3RD EAC REGIONAL SCIENCE, TECHNOLOGY AND INNOVATION 2024
CONFERENCE REPORT

THEME:
ACCELERATING DEVELOPMENT AND DIFFUSION OF SCIENCE, TECHNOLOGY AND INNOVATION SOLUTIONS FOR A GREEN, INCLUSIVE AND RESILIENT EAST AFRICA

DATE: 6-8 March, 2024
VENUE: Nairobi, Kenya

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Preface
The three-day 3rd EAC STI Regional Conference was organized under the auspices of the East African Community by the following of its institutions:
• The East African Science and Technology Commission (EASTECO)
• The Inter-University Council for East Africa (IUCEA)
with the support of:
• Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
• Stockholm Environment Institute (SEI)
• UNESCO
• Training Centre in Communication (TCC AFRICA)

Acknowledgements
The organizers would like to thank all persons and organizations who played a role in making the conference a success, including the following:
• Ministers responsible for education in the region
• Ministers responsible for science, technology and innovation in the region
• Ministers responsible for EAC affairs in the region
• National councils/commissions of science, technology and innovation in the region
• Participating universities and research institutions
• The host - Republic of Kenya

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## DAY ONE

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- **Parallel Session 2A** – Soil Sciences
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- **Parallel Session 2C** – Data Analytics & ICT for e-Government

## DAY THREE

**PLENARY SESSION 5:** Natural Resources Management

**PLENARY SESSION 6:** Information Communication Technology and Digital Economy

**MINISTERIAL SESSION**
The 3rd EAC Regional Science, Technology and Innovation Workshop followed up on the success of the first and second conferences held, respectively, in Kampala, Uganda in 2019 and Bujumbura, Burundi in 2021. Once again, the conference brought together diverse actors in the STI system, including policy makers, industry players, academicians, researchers, innovators, students and development partners.

The conference was made possible by the collaboration of two key institutions of the East African Community – the East African Science and Technology Commission (EASTECO) and the Inter-University Council for East Africa (IUCEA). With support from the German Agency for International Cooperation (GIZ), these two organizations mobilized the key players in the field of science, technology and innovation from across the Partner States of the EAC.

The results of this great collaboration have been astounding. Under the theme, “Accelerating development and diffusion of Science, Technology and Innovation solutions for a green, inclusive and resilient East Africa,” expert presentations were followed by exciting discussions, penetrating insights, and vibrant debate on the latest trends in science, technology and innovation ideas in the region. This report is therefore an invaluable record of the proceedings of this important conference and will be of keen interest to policy makers, scientists, educators, researchers, innovators, industrialists, and scholars in East Africa and beyond.

We believe that the conference largely achieved its purpose. Conferences of this nature are important in stimulating the establishment and strengthening of lasting strategic alliances among stakeholders, in addition to promoting the generation, dissemination and translation of research findings for socioeconomic development. The value of the collaborations, networks, and partnerships harnessed among stakeholders through the conference are a source of immense pride to the entire region.

However, there is still much to be done. As with the previous two conferences, EASTECO and IUCEA have been tasked with the difficult but important task of overseeing the implementation of the resolutions arising from the conference. It is a task that we humbly and dutifully accept.

Finally, we are grateful to the government of the Republic of Kenya for its support and hospitality, and to all those who participated in one way or another to ensure the success of the conference.
EXECUTIVE SUMMARY

Introduction
The African Union (AU) Agenda 2063, foresees a prosperous continent based on inclusive growth and sustainable development with Science, Technology and Innovation as multi-function tools and enablers for achieving the continental development goals. Equally, the Treaty for establishment of the East African Community (EAC) recognizes Science and Technology as a key driver for sustainable socio-economic development in the region. Further, the EAC Vision 2050 emphasizes STI as one of the key drivers for sustainable socio-economic development and calls on higher education institutions to mainstream research and innovation towards socio-economic transformation of the region.

It is against this background that under the auspices of the EAC, the East African Science and Technology Commission (EASTECO) and the Inter-University Council for East Africa (IUCEA) in collaboration with various STI stakeholders in the region and globally jointly organized the 3rd EAC Regional STI Conference. This was meant to provide an avenue for sharing experiences, best practice and applications of STI outputs; strengthening collaborations; and facilitating regional integration and sustainable development.

The overarching theme of the conference was, “Accelerating development and diffusion of Science, Technology and Innovation solutions for a green, inclusive and resilient East Africa”. The biennial conference built on the deliberations and success of the 1st and 2nd conferences, which were held, respectively, in Kampala, Uganda in 2019 and Bujumbura, Burundi in 2021. The conference brought together diverse actors in the STI system, including policy makers, industry players, academicians, researchers, innovators, students and development partners.

The output of the conference will be published in the East African Journal of Science, Technology and Innovation (EAJSTI) to boost the dissemination of research findings within the region and improve regional visibility and competitiveness. The STI Conference will therefore stimulate the establishment and strengthening of strategic alliances among stakeholders to promote the generation, dissemination and translation of research findings; building collaborations and networks; and harness partnerships among stakeholders in the region.

Conference Format
The three-day 3rd EAC STI Regional Conference (6-8 March) was conducted in a hybrid mode through physical attendance and virtual platforms. The presentations centred around four main thematic areas:

i. Agricultural Productivity, Resilience and Food Security;
ii. Health and Nutrition;
iii. Natural Resources Management; and
iv. Information Communication Technology and Digital Economy.

There were six Plenary Sessions, each focusing on a theme that was addressed by
a keynote speaker and four panellists, followed by plenary discussions. Two Plenary Sessions were held each day, as follows:

**DAY 1**
Plenary Session 1: Agricultural Productivity, resilience, and food security

Plenary Session 2: Stimulating digital entrepreneurship

**DAY 2**
Plenary Session 3: Open science and science diplomacy: Bridging borders for global impact

Plenary Session 4: ICT emerging technologies in driving digital transformation in industrialization in East Africa

**DAY 3**
Plenary Session 5: Natural Resources Management

Plenary Session 6: Information Communication Technology and Digital Economy

The Plenary Sessions were supplemented with a total of nine Parallel Sessions held on the second day of the conference. These Parallel Sessions tackled various sub-themes and looked at case studies from around the region. At the end of the Plenary deliberations on the third day, a Ministerial Session was held attended by ministers and/or their representatives from EAC Partner States and at which the Conference Resolutions were read out.

**General Overview of the Presentations**
The presentations drew from the rich and diverse experiences of the keynote experts and panellists for each Plenary. There was much interest in the development of science, technology and innovations in diverse areas that included agriculture, financial technology, education, health, and other sectors. Similarities and differences in policies and approach among the partner states were explored, leading logically to serious examination of possible areas of policy convergence and collaborative ventures.

The deliberations did not, however, obscure the differing cultural, political and economic contexts of individual countries. These were evident in the various presentations and provided a strong argument for further discussion of some resolutions by higher organs of the Partner States using existing protocols and regional committees of the EAC.

**Conclusion**
Participants were of the view that the 3rd EAC Regional STI Conference had advanced on the progress made in previous conferences and arrived at far-reaching recommendations. It was left to individual institutions – principally the joint partners behind the conference – to take up the implementation of the conference resolutions and to report at the next conference.

Rwanda having made the request, it was announced that the 4th EAC Regional STI Conference shall be held in Rwanda.
INTRODUCTION

Background and Context

The contribution of science, technology and innovation (STI) is globally recognised in transformation of systems to be more efficient, resilient and sustainable, as well as in accelerating socio-economic development. The African Union (AU) Agenda 2063, foresees a prosperous continent based on inclusive growth and sustainable development with STI as multi-function tools and enablers for achieving the continental development goals. Equally, the Treaty for establishment of the East African Community (EAC) recognizes Science and Technology as a key driver for sustainable socio-economic development in the region. Further, the EAC Vision 2050 emphasizes STI as one of the key drivers for sustainable socio-economic development and calls on higher education institutions to mainstream research and innovation towards socio-economic transformation of the region. It is against this background that the East African Science and Technology Commission (EASTECO) and the Inter-University Council for East Africa (IUCEA) in collaboration with various STI stakeholders in the region and globally jointly organized the 3rd EAC Regional STI Conference, as an avenue for sharing experiences, best practice and applications of STI outputs, strengthening collaborations, facilitating regional integration and sustainable development.

The 3rd EAC Regional STI Conference was convened under the overarching theme of “Accelerating development and diffusion of Science, technology and Innovation solutions for a green, inclusive and resilient East Africa”. This biennial Conference built on the deliberations and success of the first and second conferences, which were respectively held in Kampala, Uganda in 2019 and Bujumbura, Burundi in 2021. The Conference brought together diverse actors in the STI system, including policy makers, industry players, academicians, researchers, innovators, students and development partners.

The Conference provided a multifaceted platform for the STI players in the EAC region and beyond to share their experiences, best practices and results within the knowledge and technology generation, translation and transfer chain. The Conference consisted of keynote presentations, paper presentations, panel discussions, exhibitions and a high-level policy makers’ interaction session.

Under the overarching theme, the conference engagement sessions were structured into four thematic areas, namely: (i) Agricultural Productivity, Resilience and Food Security; (ii) Health and Nutrition; (iii) Natural Resources Management; and (iv) Information Communication Technology and Digital Economy. All full paper submissions in the conference were peer-reviewed and evaluated based on originality, technical and/or research depth, accuracy and relevance to conference theme and topics. The accepted peer-reviewed papers will be published in the East African Journal of Science, Technology and Innovation (EAJSTI) to boost the dissemination of research findings within the region and improve regional visibility and competitiveness.
Purpose of the Conference

A number of stakeholders exist within the STI space in the Community. These stakeholders include a number of national institutions, government ministries for science, technology and innovation, national commissions for science and technology, research institutes, academies of science and non-governmental organizations. The stakeholders largely work in isolation and their level of collaboration in research, technology and innovation development is limited, resulting in uncoordinated research, duplication of research, and failure to implement research activities effectively. Furthermore, most of the research work done in the region remains on shelves and not developed further or circulated adequately. In addition, no clear collaboration mechanisms between non-educational research organizations and universities exist, and platforms for the exchange of scientific information are limited. The STI conference therefore sought to enhance networking relations among researchers, technology developers and innovators; establish a platform for stakeholders for setting agenda as well as priorities and niches in STI in the region; enhance linkages and partnerships between academia, industry and the public sector; enhance exposure to stakeholders on priority issues for research, extension services, teaching and learning; and enhance capacity for benchmarking research outputs in the region. The output of the conference will be published in the East African Journal of Science, Technology and Innovation (EAJSTI) to boost the dissemination of research findings within the region and improve regional visibility and competitiveness. The STI Conference therefore served to stimulate the establishment and strengthening of strategic alliances among stakeholders to promote the generation, dissemination and translation of research findings; building collaborations and networks; and harnessing partnerships among stakeholders in the region.

The conference, therefore, envisioned enhanced sharing of research findings, collaboration and linkages through conference presentation, ministerial roundtable, exhibitions and publication for regional integration and socio-economic development. The conference sought to contribute to the future of Technology, Science and Innovation by bringing together leading scholars, academics, and researchers in the field. Developed on the principles of open exchange of information and cross-border learning, this conference is designed to facilitate heated discussions and provide inspiration to the network that’s shaping the direction of one of the most important fields of technology and sciences development.
Objectives of the Conference

The objectives of the 3rd EAC Regional STI Conference are:
1. To provide a platform for information and knowledge sharing through conference presentation, exhibitions and publication;
2. To enhance the dissemination of research results through publication in peer review journal;
3. To stimulate and promote networking, partnerships and collaboration among the scientific community in the EAC region;
4. To promote uptake of research and development products and services among STI stakeholders.

About the Conference

Scientific papers were presented on aspects of the various sub themes under each of the four thematic areas, but not limited to those areas. The conference was held in a hybrid mode through face-to-face and virtual platforms. The conference comprised a high-level policy dialogue, panel discussions, parallel presentations, showcasing of events/innovation exhibitions and a ministerial session. A detailed program guided the conference structure, whose different sessions were:

(a) High level policy dialogue session: This involved senior government officials and ministers from Ministries responsible for STI. The interactive high-level policy dialogue focused on broad and crosscutting issues and strategic direction including opportunities and transformative levers, partnerships, commitments, actions and other measures to accelerate STI applications/solutions implementations.

(b) Plenary Sessions: A general plenary discussion was held at the end of each session where key issues were discussed, and session recommendations derived to inform conference resolutions.

(c) Exhibition session: Special sessions for exhibitions of scientific innovations and technologies were interspersed within the thematic sessions, in which participants were allowed to visit exhibition booths of their interest to interact and learn.
(d) Ministerial terminal session: A terminal ministerial session was held to present consolidated recommendations to a technical policy panel for roundtable discussion to come up with conference resolutions.

(e) Special session and events: Special sessions were held on request from partners. These included a youth engagement on technologies and innovation of the future and a session on entrepreneurship promotion through education and research and development. Side events by partners were held for special and specific sessions.

The expected outputs of the conference include:

i. Journal Publication produced
ii. Conference proceedings published
iii. A Technical Conference report published
iv. Policy briefs published

The expected outcomes of the conference were:

i. Enhanced networking relations among researchers, technology developers and innovators

ii. Established Platform for STI stakeholders for setting agenda as well as priorities and niches

iii. Enhanced linkages and partnerships between academia, industry and the public sector

iv. Enhanced capacity for exchange of scientific ideas among researchers, faculty, and industrialists in the region.

The conference was open to all stakeholders including EAC Partner States, the African Union, Regional Economic Communities, Civil society, business and industry organizations, academic and research institutions, and development partners.
DAY ONE

The key role played by science, technology and innovation (STI) in efforts to improve the quality of life of the people of East Africa was emphasized right from the beginning of the conference. The first day’s activities included the opening ceremony and first two Plenary Sessions. Speakers at the opening ceremony emphasized the importance of using STI to widen and deepen economic, political, social and cultural integration, as well as to foster collaboration between Partner States and institutions. Integral to this effort is the cultivation of an enabling policy environment; in this regard, two policy documents were launched by EASTECO: The Regional STI Policy and the Regional Intellectual Property Policy.

The first Plenary Session focused on the theme of “Agricultural productivity, resilience, and food security,” while the second Plenary Session had as its theme, “Stimulating digital entrepreneurship.” Both themes were ably tackled through keynote presentations and panellist sessions followed by enlightening plenary discussions. An overriding aspect emerging from the presentations and discussions was the interconnectedness of science, technology and innovations with the current discourse on climate change and issues of inclusivity. During the breaks from conference activities, participants had the opportunity to visit the many exhibition stands by various organizations and universities.
Opening Ceremony

Masters of Ceremonies

Fortunate Muyambi, Deputy Executive Secretary, EASTECO
Prof Rai Idris, Deputy Executive Secretary, IUCEA

Prof Gaspard Banyankimbona, Executive Secretary, IUCEA

On behalf of the Inter-University Council for East Africa (IUCEA), Prof Banyankimbona welcomed all participants to the 3rd EAC Regional Science, Technology, and Innovation (STI) Conference. Saying this was a pivotal moment in history, he added that the combined forces of science, technology, and innovation held the key to unlocking sustainable development not only for the East African Community but globally. The event, he said, was co-organized with the East African Science and Technology Commission, a sister Institution of the EAC. He expressed his deep appreciation of the presence of a diverse and distinguished audience that included scientists, researchers, innovators, university leaders, and policymakers, altogether representing the collective intellect and dedication shaping the future of our region.

For decades, Prof Banyankimbona said, IUCEA has served as a bridge, fostering collaboration and excellence in higher education across East Africa. The EAC Institution firmly believes that research, development, and innovation (RDI) are not mere academic pursuits but the very engines driving sustainable development. A conference like the present one, therefore, serves as a crucial platform for sharing knowledge, fostering collaborative problem-solving, and propelling the creation of impactful solutions to the challenges faced by society collectively. The executive secretary took the opportunity to appreciate the presence of different development partners who had been supporting this initiative from its inception. These include the German Cooperation represented by GIZ and the African Development Bank.

Prof Banyankimbona said the thematic areas chosen for the conference represent a strategic alignment with the focus areas of various regional initiatives such as the East and Southern African Higher Education Centres of Excellence, ACE II, a World Bank-funded project that IUCEA proudly coordinates. This synergy is a testament to the vital role that well-equipped universities and collaborative research efforts play in addressing the unique development priorities of the region. Going forward, the conference is a great opportunity for IUCEA to appreciate the research trends on areas of crucial importance like climate change, food security and resilience. There is also an attempt to establish a permanent think tank on the same as per IUCEA strategies.

Scientists and researchers mainly from IUCEA member institutions will be presenting their groundbreaking work at the conference, Prof Banyankimbona said. He commended their dedication to pushing the boundaries of knowledge and exploring innovative solutions. The IUCEA chief executive expressed his...
appreciation to the esteemed invited keynote speakers, whose invaluable insights and expertise would undoubtedly enrich the collective understanding of participants. The presence of Vice Chancellors from member institutions of the IUCEA was a testament to the unwavering commitment of the region’s university leaders to advancing science and technology within the region, he said. Their participation was not only symbolic but also signified a collective vision for building a stronger and more prosperous East Africa through strategic RDI initiatives and collaborative partnerships.

Over the next three days, Prof Banyankimbona said, all participants were encouraged to engage in open dialogue, build new connections, and forge collaborations that would propel scientific advancements and contribute to sustainable development in the region. He urged the participants to use the platform to foster cross-disciplinary exchange, challenge existing paradigms, and collectively seek solutions that address the most complex problems facing our communities. With the combined efforts and intellect of all present, he said, the conference would pave the way for significant progress. Together, the participants can harness the power of science, technology, and innovation to build a brighter future for East Africa, one where scientific advancements translate into tangible benefits for citizens, and where collaborative RDI initiatives pave the way for a more prosperous and sustainable future for generations to come.

Prof Banyankimbona said that IUCEA would continue to work with EASTECO, universities, the private sector and all other partners to deliver effectively on its mandate. He further thanked the Chief Guest for accepting to officiate the event and the government and people of Kenya for hosting the conference. He also thanked the Secretary General of the East African Community, Hon Dr Peter Mathuki, for his leadership. Additionally, Prof Banyankimbona thanked the different organizing committee teams for the effort that went into the preparations process for the conference. On behalf of the IUCEA fraternity, he also thanked all EAC Partner states, Member Universities and development partners for their continued and enabling political and financial commitment.

Dr Sylvance Okoth, Executive Secretary of EASTECO

Dr Okoth welcomed participants to the 3rd EAC Regional Science Technology and Innovation Conference, which he said was hosted collaboratively between the East African Science and Technology Commission (EATECO) and the Inter-University Council for East Africa (IUCEA), and supported by Partner States of the EAC and development partners, all of whom were represented at the conference.

Various EAC instruments including the Treaty for the Establishment of the East African Community, the Common Market Protocol and the Protocol on the establishment of East African Science and Technology Commission recognize the fundamental importance of science and technology in economic development, he said. EASTECO, he added, had developed STI policies, strategies and regulations to operationalize various aspects of these instruments in its quest to promote the development, management and application of science and technology in Partner States.

The STI conference, Dr Okoth said, was therefore one of the interventions through which science and technology promotes the EAC integration agenda, as it accords stakeholders an opportunity to come together to exchange scientific information, and in the process, create new linkages and strengthen bonds of collaboration. The commission, according to the EASTECO executive secretary, aims to enhance production, dissemination and adoption of new and emerging technologies and innovations to spur social and economic enterprises in the region. The conference, therefore, would be listening to outputs of scientific production in both oral and poster presentations; participants would also have the opportunity to interact with exhibitions of scientific innovations and witness intellectual discourse.

On behalf of the organizing committee, Dr Okoth thanked the Government of Kenya for accepting to host this conference.
Mr Richter thanked the organizers for the well-attended event, saying GIZ was proud to be a part of the event and to support the East African integration process. This, he said, included support in areas of development and sustainability. The integration process was a boost to the region’s economies, he said, especially now that the bloc had grown with the admission of Somalia into the EAC in 2023. Innovation played an important role in fostering development, and, in this regard, Kenya and Rwanda are stellar lights in the area of digital transformation.

He urged the integration of science, technology and innovation into society within the Partner States, saying this is something GIZ would like to be a part of. He looked forward, he said, to seeing how the innovation ecosystem works to develop joint investment opportunities with the private sector and to see the latter take a leading role. The current priority for the German government, he said, is to support the digital economy.

It needs to be understood, he said, that STI is a joint effort of policy makers, governments, institutional frameworks, centres with innovation ability, and the private sector. AI, he said, is at the moment disrupting not only higher education but also basic education systems and he looked forward to having discussions on this. He invited participants to connect with German researchers and institutions in this area.

Ms Hendrina Doroba Chalwe, Division Manager, Education and Skills Development, African Development Bank Group

On behalf of Director General Nnenna-Nwabufo, Ms Chalwe said she was honoured for the opportunity to represent the African Development Bank at the conference under the theme, “Accelerating development and diffusion of STI solutions for a resilient East Africa.” She expressed her gratitude to the organizers of the conference for their efforts in putting together such a timely event. Accelerating development and diffusion of STI in East Africa, she said, would not only lead to the growth of innovative solutions to our regional challenges but also drive commercialization of such innovations for industrial development.

In her speech, Ms Chalwe pointed out that the East African Community had made great strides in adopting STI solutions for development. However, there was still much to be done to harness its full potential and accelerate socio-economic transformation as outlined in the East African Community Vision 2050 and Agenda 2063 of the Africa We Want. Today, East Africa’s innovation level is insufficient to reach ambitious levels of inclusive growth and development due to prevailing technological and innovation constraints, which include financing, and information asymmetries that need to be addressed to harness STI potential fully.

