

Climate Change Shocks Sensitivity Index of Smallholder Farmers Engaged in Farming and Non Farming Activities in Kinakoba Ward, Tana River County, Kenya

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Understanding the future of smallholder farmers of Kinakomba Ward in Tana River is critical to the design and development of policies. One of the major concerns is establishing how sensitive these farmers are to climate change shocks. This study sought to determine sensitivity index of smallholder farmers that rely on rainfed agriculture and non-farming activities to climate change related shocks with the intent of formulating appropriate programmes and policies. A descriptive survey research design was used. Stratified random sampling was employed to select 390 households. The qualitative and quantitative data collected using questionnaires was analysed by use of metric of sensitivity and chi-square goodness of fit test. The study revealed that smallholder farmers who relied on farming activity alone had a sensitivity of 43.17% to climate change related shocks while those who rely on non-farming activities has a sensitivity of 36.40%. When the households engage in both farming and non-farming, the sensitivity will increase by 21.20% due to the interactions between the two activities. Although the sensitivity percentage for the farmers who engaged in the two activities is low, sensitivity was statistically significant at $P=0.00038$. Further findings showed that the ratio of farming to non-farming was 0.58 and those households dependent on farming and engaged in non-farming was 0.45 and when they engage in both activities at the same time, they were more sensitive at 0.942. Despite the significance sensitivity to climate change related shocks, farming sector was ranked as more important (81.5%) than other livelihood activities. The study concluded that sensitivity of the smallholder farmers to climate change related shocks had a significant influence on their livelihoods. The County Government in partnership with stakeholders develops interventions of adaptation options and empowerment of farmers with skills in diversification of livelihoods options.

Keywords: Climate change related shocks, farming, Sensitivity index, smallholder farmers

Ideal Hardening off Watering Interval of East African Greenheart (*Warburgia glandensis*), Nursery Seedlings in East Mau Watershed, Njoro, Kenya

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Water is becoming an increasingly a scarce resource in most areas but yet essential in establishing nursery seedlings. This calls for the effective and efficient use of this important resource. Hardening off of nursery seedlings through reduction of watering regime is necessary before transplanting seedlings to the field. This leads to better survival yet the interval of watering is not well established and this might vary with species and locality. An experiment was set up during the dry season just before planting out to determine the best hardening off watering interval for East African greenheart (*Warburgia glandensis*) seedlings in Egerton University, East Mau watershed, Njoro, Kenya. The experiment was laid down as a completely randomized design (CRD) with 5 treatments replicated 3 times. Treatments comprised of different watering intervals, which were as follows: twice daily, once daily, 2 days, 4 days and 6 days. These treatments were applied for 2 months on 9 months old seedlings during January to March 2018. Analysis of variance was used to determine treatment differences while DMRT was used to determine the significantly different treatment means at $p \leq 0.05$. The results revealed that the best growth was shown by twice daily, once daily, 2 days and 4 days intervals for shoot biomass, total plant biomass and total leaf area. However, the recommended watering interval is 4 days since it showed good growth for most of the variables with minimal water use equivalent to 12.5% of the water used by seedling watered twice daily which saves 87.5% of the water used. The results can be applied in the Kenyan highlands for East African greenheart and other leaf succulent plants. However more studies needs to be done for other non-succulent species using different pot sizes and soil mixtures.

Keywords: Nursery seedlings, East African greenheart, watering interval

Visitor's Perceptions towards the Causes of Seasonality in the Kenyan Tourism Industry: A Case of Nairobi National Park, Kenya

