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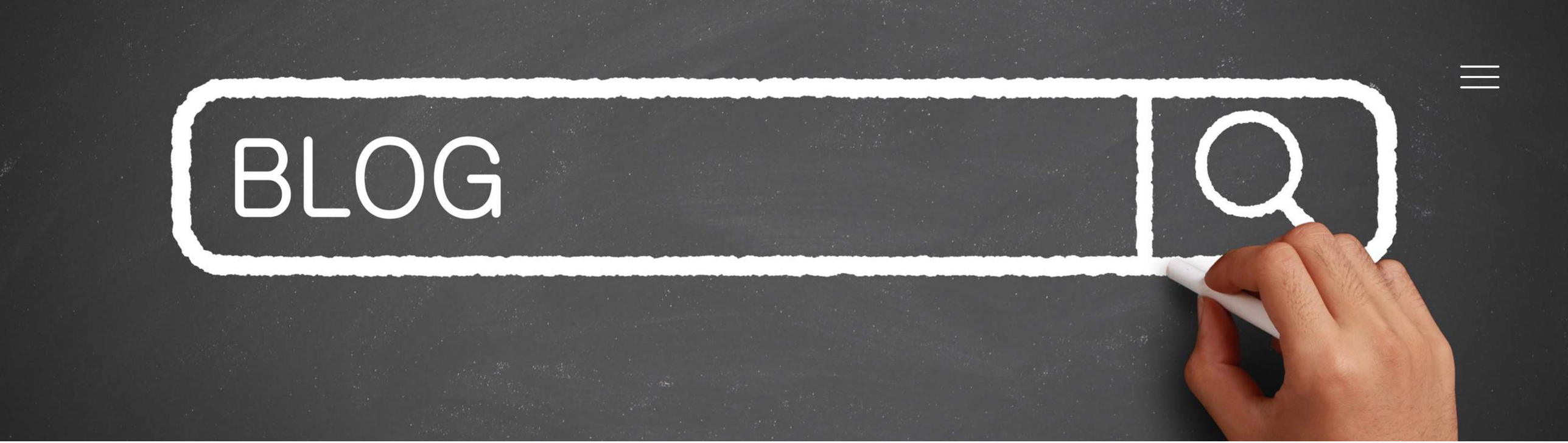
APET
African Union Panel on Emerging Technologies

Blogging for Impact

2022 SERIES

African Union High-Level Panel on Emerging Technologies (APET)

Calestous Juma Executive Dialogue (CJED)



APET-CJED BLOGS 3RD EDITION

Synopsis

The APET-CJED blogs are developed by the African Union High-Level Panel on Emerging Technologies (APET), with the support of its secretariat.

The 2022 series of the APET-CJED blogs focus on a myriad of challenges confronting various African countries and how they can identify and harness emerging technologies and innovations to address these barriers. The blogs capture and apply evidence-based innovation and knowledge to support African countries in effectively harnessing existing and emerging technologies for socio-economic growth.

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Blog #1 Published on Jan 17, 2022

Alleviating Maternal Deaths in Africa through Innovation and Emerging Technologies

Robust healthcare for Africa is significant towards strengthening Africa's sustainable socio-economic development. In addition, healthcare is also a fundamental human right, as reiterated by the United Nation's (UN's) Sustainable Development Goal Number 3 (SDG 3).[1] The UN's SDG 3 strives to ensure healthy lives and promote the well-being of global citizenry of all ages. On the other hand, the African Union's (AU) Agenda 2063 envisions a prosperous Africa based on inclusive growth and sustainable socio-economic development and growth.[2] However, for African countries to realise these aspirations, Africa should ensure a healthy and well-nourished citizenry. This requires adequate levels of investment and policy interventions so to augment access to quality maternal healthcare.

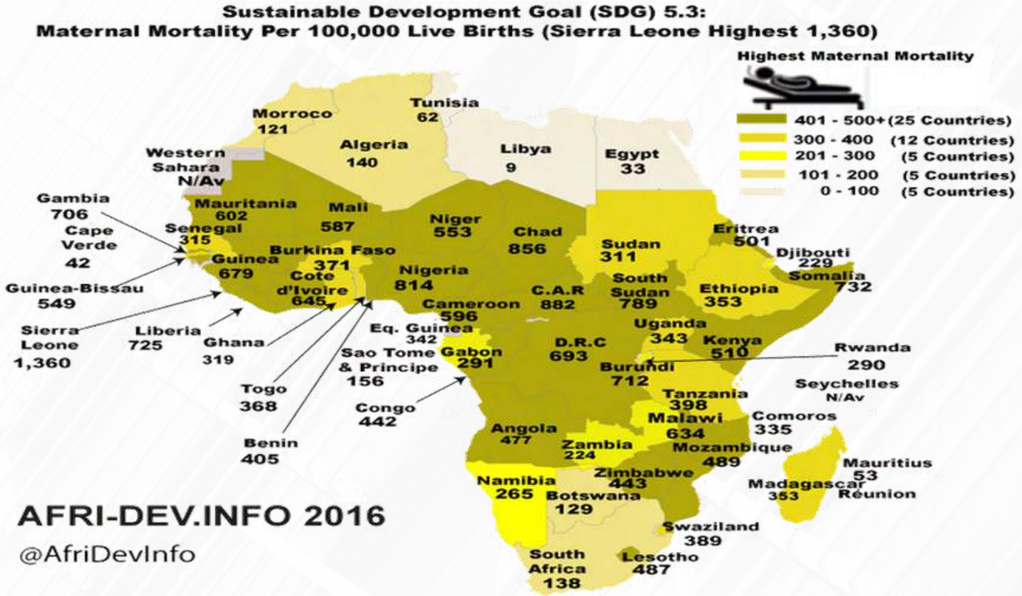

Figure 1: Africa Maternal Mortality rate as at 2016. SOURCE: http://www.afri-dev.info/

Even since independence, most African countries have been attempting to enhance their strategic healthcare facilities and services. Conversely, African countries have encountered various challenges imposed by the continent's widespread poverty, epidemic diseases, and food insecurity.[3]

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For example, infectious diseases such as HIV/AIDS and Tuberculosis (TB) have been reported as responsible for the high mortality rates in Africa.[4] Concomitantly, other diseases such as cardiovascular diseases, diabetes, and cancer are also compounding the mortality rate in Africa.[5] Furthermore, epidemic and pandemic diseases such as COVID-19 and Ebola have further burdened the mortality rate in Africa.

Remarkably, the negative impacts of Africa's healthcare challenges are predominantly experienced by African women. This is because African women are barely considered and catered to when formulating and improving Africa's healthcare services and provisions.

For example, Antenatal Care (ANC) receives limited attention and investments, characterised by limited equipment, technology, and necessary infrastructure. Even though there has been progress towards enhancing the child survival rates, ANC has remained challenging for most of Africa's healthcare provision frameworks.

ANC services are crucial in prioritising and protecting women's health and their unborn children. This preventive healthcare tool can potentially enable African women to learn from skilled healthcare personnel to encourage robust healthcare measures and behaviours during pregnancy. Moreover, ANC also enables pregnant women to have access to micronutrients and vitamins supplements, treatment from hypertension, and immunisation. In addition, ANC is providing HIV and other sexually transmitted diseases (STD) testing mechanisms. Therefore, such provisions enable the necessary ANC-based medication to prevent mother-to-child transmission of HIV.[6]

An estimated 1.12 million newborn deaths occur annually in Africa.[7] The common primary causes of these newborn deaths include premature births, low birth weight, infections, lack of oxygen at birth, and birth trauma.[8] In addition, African mothers have suffered high maternal mortality rates of approximately 533 maternal deaths per 100,000 live births.[9] This totals to approximately 200,000 maternal deaths annually.[10] Therefore, the ANC services are essential towards screening the women population so as to detect early signs of diseases, as well as determine the risk factors for such diseases. This can therefore help establish and implement timely intervention programmes. Most importantly, the early detection of signs and risks factors to the unborn babies and their mothers can also reduce the mortality rate associated with pregnancy and births.

Furthermore, ANC provides a platform for timely and meaningful interaction between health workers and pregnant women. This provides an opportunity for healthcare education and strengthening pregnant women with the capacity to detect and report pregnancy complication indicators in a timely manner. The healthcare practitioners and pregnant women can collaboratively develop a birth plan to ensure baby delivery at an available healthcare facility.[11]

Africa's ANC coverage has been progressively improving because over two-thirds of pregnant women have received at least one (1) ANC contact during the course of their pregnancy.[12] However, the World Health Organisation (WHO) has recommended that pregnant women have four (4) ANC visits during their pregnancy cycle.[13] Nonetheless, African women with at least four ANC visits remain at 44% across the continent. This limited ANC attendance is attributable to the long distances between pregnant women in rural communities and their nearest ANC clinics. Consequently, this makes it difficult for pregnant women, and sometimes without the appropriate transportation, to attend their necessary ANC clinic appointments.

