KeSEBAE 51 YEARS

AfroAgEng
PAN AFRICAN SOCIETY FOR AGRICULTURAL ENGINEERING

5th PASAE International Conference 2023

Engineering Agenda 2063: The Africa We Want

6th - 8th December, 2023

University of Nairobi Towers

20 PDUs

Hosted By: Faculty of Engineering, Department of Environmental & Biosystems Engineering

Supported By: Ministry of Agriculture and Livestock Development

REPUBLIC OF KENYA

KeSEBAE 51 YEARS

AfroAgEng
PAN AFRICAN SOCIETY FOR AGRICULTURAL ENGINEERING

Our Partners

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Ministry of Agriculture and Livestock Development

ENGINEERS BOARD OF KENYA
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African Union

The Institution of Engineers of Kenya
Founded 1972

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AfroAgEng

PAN AFRICAN SOCIETY FOR AGRICULTURAL ENGINEERING

About PASAE

AfroAgEng was formed in 2012, as the network of professionals in academia, research, industry and policy, as well as companies and private individuals with interest in the application of engineering principles in agriculture, food and related land-based industries and is the umbrella organization connecting national and regional associations and societies of Agricultural and Biosystems Engineering in Africa. AfroAgEng is a member of CIGR, the global organization for Agricultural and Biosystems Engineering.

Our Vision

To promote and support a network of young Agricultural Engineers as the pipeline for future leadership in the discipline and profession.

Our Mission

To promote and advance the profession of Agricultural Engineering in Africa. The Society seeks to become a key knowledge partner and visible policy advocate on the role of engineering and technology in the transformation and industrialization of agriculture in Africa towards Agenda 2063 and beyond – the Africa We Want.

What We Do

Raise awareness about the critical role of engineering and technological innovations in agriculture and related bio-based industries in Africa.

Promote curriculum reform and academic mobility among Agricultural Engineering programs.

Facilitate the exchange and sharing of information on the different aspects of Agricultural, Biosystems and Bioresources Engineering.

Assist individual members to develop their professional knowledge, skills and network through information exchange.

To achieve these, the Society will be active in organising and supporting networking events such as conferences, workshop, seminars and symposiums on current and emerging issues facing engineering and technology in agriculture, and related publications.

ABOUT KeSEBAE

Our Vision

To promote and advance the professional and economic development of our members' and improvement of society.

Our Mission

To become a key knowledge partner and visible policy advocate on the role of engineering and technology in the transformation and industrialization of the environment, food, energy, water and related sectors for sustainable development in Kenya.

What We Do

a. Professional Development

We support the professional development of our members to enable them register and practice at the highest possible level in Kenya and around the world.

b. Advocacy

We advocate for policies, laws and practices that protect the environment, support human development and improve the well being of society generally.

c. Training and Mentorship

KeSEBAE conducts training and mentorship programmes for its members, ensuring they grow professionally and remain abreast with current technologies and practices. The Society currently runs a mentorship programme aimed at having its young members gain registration as professional engineers recognized in Kenya and abroad.

We also support initiatives by related professional institutions such as the Pan African Society of Agricultural Engineers.

d. Knowledge Sharing

KeSEBAE publishes knowledge resources through (a) Journal of Engineering in Agriculture and the Environment (JEAE) and (b) KeSEBAE News.

e. Chapters

The Society has two main Chapters: (i) Young Engineers Chapter, and (ii) Women in Engineering Chapter

KeSEBAE Chairperson Welcoming Note

Eng. Prof. Lawrence Gumbe

Chairman, Kenya Society of Environmental, Biological and Agricultural Engineers (KeSEBAE)

Ladies and gentlemen. It is with great pleasure that I invite you to this year's conference. We are hosting this year's conference with our partners, the Pan African Society of Agricultural Engineers (PASAE) as a sign of our commitment to the African continent's aspirations and objectives.

The Theme of our conference is Engineering Agenda 2063, the Africa we Want. This theme is borrowed from the African Union Agenda 2063.

But before delving into the above, allow me to provide some background to this noble profession of engineering and to contextualise why this conference is important to the discipline of engineering in Africa in general and to Kenya in particular.

The noble profession of engineering is responsible for the creation, improvement and protection of the environment, providing facilities for living, industry and transportation, including large buildings, roads, bridges, canals and railways, water supply systems, dams, irrigation, harbours, docks, aqueducts, tunnels and other infrastructure and systems.

Planning is key to development. Engineers are uniquely qualified to lead the planning process because their education and training enables them to visualize complex systems, breakdown the same into components and re-integrate the same into a judicious whole. Kenya has a national government and 47 county governments. All the 48 governments have a planning role. We are, therefore, urging the national and county governments to involve engineers in their planning roles.

Engineering has been defined as the art and science of using nature forces and materials for the benefit of humankind. Art, science and technology are the building blocks of engineering as an academic discipline and as a profession.

Science provides the foundational principles for engineering, then engineering conceptualises and designs new devices, processes, and systems, which then get produced through technological knowhow and subsequently constitutes technology, which in turn feeds back into science to allow for development of new scientific principles.

The engineering process consists in innovation, design, and supervision of the construction of the artefact or structure. Technology on the other hand is concerned with the actual process of construction and maintenance of the objects and structures so designed by the engineer. The process of innovation in engineering and design in engineering requires a broad understanding of the issues surrounding the task at hand, which in turn requires a deep knowledge of science and the arts as the foundational disciplines of knowledge.

Science and Art are important to Engineering. There are two paramount differences between art and science. The first is that art is subjective while science is objective. The second is that art expresses knowledge, most often in the form of historically accepted norms and subjective representation, while science is the system of acquiring knowledge. Art and science are therefore in fundamental character very dissimilar but both are important to engineering.

Africa's Agenda 2063 is a 50-year blueprint that aims at propelling the African continent into being an impactful continent where the following aspirations are achieved:

1. A prosperous Africa based on inclusive growth and sustainable development
2. An integrated continent, politically united based on the ideals of Pan-Africanism and the vision of Africa's Renaissance

3. An Africa of good governance, democracy, respect for human rights, justice and the rule of law

4. A peaceful and secure Africa

5. An Africa with a strong cultural identity, common heritage, values and ethics

6. An Africa, whose development is people-driven, relying on the potential of African people, especially its women and youth, and caring for children

7. Africa as a strong, united, resilient and influential global player and partner

Borrowing from these aspirations, the joint 5th PASAE-KeSEBAE conference focuses on the following sub-themes:

a. Seamless Connections: This encompasses the development of roads, railways, air transport, water transport, and ICT infrastructure

b. Energy for Africa: It focuses on the need to ensure reliable and sustainable energy sources across the continent

c. Industrialized Agriculture: It aims to enhance food security through the adoption of advanced agricultural practices

d. Housing: Emphasizes the importance of providing adequate and affordable housing for all Africans

e. Free Trade in Services: Focuses on promoting economic growth by facilitating the exchange of services across borders

f. Security: Seeks to create a safe and stable environment for African nations

g. Sustainable Environment and Climate Change, Blue Economy: Aims to protect the environment and harness the potential of Africa's oceans and water resources

h. Engineering Education and Practice: Focuses on the development of skilled engineers to drive innovation and infrastructure development

The modern world has been largely an engineering project. The structures, machines, processes and organization which have led to increased affluence, life expectancy, comfort and enlightenment are all largely due to engineering efforts. To achieve the goals of Agenda 2063, Africa must look at the above aspiration largely as a huge engineering intervention.

In Kenya for instance, Vision 2030 aims to transform Kenya into a newly industrialized, middle income country, providing a high quality of life to all its citizens by the year 2030. This vision is very largely an engineering one.

Historically, as civilizations developed, people began reshaping their environment with farms, villages, ships, roads, and eventually great cities. With each advance came new challenges that required more complex and creative solutions. One early example of an activity that we now call engineering was the construction and improvement of the aqueduct system that transported water in and around Rome starting in the fourth century BC. A project of that scope today would be largely the responsibility of engineers.

The profession we know as engineering today emerged during the 1500's when specialists began using mathematics to design military fortifications. These special military architects would generally let craftsmen do the actual construction, thus becoming the first true engineers in the modern sense of the word.

Starting in the mid-nineteenth century, new processing methods - most notably for steel and petroleum - reshaped transportation, construction, and manufacturing. Scientist, inventors and entrepreneurs flourished and "game-changing" technologies appeared in several different industries.

Advances were made in all areas, including technologies that transformed everyday activities.

It was during the late 1800's when inventors began identifying with the engineering process and the engineering profession began to divide into special disciplines, such as civil, mechanical, and electrical engineering.

Initially, engineers were trained at military academies or through industry apprenticeship programmes. Since the mid 1800s more emphasis has been place on formal training that includes significant courses in mathematics and science. For example, the Massachusetts Institute of Technology opened in 1865 with 15 students.

The largest engineering project in the last century in Kenya was the Uganda Railway. The railway was built from 1896–1901 between Mombasa and Kisumu. It was built by engineers from Britain and artisans from India.

Local personnel to operate and maintain railway had to be trained, mainly, in Kenya. Institutions of training of artisans and technicians were, therefore, created.

In more recent times, engineering has been taught in Kenya from 1956. In 1956 the Royal Technical College of East Africa (RTCEA) was

established as the first institution of polytechnic status in East Africa. RTCEA was conceptualized as an institution to focus on offering education and training in engineering and commerce and supported by studies in the sciences and the arts.