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Seasonality presents a number of issues that require special attention and strategies. In particular, seasonality affects the number of tourists to a region and therefore may threaten the viability of tourism enterprises and regions whether severely or mildly. Seasonality causes the fluctuation in tourists and visitor numbers to a destination. Consequently, some destinations at certain times have more tourists and visitors than they are able to accommodate, while other have few tourists and visitors to the region. Kenyan tourism industry has in recent years suffered low tourist receipts especially at the coast. The main objective is to establish the visitor's perceptions towards the causes of seasonality in the Kenyan tourism industry, specifically, the causes of seasonality at the Nairobi National Park (NNP). The target visitor population at the NNP was 448 visitors for August, 2017, (KWS, 2018). The formula by Miller and Brewer (2003) was used to get the sample size of 205 respondents. Data was collected using questionnaires and interviews, then cleaned, edited and analyzed. Statistical Package for Social Sciences (SPSS) was used to analyse quantitative data, while qualitative data was analysed by use of content analysis. Descriptive analysis test used means, percentages and frequency distributions and charts. Inferential analysis used correlation and regression analysis including ANOVA and X²-square test to establish the level of relationships between the research variables. The findings indicate that the NNP experiences seasonality. Out of 64 respondent's majority strongly agreed both natural and institutional seasonality that weather season both natural and institutionalized seasonality account for 80%; Calendar influence, natural and institutionalized seasonality 51%; Timing decision, natural and institutionalized seasonality 77% finally, Social pressures, natural and institutionally seasonality 50%. All the predictors were statistically significant at $\alpha=0.05$ since p-values are less than 0.05. The study recommends that the government to give incentives to domestic tourists to visit the park regularly, in order to reduce the negativity of institutionalized seasonality. Further studies be done on the strategies to mitigate the causes of seasonality at the NNP.

Keywords: Tourism, tourists, seasonality, Nairobi National Park

Gender Differences in Climate Change Adaptation among Potato farmers in Meru County

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The impact of climate change on natural resources has necessitated the need to adapt potato farming to increase farmers' resilience against climate change in Sub-Saharan Africa (SSA). Production of Potato (*Solanum tuberosum. L*) has been declining over the years in SSA due to climate change and variability. This has resulted to low food supply and low income among smallholder farmers exacerbating levels of food and nutrition insecurity, and poverty. For instance, in 2017, International Potato Center reported a tremendous reduction in potato yields by 56% due to reduced rainfall. The study used data from 384 randomly selected potato farmers from Meru County through field survey. Statistical analysis such as chi-square and t-tests were used. Out of 384 households, 135 were female-headed. The coping practices considered include; adoption of climate resilient potato varieties, crop rotation, irrigation, intercropping, soil conservation, increased use of pesticides and use of organic fertilizers. Climate resilient varieties have the potential of increasing farmers' resilience to climate change due to their desirable attributes of high yield, early maturity and resistance. The results showed that there was a significant difference between male and female headed households in terms of adoption of resilient varieties with males having an adoption level of 58.34% higher than the females who were constrained in terms of accessibility to resources such as land, information, seed, capital and collateral to secure credit. From the results above, there is need for government and non-governmental stakeholders to deploy extension officers in the area to ensure farmers are informed on climate change adaptation strategies such as improved varieties and are enabled to adopt them through proper dissemination and creation of strong seed systems. More so, collective action among female farmers should be encouraged to reap benefits of social networks and form a strong collateral base for credit.

Keywords: Adaptation, climate change, female farmers, potatoes.

January 17, 2002 Nyiragongo Eruption and Climate Change

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Nyiragongo volcano is the most active of the Virunga mountains located in the Western part of the Eastern Africa Rift system. From the historical volcanic records, two recent eruptions January 10, 1977 and January 17, 2002 impacted heavily the environment where soil, forests, drainage system, settlement, farming and livestock were affected. Another major impact of volcano eruption is reported from world's volcanoes (Laki, Krakatoa, Pinatubo...), where ash, dust, carbon dioxide, sulfur dioxide and other greenhouse gas are released into the atmosphere affecting the regime of temperature and rainfall, hence the overall climatic system. To establish such impact of Nyiragongo volcano eruption in 2002, data from six meteorological stations accessed for some physically and for others through online retrieval from www.infoclimat, were collected and analyzed using a Statistical Software Package for Social Scientist (SPSS), in which the two sample t-test was applied, and involving the comparison of two sets of parameters (temperature, rainfall, humidity, saturation point, wind speed, air pressure, and visibility) before and after the 2002 eruption. The results reveal a significant difference at .05 significant level of Nyiragongo volcano on the regime of rainfall (p value.007) air saturation (p value: .010) and air pressure (p value .000). However, a no significant difference between the four other meteorological parameters: Temperature (p value.335), humidity (p value.869), wind speed (p value .660) and visibility (p value.144) was mentioned. The mean temperature raised at 0.55 after the eruption due probably to the CO₂ emissions. Further investigation of the impact of volcano eruptions on the farming and livestock in surrounding areas of the volcano, will prevent any crisis of food supply.

