



# KeSEBAE NEWS



Newsletter of the Kenya Society of Environmental, Biological and Agricultural Engineers

Volume 5. No. 2

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## Aquacultural Engineering

By: Luke Oremo Odero



Eng. Prof. Lawrence Gumbe (Left) Receiving A Gift from Prof. Julius A. Ogeng'o, The Deputy Vice Chancellor Academic Affairs, During KeSEBAE Courtesy Visit to The University of Nairobi On Wednesday 1 March 2023.

With our global population exponentially increasing, so does the demand for food, especially for high-quality protein sources. Aquaculture, the farming of aquatic organisms, has materialized as a major solution to this challenge. Aquacultural engineering plays a crucial role in the development and sustainability of this growing industry. Aquacultural engineering is a multidisciplinary field that draws upon principles of biology, chemistry, physics, and engineering. It encompasses a wide range of applications, including fish farming, shellfish culture, seaweed cultivation and aquatic plant production. It involves the design, construction and maintenance of systems that support the growth and cultivation of aquatic organisms.

### 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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These systems range from simple ponds to complex recirculating aquaculture systems that utilize sophisticated technology to maintain optimal water quality and temperature.

One of the most important aspects of aquacultural engineering is water quality management. In order for aquatic organisms to grow and thrive, their environment must be carefully controlled to maintain a specific set of conditions. This includes factors such as dissolved oxygen, pH, temperature and ammonia levels. Engineers design and implement systems to monitor and adjust these parameters to create an ideal environment for the organisms being cultivated.

Another key area of aquacultural engineering is the development of feed and feeding systems. Many species of aquatic organisms have unique dietary requirements, and engineers work to create specialized feed that meets these needs. Feeding systems can range from simple hand feeding to automated feeders that dispense food based on set schedules or environmental conditions.

Aquacultural engineering is involved in the design of *sustainable production systems*. Sustainable aquaculture involves minimizing the environmental impact of farming practices, while also maximizing the efficiency of resource use. This can include the use of renewable energy sources, the recycling of waste products, and the development of closed-loop systems that minimize the use of water and nutrients. Engineers consider factors such as the size and shape of the design of aquaculture facilities, the types of organisms being cultivated, and the environment in which the facility is located. They also take into account the various equipment needed for successful

aquaculture, including pumps, filters and aeration systems.

Aquacultural engineers also play a crucial role in the development of new species for aquaculture. This includes the selective breeding of existing species to improve growth rates, disease resistance, and other desirable traits. It also involves the development of entirely new species that are better suited to aquaculture. For example, scientists are currently exploring the potential for farming species like sea cucumbers, which have high commercial value and can be raised in closed-loop systems.

In recent years, aquaculture engineering has seen rapid advancements in technology, particularly in the development of recirculating aquaculture systems (RAS). RAS allows for the efficient use of water and energy and minimizes the environmental impact of aquaculture. These systems utilize sophisticated filtration and water treatment technology to maintain optimal water quality, while also providing a controlled environment for the cultivation of aquatic organisms.

The future of aquacultural engineering looks promising, with continued advancements in technology and a growing demand for sustainable food sources. Engineers in this field plays a crucial role in developing innovative solutions to meet these challenges.

Some of the key elements involved in aquacultural engineering include:

**i. Aquatic animal and plant biology:**

Engineers must understand the biology of the aquatic organisms they are cultivating, including their physiology, growth rates, and nutritional requirements.

- ii. Water Chemistry and Quality:** Engineers need to maintain optimal water quality parameters for the organisms being cultivated, including dissolved oxygen, pH, temperature and nutrient levels.
- iii. Hydrodynamics:** Engineers use hydrodynamics principles to design efficient water circulation systems that ensure uniform water flow and reduce energy consumption.
- iv. Feed Formulation and Feeding Systems:** Engineers develop specialized feed formulations that meet the nutritional requirements of the organisms being cultivated, and design feeding systems that are efficient and reliable.
- v. Aquatic Animal Health and Disease Management:** Engineers work with veterinarians and biologists to develop strategies for preventing and treating diseases in aquatic animals, including the use of vaccines and biosecurity measures.
- vi. Environmental Impact Assessment:** Engineers conduct environmental impact assessments to ensure that aquaculture systems are sustainable and do not have adverse impacts on the environment.
- vii. Facility Design and Construction:** Engineers design and construct aquaculture facilities that are sustainable for the organisms being cultivated and the environmental conditions in which they will be grown.
- viii. Water Treatment Technologies:** Engineers develop and implement water treatment technologies to maintain optimal water quality parameters, including infiltration, UV sterilization and chemical treatments.
- ix. Automation and Control Systems:** Engineers develop and implement automation and control systems to monitor and manage water quality parameters, feeding systems and other aspects of aquaculture production.
- x. Sustainable Aquaculture Practices:** Engineers promote sustainable aquaculture practices that minimize the environmental impact of aquaculture, such as using renewable energy sources, recycling waste products and reducing water use.
- xi. Genetics and breeding:** Engineers work with biologists to develop and implement breeding programs to improve the growth rate, disease resistance and other desirable traits of aquatic organisms.
- xii. Bioremediation:** Engineers use bioremediation techniques to treat and remediate contaminated water and sediments in aquaculture systems.
- xiii. Aquaponics:** Engineers design and implement aquaponic systems that integrate aquaculture with hydroponics, creating a symbiotic relationship between aquatic animals and plants.
- xiv. Recirculating Aquaculture Systems:** Engineers develop and implement recirculating aquaculture systems that minimize water use and waste, while maintaining optimal water quality parameters.
- xv. Land-Based Aquaculture Systems:** Engineers design and implement land-based aquaculture systems that use recirculating