This has been worsened by the slow recovery of the global economy from the impacts of COVID-19 and the effects of the Russia-Ukraine war, which has affected value and distribution chains globally and contributed to the global cost of living crisis. A critical pathway in responding to these challenges and ensuring that STI works for East Africa is the urgent need to train the next generation of scientists and innovators, who should take the lead in driving the region’s development agenda, Ms Chalwe said.

She added that any inclusive growth and sustainable development calls for the growth of innovations to promote the creation of new enterprises, increase productivity, support new jobs, and drive economic prosperity. Critically, the slow progress in building the skilled workforce in STI has adversely affected the Community’s ability to transform its economies and increase productivity and competitiveness.
It is essential to note that the quality of learning at all levels of skills development, particularly in science, technology, engineering, and mathematics (STEM), is low compared to other regions. As an example, she said that in Africa as a continent, of all students that graduated from higher education institutions in 2021, those in STEM fields were on average 21.7% compared to 25.6% in other regions of the world. Addressing this could be made possible by combining our interventions with the power of science, technology, and innovations through enhancing the capacity of our high education and research institutions and promoting multi-stakeholder partnerships for homegrown solutions to our development challenges.

Clearly, harnessing science, technology, and innovation requires deliberate investments in human capital development tailored to the changing socio-economic development ecosystem, Ms Chalwe stated. To promote STI solutions for a resilient East Africa and enhance value addition and competitiveness in the region, the African Development Bank, she said, was working with other partners to train scientists and innovators through quality and relevant STEM skills. This is by emphasizing technology’s role in fostering the next generation of STI leaders, through championing investments in STEM in our education systems.

The Bank had done this through its Skills for Employability and Productivity for Africa (SEPA) Action Plan (2022-2025) guiding its investments, operations, and strategic engagements in science and innovation in Africa. The Action Plan aims to develop a skilled and competitive workforce capable of increasing productivity and spurring innovation for access to decent jobs and improved quality of life of the people in Africa.

Some of the Bank’s investments in East Africa include the Kenya HEST Project, through which the Bank upgraded training equipment for science and engineering programs in eight public universities and trained 400 (26% women) teaching staff at master’s and PhD levels and 46 technicians. The project had also contributed to the accreditation of 15 engineering programmes and introduction of 23 new academic/relevant science and technology programmes, she said. Due to the improved training facilities and staff, the training facilities have benefited over 11,000 (16% women) students.

She also gave the example of the Rwanda Regional ICT Centre of Excellence – the Carnegie Mellon University in Kigali – which provides master’s degree programmes in computer sciences and ICT. To date, there are more than 262 graduates from the Centre, 30% of them women, and almost all are fully employed. The ICT skills acquired through this programme have played an important role in supporting health systems, cyber security, and the use of big data.

The Bank has also partnered with philanthropies like the Rockefeller Foundation and Microsoft Philanthropies, bringing the “Coding for Employment” programme to Africa. The programme offers free online platforms that provide in-demand technical courses such as web development, design, data science, and digital marketing. So far, online and in-person Coding for Employment programs have reached 152,000 youth across the continent., she said.

Besides, the Bank has invested $45 million to support three of the five Pan African University (PAU) Institutes collaborating with the African Union to enhance access to equitable and quality higher education. The PAU has graduated 1,896 (67% male and 33% female), 1,591 graduates at master’s level and 305 graduates at PhD level in fields the member states have determined as essential to move Agenda 2063 ahead. Following the success of Phase 1, the project’s Phase II design, estimated at $102 million, is in progress, with approval expected this year.

In addition, through the East Africa Centre of Excellence for Skills and Tertiary Education in Biomedical Sciences, the bank is supporting the creation of a network of COE in biomedical sciences and engineering – nephrology and urology in Kenya, biomedical engineering and e-health in Rwanda, oncology (Cancer Institute) in Uganda, Cardiovascular Sciences in Tanzania, and nutritional sciences in Burundi. In terms of impact, for example, at the Kidney Institute Project in Kenya, the Bank has supported the training of over 300 health personnel in specialized programmes in urology and nephrology in readiness for the upcoming Kidney Institute.

The Project also supported the establishment of a histocompatibility and immunogenetics laboratory,
the first of its kind in East Africa, to facilitate donor matching for organ transplants locally. Before this laboratory was established, samples from the region were transported to South Africa and other countries for matching, and many patients also sought treatment outside the country.

By utilizing its convening power, the Bank has led high-level policy dialogue on Science, Technology, and Innovation since 2012. So far, the Bank has organized three fora whose success demonstrates the Bank’s convening power and strategic and catalytic role in promoting intelligent investments. Following these fora, notable results have been achieved, including (i) increased investments in Science, Technology, and Innovation projects aimed at boosting youth skills development, employability, entrepreneurship, and innovation for employment in Africa; and (ii) enhanced strategic partnerships and collaboration at the regional level to promote science skills.

Building on the success of the last Forum, the Bank and its partners have started preparations for the next one, to be held in 2024, under the theme, “Science, Technology and Innovation for climate-friendly jobs.” She urged all stakeholders to work together for the East African Community to tap into and benefit from the STI opportunities and accelerate its diffusion. The Bank, she said, can be counted on a preferred development partner.

Dr Ezekiel Machogu, Cabinet Secretary, Ministry of Education, Kenya

Dr Machogu was represented at the meeting by the Director of the National Council for Science, Technology and Innovation (NACOSTI) Prof Walter Oyawa. In his remarks, the minister said he was delighted to address the 3rd Regional Science Technology and Innovation (STI) conference that had been organized by the East African Community (EAC), under the collaborative arrangement of the East African Science and Technology Commission (EATECO) and the Inter-University Council of East Africa (IUCEA).

The EAC, he said, aims to widen and deepen economic, political, social and cultural integration in order to improve the quality of life of the people of East Africa through increased competitiveness, value added production, trade and investments.

Article 103 of the treaty for the establishment of the East African Community recognizes the fundamental importance of science and technology in economic development of the community, the minister said. The treaty further commits the partner states to promote co-operation in the development of science and technology within the community through initiatives such as:

(a) The joint establishment and support of scientific and technological research and of institutions in the various disciplines of science and technology;
(b) The creation of a conducive environment for the promotion of science and technology within the community;
(c) The mobilization of technical and financial support from local and foreign sources and from international organizations or agencies for the development of science and technology in the community;
(d) The exchange of scientific information, personnel and the promotion and publication of research and scientific findings;
(e) The collaboration in the training of personnel in the various scientific and technological disciplines at all levels using existing institutions and newly established ones.

The EAC Common Market Protocol also accords STI significant prominence as a driver for economic growth, Dr Machogu told the conference. To this end, article 42 of the protocol directs partner states to undertake joint research and development to facilitate co-operation in the development of science, technology and innovation within the community. It commits the partner states to, among others, undertake
the following five activities:
(i) Disseminate the results of activities in research, technological development and demonstration programme;
(ii) Facilitate access to their technological and research facilities by researchers and other experts;
(iii) Encourage private sector participation in activities relating to intra-regional research and transfer of technology;
(iv) Establish a mechanism for the co-ordination of science, technology and innovation (STI) activities.
(v) Disseminate and exchange industrial and technological information for enhanced socio-economic development of the region.

Convening of the 3rd STI conference, the minister said, goes a long way in promoting the achievement of the objectives of the treaty and the common market protocol. The conference, he added, brought together all players in the STI ecosystem in the region and beyond, to exchange information and create an effective network for collaboration that supports the translation of STI outputs into goods and services for the benefit of the community.

Dr Machogu noted that the EAC was committed to promoting and coordinating the development, management and application of science and technology to support regional integration and socio-economic development in the EAC region, thereby contributing to a prosperous, competitive, secure and united East Africa through collaboration in science, technology and innovation. Kenya, he said, was and remained a regional and African powerhouse in science, technology and innovation. However, in order to leap-frog and align the country to global trends and the fast-changing socio-economic landscape, the country had adopted a new education curriculum that was competence-based. The main goal of this curriculum is to enable Kenya cement itself as a global leader in technology, innovation and industrialization.

This approach, he said, was in line with the East African Community (EAC) development Strategy on Education, which seeks to transform this region into a middle income one by 2030, through use of STEM to spur innovation and industrialization. The educational reforms in Kenya were geared towards improving the capabilities of graduates at all levels of education as envisioned by the Presidential Working Party on Education Reforms, he said, laying monumental emphasis on Engineering and Mathematics (STEM) at all levels of Education. He cited the Basic Education Curriculum Framework (BECF), which he said provided for three pathways at Senior School comprising Science, Technology, Engineering and Mathematics (STEM); Social Sciences; and Arts & Sports. This framework further anticipates that 60% of the students at senior school would transition to STEM pathway as they progress.

The minister said it was impossible to talk of science, technology and innovation without mentioning, and discussing, progress made in the Technical, Vocational, Educational and Technological sector, and its contribution to science, technology and innovation. Kenya had prioritized the TVET sector to empower graduates provide meaningful and practical solutions that would drive innovation and industrialization, he said. Government investment in this sector has seen the number of national polytechnics increase from 11 in 2012 to the current 24, with plans to have at least one national polytechnic at each of the 47 counties in Kenya. Moreover, the ministry projects to have one technical and vocation college in each of the 290 constituencies in the country over the coming months. All these are efforts to ensure that Kenya thrives on a climate of innovation and industrialization in the coming years.

Universities are key to fostering research, technological advancements and innovation. There also has been rapid expansion of universities in Kenya from 2012, when there were only had 35 universities, compared to the current 78, in less than a decade. The high number of universities in Kenya showcases the huge opportunity for collaborative research and teaching within the region in science, technology and innovation, Dr Machogu said.

Kenya has implemented the Competency Based Education and Training Framework and admitted its first batch of students in 2023 for Grade 6. These students are expected to join university in 2029. The government projects that 60% of the learners will join STEM courses, 25% humanities and 15% creative studies. Kenyan universities are undertaking internal review of curriculum and other programmes to align with the new system as they prepare to receive the next generation of researchers and innovators, he said.
Funding for research is critical in driving the science, technological and innovation agenda. It is necessary, Dr Machogu said, to provide adequate funding for research in order to realize Kenya’s development goals. Though the country is doing fairly well in the region with funding of 0.8% of its GDP, this is short of the global recommended rate of at least 2% of the GDP. In order to mitigate this, the draft Sessional Paper on Education 2024, he said, proposes an allocation of 2% of the GDP towards research, with at least a third of that allocation going to TVET and another third to Universities. The minister urged delegates to ask themselves the extent to which opportunities in science, technology and innovation were inclusive and accessible to all despite gender, socio-economic status, physical challenges, race, ethnicity and religion. Sustainable Development Goal number four, he said, stipulates that by 2030, all countries should provide equal access and quality technical vocational education and training for all women and men. Further still, the African Union in its Agenda 2063 had ratified the Continental Strategy for Technical and Vocational Education and Training, to foster youth employment and entrepreneurship.

To demonstrate how dire the challenge of inclusivity is, the minister said the United Nations Educational, Scientific, and Cultural Organization (UNESCO) had reported that only 30% of girls in higher education in Kenya took courses in STEM. Data from 2021 indicated that universities had 59.4% male students and 40.6% female students, while TVETs had a 78% male and 22% female student population. This, he said, was the likely trend across the region.

Dr Machogu also asked participants to have a deeper reflection on conversations that took place during the 2nd EAC Regional Science, Technology and Innovation conference. The programme for this year’s conference, he said, contained a rich mix of thematic sessions covering agricultural productivity, resilience, food security, stimulating digital entrepreneurship, emerging technologies in driving digitization & industrialization in East Africa, and open science and science diplomacy. Kenya, he added, was proud to host the event; he expressed the government’s gratitude to EASTECO and IUCEA for co-organizing the conference, with financial support from GIZ-EAC /Tanzania.

Finally, Dr Machogu said he looked forward to fruitful ministerial dialogues on accelerating development and diffusion of science, technology and innovation solutions for a resilient East Africa. He then declared the 3rd EAC Regional Science, Technology and Innovation conference officially opened and invited participants to attend all the sessions and exhibitions.
LAUNCH OF EAC REGIONAL POLICIES

EASTECO launched the following two regional policies that had taken almost 4 years to develop and domesticate:
- Regional STI Policy
- Regional Intellectual Property Policy

PLENARY SESSION 1

Agricultural productivity, resilience, and food security

Preamble
Food security must address issues of food availability in the right quantity and quality. There must also be access to the food wherever it is. Increased hunger, malnutrition and poverty in the EAC countries can be tackled through production and resilience strategies that also take stock of challenges such as climate change, drought, and diseases. This Plenary Session delved into these issues and associated matters, including issues of biodiversity protection, technology adaptation, and the vexing question of Genetically Modified Organisms.
Agriculture is a vital sector in the economies of East Africa Countries. The sector plays a significant role in livelihoods of citizens in East Africa Community (EAC). More than 70% of the Industries in EAC region are agro-based and dependent on Agriculture as the main source of raw materials. However, the productivity of agriculture in the EAC region is alarming decreasing mainly because of mounting pressures of climate change concerns, diminishing resources, limited application of modern technologies as well as changing demographic trends. The challenge of low agricultural productivity has thus been a major cause of increased hunger, malnutrition and poverty in the EAC Countries. It is therefore pertinent for all players to focus and put in place deliberate efforts to enhance agricultural productivity, resilience and food security in East Africa.

Title of Presentation: Leveraging Science, Technology, and Innovation in the enhancement for agricultural productivity, resilience, and food security in East Africa.

Session Moderator: Dr Joseph Ssemakula, Uganda Matyrs University
Session Rapporteur: Milton Melingasuk

Panelists:
- Prof. Joyce Kinabo, Professor of Human Nutrition, Sokoine University, United Republic of Tanzania
- Dr. Roy Mugiira, CEO, National Biosafety Authority, Kenya
- Dr. Richard Edema, Centre Director, Makerere University Regional Centre for Crop Improvement (MaRCCI), Uganda
- Prof George Owuor, Centre Leader, Centre of Excellence in Sustainable Agriculture & Agribusiness Management (CESAAM), Egerton University, Kenya

Keynote Presentation
Dr Oduor told the conference that we cannot talk about food security without understanding the different aspects that inform it. For us to say that we are food secure, we must deal with food availability. It must be there in the right quantity and quality. You must then be able to access that food from wherever it is. Thereafter, you must be able to utilize it, which means processing it. There is then a critical aspect of stability; this means that if you have a cycle of drought, you will starve and fail to have food. Food security is important for security and human safety.

According to Dr Oduor, the question then arises: How do we become one people and one region when we have food insecurity? We need to identify areas of food availability in the region, e.g. Uganda has banana which they consume, while maize is grown there to be sold to Kenya. This means we need free trade and movement of food in the region. All this is essential to meet the SDG goals, said Dr Oduor. There are also challenges of climate change, such as drought, diseases and others that have an impact on production, As such, we need
resilience strategies.

The EAC population is growing rapidly and we need to think of how to feed the larger numbers, said Dr Oduor. Agriculture is an important sector in the region which needs to be taken seriously. The youth don’t want agriculture; they need to be encouraged to practice it. But how do we attract them to agriculture? he asked. Agricultural lands are there, yet we are struggling with food insufficiency and food insecurity. There is therefore a need to share opinions on strategies of food production in the region. As an illustration of the prevalent ignorance of the world around us and the need to understand our contexts, Dr Oduor said that whereas Europe asks what is shortage, Africa asks what is food.

Technologies have a lifespan, he said, and we must take advantage of a technology at the right time. He gave the example of coal, which Africa did not benefit from and it has now been passed by that phase of technology since coal is now considered to be “dirty” energy. The Green Revolution, he said, started in the 1940s. The caveat of carbon credit has now come in. AI is an opportunity about to be lost by Africa, just as other opportunities were lost in the past. For example, many professors equate ChatGPT with plagiarism and have not embraced that technology.

Recombinant GMO technology, too, was a lost opportunity. GMO debates, he said, are usually polarized. We need to think of biotechnology and the modification of useful genes. The application of modern biotechnology in health is a worthy undertaking, he said. Insulin is itself a GMO product used to treat Ebola and diabetes. Wrong beliefs on GMOs serve to retard Africa, said Dr Oduor. Anti-GMO technology campaigns make all sorts of claims against it: That it causes cancer, does not germinate, it causes impotence, it causes fertility, it destroys biodiversity, and so on. GMOS are misunderstood, perhaps because of fear of innovations.

Panelists
Prof George Owuor said that stakeholders need to be engaged as one develops an innovation, which means that we must encourage partnerships. In this regard, universities need liaison offices to reach out to industry to sell research products. There is poor awareness of STI, he said. Agro-based industries should have been invited to participate in the congress as users of the technology. There should be a common ICT policy across the region regarding data access and privacy, he said.

The EU, he said, is concerned about food safety for Africa because it imports its food. Therefore, to increase industrial production is part of our development strategy. GMOs are known by few people. Awareness is needed; we need to seek partners, said Prof Owuor.

We need to separate research and business, he said. In this effort, we must
create awareness, develop easy manuals in local languages to reach out to the people, and involve industries in conferences. We need them to hear and dialogue with them. We have good policies, but lack protective policies. Protecting innovations is essential. There is a need for an STI policy across the region to allow us to address data concerns.

**Dr Roy Mugiira** said that the fear of GMO technology is because this touches on life. Scientists can now do genome editing. Three issues are important to recognize:
1. There should be an evidence-based regulatory framework.
2. Bio-economy should be embraced.
3. Build public confidence through enhanced education and awareness

The way forward is for the region to adopt international standards, he said, and work out substantial equivalence in order to use biotechnology to increase production. In seeking to use biotechnology, we must also ask socio-economic questions as well.

**Dr Richard Edema** said that hybrid is not GMO technology. GMO is necessary, he added, when there is no variation. We are looking for better plants all the time for food and other needs. In doing so, we need technological abilities. Dr Edema said it is necessary to identify the type of agricultural crops needed in the region. If maize has a small cob, selection is done to increase their size. Manipulation is done to improve variation. Variation needs to be manipulated to include colour, size, age, etc. Grafting can also be done, he said. We solve problems by creating solutions. The agricultural sector is also beginning to use AI, including the use of drones to analyze plants.

**Prof Joyce Kinabo** reminded conference participants that without plants, there is no life. Plants extract elements from the soil to make food for animals. Agriculture is a sector that manufactures nutrients, and nutrition utilizes them. With improved nutrition, we get improved productivity. Also, the ability to innovate. Large areas of land are allocated to cereals and very little to vegetables. Nutrients cannot be supplied by one crop. The ability by different plants to extract nutrients varies. This calls for diversity of production. Without diversity of production there cannot be diversity of consumption. Diversity in crop production rather than monoculture will address some of the problems, restoring biodiversity. Monoculture leads to a monotonous and less diversified diet. Genetic diversity conservation has largely been lost; genetic materials should be kept for future generations. A genetic store exists in Norway; why can’t we have it here in East Africa? she asked.

Training of agriculture and nutrition should change, said Prof Kinabo. At Sokoine University, agriculture is taught to all undergraduate students. She decried that there is little diversity in cooking methods in East Africa.
KEY POINTS AND EMERGING ISSUES

Whereas the 3rd EAC Regional STI Conference has mainly involved academicians presenting their science, technology, and innovation breakthroughs, industries that are expected to take up and implement these technologies have been absent from the forum. This is also true of the two earlier conferences in Kampala and Bujumbura. However, IUCEA organizes separate engagement sessions with industrialists to bridge this gap and ensure that industry is not left behind.

Access to markets for agricultural produce is not a major issue; rather, of crucial importance is the fact that East Africa still has a lot of arable land for which it needs to identify crops that are critical for serving its own interests.

Curriculums need to be developed for the purpose of advancing science diplomacy, which is necessary to protect the region’s research interests. In this regard, there is a need for collaboration among Partner States to enhance science diplomacy.

The impact of GMO technology on biodiversity also needs to be looked into, as well as the risk of anti-microbial and pest resistance. It was noted that herbicide resistance is lowered by GMO, hence it is unnecessary to spray GMO crops much because they are already protected. The environment and agriculture, however, are about much more than GMOs and there is a need to start thinking about biodiversity. In particular, it is important to take steps to preserve indigenous knowledge and crops.
Preamble
The digital ecosystem in East Africa has been rapidly evolving. The application of digital technology in entrepreneurship has served to accelerate socio-economic development in various spheres. There is a need to build a strong infrastructural base to support the digital revolution and to address the lack of digital skills among entrepreneurs in order to further enhance the digital business landscape, especially among women and the youth. Moreover, challenges of ICT policy constraints and the protection of the intellectual property of innovators will all need to be addressed. This session delved into these issues and made far-reaching recommendations for incorporation into the conference resolutions.

Keynote Presentation: Dr. David Cheboryot, Director, E4Impact Entrepreneurship Centres
The East Africa region has exhibited a strong entrepreneurial mindset with a growing number of digital entrepreneurial intermediaries. However, the existing digital entrepreneurial potential in the region has not translated into a vibrant digital entrepreneurial ecosystem, with commercial digital hubs that can generate talent and ventures to compete at the highest global level. There is a need therefore for the EAC Region to strategically design and implement customized interventions to strengthen the entrepreneurship ecosystem of mutually reinforcing components that include a digital knowledge base and ICT market; a digital business-friendly environment; access to finance; digital skills and e-leadership; and an entrepreneurial culture.

Title of Presentation: Building innovation and entrepreneurship systems by nurturing digital skills.