Keywords: Climate change, meteorological parameters, Nyiragongo volcano

Avian and Habitat Diversity in the Semi-Arid Lands: A Case of Chemeron, Baringo, Kenya

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Semi-arid woodlands are important and critical habitats that provide breeding and feeding grounds for a variety of bird species, some of which are endangered or threatened with extinction. Habitat type and size influences abundance and diversity of birds globally and particularly in developing countries that are characterized by rapid human population growth and haphazard urban, agricultural and industrial development. The objective of this study was to assess avian and habitat diversity at Chemeron, a semi-arid land in Baringo County, Kenya. Four 2-km long transects radiating from a central point within the study area were selected for a ground survey of birds that was conducted on foot. The surveys were conducted between 6 and 10 a.m and between 4 and 6p.m for two weeks in October 2020. Bird species were observed and identified to the species level using high resolution binoculars, field guide books and available taxonomic keys. There were two main habitat types: *Acacia-Balanites-Boscia* woodlands dominated by *Acacia senegal*, *Acacia mellifera*, *Acacia nilotica* and *Balanites aegyptica*. The second kind of habitat consisted of the invasive *Acalypha fruticosa* and *Indigofera arrecta* with *Acacia reficiens-Acacia brevispica* overstorey. A total of 24 bird species were sighted and identified to the species level including the endangered Clarke's weaver (*Ploceus golandi*) and the vulnerable Yellow necked spurfowl (*Fringilla leucoscepus*). 79% of the birds were sighted as singles or in pairs except for the gregarious white browed sparrow weaver (*Plocepasser mahali*) and Clark's weaver (*Ploceus bicolor*). Approximately 80% of the birds are insectivorous; 13% frugivore and 7% nectarivores. The high diversity of bird species in the study area can be attributed to the varied diversity of habitats that provide feeding, nesting, refuge and breeding grounds for the birds. From the foregoing findings, we can conclude that ASALs offer ample habitat for birds including some of which face global extinction. We recommend that sustainable utilization of rangeland resources so as to protect such critical avian habitats.

Keywords: Acacia woodlands, Avian diversity, extinction, habitat diversity, rangelands

Does the Removal of Copper Leaf (*Acalypha fruticosa*) Influence Plant Species Diversity and Abundance? A Case of Chemeron, Baringo County, Kenya

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Studies on invasive plant species have gained prominence owing to their potential to significantly alter plant species community composition and structure thereby negatively impacting on ecosystem services. The effects may include a reduction in the abundance of palatable plant species that constitute important forage for livestock, and medicines for the local communities. The aim of this study was to assess the impacts of copper leaf (*Acalypha fruticosa*) on plant species diversity and abundance at Chemeron, Baringo County in Kenya. Two sites (one with *A. fruticosa* and the other without this invasive species) were selected within the Chemeron Research Centre. Two transects measuring 100m X 20m on each site were laid parallel to each other. Plant samples were collected from five 1m X 1m quadrats that were laid at intervals of 20m. The plant samples were identified to the species level using available taxonomic keys. Various indices including Shannon-Wiener (H'), Evenness Index, Richness Index and Simpson's Index of Diversity Index (1-D) were calculated. All the diversity, richness and evenness indices were considerably higher in the site without *A. fruticosa* compared to that where this invasive species was present. The H' and D ranged from 2.34 to 3.28, and 0.87 to 0.94 in site without and with *A. fruticosa*, respectively. Out of the 47 plant species identified, 37 and 18 of them occurred in the in site without and with *A. fruticosa*, respectively. The plants were also evenly distributed in the site without *A. fruticosa* compared to that with the invasive plant present. We conclude that *A. fruticosa* has a significant influence on plant species abundance and diversity as well as distribution. We therefore recommend to the pastoralists and rangeland managers that copper leaf be removed from grazing lands to stimulate the growth of palatable plant species that support livestock production.

