabbage. Hence paying more attention to management practice is very important to sustain irrigated agriculture in the area.*

**Keywords**: Irrigated agriculture, Soil salinity, Nutrient balances, Leaching, Management practices, Water sources, Rift-valley, and Water use productivity.

1. **College of Natural and Computational Sciences**

**Department**: Biology

**Program**: Biodiversity Conservation and Management

**ECOLOGY OF SMALL MAMMALS IN HUMAN-MODIFIED**

**HABITATS NEAR THE WESTERN SHORE OF LAKE ABAYA,**

**SOUTHERN ETHIOPIA**

**ZEWDNEH TOMASS TONJO**

Principal supervisor: Prof. Dr. Herwig Leirs (University of Antwerp, Belgium)

Co-supervisors: Simon Shibru (PhD, Assoc. Professor) (Arba Minch University)

Meheretu Yonas (PhD, Assoc. Professor) (Mekelle University)

**ABSTRACT**

*Farmland protected area interfaces suffer severe anthropogenic land use/cover changes worldwide. The human-modified habitats in the Abaya-Chamo Basin (ACB) allow studying what their effects are on small mammal assemblage and new types of conflicts. This study was aimed at investigating: (i) the assemblage of small mammals in rather recently developed mosaic agro-ecosystem and reveals the role of uncultivated areas for ecosystem functioning and (ii) the dynamics of rodents and their damage to crops in smallholder farming systems. For these purposes, farmers’ perspectives of rodent pests and available rodent pest management practices were surveyed and the survey results motivated our research in the ecology of the small mammals, to support farmers’ claims with empirical evidences. Using our landscape-level sampling data, we addressed how season and habitat affect diversity, abundance and reproductive state of small mammals. The findings highlighted that (i) Mastomys erythroleucus is a generalist rodent species more responsible for the crop damage, (ii) small mammal species limited to habitat relics (e.g., Gerbilliscus phillipsi, Lemniscomys macculus and Elephantulus rufescens) are more likely to suffer local extinction and (iii) uncultivated areas support higher small mammal diversity including the vulnerable Ethiopia endemic arboreal species, G. minnae. The results call for landscape-level nature conservation that would also contribute to sustainable rodent pest management. Then we investigated farmland scale small mammal dynamics in response to variations in rainfed maize cropping stages, using capture-mark-recapture trappings in a permanent grid, before land preparation for maize planting, at 4-leaf, 6-leaf and maturity stages of maize crop and during fallow period soon after harvest, in two years (2019 and 2020). From this investigation, we concluded that: (i) the abundance and biomass of the two co-existing pest rodents (M. erythroleucus and Arvicanthis niloticus) follow maize cropping stages while they were breeding throughout the rainfed maize growing season and (ii) the period when the field was covered with crop supported higher small mammal diversity than when it was fallow. The results suggest consideration of vulnerable crop stages for targeted rodent pest management. Subsequently, we hypothesized that: (i) rodent pests of maize crop prefer more hedge field border to field centre and (ii) the extent of crop damage would be higher near hedge border than near field centre and its open border. To verify this, we selected three smallholder maize fields, each surrounded by one hedge and three open borders and set each 100 x 100 m permanent grid, during the long rain maize growing season during two years (2019 and 2020). Rodent damaged young maize plants and maize stems with rodent damaged cobs were counted in a sampling space of 10 maize planting holes × 4 maize rows at 5, 10, 20, 30, 40 and 50 m on each of the three parallel transect lines running from opposite facing hedge and open borders to the field centre. Soon after assessing rodent damage at each crop stage, we conducted overnight trapping of rodents in each grid to relate their densities to the extent of the crop damage they cause. From this setup, we showed that both the overall number and reproductively active individuals of the pest rodents (M. erythroleucus and A. niloticus) were higher close to the hedges and caused significantly higher crop damage. These findings suggested spatial and crop stage considerations for tailored rodent pest management. When consumed by the policy makers, these findings would explore ecologically based rodent management in the region.*

***Keywords***: anthropogenic habitats, crop damage, generalist rodents, integrated rodent pest management, nature conservation, smallholder farming, small mammals