water systems or ponds to cultivate aquatic organisms.

**xvi. Offshore Aquaculture Systems:** Engineers design and implement offshore aquaculture systems that use cages or pens to cultivate marine organisms in open water.

**xvii. Seafood Processing:** Engineers design and implement seafood processing facilities that handle and package aquatic organisms for human consumption.

**xviii. Aquatic Animal Welfare:** Engineers work to ensure that the aquatic organisms being

cultivated are kept in conditions that promote their welfare and minimize stress.

**xix. Aquatic Ecology:** Engineers work to understand the ecological interactions between aquatic organisms and their environment, and to develop strategies for managing these interactions.

**xx. Marketing and Economics:** Engineers work with marketing and economic experts to develop and implement strategies for marketing aquaculture products and optimizing the profitability of aquaculture operations.

One of the main challenges in aquaculture is disease management. Like any other livestock, aquatic organisms can be vulnerable to disease outbreaks that can devastate an entire population. Aquacultural engineers work closely with biologists and veterinarians to develop strategies for disease prevention and treatment. This can include the design of quarantine systems to prevent the introduction of pathogens, the development of vaccines and the implementation of biosecurity measures to prevent the spread of disease.

In conclusion, aquacultural engineering is a complex and dynamic field that plays a crucial role in the sustainable production of high-quality protein

sources. Engineers in this field design and implement systems to manage water quality, develop specialized feed, design aquaculture facilities, and innovate new technologies to support this growing industry.

Furthermore, aquacultural engineering is also concerned with the economics of aquaculture. Engineers work with business managers and economists to develop strategies for cost-effective production, market analysis and risk management. This involves understanding the factors that drive demand for aquatic products, as well as the cost structures and risks associated with aquaculture production.

## KeSEBAE Courtesy Visits

KeSEBAE paid courtesy visit to Kenyatta University and the University of Nairobi, early this month of March.

The visits were fruitful with the university agreeing to Memorandum of Understanding and Collaboration Agreement respectively.

The following are the basis of the collaboration:

- KeSEBAE nominating adjunct professors and adjunct lecturers to be appointed by the universities.
- Joint production of journals and other publications including the Journal of Engineering in Agriculture and the Environment, JEAE.

- Conducting of courses, seminars and workshops.
- KeSEBAE assisting the universities in curriculum development.
- Provision of mentorship to university staff and students as well as preparing staff for registration by the Engineers Board of Kenya by KeSEBAE.
- KeSEBAE to help in the placement of students in firms as well as facilitate attachment and internship for the students.
- Hosting and organizing of KeSEBAE Conference.
- Cooperate in the recognition and accreditation of the university programmes and curricula by statutory bodies and professional societies.