RTCEA eventually would become the present University of Nairobi (UoN) having gone through the stages of the Royal college, Nairobi, as a college under the University of London in 1960, the University College, Nairobi, as a constituent college of University of East Africa, in 1963, and finally as the University of Nairobi in 1970.

As part of the University of East Africa, and even a few years thereafter as the University of Nairobi, UoN was the leading university for engineering education in East Africa. Kenya therefore has had a strong tradition in the education and training of engineers in the eastern African region, courtesy of the initial foundation of the University of Nairobi as a technical college.

Over the years, as a number of universities in Kenya increased, a number of Universities in the country also started offering programmes in engineering. The new universities were Moi University, followed by Egerton University, the Jomo Kenyatta University of Agriculture and Technology and Masinde Muliro University of Science and Technology.

Today various aspects of engineering are offered in at least 14 universities in Kenya. Most of the engineering programmes have adopted the engineering science model as inspired by the University of Nairobi. Another reason that has inspired this is the fact that the engineering professional body in Kenya, the Engineers Board of Kenya (EBK), traditionally has only accredited programmes that have followed in the engineering science model.

Engineers are helping feed and support an increasingly urban world population that could reach 10 billion by the year 2050. They are working to ensure that all people have access to clean, fresh water and adequate shelter.

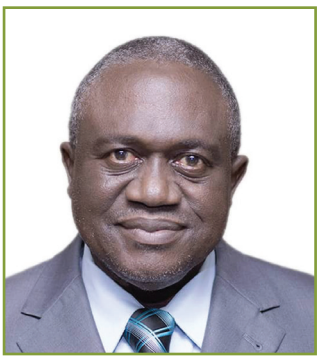
Engineers today are developing safe, efficient, and renewable forms of energy. They are helping to improve our health with more effective drugs and medical treatments. They are working to design new and more powerful ways of creating, storing, and using information.

Engineers are now and will continue to be critical to advancing technologies that will allow individuals to work, learn, and play in new and interesting ways. If Africa is to realise its Agenda 2063 goals, much more attention must be paid to engineering training and practice across the continent and to the overall role of engineers in the African society.

Engineering the future of Africa is pertinent to the Kenya Society of Environmental, Biological and Agricultural Engineers and to the Pan African Society of Agricultural Engineers.

As a society, we look forward to a vibrant engagement with all the various players from across the continent over the next three days. And on behalf of KeSEBAE, I say, KARIBUNI.

PASAE President Welcoming Message



Prof. Michael Faborode, FAEng, FNSE

President, Pan African Society For Agricultural Engineering (PASAE)

It is with great pleasure and excitement that I welcome you all to the 5th Pan African Society for Agricultural Engineering (PASAE), AfroAgEng International Conference, in collaboration with the Kenya Society of Environmental, Biological and Agricultural Engineers (KeSEBAE) – 2023 Nairobi, Kenya. We, as the PASAE endeavour to promote and advance the profession of Agricultural Engineering in Africa. As a Society, we continuously seek to become a key knowledge partner and visible policy advocate on the role of engineering and technology in the transformation and industrialization of agriculture in Africa towards Agenda 2063 and beyond – the Africa We Want.

The PASAE/KeSEBAE International Conference being held in Nairobi, Kenya will be the Society's 5th International Conference, following on from four successful previous Conferences, since the year 2018: 1st PASAE Conference in Nairobi, Kenya: Engineering and Technology for Agriculture transformation in Africa [2018]; 2nd PASAE/ANAFIDE Conference in Rabat, Morocco: Role of Agricultural Engineering in Meeting the Challenge of Global Food Security [2019]; 3rd PASAE/NIAE International Conference in Abuja, Nigeria: Engineering Africa's Agro-Industrial Transformation for Economic Prosperity and Sustainable Development [2021] and 4th PASAE International Conference = Kumasi, Ghana: Engineering Africa's Agriculture as Business for Sustainable Development with focus on Agenda 2063 [2022]. The previously held Conferences were a success and a constant reminder of the value and insurmountable potential that Agricultural Engineering has within Africa. Here we are again in Nairobi. This year's 5th PASAE Conference will be no different, as we envision a groundbreaking Conference geared towards the attainment of the Africa We Want.

The 5th PASAE Conference in Nairobi, Kenya will look to be in alignment with the objectives of the PASAE Report on Agricultural Engineering in Africa. The PASAE Report, published in 2021, focuses on Agricultural Engineering and highlights its crucial role in Africa as a key driver for transforming agriculture to deliver food and water security, sustainable agricultural production, and thus to support economic prosperity. The link to the report is as follows: **https://www.pasae.org.za/0_pdf/publications/Jeff/Final%20Agricultural%20Engineering%20in%20Africa%20PASAE%20Report%20(Hi-Res).pdf.** A must read for all interested delegates.

To the registered delegates, thank you for registering! We look forward to seeing and hosting you in Nairobi, Kenya from the 6th to the 8th of December 2023. If you have not yet registered to attend the upcoming Conference in Nairobi, Kenya, we urge you to do so with haste, as it will be a memorable and groundbreaking Conference, you will most certainly not regret it.

In concluding, we would like to give great thanks to the KeSEBAE Organizing Committee for their tireless efforts and dedication to organizing the upcoming Conference in Nairobi, Kenya. Their hard work will most definitely result in yet another successful PASAE International Conference.

Welcome to Nairobi!

KeSEBAE Honorary Secretary Message

Eng. Shiribwa Mwamzali

Honorary Secretary, Kenya Society of Environmental, Biological and Agricultural Engineers (KeSEBAE)

This is the second Pan Africa Society of Agricultural Engineer (PASAE) organized by Kenya Society of Environmental Biological and Agricultural Engineers (KESEBAE). The first such PASAE conference was held at the Southern Sand Hotel in 2018 Nairobi. It is great a honour for PASAE to think about coming back to Nairobi the City in the Sun.

KeSEBAE is a premier society of engineers, environmentalists, biologists and other professionals that have an interest in engineering and nature. This is the only engineering society in Kenya that recognizes the role played by other disciplines and invites them to join in the society to foster development.

The objects of the society are to promote the science and art of engineering in the environment, biology-based production and processing industries, management systems and agriculture: to encourage original research; to foster cooperation amongst relevant engineering practitioners; to advance the standards of engineering; to increase and extend the association of relevant engineers among themselves and with allied scientists and technologists; to encourage the professional improvement of its members and severally and in cooperation with other groups and to broaden the usefulness of relevant engineering.

The society has a total of 500 members distributed in the following classes; Fellow, Corporate Member, Graduate Member, Student Member and Corporate Firms:

The number of Biosystem and Agricultural engineers graduating from various universities in Kenya is large. Every year, not less than 150 students graduate from accredited Biosystems and Agricultural engineering degree courses in Kenya. This calls for more concerted efforts to recruit and retain them as members of KeSEBAE.

I wish to applaud PASAE for raising the visibility of KeSEBAE to new heights on the continental level with vibrancy and engagements. It is noteworthy that PASAE has engaged with Africa Union to ensure that engineers remain at the centre of Africa Agenda 2063. The goals of Africa Agenda 2063 are:

- A high standard of living, quality of life and well-being for all citizens
- Well educated citizens and skills revolution underpinned by science, technology and innovation.
- Healthy and well-nourished citizens
- Transformed economies

These goals can only be achieved if and when Biosystems and Agricultural engineers remain committed to be at the centre of continental development. This is the reason why the theme of this year's conference is Engineering Agenda 2063: The Africa We Want

The subthemes of the conference are

- Seamless connections (Roads, Railways, Air Transport and Water Transport
- Energy for Africa
- Industrialized Agriculture
- Housing
- Free Trade in Services
- Security
- Sustainable Environment
- Engineering Education and Practice

This conference brings together stakeholders from private and public sectors, academia,

industry, policy makers and development partners to discuss and explore how to make Africa the one we want. Planned engagements include dynamic panel discussions, paper presentations and exhibitions by companies and public institutions.

To pull through organizing a conference of such magnitude is no mean fete. It required a lot of planning and collaboration between PASAE Council and the Local Organizing Committee. I am indeed indebted to the PASAE Council, the Executive Committee of KeSEBAE that was converted to the Local Organising Committee-LOC for working tirelessly to make it possible for us to hold this conference. The LOC sourced, vetted and put all papers together in readiness for presentation. The conference would not have been possible if there were no paper writers and presenters. Neither would be flavour of the conference be palatable without discussants who put their time and energy to prepare for various slots.

We are greatly honoured to be associated with those firms that have made contributions in kind, thoughts and in cash. Receive our sincere appreciation for your exemplary contributions. May your vats never dry up and may they be open for others to partake from them. In a special way, I want to mention the Ministry of Agriculture through the State Department of Crop Development. The Ministry has been at the center of KeSEBAE activities for the entire 2023. CAMCO was the first company off the blocks in supporting the conference. When we approached CAMCO, they did not hesitate to come out first.

We made several courtesy call visits to a number of firms to sensitize them on this conference. We are indebted to the following for allowing us to share with them the preparations of the conference; the University of Nairobi, Kenya Commercial Bank, National Environmental Management Authority, Technical University of Kenya, Kenyatta University, Engineers Board of Kenya, CAMCO Equipment Kenya Ltd, United Nations Environmental Programme –UNEP, Rural Electrification and Renewable Energy Corporation, Kenya Industrial Research and Development Institute

The University of Nairobi -UoN which is the mother of all universities in Kenya did not disappoint its Department of Environmental Biosystems Engineering – EBE when the department approached it on this conference to collaborate with KeSEBAE. We are indeed grateful to the Vice Chancellor of the University of Nairobi for allowing the department of EBE to establish international networks for now and the future through KeSEBAE and PASAE.