Keywords: Baringo, Copper leaf, Plant Diversity, Diversity Indices, Invasive Species

Towards Identification of Alternative Feeds for Mariculture; Preliminary Evaluation of Polychaete Based Giant Tiger Prawn Meal

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Aquaculture development in Kenya and elsewhere, is frequently hampered by lack of suitable, affordable and sustainable feed sources. This is especially so for mariculture, where cultured organisms are commonly at higher trophic levels, requiring protein and lipid dense formulations. Fish meal and oils are frequently incorporated into mariculture feeds contributing to overfishing and unsustainability. Marine intertidal polychaetes, have been explored as suitable mariculture feeds and cultured as superior alternative feeds for critical growth stages. *Marphysa mosambica* is a tropical intertidal polychaete, commonly exploited as a bait in artisanal fishery. This study compares nutritional content of known quantities of cultured and wild polychaete, with locally available feeds (catfish & tilapia meals, Kamuthanga growers & pellets, Skretting) and feed ingredients (earthworm, soya). Subsequently, efficacy of polychaete based feed formulations on hapa net cultured giant black tiger prawn (*Penaeus monodon*), growth is compared to commercial feeds. Preliminary results suggest cultured polychaete protein content (79.96%) is comparable to earthworm meal, but significantly ($P < 0.001$) higher than the commercial feeds (38.75%) and soya (42.02%). Similarly cultured polychaete lipid content (6.78%) was also comparable earthworm and commercial meal, but significantly ($P < 0.05$) higher than soya (2.59%) or wild polychaetes (1.92%). Differences were attributed to variation in quantity and quality of feed ingredients available to local formulators. Significantly ($P < 0.001$) higher shrimp weight, were recorded on polychaete meal formulation (3.40 ± 0.09 g), with correspondingly higher growth rate ($0.22 \text{ g} \cdot \text{d}^{-1}$) than on either commercial ($0.15 \text{ g} \cdot \text{d}^{-1}$) or mix diet ($0.13 \text{ g} \cdot \text{d}^{-1}$). Despite bottlenecks in the culture of this tropical marine polychaetes, they are superior alternative tiger prawn feed sources compared to locally available commercial feed. However, earthworm based meals require further evaluation as mariculture feeds. Nonetheless, further elaboration of polychaete amino and fatty acid profiles, is recommended.

Keywords: Commercial feeds, growth rate, lipid, *Marphysa* meal, protein

The Influence of Selected Water Quality Parameters on the Length-Weight Relationship and Fulton's Condition Factor of *Oreochromis niloticus baringoensis* (Trewavas, 1983) in the Hot Springs of Lorwai Swamp, Kenya

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Water quality has been documented to affect the biology and well-being of fish and is equally important in aquaculture production. This study therefore aimed at determining the influence of selected water quality parameters on the Length-Weight Relationship (LWR) and Fulton's condition factor (k) of *Oreochromis niloticus baringoensis* (Trewavas, 1983) in two hot springs draining into Lorwai Swamp; Lake Bogoria Spa spring and Chelaba spring between the months of July and August, 2018. Using a seine net, a total of 445 fish were collected; 244 from Lake Bogoria Spa spring and 201 from Chelaba spring. LWR was determined using Le Cren's equation; $W=aTL^b$ and the k value determined using Ricker's equation; $100W/L^3$. LWR results indicated an isometric growth for fish from both springs. The mean (\pm SD) k values for fish in Lake Bogoria Spa spring were 2.02 ± 0.25 for the males, 2.02 ± 0.27 for the females and 2.00 ± 0.26 for both sexes. In Chelaba spring, the mean k values were 2.03 ± 0.21 for the males, 1.97 ± 0.25 for the females and 2.00 ± 0.23 for both sexes. These values indicated that the fish in these hot springs are in a very good condition and healthy status with k values above 1 and this is despite the unfavorable environment with low dissolved oxygen and high-water temperatures. There was a positive correlation between Electrical Conductivity, Dissolved Oxygen, nitrates and Total Nitrogen with the length, weight and "k" in Lake Bogoria Spa spring while Chlorophyll-a correlated positively with length and weight in Chelaba spring. These results show that this strain of tilapia seems to have adapted to high-water temperatures of up to 36 °C. Therefore, this strain of tilapia may have potential to be incorporated in aquaculture production especially in hot and arid zones. Thus, this strain should be studied further for purposes of aquaculture production or used to improve other strains of tilapia used in aquaculture.

