

Watershed Management in Kenya



1.0 Introduction

Watershed management is defined as the process of implementing land use practices and water management practices to protect and improve the quality of the water and other natural resources within a watershed by managing the use of those land and water resources in a comprehensive manner. In Kenya, Watershed Management is under Water Resource Authority. Climate change is affecting water systems around the globe. It has resulted in degradation of wetlands, changing rainfall patterns, increased incidents of extreme weather patterns and deterioration of water quality and quantity. Watershed management is therefore very important to ensuring sustainable development.

Efforts to enhance watershed management in Kenya have been stimulated by non-governmental organisations in partnership with the government. Some of the projects in this line are the Lake Naivasha **Payment for Environmental Services (PES)** scheme, Upper Tana basin restoration project conducted by scientists from **Consultative Group on International Agricultural Research (CGIAR)** Research Program on Water, Land and Ecosystems (WLE), Empowering citizens in watershed management and Adaptive and Inclusive Watershed Management in East Africa program by International Institute for Sustainable Development (IISD).

DEAR READER

Welcome to KeSEBAE Newsletter.

A fortnightly Newsletter touching on topical issues affecting our environment.

KeSEBAE NEWS is a Newsletter of the Kenya Society of Environmental, Biological and Agricultural Engineers (KeSEBAE)

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In the last decade, PES schemes have been used for watershed management in many countries in Africa, Latin America and Asia. In Africa, several schemes were started under different names. Most, promoted by NGOs such as World-Wide Fund for Nature (WWF), Care international, World Agroforestry Centre (ICRAF). Pro-poor Rewards for Environmental Services in Africa (PRESA), for example, is a program spearheaded by ICRAF piloting a number of PES projects in East and West Africa. As at 2013, the program implemented PES projects across seven watersheds in Kenya, Tanzania, Uganda and Guinea the projects targeted watersheds with unsustainable agricultural activities and deforestation. PRESA projects sites in Kenya are Sasumua, Lake Victoria and Upper Tana.

The challenges encountered in watershed management in Kenya include, land tenure most state-owned land is abused, lack of capital for the venture, environmental degradation due to poverty, lack of labour and cultural limitations. Possible solutions to curb the problems have been discussed.

1.1.Definitions

The watershed of a body of water is the area of land that drains or sheds water into a specific receiving waterbody, such as a lake or river. Rainwater or melted snow runs downhill in the watershed collects and transports sediment and other materials and deposits them into receiving waterbody.

Watershed management is the study of the relevant characteristics of a watershed aimed at the sustainable distribution of its resources and the process of creating and implementing plans, programs, and projects to sustain and enhance

watershed functions that affect the plant, animal and human communities within a watershed boundary.

The features of a watershed included in watershed management are water supply, water quality, drainage, storm-water runoff, water rights and the overall planning and utilization of watershed landowners, land use agencies, storm-water management experts, environmental specialists, water use surveyors and communities. These all play an integral part in the management of a watershed.

The major socio-cultural and economic factors include; land tenure, capital, labour, perception and beliefs and gender.

1.2.Watershed Management Legislation

Watershed management in Kenya is legally the mandate of **Water Resource Authority** (WRA) formerly known as Water Resources Management Authority (WARMA). It is a state corporation established under Section 11 of the Water Act, 2016. It is mandated through delegated Authority on behalf of the National government to safeguard the right to clean water by ensuring that there is proper regulation of the management and use of water resources, in order to ensure sufficient water to everyone – now and the future. The Authority has been in existence for 12 years following its establishment under the Water Act, 2002 as WARMA. The guidelines of water resource management stipulated in the National Water Resources Management Strategy (NWRMS) developed by the ministry of Water, Irrigation and Sanitation. WRA develops Catchment Management Strategies based on NWRMS.