On behalf of the Local Organising Committee, KeSEBAE Council and PASAE Council, we are delighted to welcome you to the 5th PASAE conference. For our International delegates, welcome to Nairobi the city in the sun and Kenya at large. For our visitors please sample and enjoy to the fullest the warm hospitality of the city. If you planned your visit well, you can visit the Nairobi national park. Nowhere in the world do you find a national park in the city like the one we have here in Nairobi.

Speech of the Dean, Fuculty of Engineering, University of Nairobi

Eng. Prof. Ayub N. Gitau

Dean, Faculty of Engineering,
University of Nairobi

It is with great pleasure that I invite you all to this landmark conference. We come together not merely as individuals, but as a collective force driven by a common purpose – the pursuit of knowledge, innovation and sustainable development.

Over the past years, Kenya has been a beacon of growth and resilience, demonstrating that the synergy between academic excellence, industry and innovative entrepreneurship is the key to unlocking a Nation's full potential. The PASAE international Conference serves as a platform to celebrate these achievements, exchange ideas, and chart a course for an even brighter future. In the days ahead, we will be privileged to be joined by esteemed speakers who are trailblazers in their respective fields. Their insights and experiences will undoubtedly inspire and guide us as we navigate the ever-evolving landscape of the Engineering field.

The Conference has become a hallmark event, providing a platform for the exchange of ideas, the showcase of cutting-edge research and the forging of collaborations that transcend boundaries. It is a testament to the dynamic spirit of the engineering community, both locally and globally.

As we delve into the diverse sessions and engage with thought leaders and experts, let us seize the opportunity to not only absorb knowledge but to actively participate, share our experiences and contribute to collective knowledge sharing.

This conference will not just be a gathering of minds; it is a crucible for ideas, a melting pot where diverse perspectives converge and new visions emerge. It is a testament to our shared commitment of fostering sustainable development, ensuring reliable and sustainable Energy sources for Africa, providing adequate and affordable infrastructure for all Africans, enhancing food security through the adoption of advanced Biosystem practices, focusing on the development of skilled engineers to drive innovation and infrastructure development among others.

As we embark on this intellectual journey, let us embrace the opportunity to connect, collaborate and catalyze change. The success of this conference lies not only in the knowledge we gain but also in the relationships we build and the impact we collectively create.

On behalf of The University of Nairobi, Faculty of Engineering and the Department of Environmental and Biosystems Engineering, we are more than honored to host the 5th PASAE international conference, 2023. The Faculty of Engineering is the premier engineering institution in Kenya and the region and it is known for excellence in Engineering. The Faculty has grown to a student enrolment of over 4000 undergraduates who pursue numerous Engineering programs accredited by the professional bodies in the five departments leading to the award of Bachelor of Science degrees in Biosystems Engineering, Civil Engineering, Electrical and Electronics Engineering, Mechanical Engineering, and Geospatial and Space Technology.

The Vision of the Faculty is to be a leading center for the development of knowledge in the Engineering discipline and to inspire through our activities and relationships, in order to raise the standards of life of the people of Kenya and

Africa as a whole by advancing the knowledge and practice of the engineering discipline and to foster the intellectual and economic vitality of the Kenyan people through teaching, research and outreach.

I extend my deepest gratitude to all the organizers, sponsors and participants who have worked tirelessly to make this event a reality. Your dedication is the driving force behind the success of the Conference.

In conclusion, let us seize this moment to celebrate the strides Kenya has made, to learn from each other and to inspire positive change. To our participants, I encourage you to actively engage in the sessions, share your insights and forge networks that extend beyond the confines of the conference. May this conference be a beacon of enlightenment, fostering collaboration, innovation and linkages.

Thank you and I wish you all a rewarding and enlightening experience!

Message from the Chairman, Department of Environmental and Biosystems Engineering, University of Nairobi

Dr JPO Obiero

Chairman, Department of Environmental and Biosystems Engineering

On behalf of the Department of Environmental and Biosystems Engineering, I am grateful to have had the privilege of hosting the 5th PASAE International Conference 2023 at the University of Nairobi, representing the Department of Environmental and Biosystems Engineering. This recognition highlights our department's significant role in addressing societal challenges through engineering solutions. Our department is actively involved in training engineers at both undergraduate and postgraduate levels, focusing on areas such as process and food engineering, soil and water conservation, power and machinery engineering design, and the application of artificial intelligence and machine learning in crop production. We appreciate the opportunity to showcase our contributions in these fields during the conference.

The department currently has an estimated undergraduate student population of 240. Additionally, there are approximately 40 students in the M.Sc program at various stages, from proposal to thesis submission. Furthermore, there are about 15 students in the PhD program at different stages, ranging from proposal development to thesis submission. Graduates from our department have found employment in various sectors, both locally and internationally. These sectors include private companies, parastatals, international organizations, consultancy firms, research institutions, and academia. Many of our graduates have pursued competitive postgraduate programs both locally and overseas, showcasing their scholarly abilities. Furthermore, a significant number of our graduates have been hired as academic staff in other universities, highlighting our department's role as a training ground for future academic staff.

The department has successfully established and continues to foster collaborations with various industry partners, as well as local and international organizations and institutions. Currently, the department is engaged in a fruitful collaboration with the University of Florence (UNIFI) in Italy, University of Massachusetts Amherst, USA, and Cukurova University, Turkey, among others. Through these collaborations, both staff and students have greatly benefited from joint research projects and valuable student and staff exchange programs. Moreover, the department has also actively participated in joint activities with esteemed organizations such as the Agricultural Society of Kenya and the Volkswagen Foundation, further enhancing its local engagement. These collaborations serve as a testament to the department's commitment to fostering meaningful partnerships and promoting knowledge exchange on a global scale.

We are delighted to announce our association with the PASAE conference once again. As a department, we prioritize innovation and collaboration with industry, and conferences like this provide the perfect platform for knowledge sharing and establishing common interests. By bringing together experts from both research and industry, we aim to strengthen future collaborations and foster a culture of growth and development. We encourage all participants to actively engage in discussions and make the most of this opportunity to expand their networks and deepen their understanding of the field.

We wish you all a successful 2023 PASAE conference.

CONCEPT NOTE

The annual international conference for 2023, organized by the Kenya Society of Environmental, Biological and Agricultural Engineers (KeSEBAE) in collaboration with the Pan African Society for Agricultural Engineering (PASAE), is set to take place from Wednesday 6th to Friday 8th December 2023. The conference will revolve around the theme of "Engineering Agenda 2063: The Africa We Want."

Engineering Agenda 2063

Our 5th PASAE International Conference 2023 was adopted from the African Union's 50th Anniversary Solemn Declaration in May 2013. This declaration reaffirmed Africa's commitment to achieving an integrated, prosperous and peaceful continent driven by its own citizens. The Agenda 2063 outlines the continent's plan to realize this vision over a 50-year period from The Agenda 2063 is envisioned through structural transformations; increased peace and reduction in the number of conflicts; renewed economic growth and social progress; the need for people centered development, gender equality and youth empowerment; changing global contexts such as increased globalization and the ICT revolution; the increased unity of Africa which makes it a global power to be reckoned with and capable of rallying support around its own common agenda; and emerging development and investment opportunities in areas such as agri-business, infrastructure development, health and education as well as the value addition in African commodities.

The Agenda 2063 Has the Following Aspirations

- A Prosperous Africa, based on Inclusive Growth and Sustainable Development.
- An Integrated Continent Politically united and based on the ideals of Pan Africanism and the vision of African Renaissance.
- An Africa of Good Governance, Democracy, Respect for Human Rights, Justice and the Rule of Law.
- A Peaceful and Secure Africa.
- Africa with a Strong Cultural Identity Common Heritage, Values and Ethics.
- An Africa Whose Development is people driven, relying on the potential offered by African People, especially its Women and Youth, and caring for Children.
- An Africa as A Strong, United, Resilient and Influential Global Player and Partner.

Sub Themes

Seamless Connections:

This encompasses the development of roads, railways, air transport, water transport, and ICT infrastructure.

Housing:

Emphasizes the importance of providing adequate and affordable housing for all Africans.

Energy for Africa:

It focuses on the need to ensure reliable and sustainable energy sources across the continent.

Free Trade in Services:

Focuses on promoting economic growth by facilitating the exchange of services across borders

Industrialized Agriculture:

It aims to enhance food security through the adoption of advanced agricultural practices.

Security:

Seeks to create a safe and stable environment for African nations

Sustainable Environment and Climate Change, Blue Economy:

Aims to protect the environment and harness the potential of Africa's oceans and water resources.

Engineering Education and Practice:

Focuses on the development of skilled engineers to drive innovation and infrastructure development.