Furthermore, there is limited awareness about the significant benefits of attending ANC clinics. As a result, pregnant women may delay their ANC attendance appointments because they are not aware of the recommended frequency of their ANC consultations. Furthermore, there may also be unaddressed misconceptions accompanied by negative social, cultural and religious beliefs within African societies against ANC consultations. Regrettably, pregnant adolescents and unmarried younger women tend to hide their pregnancies to avoid potential exclusion from school and stigmatisation. There is also limited support for pregnant women from their peers, husbands, and family members.

Therefore, these challenges need to be addressed adequately by African policymakers through robust policy interventions. In realising the importance of ensuring maternal and infant health benefits of ANC consultations during pregnancy, the African Union High-Level Panel on Emerging Technologies (APET) is encouraging the deployment of emerging technologies to expand and support the acceptance and utilisation of ANC services and facilities in Africa. These emerging technologies can help pregnant women access information about pregnancy, remind ANC appointments, enable timely monitoring and interventions by healthcare professionals.

For example, the Zanzibar Island of Tanzania has leveraged mobile phone technologies to send ANC attendance reminders to pregnant women. These mobile technology reminders known as the “wired mothers” can send automated Short Messaging Service (SMS) to pregnant women and mothers with unidirectional text messaging. This SMS system also provides a mobile phone voucher system to afford the possibility of a direct two-way communication mechanism between the mothers and their primary healthcare providers.[14] Consequently, this intervention has significantly encouraged and improved the proportion of Zanzibar women towards attending and receiving the recommended four (4) antenatal care consultations during the pregnancy cycle. Therefore, APET recommends that African countries should expand these kinds of mobile phone “wired mothers” applications so to enhance the maternal and newborn healthcare systems.

APET is also urging African countries to adopt the Internet of Things (IoT) technologies to ensure the effective and efficient healthcare of pregnant women through expanded access to ANC services across the African continent. The IoT can interconnect pregnant women and healthcare facilities by using the internet of computing devices embedded in everyday objects and sending healthcare data to healthcare facilities.[15] For example, IoT devices such as the RF-Tags and sensors are attached to pregnant women to monitor and evaluate their vital signs such as body temperatures, pulse rates, respiration (breathing) rates, and blood pressure by professional medical staff on a daily basis. Potentially, these monitoring and evaluation using IoT-enabled mechanisms can help medical practitioners institute timely intervention for pregnant women. Therefore, these improved healthcare mechanisms can timely eradicate potential pregnancy complications and prevent any form of potentially harmful incidents. However, ethical and regulatory frameworks should be established to strengthen the relevant policy frameworks to enhance and consider safety, privacy, religious, legal, and societal concerns.[16]

The continued limited access to hospitals and adequate medical staff members have further caused challenges for pregnant women in Africa. This is predominantly observed in rural Africa. Furthermore, the insufficient data management systems within healthcare systems also negatively impact the quality of healthcare for pregnant mothers when accessing ANC clinic facilities and services. For African countries to enhance ANC facility-data-management-technology-systems (derived from IoTs), APET encourages African countries to utilise blockchain technology-enabled-management-systems. This is because blockchain technology management systems can enable efficient and reliable records keeping mechanisms for future use.[17]

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Figure 2: Gifted Mom Application: Bringing healthcare to the fingertips of pregnant women and nursing mothers in Africa.
SOURCE: https://www.businesscalltoaction.org/member/giftedmom

For example, Cameroonian medical doctors have developed a blockchain technology-enabled "Gifted Mom"[18] application to provide pregnant women and new mothers access to healthcare information and strengthen their linkages to antenatal care services.[19]

Notably, the gifted mom application sends reminder notifications to pregnant women about their next appointment. In addition, the application sends pregnant women vital pregnancy, labour and delivery, vaccination, breastfeeding, and post-natal healthcare information for healthcare educational purposes.[20] Furthermore, the blockchain technology application enables creating and sharing common health information databases.[21] As such, the application assists healthcare providers consolidate the patient's health data and subsequently formulating and implementing intervention in real-time. Blockchain-enabled healthcare systems can safeguard and exchange patient data between hospitals, diagnostic laboratories, pharmacy firms, and physicians.
Most importantly, blockchain applications can accurately detect acute and dangerous medical mistakes across the medical field to enhance the performance, security, and transparency of sharing medical data within the healthcare system. Furthermore, this technology can effectively enable medical institutions to enhance their capacity to analyse medical records. Thus, APET believes that the technology application within the African context can significantly improve the African healthcare systems.

For example, African countries can improve their electronic medical records (EMR) systems containing detailed patient encounter information such as an encounter summary, medical history, test results, and allergy details.[22] Currently, these African EMRs are collected, retained and handled by professionals from that specific medical institution. Regrettably, these useful EMR systems are limitedly collected, aggregated, and consolidated from multiple medical institutions.

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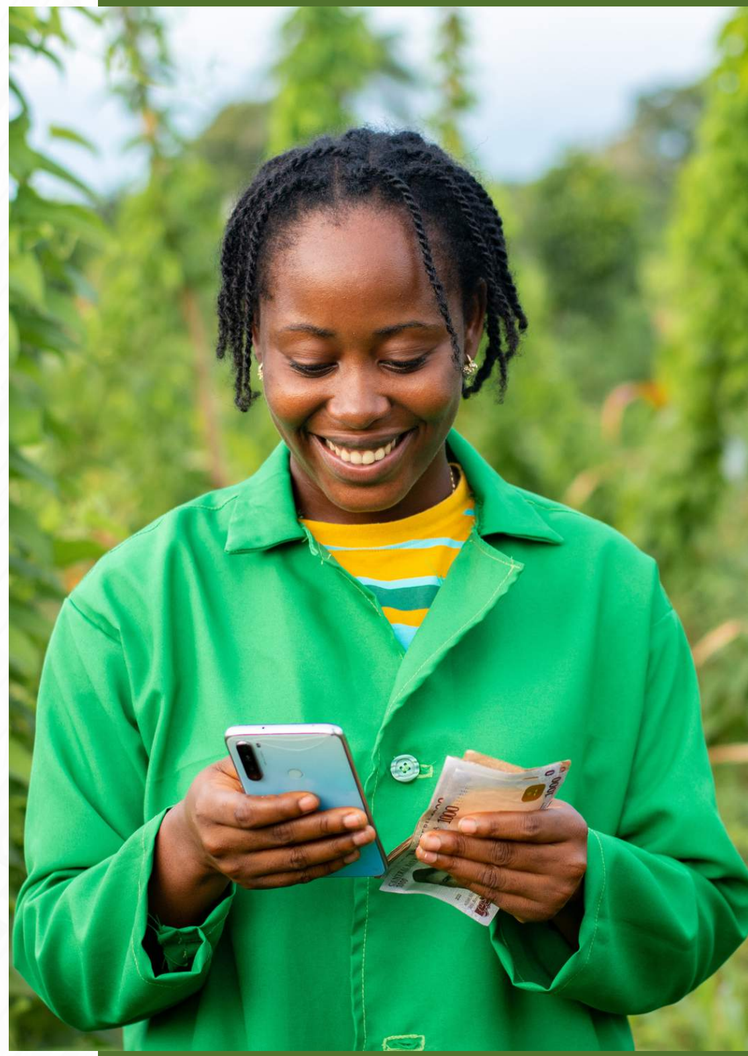
This limits the ability to ensure that the patient's complete medical records are available to authorised practitioners during patient encounters. Notably, no African country has successfully implemented a nationwide EHR system.[23] Therefore, blockchain technologies can help consolidate EMR systems at regional and national levels to enable comprehensive medical assistance for patients.

APET believes that digital technologies such as IoT enabled by blockchain technologies can improve the healthcare and medical service systems for Africa's pregnant women. As a result, such healthcare-based technology advancements can enhance the safety of pregnant women when accessing antenatal healthcare services. Therefore, African countries should adopt and expand the ANC-enabling technologies to address maternal healthcare challenges. As such, African countries should enhance their investments and resource mobilisation towards expanding their ANC clinics capacity and accompanying infrastructure vital for pregnant women. Furthermore, African countries should establish and develop the necessary enabling policy frameworks to expand their ANC development and implementation in Africa.

Link: https://www.nepad.org/blog/alleviating-maternal-deaths-africa-through-innovation-and-emerging-technologies

Blog #2 Published on Jan 24, 2022

Strengthening Competitiveness in Africa's Agricultural Value Chain using Smart Technologies



The COVID-19 pandemic has impacted global value chains (GVCs) by interrupting transportation and logistics frameworks, supply and production mechanisms, and demand and consumption patterns.[1] On the pandemic onset, movement and trade restrictions were imposed by most African countries to control the spread of the COVID-19 pandemic. The agricultural extension and advisory services also confronted substantial disruptions due to limited movement.[2] Consequently, this created a food supply crisis that deterred and threatened Africa's socio-economic development and growth, as well as food security.[3] These disruptions also highlighted gaps and weaknesses in Africa's agricultural value chain.

The negative impacts of the COVID-19 pandemic in African agricultural value chains and food supply systems have been significant because many African countries are substantially reliant on food importation. Reports have shown that African countries are substantially dependent on importing agricultural necessities outside the continent.[4] These imports include agricultural products such as seeds, fertilisers, veterinary inputs, fish fingerlings, and feeds. Therefore, the collapse of the international markets for agricultural inputs and outputs has exposed the weak agriculture value chains in Africa in terms of food supply and demand. This has resulted in dwindling of farming yields and food production across the African continent.