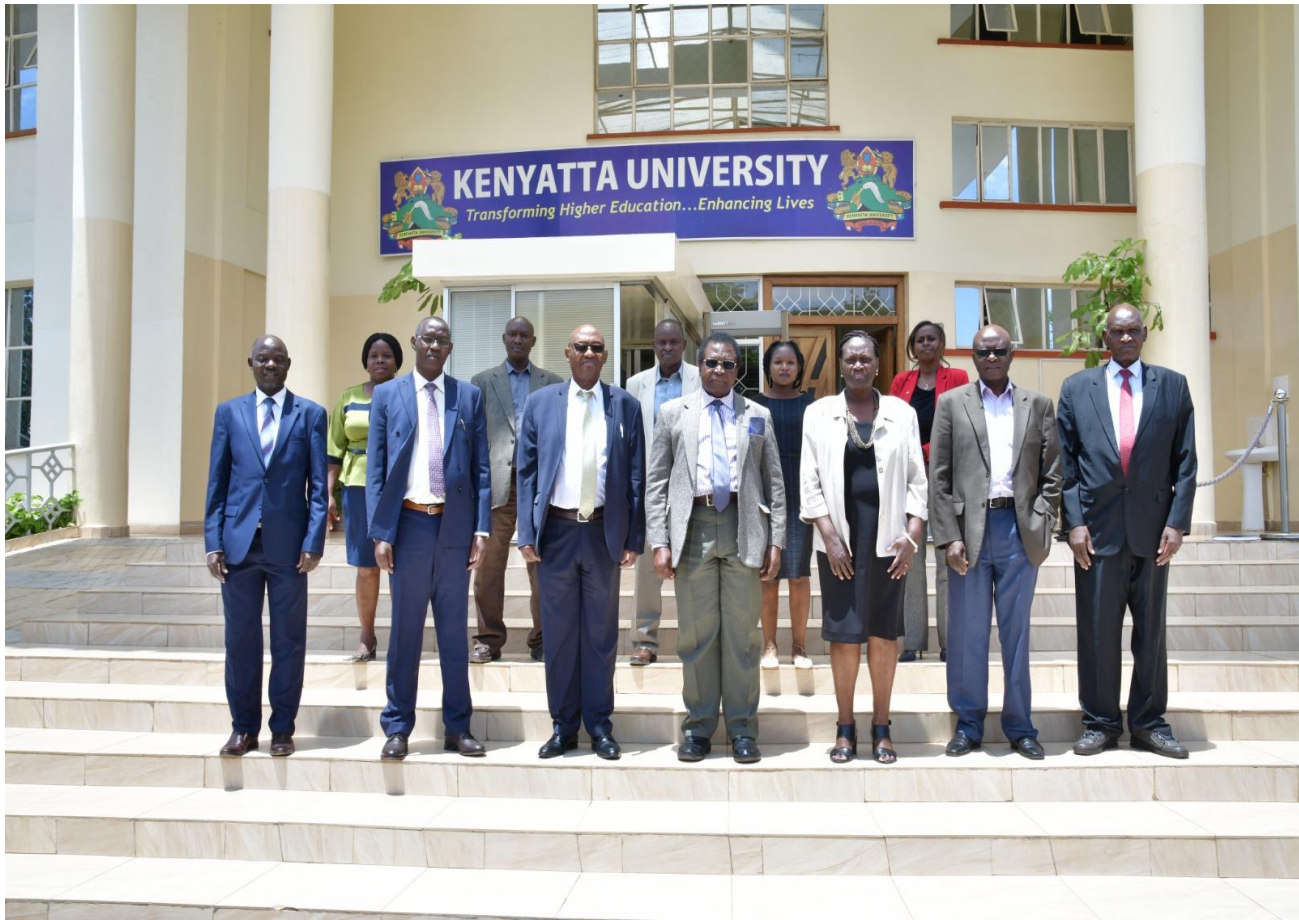


From Right: Mr. John A. O. Orindi, Hellen Agenga, Eng. Prof. Ayub Gitau, Brian Ouma, Prof. Julius A. Ogeng'o, Eng. Prof. Lawrence Gumbe, Eng. Mwamzali, Ezekiel Oranga, Yvonne Madahana, Claudia Bess And Eng. Prof. Duncan Mbuge (At the Back) Shared A Photo During the Courtesy Call Between KeSEBAE And the University of Nairobi

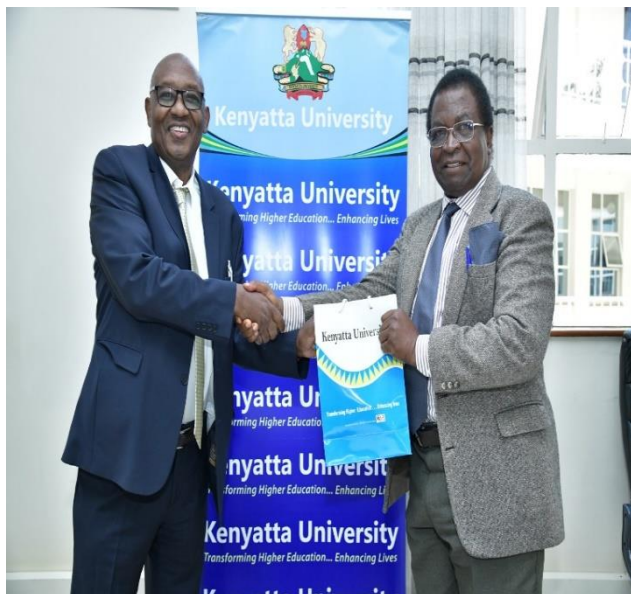


Eng. Prof. Lawrence Gumbe (Left) Receiving A Gift from Prof. Julius A. Ogeng'o, The Deputy Vice Chancellor Academic Affairs, During KeSEBAE Courtesy Visit to The University of Nairobi On Wednesday 1 March 2023.