Session Moderator: Mercy Kimalat, CEO, ASSEK
Session Rapporteur: Dr Samuel Obino Mokaya

Panelists:
- Pascal Nyiringango - Head of Business Development and Commercialization, Center of Energy- ACE-ESD, University of Rwanda
- Denis Denaya - Executive Director, Koneta Hub – South Sudan (Virtual)
- Dr. Amos Nungu – Director General-COSTECH, United Republic of Tanzania
- Dr. Joyce Ngure – Assistant Director of Research, State Department for Higher Education and Research, Ministry of Education

Keynote Presentation
Mr Cheboryot begun his presentation by saying that the emergence of digital transformation had revolutionized the entrepreneurial landscape. It has enabled entrepreneurs to overcome traditional challenges and operate on an unprecedented scale. These technologies have provided access to broader
East Africa has a rapidly evolving digital ecosystem, he said. The application of digital technology in entrepreneurship is the way to go in accelerating socio-economic development in the East African region as this will enable entrepreneurs access and achieve a larger market audience. However, he said, this can only be achieved with creation of an appropriate digital eco-system that provides the necessary infrastructure and support to both prospective and existing entrepreneurs. This is in line with the pursuance and achievement of sustainable development goals in East Africa. Therefore, digital entrepreneurship should be adopted as part of the East African transformation agenda of reaching the masses.

Although digital entrepreneurship is globally recognized as transformation and revolutionary in accelerating socio-economic in the modern competitive business landscape, the major challenge in this endeavour is a lack of adequate digital skills among entrepreneurs. There is a need for universities and other training institutions in the region to play an active role in providing technical skills necessary to improve adoption of ICT in entrepreneurship. Further, entrepreneurship should be part of the curriculum in all programmes as this will help create the masses with capability to engage in successful entrepreneurship. As this is being done, the focus on digital literacy should also extend to the rural masses who have no access to higher learning institutions.

This is justified on grounds that entrepreneurial mindsets have a positive affect successful entrepreneurial and sustainable growth.

The Entrepreneurial Landscape in East African Region
It is no secret that almost each day, several new start-ups are registered but very few run beyond one year due to non-existence of a conducive ecosystem. It goes without saying that a conducive environment is a primary factor that motivates and propels new enterprise creation. Kenya and Egypt are among few African countries that have made great strides in promoting digital entrepreneurship but more needs to be done. The creation of digital hubs and technology centres in both rural and urban areas in the panacea to digital entrepreneurship.

Creation of such hubs and centres is not enough without a friendly regulatory environment. The East African governments need to recognize the role of digital entrepreneurship as a solution to job creation hence formulate and enact policies and laws that support registration and operation of such enterprises. It is noted that Kenya has the highest number of hubs and coding schools in East Africa and should be used as a model to promote digital entrepreneurship in the region. It is widely recognized that hubs provide fertile grounds for innovation among the youth who are the creators and consumers of digital products. Further, there should be deliberate efforts to encourage the youth to engage in digital entrepreneurship to provide jobs and enhance socio-economic development in
The contention is based on grounds that digital entrepreneurship is applicable in any sector of the economy – agriculture, health, etc. Emerging sectors included Edutech (the use of digital technology to facilitate education), Fintech (financial technology) and Healthtech (health technology). We therefore need to position innovators as creators of technology and give them a significant voice. Egypt, Kenya, Nigeria and South Africa constitute 60% of Africa’s digital entrepreneurship.

Opportunities for Digital Entrepreneurship
A number of opportunities exist for digital entrepreneurship. They include:
1. High optimism among the youth to engage in digital entrepreneurship.
2. Shift to e-commerce in conducting business as it reduces trade costs such as mobile money.
3. Increase in digital literacy provided through programmes in training institutions.
4. Introduction of friendly reforms that encourage more people into entrepreneurship as a solution to job creation.
5. Digital transformation creates technological spill-overs to almost all other sectors.
6. Operationalization of the African Continental Free Trade Area (AfCFTA) that will give digital entrepreneurs a larger area in which to operate through access to a larger market.

Unique Challenges to Digital Entrepreneurship
Digital entrepreneurship is defined as digitalization of all or part of business processes. This should deliver solutions for sustainable development. Even though recognized as a solution to job creation and enhanced socio-economic development in the East African region, the adoption of digital entrepreneurship still remains low. This is attributable to a number of challenges. These include inadequate infrastructure, especially internet access in large parts of these countries. It is important to note that the internet is the primary facilitator to digital entrepreneurship and its limited access is therefore a major hindrance.

Mentorship programmes are essential. Up to 80% of opportunities are concentrated in urban areas. Digital skills penetration is quite low in rural areas, he said. For instance, there is insufficient use of e-payment systems. There is also poor needs assessment on digital and technology requirements for entrepreneurs – there is scanty data on the use of digital entrepreneurship to help inform policy and operational guidelines.

There is inadequate awareness of intellectual property rights leading to loss of innovations to big companies with no benefit to the innovators who are usually the youth. It is laudable that EASTECO has formulated an IP policy to guide development and management on innovation in the region. There is also no established arrangement bringing key stakeholders to create the required eco-system for digital entrepreneurship – government, private sector, training institutions, entrepreneurs among others.
Conclusions
It is evident that great strides have been made in promoting and supporting digital entrepreneurship in the region, said Mr Cheboryot. A number of governments have developed policies and programs for its promotion while others have not. Governments however need to do more to promote digital entrepreneurship in the region, especially among the youth and women.

It is also important to note that adoption of digital entrepreneurship is still low in the region which makes cost of doing business high hence low profits and stunted enterprise growth. The existence of a number of digital hubs and technology centres is critical to promotion of digital entrepreneurship. Programmes to promote digital entrepreneurship are scarce in the region. Awareness on digital entrepreneurship by the population is still low in the region.

Panelists
Pascal Nyiringango said that we should be thinking of moving from Education for All to Education for Impact. Technological transfer is therefore important for this to happen. Universities are very rich in talent, he said, but are not good in commercialization. Universities need to charge for use of the talent among them. Synergy can be developed between the universities, who have the talent, and the industries, who have the money.

Dr Nyiringango agreed with the keynote speaker that you cannot have proper digital solutions without infrastructure. If one is not connected to the internet, for example, it is not possible to innovate. Kenya has high connectivity, contributing to making it second in Africa in innovation. It is a threat, he said, when over 65% of young people in Rwanda and other countries in the region are jobless.

Dr Amos Nungu said the region should be encouraging more innovation hubs, with the support of governments. Mentorship programmes are important in this respect. As long as the Commission for Science and Technology (COSTECH) endorses an innovation, he said, no tax is paid for an innovation for a fixed period of time. The commission advises the government on policy issues. The government is in the business of providing a conducive environment for innovation to happen.

Dr Joyce Ngure said that the Ministry of Education has a directorate of research, science and technology. The ministry nurtures NACOSTI and other agencies under it to handle STI issues. There are research institutions, higher education institutions including universities and TVETS, the government as the enabler, and then industry. The research institutions and universities have been producing innovations, she said, as witnessed by some of those at the conference exhibition stands. The ministry nurtures innovators through training and mentorship for all stakeholders. Unfortunately, sometimes industry is not represented, as was the case in the present conference, she said. Yet, they are a critical part of innovation. Some researchers have no idea of the goldmine that they are sitting on. A case in point is when a clinical person is told to collect data, which they do and give
the data as it is to donors. She then posed the question: What do donors do with that data? The pharmaceutical industries begin targeting us with diabetes and hypertension medicines and we become consumers of innovation products rather than for us producing our own products. Some of our innovators do not know that they are supposed to keep their innovations secret. They tell each and every secret of how they got the innovation. Some people from other countries come simply to take away data from our innovators.

The ministry also tries to encourage multidisciplinary research, she said. Research must not only Involve Researchers In Other Disciplines, But Also Industry. For Instance, Research On Leather Should involve the leather industry to specify what their problems and needs were. The ministry has also tried creating a database of all researchers and innovators, she said.

Denis Denaya, joining the conference virtually, said that he met other IT professionals and was inspired to begin Koneta Hub, which was now three years old. The word “Koneta” means “Let’s do it.” They work in the area of digital inclusion, he said, for different categories of people including students. The idea is to spark an innovation mind-set for university students.

Digital technology, he said, enables people to better sell their ideas, goods and services. If one does not have the skills to manoeuvre on the Internet, even using social media becomes a problem. Having the Internet is important, he said, and one must be intentional about it.
KEY POINTS AND EMERGING ISSUES

Countries should fund their own research. Foreign funding comes with conditions. A dedicated innovation fund is important in this regard.

Industrial linkage with academia is missing. It is difficult to get industries to pay for innovation where there is no competition hence no incentive. Governments, academia and industry all have a role, but the government should take the lead.

EASTECO was lauded for launching its Intellectual Property and Science, Technology and Innovation policies, which is a positive step. The approach to innovation should however be demand driven, with efforts to empower communities to come up with problems that can be handled by research institutions. An innovation without market uptake will die, because no one wants it. This is being tackled through design innovation and measures to find out what the market wants.

Achieving a 24-hour economy is important for hastened development. Governments should in addition promote internet/Wi-Fi access to all areas to facilitate digital entrepreneurship.

Recognizing prior learning – i.e. African traditional knowledge – is also important. Traditional and cultural knowledge should be protected. Indigenous knowledge can be used to make industrial products, e.g. Amarula. Moreover, existing successful digital entrepreneurs should be used as role models motivations for the youth through networking events and guest speaking in academic institutions.

Students should specialize in the second year at university after identifying areas of interest. They should not specialize in the first year. Curricula should also be regularly updated. We should incorporate industry in curriculum development; in fact, it was noted that for new programmes, there is stakeholder engagement but this has not been the case for old programmes.

Technical education should take centre stage in secondary schools to create a technology and innovation culture at the formative stage in learning. Additionally, universities and other training institutions should re-engineer their programmes to be practical-based than theoretical, which is the current case with many of them. This will enable the youth to engage in entrepreneurship while still in college and thereafter.

Promotion of dons in universities and other tertiary institutions should also be pegged on how their research efforts have led to the creation of commercialized innovations and products – solutions to community problems – and not merely publications in journals.
DAY TWO

The second day of the conference saw myriad activities, with two Plenary Sessions and nine Parallel Sessions. The third Plenary Session of the conference tackled the theme, Open Science and Science Diplomacy: Bridging Borders for Global Impact.” The keynote presentation, panellists’ session and plenary discussions delved into the emergence of open science and the ways in which it could be mainstreamed in academia while taking care of Intellectual Property concerns.

The theme of the fourth Plenary Session was, ICT emerging technologies in driving digital transformation in industrialization in East Africa.” The keynote presentation, panellists’ session and plenary discussion led to a number of key recommendations on how regional economies can harness digital technologies in various industries in order to generate inclusive growth and eradicate poverty.

Parallel Sessions 1 was held in between the two Plenary Sessions. Each of the six parallel sessions saw presentations and discussions of up to four papers touching on specific areas of recent scientific research, technology and innovation. Parallel Sessions 2 was divided into three sessions, with each of these parallel sessions tackling up to three presentations on recent research areas.
PLENARY SESSION 3

Open science and science diplomacy: Bridging borders for global impact.

Preamble
Thought leadership in the area of open science is needed more than ever before in order to advance its objectives and overcome the fears that have held back many researchers from embracing it. Open science is not just about access to research publications, even though this is important; it is also about providing the right context to understand research, the resources to replicate it, the tools to collaborate and make science better, and building the framework for a more equitable participation and distribution of knowledge. This session focused on addressing the challenges facing open science, for which it is also critical to adopt a collaborative multi-sectoral approach that ropes in all the EAC Partner States; this is because the potential value of Intellectual Property derived from the commercialization of protected products and services goes beyond the confines of individual Partner States. Hence, the IP system of any individual state is incapable of adequately safeguarding the rights of inventors and creators against IP challenges.

Keynote Presentation: Ms Joy Owango, Executive Director, Training Centre in Communication

This conference theme aims to explore the dynamic relationship between open science principles and the practice of science diplomacy. Open science emphasizes transparency, accessibility, and collaboration in research, while science diplomacy focuses on building international partnerships to address global challenges. The intersection of these two concepts creates a powerful synergy that can foster innovation, address shared global issues, and promote mutual understanding.

Title of Presentation: Identifying challenges in implementing open science and science diplomacy and exploring opportunities for overcoming barriers to collaboration.

Session Moderator: Dr Joseph Ssemakula
Session Rapporteur: Milton Melingasuk

Panelists:
- Dr Richard Glover- UNESCO Consultant
- Prof Meoli Kershorda – Executive Secretary, Kenya Education Network
- Prof Muliaro Wafula – Lead Scientist, Africa Open Science Platform (AOSP) EA Node
- Mr. Steven Ssebbale – Head of Policy, Uganda National Council for Science and Technology

Keynote Presentation
Ms Owango started her presentation by explaining the objectives of the Training
Centre for Communication that she heads, which she said seeks to train, support and empower researchers, institutes, and governments through capacity building in improving the visibility and impact of their research at an individual, institutional, national and regional level.

She further explained the goals of the organization as to:
(i) Empower researchers – to transform science through inclusivity, choice, credit and transparency;
(ii) Redefine quality – to assess and communicate the full arc of research more fairly and accurately; and
(iii) Open science – to build a foundation of knowledge from which we all advance.

Ms Owango then focused on the last goal to do with open science, which itself has several goals:
(i) Ensure integrity and earn trust;
(ii) Foster collaboration and build on existing work;
(iii) Accelerate research dissemination; and
(iv) Enable ALL to participate in the process/benefits of science.

Saying the cost of research is high, Ms Owango said access to research is also limited. This makes the case for open science compelling, for which EASTECO has been a partner of TCC. The Centre, she said, had supported over 30,000 researchers over the years. PLOS were first to advocate for Open Science. In the transition to open science, she said, access is just the beginning. “Open” is about more than just being able to read or share an article. It is about providing the right context to understand it, the resources to replicate it, the tools to collaborate and make science better, and building the framework for more equitable participation and distribution of knowledge.

All this, she said, requires open science thought leadership; advocacy and engagement; open science communities of practice; and increasing equitable participation in open science. Subscription-based publishing models, Ms Owango said, create barriers to access knowledge. Article Publishing Charges (APCs)-based models create barriers to participating in knowledge creation. Hence, there is a need for new models for sustainable and equitable open access. Open science, she said, requires action to make its importance understood. Additionally, it calls for targeting of stakeholders, who may include: Ministries and directorates responsible for STI; higher education/university commissions; national research councils; funders; representative(s) from National Consortium (Library consortia); and institutional leaders.

The case for advancing open science, she said, is based on the following grounds:
• Open Science presents a compelling case for transformational science, efficiency and higher return on investment of public research funding.
• There is urgent need for Policy frameworks, national guidance to address
policy development gaps.

- The UNESCO Recommendation on Open Science – we now have an internationally agreed definition, as well as a set of shared values and guiding principles for open science.
- It also identifies a set of actions conducive to a fair and equitable operationalization of open science for all at the individual, institutional, national, regional and international levels.
- For this to be effectively achieved, continuous Capacity Strengthening needs to be done at institutional, national and regional levels through strategic multi-stakeholder engagement.

There is a need to have national dialogues in each country on Open Science, she said, bringing in all the stakeholders to discuss IP rights, compensation, etc.

**Barriers and Challenges**

Ms Owango enumerated the barriers and challenges to open science as:

- Leadership
- Infrastructure
- Rewards and incentives
- Research integrity (ethical issues)
- Legal (including Intellectual Property)
- Ethical issues

Finally, in order to advance the cause of open science, Ms Owango suggested the following measures:

(i) National/ Regional Open Science Policy Dialogues should be multi-sectoral
(ii) Innovative rewards and incentives schemes (government vs Institute)
(iii) Cohesive conversation among Stakeholders on Open Science
(iv) Develop or adopt the best and reliable Open source infrastructures (platforms, repositories etc.) which are cost effective.

**Panelists:**

**Dr Richard Glover** gave a presentation virtually on, “Readiness of Eastern African Countries for Implementation of the UNESCO Recommendation on Open Science.” He provided excerpts from a UNESCO study on Enabling Environment for Open Science in Eastern Africa and Draft Eastern Africa Implementation Strategy. The study covered the 15 countries of Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, South Sudan, Sudan, Tanzania, and Uganda. The study enumerated the challenges faced by open science in these countries as:

- Low level of research maturity and lack of research cooperation
- Lack of institutional and national policies/strategies
- Lack of technical expertise/inadequate staffing/skills
• Limited investment of financial resources in Open Science infrastructure and activities
• Lack of commitment/poor institutional/government/donor support for research and ICT infrastructure
• Lack of advocacy and sensitization/low awareness about Open Science
• Misperceptions/Scepticism about Open Science (Kenya, Tanzania and Uganda)

After examining the opportunities for open science in individual countries in the region, Dr Glover made the following policy recommendations:

• Adequate financial resources, e.g. from national R&D budgetary allocations of the target countries, should be directed towards investment in open science infrastructure and activities.
• National governments, institutions, donor agencies and other research stakeholders in the target countries should support provision of ICT infrastructure (internet connectivity, institutional repositories) to enhance open science activities.
• Training in open science activities should be up-scaled to stem the apparent low level of research maturity and technical expertise as well as inadequate staff with requisite skills in this vital area in many target countries.
• Supporting mechanisms such as material and financial resources should be directed by national governments and institutions towards enhancing collective and large-scale advocacy and awareness creation which is hitherto an isolated effort of small advocacy groups, so as to curtail the growing misconceptions and scepticisms about open science.
• Governments and institutions should establish enabling legal frameworks and governance structures to regulate, build trust and ensure decorum in open science activities in the target countries.

Prof Meoli Kershoda gave a presentation entitled, “Research Engagement @ KENET: Promoting open science practices in Kenya.” He said KENET was endorsed as National Research and Education Network (NREN) of Kenya by the Ministry of Education. In presenting his case for the adoption of open science practices, he gave figures for research activities of various countries in Africa that showed that the region lagged far behind South Africa, Egypt and Nigeria. Prof Meoli suggested that the research productivity of East African countries could be increased tenfold through the following measures:

• Adoption of open science practices by universities and research institutes
• Research engagement at scale in all STEM areas
• PhD scholarships for young graduates (less than 30 years) in STEM areas
• STEM talent pipeline is broken – lack of careers and employment even for PhDs in Physics or engineering!!
• Academic leadership
Prof Muliaro Wafula, in his presentation, focused on what he called the “Diplomacy Trinity” and its benefits. This Diplomacy Trinity consists of:

- Diplomacy for science – the use of diplomatic action to facilitate international scientific collaboration.
- Science for diplomacy – soft power to advance diplomatic objectives
- Science in diplomacy – direct support of diplomatic processes through science. Support decision-making in foreign and security policies.

Prof Wafula enumerated the EAC STI sectoral policy objectives for open science as being to:

- Promote the development of effective institutional, national and regional open science policies and legal frameworks
- Align Open Science policies, strategies, and actions from individual institutions to local and international levels
- Encourage research-performing institutions, particularly those in receipt of public funds, to implement policies and strategies for Open Science.
- Recommend economic investment in Open Science and Open.
- Recommend that academic research and knowledge from the East African region be freely available to all who wish to access, use, or reuse them while at the same time being protected from misuse and misappropriation.
- Emphasize recognition, respect, and acknowledgment of the regional diversity of East African (and African) scientific journals, institutional repositories, and academic systems and, conversely, that researchers and corporations in the East African region should benefit from being able to access research.
- Encourage research-performing institutions, universities, university commissions, scientific unions and associations, and learned societies to adopt statements of principle in line with the Open Science policy.
- Recommend shared values and principles for Open Science, identifies measures on Open Access and Open Data from partner states, and brings citizens closer to science and commitments to facilitate the production and dissemination of scientific knowledge in the East African region.
- Develop Open Science and Open Access values and measures through a regionally balanced, multi-stakeholder, inclusive, and transparent consultative process. The proposed policy initiatives should promote Open Scholarship, Open Source, and Open Standards for interoperability purposes.
- Promote STI enabling environments through the committed provision of quality open-access digital research materials.

He said the African Open Science Platform (AOSP) had an important role to play given that the potential value of Intellectual Property derived from the commercialization of protected products and services goes beyond the confines of individual Partner States, hence the IP system of any individual state is incapable of adequately safeguarding the rights of inventors and creators against IP challenges across national borders. The AOSP EA Node seeks to develop and
offer e-infrastructure (notably repositories of documentation, information systems and automated mechanisms for fast-tracking the assessment, registration and grant of IP rights) in order to stimulate research, innovation and creativity; enable access to technology; and promote the growth of enterprises.

Steven Ssebbale said work was ongoing on an initiative bringing together 17 African counties, and this includes Open Science. He spoke of the need to come up with ways to deconstruct long-held scepticism regarding Open Science. Challenges, he said, will have to be dealt with methodically so that Open Science can be embraced. Even though open science was still an embryonic concept, he said, building partnerships with other countries will help in its development.

KEY POINTS AND EMERGING ISSUES

The kind of mathematical models used in ICT, it was noted, are also useful in other areas, e.g. agriculture. Computational resources are therefore not restricted to engineering or science. Open Science is however data intensive and computing intensive.

Open access is a subset of open science. Researchers decide who to grant access to data. Therefore, “open” does not mean data is accessible to anyone. It only means one can give access to collaborators. In fact, even though open science is assumed to be free, many academics have to pay to be published. It was noted that the WB Equitable Publishing Programme has been created, which is free to publish and free to read.