Consequently, this has led to the loss of jobs as job creation efforts have significantly declined within the agricultural sector due to the disrupted exportation and importation trade activities. These have also effectively reduced trade flows and increased trade deficits for many African countries.[5] For example, reports have estimated that the export supply disruptions cost African countries risk losses ranging between US $1 billion and US $5 billion in 2020, which has negatively impacted approximately 10 million farmers in the form of job losses.[6] The pre-COVID-19 pandemic food shortage expectations in West Africa were envisaged to impact approximately 22 million people negatively. However, the COVID-19 pandemic amplified the food shortages and need for food assistance to approximately 28 million people.[7] This demonstrates the challenges of food insecurity in Africa, among other things, caused by inefficient value chains.

Notably, agriculture has remained fundamental to Africa's sustainable socio-economic growth and strategies towards poverty alleviation as outlined in the African Union's Agenda 2063 and the African Union Summit Decision on Accelerated Agricultural Growth and Transformation.[8] The United Nation's Sustainable Development Goal Number 2 (SDG 2) aspires to eliminate hunger, poverty, and food insecurity by 2030 through smart agricultural frameworks.[9]

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These aspirations from these frameworks can be accomplished through robust agricultural value chain systems across the African continent. The systems can establish and create opportunities for small-scale subsistence and large-scale farming, as well as export commercial farming.[10] By accomplishing and sustaining these value chain systems, African countries can further enhance their agricultural and economic development and growth. Therefore, innovative solutions to address these challenges currently facing African farmers need to be established and urgently implemented.

The African Union High-Level Panel on Emerging Technologies (APET) believes that the COVID-19 pandemic has presented unique opportunities for African countries to develop and strengthen inclusive agro-value chains across the continent using smart technologies. These smart technologies are essential in bridging and addressing the gap highlighted by the COVID-19 pandemic lockdowns. This can be accomplished by using smart technologies to enhance the African agriculture value chain systems.

APET encourages African governments and the business sector to formulate public-private sector partnerships to strengthen and develop resilient agri-business infrastructure through smart technologies. By digitising the various agro-value chain activities, African countries can ensure more effective interactions between farmers, input suppliers, transport and logistics service providers, financiers, and other value chain, partners.

The panel further encourages African countries to prioritise the adoption of smart technologies to effectively implement initiatives like the African Continental Free Trade Area (AfCFTA), potentially enhancing Africa's agricultural trade. Such efforts can substantially improve Africa's trade revenues, food security, and expand job creation and employment opportunities within the agricultural sector across the African continent. African countries need to utilise smart technologies to mitigate the challenges that have caused Africa's agricultural economy to remain fragmented, inefficient, and informal. This can help African smallholder farmers acquire market accessibility and enable sustainable operational costs.

Kenyan farmers leverage digital technologies such as Twiga Foods to augment agricultural e-commerce businesses. The Twiga Foods e-business technology is helping Kenyan farmers access food and grocery outlets within the country's informal retail business sector.[11] It is enabled by mobile technologies to aggregate the supply and demand fragmentation within the agricultural value chain. Consequently, this technology enables efficient supply chain systems in Kenya, thereby reducing the food supply cost for African consumers. APET encourages African countries to pursue technology-enabled platforms such as Twiga foods to enhance market access for African farmers and food processors. This can potentially augment sustainable and reliable supply within Africa's informal and formal retailers.

Operationally, the Twiga Foods application consolidates vendors for farmers' produce and crops by utilising geographic information system (GIS) technology. The GIS mapping leverages artificial intelligence (AI) enabled distribution platforms to consolidate consumers that are seeking orders as well as the location of potential and active customers. This application also advises on the conditions of the roads to determine and maximise efficient deliveries. It also enables efficient payment platforms through digital mobile money applications such as the M-PESA. Consequently, the adoption of this technology has improved the market access efficiencies for Kenyan farmers.

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Figure 1: How Twiga Foods address insecurity. SOURCE: https://web.facebook.com/twigafoods/posts/in-kenya-most-people-spend-55-of-our-income-on-food-twiga-foods-platform-aggrega/2466593020227618/?__rdc=1&__rdr

Twiga Foods smart technology platform has decreased the typical post-harvest losses for Kenyan farmers from approximately 30% per annum down to approximately 4% per annum.[12]

Nigerian and Kenyan farmers have created the Hello Tractor application to connect tractor owners to farmers through the Internet of Things (IoT) enabled digital technology solutions. The Hello Tractor digital application bridges the gap between manual and mechanised farming by enabling farmers to place orders for tractors quickly and efficiently.[13] After the installation of the Hello Tractor application into a smartphone, the digital application connects farmers to their nearest available tractor with the appropriate equipment for the job that the farmer requires. Consequently, this Hello Tractor application has improved the agricultural businesses for the tractor owners. This has been accomplished because farmers are experiencing easier accessibility to machinery to improve their farming production capacity and efficiency vastly. The Hello Tractor platform has enabled business accessibility to approximately 3,000 tractor owners in these countries. Most importantly, the platform has enabled tractor owners to determine their tractors' fuel usage and maintenance.

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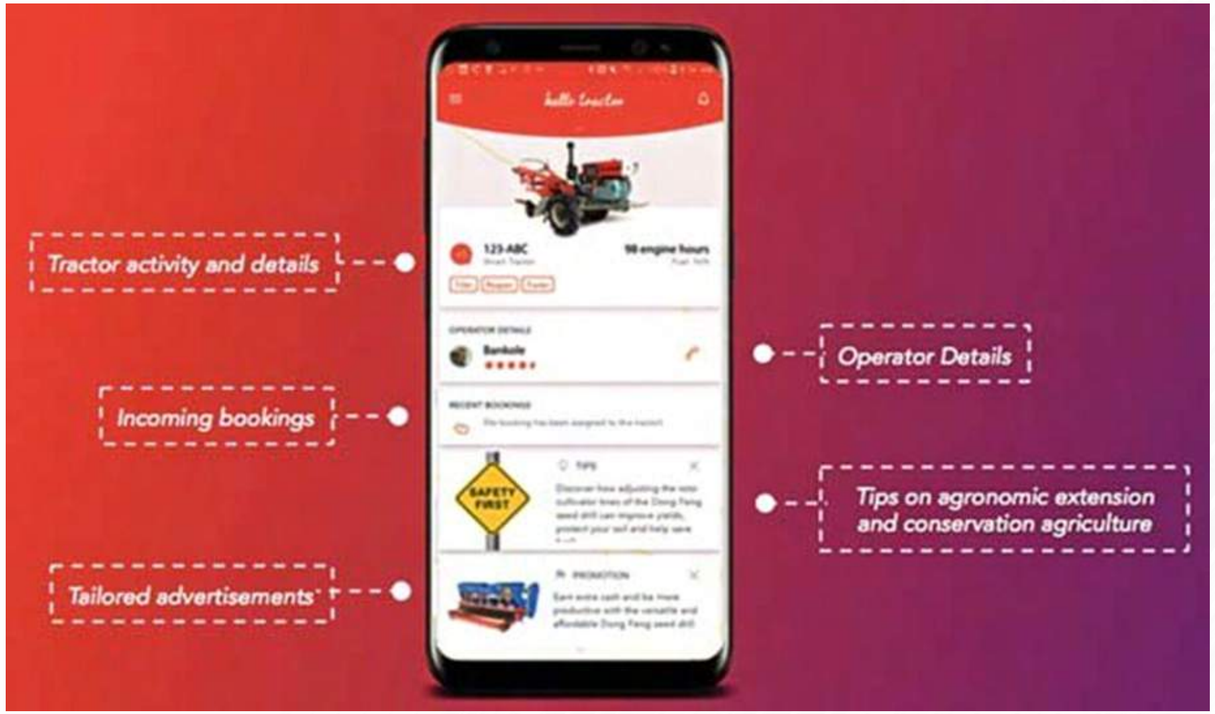

Figure 2: The Hello Tractor app layout. SOURCE: https://www.researchgate.net/figure/Hello-Tractor-owner-app_fig4_328582493

Some African farmers find it difficult to access financial services and farm input loans. Therefore, the deployment of smart technologies such as digital financial services (DFS) has potentially enabled financial services for farmers during the pandemic. For example, Safaricom financial services has developed an agricultural platform called Digifarms. Through the Digifarms application, farmers can access various agricultural and financial services via their smartphones.[14] Additionally, the Digifarms platform offers farmers digital vouchers that can be used to purchase farming inputs at discounted prices. The digital application is also enabling access to the extension and administrative services. Subsequently, the farmers are trained to utilise these extension and administrative services through various modules to acquire practical guidance and support. Farmers can utilise Digifarms' loan module to apply for small loans to purchase farming inputs such as fertiliser, livestock, and feed.