**Department:** Biology

**Program:** Biodiversity Conservation and Management

**HABITAT FRAGMENTATION EFFECTS ON VASCULAR EPIPHYTES, BRYOPHYTES AND DYNAMICS OF CROP PESTS IN COFFEE AGROECOSYSTEM OF KAFA, SOUTHWEST ETHIOPIA**

**MULATU OSIE**

Principal Supervisor: Prof. Sileshi Nemomissa (PhD) (Addis Ababa University)

Co-supervisor: Simon Shibru (PhD) (Arba minch university)

**Abstract**

*The world is facing an unprecedented decline in global biodiversity and associated ecosystem services as a result of both habitat loss and fragmentation. Remarkable changes have been observed in species richness, community composition and population dynamics. This research aimed to investigate farmers’**hands and minds**on ecosystem services and disservices trade-offs and conservation practices in southwestern Ethiopia. In my first paper, I explored farmers’ perception towards Kafa Biosphere Reserve. Although farmers have positive perception in general, I found differences in age groups, education categories and along the distance gradients. Their perception has to be strengthened with allocation of appropriate benefit sharing and provision of possible development projects with a focus of creating job opportunities.In paper II, I examined farmers’ strategies in tree-crop integration and ecosystem disservices management. The result showed variations in tree-crop composition and raiding of crops and beehives for farmers living near to and far from the forests. Mean number of naturally grown woody species increased close to the forest. Farmers developed indigenous management strategies to mitigate the problems of ecosystem disservices. In paper III, I investigated vascular epiphytes diversity in Kafa Biosphere Reserve and nearby coffee agroecosystem to explore the effect of habitat fragmentation on these structurally dependent organisms. I recorded significant differences in species richness and tree diversity in core forest, forest edges and remnant trees in farmlands which were high in core forests as compared to forest edges and remnant trees, respectively. Forest specialist epiphytes were more vulnerable to habitat fragmentation than generalists. In paper IV, I explored the dynamics of habitat heterogeneity on natural enemy-pests. I found significance differences of predation rate of potential predators on caterpillars against land-use types and landscape structure. Whereas higher predation rate of birds was recorded in the complex landscapes, simplified ones with less tree cover have exhibited more predation by arthropods. Thus, habitat simplification enhances the spilling over of pest population because of reduced ecosystem services delivered by birds and arthropods population to suppress crop pests.*

*In paper V, I examined the effects of microclimate on moss growth as an environment change indicator toolset. Schwetschkea fabronioides (Welw & Duby) Broth. were transplanted to eighteen experimental sites in the forests, forest edges and farmlands. I found variation in growth and survival of moss transplants among the habitat types. Their growth was better in the forests and in wet summer season than in forest edges and farmlands. Survival of moss transplants in all sites decreased with deficiency of moisture in warm seasons.In conclusion, farmers have to be supported with better scientific technologies and alternative crop species which would not be attacked by generalist crop raiders but grow well under the local agroclimatic conditions. Conservation of forests with old age trees was crucial to maintain habitat specialist vascular epiphytes. Ecosystem services such as pest control were positively correlated to diversity and abundance of natural enemies and structurally complex natural habitats. Land-use changes result changes in such ecosystem functions and processes. Changes in microclimate can significantly affect the distribution, abundances and adaptation of species. All these changes and effects have direct or indirect costs on livelihoods of farmers. Therefore, in order to augment the livelihoods of farmers in trade-offs ecosystem disservices and environmental conservation, further ecological and socio-economic studies are needed across the landscapes.*

**Key words**: Biocontrol; bioindicator; crop raiding; demographic profiles; Johansson’s scheme; Kafa Biosphere Reserve; predation rate

**Department:** Mathematics

**Program:** Operations Research

**A TWO-STAGE INTERVAL-VALUED NEUTROSOPHIC SOFT SET TRAFFIC SIGNAL CONTROL MODEL FOR FOUR WAY ISOLATED SIGNALIZED INTERSECTIONS**

**ENDALKACHEW TESHOME AYELE**

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Co-Supervisor: Berhanu Guta (Ph.D.) Department of Mathematics, Addis Ababa University, Addis Ababa, Ethiopia