A majority of countries in the EAC are poor negotiators; the issue of how to secure Intellectual Property rights before a publication goes on Open Science platforms was discussed extensively, including how much information to release without putting everything out into the public. This is related to the issue of data diplomacy, with some countries ready to give out data and others unwilling. It is therefore critical for the EAC countries to come up with a common ICT policy.

Infrastructure, training of students, and application could be done from outside the region even if research is published collaboratively. This raises questions of quality, an aspect that has to be addressed.

A certain level of ICT readiness is needed to engage in Open Science, and it was noted with concern that some TVET institutions were lagging far behind. Yet, inclusion of TVET institutions is important, especially because they tend to focus on applied research rather than pure academic research. KENET is creating shared infrastructure, which means different universities can share infrastructure.
PARALLEL SESSIONS 1: PAPER PRESENTATIONS

Preamble
Six Parallel Sessions were held, 1A to 1F, each with four papers lined up. Each of the six sessions was focused on one sub-thematic area, and these were: Precision Agriculture Technologies and Data Science in Agriculture; Water Resources and Waste Management; Biomedical Engineering and E-health; Biodiversity and Forestry and Agroforestry; Climate Change Mitigation, Bioeconomy and Environmental Health; and Nutrition and Environmental Health. The papers presented gave detailed case studies indicating the background of the study, the problem, the methodology utilized, research findings, and recommendations.

Parallel Session 1A – Precision Agriculture Technologies, and Data Science in Agriculture

Session Moderator: Dr Joshua Ogendo
Session Rapporteur: Dr Charles Masembe

Presentations:
2. Climate Smart Agricultural Technologies (TIMPS) as a Resilience Strategy for Semi-Arid Agroecosystems Production in Kenya by Hellen W. Kamiri.
4. Exploring the Integration of Emerging Technologies in Agriculture 4.0 to Enhance Food Security in Sub-Saharan Africa: A Comprehensive Review by Harriet Ratemo

Using Normalized Difference Vegetation Index to Predict Potato (Solanum Tuberosum L.) Apical Rooted Cuttings Yields in Njoro, Kenya
WINNIE CHEBET WAMBUGU

The potato, Ms Wambugu said, is the second most important food crop in Kenya; however, 98% of smallholder farmers lack access to high-quality seed. Seed potato yield estimation prior to harvest plays a vital role in the Kenyan economy. Current methods of yield predictions involve the use of conventional techniques, but face a dual challenge: Poor predictions due to errors caused by incomplete ground observations; and the fact that they are time consuming, expensive, and heavily rely on soil and plant tests. Developing a rapid and convenient approach for timely yield estimation would be impactful, she said. Little research has been made on seed potato yield prediction using GreenSeeker and more specifically in controlled...
environments in Kenya.

The Normalized Difference Vegetable Index (NDVI) can be accurately used to predict crop yield, tests show. NDVI proved effective in predicting potato apical rooted cuttings yields. This information can be used to improve potato production in Kenya by helping farmers make informed decisions about planting, fertilizing, and harvesting. Ms Wambugu recommended that farmers should use GreenSeeker at 60 DAP for accurate yield prediction. She also said that further research was needed to validate these findings in field conditions.

Climate Smart Agricultural Technologies (TIMPS) as a Resilience Strategy for Semi-Arid Agroecosystems production in Kenya

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Abstract

Improving soil moisture levels is a fundamental strategy to enhance crop productivity and the resilience of semi-arid agroecosystems. Zai pits and semicircular bund technologies coupled with the right climate smart crops offer great agro ecological potential as such practices conserve soil moisture, improves the soil ecology, stabilizes and enhances crop yield and water conservation. These technologies have been tested in several regions in African but side-by-side evaluations on same farm have not been validated. Thus, this study evaluated and validated performance of selected land, soil and water management strategies in conserving soil moisture and improvement of crop production. The study adopted an integrated land and water management approach which incorporated validation of existing climate smart natural resource management practices when applied together with climate smart crops. A Side-by-side comparison of crops and soil water management measurements was implemented for Zai pits and semicircular bunds for soil moisture conservation in green grams and pigeon pea cropping in Machakos and Tharaka Nithi counties of Kenya. Biometric data collection, yield and yield components and monitoring of soil moisture was carried out in the long rains and short rains of 2021 and 2022. Our findings showed significant improvement in the yield of climate smart crops planted in Zai pits and semicircular bunds. Water and soil management practices had significant effect on soil moisture retention during the study period at 0-15 cm soil depth at various growth stages. Zai pit had the highest soil moisture levels which corresponded to a significantly improvement in yield by 43 and 30% in green grams and pigeon pea respectively compared to a control across the seasons and crop growth stages. The studied technologies emphasize the importance of diversifying climate smart strategies in farming systems to enhance resilience of agricultural systems and reduce vulnerability to extreme climatic events.

Keywords: Climate Smart Agricultural Technologies, Green grams, Soil moisture, Crop Yield, Zai pits
Development and evaluation of a reverse transcription loop-mediated isothermal amplification (RT-LAMP) for rapid typing of serotype ‘O’ foot-and-mouth disease virus in endemic regions of Tanzania
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Abstract
Foot-and-mouth disease (FMD) is an economically viral disease of all cloven-hoofed animals. Caused by FMD virus (FMDV), the disease threatens sustainable food production which is geared towards solving food security problems and poverty. In Tanzania, four serotypes are in circulation but serotype ‘O’ has the widest distribution. The disease is endemic in Tanzania with outbreaks occurring annually, with losses evidenced in production, death in young stock, and trade sanctions on livestock and livestock products, hence timely diagnosis is vital to inform on control measures. A reverse transcription loop-mediated isothermal amplification (RT-LAMP) assay that can rapidly and accurately diagnose serotype ‘O’ FMDV under laboratory settings was developed for appropriate management of the disease. A total of 44 archived FMDV epithelial tissues from cattle collected from different regions in Tanzania were purposively employed and LAMP primers were designed using Primer Explorer V5 software. The virus was screened using RT-LAMP from extracted total RNAs, while the detection of serotype ‘O’ VP1 gene was carried out using the designed LAMP primers. To determine specificity, cross-reactivity was evaluated using serotype ‘O’ primers against other FMDV serotypes while sensitivity was inferred as a detection limit by conducting an RT-LAMP assay on a serial ten-fold dilution of one viral sample. The RT-LAMP assay successfully amplified the 3D polymerase gene of FMDV. The VP1 gene of serotype ‘O’ FMDV was detected within 13—26 min, with annealing derivatives in the range of 70.0—89.0°C. The assay was highly specific as no cross-reactivity occurred and recorded a detection limit of 3.78 ×10-2 ng/µl at 10-2 dilution. This assay is rapid, accurate, and cost-effective. Furthermore, it enhances FMDV surveillance, provides baseline information for managing outbreaks, and supports the development of serotype-specific vaccines, ultimately addressing concerns related to food security and agriculture.

Keywords: LAMP, FMDV, VP1 gene, diagnosis

Exploring the Integration of Emerging Technologies in Agriculture 4.0 to Enhance Food Security in Sub-Saharan Africa: A Comprehensive Review
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Abstract
The purpose of this study was to examine the state of research into the integration of emerging technologies in Agriculture 4.0 (A4.0), to identify the key determinants influencing the assimilation of these technologies in A4.0 while also identifying challenges and unexplored
avenues for exploration in the specific unique context of Sub-Saharan Africa. A structured literature review methodology was used in this study. The authors reviewed research literature published between the years 2012 and 2022 which yielded insights from 55 articles. Our scrutiny revealed a notable dearth of studies concerning A4.0 technologies in the Sub-Saharan context. Despite this gap, our analysis of the key technologies in terms of A4.0 underscores that the majority of literature concerning these technologies is still in its early stages. In certain instances, the literature is conspicuously absent. About sub-Saharan Africa, certain A4.0 technologies, such as digital twins, lack established use cases. We observed that a few authors are continually engaged in this field, with their contribution often having limited visibility in mainstream databases and publications.

This study further illuminated a scarcity of diversity and rigor in the methodological approaches adopted by authors, coupled with restricted usage of theoretical models or frameworks despite the few that were used. This study was able to aggregate the primary determinants influencing the adoption of A4.0 technologies and use cases with evidence in the Sub-Saharan context. In terms of originality and value, this study provides a comprehensive systematic literature review of research published on Agriculture 4.0 within the context of Sub-Saharan Africa.

**Keywords:** Agriculture 4.0, A4.0 adoption frameworks, Food Security, Smart Agriculture

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**Parallel Session 1B – Water Resources and Waste Management**

**Session Moderator:** Dr Charles Niwagaba  
**Session Rapporteur:** Dr Lughano Kusiluka

**Presentations:**
1. The Impact of High Turbidity Feed Water on The Performance of Gravity-Driven Membrane Modules by Mutenyo Mercy
2. Study on the evolution of physicochemical parameters indicators of water quality in the pelagic zone of the northern Lake Tanganyika basin by Stanislas Ndayishimiye
4. Implications of adopting insects for recycling organic waste on household recycling income by Perpetual Galena

**The Impact of High Turbidity Feed Water on the Performance of Gravity Driven Membrane Modules**

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Abstract

Majority of the low-income households in Uganda who use surface water, collect it from ponds, rivers and lakes at turbidity in the range of 60 – 160 NTU. Evident increase in this turbidity is observed mainly after rainfall events. The Gravity Driven Membrane (GDM) system is a low-cost water treatment method fully driven by gravity thereby requiring no electricity for operation. The filters also do not require regular back flushing for sustainable operation. This makes the system low- cost. This study evaluated the performance of the GDM filters with raw water of high turbidity. Flux values, turbidity, pH, electrical conductivity, temperature and E. coli were monitored both in the raw water and filtered water. The flux values were observed to be in the range of 5-22L/h/m². The data collected indicated a 99% removal of turbidity.

A decrease in E. coli from too numerous to count to an average of 7 CFU/100 mL with log removal value of 2-3 was obtained. There was no significant difference between the pH and electrical conductivity of the raw water and filtered water indicating that GDM is not suited for treatment of water with high dissolved solids content. The GDM if used with other treatment methods like chlorination has the potential to be applied for the provision of affordable safe water to rural Ugandans. (217 words).

Keywords: Gravity-driven membrane (GDM); flux stabilization; ultrafiltration; high turbidity; water treatment

Evolution of physicochemical parameters in the pelagic zone of the northern Lake Tanganyika basin

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Abstract

The northern of Lake Tanganyika in vicinity of Bujumbura City is more exposed to anthropogenic impact than the rest of the aquatic ecosystem. The aim of this study was to assess changes in the physico-chemical quality of the water column on two sites of the pelagic zone of the northern basin of Lake Tanganyika, one offshore Nyamugari beach and the other offshore Bujumbura port, near the REGIDESO raw water catchment site. To perform the study, a three-month sampling campaign was carried out. The water column at different depths between 0 and 100m offshore Nyamugari beach and between 0 and 35m offshore Bujumbura port was sampled. Twelve physico-chemical parameters were investigated, some of them were measured directly in situ, other samples were taken for laboratory analysis at the Faculty of Sciences of the University of Burundi. Parameters such as COD, BOD5 and nutrients concentrations were analyzed. The results showed a vertical thermal stratification, varying in intensity and unstable in July for the site offshore Nyamugari beach. For the site offshore Bujumbura port, the water column remained homogeneous throughout the sampling period, with high turbidity consistent with low water transparency. Temperature, dissolved oxygen, pH, conductivity and TDS showed values and profiles similar to those obtained in the previous researches. Similarly, higher nutrient concentrations were observed in hypolimnion than in
the epilimnion and this corroborates the results of previous researches. However, the values of COD and BOD5 concentrations found at the site offshore Bujumbura port, ranging from 4 to 330mgO2/l and from 0 to 20 mgO2/l respectively, indicate a major organic pollution especially concerning as it is near the REGIDESO raw water catchment site.

**Keywords:** Lake Tanganyika, northern basin, pelagic zone, physicochemistry, stratification

**Waste Reduction, Biomass Conversion and Growth Performance of Black Soldier Fly Larvae Using Organic Waste**

DESTA MULU

**Implications of adopting insects for recycling organic waste on household recycling income**

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**Abstract**

Managing organic waste, especially in urban and peri-urban areas, is a significant challenge that calls for local and efficient waste management solutions. The use of insects such as black soldier fly (BSF) is emerging as one of the local solutions that bio-convert organic waste into larval biomass and the residual is a nutrient-rich organic fertilizer. However, the adoption levels of BSF are low. Understanding the implication of using the insects on household waste recycling income is vital in promoting their use in organic waste management. Primary data was collected from a sample of 222 households, 105 using BSF and 117 using conventional composting in Kiambu County. STATA software was used in running the Endogenous switching regression model. Our findings revealed that factors such as the size of land for recycling organic waste, access to information on efficient organic waste management, access to segregated waste, distance to the source of waste, and value addition/amendment of organic fertilizer significantly influenced the selection of BSF as an approach for recycling organic waste. The average treatment effect (ATT) among households using BSF was 2.224 (18.7%) indicating that the adoption of BSF positively affected household recycling income. Moreover, the average treatment effect on the untreated households (those not using BSF) indicated that the households would increase their recycling income by 18.8% if they adopted BSF in recycling organic waste. Our findings reveal the potential of BSF in producing frass fertilizer as an additional household income, and alternative to inorganic fertilizer for agricultural production. Policy development on efficient waste management should be aimed at increasing awareness on the economic, environmental and circular economy benefits of using BSF for organic waste recycling. Moreover, households should be encouraged to adopt BSF so that they benefit from recycling organic waste into fertilizer and animal feed protein. (297 words).

**Keywords:** Black soldier fly, conventional composting, recycling, organic waste management
A GIS-Based Method for Analyzing the Impact of Physical Planning in the Spread of COVID-19 in Kampala City

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Abstract

This study focused on analyzing the impact of Physical planning on the spread of COVID-19 in Kampala City, Uganda. This assessment was done based on the confirmed COVID-19 cases registered between 21st March 2020 and 27th March 2021 and the Kampala Physical Development Plan of 2012 as a standard to determine the level of conformance to Physical planning in Kampala City. The GIS-based methods that were used were the global Moran’s Index, Anselin’s Local Indicator of Spatial Association (LISA), Post-Classification Change detection, and the Geographically Weighted Regression (GWR) model. The Global Moran’s I was used to determine global spatial autocorrelation whereas Anselin’s LISA was used to determine the local spatial autocorrelation. The post-classification change detection was used to determine the level of conformance to spatial planning between the Kampala physical development plan and the existing land uses. The GWR was used to model the relationship between conformance to Physical planning and the spatial distribution of COVID-19 cases.

Spatial distribution results show that the distribution characteristics of COVID-19 across Kampala are distinct with instances of clustering. Parishes located in the Central Business District were identified as the major disease risk whereas those located in the suburb Divisions of Kawempe, Makindye, Nakawa, and Rubaga were identified as cold spots of COVID-19. The trend of Physical planning in Kampala shows that the city is moving towards mixed-use developments with a positive non-conformity of 25.11%. Analysis through the GWR revealed a negative relationship between Physical planning and spatial distribution of COVID-19. Also, relationship results further specified that Physical planning could explain 51% of the variations in the spatial distribution of COVID-19 cases within Kampala City. Therefore, to transform Kampala into a pandemic-resilient city, there is a need to develop appropriate compact Physical planning designs. (291 words).

Keywords: Physical Planning, COVID-19, Kampala City
Sterilized malaria vector, Anopheles funestus can autodisseminate sufficient pyriproxyfen to the breeding habitat under semi-field settings

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Abstract
An. funestus, the dominant malaria vector, prefers to oviposit in permanent and/ or semi-permanent breeding habitats located far from human dwellings. Difficulties in identifying and accessing these habitats jeopardize the feasibility of conventional larviciding. Therefore, a semi-field study was conducted to assess the potential of autodissemination of pyriproxyfen (PPF) by An. funestus for its control. This study was conducted inside a semi-field system. Therein, two identical separate chambers, the treatment chamber with a PPF-treated clay pot (0.25g AI), and the control chamber with an untreated clay pot. In both chambers, one artificial breeding habitat made of a plastic basin with one liter of water was provided. Three hundred blood-fed female An. funestus aged 5-9 days were held inside a clay pot for 30 minutes and 48 hours before being released for oviposition. The impact of PPF on adult emergence, fecundity, and fertility through autodissemination and sterilization effects were assessed by comparing the treatment with its appropriate control group. Mean (95% CI) percentage of adult emerged was 15.5% (14.9 – 16.1%) and 70.3% (69 – 71%) in the PPF and control chamber for females exposed for 30 minutes (p < 0.0001) whereas, was 19% (12 – 28%) and 95.0 (88 – 98%) in the PPF and control chamber for female exposed for 48 hours (p < 0.0001) respectively. Eggs laid by exposed mosquitoes and its hatch rate were significantly reduced compared to unexposed females (p < 0.0001). Approximately, 90% of females exposed for 48 hours retained abnormal ovarian follicles and only 42% in females exposed for 30 minutes. The study demonstrated sterilization and adult emergence inhibition via autodissemination of pyriproxyfen by Anopheles funestus. Additionally, it offers proof that sterilized An. funestus can transfer pyriproxyfen to prevent adult emergence at breeding habitats. These findings warrant further assessment of the autodissemination of pyriproxyfen in controlling wild population of Anopheles funestus, and highlights its potential for complementing LLINs.

Keywords: Anopheles funestus, Autodissemination, Pyriproxyfen, Sterilization, Semi-field settings.
Factors associated with Menstrual Hygiene Management among adolescent girls in primary schools in Northern Division, Mbale city

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Abstract
The study sought to assess girls’ knowledge, attitude, and practices regarding menstrual hygiene management in Northern Division, Mbale City, Uganda. Active participation of the girl child in development is hampered by MHM challenges. MHM is an important gender issue and a critical component in holistic human development. It affects about 25% of the global population aged between 15 and 49 years. MHM amongst girls in rural government-run primary schools in Uganda is an under-examined area of research. The study aimed at assessing girls’ Knowledge, Attitudes and Practices regarding MHM in Mbale City to generate data that would be used to plan for a program to create awareness about MH which will improve education and improve quality of life. A cross sectional study that involved collection of quantitative data. Data was collected using pre-tested semi-structured questionnaires developed from reviewed literature. Data entry and cleaning was performed using EpiData version while analysis done using Stata version12. Proportions, measures of central tendency and measures of variation were used to describe the study subjects, the results were summarized into graphs, tables, and pie chart. A total of 408 primary school pupils were interviewed.

The study respondents were randomly selected from 10 primary schools using simple random sampling technique. Overall 237/408 (58.2%) not knowledgeable about menstrual hygiene. Majority 213/408 (52.4%) good attitude towards menstrual hygiene. 310/408(76.2) believed that menstruation was not a burden to women. More than half of the respondents 223/408 (54.55%) good menstrual hygiene practices. 208/408 (51%) used good absorbent materials and 245/408 (60.1%) changed pads twice a day. Fathers’ occupation, mother’s occupation and source of information were found to be significantly associated with knowledge of children regarding MHM. Age, parent’s education level, parents’ occupation and source of information were significantly associated with practice of children regarding MHM

Keywords: menstrual hygiene management; knowledge, attitudes, Practices, global population, holistic human development

Co-administration of Artesunate and Coenzyme Q10 enhanced treatment outcomes during experimental cerebral malaria by ameliorating lethal inflammatory and oxidative mediators

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Abstract
Cerebral Malaria (CM) is a form of malaria that is associated with high morbidity and mortality rates. The efficacy of the current antimalarial regimens has demonstrated poor treatment outcomes, thus the development of new approaches for the treatment of CM is urgently needed. This study aimed to evaluate the efficacy of co-administration of artesunate and Coenzyme-Q10 (Co-Q10) as adjunctive therapy for the treatment of cerebral malaria. Experimental cerebral malaria (ECM) was simulated in female C57BL/6 mice by infection with Plasmodium berghei ANKA (PbA). Adjunctive therapy combined with 6 mg/kg body weight
artesunate and 200mg/kg was administered and mice were sacrificed at the onset of ECM phase. Body and relative organ weights, survival analysis, parasitemia levels, and clinical scores were evaluated during the study period. At day 9 post-infection, mice were euthanized blood and various organs were processed for the analysis of oxidative and inflammatory mediators, blood–brain barrier (BBB) integrity, biochemical changes and edema. Co-administration of artesunate and Co-Q10 improved the survival rate, protected the integrity of the BBB, edema and improved neurological function in infected mice. Furthermore, the co-administration significantly decreased PbA-induced elevation of inflammatory cytokines (TNF-α, IFN-γ, IL-1, IL-12 and IL-6) gene expression. The amplified levels of brain chemokines (CCR5, CXXR3, CXCL9, CXCL10), and adhesion molecules (ICAM-1 and VCAM1) caused by PbA were also annulled by co-administration. Notably, exposure to both artesunate and Co-Q10 promoted a reduction in serum levels of ALT, AST, urea, uric acid, albumin and creatinine, peroxidation and oxidant damage by ameliorating PbA-driven elevation of malondialdehyde (MDA) in the brain, liver, spleen and serum. Co-exposure to artesunate and Co-Q10 attenuated PbA-driven depletion of nitric oxide (NO) and reduced glutathione (GSH). In conclusion, this study demonstrated that artesunate combined with Co-Q10 could be useful in protecting against lethal inflammatory and oxidative mediators associated with pathophysiology observed during the ECM.