KeSEBAE Chairperson, Eng. Prof. Lawrence Gumbe Presenting A Copy of Journal of Engineering in Agriculture and Environment to Prof. Julius A. Ogeng'o, The Deputy Vice Chancellor Academic Affairs of The University of Nairobi.



Left: Ezekiel Oranga, Eng. Richard Kanui, Eng. Prof. Lawrence Gumbe, Prof. Paul Okemo, Prof. Theuri, Eng. Shiribwa Mwamzali, Dr. James Koskei, Claudia Bess, Yvonne Madahana, Eng. John Nyaguti, Eng. Dr. Fidelis Kilonzo And Dr. Mildred Nawiri Shared A Photo During the Courtesy Call Between KeSEBAE And Kenyatta University.



Left: Eng. Prof. Lawrence Gumbe Receiving A Gift from Prof. Paul Okemo, The Deputy Vice Chancellor Administration, During KeSEBAE Courtesy Visit to Kenyatta University on Thursday 2 March 2023.



Right: Eng. Prof. of Kenyatta University. Lawrence Gumbe Presenting A Copy of Journal of Engineering in Agriculture and Environment to Prof. Paul Okemo, The Deputy Vice Chancellor Administration

# JOINT INTERNATIONAL ANNUAL CONFERENCE 2023

**THEME: Engineering Agenda 2063:  
The Africa We Want**

AGENDA 2063 is Africa's blueprint and master plan for transforming Africa into the global powerhouse of the future.



Wed 6 – Fri 8 Dec 2023



Nairobi

**EARN  
20 CPD  
POINTS**

## SUB-THEMES

1. Seamless connections (Roads, Railways, Air Transport and Water Transport)
2. Energy for Africa
3. Industrialized Agriculture
4. Housing
5. Free Trade in Services
6. Security
7. Sustainable Environment
8. Engineering Education and Practice

## KEY DATES:

**Abstract Submission:** 11 Oct 2023  
**Paper Submission:** 10 Nov 2023  
**Payment Deadline :** 25 Oct 2023

## CHARGES

**Members:** KES 15,000 ( \$150)  
**Non Members :** KES 20,000 (\$200)  
**Undergrad Students:** KES 2,000 (\$20)  
**Field Visit :** KES 5,000 (\$50)  
**Virtual:** KES 5,000 (\$50)

## Bank Payment Mode

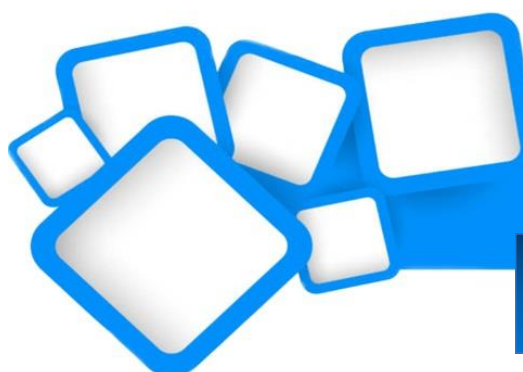
**Absa Bank:** Nairobi University Express Branch  
**Account Name:** Kenya Society of Environmental,  
Biological and Agricultural Engineers  
**Account Number:** 2038150696

## Mpesa Payment Mode

**Paybill:** 4002575  
**Account No:** Full Name

## Contact Details

**Call:** 0788712156  
**Email:** info@kesebae.or.ke  
**Web:** www.kesebae.or.ke



# Call for Papers

## To the Next Editions of the JEAE

# JEAE

*Journal of Engineering in Agriculture and the Environment*

The Journal of Engineering in Agriculture and the Environment (JEAE) is a Publication of the Kenya Society of Environmental, Biological and Agricultural Engineers (KeSEBAE) through which researchers in the fields of Environment, Agriculture and related fields share research information and findings with their peers from around the globe.

The JEAE Editorial Board wishes to invite interested researchers with complete work in any relevant topic, to submit their papers for publication in the next editions of the Journal.