The country Kenya is divided into six-drainage based catchment areas; Athi Basin Area, Tana Basin Area,

Ewaso Ng'iro North Basin Area, Rift Valley Basin area, Lake Victoria

In the Ewaso Ngiro North Basin, the upstream mountainous region provides water by high precipitation and low-evaporation. The lowlands receive water from the higher regions through the river. The water supply is assured throughout the years.

2.0. Importance of watershed management

Climate change is affecting water systems around the globe. It has resulted in degradation of wetlands, changing rainfall patterns, increased incidents of extreme weather patterns and deterioration of water quality and quantity.

All activities that occur within a watershed will directly or indirectly affect watershed's water quality. These activities include new developments on land, run off water, agricultural activities and household activities such as gardening or lawn care, sewage system use and maintenance, water diversion and car maintenance.



Figure 2.1: Mau Forest Watershed destruction

Source: BBC News

Runoff from rainwater can contribute to a large extent to pollution into the lake or river or sea.

Watershed management helps to control pollution of

the water and other natural resources. This is by identifying the different kind of pollution present in the watershed and how they are transported and methods of reducing or eliminating the pollution sources.

3.0. PES Scheme for Lake Naivasha Watershed, Kenya

The PES in Naivasha watershed was designed to be implemented in three phases, the first started in 2006, and involved the scoping and feasibility study. The implementation started in 2007 and the final scale up phase continued afterwards.



Figure 2.1: Lake Naivasha basin **Source:** WWF Kenya

Lake Naivasha is situated in the East Rift Valley of Kenya. It is the largest inland freshwater lake in Kenya and is fed by two perennial rivers; Malewa and Gilgil. Commercial horticulture is one of the main economic activities around the lake other activities include ranching, agriculture, tourism, fishing and geothermal power production.

3.1. Commencement by Hydrological Assessment

The PES scheme project began by hydrological assessment, economic analyses, livelihood analysis and legal and policy assessment. The objective of hydrological assessment was to characterize the watershed problem by interventions to enhance the provision of ES. The assessment employed the use of the Soil and Water Assessment tool (SWAT) model. Under this, the water quality was identified as the key watershed services under threat. Soil erosion was found to be a major source of sediments and agricultural chemicals in the water. The study identified five erosion hotspots in the watershed; two in Turasha and Wanjohi sub catchments. Land-use change recommendations made were established as grass strips and terraces on steep slopes to reduce soil erosion, rehabilitation and maintenance of riparian zones and agroforestry.

3.3. Economic Analysis, Buyer Seller Nexus

Economic analysis was initiated to identify potential buyers of the ES, assess their willingness to join the scheme and carry out a cost/benefit analysis for the conservation measures selected during the hydrological assessment.

The opportunity cost the farmers or sellers had to incur as a result of conservation as well as the benefits the buyers were to receive was assessed in the CBA. Commercial flower growers, water companies, power-generating companies and businesses in the tourism industry such as hotels and government-owned Kenya Wildlife Service were identified as the potential buyers.

The economic analysis provided sufficient financial justification for implementation of the scheme. Crop

strip and restoration of riparian areas were found to be the most economical and feasible interventions.

3.4.Livelihood Assessment

The objective of the livelihood assessment was to establish livelihood aspects that would impact the design of PES scheme and also assess the willingness of the sellers to voluntarily join the scheme.

Compensation should be in form of goods and services not cash based as majority of the land owners are men so the money may not reach the women who are very important in the implementation and sustainability of conservation measures. Under legal and policy analysis, the viability of PES in terms of Kenyan law and the legally feasible structure for engaging the upstream sellers or stewards and downstream buyers of ES was determined. The law recognised community-based Water Resources Users' Association (WRUA) as responsible for water management at the local level and Water Resource Authority. The selected watershed management measures were found to be best implemented through the established WRUAs and with the involvement and permission of WRMA, now known as WRA.

3.5.Turasha and Wanjohi Sub-catchment Areas

For a start, the Turasha and Wanjohi sub-catchments piloted the project. the two are located in the foothills of Aberdare ranges, and both are sub-catchments of Malewa River that feeds into the lake.