PROGRAMME

DAY 1: Wednesday, 6 December 2023

Time	Presentation	Presenter	Moderator 1	Moderator 2
08:00 hrs	Arrival and Registration		Secretariat	
08: 30 hrs	Welcome Remarks and Climate setting		**Eng. Shiribwa Mwamzali**	
09:00 hrs	Opening Ceremony	1. **Chief Guest: Hon. Musalia Mudavadi**, E.G. H, Prime Cabinet Secretary 2. **Dr. Paul Ronoh**, Principal Secretary, State Department of Crop Development, Ministry of Agriculture and Livestock Development **Vice Chancellors:** i. **Prof. Stephen Gitahi Kiama**, University of Nairobi ii. **Prof. Paul Wainaina**, Kenyatta University iii. **Eng. Prof. Douglas Shitanda**, South Eastern Kenya University iv. **Prof. Dr.-Ing. Benedict M. Mutua**, Technical University of Kenya 3. **Eng. Erastus Mwongera**, Chairperson, Engineers Board of Kenya 4. **Erick Ohaga**, President, Institution of Engineers in Kenya 5. **H.E Ms. Jean Njeri Kamau**, Permanent Representative of Kenya to African Union 6. **Prof. Michael O. Faborode**, President, PASAE	**Eng. Shiribwa Mwamzali**	**Prof. Jeff Smithers**
10:30 hrs	**Health Break**		**Secretariat**	
		Keynote Presentations		
11:00 hrs	**1. Dr. Pascal Sanginga:** AFDB's Agenda for Feeding Africa through the Development of Special Agro-Industrial Processing Zones (SAPZ)		**Eng. Richard Kanui/ Eng. Claudia Bess**	**Eng. Prof. Duncan Mbuge**
	2. PASAE: PASAE's Road Map for Knowledge Based-Transformation of Agricultural Mechanization Using Emerging Technologies			
	3. UNEP: UNEP's Agenda for Preserving the African Environment and Water Resources while Intensifying Agricultural Productivity for a Prosperous Hunger-Free Continent			
	4. National Irrigation Authority: Status of Irrigation Development in Kenya			
	5. Prof. Margaret Gitau, ASABE: Alliance for Modernising African Agrifood Systems			
13:00 hrs	**Lunch Break**		**Secretariat**	

Time	Presentation	Moderator 1	Moderator 2	Presentation	Moderator 1	Moderator 2
Technical Session 1				**Technical Session 2**		
14:00 hrs	1. **Adebayo, S. E:** Effect of Machine Parameters on Physical and Sensory Properties (Desirability) of Coated Peanut Snacks	**Eng. Prof. Ayub Gitau**	**Eng. Kennedy Makudiuh**	1. **Dr. Patrick Ajwang**: Towards the Development of Design and Construction Standards for Climate Smart Horticultural Greenhouses in Kenya.	**Eng. Dr. Jedidah Maina**	**Eng. Amos Kiptanui**
	2. **Emmanuel Mugwaneza, Daudi M. Nyaangai, Nobert Wanjala Wafula:** Performance Evaluation of Experimental Solar Evaporative Cooling Systems			2. **Vitalis Kibiwot Ngelechei, Daudi M. Nyaanga, and Musa Njue**: Modelling of Engine Performance for Optimal Operation _ Case of Biodiesel Blends		
	3. **Samuel M. Nyaanga, Peter A. Kabok, Macben Makenzi:** Design, Installation and Evaluation of Solar Irrigation Projects in the Kenyan Lake Victoria Basin			3. **Ibrahim Abayomi**: Modelling of Phosphorus Loss from Sediment Yield Using the Soil and Water Assessment Tool Model a Case Study of Chanchaga Watershed Nigeria		
	4. **Tilahun Workneh**: Potential Evaporative Coolers for Shelf-Life Extension of Fresh Fruits and Vegetables in Sub-Saharn Hot and Semi-Arid Regions Supply Chain			4. **Dauda, Kola Abdulkadir**: Creation of Micro-Catchment System with Contour Bunds to Enhance Citrus Cultivation		
15:30 hrs	**PASAE Council Meeting**	**PASAE Secretariat**				
	5. **Adeoye Peter:** Assessment of Water Use and Yield of Okra (Abelmoschus esculentus) Using Manual, Semi- Automated and Automated Irrigation			5. **Prof. Bancy M. Mati:** Association of Irrigation Acceleration Platform (AIAP) and its contribution to taking irrigation to the next level in Kenya		**Moderator 2**

Time	Presentation	Moderator 1	Moderator 2	Presentation	Moderator 1	Moderator 2
	6. **Adebayo, S. E:** Prediction of Quality Parameters and Classification of Pear Fruit Maturity stages using backscattering imaging and artificial neural network			6. **Priscilla Bygrace Sesani Romulus Okoth Okwanya, Samwel Nyakacha**: Wastewater Reuse Under Drip Irrigation System Towards **Sustainable** Use of Treated Wastewater in Irrigation for Peri-Urban Agriculture		
	7. **Khuthadzo Mugodo:** A Review of the Literature on the Trends in Sweet Potato Drying and the Application of Pre-Drying Treatments			7. **Hellen Nafuna Ngema:** Assessment of Rainfall Impact on Groundwater Vulnerability		
16:00 hrs	**Health Break**	**Moderator 1**	**Moderator 2**		**Moderator 1**	
16:30 hrs	8. **Emmanuel Bobobee**: Drudgery evaluation in agriculture – empirical evidence from Ghana and South Africa	**Prof. Michael Okoth**	**Catherine Ndumia**	8. **Eng. Claudia Bess:** Production of an organic controlled-release fertilizer from cassava leaves and peels	**Dr. J. P. Obiero**	**Eng. Prof. Duncan Mbuge**
	9. **Animashaun, I. M**: Development of a Low-Cost Drip Irrigation System for Low-Income Farmers			9. **Abimaje Veronica Thomas and Zinash Delebo Osunde:** Effect of Blanching and Drying Temperatures on Some Proximate Qualities of Cherry Tomato (Lycopersicon esculentum)		

Time	Presentation	Moderator 1	Moderator 2	Presentation	Moderator 1	Moderator 2
	10. **Everlyne Serro**: Senior Manager Sustainability Safaricom Ltd: The communication network and its link to development:			10. **Hellen Nafuna Ngema:** Farmlevel Carbon Sequencing from Biochar to Manage Sugrcane Waste by Small Holder Farmers		
	11. **Aliyu Mohammed**: Solid Biofuel Production by Hydrothermal Carbonization of Wood Shavings Effect of Carbonization Temperature and Biomass-to-Water Ratio on Hydrochars Properties					
	12. **J.S Ali, H. L. Rutto, T. Seodigeng, S. L. Kiambi, C. M. Maende**: Alkali-impregnated Blast Furnace Slag Heterogeneous Catalyst for Biodiesel Production			11. **Dr. Erion Bwambale**: Modelling and Simulation of Smart Irrigation Systems for Improved Water Use Efficiency		
	13. **Abodenyi Victoria Ada**: Environmental Conservation Against Climate Change Catastrophe: A Review			12. **Eng. Dr. Daniel Atambo:** Factors Influencing Watermain Break Rates		
18:00 hrs	Adjournment			Secretariat		
18:30 hrs	Sponsored Cocktail			Secretariat		

DAY 2: Thursday 7, December 2023

Time	Presentation	Moderator1	Moderator2
08:30 hrs	Sponsors	**Secretariat**	
09:00 hrs	1. **Students Voices** (ESA, EBESA, KUBEC, SABEE)	**Eng. Prof. Cleophas Maende**	**Prof. Daudi Nyaanga**
	2. **Eng. Richard Kanui**: Agricultural Mechanization		
	3. **Eng. Prof. David Some:** Education and Practice		
	4. **Eng. Prof. Ayub Gitau:** Engineering Education		
	5. **Eng. Prof. Moses Marenya –** Accreditation of Engineering Courses		
10:30 hrs	**Health Break**	**Secretariat**	

Time	Presentation	Moderator1	Moderator2	Presentation	Moderator 1	Moderator 2
11:00 hrs	1. **Eng. Claudia Bess:** Upcycling of high-density polyethylene plastics through the production of eco-friendly paver blocks	**Eng. Prof. Japheth Onyando**	**Eng.Prof. James Raude Messo**	1. **Basil C. Nkenke**: Response of Some Soil Physical Properties to Different Tillage Methods in Obubra, Cross River State – Nigeria	**Prof. Emanuel Bobobee**	**Eng. Claudia Bess**
	2. **Akpan, M. Ga; Alonge, A. Fa; & Jerome, I. Ta**: Effects of Temperature and Solid-liquid-ratio on the extraction of total phenolic content of Hibiscus sabdariffa leaves			2. **Akanga, Anietie Effiong:** A Review of the Performances of Some Existing Manually Operated and Tractor Drawn Seed Planters		
	3. **Adeoye, Peter Aderemi:** Determination of Crop Coefficients for Garden egg (Solanum melongena) Using Non- weighing Lysimeter in Minna, Niger State, Nigeria			3. **3. Pearl Nutifafa Yakanu:** Mechanising Tiger nut harvesting in Ghana		
12:30 hrs	Closing Ceremony and Field Excursions Logistics				**Eng. Prof. Lawrence Gumbe**	**Eng. Prof. Ayub Gitau**
13:00 hrs	**Lunch Break**			**Secretariat**		
	KeSEBAE Annual General Meeting			PASAE General Assembly Meeting		
14:00 hrs	Adjournment			Secretariat		

DAY 3: Friday 8, December 2023

Time	Activity	Moderator
07:00 hrs	Field Excursion	Secretariat
18: 00 hrs	**Departure**	**Secretariat**

PAPERS

Effect of Machine Parameters on Physical and Sensory Properties (Desirability) of Coated Peanut Snacks

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Abstract

Peanut coating is an important step in peanut burger production. Understanding the dynamic process of coating can better set up coating parameters and improve coating. In order to improve poor coating quality and high breakage rate of peanut seeds caused by unreasonable machine parameters of coating equipment. The combined effect of machine speed and the angle of tilt of coating pan was studied. From the result obtained, it was observed that the desirability of the coating increases with increase in speed from 25 to 31 rpm and then start to decrease when the speed was further increased from 32 to 45 rpm. However, the desirability remains constant as the tilt angle was increased from 25 to 30o and start to increase with further increase in tilt angle from 30 to 35o. The highest desirability of 93.2% was obtained when the speed was 30.76 rpm and the tilt angle is 35.00°. It was discovered that machine parameters affect the desirability of peanut burger snacks by the consuming consumers.