Abstract

*One of the major problems of both developed and developing countries is traffic congestion in urban road transportation systems. Some of the adverse consequences of traffic congestion are loss of productive time, delay in transportation, increase in transportation cost, excess fuel consumption, the safety of people, increase in air pollution level, and disruption of day-to-day activities. Researchers have shown that among others, a traditional traffic control system is one of the main reasons for traffic congestion at traffic junctions. Most countries throughout the world use pre-timed/ fixed cycle time traffic control systems. But these traffic control systems do not give an optimal signal time setting as they do not take into account the time-dependent heavy traffic conditions at the junctions. They merely use a predetermined sequence or order for both signal phase change and time setting. Sometimes this also leads to more congestion at the junctions. As an improvement of the fixed time traffic control method, a fuzzy logic traffic control model was developed which takes into account the current traffic conditions at the junctions and works based on the fuzzy logic principle under imprecise and uncertain conditions. But as a real-life situation, in addition to uncertainty and impreciseness, there is also indeterminacy in traffic signal control constraints that fuzzy logic cannot handle. The aim of this research is to develop a new traffic signal control model that can solve the limitations of fixed time signal control and fuzzy logic signal control using a flexible approach based on interval-valued neutrosophic soft set and its decision-making technique, specially developed for this purpose. We have developed an algorithm for controlling phase change and green time extension/termination as warranted*

*by the traffic conditions prevailing at any time. This algorithm takes into account the existing traffic conditions, their uncertainty, and indeterminacy. The decision-making technique developed allows both phase change and green time setting to be managed dynamically, depending on the current traffic intensity and queuing of vehicles at different lanes, as opposed to an order or a pre-determined sequence followed in existing traffic control models. The efficiency of the developed model is compared with the existing fixed-time signal control model using eld data obtained from St.Stifanos traffic junction in Addis Ababa using a simulation study. MATLAB software is used to simulate the situation of an isolated signalized intersection based on IVNSS theory. Simulation results verify that the IVNSS traffic signal model performs better than the fixed time signal control model. Keywords: Signal control, soft set, neutrosophic set, interval-valued neutrosophic set, and interval-valued neutrosophic soft set.*

**Department:** Mathematics

**Program:** Operations Research

**WATER ALLOCATION OPTIMIZATION UNDER CONFLICTING**

**DEMAND AND SUPPLY AT A WATERSHED SCALE: THE**

**CASE IN GIDABO DAM AND GIDABO WATERSHED, ETHIOPIA**

**MEKONNEN REDI ALEMU**

Principal Supervisor: N. Thillaigovindan (Prof.) Department of Mathematics, Arba Minch University, Arba Minch, Ethiopia.

Co- Supervisor: Mihret Dananto (Ph.D), Faculty of Bio-System and Water Resource Eng. Hawasa University