The buyers were mainly the commercial horticultural crop growers and represented in an umbrella called Lake Naivasha Water Resources Users Association (LANAWRUA).

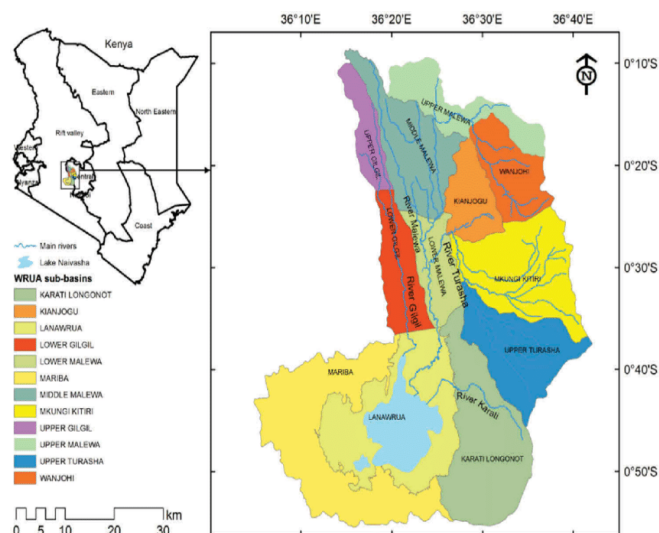


Figure 3.5.: Lake Naivasha basin WRUA map

Source: Research gate

The scheme started with 565 farmers in the two sub-catchment areas. The buyers' association, LANAWRUA, is composed of Lake Naivasha Growers Group (LNGG) and the Lake Naivasha Riparian Association (LNR).

The two associations represented the sellers and the buyers, respectively, entered into a legally binding contract with the sellers committing to undertake mutually agreed conservation practices and the buyers committing to compensate the sellers for the conservation activities. The farmers were supplied with suitable grass varieties (usable as fodder and appropriate for conservation) and agroforestry tree seedlings.

LANWRUA made first two payments (about USD 10,000 each) to the sellers through their respective WRUAs. The payments were agreed to be conditional only paid to farmers who implemented the agreed conservation measures were shared to 470 farmers and 504 farmers for the first and second payments, respectively. The payment was in form of vouchers which are redeemable for agricultural inputs at agreed local shops.

The project went further and encapsulated majority of the Lake Naivasha basin.

4.0. Restoring the Tana River Watershed

The work in the Upper Tana basin conducted by scientists from CGIAR Research Program on Water, Land and Ecosystems (WLE), is part of an integral research program designed to protect the watershed, reduce degradation of land and increase resilience of smallholder farmers.



Figure 4.0.: Upper Tana **Source:** International Water Association

The work is being led by The Nature Conservancy (TNC), which has created a water fund for the conservation efforts. The International Center for Tropical Agriculture (CIAT) is founding partner

The objective of this work is to restore and protect the condition of the Upper Tana River watershed, improve water security for Nairobi and secure the country's principle hydropower source.

. The Upper Tana provides 90 per cent of the water to Nairobi and contributes two-thirds of Kenya's power supply through hydropower generation. The upper watershed comprises a densely populated agricultural zone inhabited predominantly by small holder farmers.



Figure 4.1: CIAT Researchers on Upper Tana

Source: CGIAR

TNC and CIAT utilized the latest research and modelling tools with the aim of prioritizing restoration and conservation work in the watershed.

CIAT researchers conducted periodic river gauging and sediment discharge monitoring in critical parts of the watershed. They produced high resolution satellite images which were translated to maps that revealed where and how the watershed is being degraded by quarry chains, upstream farming and other developments.

Based on cost-benefit analysis, researchers are able to recommend ecosystem-based approaches to mitigate sedimentation and erosion in the predominantly rural upstream watersheds that safeguard the quantity and quality of water for downstream users.