Keywords: Coating, Quality, Peanut, Machine Speed, Tilt Angle.

Determination of Crop Coefficients for Garden egg (Solanum melongena) Using Non - weighing Lysimeter in Minna, Niger State, Nigeria

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Abstract

The paper concentrated on the development and performance evaluation of non-weighing lysimeter for garden egg in Minna, Niger State. A mini non-weighing lysimeter was designed, constructed and was used for crop water requirement and crop coefficient determination. Result obtained showed that the number of fruits per plant is 6 in mid-stage and 25 in late stage. Weight of fruits per plant is 8.12 gm, and the total yield of lysimeter area is 91.7g/0.18cm2 which translated into 9.17kg/m2. Water Use Efficiency (WUE) was determined as 28.4kg/m3. More so, a total actual plant evapotranspiration of 194.58 mm was established. Crop factors of 0.44, 1.58 and 0.51 were also obtained at the beginning, middle and late growing stages respectively. However, the average daily water use obtained compared very closely with potential crop water use estimated based on weather-crop coefficient data, which implies that the mini-lysimeters setup for the study were quite effective. This technique grants easy opportunity to estimate crop water use and other components of the soil water balance under rainfall condition. The computed crop coefficient can be used to estimate the gross water requirement of the various stages of the crop if it were to be cultivated in another agro-climatic environment.

Keywords: Crop Water Requirement, Crop Factor, Garden Egg, Mini Lysimeter and Water Use Efficiency

Towards the Development of Design and Construction Standards for Climate-Smart Horticultural Greenhouses in Kenya

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Abstract

Standardization is the process of developing broadly acceptable guidelines (by consensus) that stipulate or recommend minimum levels of performance and quality of goods and services and optional conditions for operations in a given environment. Standards may be distinguished according to their subject matter, purpose and range of applications. Standards help in developing clear specifications, reduce uncertainty, achieve reliability and reduce costs. They also help to reduce time and money spent on design and production, and promote international trade. In Kenya, the expanding horticultural greenhouse industry has many suppliers and contractors who erect greenhouses of different design, shape and climate control systems. Sometimes farmers have complained about the cost, structural and environmental performance of their greenhouses. The dimensions and strength of materials used also vary from supplier to supplier. And whereas there is an urgent need to develop climate smart greenhouses in Kenya, the standards for such constructions have hardly been elucidated in Kenya. The design of greenhouses is based on a number of design factors, including the geotechnical conditions, climatic factors and the crop to be grown. The changing climatic conditions call for new standards for the development of horticultural greenhouses. This paper will present a review of the materials plus existing design and construction standards used in the Kenyan greenhouse industry today. Recommendations for modifications to cater for changing climatic conditions will be suggested.

Keywords: Greenhouses, Standardization, Climate-smart Horticulture

Modelling of phosphorus loss from sediment yield using the soil and water assessment tool (SWAT) model: a case study of Chanchaga Watershed, Nigeria

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Abstract

The behaviour of phosphorus (P) losses from nonpoint sources into surface water through sediment yield under different agricultural practices has yet to be estimated in the Chanchaga watershed. The research estimates the effect of the Ridge Across the Slope (RAcS) and Ridge Along the Slope (RAIS) on phosphorus loss from sediment yield (P loss) using the Soil and Water Assessment Tool (SWAT model). The study used a mixed factorial design, with four treatments (groundnut, cowpea, soybean, and no crop) and replicated these crops and no crop (control) three times on the ridge across and along the slope. Phosphorus data were collected on the farmland for two years (2018-2019). Three slope gradients and two soil textural classes were integrated into the SWAT model to capture the terrains. Phosphorus concentrations from the farmland were calibrated and validated using SUFI2 for one year each. The output of the models was evaluated using Nash-Sutcliffe efficiency (NSE), coefficient of determination (R2) and percent bias (PBIAS). The results revealed Nash—Sutcliffe

efficiencies (NSE) values of 0.72 and 0.77 for the RAcS during the calibration and validation phases. The coefficients of determination (R2) were calculated as 0.73 and 0.78, respectively, in Shatta. Correspondingly, the NSE and R2 values for RAcS were determined to be 0.49 and 0.66, 0.50 and 0.67, respectively. These findings indicate satisfactory model performance (NSE >0.5 and PBIAS ± 25%) for the RAcS. In the Koropa subbasins, NSE values of 0.72 and 0.46 were achieved for RAcS during the calibration and validation stages. Conversely, the NSE values for RAIS were notably lower at 0.32 and 0.03. This finding implies that the models for RAIS were inappropriate, while the model's performance for RAcS was satisfactory. RAcS demonstrates effective mitigation of phosphorus (P) loss in sediment yield at two stations, reducing eutrophication. However, the concentration of P loss in RAIS remains high, implying that excessive phosphorus can contribute to excessive algae growth, leading to a decline in water quality and hindered fish growth. Cowpea and groundnut planting along the slope are recommended to reduce P loss.

Potential Evaporative Coolers for Shelf-Life Extension of Fresh Fruits and Vegetables in Sub-Saharn Hot and Semi-Arid Regions Supply Chain

Tilahun Seyoum Workneh

Abstract

Fruit and vegetables are a significant crop grown and eaten all over Africa and the world, providing a wide range of nutrients and health advantages. However, post-harvest losses render production unprofitable in rural and semi-urban areas in sub-Saharan Africa, making quality and shelf life a constant challenge. This article discusses the current state of cost-effective affordable refrigeration technologies for preserving fresh produce quality and minimising waste. Fruits and vegetables can be kept fresh and improved through cooling technologies. Different evaporative cooling technologies such as naturally ventilated, single wet pad forced ventilation, multiple wet pad and forced ventilation evaporative coolers are discussed in the current study. Evaporative cooling preserves the quality of fruits and vegetables like carrots, tomatoes, mangoes, menderin, orange, banana, cabbage and green pepper for significant periods of time during storage. It has also been found that the designs of these coolers can be scaled up or down based on the capacity of farmers, retailers or wholesallers in the supply chain.

Assessment of Water Use and Yield of Okra (Abelmoschus esculentus) Using Manual, Semi- Automated and Automated Irrigation.

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Abstract

The conservation of water is crucial to sustainable agricultural production during dry season when there is little or no rainfall to improve crop production. Thus, this study is aimed at evaluating the effects of different methods of water applications through drip irrigation on the growth, yield, and water use efficiency of okra during dry season. A field experiment was therefore conducted in Minna using bucket method of propagation randomly with three replications. One was subject to manual irrigation through watering can, the second one was irrigated through drip irrigation method calibrated to irrigate at certain interval while the third plot was irrigated through drip irrigation calibrated using soil moisture contents and other soil moisture parameters. The yield and crop parameter of okra

was calculated during growth and fruiting periods of the okra. Results revealed that automated drip irrigation recorded higher growth parameters of 2.5cm of stem girth,7.5 cm of plant height 1.5 cm leaf area index and 33 leaf number over semi-automated irrigation and manual irrigation plots. Yield parameters also showed that plot subjected to automated irrigation performed better with a total yield of 1.09 kg/m2 and 10.9 kg/ha over other plots. The highest irrigation water use (IWU) of 3.24 kg/m3 was recorded while semi-automated and manual irrigation recorded IWU of 3.02kg/m3 and 2.74 kg/m3 respectively.

Keywords: Irrigation, Water Use Efficiency and Okra Yield

Prediction of Quality Parameters and Classification of Pear Fruit Maturity stages using Backscattering Imaging and Artificial Neural Network

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Abstract

Historically quantification of fruit qualities and classification depend on various destructive techniques that require the removal of a little quantity of fruit tissue for the measurement of SSC, total acidity, and others. These techniques resulted in a large amount of postharvest losses and inability to measure the whole batch as few samples from the batches are used for the measurement. The application of backscattering imaging as non-destructive technique for evaluation of fruit quality parameters has been evolving. In this study, backscattering images of pear fruit were obtained using five laser diode at visible and near infrared wavelengths. Region of interest were extracted from the backscattering images obtained and these were used to classify pear fruit into different days after full bloom (dafb). Classification and prediction models were built using artificial neural networks (ANN). Correlation coefficient (r), root mean square error of cross-validation (RMSECV), root mean square error of calibration (RMSEC) were employed to test the performance of the prediction models while sensitivity and specificity were used to evaluate the classification models. The results shown that the SSC of pear increase as the fruits matures. SSC gave a range of 9.2 to 17.2 %brix while 85.5 to 264.2 N/cm2 was the range of firmness obtained during the period of monitoring pear maturity. ANN classifiers recorded highest classification accuracy of 90.42% when four wavelengths 532, 660, 785 and 830 nm combined. The study revealed that backscattering imaging with computational methods can be employed to predict fruit quality index and mapping into different maturity stages.

Keywords: Imaging, Fruit Quality, Region of Interest, Laser Diodes.