Robotics technology can potentially improve farming activities throughout the food supply chain. For example, vegetable growers, fruit packers, egg producers and processors have observed enhanced efficiencies and financial benefits enabled by automation. This is accomplished while maintaining high food quality standards at reasonable prices for consumers.[15] For example, the Royal Association of British Dairy Farmers has estimated that 5% of dairy farming in the United Kingdom has adopted robotic milking parlours. Worth noting, these automated milking parlours constitute approximately one-third of all new milking systems being purchased by farmers.

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In addition, farmers around the world are also exploring robotic feed pushers and feeders to decrease labour costs so they can dedicate efforts towards cow welfare and performance. Therefore, African countries should consider these options to improve their production capacities.

Automation generates ample production with minimal effort. In turn, this creates more time and opportunities for farmers to focus on customer satisfaction across the supply chain. This is accomplished by creating marginal improvements of their products and advice that can significantly benefit agricultural businesses. APET advises that the adoption of robotics can substantially expand the supply chain and deploy smart technology into productive farming activities. For example, automated weeding machines can straddle rows of crops and mechanically remove any weeds within those fields. Furthermore, smart technologies enable accurate and efficient stock management systems in beef, sheep, dairy, pig, and poultry farming activities. African farmers can also adapt automated body condition scoring infrared camera systems for their cattle. This enables heat detection collars and satellite-tracked movement tools that can enhance farming decision-making and precision farming.

APET notes that the effectiveness of smart technologies should extend beyond new machinery and the continual release of smartphone applications. However, the machinery and smart technologies should strengthen agricultural value chain solutions and be incorporated into current farming practices to create efficient and sustainable farming businesses. Therefore, African countries should seamlessly incorporate the new technological and innovative solutions into the existing agricultural business operational frameworks. This can be accomplished through cooperation between agro-business partners and customers to formulate mutually beneficial outcomes.

APET believes that the technology revolution can change agricultural businesses, allow farmers to improve agro-business connectivity options easily, and enable efficient interfacing options with partners and customers. Therefore, the technological innovation in Africa's agricultural supply chain can deliver lucrative benefits. These smart technological innovations can offer timely deliveries of farming produce and crops into Africa's supply chain. APET is encouraging African countries to embrace smart technology opportunities to enhance the agricultural value chain across the African continent. Thus, African countries are encouraged to replicate these smart technologies into their systems to enhance their agricultural value chain and mitigate the challenges posed by the COVID-19 pandemic. In this way, African countries can accomplish the African Union's Agenda 2063 aspirations.

Link: https://www.nepad.org/blog/strengthening-competitiveness-africas-agricultural-value-chain-using-smart-technologies

Blog #3 Published on Feb 7, 2022

Returning to School in the “New Normal”: From Pandemic Disruptions to Recovery

In the last few decades, African countries have exponentially increased primary school enrolment and completion outputs from 27% in 1971 up to 67% in 2015. In addition, the enrolments and completion rates of lower secondary schools also improved from 5% in 1971 to approximately 40% in 2015.[1] Quality education has been identified as an enabler and fundamental to Africa’s sustainable socio-economic development process.

The United Nation’s (UN) Sustainable Development Goal Number 4 (SDG4) aspires to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all citizenries. The African Union’s (AU) Agenda 2063 recognises the importance of education as a prerequisite for the continent’s sustainable socio-economic development and growth. To this end, the African Union Commission (AUC) commissioned the Continental Education Strategy for Africa (CESA-16-25)[2] to enable a qualitative education and training system so as to develop a highly-skilled African workforce. This was formulated to ensure that Africans can achieve the vision and ambitions of the AU’s Agenda 2063. Such an approach can help African countries grow their economic competitiveness, reduce poverty, enhance healthcare services, and bolster job creation efforts.[3]

However, despite this significant improvement in education success, the quality of education in Africa has comparatively remained low, and the number of out-of-school children has been increasing. Notably, approximately one-third of African children barely complete their primary school education.[4] This is attributable to the limited number of highly trained teaching professionals as well as the limited access to high-quality schools and laboratory infrastructure. Most teachers, more especially science, technology, engineering, and mathematics (STEM) teachers, are shunning the teaching profession because of limited incentives such as the low remuneration and unavailability of an enabling environment for teaching and learning, more especially in rural Africa.

The COVID-19 pandemic has created enormous disruptions in the African education system as most schools were closed on the onset of the pandemic in an attempt to curb the spread of disease. During the peak of the pandemic in 2020, approximately 32 million children in Eastern and Southern Africa were out of school. This was additional to about 37 million who were already out of school pre-COVID-19 pandemic.[5] Many African schools attempted to continue with teaching and learning activities during this period by using e-learning tools such as blackboard, google meet, Ms Teams, and Zoom, among others. However, some schools could not access these digital tools because of limited internet access utilised television and radio to conduct their teaching and learning.

Blog #3 Published on Feb 7, 2022

Figure 1: Major challenges throughout the world remain for #SDG 4 - the quality of education.
SOURCE: https://dashboards.sdgindex.org

The ONE Campaign using the Lost Potential Tracker has estimated that approximately 70 million children around the world in 2021 alone have failed to obtain basic literacy skills by their 10th birthday because of COVID-19 and pre-pandemic drivers.[6] To put this into perspective, the 70 million children who could not gain basic literacy skills were equivalent to the combined population of Senegal and Kenya. Consequently, this reversed the considerable gains attempted by most African countries to enable the "Education For All" drive. As such, Most African countries are barely establishing their education systems to eradicate poverty and hunger from the African continent. Regrettably, African countries, in the long run, will fail to improve their quality education outcomes characterised by a skilful workforce, a protected planet, and an inclusive and peaceful society.

The "New Normal" in Africa's demonstrates that there will be more of the "left-behind" and out-of-school children who may not have the opportunity to obtain quality education as aspired by the AU.[7] In addition, COVID-19 is here to stay, and the world will have to live with COVID-19 into the foreseeable future. Thus, African countries should adapt and adjust to this reality of co-existing with COVID-19. This means that Africa's education should incorporate a hybrid of e-learning and restricted physical classes to curb the spread of the pandemic.

Blog #3 Published on Feb 7, 2022

Unfortunately, the pandemic has demonstrated that Africa has a digital divide regarding e-learning as most students are unable to utilise digital platforms in schools. This is because of the limited basic information and information technology (ICT) tools and infrastructure, as well as limited internet access and reliable broadband. Therefore, Africa's educational systems should adapt to this reality to enable the youth back to school. This includes sufficiently addressing the persistent out-of-school children due to the pandemic and pre-pandemic challenges.

To address these challenges, the African Union High-Level Panel on Emerging Technologies (APET) recommends that African countries should urgently address the high number of out-of-school children. African governments should prioritise education for all citizenry by ensuring that schools remain open and safe. Failing which, African countries will have persistent skills shortages in the near future of a well-trained workforce, and thereby negatively impact their socio-economic development and growth. APET is acutely aware of the concerns about the continual COVID-19 waves that have caused educational disturbances. These COVID-19 waves have caused African countries such as Botswana, Namibia, Zambia, Uganda, and Zimbabwe to either close their schools nationwide or extend their academic winter breaks that have resulted in continuous school closures in most of 2021. During the same period, African countries such as Rwanda and Mozambique have continued to partially close their schools in the areas that have been worst affected by the virus. South Africa has opened their schooling activities despite the COVID-19 uptake. Even though all countries are opening their economic activities in 2022, it is not clear how the COVID-19 waves will impact the schooling programme in the year 2022.

African countries have learnt from the pandemic that keeping schools safe remains vital. Furthermore, it is damaging for African children and their communities when their classrooms remain closed because they are not acquiring basic literacy skills that may have ripple effects on the education systems in the long term. APET notes that the negative impacts of the closures are too enormous to justify continuing with the lockdown approach but seeking safe options to keep schooling operational. APET suggests that Africans use smart technologies and innovation to keep schools safe and operational. However, pursuing e-learning alone cannot replace the overall benefits of face-to-face and experiential teaching and learning. Therefore, Africa's Ministries of Education and Health are encouraged to adopt strategic real-time and evidence-based monitoring of the COVID-19 infections continually and cooperatively. Subsequently, African countries should also prioritise timely COVID-19 infection responses within schools, colleges, and universities by using relevant and localised mitigating and preventative measures instead of nationwide school closures.

Reports since the advent of the pandemic have shown that children and schools are not the major drivers of the COVID-19 pandemic.[8] Thus, the health risks to children due to COVID-19 infections have remained limited. Since one-fifth of all school-aged children were already out of school pre-pandemic, it remains clear that the continuing disruptions are further exacerbating the continent's teaching and learning crisis. In addition, the pandemic is also aggravating the already delicate educational financing situation of schools, colleges, and universities. Notably, there was a limited number of African countries investing at least 20% of their budgets into education as per the pre-crisis "Education For All" targets. However, the priorities of African governments during this pandemic time may refocus on other emerging threats and needs instead of the education sector. However, APET urges African governments to consider the education crisis with urgent and actionable interventions.

APET is also urging African governments to urgently invest in safety measures such as easier access to masks, guaranteeing adequate ventilation, and social distancing. These measures can be accomplished through sufficiently providing classroom infrastructure such as desks and chairs to enable social distancing.