The goal of the project was to inform investment decisions and encourage public policies that will ensure the sustainable use and restoration of ecologically critical areas.

The methodology developed for the Upper Tana River is expected to be replicated in other watersheds across Africa. A comparative analysis of ecosystem

services in different landscapes and among different livelihood scenarios can help scale up work.

Researchers are also assessing possible incentives for farmers and governments to invest in land restoration efforts. Scientists will be exploring new approaches to understand, monitor and evaluate land degradation and consider incentive schemes such as carbon credits, subsidies and rewards for ecosystem services. Women, youth and marginalised groups will be brought into the discussions through direct participation in conservation activities and joint planning workshops. (2015)

5.0 Empowering citizens program in Watershed protection

In September 2017, empowering citizens programme was launched in Laikipia and Kajiado counties. The watershed programme intervention addressed issue of poor water governance in the Athi and Ewaso Ng'iro North catchment area and strengthen relationships with its stakeholders.



Figure 5.0: Empowering Citizens- Watershed Protection Programme. **Source:** Wetlands International

Water security is a key concern in the two counties. During the drought period, conflicts arose due to

water allocation. The program focuses on addressing and solving this issue. The program worked with Civil Society Organisation (CSOs) for evidence-based lobbying and advocacy on Water, Sanitation and Hygiene (WASH) services, Integrated Water Resource Management (IWRM) issues, fulfilled human right to water, sanitation and sustainable allocation of water resources. The program strategically aims to make the voice of citizens heard thereby strengthening governance and accountability.

By the end of the program, several Water Resource User Associations in the two counties developed and committed to implement advocacy action plans as strategies for policy influencing and conflict resolution. The county government of Kajiado, Department of Water and Public health have established the county WASH/WRM technical Working Group, mandated to provide a platform for joint planning, information sharing and effective coordination of WASH/WRM interventions in the county.

6.0 Adaptive and Inclusive Watershed Management in East Africa

Women who are the main users of water for household and small-scale agriculture, are often excluded from decision making around water issues.

Incorporating climate change and gender considerations into planning, budgeting and monitoring in the water sector can help minimize challenges related to climate change. This concept is referred to as adaptive and inclusive watershed management.



Figure 6.0: Women Involvement in Watershed Management **Source:** IISD

The first stage of this project focused on improving understanding and capacity to incorporate ecosystem management, gender responsiveness and climate adaptation into the adaptive watershed (TAW) management efforts. IISD is currently exploring how well Uganda and Kenya incorporate key elements of adaptive and inclusive watershed management practices through their policies, planning and institutional systems.

7.0. Challenges of Watershed Management in Kenya

7.1. Land Tenure

Land tenure is the terms and conditions on which land and other natural resources i.e. Trees and water are held and used. Resources are categorised into management regimes. There are four Resource Management regimes; Private regime, State Property regime, open access non property regime and common property regime. In Kenya, state property regime (rights of ownership and management of natural resources are vested in the state i.e. government. State owned and managed properties are always inadequately and misappropriately managed. A good example is the Mau water catchment which

is quickly degrading due to illegal settlement in the forest.



Figure 7.1: Illegal Settlements in Mau Forest

Source: AllAfrica.com

7.2. Capital

Watershed management requires an intensive investment of capital. For instance, labour is required for the construction of water harvesting structures, terraces, planting of trees. Majority of the land users in Kenya i.e., farmers, are subsistence producers. Low income implies the farmers savings are inadequate hence incapable of adopting green revolution technology, resulting in low yields.

7.3. The environment-poverty Nexus

Impoverished people depend on the environment for livelihood (fish, timber, wild fruits, charcoal, food, medicine). Poverty land users use the available resources in an unsustainable manner leading to their degradation

7.4. Labour

Labour, is the most limiting constraint of most small smallholder land users in Kenya in the adoption and sustenance of watershed management techniques.