Development of a Low-Cost Drip Irrigation System for Low-Income Farmers

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Abstract

Recently, the use drip irrigation system is becoming more popular among many commercial farmers in Nigeria and the West Africa at large due to the reduced level of the available fresh water occasioned by climate change. However, the drip irrigation system is associated with high initial and maintenance

cost, a limiting factor to low-income farmers. To this end, this project was aimed at developing low-cost drip irrigation system. To achieve this, soil sample of the area to be irrigated was collected and assessed for moisture content, bulk density, porosity, and infiltration rate. Thereafter, the system was designed and constructed to have high efficiency at low cost. The design was site-specific and consideration was given to the emitter spacing, emitter flow rates, dripline diameter and wall thickness. The construction was done exclusively from cheap and locally available materials (such as T – Joint, Control Valve, PVC Pipe (1/2, 3/4 inches), Hose Pipe, PVC gum, Elbow connector, Union connector, T – Connector, Nail, Sieve, 25 litres Jerry can), integrating the medical infusion set as emitter. The result shows that the moisture content, bulk density, porosity and infiltration rate were 12.5%, 1.23g/cm3, 46.1% and 60.06% respectively. The maximum to minimum emitter discharges were also noted to be 73.31cl/hr, 72.13 cl/hr, 71.89 cl/hr, 71.63 cl/hr and 70.42 cl/hr for laterals 2,1,3,6 and 5 respectively. More so, using sugarcane with irrigation frequency of 5 day and time required of an hour as a case study, the net and gross irrigation requirements of 43.04 mm, 42.55 mm were obtained respectively. It can be concluded that construction of drip irrigation system of high efficiency and low cost was achieved. Since, the main factor that affect the crop type to irrigate is the maximum duration of operation, it is recommended that the performance of the system be tested with several crops.

A Review of The Literature on the Trends in Sweet Potato Drying and the Application of Pre-Drying Treatments

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Abstract

Conventional sweet potato (SP) drying methods, including convective hot-air drying, have been found to be relatively slow, energy-intensive and detrimental to the quality of perishable commodities, such as SP. Regardless, they continue to be the most prevalent methods for drying SP, as drying remains an essential stage in SP processing for the production of shelf-stable flours. Consequently, there has been a growing trend in the use of pre-drying treatments and hybrid drying techniques in order to enhance the drying rate and maintain the quality. These include novel physical pre-treatments, such as ultrasound and hybrid drying techniques, such as hot-air combined with infrared and microwave drying. Research studies have found that the drying rate of combined/hybrid methods can be twice as fast as that achieved by conventional techniques. Additionally, specific energy consumption can also be reduced by up to 86%. Combining infrared and freeze drying, for instance, has been found to reduce the drying time by up to 47%. It has been discovered that pre-drying treatments increases the drying rate of SP. Therefore, the purpose of the present study is to provide a review of the literature on the detection of global trends in the use of chemical, physical and thermal pre-drying treatments, as well as novel techniques, such as carbon maceration. In addition, the recent developments in SP drying techniques and the variables that affect the drying process. The findings of this review will provide a clear understanding of the various drying techniques used for SP and will be beneficial in setting the drying conditions (e.g. temperature) and choosing of pre-drying treatment, cultivar and the appropriate slice thickness.

Keywords: Sweet Potato, Drying Techniques, Pre-Drying Treatments, Quality

Drudgery evaluation in agriculture – empirical evidence from Ghana and South Africa

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Abstract

Agriculture is a grueling task full of drudgery and the low level of engineering technology inputs into African agriculture is a major constraint hindering the agricultural and food production sector in many parts of the continent. A major challenge to all year-round crop production for food security, industry and export in Africa is the time consuming, labour intensive and expensive manual methods adopted by farmers. This paper discusses the calibration of the drudgery in doing several agricultural tasks by smallholder farmers using manual tools and compared with mechanised tractor operations. The heart rate is used as proxy for drudgery. The heavier and more stressful the physical activity, the higher the heartbeat and this translates into longer periods to rest to recuperate. A Polar heart rate sensor and monitor has been used to capture and store heart rates of farmers and tractor operators doing several activities with particular emphasis on root and tuber harvesting. The work heart rate for any physical activity correlates strongly with the ease of doing such activity, with shorter rest periods for easy tasks, compared with longer rest periods for more strenuous and difficult activities. The longer the rest period the shorter the useful and productive time the worker can stay on the job, thus directly reflecting on his efficiency and productivity. The solution recommended is the adoption of appropriate mechanisation to reduce drudgery and increase production.

Keywords: Smallholder Agriculture, Drudgery, Rest Periods, Mechanisation

Effect of Blanching and Drying Temperatures on Some Proximate Qualities of Cherry Tomato (Lycopersicon esculentum)

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Abstract

A research on the Effect of Blanching and oven drying temperatures on some proximate qualities of blanched and oven dried cherry tomato in Nigeria was undertaken as a means of assessing it potential for storage. Presently, farmers adopt open sun drying before preservation which results to the production of low-quality product due to uncontrolled temperature and drying conditions arising from weather changes. In addition, the hygiene of the final dried product is affected due to contaminations from the open air which often times carries dust and other particles, hence leading to low acceptability by consumers. 10800g of fresh tomato fruits was obtained and cleaned. They were divided into six portions weighing 2400g, 2400g, 2400g, 2400g, for the main experiment while 600g each were used as two controls (fresh and sundry). A split plot experimental design with two independent variables: blanching and drying temperatures at four levels each was used in the study. The four levels of blanching temperatures and oven-drying temperatures were 550C, 650C, 750C and 850C each. The proximate qualities: moisture content, protein content, crude fibre content and carbohydrate were analysed. Results indicates that all the proximate qualities except moisture content increased after blanching and oven drying compared with fresh and sundried samples as the highest protein content of 18.92% at 750C and 850C blanching and drying temperatures respectively, crude fibre content of 21.06% at 750C blanching temperature and 850C drying temperature and carbohydrate contents of

70.31% at blanching and drying temperatures of 550C and 550C respectively were obtained. The fresh and sundried samples had 13.58% and 1.2% respectively for protein, 8.92% and 0.84% respectively for crude fibre and 68.24% and 5.61% respectively for carbohydrate. These results indicate that blanching and drying treatment improves proximate qualities of cherry tomato which can be stored for further studies.

Keywords: Blanching, Drying, Proximate, Temperature

Assessment of Rainfall Impact on Groundwater Vulnerability

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Abstract

The research study was conducted in Northern Lake Victoria basin to assess rainfall impact on groundwater as a fresh water source on 30 farms. Depth Aquifer Recharge and Transmissivity (DART) index quantitative method was applied that revealed that rainfall was directly related to groundwater vulnerability index. Positive DART index was realized during long rainfall season between April and June; and during short rainfall season in September and October. The other months had negative values during dry season. DART indices ranged between -8.40 and 2.50 with positive values with positive values representing more resilience to negative impact of erratic rainfall. There were two groundwater vulnerability Index Thresholds of -8.40 and -4.80 that marked onset of long and short rainfall seasons respectively. Mann-Kendall trend analysis and t-test performed indicated a downward trend and a significant difference of groundwater vulnerability index values because of seasonal rainfall changes that caused wells to dry up thus increasing water insecurity. The research study results confirmed the severity of rainfall patterns on groundwater recharge.

Keywords: Climate Change, Groundwater Vulnerability Index, Groundwater Thresholds, Rainfall, Northern Lake Victoria Basin

Farmlevel Carbon Sequencing from Biochar to Manage Sugarcane Waste by Small Holder Farmers

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Abstract

Biochar is a type of charcoal that is produced through pyrolysis process. Biochar has a highly porous structure with a large surface area of great capacity to enhance carbon sequestration, minimize soil erosion, promote beneficial microbial activity, increase nutrient retention, puffer soil PH, improve soil structure as well as reduce amount of inorganic fertilizers applied. But these enormous benefits of biochar application remain absent among smallholder sugarcane farmers. The research study was conducted in Nzoia Sugar out grower's region with main objective of establishing most effective biochar making technology from sugarcane waste in 2023. The study revealed that the soil carbon was 0.74% less than the required amount of 5% and 8% adequate for crop production. The highest amount of biochar produced was 40% for sugarcane tops. The best ratio of mixing biochar with manure before application was 1:3 that will assist farmers to reduce over reliance on chemical fertilizers that are costly and affect soil PH when used continuously. Use of biochar is a sure way of managing the menace of sugarcane waste that pollute environment through open burning by smallholder farmers.

Keywords: Biochar, Carbon Sequencing, Climate Change Adaptation, Soil Health, Soil Carbon, Carbon Credit.

Response of Some Soil Physical Properties to Different Tillage Methods in Obubra, Cross River State –Nigeria

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Abstract

Some of the benefits of tillage are to improve the status of soil properties, soften the hard pans to increase infiltration and thus reduce the effects of climate change. A research was undertaken to determine the effects of tillage on soil properties in Obubra area of Cross River state of Nigeria. Four tillage methods were adopted for the fieldwork. These tillage methods are ploughing only, harrowing only, ploughing plus harrowing and zero tillage. Soil properties evaluated were bulk density, porosity, penetration resistance and infiltration rate. The field was laid out in a Randomized Complete Block Design (RCBD) replicated four times. The bulk density was determined using gravimetric method. Porosity was calculated from the bulk density values. Penetration resistance was measured using a direct pocket penetrometer pressed to soil depth of 60 cm and recorded at 5 cm interval. Infiltration rate was determined by the use of double ring infiltrometer. Results showed that Plough + Harrow produced the lowest bulk density in the three planting seasons and No-till produced the highest bulk density. Plough + Harrow produced the highest porosity in all the planting seasons and No-till produced the lowest porosity in all the planting season. No-till produced the highest penetration resistance in all the planting season, while Plough + Harrow produced the lowest penetration resistance in all the planting season. Plough + Harrow produced the highest infiltration rate in all the planting season. No-till produced virtually the lowest infiltration rate in all the planting season.