Keywords: Condition factor, hot springs, length-weight relationship, Lorwai Swamp, *Oreochromis niloticus baringoensis*, water quality

Prediction of Infiltration Rate in Different Land Use Types Using Modified Horton Equations in Upper Njoro River Catchment

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Infiltration rate is a fundamental parameter in understanding a wide range of soil functions. The determination of the infiltration rate in the field usually requires a lot of time. Horton's equation is a viable option when measuring ground infiltration rates or volumes since it provides a good fit to data. However it is cumbersome in practice since it contains three constants that must be evaluated experimentally. The study aimed at developing equations that can be used to predict infiltration rate in different land use types based on Horton equations. The in-situ measurements of infiltration rate of the soil were done by a double ring infiltrometer in the upper part of Njoro River catchment. Tests were carried out four times in four land use types that included grassland, natural forest land, deforested and fallow agricultural land from May to December 2017. The field collected infiltration data was used to determine the constants of Horton's equation. The models describing data in various land use types were developed through regression analysis. Horton function was adapted to develop new infiltration rate equations for natural, fallow agricultural land, grassland and deforested land respectively. The study recommends the models to be applied to the other similar land use types where tests were not conducted. The equations can also be used to check the accuracy and reliability of automated soil water movement systems at defined intervals.

Keywords: Infiltration rate, In-situ measurements, Land use types, Horton function, Regression analysis

Parasite Communities of *Oreochromis niloticus baringoensis* (Trewavas, 1983) in Relation to Selected Water Quality Parameters in the Springs of Lorwai Swamp and Lake Baringo,

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Parasite infections may lead to mortalities in fish therefore destabilizing the biodiversity and ecosystem functions. In addition, some fish parasites have also been reported to be zoonotic and may cause serious health problems in humans. Swamps such as Lorwai Swamp in Baringo County are important water and food resources especially for local communities. However, there is scarce information on the parasite species infecting *Oreochromis niloticus baringoensis* in the hot springs of Lorwai Swamp. The purpose of this study was to provide a knowledge base on the parasite species infecting *O. niloticus baringoensis* in these springs, facilitate their comparison with those in Lake Baringo and determine their relationship with selected water quality parameters. A total of 347 fish were collected in July and August, 2018 and standard parasitological procedures used to examine the presence of parasites. Physico-chemical parameters were measured *in situ* and water samples collected for chlorophyll-*a* determination and nutrient analyses in the laboratory using standard methods. Relationship between parasitic infections and selected water quality parameters was determined by PCA using SPSS version 20. *Heterophyes* sp. and *Contracaecum* sp. which have been documented to be zoonotic were recovered at prevalence of 25.47% and 23.59% respectively. *Amirthalingamia macracantha* and *Contracaecum* sp. correlated positively with nitrogen compounds while *Clinostomum* sp. and *Tylodelphy* ssp. correlated negatively with dissolved oxygen (DO). *O. niloticus baringoensis* from Lake Baringo also recorded high parasite prevalence than those in the hot springs. Our results indicate that water quality parameters correlate with prevalence of fish parasites. Therefore, there should be implementation of water quality monitoring through catchment management strategies and proper waste disposal. The presence of zoonotic parasites calls for public sensitization on risks of consuming infected fish and ways of proper handling and preparation of fish for consumption.

Keywords: Hot springs, Lake Baringo, Lorwai Swamp, *Oreochromis niloticus baringoensis*, parasite communities, water quality,

Provisioning of Water Ecosystem Services in Kapingazi Catchment, Embu County, Kenya. What are the Anthropogenic Activities Impacting on their Supply within the Catchment?

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Ecosystems provide valuable ecosystem services which are the foundation of man's sustainable development such as water provision. However, when humans exploit ecosystems in providing for their own sustenance, they also affect ecosystem services intensively and consequently degrade the environment, endangering man's survival and development. Kapingazi catchment is home to various ecosystem services mainly water provision to downstream users. Kapingazi River flowing from this catchment contributes to Tana River with several national hydroelectric power stations that contribute to 52.1% of hydro-electric power of Kenya's electricity. Destruction of the catchment area through anthropogenic activities, have threatened Kapingazi River with its water flows and quality fluctuating significantly. The aim of this research was therefore to assess the anthropogenic activities impacting on water service provision in Kapingazi catchment in Embu County, Kenya. Data collection was conducted between March and May, 2018. The study adopted cross sectional research design. Primary and secondary data were collected from Kapingazi catchment. Various anthropogenic activities were analysed based on catchment users who caused them including; cultivation at the riparian area, availability of eucalyptus trees at the riparian area, chemical control of pests and diseases, water abstraction, washing in the river, deforestation, quarrying, soil erosion, poor waste disposal and management. Logistic regression analysis showed that farmers' activities ($p = 0.002$) had significant impact on changes in water quality while farmers' activities ($p = 0.036$) and industrial activities by tea factories ($p = 0.014$) and coffee factories ($p = 0.013$) had significant impact on changes in water quantity at 95% confidence level. Negative impacts weaken water provision ecosystem service through changing ecosystem structure hence the need to reverse them in Kapingazi catchment. This can be achieved through proper waste management, soil and water conservation measures and enforcement of water regulations in order to provide improved water services of Kapingazi River.