The study respondents were randomly selected from 10 primary schools using simple random sampling technique. Overall 237/408 (58.2%) not knowledgeable about menstrual hygiene. Majority 213/408 (52.4 %) good attitude towards menstrual hygiene. 310/408(76.2) believed that menstruation was not a burden to women. More than half of the respondents 223/408 (54.55%) good menstrual hygiene practices. 208/408 (51%) used good absorbent materials and 245/408 (60.1%) changed pads twice a day. Fathers’ occupation, mother’s occupation and source of information were found to be significantly associated with knowledge of children regarding MHM. Age, parent’s education level, parents’ occupation and source of information were significantly associated with practice of children regarding MHM.

Keywords: Artesunate, Coenzyme Q10, Experimental cerebral malaria, Inflammation, oxidation stress

Parallel Session 1D – Biodiversity, Forestry and Agroforestry

Session Moderator: Dr Bernard Barasa
Session Rapporteur: Dr Ndikumana Theophile

Presentations:
1. Assessing the Impacts of Invasive Weed Parthenium hysterophorus (Ragweed) to Plant Diversity in Baringo Lowlands Kenya by Sally Patricia Asiyo
2. The effect of different growing media on seed germination and seedling growth of Telfairia pedate by Philipina Shayo
3. Scaling hermetic storage bags through access to finance: lessons from Tanzania by Dieudonne Baributsa
4. Impact of physical infrastructures on agricultural production in Burundi by Bonaventure Minani
Assessing the Impacts of Invasive Weed Parthenium hysterophorus (Ragweed) to Plant Diversity in Baringo Lowlands Kenya

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Abstract
Parthenium hysterophorus is recognized as a substantial threat to biodiversity, agriculture, and public health. Despite well-documented impacts, a knowledge gap persists concerning the mechanisms through which Parthenium hysterophorus influences the diversity of native plant species and soil attributes across diverse land-use contexts. A comprehensive assessment of the impacts of Parthenium hysterophorus on native plant communities’ populations within invaded landscapes in Baringo rangelands, Kenya was conducted during the dry and wet seasons of 2023. The study was aimed at evaluating Parthenium weed effects on the diversity and population dynamics of native plant communities and soil seed bank within the rangelands under diverse land uses. Vegetation sampling was carried out during the dry and wet seasons to account for temporal variability.

For each land use type (grazed fields under natural pasture, seasonal cropping, seeded pasture), 1 x 1m quadrats were placed at a 10m interval along a 200m transect and plant species diversity, population, dominance and percentage cover assessed. Significant Parthenium weed densities were observed between the land uses whereby seeded pasture had lower Parthenium invasion densities compared to seasonal cropping and grazed rangelands. A higher plant species diversity was observed in seasonal cropped land, while grazing field showed loss of native plants due to competition and browsing by animals. This study has shed light on Parthenium weed’s ecological effects on native plant communities which is vital for devising effective control measures and management strategies.

Keywords: Biodiversity, Land-use Impacts, Soil Seed Bank, Plant Community Diversity

The effect of different growing media on seed germination and seedling growth of Telfairia pedata

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Abstract

Telfairia pedata (Smiths ex Sim) Hook commonly known as Oyster nut, a herbaceous vine belonging to Cucurbitaceae family, regularly grown as a food crop in Tanzania, the coast of Kenya, Uganda, Mozambique and Angola, essential to the livelihood of small-scale farmers in East Africa. Despite the species’ importance in enhancing agro-biodiversity, it’s nutritional, and economic value to the community, little is known about its seedling growth performance in different growing media. A field experiment was conducted at the Forestry Training Institute, Olmotonyi nursery in 2021 to assess the growth performance of T. pedata. Replicated three times, a Randomized Complete Block Design (RCBD) was applied.

The experiment involved pretreated seeds of T. pedata in hot water (100ºC) and four types of growing media (forest top soil, sand soil, clay soil with NPK and silt soil as a control) were used. Height of the seedlings (cm), number of leaves, average height (cm), root collar diameter (cm) and germination percentage were determined. The chemical properties of each growing media including nitrogen, pH, potassium and phosphorus were also determined. The findings of this study after 12 weeks indicated that the germination of T. pedata had early sprouting (83%), seedling height (65 cm), root collar diameter (2.84 cm) and average number of leaves (3.0) recorded significantly higher performance in seeds raised in soil with NPK while the seeds raised in silt soil had the lowest performance. The findings of this study showed that the growth media containing fertilizer is recommended as appropriate growth media to improve soil fertility to raise and produce vigour T. pedata seedlings.

Keywords: Germination, Soil mixture, Initial growth, Pre-treatments, Seedling, Telfairia pedata

Scaling hermetic storage bags through access to finance: lessons from Tanzania

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Abstract

Grain storage is a serious challenge among farmers in East Africa, primarily due to insect pests. Hermetic storage technologies, including the Purdue Improved Crop Storage (PICS), have gained traction among farmers, driven by investments from governments, donors, and the private sector. While the use of PICS bags to store grain for home consumption has increased, efforts to scale this technology for income generation have been lacking. Most farmers sell their maize at harvest and miss the opportunity to tap into price arbitrage during the lean season. In 2022, building on an existing input loan partnership, a Collateral Management Agreement (CMA) was established between banks and producers’ organizations (POs) in the Rukwa and Ruvuma regions. The purpose was to ease the liquidity constraints that force farmers to sell their grain at harvest when maize prices are the lowest. The CMA was expected to unlock the stored maize grain’s collateral value, thereby facilitating access to loans to meet household needs at harvest. Despite 33 POs applying for loans and over 50% being approved, the key players (banks and POs) did not actively participate in the CMA. An exploratory evaluation (EE) was conducted in 2023 to understand the dynamics behind this non-participation, involving 601 farmers (POs and non-POs members), 30 PO leaders, 30 village leaders, banks, and grain buyers. The EE revealed that several market and non-market
factors influenced the non-participation in the CMA. These include:
(i) low maize yields in both regions in 2022
(ii) historically high maize prices and uncertainty about future prices
(iii) banks’ reluctance to add output loans to yet unpaid input loans
(iv) elevated warehouse management costs; and
(v) high logistic costs (e.g., transport, cleaning, and packing the maize in PICS bag at harvest, and repacking in woven bags at the time of sale with no price premium guaranteed). These findings provide crucial lessons for shaping future interventions to understand further how to improve credit access and boost the adoption of hermetic bags.

**Keywords:** Output loan, grain aggregation, credit access, farmers groups

**Impact of physical infrastructures on agricultural production in Burundi**

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**Abstract**

In developing countries like Burundi, physical infrastructures are essential for the development of agriculture, the pillar of its economy. Our work considers four components of physical infrastructure: electricity, transport, ICT and water and sanitation. The Objective of this study is to evaluate the impact of physical infrastructures on agricultural production in Burundi. We use the Engle-Granger method to estimate quarterly data from 2005q1 to 2020q 4. First, the results revealed that all series under study are integrated of order one (ADF unit root test) and cointegrated (Engle-Granger cointegration test). Secondly, the OLS results show that in the long term, electricity, water and sanitation infrastructures considerably contribute to agricultural production, while ICTs influence agricultural production less. Furthermore, transport infrastructure has not immediate effect on agricultural production. Thirdly, the results of the ECM reveal that in the short term, ICTs play an important role in improving agricultural production, water and sanitation infrastructures have not impact and transport infrastructures have a negative and significant impact on agricultural production. These results have policy implications that would enable Burundian government decision-makers to adopt strategies aimed at increasing the resources allocated to basic physical infrastructures, in particular the electricity, water and sanitation, ICTs sectors, as well as to improve their offer.

**Keywords:** Impact, physical infrastructures, agricultural production, Engle-Granger method, Burundi.
Factors Influencing Farmers’ Choice of Agrometeorological Information Pathways

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Abstract

Development of agriculture sub-sector in Kenya is adversely affected by climate change and variability due to overdependence on rain-fed agriculture and use of outdated farming technologies. Agrometeorological information dissemination likely boosts farmers’ production, planning, and adaptation strategies. The effectiveness of agro-information among farmers depends on packaging of the information and the dissemination pathway used. Despite their transformative potential, factors influencing the choice of information dissemination pathways among small-scale sorghum farmers remain unclear, while their adaptive capacity to the threats of climate variability remains weak.

This study intends to address the aforementioned gap by identifying information pathways used by sorghum farmers and evaluating socio-economic, institutional, and land-related characteristics influencing access to such pathways. Primary data were collected using a pretested semi-structured questionnaire from 423 randomly selected small-scale sorghum farmers in Busia sub-county, Kenya. A multivariate Probit model was used to analyse factors influencing farmers’ choice of agrometeorological information pathways. Education, gender, proportion of income allocated to farming, access to credit facilities, frequency of extension visits, training counts, access to internet services, radio ownership, and use of comprehensible language influenced choice of agrometeorological information dissemination pathways.
In this regard, pathways found to be complementary or substitutes give new knowledge on channels to adopt in information dissemination. Policy formulations should enhance the use of these pathways to improve farmers’ adaptation to climate change strategies.

**Keywords:** Agrometeorological information, climate variability, dissemination pathway, Multivariate Probit model, small-scale farmers

**Wood diversity, carbon stocks and land use dynamics of the Lwampango relict forest in the Kaziba chiefdom, eastern DR Congo**

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**Abstract**

The mountain forests are diversified and store large quantities of carbon, despite facing threats. This study aims to assess the floristic diversity, carbon stock, evaluate threats, and quantify land use changes of the Lwampango mountain relict forest from 1990 to 2021. The woody species inventory was conducted in 24 plots of 20x20m each, and the above-ground biomass was estimated using the equation of Chave et al. (2014). The land cover of Lwampango forest was quantified using a mapping approach coupled with remote sensing. A total of 1032 individuals from 22 woody species, 21 genera and 17 families were inventoried. Macaranga kilimandscharica, Maesa lanceolata, Hagenia abyssinica and Polyscias fulva belong to the group of ecologically important species. The forest is estimated to store 136.3 tonnes/ha of carbon. Over its entire surface area, the Lwampango forest has an estimated stock potential of 25317.4 tonnes of carbon and 92915.07 tonnes of sequestered carbon dioxide. Our study indicates that the dense vegetation of the Lwampango forest has undergone a regression in the period from 1990 to 2011 due to anthropogenic activities, compared to the period from 2011 to 2021 where dense vegetation is beginning to progress. Conserving this relict forest would further increase carbon storage and reduce the current global warming problem.

**Keywords:** Relict forests conservation; Wood diversity; carbon stocks; land use dynamics; global warming

**Performance evaluation of a bioethanol stove in domestic setting: implications on cost, time and user perception**

**ALL AUTHORS; 1*MAMBO W., 2BASEMERA S., 1KITIMBO M., 2NAKIYINI J., 1KAMUGASHA D.**
Abstract
Most households in Uganda use wood fuel for cooking and heating which pose numerous environmental and health hazards, hence leading to the desire for transition to alternative clean cooking solutions. Uganda Industrial Research Institute and Raising Gabdho Foundation developed a bioethanol stove prototype for a typical household. Given the need for information on user perception and its comparison with other cooking alternatives for further improvement, this study presents a controlled cooking test which was conducted for performance evaluation of the prototype in terms of user perception, cost of cooking, and cooking time in comparison to Liquified Petroleum Gas (LPG), Electric Pressure Cooker (EPC), briquettes, and charcoal while cooking beans and posho for a family of four people by four cooks in triplicates. Controlled Cooking Test protocol from the Clean Cooking Alliance was adapted for the study, implemented, data collected and then analyzed using One-way ANOVA and Tukey HSD test in ASTATSA software. The cost of cooking using ethanol & pressure cooker with the flame regulated was not significantly different from that of charcoal, EPC, and briquettes using pressure cooker, but less than LPG which shows the possibility of households shifting from the use of charcoal to cleaner cooking solutions without significant cost implications on cooking fuel expenditure. The speed of cooking using ethanol & pressure cooker with the flame regulated was significantly higher than that of charcoal with aluminium saucepan, but not different from that of EPC, LPG, and charcoal with pressure cooker. The bioethanol stove was easy to ignite, burnt with blue flame after regulation, cooked fast, convenient for indoor cooking, and stable when mingling. However, it needed complete combustion at maximum stove power, elimination of sharp edges, and design modifications for grilling and to accommodate other saucepan sizes. (290 words).

Keywords: Cooking cost; cooking time; clean cooking; electric pressure cooker; controlled cooking test; bioethanol fuel.

Evaluating Effectiveness of the Blend of Moringa oleifera Lam and Synthetic Coagulants in Coagulation/ Flocculation of Wastewater from Wastepaper Recycling Mill

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Abstract
Wastepaper recycling is a growing global industry addressing the high pollution and toxic components from defibering, deinking and papermaking processes. Nonetheless, inefficient treatment of wastepaper mills effluent negatively impacts water ecosystems and users’ health. This study evaluated the efficiency of using Moringa oleifera Lam plant parts, alum and polyaluminium chloride coagulants. The study established effective doses for individual and blended coagulants and determined their efficacy in treating wastewater from wastepaper recycling. Wastewater samples were obtained from Maz International Paper Mill using grab sampling method. A randomized design was applied, using standard jar test procedures to assess the effective doses of defatted Moringa oleifera seeds (DMos), fatted Moringa oleifera (FMos), Moringa oleifera bark (BMo), Alum and Polyaluminium chloride (PAC). Analysis
of Variance (Anova) on the data acquired were conducted and the means obtained separated using Fisher’s least significant difference. The study revealed that effective doses were DMos; 16g/ml (144.0NTU), FMos; 18g/ml (250.2NTU), BMo; 80g/ml (881.0NTU), alum; 0.75g/ml (24.1NTU), PAC; 3.6g/ml (162.2NTU), DMos/Alum; 20/80% (17.1NTU), FMos/Alum; 30/70% (25.2NTU), DMos/PAC; 70/30% (93.6NTU), and FMos/PAC; 70/30% (110.4NTU).

However, there was no synergy assessed for the blends of BMo/Alum and BMo/ PAC. The results established that turbidity of the wastewater from wastepaper recycling mill was reduced using various effective doses. Alum was the most efficient individual coagulant, while DMos/Alum was the most efficient blended coagulant. In conclusion, the turbidity of the wastewater from wastepaper recycling mill was effectively reduced using the blend of DMos and alum. The study recommends using a DMos-alum blend for effective wastewater treatment in wastepaper recycling mills. (255 words).

Keywords: Wastepaper, Wastewater, Moringa oleifera, Synthetic Coagulants

Parallel Session 1F - Nutrition and Environmental Health

Session Moderator: Dr Andrea Pembe
Session Rapporteur: Dr Vivian Levi Enoka

Presentations:
1. Ambient air pollution exposure and child birthweight in East African countries by Valérien Baharane
2. Imake Food Dryer by Joseph Nyeko Churchill
3. Stretching limits of ecosystem service provision by black soldier fly (Hermetia illucens) larvae beyond the horizons of food, feed, and fertilizer for cleaner cities by Kabi F, Kaweesi G,G and Lutakome P

Ambient air pollution exposure and child birthweight in East African Countries

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Abstract
Exposure to air pollution during pregnancy has been associated with adverse impacts on fetal development including reduced birth weights. However, the extent of these effects is poorly documented in developing countries. Using the latest published Demographic and Health Surveys and a unique MERRA-2 air pollution datasets, we developed the multilinear and logistic regression models to assess the effects of prenatal exposure to fine particulate matter (PM2.5), Carbon monoxide (CO), and Ground-level Ozone (O3) on the children’s birth weight in East African Countries. Our estimates revealed that prenatal exposure to 1 ppb of O3 concentrations above the mean value reduced the birthweight by 0.0079 kg (standard deviation (SD): 0.0013; p<0.01). After adjusting the model for weather variables and household socioeconomic factors, the effect of O3 on birthweight was found to be moderate with a reduction of 0.0051 kg (SD: 0.0014 kg; p<0.01) on each increase of 1 ppb in prenatal O3
exposure above the mean value, and with adjusted odd ratio of 1.0063 (95% Confidence interval: 0.9741–1.0122; p<0.05) on the underweight birth occurrence. PM2.5 and CO did not demonstrate significant impacts on the birthweight (p>0.05), although CO seemed to act in the negative direction. Furthermore, the child birthweight was found to be much influenced by socioeconomic factors with children born in richer families or with higher maternal education levels recording higher birthweights than their counterparts. The findings from this study should be good informative for policies aimed at protecting child health by incorporating maternal health as an integral part of the air pollution control systems and increasing air pollution public awareness in local communities. However, the current study also suggests several areas for further research with one of the important questions being the identification of the susceptible exposure periods. (291 words).

Keywords: Air pollution; birthweight; underweight birth; children growth; maternal health; East Africa

iMake Food Dryer to Nourished Zero Food Waste in Northern Uganda

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Abstract
Agriculture is the main source of livelihood in Uganda and across Africa yet 45% of harvested produce (mainly fruits and vegetables) are lost before consumption, according to FAO (2013). The post-harvest losses are due to the use of inappropriate post-harvest handling technologies to improve poor handling and preservation practices among farmers. The common methods used by 90% of the Ugandan farmers are open sun drying and solar dryers which are limited to drying high sugar and acid content fruits and not recommended for drying vegetables as they take 3-8 days to dehydrate, unhygienic and highly dependent on the weather which is very unpredictable in today’s climate change. iMake Food Dryer is a high commercial temperature oven machine suitable for drying a very large variety of fruits and vegetables that prolong the shelve-life from 3 days to at least 1 year, increasing farmer’s income by 100% and reducing food insecurity as it avails food in period of scarcity and climate unpredictability. It is powered by biogas made from kitchen and animal remains as clean biofuel and solar energy to dehydrate food clean while maintaining all the nutrients in typically 5 hours. It dehydrates 5 times faster than solar dryers and 10 times faster than the open sun drying method while maintaining all the nutrients in the food. With iMake, a farmer can dry up to 200kg of products within a day with only 5kg of biofuel through a gasification process with zero CO2 emission despite whether it is raining or shining. This makes iMake not only reliable but also very convenient for use and environmentally friendly. The losses dose not only mean less food available for consumption, but also less profitability for the farmers, reducing their earnings and keeping them in the cycle of poverty. This challenge is affecting over 15 million smallholder farmers in Uganda, according to the Uganda bureau of statistics (2015).

Keywords: Turning post-harvest losses into profit, improving nutrition, and providing clean renewable energy to Africa.
Stretching limits of ecosystem service provision by black soldier fly (Hermetia illucens) larvae beyond the horizons of food, feed and fertilizer for cleaner cities

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Abstract
Due to higher rates of urbanization, municipal waste generation in our cities is anticipated to grow at a rate higher than 40% by 2050. Here, we evaluated emerging black soldier fly larvae (BSFL) as a bio-waste management technology for efficient municipal trash conversion to high-value industrial raw materials beyond food, feed and fertilizers. Effect of graded levels of maize bran inclusion to shredded municipal waste on larval growth, substrate and larval proximate composition, metabolizable energy (ME), fatty acid profile, saponification value and substrate physical characteristics was assessed. Substrate moisture reduced from 80% to 60% due to increasing dietary maize bran while ME increased from 10.9 to 12 MJ/kg DM. Maize bran inclusion decreased larval mortality at a decreasing rate (P<0.05) from 5% to 3% but with an optimal level of 20% eliciting the lowest larval mortality. Conversely, substrate pH and temperature increased following quadratic trends (P<0.05) with highest values observed at intermediate levels. Lipid production per unit larval weight increased at a decreasing rate (P<0.05) but closely followed similar trends of individual larval length, girth and weight. Saponification value (208 mg KOH/g of larval lipids) at intermediate levels of maize bran inclusion suggests that more short chain fatty acid suitable for soap salt formation are synthesized. Total saturated fatty acids (SFA) ranged from 53.5 to 63.2% but increased at a decreasing rate (P<0.05). Total SFA lipids were at least 3 times the total polyunsaturated fatty acids (PUFA) and omega (n-6) while only minute quantities of the essential n-3 lipids were observed. Therefore, BSFL can be useful in an industrial symbiosis model for cleaner cities to support a circular bio-economy where larval lipids can be used as industrial raw material for soap manufacturing while defatted larval residue may be fed to livestock and frass used as fertilizer for food production.

Keywords: Circular bio economy; Essential fatty acids; Industrial raw material; Municipal waste management; Saponification value; clean cities

KEY POINTS AND EMERGING ISSUES
The use of emerging A4 technologies to achieve long-term development in areas such as crop production, soil monitoring, animal production, and management offers a big opportunity. These can be useful in improving quantity, quality, and accessibility of agricultural products. They can also be used in monitoring, control, prediction, and logistics in the agricultural system to reduce hunger. There is therefore a need for A4 technology adoption and influencers as well as an enabling environment.

The is a need for transformation of Kampala City to make it a pandemic-resilient city by developing compact physical planning designs. Further multi-disciplinary study exploring various COVID-19 contributing factors and further research on evaluating how settlement patterns and building layouts influence the spread of COVID-19 in Kampala City are also needed.
Teachers should support children form school health clubs through which they carry out awareness creation campaigns so as to increase children’s awareness on menstrual hygiene management. School management teams should consider procuring incinerators in schools to ensure proper and hygienic disposal of menstrual pads with minimal impact on the environment.

A test of the combination of Coenzyme Q10 and artesunate in clinical studies should be done to see whether the two can enhance treatment outcome for cerebral malaria as a part of efforts to address drug resistance and efficacy.

PLENARY SESSION 4

ICT emerging technologies in driving digital transformation in industrialization in East Africa.

Preamble
This session examined the many benefits of utilizing emerging technologies to drive digital transformation, among them increased efficiency and productivity; cost reduction; skills development; data security; and access to global markets. For these benefits to be realized, however, various challenges must be overcome and investment in ICT infrastructure prioritized. Once that is done, ICT can easily play a key contribution in the attainment of multiple SDGs through its impact in agriculture, the financial system, health, and other sectors.