Manuscripts may be submitted online or via email to:

**Prof. Lawrence Gumbe**, Chairperson, JEAE Editorial Board

Via Email: [info@kesebae.or.ke](mailto:info@kesebae.or.ke) or online via: [https://www.kesebae.or.ke/journal/manuscript\\_submit.php](https://www.kesebae.or.ke/journal/manuscript_submit.php)

## Criteria for Article Selection

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

- a. Are written in the English language
- b. Are relevant to the application of engineering and technology in agriculture, the environment and biological systems
- c. Have not been previously published elsewhere, or, if previously published are supported by a copyright permission
- d. Deals with theoretical, practical and adoptable innovations applicable to engineering and technology in agriculture, the environment and biological systems
- e. Have a 150 to 250 words abstract, preceding the main body of the article
- 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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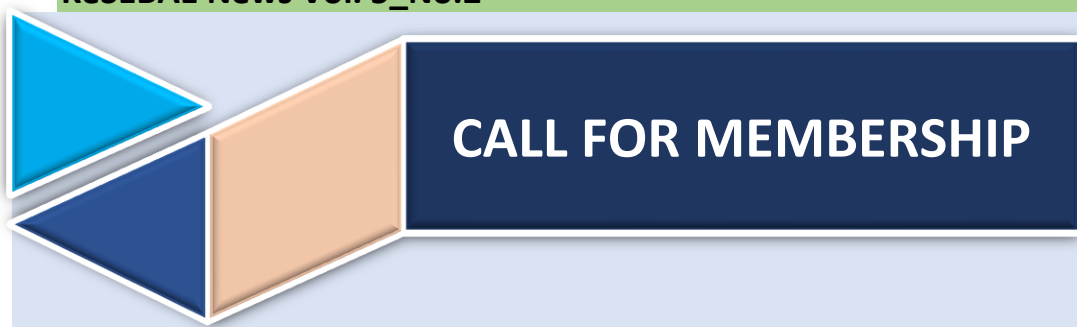
## CALL FOR ARTICLES TO KeSEBAE NEWS

**KeSEBAE NEWS Editorial** wishes to call for topical articles for publication in future editions of KeSEBAE NEWS.

Please transmit the same to the **Editor: Ezekiel Oranga** via Email: [info@kesebae.or.ke](mailto:info@kesebae.or.ke)

**NOTE:** A payment will be made to the author of each selected article





### Be a KeSEBAE Member:

The annual subscription fees, admission fees and reinstatement fees for members of all grades (except Honorary and Life Members who shall pay no dues or fees) are indicated below: The annual dues are as follows:

| Membership Category | Annual Subscription (KES) | Admission Fees (KES) | Reinstatement Fees (KES) |
|---------------------|---------------------------|----------------------|--------------------------|
| <i>Fellow</i>       | 5,000                     | 1,000                | 2,000                    |
| <i>Member</i>       | 2,000                     | 1,000                | 2,000                    |
| <i>Ass.Member</i>   | 1,000                     | 1,000                | 2,000                    |
| <i>Aff.Member</i>   | 500                       | 1,000                | 2,000                    |
| <i>Student</i>      | 300                       | 100                  | -                        |

### Membership Renewal

Members of all grades are requested to renew their 2022 membership as follows.

| Membership Category   | Annual Subscription Fee (KES) |
|-----------------------|-------------------------------|
| <i>Fellow</i>         | 5,000                         |
| <i>Member</i>         | 2,000                         |
| <i>Ass. Member</i>    | 1,000                         |
| <i>Aff. Member</i>    | 500                           |
| <i>Student Member</i> | 300                           |

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### PAYMENT DETAILS

| Bank         |   |
|--------------|---|
| Bank         | Absa Bank Kenya Plc                           |
| Branch       | Nairobi University Express Branch             |
| Account Name | Kenya Society of Env. Bio. & Agric. Engineers |
| Account No.  | 2038150696                                    |
| Swift Code   | BARCKENX                                      |
| Currency     | Kenya Shillings                               |

### M-PESA DETAILS

Pay Bill No.: 4002575  
Account No: Your Full Name



| Important Links |   |
|-----------------|---|
| KeSEBAE         | <a href="https://www.kesebae.or.ke/">https://www.kesebae.or.ke/</a>                 |
| JEAE            | <a href="https://www.kesebae.or.ke/journal/">https://www.kesebae.or.ke/journal/</a> |
| EBK             | <a href="https://ebk.or.ke/">https://ebk.or.ke/</a>                                 |
| IEK             | <a href="https://www.iekenya.org/">https://www.iekenya.org/</a>                     |
| PASAE           | <a href="http://www.pasae.org.za/">http://www.pasae.org.za/</a>                     |
| Email           | <a href="mailto:info@kesebae.or.ke">info@kesebae.or.ke</a>                          |