Keywords: Soil, Physical Properties, Tillage

Design, Installation and Evaluation of Solar Irrigation Projects in the Kenyan Lake Victoria Basin

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Abstract

The paper presents an overview of efforts being made to transit to green energy in the Promotion of Climate Smart Agriculture through use of solar to power Irrigation Projects in the Kenyan Lake Basin Region. The design, installation, commissioning and initial performance of the Muhoroni I.T.T. C. Solar Irrigation Project, Kisumu County is presented. The sizing of the solar panels and associated inverters

(to supply the required water including storage) was based on the months of lowest irradiance (June). The first season crop (kales) was grown in 2022 July and harvested in September 2022. The solar pumping, irrigation uniformity/effect was evaluated and gauged against non-irrigated neighbouring fields/farms. It was concluded that there is enough energy to deliver sufficient water to enhance crop productivity in the region. Similar projects were recommended and initiated for other sites including A Lupe in Busia and Lichota in Migori County.

Key Words: Solar energy, Water pumping, Irrigation, Crop productivity

Creation of Micro-Catchment System with Contour Bunds to Enhance Citrus Cultivation

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Abstract

Semi-Circular bund micro-catchment system is a directly productive form of soil and water conservation which focused on harvesting and conserving rainwater for improved crop productivity. This system has been designed, constructed and runoff coefficient for the study area was evaluated from the field measurements of rainfall and runoff. The results shown that the computed average crop water requirement of Citrus is 3.63mm/day and on average, an annual rainfall of 1162mm or higher can be expected at 50% probability of occurrence and at average frequency of occurrence of 3 years interval. Physical analysis shows that the soil in the study area is sandy loam. The chemical analysis results also revealed that the salinity, infiltration rate, toxicity and fertility level of the soil in the study area are satisfactory and suitable for citrus production. The mean run-off coefficient for the catchment area throughout the period of observation is 0.54. Collecting rainwater for agricultural purpose and soil/water conservation has been adopted in numerous projects in Africa and is considered as "state of the art" approaches. Therefore, there is no doubt that implementation of this technique will expand in Nigeria and the world at large very soon.

Environmental Conservation Against Climate Change Catastrophe: A Review

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Abstract

Environmental conservation from climate change catastrophe include measures that can be taken to curtail the effects of climate change on the environment. This paper has reviewed the damaging effects of climate change on the environment, which one of the striking effect is seen in global agriculture with nosedive decline in crop production because of high temperature rise. The incessant rise in global heatwaves also indicate the negative impact of climate change catastrophe. The paper also discussed why the environment should be conserved; showed measures to reducing the effect of climate change on the environment and this can be done by protecting vital natural resources by way

of living and responsible practices of organizations.

Keywords: Climate change, Environment, Global change, Conservation, Heatwaves

Modelling and Simulation of Smart Irrigation Systems for Improved Water Use Efficiency

Erion Bwambale

Abstract

Water scarcity at a global level continues to escalate, posing a challenge to achieving sustainable agricultural production. The need to feed an ever-growing population has necessitated the adoption of innovative irrigation strategies, such as drip irrigation. However, conventional irrigation methods often fail to adapt to the real-time spatial and temporal dynamics of soil, plant, and weather environment, leading to either over-irrigation or under-irrigation and a subsequent reduction in water use efficiency. With the increasing amount of data generated by advancements in sensor technology and improvements in computational power, there has been a growing trend towards maximizing crop yields per unit of water consumed in irrigated agriculture. In this thesis, a data-driven approach was employed to model soil moisture dynamics using the system identification toolbox in MATLAB. Sensor measurements about the soil agrohydrological model were obtained from an open-loop experiment conducted on a tomato crop (Solanum lycopersicum L.) in an open field environment under drip irrigation. The soil moisture dynamics model was used to design a model predictive controller for smart irrigation scheduling. The model predictive control algorithm was compared against a manual and an open-loop irrigation control strategy to evaluate the resulting water savings and water use efficiency. The results of the data-driven modelling indicate that a state-space model represented the soil moisture dynamics with improved accuracy, with an estimated fit of 97.04 % and mean square error and a final prediction error of 1.74 × 10-7 and 1.75 × 10-7 respectively as compared to other model structures. The model predictive control algorithm effectively captured the soil moisture dynamics and accurately predicted future irrigation requirements. The model-based irrigation scheduling approach resulted in 29 % water savings and an improvement in water use efficiency of up to 10.4 kg/m3 compared to the 7.1 kg/m3 and 5.6 kg/m3 open-loop and manual control-based irrigation strategies respectively. These findings have important implications for farmers and agricultural stakeholders, as they offer practical solutions to address the ongoing challenges posed by water scarcity.

Mechanising Tiger Nut Harvesting in Ghana

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Abstract

Tiger nuts (Cyperus esculentus L.), is a perennial grass-like plant with a chewy nut cultivated in many parts of the world. In Africa, major producers are located in West Africa. Tiger nut is considered a minor crop in Ghana but is becoming an important crop due to its nutritional and health benefits. Harvesting is a major production operation necessary for the processing and storage of Tiger nuts. The traditional method of harvesting is usually by manual means, where the entire root system is uprooted with hand or hand tools. Most of the nuts may not be manually harvested due to the drudgery involved coupled with high labour intensity, low harvesting efficiency and high harvesting cost that negatively impacts the development of the tiger nuts industry in Ghana. Farmers in Ghana are not able to afford the more sophisticated and expensive combine harvesters, hence the need for a tractor drawn harvester adapted to suit the condition. The desired expansion of the tiger nut production in Ghana can be achieved through addressing labour shortage issues by mechanizing harvesting. This study focused

on the development of a tractor drawn mechanical harvester designed with three components: the digging unit, conveyor part and the rotating separator drum. The harvester is fitted with a digging blade to excavate the soil underneath the nuts. The prototype harvester will be tested during 2024 cropping season to alleviate the drudgery associated with manual harvesting to increase the yield and efficiency of production to attract the youth into the industry.

Keywords: Tiger Nut, Manual Harvesting, Drudgery, Mechanical Harvester

Effects of Temperature and Solid-liquid-ratio on the extraction of total phenolic content of Hibiscus sabdariffa leaves

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Abstract

Hibiscus sabdariffa leaves (HSL) can be used as tea leaves because of its bioactive compounds. This study demonstrates the effects of extraction temperature and solid liquid extraction ratio on the total phenolic content (TPC) of HSL. The HSL was harvested, washed dried with vacuum dryer at 40 °C and ground. The resultant powder was characterized in terms of tapped and bulk density, carr and Hausner ratio to ascertain its flow characteristics prior to the extraction using distilled water as the extraction medium at 70, 80and 90 °C and at the solid-liquid ratio of 1:9 and 3:7. The bulk and tapped density of 212m were 20.29 ± 0.1753 g/ml and 25.58 ± 0.2700 g/ml respectively .The carr index and Hausner ratio were 20.67 ± 1.154 and 1.26 ± 0.0185 respectively. Maximum extraction TPC was observed at 90 °C and at the solid-liquid ratio of 1:9 while the least TPC was observed at 70° C at 3:7 solid-liquid ratio.

A Review of the Performances of Some Existing Manually Operated and Tractor Drawn Seed Planters

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Abstract

Roselle (Hibiscus sabdariffa L.) is one of the important vegetables of okra family with several domestic and industrial applications. To boost its production using mechanized system, there is need to develop Roselle seed planter. Presently, there is no specific planter meant for sowing Roselle seeds. Hence, there was need to gather data on catalogues and performances of some existing manually operated seed planters and tractor drawn seed planters for various seeds, e.g., okra, maize, soybean, cotton, wheat, tumeric rhizome, root, tuber setts and bulb, and other related seeds. These data are necessary for the development of sophisticated Roselle seed planter with high precision after a careful study.

Keywords: Performances, Roselle seeds, Seed planters, Tractors

Wastewater Reuse Under Drip Irrigation System Towards Sustainable Use of Treated Wastewater in Irrigation for Peri-Urban Agriculture

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Abstract

In a world where water scarcity is a never-ending issue, wastewater treatment and reuse in agriculture are attractive. Although as an issue of social acquaintance in most peri urban agriculture, wastewater use with drip irrigation is an appropriate method to cope with uncovering the reclamation of wastewater. Due to the clogging nature of drip emitters, the rate of clogging under treated wastewater irrigation from a peri-urban community treatment plant was investigated. The clogging tests in this experiment observed the operation time for a duration during which the discharge of a set of emitters drops to 50% of the initial discharge. The drip irrigation system operated for 12 hours/day, seven days a week (with a system shut off at night). Water was collected for discharge characterization at a 72-hour interval to assess the state of emitter clogging. The results showed that with irrigation time, the emitter discharge dropped steadily yet continuously and was considered clogged after 650 hours at 50% of the initial mean discharge. Complete clogging did not occur in the emitters with the short operation time of the study, although the discharge in the laterals reduced to an average of 65.66%. Practically, this could mean an irrigation system using wastewater takes nearly two (2) months with a daily operation of 12 hours before the system potentially achieves the same clogging level. This would be towards the days of the first harvest for quick maturing vegetables like spinach, beets, mustard and turnip greens. This could also translate to 2.25 years of operation for a continuously irrigated perennial crop such as fruit trees, operating for three hours daily, twice a week. This implementation of treated wastewater use in agriculture should be well coordinated. This would improve agriculture production, contributing towards food security and sustainable agriculture under SDG 2, and on the other hand reducing water stress through recycling and reusing wastewater, towards SDG 12.5.