Keynote Presentation: Eng. Daniel Murenzi, Principal Information Technology Officer, East African Community

In East Africa, the role of Information and Communication Technology (ICT) emerging technologies has been significant in driving digital transformation across key industries. There is a need to harness digital technologies and innovation to transform East African societies and economies to promote integration, generate inclusive economic growth, stimulate job creation, break the digital divide, and eradicate poverty for the region’s socio-economic development and ensure East Africa’s ownership of modern tools of digital management.

Title of Presentation: Role of ICT emerging technologies in driving digital transformation in industrialization in East Africa

Session Moderator: Dr Annabella Basaza
Session Rapporteur: Dr John Nyiro Mwero

Panelists:
- Prof Catherine Ngila, Executive Director, African Foundation for Women & Youth in Education & STI
- Dr. Martin Ongol, Executive Secretary, NCST Uganda
• Prof. Charles Kwesiga, Executive Director, Uganda Research Institute
• Prof. Paul Baki, Secretary, Kenya National Academy of Sciences and Professor of Physics

Keynote Presentation
Eng Murenzi started his presentation by pointing out that Information and Communication Technology (ICT) and emerging technologies were critical in driving digital transformation in industrialization for the economic development of East Africa. The integration of these technologies can significantly enhance various aspects of industrial processes, leading to increased efficiency, productivity, and competitiveness. Some ways in which ICT emerging technologies can drive digital transformation in industrialization in East Africa through Digital Agenda are in financial services, agriculture, health, climate change, education, and trade. According to Eng Murenzi, the adoption of ICT emerging technologies in East African industries can drive digital transformation, improve efficiency, competitiveness, and innovation, and contribute to the growth of the industrial sector in the region. It is essential for governments, businesses, and other stakeholders to invest in these technologies and create a supportive ecosystem for their adoption and implementation.

The goal is to enable autonomous decision-making processes, monitor assets and processes in real-time, and enable equally real-time connected value creation networks through early involvement of stakeholders, and allow vertical and horizontal integration.

The benefits of emerging technologies in driving digital transformation, Eng Murenzi said, include:

- Increased efficiency and productivity
- Cost reduction of doing business
- Skill development and job creation
- Data security and compliance
- Access to global markets

As an example of how applied technology has helped business, Eng Murenzi said the time for processing goods at Mombasa port had been reduced from 18 days to 3 days.

Key aspects of the role of ICT and emerging technologies
Eng Murenzi advocated the adoption of the following key aspects of the role of ICT and emerging technologies in driving digital transformation in industrialization in East Africa:

- Smart manufacturing – Both integration of automation and control systems in manufacturing processes, and IoT to enable real-time monitoring, predictive maintenance, and data-driven decision-making.
- Data analytics and AI – For both data-driven decision making and predictive
maintenance.
- **Supply Chain Management** – Involving both Blockchain and RFID technologies.
- **Energy efficiency** – The use of smart grids and renewable energy integration.
- **E-Government initiatives** – Through digital platforms and e-commerce.
- **Skills Development and education** – Use of e-learning platforms and capacity building to enhance digital literacy and technical skills.
- **Collaboration and innovation** – Done through open innovation platforms and technology hubs.
- **Digital Infrastructure investment** – This is mainly in the areas of broadband connectivity and cybersecurity measures.

Eng Murenzi concluded by stating that the effective integration of ICT and emerging technologies in East Africa’s industrialization can lead to improved productivity, increased competitiveness, and sustainable economic development. Governments, industries, and educational institutions need to collaborate to create a conducive environment for the adoption and utilization of these technologies.

**Panelists**

**Prof. Catherine Ngila**, in her presentation, said that the role of Information and Communication Technology (ICT) emerging technologies has been significant in driving digital transformation across key industries in East Africa. SDGs, she said, are what determine issues of development, including innovations. Four goals are particularly key and form the focus this year:

- **SDG1** – End poverty in all its forms everywhere.
- **SDG2** – End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- **SDG16** – Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- **SDG17** – Strengthen the means of implementation and revitalize the global partnership for sustainable development

Infrastructure and capacity development are important in digital transformation, she said. Digital transformation is very good but might have its not-so-pleasant side effects, including propagating laziness. New frontiers of potential in digital transformation could include Artificial Intelligence, nanotechnology, quantum computing, biotechnology, the Internet of Things, 3D printing, and autonomous cars.

**Dr. Martin Ongol**, in his presentation, said infrastructure is the backbone of STI and that East Africa was doing badly in this area. Thus, we live in an era of many challenges but there is also plenty of opportunity in digital transformation. Technologies, he said, have helped a lot in easing of business within the East African region, including movement of goods, payments, etc. If we are to
promote industrialization within the digital transformation platform, some key issues will be of utmost importance, such as access to electricity and Internet connectivity, because these are issues hindering Internet technology and digital transformation.

Moreover, he said, cognitive skills and transferrable skills need to be embedded in training. Digital transformation can help in telemedicine – including medical imagery and medical supply chain, and drug discovery. In agriculture, we need to develop systems that can capture data. There is room for development from our end in terms of agricultural marketing, products standards, etc. There is also a need for financial technology (Fintech), entailing the use of business process automation, mobile technology, etc. The regulatory policy framework, he said, seeks to always improve to take care of evolving circumstances. Most countries in the region, however, score poorly on the global digital indices.

Prof. Charles Kwesiga, on his part, acknowledged the work done by research and development institutions across East Africa. URI, which he heads, is meant to catalyze the socio-economic transformation of Uganda and the region through enhanced technology use. The global ranking of HDI for EAC countries, Prof Kwesiga said, is very low – with Kenya the highest at position 143 out of 189 countries. Uganda is ranked at position 159, Rwanda 150, and South Sudan 185. Research allocation, too, is still low in the partner states and none of them allocates even 1% of the national budget to research. The challenge, he said, is that we are not embracing appropriate technologies, putting the region in danger of being left behind by every technological revolution. There is a gap in human capital. The institutions producing high sounding degrees have graduates with no skills. We have to improve on this, he said.

There is also the challenge of financial infrastructure, essentially a lack of affordable finances. Opportunities that avail themselves include developing our own technologies in order to bridge the gap in technologies, and providing platforms for apprenticeship so as to bridge the skills gap.

Prof. Paul Baki said that academies of science were not schools in the literal sense, but institutions that deal with resolution of real issues in society, or applied research. The academy is an association of people from across all disciplines from academia, with the sciences and arts as well. Experts can be brought together under the EAC, he said, to provide advice on various problems in our countries. Networking and collaborations also present an opportunity since there are many things that researchers of different disciplines can do together. There is need for multi-disciplinary engagements to resolve problems across borders. “One head cannot keep all the wisdom” – this African saying means that we are stronger together and addresses the need for collaborative ventures.

We seem to be stuck in the past and this seems to be a challenge to digital
transformation, he said. Digital transformation can be used to resolve conflicts, for instance on the dam in Ethiopia that has caused conflict with Egypt. Opportunity presents itself in service provision – when information is needed on near real-time basis. For example, space weather can be predicted a few days earlier to save on potential damage/loss. The same also applies in aircraft landing safety.

KEY POINTS AND EMERGING ISSUES

A request to Prof Charles Kvesiga by a Ugandan participant to take part in a drone study was positively considered, with the participant being welcomed to discuss modalities of cooperation once back in Kampala.

Investment in digital transformation is a key concern and innovative ways to attract investments in digital transformation were discussed. These include grants, self-financing; and opportunities from financial institutions including ADB. Some governments have also adopted a model where the investors are required to make a contribution to research.

Concern was raised regarding an impression that universities are laggards in innovation, yet those who harbour this notion are recent graduates of those same universities. The universities are doing a great job in digital transformation, it was felt, but the question arises of whether we do know exactly where digital transformation is leading us to; as an example, we do not know what AI will eventually lead to. The impact of digital transformation on social life was also considered, raising the question of whether society was becoming more antisocial every day and thus weakening the social fabric. However, there is an opportunity now to find new ways of socializing, such as that provided by social media.
PARALLEL SESSIONS 2: PAPER PRESENTATIONS

Preamble
In this second set of parallel sessions, three sessions were held. Each of these sessions had three papers lined up for presentation. The sub-themes covered were: Soil Sciences; Food Systems and Agribusiness; and IoT, Data Analytics & ICT for e-Government. The presentations reflected experiences from across the East African region and served to show practical examples of the use of the latest tools of research in science, technology and innovation.

Parallel Session 2A – Soil Sciences

Session Moderator: Dr Niyonzima Francois
Session Rapporteur: Milton Melingasuk

Presentations:
1. Effects of sowing density and different fertilizer sources on maize agronomic performance and soil properties in central Benin by Tobi Moriaque
2. Determination of liming material requirements to correct soil acidity and improve soil chemical properties in Ngoma District, Rwanda by Giramata Joie Claire & Bazimenyera Jean De Dieu
3. Bio Fertilizers for Environmentally Sustainable Soil Health Management by Chrispo Mutebi

Effects of sowing density and different fertilizer sources on maize agronomic performance and soil properties in central Benin
TOBI MORIAQUE

Abstract
Mr Moriaque told the conference that in Benin, forest destruction, land overexploitation, and unsuitable agricultural practices had contributed to significant soil degradation. As a result, crop yields are declining and strategic cereal crops (such as maize) for maintaining food security are severely affected. Integrated soil fertility management that includes combined application of organic matter and reduced doses of mineral fertilizers, he said, enabled sustained production and improved soil fertility.

Additionally, biochar in soils can act as a carbon sink and mitigate increasing greenhouse gas emissions; and improve soil physical, biological and chemical characteristics. A study was therefore conducted to evaluate the effect of sowing density and various sources of fertilizer on maize performance, moisture content, and soil acidity in central Benin.

The results of the study indicated, according to Mr Moriaque, that the application of biochar with a microdose of mineral fertilizers not only increases maize yield but also its Nitrogen uptake on degraded soil. However, due to pedo-climatic variation, application of climate risk management tools would be further required to assess the long-term effects of this technique of maize productivity.
Determination of Liming Material Requirements to Correct Soil Acidity and Improve Soil Chemical Properties in Ngoma District, Rwanda 2023-2024
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Abstract
Soil acidity is the main constraint to agricultural development in many parts of sub-Sahara Africa. In Rwanda, it is estimated that more than 45% of arable land is acidic. In agriculture, limes play great importance in correcting soil acidity, reducing Aluminum saturation, and hence favoring plant nutrition. The aim of this study was to estimate the amount of limes needed for rectifying soil acidity up to and improving soil chemical properties. The composite soil samples were collected from Ngoma District and various parameters were analyzed in the laboratory using various following methods. Total nitrogen by the Kjeldahl method, available phosphorous by the Bray II method, Potassium and Exchangeable acidity by titration method, Calcium content in lime, and Exchangeable base (K+, Ca2+, Mg2+) by EDTA method.

The results obtained showed that the soil in the study area has a pH is 4.9, and a total nitrogen of 0.03%. They also revealed that site 1 has 85.6% of calcium carbonate content (burned lime), site 2 has 67% of calcium carbonate content (agro-lime), and site 3 has 57.6% of calcium carbonate content (travertine). Thus, liming materials can correct acidity levels differently, the lime requirement to correct soil acidity up to the pH-range for plant growth was found between 0.115 t/ha and 0.245 t/ha or between 115.5kg/ha and 245 kg/ha of Mg CaCO3 (dolomitic limestone) of Musanze mining sites. Based on these results, the farmers are recommended to use the liming material as suggested by this research for correcting the soil acidity thus improving the productivity and soil stability.

Keywords: Soil PH, exchangeable Acidity, lime recommendation

Bio fertilizers for environmentally sustainable soil health management
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Abstract
There is current interest in agrarian sustainability with soil microorganisms instead of agro-chemicals. Bio fertilizers are known to be eco friendly but their use has been constrained by inadequate knowledge about bio inoculants and lack of promotion network and publicity among the end users. This paper is a review of the current technical information as a way of creating awareness for the promotion of the use of bio fertilizers. Publon, Google Scholar, Science Direct and Microsoft Academic data bases were used for the review in 2022. Research and review articles published from 2020 onwards were considered as current information for the review. The findings of the review were that; both primary and secondary macronutrients can be provided by bio fertilizers. Potential microbes for bio fertilizer formulation that the review found were; free-living nitrogen fixing bacteria and cyanobacteria, symbiotic nitrogen-fixing bacteria and fungi such as mycorrhiza. Important functions of bacteria noted were; conferring to plants the ability for salt tolerance, lignin degradation and remediation of heavy metals from the soil. Bio Compost, vermicompost and termite soil with their rich microorganism content were found suitable for use as eco friendly bio fertilizers. In order to reap maximum benefit from bio fertilizers the need for their formulation in appropriate materials was highlighted. Apart from addition of nutrients to the soil, bio fertilizers were found to play an important role
in plant health. This paper attempted to provide adequate knowledge about bio inoculants as well as promoting and publicizing them among the end users. The conclusion of the review is that bio fertilizers are suitable for environmentally sustainable soil health management.

Keywords: Bio fertilizer, Microorganism consortia, Nitrogen-fixation, Rhizosphere management

Parallel Session 2B – Food Systems and Agribusiness

Session Moderator: Dr Chrispin Kowenje
Session Rapporteur: Dr Namulawa Victoria

Presentations:
1. Scaling hermetic storage bags through access to finance: lessons from Tanzania by Dieudonne Baributsa
2. Characterization of Organic Waste Producers and Collectors and Evaluating their Willingness to Add Value to Segregated Organic Waste for Insect Products by Teresia Wamwondwei
3. The determinants and impacts of agriculture loan on maize yield among maize farmers in Tanzania by Happiness Kilombele

Scaling hermetic storage bags through access to finance: lessons from Tanzania
DIEUDONNE BARIBUTSA
This presentation was made at an earlier session. Refer to Parallel Session 1D.

Knowledge, Attitude, And Practices of Insect-Based Organic Waste Management and Willingness to Add Value Organic Waste to Insect Products in Nairobi County, Kenya
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Abstract
Organic waste management remains a great challenge, particularly in the rapidly growing urban areas. This study surveyed 485 organic waste producers and collectors to assess factors influencing their knowledge, attitudes, and practices (KAPs) and willingness to use insect-based technologies to recycle organic waste into value-added products. Logistic regression, multinomial logit, and Tobit model were used for analysis. Most respondents (98.6%) knew about insect-based waste management, with 80% of them expressing a positive attitude towards the practice, while only 57.4% were practicing it. Black soldier flies (33.8%), crickets (10.2%), mealworms (5.3%), and cockroaches (3.9%) were the most known insect species. Pig and poultry farmers were the most willing to add value (89%), while 75% of respondents were willing to sell the waste if not able to add value. The amount of waste the respondents were willing to recycle was highly influenced by market availability and cost-effectiveness.
Despite most respondents possessing good knowledge, positive attitude, and willingness to add value, only a few of them recycled organic waste using insects with the majority citing inaccessibility to training. Subsequently, effective training is therefore crucial (181 words).

**Keywords:** Waste management, Organic waste recycling, insect farming, KAP, circular economy

**The determinants and impacts of agriculture loans on maize yield among members of maize producer organizations in Tanzania**

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**Abstract**

Access to agriculture loans remains a challenge among smallholder farmers in East Africa. Various development partners, including governmental and non-governmental stakeholders in Tanzania, have made efforts to increase access to agricultural loans. One of the strategies to improve farmers’ access to loans has been the creation of producer organizations. There is limited information on how farmers among producer organizations access agricultural loans and their impact on crop productivity. In 2022, we sampled 1140 maize farmers among producers’ organizations in Rukwa and Ruvuma, Tanzania, to assess factors influencing the acquisition of agriculture loans and their impacts on maize yield. Analysis was conducted using the endogenous switching regression (ESR) model, a two-stage model that estimates factors in the first stage and impact estimations in the second stage. Results show that 25.53% of the surveyed households acquired agriculture loans in the 2021/2022 crop season. Of these, only 21.77% acquired the loan from the producer organization; the rest obtained loans from other sources such as commercial/development banks, microfinance institutions, fellow farmers, and credit groups. Despite their memberships in producer organizations, very few borrowers obtained loans directly from these organizations. In addition, membership in saving and credit groups, training, and herbicide usage influence agriculture loan acquisition. Results also revealed that agriculture loan users achieved a maize yield of 1359.73 kg, compared to the potential of 1262.96 kg without the loan, indicating a boost of 106.77 kg. Non-users had a yield of 1245.82 kg, but with the loan, their average yield would have been 2536.98 kg, signifying a potential gain of 1291.16 kg for those not utilizing agriculture loans. Analyzing the impacts by gender of household heads showed that female-headed households had higher maize yield than male-headed households. These findings call for targeted efforts based on gender to increase access to agriculture finance.

**Keywords:** Producer organizations; maize productivity; impact estimations; gender disparities
Parallel Session 2C – Data Analytics & ICT for e-Government

Session Moderator: Dr Alphonse Nkurunziza
Session Rapporteur: Dr Gabriel Shirima

Presentations:
1. Data-Driven Decision Making: A Case Study of Tertiary Institutions in Uganda by Fredrick Edward Kitoogo
2. Smart IoT and Machine Learning Based Irrigation system by Wayne Steven Okello
3. Use of Earth Observation in disentangling the contribution of woody and herbaceous biomass for forage, fuelwood and carbon mapping in Eastern Africa by Kahiu Njoki et al

Data-Driven Decision Making: A Case Study of Tertiary Institutions in Uganda
DIEUDONNE BARIBUTSA
This presentation was made at an earlier session. Refer to Parallel Session 1D.

Knowledge, Attitude, And Practices of Insect-Based Organic Waste Management and Willingness to Add Value Organic Waste to Insect Products in Nairobi County, Kenya
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Abstract
The aim of this study is to assess the degree of adoption of data-driven decision-making (DDDM) in Ugandan tertiary institutions. The objective of this study is to provide insight into the present condition of DDDM, evaluate its efficacy, identify the obstacles encountered when utilizing data for decision-making, and suggest a structure for enhanced DDDM utilization. Existing frameworks, methodologies, and best practices in DDDM as they pertain to higher education are examined in the literature review. In an academic context, comprehension of the ways in which data science and analytics, business intelligence, and digital infrastructures facilitate well-informed decision-making is of paramount importance. The research methodology utilizes a mixed-methods structure, which integrates interviews, surveys, data mining, and predictive analytics. The acquisition of quantitative data regarding the degree of data integration in decision-making processes is facilitated by surveys, data mining, and predictive analytics. Conversely, qualitative insights into the challenges and successes encountered by various institutions are obtained through interviews. In institutions surveyed, preliminary results indicate varying degrees of DDDM implementation. Obstacles consist of restricted data literacy, inadequate data quality, and accessibility, resource limitations, and institutional opposition to transformation. On the contrary, success tales underscore enhanced student outcomes, resource allocation, and strategic planning. The results emphasize the criticality of cultivating
a culture that is focused on data in higher education establishments. Generally, institutions that have a clearly defined DDDM strategy and a dedication to enhancing data literacy among stakeholders achieve more favorable results. This study provides valuable insights that can inform policies, practices, and reporting in academic settings, thereby contributing to the wider discourse on data utilization in academia. Such contributions can enhance decision-making processes. (298 words).

**Keywords:** Data-Driven Decision Making, Tertiary Institutions, Data Science and Analytics, Decision-making Process

**A Smart IoT and Machine Learning-based Irrigation System**

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**Abstract**

Agriculture is a vital sector, providing food to the global population and raw materials to various industries. Although it is a major source of income for many people, it is severely affected by water scarcity which consequently impacts crop yields. Effective water management is therefore essential for ensuring stable and sustainable farming practices. Irrigation systems play a great role in mitigating water scarcity and enhancing crop productivity by enabling agriculture to be carried during any season. Traditional irrigation systems rely on manual labor, constant vigilance and rudimentary tools while modern irrigation systems like drip irrigation, sprinkler systems offer a better control. However, they still face challenges of adaptability and resource optimization. This paper describes a smart irrigation system that utilizes Internet of Things (IoT) and machine learning to optimize water usage thereby reducing operational costs and enhancing crop yields. The system integrates an ESP32 microcontroller board, low-cost sensors i.e., resistive soil moisture sensors, submersible digital temperature sensors, light-dependent resistors, a water pump, machine learning models and a web application. The sensor readings are continuously logged to the Firebase real-time database and a web application was developed to provide real-time visualizations of the system performance, enabling remote monitoring and control. Machine learning models were trained to predict optimal irrigation timings based on incoming sensor data. Four (4) classification algorithms were employed i.e., random forest, XGBoost, Support Vector Machine (SVM) and logistic regression, with random forest performing best, achieving an accuracy of 90.67%. The random forest model was deployed on the ESP32 microcontroller board and autonomously controls the water pump according to the changing environment conditions. In addition, the developed system allows selection of a specific crop for irrigation based on its respective water requirements.