This is due to competition for labour from the activities that involve watershed management and farm activities. Smallholder farmers tend to prioritize farm activities since their livelihood depends on it.

7.5. Cultural factors

Among the pastoral communities such as Maasai and Samburu, it is culturally sound and prestigious to keep large numbers of livestock. This overbears on the land resources leading to environmental degradation and destruction of watersheds.

7.6. Possible solutions to watershed management problems in Kenya

Advocacy for private property regime. Private ownership of land guarantees security of tenure and likely result in the adoption of appropriate and efficient watershed management strategies.

Enacting policies and penalties for wrong land use or use of land in a manner that leads to its degradation. Especially in the community whose domain is within the watershed region.

Evacuating people from watersheds using governmental officers such as the Mau Forest while providing for them alternative areas to stay.

Providing capital to small holders of land in Kenya by the government or other liaisons with private or foreign institutions, to give them an opportunity to participate in watershed management. This automatically eliminates the problem of lack of capital. The government should provide ranching options to pastoral communities and give advice on the land carrying capacities to prevent overstocking that leads to degradation of watershed

Kenya Society of Environmental, Biological and Agricultural Engineers held its Annual Conference VIRTUALLY on Wednesday 24 and Thursday 25 November 2021. The theme of the conference was **ENGINEERING FOR TRANSFORMATION**.

The Conference attracted attendance of **one hundred fifteen (115) Engineers** (*Professional Consulting Engineers; Professional Engineers and Graduate Engineers and Student Engineers*) and **Stakeholders** from Kenya, United State of America, South Africa, Ghana, among others. Of special mention is Prof. Emmanuel Bobobee from Ghana, who made a two highly informative presentations.

The Conference was divided into seven (7) Technical Sessions:

- I. Energy**
- II. Environment**
- III. Disaster Management**
- IV. Engineering Education, Research and Practice**
- V. Mechanization, Irrigation and Water Resources**
- VI. Processing, Infrastructure and Structures**
- VII. Blue Economy and Emerging Issues**

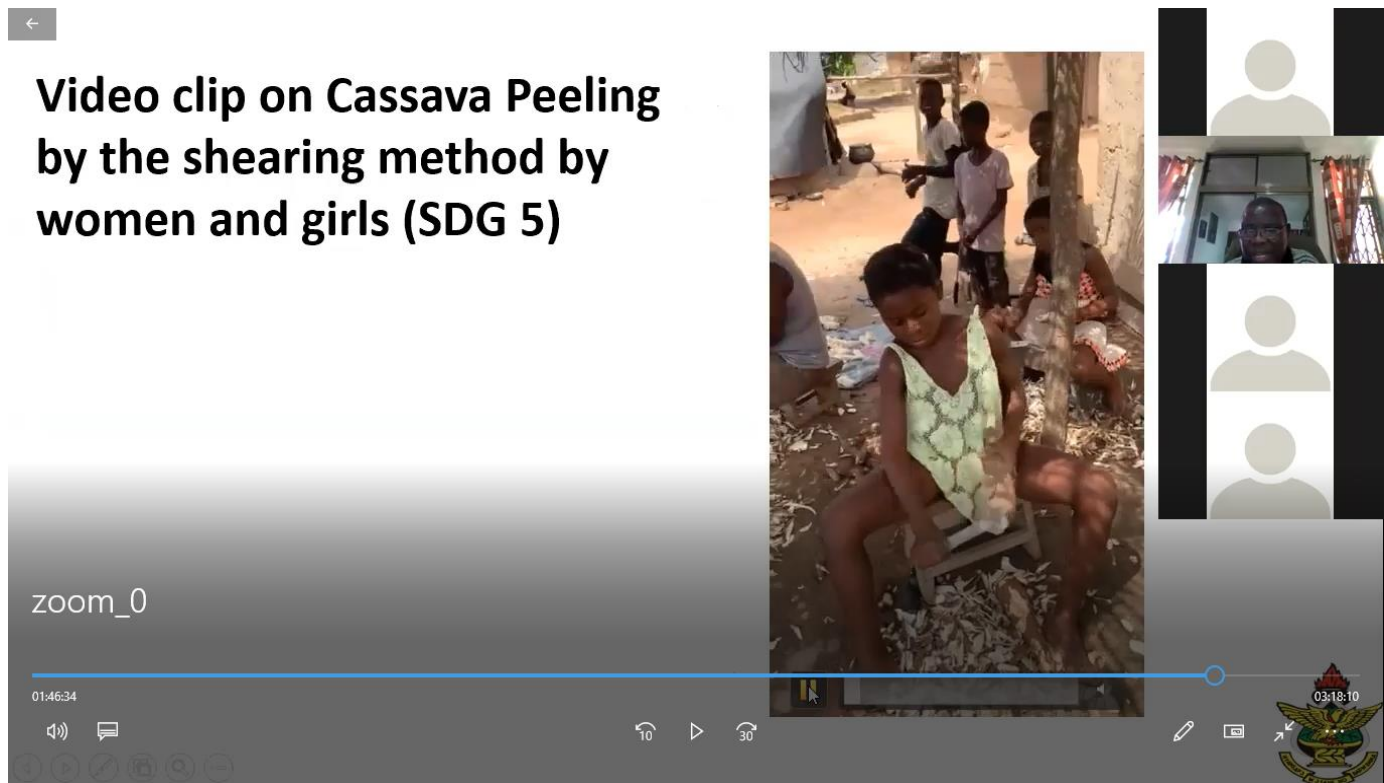
A total of **twenty-eight (28)** papers were presented under the **seven (7) Technical Sessions** as per the table following the images.