Keywords: Drip Irrigation, Treated wastewater, Sustainable use, Peri-Urban Agriculture, emitter clogging

Performance Evaluation of Experimental Solar Evaporative Cooling Systems

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Abstract

Evaporative cooling systems have many advantages over refrigeration systems, such as do not necessarily require connection to the national grid, do not use refrigerants, so there is no emission of carbon dioxide into the environment; and can be constructed from locally available materials. However, Little information on incorporating desiccant as an air preconditioning component to increase the performance of these coolers is available. This study investigated the performance of an evaporative cooler with an air preconditioning component (silica gel desiccant), an evaporative cooler without desiccant, and an evaporative charcoal cooler. Dry and wet bulb temperatures; and relative humidity were recorded during the experiment and used to determine cooling efficiencies of the systems, temperature drop, and humidity increase as performance indicators. The results showed that the evaporative cooler with desiccant had a cooling efficiency of 87.2% followed by an evaporative charcoal cooler with 79.3%, and then the evaporative cooler without a desiccant (67.2%). The evaporative cooler with desiccant dropped 3.7oC from the ambient temperature,

followed by the evaporative charcoal cooler (3.2oC), and the evaporative cooler without desiccant (2.8oC). The humidity increase for experimental evaporative coolers is 30.7%, 23%, and 26.1% for the evaporative cooler with desiccant, evaporative cooler without desiccant, and evaporative charcoal cooler respectively. The desiccant evaporative cooler did not use any ozone-depleting refrigerants, and it operated successfully on solar energy. A solar-powered desiccant evaporative cooler provides conditions that can enhance the shelf life of a wide range of fruits and vegetables. Thus, it can be used by farmers who have no appropriate storage cooling to preserve their fresh produce.

Keywords: Evaporative Cooler, Desiccant, Temperature Drop, Relative Humidity, Cooling Efficiency

Solid Biofuel Production by Hydrothermal Carbonization of Wood Shavings: Effect of Carbonization Temperature and Biomass-to-Water Ratio on Hydrochar's Properties

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Abstract

Hydrothermal carbonization (HTC) is recognised as a low temperature and effective technique for the conversion of biomass to solid biofuel. In this study, the effect of process temperature and biomass-to-water ratio (B/W) on the fuel properties of hydrochar produced from wood shavings was investigated. HTC was conducted in an autoclave using reaction temperature of 230 °C and 260 °C for 20 minutes with B/W ratio of 0.11 to 0.43. The produced hydrochars were characterised by the mass yield (MY), higher heating value (HHV), proximate and ultimate properties. The results showed that the properties of the hydrochars improved with increasing process temperature and B/W ratio. The higher heating value (HHV) increased to 26.74 MJ/kg as the severity of the reaction was increased to the process temperature of 260 °C. Also, the atomic H/C and O/C ratios of hydrochars produced at 230 °C and 260 °C were closed to the regions of a peat and lignite on the plotted van Krevelen diagram. Hence, the produced hydrochar has a promising potential as a sustainable solid biofuel for energy application.

Keywords: Wood Shavings, Biomass/Water Ratio, Thermochemical Conversion, Hydrothermal Carbonization, Hydrochar

Modelling of Engine Performance for Optimal Operation _ Case of Biodiesel Blends

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Abstract

Internal combustion (CI) compression ignition (IC) engines running on diesel, play a dominant role of today's economies, particularly in the agriculture and transport sectors. However, because of diesel associated concerns greenhouse gases (GHG) emissions, coupled with depletion of its reserves together and fluctuations in prices, the biodiesels have gained as an alternative fuel, since they can be used IC engines with little or no modification, for its benefits of reducing GHG emissions. Biodiesel blended with diesel, were introduced to mitigate its decreased power output, poor fuel atomization and increased nitrogen oxides emissions. Unfortunately, to determine the biodiesel – diesel blend for optimal engine performance, has been a difficult, since its sources are from a variety of vegetable oils whose fuel parameters and their interaction are different, causing variation in the combustion processes. The research has developed mathematical models, using Buckingham pi-

theorem analytical method and experimental data to predict CI engine performance parameters {brake thermal efficiency (Bte) and carbon monoxide (CO) emissions, while, specific fuel consumption (sfc) and nitrogen oxides (NOx) emission fueled by different biodiesels' diesel blends}. The experiments were carried out on a 3.5 kW one cylinder four stroke CI engine test rig fueled connected to an eddy current electric dynamometer. Factorial design method was to set-up experiments for the five different biodiesels' and their blends, mixed at ratios by volume of 10:90, 15:85, 20:80, 25:75 and 30:70, to run the engine operated at speeds of 1500 rpm and loaded at 0, 3, 6, 9 and 12 kg. The experimental study found out that engine fueled with biodiesel and their blends had lower Bte and CO emissions, while, sfc and NOx emission were higher, as compared those of diesel fuel. The developed mathematical model predicted Bte, sfc, CO and NOx with error margins of 1.65, 15.98, 4.69 and 2.78 % respectively as compared to the experimental results. The blending level were found to be 22.5, 21.9, 20.6, 19.98 and 19.6 percent of biodiesel for WVO, canola, coconut, sunflower and oleander respectively. Experimental results showed that biodiesel-diesel blends enhanced the engine performance compared to biodiesels and reduced emissions compared to diesel.

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Environmental and Biosystems Engineering Students Association (EBESA)

Environmental and Biosystems Engineering Students Association (EBESA) is a student's association established under the University of Nairobi Faculty of Engineering under the department of Environmental and Biosystems Engineering.

Our Vision

We envision a future where Environmental and Biosystems Engineering students are at the forefront of interdisciplinary cooperation, driving sustainable solutions and leading positive change in the world.

Our Mission

To empower the students of Environmental and Biosystems Engineering through collaboration, advocacy, and sustainable innovation, fostering a vibrant community within the University of Nairobi's Faculty of Engineering and professionals.

EBESA Objectives

- Promote Understanding of EBE: Enhance awareness and understanding of Environmental and Biosystems Engineering (EBE) by organizing sessions and forums that illustrate the applications and opportunities within the field.
- Foster Inclusivity: Expand membership outreach to engage students across all academic years, ensuring their active participation and involvement within EBESA's initiatives.
- Promote Students' welfare: Ensure that member's aspirations and interests are realized.
- Forge Industry Connections: Establish robust connections with industry professionals, alumni, and relevant stakeholders to provide students with valuable insights, mentorship, and practical exposure through workshops, talks, industrial visits, attachment and internships.
- Develop Editorial Content: Develop and disseminate relevant content via the EBESA Magazine and other channels, fostering information sharing among students, alumni, stakeholders, and industry affiliates.
- Enhance Program Visibility: Elevate the visibility and attractiveness of the EBE degree program to prospective students through outreach programs and awareness campaigns.
- Secure Funding: Source and secure financial resources necessary to sustain and expand the student organizational programs as outlined In the EBESA calendar of events.

Upcoming EBESA Events:

- SDG Innovation Challenge
- Tree Planting
- Career talk
- EBESA Open Day
- Fundraising campaign to raise school fees for needy students within the department of Environmental and Biosystems Engineering.
- EBESA Dinner

From the Students Kenyatta University Biosystems Engineering Chapter (KUBEC)

Introduction

KUBEC, (Kenyatta University Biosystems Engineering Chapter) orchestrates a diverse array of activities to enrich the academic and professional journey of its members. Delving into the multifaceted tapestry of Kubec's initiatives unveils a rich tapestry of learning, practical application, networking, and community outreach.

1. Workshops and Seminars

Kubec is a hub of knowledge dissemination, regularly organizing workshops and seminars that delve into the intricacies of Biosystems Engineering. Renowned professionals and academics are invited to share insights on cutting-edge technologies, industry trends, and emerging challenges, ensuring members stay abreast of the latest developments in their field.

2. Hands-On Projects and Demonstrations

The organization believes in learning by doing. Kubec facilitates hands-on experiences through projects and practical demonstrations. From designing innovative agricultural machinery to implementing sustainable farming practices, members actively engage in projects that bridge the gap between theory and application.

3. Industry Tours and Field Trips

To provide a real-world context to theoretical concepts, Kubec organizes industry tours and field trips. These excursions offer members the opportunity to witness biosystems engineering principles in action, visit agricultural facilities, and gain insights into the day-to-day operations of the industry.

4. Networking Events

Recognizing the importance of networking in career development, Kubec arranges networking events that connect students with professionals, alumni, and industry leaders. These events, including career fairs and mentorship programs, provide a platform for students to seek guidance, explore career paths, and establish valuable connections within the industry.

5. Research and Innovation

Kubec encourages a culture of research and innovation among its members. From participating in national competitions to conducting independent research projects, members have the opportunity to showcase their creativity and contribute to the advancement of biosystems engineering.

6. Community Outreach

Kubec is committed to making a positive impact beyond the university walls. The organization undertakes community outreach initiatives, ranging from agricultural awareness campaigns to sustainable farming projects. By applying their knowledge to address real-world challenges, members become catalysts for positive change in society.

7. Skills Development Programs:*

Understanding the importance of holistic development, Kubec offers skills development programs. These include training sessions on soft skills, leadership workshops, and courses designed to enhance members' overall competency and employability.

Conclusion

In essence, Kubec is not merely a student organization; it is a dynamic force that propels Biosystems Engineering students into a realm of comprehensive learning, practical exposure, networking opportunities, and community service. By embracing this holistic approach, Kubec stands as a beacon, guiding its members toward a future where they not only excel in their careers but also contribute meaningfully to the betterment of society.

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