**Keywords:** Agriculture; water scarcity; irrigation system; IoT; machine learning

**Use of Earth Observation in disentangling the contribution of woody and herbaceous biomass for forage, fuelwood and carbon mapping in Eastern Africa**

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Pastoralists in Africa depend on livestock for their livelihoods, while a significant percentage of the rural population depends on fuelwood to meet their domestic energy requirements. Despite notable advancements in Earth Observation (EO) derived products in mapping dryland resources for pastoral and agropastoral livelihoods, only a few focus on disentangling the contribution of woody (trees and shrubs) and herbaceous (grasses and forbs) biomass for various applications. In fact, majority of the available products ignore the contribution of low-density low stature vegetation thereby posing challenges in effectively monitoring foraging and fuelwood resources, and understanding the contribution of drylands in the biogeochemical cycles. In this presentation we will showcase innovative EO products under development at New Mexico State University for monitoring drought, foraging resources and woody biomass in Eastern Africa. Our emphasis will be on integrating optical, Radio Detection and Ranging (RADAR), Light Detection and Ranging (LIDAR), and in situ measurements within advanced machine learning models, coupled with cloud computation, to derive accurate estimates of woody biomass, while disentangling the distinct components of herbaceous and woody vegetation using leaf area index.
KEY POINTS AND EMERGING ISSUES

Research data generated could be used to inform policy to enhance agricultural and industrial products. Young researchers should be encouraged and supported in order to have a pool of talent to replace ageing professors.

There is need for deliberate efforts to put aside funds for agricultural financing as a purposive and intentional intervention to improve agricultural production. Agricultural loan services and sources to farmers should be diversified, such that farmers do not necessarily have to get loans from banks and can get them from other credit facilities and institutions. Such agricultural loans should be provided with very low or zero interest so as to remove constraints in agricultural production processes.

It is necessary to invest in agricultural training programmes so as to promote appreciation and uptake of agricultural technologies among farmers. This is particularly so for women engaged in agriculture, who need to be empowered based on the fact that female-led agricultural investments are profitable.

There is a need for studying the effect of insecticides and air pollutants upon bee populations, which are important for the process of pollination.
On the third and final day of the conference, the fifth Plenary Session tackled the theme, “Natural Resources Management.” Various advancements in bioeconomy and related subjects were extensively addressed by experts in the keynote address, panellists’ session and plenary discussions. Thereafter, the sixth and final Plenary Session was held on the theme, “Information Communication Technology and Digital Economy.” The use of Digital Financial Services to drive various sectors of the economy was explored in depth.

The Ministerial Session was also held on the final day of the conference, during which a report was given on the implementation of the resolutions of the 2nd EAC Regional STI Conference held in Bujumbura, Burundi, in 2021. This was followed by the presentation of the resolutions of the 3rd EAC Regional STI Conference by the Rapporteur General. The ministers and/or ministerial representatives present also made their remarks, which were supportive of the work and resolutions of the conference.

Three strategy documents were launched by EASTECO: The East African Regional Innovation and Technology Transfer Strategy; the East African Regional STEM Strategy; and the East African Regional Strategy for Indigenous Knowledge and Technology Systems. This was followed by the closing ceremony.
PLENARY SESSION 5
Natural Resources Management

Preamble
The contribution of bioeconomy to sustainable development came into sharp focus during this Plenary Session. While bioeconomy holds enormous potential, it is important to address the concerns of inclusivity and gender disparity. Moreover, for that potential to be fully realized, East African countries should enhance collaboration and harmonize standards even as they pursue their individual roadmaps. This is also an area that stands to benefit from closer collaboration with indigenous scientists (herbalists).

Keynote Presentation: Dr Philip Osano, Director, East African Centre SEI, Nairobi, Kenya

Natural resources are impacted by human exploitation, climate change, and natural disaster risks that require interventions for better management. Harnessing the power of science, technology, and innovation, natural resource management can become more efficient, sustainable, and aligned with conservation goals. These applications contribute to the responsible utilization of resources, biodiversity conservation, and the overall resilience of ecosystems. By leveraging these STI applications, natural resources management can become more efficient, sustainable, and aligned with conservation goals, ultimately contributing to the resilience and health of ecosystems. The integration of these technologies is essential for addressing the complex challenges associated with resource management in a rapidly changing world and helps to monitor, preserve, and sustainably use resources.

Title of Presentation: Leveraging Science, Technology, and Innovation (STI) advancements in shaping and advancing the bioeconomy.

Session Moderator: Dr Francis Mugisha
Session Rapporteur: Dr John Nduko

Panelists:
- Dr. Julius Ecuru-icipe/BioInnovate African Programme-Kenya
- Prof. Masharabu Tatien, Permanent Executive Secretary NCSTI - Burundi
- Rael Adhiambo, NACOSTI, Nairobi, Kenya
- Brenda Nakazibwe, Team Leader, Pathogen Economy, Science, Technology and Innovation, Secretariat, Office of the President-Uganda

Keynote Presentation
Dr Osano begun his presentation by drawing attention to the Global Innovation Tracker and the issues it addresses spanning science and innovation investment, technological progress, technology adoption, and socioeconomic impact. Dr Osano said GDP does not accurately reflect the contribution of bioeconomy. The wealthiest regions of Africa are predominantly composed of human capital; these are North Africa and South Africa. Modern biosciences open up new frontiers for bioresource value addition. In Sub-Saharan Africa, it is South Africa,
Botswana and Senegal that are the leading innovation economies. The least wealthy regions on the continent are Western and Eastern Africa. The origin of their wealth is almost evenly split between human and renewable natural capital. Central Africa is the only region where natural capital is the primary source of wealth. It is linked to the large forest cover.

**Triple Planetary Crisis**
Dr Osano informed participants that according to the planetary boundaries framework update, six of the nine boundaries have been transgressed, suggesting that the earth is now well outside the safe operating space for humanity. Drivers of the crisis of nature loss include: Demographic and sociocultural factors; economic and technological issues; institutions and governance; and conflicts and epidemics.

**The Promise of Bioeconomy**
According to Dr Osano, bioeconomy can have enormous benefits, including:
1. Sustainable industrialisation, job creation and green growth.
2. Improved food security – connecting smallholders to market and value chains.
3. Improved health - using biodiversity in the region to develop biobased health and pharmaceutical products.
4. New biobased products, including biomaterials for construction, bio-inputs for agriculture, enzymes for industry, and biobased feedstocks (e.g. biofertilisers, bio-packaging).
5. Creating new forms of clean sustainable modern bioenergy, such as biofuels, mitigating climate change and massive use of woodfuel that leads to deforestation.
6. Protecting the environment through converting waste, which today threatens ecosystems and freshwater resources, to useful products.

**Panelists:**
**Dr Julius Ecuru**, in his presentation, said that icipe provides PhD scholarships and grants. Of the 282 scholarships given out, up to 37% are for women. We need clear policies and strategies for bioeconomy, he said, but each country needs to develop its own roadmap. The EAC can however be used to harmonize standards.

Moreover, he said, there is a need to promote regional collaboration to enhance the scale and volumes of operations.

**Prof Masharabu Tatien**, with reference to Burundi, said the development of a bioeconomy policy for the country is aligned with its vision. A comprehensive roadmap with 22 strategic objectives has been created. The Burundi government, he said, is committed to allocate at least 3% of GDP to research by 2050.

Ms Brenda Nakazibwe gave a presentation entitled, “Pathogen economy: Leveraging pathogens to drive Uganda’s/ Africa’s Biotech Agenda.” The pathogen economy, she said, refers to the making, selling and use of goods related to the
prevention, control and treatment of goods damaged by pathogens.

Ms Nakazibwe told participants that the Science, Technology and Innovation Secretariat domiciled in the Office of the President in Uganda was focused on three areas: Import substitution, export promotion, and productivity acceleration. In so doing, they have established steps to see every idea developed to maturity. She said indigenous scientists (herbalists) were recognized by the government, and bioeconomy helps to standardize their products. As a contribution to the pathogen economy, Uganda seeks to leverage on the Clinical Trial of Natural Therapeutics (CONAT) programme. The aim is to evaluate the safety, pharmacokinetics and efficacy of herbal/natural products through clinical trials. Apart from the pathogen economy value chain, she said, they were also interested in the vaccine development value chain and drug development value chain. A bio-bank facility has also been established at Makerere University.

KEY POINTS AND EMERGING ISSUES

Science is experienced in daily life activities; starting science teaching in communities will make people love it. Africa needs to take advantage of its enormous resources and to do so in an equitable manner. This requires understanding the persona before coming up with solutions.

The word “pathogen” in the study presented by Ms Nakazibwe needed to be defined for purposes of that study. Traditional medicine is gaining significance around the region, including in Uganda and Tanzania; a number of products being produced and patented under the Tanzania government for various diseases originate from traditional medicine.
PLENARY SESSION 6

Information Communication Technology and Digital Economy

Preamble
The rollout and rapid expansion of Digital Financial Services is being felt in all countries in the region. This Plenary Session delved into this key aspect of the economy and examined the latest developments and innovations in the area, including the challenges and risks as well as growth potential. The discussion segmented DFS into various categories to analyse the use and popularity of each by customers, with a view to seeing how they can be profitably used for socioeconomic development of the region.

Keynote Presentation: Richard Ndahiro, Technical Advisory, United Nations Capital Development Fund, Kampala, Uganda

Information Communication Technology is the broader framework encompassing various technologies, while the Digital Economy specifically focuses on the economic activities enabled by digital technologies. Together, they shape the way societies, businesses, and individuals interact and conduct transactions in the modern world. Leveraging digital technologies to enhance and streamline Digital Financial Services (DFS) is crucial for improving accessibility, efficiency, and inclusivity in financial systems. By integrating these digital technologies, financial service providers can enhance the efficiency, accessibility, and security of digital financial services, ultimately contributing to financial inclusion and economic development. Additionally, collaboration between industry stakeholders, governments, and regulators is crucial to creating a supportive ecosystem for the adoption of digital financial technologies.

Title of Presentation: Leveraging digital technologies to enhance and streamline Digital Financial Services.

Session Moderator: Dr Noel Ntawuhorakomeye
Session Rapporteur: Prof Jean Uwamahoro

Panelists:
- Dr. Dickson Andala CEO, National Research Fund, Kenya
- Patrick Mugisha, Innovent Labs Africa, Kampala Uganda
- Roy Njoka, Co-Founder and CEO of Terralim
- Prof. Nkem Khumbah, Programme Manager, The African Academy of Sciences

Keynote Presentation
In his presentation done virtually, Mr Ndahiro mainly indicated how Digital Financial Services (DFS) have increased in the EAC region. Account ownership, for instance has doubled or even tripled in the region. Growth has been majorly outside the banking sector – driven by mobile money. According to Mr Ndahiro, DFS has been the power behind the region’s digital economy. Mobile services are diversified into various financial services such as payments, savings, credit,
insurance, etc., and this is still growing to extend to various economic sectors. Payments, however, dominate the usage of accounts.

Even though mobile services have gained prominence, they are yet to have as much impact on formal borrowing, with informal financial services remaining prominent in this area. Mr. Ndahiro also posited that the next growth phase is in advanced fintech services that can drive financial health.

Challenges and Risks
Mr Ndahiro explained the challenges for the industry:
1. Affordable and accessible technologies. This calls for financial institutions to know their customers.
2. Cyber security and financial fraud.
3. Data privacy & protection, data sharing frameworks and data monetization.
4. Digital and financial literacy is a major barrier to usage.
5. Complaints handling & redress
6. Unfair practices, e.g. false advertising, scams, predatory lending, and unfair debt collection.
7. Regulating more complex transactions and actors; Suptech / Regtech.

New advancement in digital technologies, such as integration of AI, would overcome many of the challenges faced, Mr Ndahiro said. Finally, Mr Ndahiro said that new digital technologies can power the road ahead for DFS/Fintech in areas such as:

- KYC
- Cyber security
- Data privacy/ protection
- Consumer protection
- Customer experience
- Consumer literacy
- Supervision / compliance

Dr Dickson Andala was represented by Gicheru from the same organization, who said that the National Research Fund (Kenya) viewed digital technologies as enablers of rapid and sustainable economic development. Therefore, the NRF will continue investing and funding research and development in advancing digital technologies. NRF, he said, was seeing an expansion of funding courtesy of digital transformation, including a greater dissemination of research output.

Mr Njoka, the second panellist, emphasized on challenges such as financial inclusion, especially with limited access on the internet in rural areas, combined with cyber security treats. The presenter indicated that the within the FinTech, they have initiated an association that intends to leverage those challenges and create an enabling environment for improvement of DFS. One of the strategies adopted by the association is to foster collaboration with researchers and they
are planning workshops to share knowledge. He said they were actively engaged in advocating policies and fostering collaboration across the region. The future of DFS is bright, he said, and can unlock financial inclusion and employment.

Patrick Mugisha spoke about the power of mobile transactions. For him, effort must be put into infrastructure to create an enabling environment. Through innovation, he said, we can overcome challenges such as regulatory and inclusion issues, in order to make DFS work better.

Prof. Nkem Khumbah said there is need to consider two aspects: (i) operational policies (space) and (ii) conceptual and foundation policy. According to him, digitalization is “Deep frontier science”. Digital technologies need human capital to be achieved through capacity building in scientists who are a creative engine of digital technologies.

According to the presenter, the future of digital advancement and its benefits for the EAC will rely on leaders to invest more in research and development. There is a need for human capacity to compete with the world because digitalization is a competition. By 2007, he said, a half of senior research staff in China were diaspora returnees. Diaspora human capital, he said, needs to be integrated in decision making. He therefore proposed a decade of diaspora return for STEM scientists in East Africa. There is a precedent in Ghana; when under Nkrumah Ghana declared a year of return, 1 million returned and brought enormous resources back. Global competitiveness comes back from the diaspora. In fact, the diaspora contributed $9.3 billion to the regional economy in 2023. Science diplomacy is critical in this, and it will serve to enhance STI capacity.

KEY POINTS AND EMERGING ISSUES

Challenges of inter-country money transactions, abuse of the service and taxation issues were identified as requiring attention by Partner States of the EAC. It was recognized that some initiatives have been started in countries like Rwanda, Uganda and Kenya to allow and regulate the trans-border transactions.

Modalities of attracting diaspora returnees should be considered, including a retention policy. This can follow the same strategies used by countries China and India who overcame the challenge. However, the African diaspora can still contribute to the R&D (including digital transformation) of their countries without necessarily returning, through initiating projects and collaborating with local scientists and policy makers. Success stories were narrated, including from the University of Juba in South Sudan. Diaspora members can also be useful in creating consortia. Governments can appoint them as advisors and in this manner, the diaspora can influence local policies.

The EAC must catch up with the rest of the world by developing and implementing strategies, including building human capacity in research and development by EAC member states. This can be coordinated through EAC organs such as IUCEA and EASTECO.
Ministerial Session

Ministerial dialogue on how to accelerate development and diffusion of science, technology and innovation solutions for a resilient East Africa

Preamble

The Ministerial Session was an important part of the conference that allowed high-level engagement of government policy makers in order for them to fully appreciate the key issues and resolutions of the conference. The ministers and/or their representatives present were informed of the status of implementation of resolutions from the 2nd EAC Regional STI Conference held in Bujumbura in 2021. They were also presented with the resolutions of the present conference.

Accelerating the development and diffusion of Science, Technology, and Innovation (STI) solutions for a resilient East Africa involves the intentional efforts and strategies aimed at fostering the rapid growth, application, and widespread adoption of scientific, technological, and innovative solutions in the East African region. It aims at enhancing the region’s capacity to respond effectively to challenges and shocks, building resilience across various sectors such as healthcare, agriculture, infrastructure, energy and the environment.

Session Moderator: Dr Idris Rai, DES/IUCEA
Session Rapporteur: Moses Ndahiro

Presenter: Fortunate Muyambi, DES / EASTECO
Ministers and their representatives present:
Hon James Magode, Minister of State for EAC, Uganda
Paula Ingabire, Minister of ICT, Rwanda (online)
Dr Amos Nungu, Director-General, COSTECH, Tanzania
Severin, PS, Ministry of ICT, Burundi
Benny Gideon Mahor, Undersecretary, Ministry of EAC Affairs, South Sudan, and Chair of the EAC Coordination Committee

Implementation of Ministerial Resolutions from 2nd STI Conference

The status of implementation of the resolutions of the 2nd STI Conference was explained by the Deputy Executive Secretary of EASTECO, Fortunate Muyambi. The 2nd STI Conference was held in Bujumbura, Burundi, on 20-22 October 2021.

Mr Muyambi explained the progress made in the implementation of the various resolutions, saying the ministers placed the duty of implementation on the Partner States, IUCEA, EASTECO and the other stakeholders. He explained the status of implementation of each of the 10 resolutions as follows:
1. Establishment of national innovation coordination centres within national commissions to enhance innovation strategies by drawing the country-level STI roadmaps – implementation is ongoing and the national science and technology commissions within the partner states are reviewing the STI policies, which shall be updated on the EASTECO webpage when ready.

2. To facilitate and coordinate regional development of integrated STI programmes through the review of STI agenda – EASTECO established a research and development working group which is fully operational. Sub-committees have been established.

3. Enhance investment in centres of excellence and research institutions with linkages to industry – IUCEA has held Academic-Public-Private Partnership Forum (APPF) for linking academia and industry.

4. To establish additional funding mechanisms and enhance efficiency through reduction in bureaucracy at the regional level for implementation of STI initiatives – EASTECO has developed a regional legal instrument for research and development fund. The necessary instruments were approved by the Sectoral Council of Ministers and await further approvals.

5. Partner states to increase contributions to R&D to at least 1% of their respective GDPs – and instrument is currently being developed to ask Partner States to commit to the resolution.

6. To establish socio-economic indicators on regional development and the current state and progress of STI initiatives in the region – the STI indicator database system has been developed and currently EASTECO is in the process of identifying the digitizing the STI indicator. Partner states have already been trained to collect STI indicator data and also test the data collection tools. The electronic database has been installed and EASTECO is now in the process of developing the STI indicator management framework.

7. STI Development Plan and Strategy – this has not been implemented and will be rolled over with the 2024 resolutions.

8. Start-up market standards, regulations and approach to global markets to be harmonized across the EAC – this is being worked on by the Directorate of Trade and Customs at the EAC Secretariat.

9. A think-tank be composed of the Councils and Commissions be established to drive home-grown solutions of STI by EASTECO. The Regional Director-Generals Consultation Forum has been established and the first consultation held on 26-27 February 2024 in Nairobi. The first business was to have STI business indicators rolled out in the Partner States.

10. An EAC standard should be established as a benchmark for Partner States on locally-developed products, including standards for imported products – a number of standards have been developed and others are in progress.
CONFERENCE RESOLUTIONS

Presenter: Isaac Mwangi, Rapporteur General

THE 3RD EAC Regional Science, Technology and Innovation Conference meeting in Nairobi from 6-8 March 2024,

JOINTLY ORGANIZED by the East African Science and Technology Commission (EASTECO) and the Inter-University Council for East Africa (IUCEA),

WITH PARTICIPANTS drawn from various stakeholders including research organizations and universities,

HAVING DELIBERATED on a wide range of issues regarding the application of science, technology and innovation across the East African Community and beyond, and considered the lessons thereof,

HEREBY RESOLVES TO:

1. Call upon EAC Partner States to speedily take advantage of emerging technologies for maximum benefit, taking into account that technologies have a lifespan.
2. Seek the development of a common ICT policy across the region regarding data access and privacy.
3. Underscore the need for free trade and movement of food in the region.
4. Urge the formulation and adoption of clear policies and strategies for promoting bioeconomy in the EAC region in tandem with international standards harmonized across the region but with each country independently developing its own roadmap for implementation.
5. Recognize the misconceptions surrounding GMO technology and to reiterate the need to create awareness of this technology for it to be embraced in order to meet the food and other needs of the region.
6. Recognize that genetic diversity has largely been lost, and for that reason to urge that genetic materials be kept safely for future generations through the creation of a regional genetic store.
7. Urge that Kenya, because of having the highest number of hubs and coding schools in East Africa, be used as a model to promote digital entrepreneurship in the region.
8. Encourage Partner States, with support of the private sector and development partners, to develop and enact appropriate regulations that promote digital entrepreneurship.
9. Urge governments to remove taxes and levies on new digital businesses for a pre-determined period for such businesses to stabilize.

10. Encourage universities and other training institutions to develop and implement digital literacy programmes targeting both rural and urban populations.

11. Recognize the need to consider education policy that focus on Education for Impact, for which technology transfer is critical, departing from Education for All policies.

12. Urge stakeholders to adopt a multidisciplinary approach to research and that for this purpose, a database be created of all researchers and innovators in the EAC region.

13. Encourage cohesive conversation among Stakeholders on Open Science, and to call upon National/Regional Open Science Policy Dialogues to take up a multi-sectoral approach.

14. Advocate for creation of innovation reward and incentive schemes at national and institutional levels.

15. Encourage the development or adoption of the best and most reliable Open Source infrastructures (platforms, repositories, etc.) which are cost effective.

16. Encourage stakeholders to allocate adequate finances from national R&D budgets to advance Open Science.

17. Reiterate the need to deconstruct long-held scepticism regarding Open Science and call for greater adoption of open science practices by universities and research institutes, including establishment of shared research computing practices.

18. Develop a regional scholarship scheme to provide PhD scholarships for young graduates (less than 30 years old) in Science, Technology, Engineering and Mathematics (STEM) areas.

19. Encourage the promotion of smart manufacturing through Integration of automation in manufacturing processes.

20. Call for greater use of Artificial Intelligence (AI) technologies in data analysis for purposes of data-driven decision making and predictive maintenance.

21. Call for implementation of blockchain and RFID technology across the region.

22. Encourage greater energy efficiency through the use of smart grids and Renewable Energy Integration.

23. Urge Partner States to adopt greater use of E-Government initiatives through Implementation of digital platforms and e-commerce.

24. Speed up skills development and education by encouraging stakeholders to adopt e-learning platforms and develop greater human capacity through appropriate training programmes.