**Abstract**

*Water allocation under conflicting demand and supply have increased in frequency and geographic coverage areas in recent decades as results of rising population demand, urbanization, industrialization, and climate change impacts, necessitating contemporary approaches to conflict resolution. Rivers and lakes that cross political boundaries have the potential to cause conflict because states might restrict access to the water resource via over-extraction or pollution. These kinds of conflicts may arise on all geographic scales from local, national, international to global levels and they are intertwined. As a result, conflicts at one level have an impact on water allocation at other levels. This dissertation proposes interdisciplinary approaches to water allocation optimization under conflicting demand and supply using operations research (OR), systems analysis (SA), artificial intelligence (AI) and computer applications from an integrated analysis of an international basin model, an internal basin model, an agro-process water allocation model and an irrigation reservoir operation model. Interdisciplinary methods to water allocation are treated as numerous models in SA and the system analyst runs these models in series or parallel to generate a number of different solutions. The description of the system in terms of component models allows solutions to be achieved at a tolerable cost of computation and within a specified time period. In the international river model, the dissertation compares cooperative and non-cooperative water allocation in the most persistent water allocation under conflicting demand and supply from chosen studies that employed mathematical modeling approaches in Nile River Basin to collect supportive evidences to water development in Blue Nile (Abay) in Ethiopia. When there are conflicts between demand and supply for water, principled allocation aids in the analysis of a specific water allocation problem from the perspectives of social equality, economic efficiency, and long-term development. Due to the international level conflicts, Ethiopia has exhaustively utilized its internal basins and it necessitates to look more and more on its international basins. To shift to irrigation technologies, Ethiopia is increasingly investing in irrigation sector in order to exploit the agricultural production potential of the country, to achieve food self-sufficiency at the national level, to generate foreign currency from export earnings and to satisfy the raw material demand of local industries. To help the planning of irrigation agriculture and reservoir operation the dissertation proposes a Bi-Level Neuro-Fuzzy System (BL-NFS) Soft Computing Methodology with a feed forward water conservation goal and a back propagation flood control goal and a third neural network correction operation. The forward operation remembers the previous states of the reservoir and with given weights and bias term it computes the output levels for reservoir diversion, release, spillover for the given input levels of inflow, storage level and irrigation demand. On the other hand the back propagation long short time memory predicts the flood risk and decides on spillover. The model was trained with data from Gidabo Irrigation Dam (GID), a newly inaugurated irrigation project in Gidabo Watershed of Central Rift Valley Basin (CRVB) in Ethiopia and it showed good practical applicability. More recently, Ethiopia is transforming from agricultural economy to agricultural development lead industrialization (ADLI). To overcome the problem of water allocation optimization under conflicting demand and supply between agricultural production, industrial processing and domestic consumption for scarce water resources, the dissertation proposes an agro-processing water allocation model. There are several agro-processing opportunities for food processing, fruit punching, oil refinery, sugar production etc., but the country imports processed outputs at export market. Several agro-processing industries are emerging with the objectives of import substitute to the unfair trade. To assist the production and water allocation problems in agro-processing industries the original contribution of using two-stage production dynamic inventory control optimization (TSP-DICO) serve the purposes of balancing production and consumption with water availability and other goals and constraints of economic and environment concerns. Any excess production beyond consumption/market demand would be removed from both agricultural and processing stages. Furthermore, the twostage productions were also scheduled based on waste control capacities in addition to water availability constraints. Thus, the water allocation problem takes the form of hierarchical decision making model also known as a bi-level fuzzy goal programming (BL-FGP). The outputs of the TSP-DICO model only give the aspiration levels for the first level decision maker (leader) goal of production maximization. For the second level decision maker (follower) goals are economic goals, environment goals and water allocation goals while inventory level constraints serve mass balance equations subjected to production capacity limit and waste conversion capacity limits. The model was trained with sampled data collected from 178 coffee wet-processing plants from Sidama and Gedeo subwatersheds in upper and middle reaches of Gidabo Watershed and depending on four water availability scenarios the problem was solved following the methodology of BL-FGP. The model showed high practical applicability measured in reliability and resilient coefficients.*

Key Terms: Agro-process model, Bi-level fuzzy goal programming, Dynamic inventory control, Recurrent neural network, Two-stage production, Water demand and supply conflict.

1. **College of Social Science and Humanities**

**Department:** English Language and Literature

**Program:** ELT (English Language Teaching)

**ENGLISH AS A FOREIGN LANGUAGE TRAINEE TEACHERS’ PERCEPTIONS AND REFLECTIONS ON THE SCHOOL-BASED TEACHING PRACTICE: THREE SELECTED COLLEGES IN SNNPR IN FOCUS**

**MANGUDAY MERCHO BAGAJE**

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Co-supervisor: Mulugeta Teka (PhD, Assoc. Prof. in TEFL), HaWasa University