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African governments should also provide clean water supply and hygiene facilities to enable the washing of hands. Furthermore, APET is encouraging African countries to provide adequate resources to encourage the catch-up on the teaching and learning losses that have occurred during the pandemic period. African countries should also strengthen education systems and mechanisms to endure future upsets and surprises such as pandemics.

Furthermore, APET is encouraging African schools and universities to augment their COVID-19 vaccination programmes and encourage the wearing of face masks policies when attending face-to-face classes. Basic hygienic necessities such as the frequent washing of hands with soaps are being encouraged in schools, colleges, and universities to prevent the spread of the COVID-19 disease. For example, Zimbabwe has developed the Tippy Tap technology, which is a hands-free device for handwashing that has found applications in rural African schools.[9] Scaling up the Tippy Tap technology has been possible because of the readily available locally sourced materials at virtually no cost. Thus, African countries can upscale similar technologies to enable hygiene practices. Such technologies should be water-efficient and cost-effective and utilise approximately 40ml of water for a single wash cycle.

In conclusion, APET notes that the “New Normal” is that Africans will co-exist with COVID-19 in the foreseeable future. Therefore, African countries should deliberately enhance their capacities to manage the pandemic while responsibly reopening the schools and their economic activities. Fundamentally, the reopening of schools should be accomplished without endangering the health of African students in schools. Thus, African governments should prioritise implementing safety guidelines and policies to prevent the spread of the disease further. Such measures can prevent the COVID-19 pandemic from further derailing the education system across the African continent. In this way, African countries will accomplish the AU’s Agenda 2063 aspirations of education for all.

Link: https://www.nepad.org/blog/returning-school-new-normal-pandemic-disruptions-recovery

Blog #4 Published on Feb 21, 2022

Improving Africa's Service Delivery through E-Governance

Governments around the world are mandated to provide basic services such as clean water, sanitation, housing, immigration documents (passports), security, and health services, among others, for their citizenry. It remains crucial for governments to efficiently provide these services sufficiently and cost-effectively. These basic services should also closely correlate with the socio-economic activities of the population to accomplish the aspirations of the African Union's Agenda 2063 and the United Nations' Sustainable Development Goals (SDGs). The AU aspirations are to ensure a better and more sustainable future for all Africans.

Unfortunately, African countries' basic service delivery has remained considerably constrained by various limitations such as fractured and uncoordinated communication between governmental departments and countries. This leads to limited coordination of government services that restrict easier access to information and crucial documents and thereby restricting efficient governance. In addition, these challenges are exacerbated by the rapid urbanisation and population growth across the African continent.[1] On the other hand, African governments are pursuing and emphasising the efficiency and effectiveness of their basic services. However, these efforts are limited by budgetary and fiscal imbalances as well as effective governmental operational mechanisms. Consequently, this leads to pressure and criticism from their citizens to deliver and provide better basic services.

There are efforts among African countries to utilise Information and Communication Technologies (ICT) tools to enable and improve governments' service delivery across the continent. In this way, African governments are progressively adopting digital and electronic government operational mechanisms in the form of e-government service delivery. Notably, e-government systems are utilising ICT tools such as digital technologies and internet-based applications to enhance access and delivery of basic services to citizens and businesses across all governmental departments.[2]

Worth noting is that e-government technology is enabling e-services that encompass digital basic services, e-commerce programmes, and accessibility to information from governments. These e-services are easily accessed through the internet. This digital communication is boosting the participation of the public in crucial activities such as voting, e-visa, banking, paying taxes, and applying for passports and certificates such as birth, marriage, and death certificates.[3] Through e-government technological tools, African countries are decreasing the cost of government spending on services and replacing their predominant inefficient paper-based filing systems. Consequently, electronic government systems are cost-effective and environmentally friendly in the long term. In addition, the e-government systems are streamlining and providing transparency in governmental service delivery through better communication frameworks.

The African Union High-Level Panel on Emerging Technologies (APET) supports the implementation of e-government services

by harnessing innovation and technologies in Africa. These e-government services include focusing on Government-to-Government (G2G), Government-to-Business-and-Citizen (G2BC), and Government-to-Citizen (G2C) activities. For instance, the United Nation's e-Government Development Index in 2018 reported that some African countries such as Ghana, Mauritius, South Africa, and Tunisia were classified with a high e-government development index. This is because these African countries have enabled various types of public services to be available online.[4] Furthermore, more than 30 other African countries such as Cameroon, Nigeria, Lesotho, Togo, and Rwanda had already made considerable progress towards their e-government service delivery efforts.

Notably, APET notes that e-governance enables citizens to access public services directly and timeously without excessive bureaucracy and minimise corrupt practices. Through this system, African governments can obtain swift feedback on the quality of public services. However, the implementation of e-government platforms has barely served many of their citizens in most of the African countries pursuing e-governance. For instance, basic services such as e-taxation, e-payment, and e-billing have only reached the middle class and rich people. Regrettably, e-government initiatives and programmes that are suitable for supporting poor and sometimes rural Africa has remained limited. As such, e-government programmes that can enable skills development for poor citizens, address unemployment, and enhance micro-entrepreneurship is barely available for most African countries.

Therefore, APET is suggesting that Africa's e-government implementation programmes could be redesigned and re-contextualised to address the essential needs and services for most African citizens rather than the relatively privileged few. In doing so, African governments can redefine and enable effective and valuable e-government services for their citizens at the local and national levels. Additionally, African countries can mainstream e-government platforms for electoral processes, harmonise healthcare management systems, support small businesses, and secure transparent procurement procedures. However, to realise these services, African governments need to strengthen their ICT infrastructure, bolster e-government financing programmes to enable effective implementation, strengthen their political leadership, and organise better communication mechanisms.

African countries such as Rwanda have advanced their existing technologies and established digital services towards establishing e-government services.[5] Fundamentally, Rwanda implemented a one-stop e-government initiative from April 2014 to enable online public services via a single portal.[6] This e-government service is operating under the brand name "Irembo", which can be interpreted as the "main entrance". The Irembo platform integrated approximately 96 basic government services to be accessed by about nine (9) million internet subscribers.[7] Consequently, these e-government systems have assisted the Rwandan government ease trade programmes and maximising their revenue collection efforts.

This e-government programme has allowed Rwandan traders to easily declare their goods and services and obtain their bills digitally. Accordingly, the Irembo system has reduced tax processing and payment costs by eradicating overheads on taxpayers when filing for their tax returns and making tax payments.[8] Most importantly, the Irembo system has enabled taxpayers to keep a record of their tax returns and easily retrieve this tax information at their own convenience whenever required. Rwandan citizens can easily apply for their passports online and further access all the necessary documents to fill online and easily submit them. This can be executed without long queues and moving from one office to another looking for information, documents, or authorisation.

The Rwandan Irembo system has also simplified Rwanda' e-commerce systems by enabling simpler business registration processes and procedures.[9]

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This was accomplished by creating a one-stop centre within the website to submit all the documents required and source information necessary to register when starting a business in Rwanda.[10] Fundamentally, this enables potential investors to easily obtain businesses' operation and registration information. As such, the World Bank has recognised Rwanda's e-government systems as a top reformer on the index of doing business, thereby making Rwanda attractive to investors.[11]

In conclusion, APET believes that African governments can leverage digital transformation so to deliver basic services to their citizens through e-government systems. In addition, APET recognises the efforts that have been pursued and implemented by the various African governments to digitise their e-government systems. This includes the continual efforts to strengthen their digital capacity. Through these efforts, African countries can accomplish the Science, Technology, and Innovation Strategy for Africa (STISA-2024) and AU's Agenda 2063. However, African countries should continue strengthening their policy, infrastructural, and skills capacity to build their strong digital government. Such efforts can effectively drive their socio-economic activities such as immigration, entrepreneurship, healthcare, education, tax filing, and banking, among others.

Link: https://www.nepad.org/blog/improving-africas-service-delivery-through-e-governance

Blog #5 Published on Feb 28, 2022

Raising the Stakes: Leveraging Smart Technologies to Enhance Cattle Feed Production in Africa

Cattle farming and meat production have always been an important socio-economic aspect and cultural activity for many Africans. This is because cattle production contributes significantly to food security and ensuring food nutrition for most African societies. In addition, cattle dung can provide cost-effective manure and fertiliser for African farmers. Culturally, cattle are symbolic for African families paying dowry during traditional weddings.

Reports have estimated that approximately 70% of Africans, totalling about 150 million rural Africans, are significantly dependent on livestock such as cattle to sustain their socio-economic livelihoods.[1] This clearly demonstrates the potential economic benefits of leveraging cattle farming in the African continent. Effectively harnessing cattle and livestock production can potentially increase job creation and entrepreneurship for African farmers.

There has been an incremental global demand for protein meat products.[2] However, the production of beef and beef products across the African continent remains limited.[3] Currently, African livestock production can barely meet the local demand for meat supply. Consequently, about one-third of African countries are importing approximately 20% of their meat supply.