The screenshot shows a Zoom presentation titled "Agri-Climate Dialogues at the national and sub national level". The presentation content includes the following bullet points:

- Kenya's Emerging Multi-Stakeholder Platform (MSP) for Climate Change
 - A brief explanation on Implementing Agri-Climate Policies, Strategies and Plans in Kenya
- Concerns on KJWA and the future of issues related to agriculture
 - Moving to implementation under SBI means putting money on the table
 - However, whereas the Koronivia decision moves conversations about agriculture to the implementation of solutions, it does not discuss funding, a matter that many in the agricultural development community suggest will prove contentious in the future

The Zoom interface shows a video player with a progress bar at 01:46:34 and a list of participants on the right. The participants include Joab Osumba, who is the presenter, and several other attendees.

Joab Osumba making a presentation titled *The Agri-climate Dialogue: The Road to Glasgow-COP 26*. What we need to know, in the KeSEBAE Virtual Conference 2021.



Prof. Emmanuel Bobobee, from Ghana, making a presentation titled *Engineering Innovations and Methodologies for Cassava Mechanization to create Job and Wealth in Africa* in the KeSEBAE Virtual Conference 2021.

Technical Session I: Energy

No.	Paper	Presenter
1.	Are Renewable Energy Technologies Often Inaccessible to the Poor and Unbanked?	Eng. Shiribwa Mwamzali
2.	Electrifying Kenya	Eng. Prof. Lawrence Gumbe
3.	Efficient Use of Thermal Energy in Milk Processing Plants	Prof. Michael Okoth
4.	Climate Smart Biomass Conversion Technologies	Prof. Dauadi Nyaanga

Technical Session II: Environment

No.	Paper	Presenter
5.	Environmental Management for Transformation	Eng. Jura Omedi
6.	The Agri-climate Dialogue: The Road to Glasgow-COP 26. What we need to know.	Dr. Joab Osumba

Technical Session III: Disaster Management

No.	Paper	Presenter
7.	Disaster Management in Kenya	Ezekiel Oranga
8.	Health and Safety at Work	Eng. Mutua