**ABSTRACT**

*The main objective of this study was to assess EFL student-teachers’ perceptions and reflections on the school-based teaching practice. It specifically examined EFL trainee teachers’ perceptions of school-based teaching practice, the difference between EFL trainee teachers’ perceptions of school-based teaching practice due to gender, EFL trainee teachers’ reflective practices contents, the level of reflection that EFL trainee teachers mainly practice, the roles cooperating teachers play during EFL trainee teachers’ reflective practices and the challenges EFL trainee teachers encountered during reflective practices. To this end, mixed method was employed to conduct the study. The participants of this study were 120 EFL trainee-teachers and four cooperating teachers at three selected colleges in Southern region. They were selected through comprehensive and purposive sampling respectively. The study employed questionnaire, interview and document analysis for data collection. Accordingly, the survey data were analysed using descriptive statistics such as mean, grand mean and standard deviation. In addition, Mann-Whitney U-test was employed to see if there was a difference in perceptions between male and female due to gender. Moreover this, the qualitative data were analysed thematically based on themes. Accordingly, the following major findings were obtained. The finding from survey data revealed that EFL trainee teachers had positive perceptions towards school-based teaching practice. The findings from interview also supported the quantitative data result. Furthermore, the findings from Mann Whitney U-test revealed that there were no perceptions differences between male and female students due to gender regarding school-based teaching practice. The findings also revealed that EFL trainee teachers were mainly interested in to reflect on contents like teaching practice, the time given for practicum, the support they have acquired, learner’s misbehavior, classroom management and error correction. Furthermore, of the four levels of reflection stated in this study, EFL trainee teachers mainly practice pre-level of reflection followed by surface and pedagogical reelection with rare occurrence of critical reflection. Moreover this, the findings revealed that the cooperating teachers were totally cooperative and supportive during EFL trainee teachers’ reflective practices. In addition, the findings revealed that EFL trainee teachers face challenges like the time arrangement of practicum, failed to develop reflective practice and evaluate their own teaching practice due to lack of sufficient training during course work and fixed lesson plan format which restrict EFL trainee teachers from reflective practice. In view of the findings, this study recommends that the EFL teacher education program has to work hard and give enough training to EFL trainee teachers on how to reflect on their own teaching experience successfully.*

**Department:** English Language and Literature

**Program:** ELT (English Language Teaching)

**THE EFFECT OF BOTTOM-UP CONTINUOUS PROFESSIONAL DEVELOPMENT APPROACH ON TEACHERS’ PERCEPTION, SELF-EFFICACY BELIEF AND PERCEIVED PEDAGOGIC EFFECTIVENESS: PRIMARY SCHOOL ENGLISH LANGUAGE TEACHERS OF ARBA MINCH IN FOCUS**

**ENDELIBU GOA**

PRINCIPAL SUPERVISOR: Elias Womango (PhD, Assoc.Prof ), Bahir Dar University

CO-SUPERVISOR: MULUGETA TEKA (PhD, Assoc. Prof. in TEFL),HaWasa University

**ABSTRACT**

*This study was an attempt to examine the effects of bottom-up Continuous Professional Development (CPD) approach on English language teachers’ perception of CPD, self-efficacy belief, and perceived pedagogic effectiveness. More specifically, the study addressed the following research questions: (1) Is there statistically significant difference in the EFL teachers’ perception between the top-to-down CPD and the bottom-up CPD approach? (2) Is there statistically significant difference in the EFL teachers’ self-efficacy belief between the top-to-down CPD and the bottom-up CPD approach? (3) Is there statistically significant difference in the EFL teachers’ pedagogic effectiveness between the top-to-down CPD and the bottom-up CPD approach? This research work was mainly experimental in design. Sixty randomly selected teachers (30 for the control group and 30 for the experimental group) were involved from five primary schools in Arba Minch. . Moreover, 10 teachers were randomly selected for interview. Besides, 12 teachers were involved in the FGDs in order to gather the necessary data for this study In addition, questionnaire, interviews, and FGDs were employed in order to obtain data required for the study. The data gathered through different instruments were subjected to both quantitative and qualitative analysis. An independent sample t-test was employed to examine the effect of the intervention between the control and experimental groups. Training materials which consisted bottom-up CPD approach were prepared and used during the experiment. The experiment was conducted for two semesters on the experimental group. The effects of bottom-up CPD approach on teachers’ perception, self-efficacy belief, and pedagogic effectiveness were examined through an independent sample t-test. The results of an independent sample t-test showed that there was a significant difference between the control group and an experimental group in teachers’ perception, self-efficacy beliefs, and pedagogic effectiveness (P<0.05). On the basis of the findings of the study, it was concluded that bottom-up CPD approach have a significant effect on subjects’ perception of CPD, self-efficacy beliefs, and perceived pedagogic effectiveness. Based on this, conclusions and recommendations were made.*