Since the African population is growing and expected to reach approximately 2.5 billion by 2050, economic growth demands are also expected to increase to support consumer purchasing power.[4] African countries should therefore ensure adequate supply of food, more especially nutritious food. The United Nation's Food and Agriculture Organisation (FAO) estimated that beef consumption in Africa will increase by approximately 200% between 2015 and 2050.[5] This presents an opportunity for cattle producers to increase their food-producing capacity. Africa's cattle farming should be strengthened to meet the growing meat demands, and the necessary interventions to enhance meat production should be actively pursued and implemented across the continent.

Various factors in the cattle production industry have caused African countries to observe limited yields of cattle breeds. This includes infections from diseases such as foot-and-mouth and constrained feeding management systems. Furthermore, because of urbanisation, there have been reduced feeding land suitable for cattle production. The feeding land has also been decreasing because of the incremental drought frequencies caused by climate change and weather variability, thereby declining arable grazing land.[6] This has led to overstocking cattle in some instances, with the hope to increase production on an already delicate and over-stretched feeding land.

The African Union High Level Panel on Emerging Technologies (APET) encourages African countries to support cattle farming by enhancing their production capacity through innovation and emerging technologies.

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Enhanced livestock production can be accomplished by adopting smart technologies towards cattle feeding management mechanisms and methodologies. Within the cattle production value chain, the cattle feeding component accounts for approximately 75% of the total variable costs of production in beef production. Therefore, APET recommends the adoption of smart technologies to improve precision livestock feeding through improved feeding protocols and management systems.

Historically, to supplement grazing land and meet the nutrient demand for livestock, farmers have utilised silage to feed their cattle.[7] The silage is forage that is manufactured by fermenting chopped fresh green material such as maise, corn, wheat, grass, among others. This fermentation is undertaken in the absence of oxygen that is referred to as anaerobic conditions. The silage is relatively a palatable forage containing high quality nutritional and energy contents. A challenge to the availability and supply of silage is climate change and the resultant droughts. Temperature increases, changes in precipitation patterns, and extreme weather events can cause lower yields of the materials required to produce the silages.

Most African farmers are aware of the negative climate change impacts and incremental drought. Yet, numerous African farmers are neglecting to build the necessary fodder bank for challenging times. African farmers can utilise modern irrigation systems to curb the crop damages and losses caused by harsh climate conditions.[8] Through these interventions, they can enhance and prioritise soil water retention and invest in making their own silage.[9]

Meat contamination has also been of concern for cattle farmers. In some instances, meat cannot be exported because of contamination of microbial-induced chemicals such as aflatoxins, a family of toxins generated by fungi (Aspergillus flavus and Aspergillus parasiticus). These aflatoxins are found on crops such as maise, corn, peanuts, cottonseed, and tree nuts. The aflatoxin-producing fungi can pollute crops in the field, harvest, and/or storage, and cattle can be exposed to aflatoxins when consuming the contaminated crops. Consuming aflatoxin-contaminated meat and dairy products poses a significant public health threat to consumers and can reportedly lead to various diseases such as cancer and tuberculosis.[10] Therefore, better and more efficient testing mechanisms for aflatoxins should be implemented in meat production.

Farmers can curb aflatoxins' spread through artificial intelligence-enabled precision agriculture monitoring systems for feed. For example, cattle farmers from Uganda invest in testing systems to detect aflatoxins in animal feeds. This is aimed at improving the quality of and eliminating the aflatoxin contamination of meat being produced.[11] The farmers are utilising lateral flow test strips to measure aflatoxins. As these tests do not require laboratory overheads and can produce accurate and reliable results, they are useful to cattle production.[12] Results can then be interpreted by scanning them using smart mobile phones. Early detection of aflatoxins aids African farmers to make informed decisions on contaminant-free feeds needed by their livestock.

To further strengthen precision livestock management systems of cattle, APET suggests that African cattle producers utilise sensors to track all activities of their herds.[13] Digitally monitoring the individual animal health and comfort can reduce operational costs because of the timely upkeep of cattle's welfare. Furthermore, beef producers can utilise wearable sensors to monitor general animal health such as rumination, illness, and lameness effectively and accurately. Sensors can also be utilised to build virtual fencing for livestock, improving their safety protocols and management systems.

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Still on the use of smart technologies for livestock farming, cattle producers can also utilise drone technology to manage their feedlots and ranches easily. Drones can monitor fence lines, water troughs, and gates[14] , and farmers can manage pasture more efficiently through aerial images and videos. Another tool is the use of robots for beef processing operations. Robots can execute small and common tasks such as daily feeding[15] , and self-automated robots can mix animal feed and deliver it to the barn for consumption. The robots can also keep the feed bins full and feed the animals multiple times daily to enhance the efficiency of production growth rates.

African farmers can also consider the 3-D printing technology to hasten their food processing capacities. Meat food producers can utilise 3-D printing to produce new types of food by utilising low-value meat cuts.[16] Consequently, this can create new opportunities to boost the carcass value and increase profitability. In addition, 3-D printing can support the efficient replacement of machine parts and enhance veterinary applications.[17]

APET further believes that African farmers can exploit blockchain technologies for their farming management systems. Blockchain technology can improve the transparency between consumers and farmers when purchasing meat products.[18] This can improve the knowledge of the origin and concerns over foodborne diseases. The lack of traceability of foodborne diseases makes some consumers sceptical of food labels. Therefore, the blockchain-enabled technologies can reinstate confidence in food products by enabling traceability of products along the entire supply chain, i.e., from producer to retailer.

African meat producers can also incorporate artificial intelligence in growing animals to sustain the market and consumer specifications and timelines. Fundamentally, farmers can utilise artificial intelligence such as machine vision to digitally capture and analyse camera images of animals' depth, size, and fat content. This can help African farmers accurately predict the animal's market potential and value.[19] Furthermore, 3-D images analysed through artificial intelligence algorithms can enable accurate body condition scores for each animal. The different measurements, such as muscling, can utilise mathematical description and assign a value to estimate a cow's condition based on the 3-D shape that the machine can derive.

Further to this, African farmers can utilise augmented reality that combines real-world observations with virtual-world information. This is accomplished by using only a pair of glasses or smartphones to enhance vision and make better management decisions.[20] For example, 3-D objects from architectural feedlot drawings can be projected to allow feedlot producers predict the accurate allocation of operational space. In addition, farmers can also inspect through the barn or feedlot and immediately observe their cows' health statistical status through augmented reality goggles.

Virtual reality can further advance augmented reality by generating 3-D imagery through computer simulations in virtual reality. Interestingly, virtual reality technology can demonstrate farm life to the public and enhance consumer and investor awareness and engagements without endangering animals or consumers. A similar concept can also be utilised for pre-sale auctions to enable farmers to view and purchase livestock through a 360-degree pre-sale auction inspection video experience.[21] The potential purchasers can navigate the auction forum from their computers and smartphones within a headset.

APET also suggests that African farmers should utilise the nutrigenomics piece to create an opportunity for precision nutrition. Nutrigenomics determines how nutrition can impact gene expression, subsequently affecting the cow's health, immunity, and growth rate.[22]

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This new technology allows the cattle to be supplemented with specific levels of nutrients at specific times. This encourages the body to assimilate and utilise those specific nutrients more efficiently and subsequently enhance productivity and, ultimately, profit. This digital technology can be interconnected via the internet-of-things (IoT) devices to improve precision cattle management practices, productivity, and timely responses to future threats.

In conclusion, APET is encouraging Africa's livestock producers to pursue high-quality and accurate feeding technologies that could lead to high-quality meat productions. This will enable African countries to accomplish the aspirations of the African Union's Agenda 2063 and the African Union Summit's decision on Accelerated Agricultural Growth and Transformation to ensure food security in Africa. African countries are encouraged to formulate the necessary policy and regulatory frameworks to enable African farmers to harness sustainable technological innovations designed to bolster animal production. Therefore, scaling up these smart technologies in livestock production can help Africa unlock new opportunities and ensure high-quality livestock agriculture to meet the rising demands of the growing African population.

Link: https://www.nepad.org/blog/raising-stakes-leveraging-smart-technologies-enhance-cattle-feed-production-africa

Blog #6 Published on Mar 23, 2022

Addressing Water Scarcity using Digital and Smart Technologies: The Case of Egypt

Access to clean and freshwater remains a fundamental human right as driven by the African Union's Agenda 2063 and United Nations' Sustainable Development Goal (UN's SDG 6) Number 6. Unfortunately, access to clean water as an essential resource in Africa is not yet fully realised. The UN has estimated that 1 in 3 people across the African continent lack access to this vital resource.[1]

Efforts to enhance access to clean water remain essential and a priority for the African continent. This will enhance the health of Africans, more especially children, to enable drinking, irrigation, farming, and industrial applications. However, access to fresh and clean water remains scarce for most African countries such as South Africa, Niger, Egypt, Sudan, and Chad, among others.

African countries, more especially in the North African region, have less than 1% of the world's freshwater,[2] making freshwater scarcity endemic. Egypt is no exception to water scarcity as it is one of the driest countries in the world and poorly endowed with natural freshwater supplies. Reports have estimated that the water present per capita availability in Egypt is approximately 985 cubic metres per year.[3] Fundamentally, about 98% of Egypt's freshwater resources originate outside its borders. For example, the Nile River originates from Ethiopia and East Africa (Uganda, Kenya, South Sudan), although it provides approximately 93% of the country's water requirements.[4] Egypt utilises groundwater aquifers and limited surface water as sources of freshwater, and in some cases, the country utilises sewage treated municipal water to provide clean water sources.