Keywords: Anthropogenic activities, catchment, ecosystem, ecosystem services, water

Factors Influencing the Performance of Improved Pastures: A Case of Lake Bogoria Production Landscape, Kenya

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Internationally, Lake Bogoria Production Landscape (LBPL) is important for wildlife species, biodiversity content and livestock feeds. However, it is at risk from degradation arising from unsustainable exploitation resources due to overstocking and inadequate natural pasture. Information on pasture species, places of planting and production capacity are well documented. However, there is limited research on the factors influencing the performance of improved pastures and impacts on environment and people. This study assessed the factors influencing the performance of improved pasture production in LBPL. A descriptive research design targeting 5,000 households spread within five administrative locations in the Baringo South Sub County was applied. Using multi-stage sampling techniques, 300 households and 12 key informants from the major stakeholder organizations were interviewed in September 2019. The instruments were reviewed by Dryland Research Training and Ecotourism Centre (DRTEC) of Egerton University for expert judgment, review of content and face validity. A sample of 10 questionnaire was used for pilot survey in Majimoto. Reliability analysis produced an alpha of 0.77. Data analysis used SPSS as percentages, means and SD and findings presented in tables and graphs. Pearson's Product Moment Correlations was done through percentage scores from addition of scores of Likert-like scale items to determine the relationships between variables. The study established that strong cultures ($r=0.65$; $p=0.0002$) and limited awareness ($r=0.55$; $p=0.0001$) influenced improved pasture production. The study recommends that the community to be trained to scale up efforts to mobilize adequate resources. The training should be on both financial and human resources to strengthen the other factors that rely on them. This will promote the realization of the goals of biodiversity conservation, which will assist in improved, pasture production.

Keywords: Culture, influence, pasture, performance, resources.

Prospects of Willingness to Pay for Improved Water Provision Ecosystem Services in Kapingazi Catchment, Embu County, Kenya

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Ecosystem services are biological foundations essential to economic prosperity and development of human beings for example water provision. However, when ecosystems are exploited for human sustenance, they affect water provision intensively. Kapingazi catchment provides various ecosystem services mainly water provision to downstream users including national hydroelectric power stations that contribute to 52.1% of hydro-electric power of Kenya's electricity. Agricultural and industrial activities have changed the ecosystem structure of the catchment leading to fluctuation of water quality and quantity of Kapingazi River. Payment for ecosystem services is one of the approaches which can enhance adoption of sustainable land management practices leading to improved water quality and water quantity in Kapingazi catchment. The aim of this research was therefore to assess the willingness to pay in improved water service provision in Kapingazi catchment in Embu County, Kenya. Household questionnaires, key informants schedules and focus group discussions were used to collect data from households, institutions and stakeholder associations respectively between March and May, 2018. The results showed that 67% of the respondents were willing to pay for improved water services in terms of water quality and water quantity within the catchment. The respondents were willing to pay an average of USD 9.10 per annum in addition to the average water user fee of USD 4.19 per month for improved water services in Kapingazi catchment. Logistic regression analysis revealed that age ($p=0.005$), education ($p=0.025$) and household size ($p=0.05$) were the factors influencing respondents' willingness to pay (WTP) for improved water service in the study area. Positive WTP for improved water service provision shows the need for improved water service provision in Kapingazi catchment. Thus, decision makers should create enabling policy for implementation of payment for ecosystem services (PES) programme for improved of water services provision in Kapingazi catchment.