**Department:** Geography and Environmental studies

**Program:** Environment and Natural resources Management

**QUANTIFICATION OF SOIL EROSION AND IMPACTS OF CONSERVATION MEASURES IN GUMARA WATERSHED, NORTHWESTERN ETHIOPIA**

**MENGIE BELAYNEH**

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Co-supervisor: Dereje Tsegaye (Ph.D.), Arba Minch University

**Abstract**

*Water-induced soil erosion continues to pose a serious threat to land resources in high rainfall areas of northwestern Ethiopian highlands. To tackle this problem soil and water conservation (SWC) measures have been practiced for at least the past two decades. In this regard, the objectives of the study were to estimate the potential annual soil loss (sheet and rill), to quantify gully erosion and its spatiotemporal dynamics, to investigate the impact of graded bund terrace on runoff loss, runoff coefficient, and sediment loss, and to evaluate the effects of SWC measures in improving vegetation cover and greenness/density and soil physicochemical properties in the Gumara watershed. The potential soil loss was analyzed using the RUSLE model. High-resolution satellite imageries from Google Earth*® *Pro and field surveys were used for gully erosion analysis. The impact of soil bunds was studied using the rainfall, runoff loss, and sediment concentration data collected from six hydrologically isolated experimental runoff plots. Land use/cover (LUC) change, NDVI/dNDVI analysis methods were applied to evaluate the improvements in vegetation cover and greenness/density. Twenty-four composite and core soil samples were collected from conserved and non-conserved cultivated and grazing land to evaluate the impact of SWC practices on soil quality. ArcGIS*® *10.3, ERDAS*® *9.2, SPSS*® *version 20, and MS*®*-Excel software were used for analysis. The annual average erosion rate (sheet and rills) of the watershed was 42.67 t ha-1 yr-1 with a high spatial variability ranging from nearly zero in a gentle slope and forestlands to as high as 442.92 t ha-1 yr-1in very steep slope crop and bare lands. Similarly, an average rate of 510, 1163, and 687 t ha-1 soil loss and 213,* 336*, and* 380 *m2 ha-1 of land have been lost due to gully erosion in the Teter, Eskane, and Koze micro-watersheds, respectively. Gully erosion on average expands in gully length, density, surface area, and soil loss by 0.68 m ha-1 yr-1, 0.07 km km-2 yr-1, 8.91 m2 ha-1 yr-1, and 23.34 t ha-1 yr-1, respectively over the period 2001-2018. High spatial and temporal variability of gully erosion was observed in the watershed. This all shows that the problem of soil erosion is severe in the watershed. The implemented SWC measures so far have shown important implications for ecological restoration. For instance, newly constructed and 11 years old soil bunds reduced runoff loss by 34.94 and 12.60%, and soil loss by 59.59 and 21.66% as compared to the non-treated counterpart, respectively. Graded soil bund in its new form had reduced runoff loss, runoff coefficient, and soil loss significantly (P < 0.05). Both the LUC and NDVI/dNDVI change detection analysis showed improvements in vegetation cover and greenness. Forestland and shrub-woodland covers increased by 48.4% (2.8-4.2%) and 8.3% (20.2-21.9%), respectively, over the period 1995-2017. About 13.5% of the watershed area experienced a significant increase in vegetation greenness. Soil and water conservation practices have resulted in a significantly higher mean value of total nitrogen, exchangeable Na+, and Mg2+ (P < 0.01), soil organic carbon, and organic matter (P < 0.05). However, still, all forms of soil erosion rates are very high; and SWC conservation measures have not been implemented in priority and continuity-based systems. Besides, follow-up at the time of construction and then maintenance has received very little attention. Therefore, on-plot erosion controlling and gully bunk and side rehabilitation mechanisms need immediate attention. Investing more efforts in a sustainable, evidence/priority, and continuity-based implementation of SWC measures needs to be a top priority.*

**Keywords**: Quantification, *Soil erosion, Spatiotemporal dynamics, Soil and water conservation, Soil properties, Vegetation cover and greenness,*