Apart from the deficient rainfalls, inadequate access to freshwater in Egypt is further heightened by Egypt's rapid population growth. Since the 1990s, Egypt's population has grown by approximately 41% and currently stands at approximately 92 million people. By 2025, the population is envisaged to reach approximately 110 million and with such population growth rates, freshwater sources may continue to diminish. Furthermore, the vast human activities along the Nile River have exacerbated water scarcity in Egypt. This has led to the pollution that comes from municipal and industrial waste. Affluents from the waste are negatively impacting the usability of the water and endangering the aquatic ecosystem that depends on the water.[5] In addition, Egypt's irrigation systems are also responsible for wasting the already limited water sources. Reports have shown that approximately 35% of underground water leaks through the water irrigation infrastructural system.[6]

To address these challenges, Egypt has formulated several policy frameworks to regulate water production and management to enable socio-economic development activities such as agriculture, industrial applications, portable water for drinking, and

fisheries, among others. This includes, among other things, efficient water management systems and increasing water supply through water treatment and desalination.

Egypt's Vision 2030 to increase water supply across the country has primarily focused on enhancing sustainable energy generation and management and enabling innovation and scientific research towards enhancing water supply and distribution. This has been accomplished through transparent and efficient governance systems to ensure sustainable environmental management. Water management through sustainable environmental management has been underscored and integrated into the country's socio-economic development to preserve natural resources.[7]

Despite the water scarcity challenges, Egypt has adopted some of the most advanced digital and smart water technologies to mitigate the challenges of water scarcity. These technologies have been focused on preserving the existing water sources and bodies as well as increasing the water supply through water treatment and desalination.

Egypt has adopted smart water technologies such as sensors that are operated using digital technologies. These digital sensor technologies enable real-time monitoring and evaluation of water-related data such as pressure, water quality, and moisture.[8] This has significantly enabled Egypt to develop and implement sustainable irrigation systems to eliminate water wastages and leakages. For example, within the country's agricultural activities, Egypt is utilising moisture sensors to regulate irrigation and further enhance water conservation in the country.[9] These digitised moisture sensors can be placed inside the soil to measure the soil's moisture percentage. This data is then digitally transmitted to the farmer's smartphone application via satellite signals to enable the farmer to formulate timely and efficient decisions. For instance, this technology has realised applications in the Al Sharqia governorate.

Consequently, by using these digital sensors to measure the degree of humidity, the farmers can decide on their irrigation protocols and activities in a timely manner. This is helping Egypt sustainably preserve water because the irrigation of crops and vegetables is implemented only on a need basis. Furthermore, this technology is enabling farmers to determine if their fields have been irrigated adequately. Once the fields have been adequately irrigated, farmers can immediately stop the irrigation after they are notified of the adequate irrigation through their smartphone applications.

Furthermore, Egypt has adopted the Irrigation Water Information (IRWI) application.[10] This IRWI application provides farmers with customised information about their land chemistry and type, local weather conditions, and suitable crop types. The application can also provide crop evaporation values and the amount of water required. This is normally based on the crop types, irrigation systems, farm sizes, planting times, types of water pumps, energy sources, and soil types. Consequently, this has enabled farmers to conserve more water for future irrigation.

To increase water supply, Egypt has also developed several desalination technologies to purify seawater into potable water.[11] Seawater desalination can be accomplished through seawater evaporation and subsequently condensing and cooling through the process of distillation.[12] Consequently, the newly treated water can be utilised for consumption and irrigation. Egypt's current freshwater capacity is 800,000 cubic metres of water per day. However, the Egyptian government is targeting approximately 6.4 million cubic metres by 2050.[13]

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Traditionally, Egypt's desalination process involves using a huge amount of energy to distil the seawater, which turns out to be very expensive. To address this challenge, Egypt utilises membrane technology to desalinate seawater cost-effectively and inexpensively. The technology can also be utilised for pervaporation, reverse osmosis, forward osmosis, nanofiltration, and ultrafiltration, among others.[14] To further improve the membrane technology-enabled water treatment output without compromising the quality of water being produced, some scientists are exploring the possibility of utilising nanotechnology to enhance water permeability and remove pollutants from seawater or wastewater.[15] This is aimed at improving the water supply output cost-effectively.

The African Union High-Level Panel on Emerging Technologies (APET) appreciates Egypt's responses and efforts towards addressing water scarcity challenges. Thus, APET encourages all African countries to invest more resources towards enhancing their water supply and water quality through various smart technologies. By adopting these smart technologies for water supply and management, African countries can effectively meet their water demand through strengthened and sustainable management systems. In this way, African countries can accomplish the African Union's Agenda 2030 in enhancing water productivity and conservation. Thus, APET believes these smart technologies can be replicated in other African countries to provide their citizenry with adequate high-quality water. Thus, APET recommends that African countries embrace new technologies to deal with the African water challenges to accomplish the "Africa We Want."

Link: https://www.nepad.org/blog/addressing-water-scarcity-using-digital-and-smart-technologies-case-of-egypt



Blog #7 Published on Mar 28, 2022

Obstetric Fistula: Enhancing Preventative Maternal Healthcare for African Women using Smart Technologies

Access to basic and preventative maternal health for African women is regarded as a fundamental human right and essential. Maternal health is not only considered crucial to the health of the mothers giving birth but also the babies being given birth to. Healthy babies will yield to economically healthy citizens, which has direct implications on the socio-economic development of the African continent.

Women represent slightly over 50% of the African population and remain an essential human resource. Thus, their health has significant implications for the continent's economic development.[1] Recognising the importance of women's health, African countries should ensure the provision of maternal and preventative health healthcare.

The United Nation's Sustainable Development Goal Number 3 strives to ensure healthy lives and promote the well-being of global citizenry of all ages, including pregnant women and the babies they are carrying.[2] Furthermore, the African Union's (AU) Agenda 2063 envisions a prosperous Africa based on inclusive growth and sustainable socio-economic development and growth.[3] In addition, the regional African Charter on Human and People's Rights (Banjul Charter) and the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa also recognise women's right to health as a fundamental right.[4]

Despite calls to improve the health conditions of women across the African continent, African women remain subject to a myriad of healthcare challenges. The World Health Organisation (WHO) reports that African women are highly likely to die from diseases such as Human Immunodeficiency Virus Acquired Immunodeficiency Syndrome (HIV/AIDS), tuberculosis, malaria, maternal and perinatal complications, and nutritional deficiencies, more than other women from other parts of the world.[5]

Maternal healthcare remains crucial as it's a leading cause of death in African Women. One threat to maternal health on the continent is Obstetric Fistula, a "hole formed between the birth canal and bladder and/or rectum, and caused by prolonged, obstructed labour without access to timely, high-quality medical treatment"[6].

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This condition can lead to continuous urinary and, in some cases, faecal incontinence[7] and may be triggered by malignancy, radiation therapy, surgery, and traumatic injury.[8]

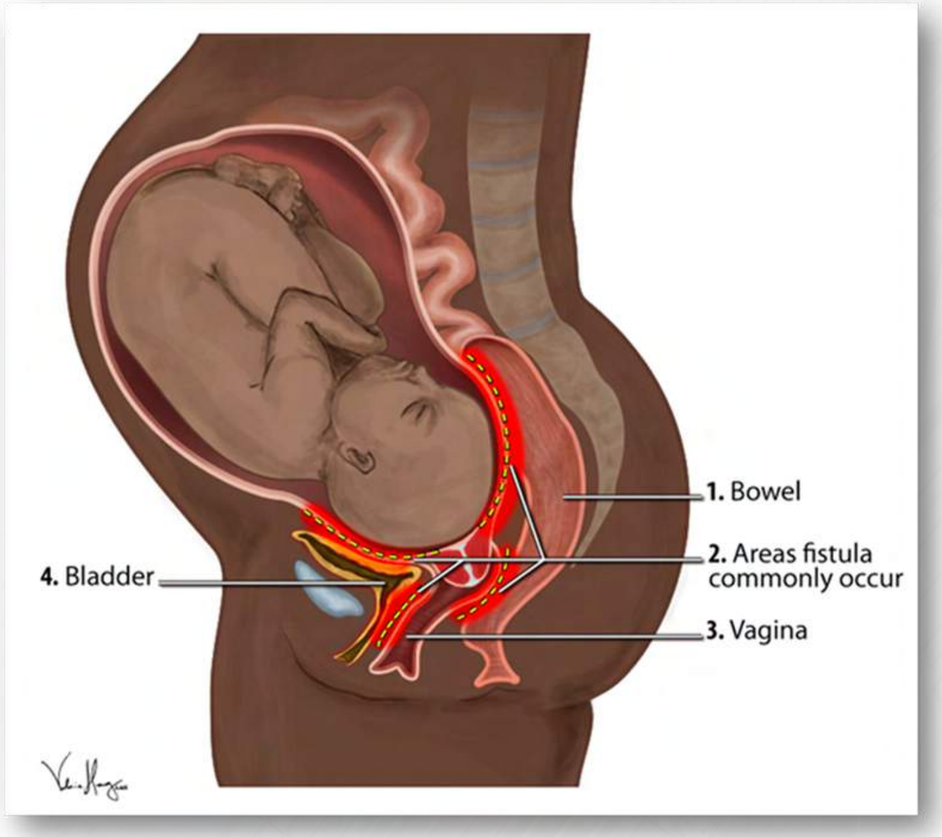

Figure 1: An illustration of areas where obstetric fistula commonly occurs. SOURCE: https://en.wikipedia.org/wiki/Obstetric_fistula#/media/File:Obstetric_Fistula_Locations_Diagram.png