Keywords: Catchment, ecosystem, ecosystem services, water, willingness to pay

Determination of Pollutants in Water based on Graphenated Polypyrrole-nanoalloys Nanocomposite

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In Kenya, Cancer is estimated to be the second leading cause of non-communicable diseases related deaths after cardiovascular diseases and accounting for 7% of overall national mortality. Hydrazine has been classified as human carcinogen by the Environmental Protection Agency (EPA). It has been reported that its exposure to humans causes damage to liver, kidney, lungs and respiratory tract system and has long-term effects on the central nervous system. Due to these side-effects, it is highly desirable to fabricate portable, economical, sensitive and rapid methodologies for the determination of hydrazine. This work focuses on the methodologies of harnessing the unique properties of electroconductive polymers and nanomaterials and their application in sensor technology. A highly sensitive, rapid and simple electrochemical sensor for the detection of hydrazine has been developed using graphenated polypyrrole-Ag-Au nanoalloys nanocomposite. The electrocatalysis of hydrazine on the synthesized nanocomposite was investigated in aqueous medium using cyclic voltammetry (CV) and square wave voltammetry (SWV). An increased current density, decreased oxidation over potential and low detection limits were observed. The results showed that the synthesized nanocomposite exhibited excellent characteristics for their application in the development of highly sensitive, cheap and easy to use electrochemical sensors for hydrazine detection.

Key words: Hydrazine, Nanoalloys, Cyclic voltammetry, Carcinogen, Overpotential.

Gender and Sustainable Water Management and Conservation: A Case of Tharaka Nithi County, Kenya

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Gender equity and women's empowerment are prerequisites to effective conservation, climate action and meeting the Sustainable Development Goals. In view of its ecological, social and economic value, water is an important renewable natural resource. Its significance is felt in areas such as rural development, land-use planning, food supply, tourism, scientific research and cultural heritage. A better understanding of the different roles, knowledge, needs and aspirations of women and men with regard to water management and conservation can help us achieve the twin goals of better conservation outcomes and increased gender equity. This study aimed at assessing the gender and sustainable water management and conservation in Tharaka Nithi County, Kenya. The study was carried out in four selected water projects in Tharaka Nithi County. Descriptive survey and sequential explanatory mixed method approach were adopted for the study. A sample size of 167 respondents comprising of water managers, staff in water projects, water users and local water committees participated in the study. Data was collected using questionnaires, interview schedule and focused group discussion. The findings showed that there were gender disparities in water management and conservation in Tharaka Nithi County. Women were underrepresented as staff, water managers and local water committee members in the selected water projects. The study further found that these disparities impacted negatively on sustainable water management and conservation. Conflict over water resources, delayed installation, repairs, maintenance and reporting leakages as well as cultivation in river banks were reported as trickle down effects of gender inequalities in sustainable water management and conservation. The study recommends that the water projects and institutions should incorporate more women into water management and conservation projects as well as employ gender advocacy and empowerment programs to facilitate gender equity in water management and conservation.

Key words: Gender, Dynamics, Sustainable water management, Conservation

Can Pastoral Communities Offer Sustainable Ecological Management Solutions? The Case of Mwanda-Marungu Pastoral Commons in Taita Hills, Kenya

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There has been increased interest over the last decades on community based management of natural resources (CBMNR) and their relation to environmental sustainability. Insufficient studies dedicated in Kenya to understand pastoral communities' management is striking, considering the importance of communal management for pastoralism and of pastoralism in Kenya. This research has been set up to conduct a study of customary management of relatively well functioning pastoral commons of East Africa, the Mwanda-Marungu commons which borders Tsavo west national park in Taita hills, south-west of Kenya. Through ethnographic approaches such as participant observation, semi-structured interviews and focus group with discussions of up to 234 respondents, it was examined whether customary management systems of Mwanda-Marungu would offer sustainable model that conforms to the IUCN's Other Effective area-based Conservation Measures (OECMs) and where not, as well as why and which were the sources of possible malfunctioning. Among others the results showed that these pastoral commons assure a generalized local rule requiring that all herders and livestock should have left water points and salt lick areas by 3pm so as to pave way for the wildlife to drink water and lick salt as well in order to avoid illnesses transmission and favoring humans-wildlife co-existence within the commons. Also there are important restrictions on charcoal burning and fires within commons as well as the use of religious shrines called *fighis* that all together help to conserve forests and pastoral habitats, which are absent in other areas where private plot selling and mining has started to come in and degradation is much stronger. This study demonstrates that pastoral communities in this area have devised ingenious measures that prove good management of natural resources within their commons aligned to the principals of OECMs and they could be considered for support, since where they disappear environmental degradation tends to appear.

Key Words: Pastoralism, Commons, Natural Resources, Fragile ecosystems, OECMs.