25. Urge stakeholders to collaborate in their innovation efforts through Open innovation platforms and technology hubs.

26. Encourage digital Infrastructure investment, especially in broadband connectivity and cybersecurity.
27. Encourage multi-disciplinary engagement to resolve problems across borders throughout the region.
28. Call upon the development of advanced Digital Financial Services in order to enhance access to funds and manage wealth.
29. Urge EAC Partner States to utilize science diplomacy to enhance human capital in the region by attracting highly skilled experts in STEM areas working in the diaspora to return to their home countries, and to consider declaring a Decade of Diaspora Return for that purpose.
30. Make use of the diaspora to support STI initiatives in East Africa.
KEY POINTS AND EMERGING ISSUES

The ministers and their representatives present appreciated the work and resolutions of the conference. They expressed their full support towards implementation of those resolutions. However, they pointed out that implementation would have to be at different levels. There were those resolutions that could be implemented without delay by the conference partners and stakeholders, and those that were sensitive and required further debate within the individual Partner States. Moreover, some resolutions could only be implemented through consultation and approval of the Council of Ministers of the EAC.
LAUNCH OF EAC REGIONAL STRATEGIES

EASTECO launched the following three strategy documents:
1. EA Regional Innovation and Technology Transfer Strategy
2. EA Regional STEM Strategy
3. EA Regional Strategy for Indigenous Knowledge and Technology Systems
Preamble
After three gruelling days of conference activities, speakers at the closing ceremony appreciated the effort put in by the organizers and the active participation of all the attendees. They urged the full implementation of the conference resolutions in order to transform the region.

Prof Gaspard Banyankimbona, Executive Secretary, IUCEA, in his closing remarks, said that the conference had lived up to expectations. He thanked stakeholders and development partners for their commitment. He urged participants to take full ownership of the various STI policies launched at the conference. There is an urgent need for digital transformation and the fifth industrial revolution, he said. The region needs to invest in STEM and establish infrastructure that will encourage the uptake of sciences. We cannot accept to lag behind again, he concluded.

Dr Sylvance Okoth, Executive Secretary, EASTECO, said that justice had been served to the theme of the conference. On behalf of EASTECO, he committed to work tirelessly not to let down the people of the EAC by implementing the resolutions arising from the conference.

Advocate Beny Gideon, Undersecretary, Ministry of EAC Affairs, South Sudan, closed the conference. In his remarks, he made an undertaking to implement the resolutions. He also appreciated the launch of the three strategies. Infrastructure development, he said, was the only way the region could achieve the STI resolutions. He urged implementation of resolutions at the multi-sectoral level in such a manner that the 4th conference will be able to say what percentage had been achieved. He then declared the conference closed.
6th- 8th March 2024
NAIROBI, KENYA

Venue: Sarova Panafric Hotel

The 3rd EAC Regional Science Technology & Innovation Conference

Theme: “Accelerating development and diffusion of STI solutions for a resilient East Africa”

The 3rd EAC Regional STI Conference is organised by East African Science and Technology Commission (EASTECO) and the Inter-University Council for East Africa (IUCEA) in collaboration with various STI stakeholders in the region and globally as an avenue for diffusion of new development in STI and for sharing experiences and results within the knowledge and technology generation, translation and transfer chain, applications of STI outputs, strengthening collaborations, facilitating regional integration and sustainable development.
PROGRAMME
DAY 1: WEDNESDAY, MARCH 6, 2024

09:00 – 11:00 EAT - Opening Session
Session Moderator: Fortunate Muyambi, DES/EASTECO & Prof. Idris Rai, DES/IUCEA

Kenya National Anthem

EAC Anthem

Entertainment – Traditional Performance

Prof. Gaspard Banyankimbona, Executive Secretary, IUCEA

Dr. Sylvance Okoth, Executive Secretary, EASTECO

Björn Richter, EAC GIZ Cluster Coordinator

Ms Hendrina Doroba Chalwe, African Development Bank

Hon. Dr. Peter Mathuki, Secretary General, East African Community

Dr. Beatrice Muganda Inyangala, Principal Secretary, State Department for Higher Education and Research, Kenya

Official Opening by Guest of Honour:
Hon. Ezekiel Machogu, CBS Cabinet Secretary, Ministry of Education, Kenya

Launch of EAC Regional Policies

11:00 -11:30 EAT - Photo / Health Break / Exhibition Tour
11:30 - 13:00 EAT - Plenary Session 1: Keynote & Panel Discussion

Theme: Agricultural productivity, resilience, and food security

Agriculture is a vital sector in the economies of East Africa Countries. The sector plays a significant role in the livelihoods of citizens in the East Africa Community (EAC). More than 70% of the industries in the EAC region are agro-based and dependent on agriculture as the main source of raw materials. However, the productivity of agriculture in the EAC region is alarmingly decreasing mainly because of the mounting pressures of climate change concerns, diminishing resources, limited application of modern technologies as well as changing demographic trends. The challenge of low agricultural productivity has thus been a major cause of increased hunger, malnutrition and poverty in the EAC countries. It is therefore pertinent for all players to focus and put in place deliberate efforts to enhance agricultural productivity, resilience and food security in East Africa.

Session Moderator: Dr. Joseph Ssemakula, Uganda Martyrs University

Rapporteur: Milton Melingasuk

Keynote Presentation: (25 minutes)
“Leveraging Science, Technology, and Innovation in the enhancement of agricultural productivity, resilience, and food security in East Africa” by Prof. Richard O. Oduor, Registrar, Research, Innovation and Product Development, Kenyatta University.

Panelists Session (40 Minutes)
- Panelist 1: Prof. Joyce Kinabo, Professor of Human Nutrition, Sokoine University, United Republic of Tanzania
- Panelist 2: Dr. Roy Mugiira, CEO, National Biosafety Authority, Kenya
- Panelist 3: Dr. Richard Edema, Centre Director, Makerere University Regional Centre for Crop Improvement (MaRCCI), Uganda
- Panelist 4: Prof George Owuor, Centre Leader, Centre of Excellence in Sustainable Agriculture & Agribusiness Management (CESAAM), Egerton University, Kenya

Discussion/ Q&A (25 minutes)

13:00 - 14:00 EAT - Lunch Break, Exhibition and Poster Session
14:00-17:00 EAT - Plenary Session 2: Keynote, Panel Discussion & Co-creation Session

Theme: Stimulating digital entrepreneurship

The East Africa region has exhibited a strong entrepreneurial mindset with a growing number of digital entrepreneurial intermediaries. However, the existing digital entrepreneurial potential in the region has not translated into a vibrant digital entrepreneurial ecosystem, with commercial digital hubs that can generate talent and ventures to compete at the highest global level. There is a need therefore for the EAC Region to strategically design and implement customized interventions to strengthen the entrepreneurship ecosystem of mutually reinforcing components that include a digital knowledge base and ICT market; a digital business-friendly environment; access to finance; digital skills and e-leadership; and an entrepreneurial culture.

Session Moderator: Mercy Kimalat, CEO, ASSEK
Rapporteur: Dr. Samuel Obino Mokaya

Keynote Presentation: (25 minutes)
“Building innovation & entrepreneurship ecosystems by nurturing digital skills and talents” by David Cheboryot - Director, E4Impact Entrepreneurship Centers.

Panelists Session (40 Minutes)
- Paneist 1: Pascal Nyiringango - Head of Business Development and Commercialization, Center of Energy- ACE-ESD, University of Rwanda
- Paneist 2: Denis Denaya - Executive Director, Koneta Hub – South Sudan (Virtual)
- Paneist 3: Dr. Amos Nungu – Director General-COSTECH, United Republic of Tanzania
- Paneist 4: Dr. Joyce Ngure – Assistant Director of Research, State Department for Higher Education and Research, Ministry of Education

Discussion/ Q&A (25 minutes)
Co-creation Session (1hr 15 minutes)
“A deep dive into the strategic pillars to support the regional initiative on IP Policy, Capacity Building of innovators, Early-stage investment and strategic linkage of higher education institutions with entrepreneurship Support Organisations.”

17:00- 18:00 Eat – Networking Cocktail & End Of Day One
DAY 2: THURSDAY, MARCH 7, 2024

09:00 – 10:30 EAT - Plenary Session 3: Keynote & Panel Discussion

Theme: *Open Science and Science Diplomacy: Bridging Borders for Global Impact*

This conference theme aims to explore the dynamic relationship between open science principles and the practice of science diplomacy. Open science emphasizes transparency, accessibility, and collaboration in research, while science diplomacy focuses on building international partnerships to address global challenges. The intersection of these two concepts creates a powerful synergy that can foster innovation, address shared global issues, and promote mutual understanding.

**Session Moderator:** Dr. Shubi Kajjage  
**Rapporteur:** Dr. Lizzy Mwamburi

Keynote Presentation: (20 minutes)

*Identifying challenges in implementing open science and science diplomacy and exploring opportunities for overcoming barriers to collaboration* by Ms. Joy Owango, Executive Director, Training Centre in Communication

**Panelists Session (40 Minutes)**
- Panelist 1: Dr Richard Glover- UNESCO Consultant
- Panelist 2: Prof Meoli Kershorda - Executive Secretary - Kenya Education Network
- Panelist 3: Prof Muliaro Wafula - Lead Scientist - Africa Open Science Platform (AOSP) EA Node
- Panelist 4: Mr. Steven Ssebbale - Head of policy, Uganda National Council for Science and Technology

Discussion/ Q&A (10 minutes)

10:30 - 11:00 EAT - Health Break/Exhibition Tour
### 11:00 - 13:00 EAT - Parallel Sessions 1: Paper Presentations

| 11:00 - 12:00 EAT | Parallel Session 1A: Precision Agriculture Technologies, and Data Science in Agriculture  
Moderator: Dr. Joshua Ogencho  
Rapporteur: Dr. Charles Masembe | Parallel Session 1B: Water Resources and Water Management  
Moderator: Dr. Charles Nwagaba  
Rapporteur: Dr. Lughano Kusiluka | Parallel Session 1C: Biomedical Engineering and E-health  
Moderator: Prof Bruno Sunguya  
Rapporteur: Dr. Bunani Samuel |
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| (Each Presenter 10 Minutes then Q&A: 20 Minutes at the end of presentations) | 1. Using Normalized Difference Vegetation Index to Predict Potato (Solanum Tuberosum L.) Apical Rooted Cuttings Yields in Njoro, Kenya by Winnie Chabot Wambugu  
2. Climate Smart Agricultural Technologies (TSAPS) as a Resilience Strategy for Semi-Arid Agroecosystems Production in Kenya by Hellen W. Kamiru  
3. Development and evaluation of Reverse transcription loop-mediated isothermal amplification (RT-LAMP) for rapid typing of serotype ‘O’ foot-and-mouth disease virus in endemic regions of Tanzania by Sarah M. Njeru  
2. Study on the evolution of physicochemical parameters indicators of water quality in the pelagic zone of the northern Lake Tanganyika basin by Stanislas Ndayashimy  
4. Implications of adopting insects for recycling organic waste on household recycling income by Perpetual Galena | 1. A GIS-Based Method for Analyzing the Impact Of Physical Planning In The Spread Of COVID-19 In Kampa City by Nagula Brendan  
2. Sterilized Malaria Vector, Anopheles Funestus Can Autodisseminate Sufficient Pyriproxyfen To The Breeding Habitat Under Semi-Field Settings by HAMISI Kunambi  
3. Factors Associated With Menstrual Hygiene Management Among Adolescent Girls in Primary School by Kibino Pascal  
4. Co-Administration of Artesunate and Coenzyme Q10 Enhanced Treatment Outcomes During Experimental Cerebral Malaria by Ameliorating Lethal Inflammatory And Oxidative Mediators by Nyariki James Nyabuga |

| 12:00 - 13:00 EAT | Parallel Session 1D: Biodiversity and Forestry and agroforestry  
Moderator: Dr. Bernard Barasa  
Rapporteur: Dr. Nolikumana Theophile | Parallel Session 1E: Climate Change Mitigation, Bioeconomy and Environmental Health  
Moderator: Dr. Athanase Nkunzi Miana  
Rapporteur: Dr. Hamimana Sylvester | Parallel Session 1F: Nutrition and Environmental Health  
Moderator: Dr. Andrea Pembe  
Rapporteur: Dr. Vivian Levi Enoka |
| --- | --- | --- |
| 1. Assessing the Impacts of Invasive Weed Parthenium hysterocephorus (Tagweed) to Plant Diversity in Baringo Lowlands Kenya by Sally Patricia Asayo  
2. The effect of different growing media on seed germination and seedling growth of Tefalia pedate by Philpina Shoyo  
3. Scaling hermetic storage bags through access to finance: lessons from Tanzania by Diederonne Baributsa  
4. Impact of physical infrastructures on agricultural production in Burundi by Bonaventure Minani | 1. Factors Influencing Farmers’ Choice of Agrometeorological Information Pathways by Godfrey Obwina Atsiaya  
2. Wood Diversifiy, Carbon Stocks and Land-Use Dynamics of the Lwampango Relict Forest in the Kaziba Chiefdom, Eastern Dr Congo by Nleko Mubembe  
4. Evaluating Effectiveness of the Blend of Moringa oleifera Lam and Synthetic Coagulants in Coagulation/Flocculation of Wastewater from Wastewater Recycling Mill by Nyambura Janeose Wambui | 1. Determination of The Prevalence of Gastrointestinal Parasites in Zanzibar Red Colobus Monkey In Jozan National Park by Dr. James Nyabuga  
2. Ambient air pollution exposure and child birthweight in East African countries by Valérentine Baharane  
3. Imake Food Dryer by Joseph Nyeo Churchill  
4. Stretching limits of ecosystem service provision by black soldier fly (Hermetia illucens) larvae beyond the horizons of food, feed, and fertilizer for cleaner cities by Kabi F. Kaweesi G.G and Lutakome P |

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### 13:00 - 14:00 EAT - Lunch Break, Exhibition and Poster Session
14:00-15:30 EAT - Plenary Session 4: Keynote & Panel Discussion

**Theme:** ICT emerging technologies in driving digital transformation in industrialization in East Africa

In East Africa, the role of Information and Communication Technology (ICT) emerging technologies has been significant in driving digital transformation across key industries. There is a need to harness digital technologies and innovation to transform East African societies and economies to promote integration, generate inclusive economic growth, stimulate job creation, break the digital divide, and eradicate poverty for the region's socio-economic development and ensure East Africa's ownership of modern tools of digital management.

**Session Moderator:** Dr. Annabella Basaza  
**Rapporteur:** Dr. John Nyiro Mwero

Keynote Presentation: (25 minutes)  
"Role of ICT emerging technologies in driving digital transformation in industrialization in East Africa" by Eng. Murenzi Daniel - PITO East African Community.

**Panelists Session (40 Minutes)**  
- Panelist 1: Prof. Oyawa, Director General, NACOSTI Kenya  
- Panelist 2: Dr. Martin Ongol, Executive Secretary, NCST Uganda  
- Panelist 3: Prof. Charles Kwesiga, Director - Uganda Research Institute  
- Panelist 4: Dr. Tony Omwansa - Kenya National Innovation Agency

**Discussion/ Q&A (10 minutes)**

15:30 – 17:30 EAT - Parallel Sessions 2: Paper Presentations

| 15:30 – 16:30 EAT | Parallel Session 2A: Soil Sciences  
**Moderator:** Dr. Niyonzima Francois  
**Rapporteur:** Prof. Kiri Andrew  
1. Effects of sowing density and different fertilizer sources on maize agronomic performance and soil properties in central Benin by Tobi Moriaque  
2. Determination of liming material requirements to correct soil acidity and improve soil chemical properties in Nyoma District, Rwanda by Giramata Joie Claire & Bazimyenya Jean De Dieu  
3. Bio Fertilizers for Environmentally Sustainable Soil Health Management by Chrispo Mutebi | Parallel Session 2B: Food Systems and Agribusiness  
**Moderator:** Dr. Chrispin Kwenje  
**Rapporteur:** Dr. Nambulawa Victoria  
1. Scaling hermetic storage bags through access to finance: lessons from Tanzania by Dieudonne Baributsa  
2. Characterization of Organic Waste Producers and Collectors and Evaluating their Willingness to Add Value to Segregated Organic Waste for Insect Products by Teresia Wamwondwe  
3. The determinants and impacts of agriculture loan on maize yield among maize farmers in Tanzania by Happiness Kilombe | Parallel Session 2C: IOT, Data Analytics & ICT for e-Government  
**Moderator:** Dr. Alphose Nkurunziza  
**Rapporteur:** Dr. Gabriel Shirima  
1. Data-Driven Decision Making: A Case Study of Tertiary Institutions in Uganda by Fredrick Edward Kitcego  
2. Smart IoT and Machine learning Based Irrigation system by Wayne Steven Ockello  
3. Learner behavior model for a learning management system by Charles Lwande, Lawrence Muchemi, Robert Ooko  
4. Use of Earth Observation in disentangling the contribution of woody and herbaceous biomass for forage, fuelwood and carbon mapping in Eastern Africa by Kahlil Njoku et al |

17:30 EAT – SNACK & END OF DAY TWO
DAY 3: FRIDAY, MARCH 8, 2024

09:00-10:30 EAT - Plenary Session 5:
Keynote & Panel Discussion

Theme: Natural Resources Management

Natural resources are impacted by human exploitation, climate change, and natural disaster risks that require interventions for better management. Harnessing the power of science, technology, and innovation, natural resource management can become more efficient, sustainable, and aligned with conservation goals. These applications contribute to the responsible utilization of resources, biodiversity conservation, and the overall resilience of ecosystems. By leveraging these STI applications, natural resources management can become more efficient, sustainable, and aligned with conservation goals, ultimately contributing to the resilience and health of ecosystems. The integration of these technologies is essential for addressing the complex challenges associated with resource management in a rapidly changing world and helps to monitor, preserve, and sustainably use resources.

Session Moderator: Dr. Francis Mugisha
Rapporteur: Dr. John Nduko

Keynote Presentation: (25 minutes)
“Leveraging Science, Technology, and Innovation (STI) advancements in shaping and advancing the bioeconomy” by Dr. Phillip Osano Director, East African Centre SEI, Nairobi, Kenya

Panelists Session (40 Minutes)
- Panelist 1: Dr. Julius Ecuru-icipe/BioInnovate African Programme-Kenya
- Panelist 2: Prof. Masharabu Tatien, Permanent Executive Secretary NCSTI - Burundi
- Panelist 3: Rael Adhiambo, NACOSTI, Nairobi, Kenya
- Panelist 4: Brenda Nakazibwe, Team Leader, Pathogen Economy, Science, Technology and Innovation, Secretariat, Office of the President-Uganda

Discussion/ Q&A (25 minutes)

10:30-11:00 EAT - Health Break, Exhibition and Poster Session
**11:00 -13:00 EAT - Plenary Session 6: Keynote & Panel Discussion**

**Theme:** Information Communication Technology and Digital Economy

Information Communication Technology is the broader framework encompassing various technologies, while the Digital Economy specifically focuses on the economic activities enabled by digital technologies. Together, they shape the way societies, businesses, and individuals interact and conduct transactions in the modern world. Leveraging digital technologies to enhance and streamline Digital Financial Services (DFS) is crucial for improving accessibility, efficiency, and inclusivity in financial systems. By integrating these digital technologies, financial service providers can enhance the efficiency, accessibility, and security of digital financial services, ultimately contributing to financial inclusion and economic development. Additionally, collaboration between industry stakeholders, governments, and regulators is crucial to creating a supportive ecosystem for the adoption of digital financial technologies.

**Moderator:** Dr. Noel NTAWUHORAKOMEYE  
**Rapporteur:** Prof. Jean Uwamahoro

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**Keynote Presentation:** (25 minutes)

"Leveraging digital technologies to enhance and streamline Digital Financial Services" by Tamara Cook - Chief executive Officer- Financial Sector Deepening Kenya (FSD Kenya).

**Panelists Session (40 Minutes)**
- Panelist 1: Dr Dickson Andala CEO - National Research Fund-Kenya
- Panelist 2: Joe Kanyua - Head of Digital Transformation- Safaricom
- Panelist 3: Patrick Mugisha - Innovent Labs Africa- Kampala Uganda

**Discussion/ Q&A (25 minutes)**

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**13:00 - 14:00 EAT - Lunch Break, Exhibition and Poster Session**
14:00-16:00 EAT - Ministerial Session (Panel Discussion)
Ministerial dialogue on how to Accelerate development and diffusion of science, technology and innovation solutions for a resilient East Africa

Accelerating the development and diffusion of Science, Technology, and Innovation (STI) solutions for a resilient East Africa involves the intentional efforts and strategies aimed at fostering the rapid growth, application, and widespread adoption of scientific, technological, and innovative solutions in the East African region. It aims at enhancing the region’s capacity to respond effectively to challenges and shocks, building resilience across various sectors such as healthcare, agriculture, infrastructure, energy and the environment.

Session Moderator: Fortunate Muyambi, DES/EASTECO & Prof. Idris Rai, DES/IUCEA
Rapporteur: Moses Ndahiro

Presentation of Ministerial Resolutions Implementation from the 2nd Science, Technology and Innovation Conference
Fortunate Muyambi, Deputy Executive Secretary, EASTECO

Presentation on recommendations from the Plenary Sessions
by Rapporteur General

Discussion on Resolutions by Permanent State Ministers

Launch of EAC Regional Strategies

16:00 - 16:30 EAT - Closing Remarks

Executive Secretary, EASTECO
Executive Secretary, IUCEA
Secretary General, EAC

Hon. Peninah Malonza, EGH
Cabinet Secretary, Ministry of East African Community, the ASALs and Regional Development

17:00 EAT - END OF THE CONFERENCE