Technical Session IV: Engineering Education, Research and Practice

No.	Paper	Presenter
9.	Engineering Curriculum for Transformation in Kenya	Eng. Prof. David Some
10.	Licensing of Engineers in Kenya	Eng. Jane Simiyu
11.	Engineering Research for Transformation	Eng. Prof. Ayub N. Gitau
12.	Engineering Innovations and Methodologies for Cassava Mechanization to create Job and Wealth in Africa	Prof. Emmanuel Bobobee
13.	Artificial Intelligence, Machine Learning and Intellectual Property	Prof. Emmanuel Bobobee

Technical Session V: Mechanization, Irrigation and Water Resources

No.	Paper	Presenter
14.	Development and Testing of a Soil Wetting Geometry Function for Moisture Irrigation Technology	Dr. Aidan Senzanje/Tinashe Lindel Dirwa
15.	Assessing Climate Change Impacts on Surface Water Availability Using the WEAP Model -Case of the Buffalo River Catchment, South Africa	Dr. Aidan Senzanje/ Miss N. Dlamini
16.	The Changing Environment for Engineering Profession	Dr. Fidelis Kilonzo
17.	Mechanization of Irrigation Systems	Eng. Richard Kanui
18.	Settled Pastoralists and Nomadic Irrigators: A Case Study of Dynamic Smallholder Irrigation along a Sand River in Kajiado, Kenya	Benson Mutuma Karimba
19.	Homer Based Hybrid Wind-Solar Energy System Modelling for Irrigation Pump Load Sites in Kenya	Samson S. Soshyo

Technical Session VI

No.	Paper	Presenter
20.	Extraction and Characterization of Latex from Euphorbia Nerifolia plant	Eng. Claudia Bess
21.	3D Modelling of a Greenhouse Environment	Januarius Agullo
22.	Pneumatic Drying of Grains	Prof. Daudi Nyaanga
23.	Decision Making in Wastewater Pipeline Asset Management: A Case Study of City of Dallas	Dr. Dan Atambo
24.	Non-Destructive Testing	John Birir

Technical Session VII: Blue Economy and Emerging Issues

No.	Paper	Presenter
25.	Environmental and Biosystems Engineering Students' Association (EBESA), University of Nairobi	Sirajurahman Ibrahim
26.	Engineering Students' Association (ESA), University of Nairobi	Rahma Abdul, ESA chair
27.	Farmer Led Irrigation Development (FLID) - What role for the Engineer in this Revolution?	Eng. Prof. Bancy Mati
28.	Energy Recovery from Organic Waste	Prof. Daudi Nyaanga

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KeSEBAE NEWS EDITORIAL

The **KeSEBAE NEWS** is a Newsletter of the Kenya Society of Environmental, Biological and Agricultural Engineers

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CRITERIA FOR ARTICLE SELECTION

Priority in the selection of articles for publication is that the articles:

- | | |
|--|---|
| <ul style="list-style-type: none">a. Are written in the English languageb. Are relevant to the application of engineering and technology in agriculture, the environment and biological systemsc. Have not been previously published elsewhere, or, if previously published are supported by a copyright permissiond. Deals with theoretical, practical and adoptable innovations applicable to engineering and technology in agriculture, the environment and biological systemse. Have a 150 to 250 words abstract, preceding the main body of the article | <ul style="list-style-type: none">f. The abstract should be followed by the list of 4 to 8 "Key Words"g. Manuscript should be single-spaced, under 4,000 words (approximately equivalent to 5-6 pages of A4-size paper)h. Should be submitted in both MS word (2010 or later versions) and pdf formats (i.e., authors submit the abstract and key words in MS Word and pdf after which author uploads the entire manuscript in MS word and pdf)i. Are supported by authentic sources, references or bibliography |
|--|---|

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Fellow	5,000	1,000	2,000
Member	2,000	1,000	2,000
Ass. Membe r	1,000	1,000	2,000
Aff. Member	500	1,000	2,000
Student	300	100	-

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<i>Aff. Member</i>	500
<i>Student Member</i>	300

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