In developing countries such as the African continent, obstetric Fistula can result from prolonged and obstructed labour, often occurring over several days because the unborn baby cannot pass through the pelvis.[9] This may be caused by the big size of the new-born baby since they may not easily pass through the pelvis. In some cases, the foetus may be lying in the wrong position, or the pelvis may be malformed or not fully developed. The prolonged pressure of the baby's head can damage the blood vessels supplying the tissues of the vagina, bladder, urethra, and rectum. The damage may end up cutting off the supply of oxygen; a condition referred to as ischaemia. Regrettably, this may lead to the death of the affected tissue in the form of necrosis. Subsequently, the dead tissue may then exuviate away, thereby leaving a hole between adjacent organs.[10]

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Notably, approximately two (2) million women in Sub-Saharan Africa, Asia, across the Middle East region, Latin America, and the Caribbean are living with this obstetric fistula injury. Furthermore, approximately 50 thousand to 100 thousand new cases are reported each year.[11] For instance, in Burkina Faso, the occurrence rate of Obstetric Fistula is reported at 6 out of 10,000 cases amongst gynaecological patients, with more patients affected in rural areas.[12] Leaving this condition untreated can lead to skin infections, kidney malfunction and subsequently cause death among women, especially delivering mothers.

Figure 2: Obstetric Fistula Facts. SOURCE: Mercy Ships UK. SOURCE: https://twitter.com/MercyShipsUK/status/1131454903875002368/photo/1

The various types of Obstetric Fistula can include the Vesicovaginal Fistula that occurs between the bladder and vagina and the Urethrovaginal Fistula that occurs between the urethra, known as the bladder outlet and vagina.

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There is also the Rectovaginal Fistula that occurs between the rectum and vagina; Ureterovaginal Fistula that occurs between the ureters (kidney tubes) and the vagina; and the Vesicouterine Fistula that occurs between the bladder and the uterus (womb). In some cases, more than one type of Fistula may occur simultaneously because of severe damage.[13]

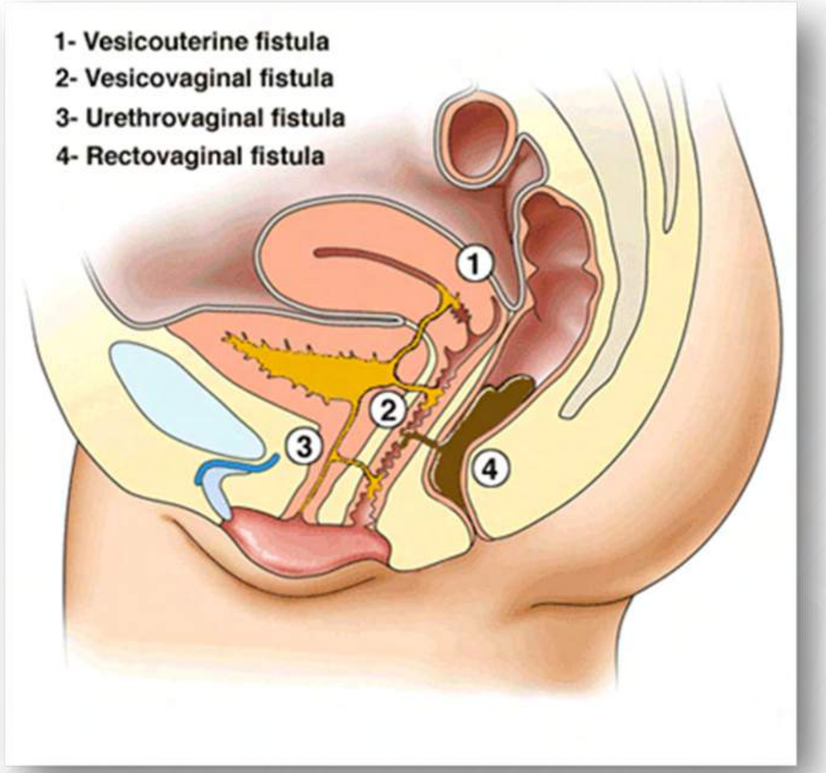

Figure 3: Types of Obstetric Fistula.
SOURCE: https://www.healinghandsclinic.co.in/obstetric-fistula-treatment/

The best approach to addressing this challenge is an urgent caesarean section. Thus, Obstetric Fistula has been effectively eliminated in the developed world because of the availability of healthcare facilities such as emergency obstetric facilities and caesarean section services.[14] However, in developing countries, this may not be readily available because of limited resources to detect such challenges during pregnancy or on delivery. There exists limited a limited number of adequately trained and skilled medical staff, as well as the lack of medical supplies and equipment in most African clinics and hospitals.[15] This calls for the formulation of effective solutions.

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The African Union High-Level Panel on Emerging Technologies (APET) notes that the obstetric fistula challenge has been eliminated in developed countries. However, this condition remains highly prevalent within African countries.[16] APET believes that Africa can eliminate Obstetric Fistula by incorporating smart technologies as part of preventative healthcare facilities to monitor this condition among African women. APET further acknowledges that health digital technologies can potentially enhance access to healthcare towards chronic maternal morbidities such as obstetric Fistula.

Uganda and Nigeria are leveraging digital Interactive Voice Response (IVR) technology to identify cases of Obstetric Fistula.[17] The IVR technology enables obstetric fistula screening and can be utilised as a referral hotline. As a hotline, it was developed to cater for inaccessible women, more especially in rural communities, that are living with obstetric fistula conditions. This technology utilises a mobile phone where a caller can dial a toll-free number. Through a consultative conversation, the technology allows the women to answer specific questions that will give insights into their health status. Subsequently, the hotline collects data on the demographics of Obstetric Fistula and experienced barriers against access to treatment.

Once the data has been collected, the women who screen positively within the intervention catchment areas receive follow-up consultation via telephonic consultative conversation from a community healthcare agent. This agent subsequently books the woman for a doctor's appointment and surgery for the patient, where applicable and necessary. Specifically, this technology was created to assist women who cannot read text messages on their mobile phones. This enables access to the most vulnerable women likely to struggle with this condition but lacks information on available preventative healthcare and medical facilities.[18]

The greatest challenge for most women towards accessing basic healthcare is usually money for transport to access basic healthcare. This is observed even in cases where healthcare facilities and services are subsidised financially by African governments in partnership with developmental partners. Therefore, technologies to enable access to funds for transportation and buying medical supplies, among others, need to be availed to these women. For instance, Mobile money technology has gained traction in trying to address access to funds for transport in places without banking facilities. African countries such as Tanzania are leveraging mobile money through the M-Pesa platform to pay for procedures and medical supplies related to preventative healthcare for such communities without banking facilities. [19]

The United Nations Population Fund has estimated that there are approximately 3000 new obstetric fistula cases in Tanzania.[20] Maternal healthcare in Tanzania is free; however, the transport costs remain a huge challenge for most women.[21] Thus, through the M-Pesa money mobile facility, women from inaccessible villages and without banking facilities can be given transport money through the mobile money platform to travel to nearby clinics and hospitals for treatment. The mobile money project has been spearheaded by the Comprehensive Community-Based Rehabilitation in Tanzania (CCBRT), collaborating with the UN Population Fund (UNFPA) and the telecommunications company Vodacom.[22] They provide patients suffering from obstetric Fistula with transport costs for their repair surgery.

Women who suffer from obstetric Fistula are often subjected to constant incontinence, shame, social segregation, and health problems.[23] Thus, addressing these social segregations and health problems remains crucial when addressing preventative healthcare measures for African countries. Even though approximately 2 million young women live with untreated Obstetric Fistula in Asia and sub-Saharan Africa, APET notes that obstetric Fistula can be preventable

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and treatable.[24] For example, this condition can largely be avoided by delaying the age of first pregnancy, ending the harmful traditional practices that promote obstetric fistula injuries, and timely access to obstetric care. As such, appropriately preventing and managing obstetric fistula conditions using supporting technologies can largely contribute to the Sustainable Development Goal 3 of enhancing maternal health.

In 2010, in Burundi, approximately 40% of women had limited or no access to skilled attendants at birth. The caesarean section rate was estimated to be approximately 4% against the minimum acceptable caesarean rate of 5%.[25] On the other hand, the annual incidence of obstetric Fistula was estimated to range between 0.2% and 0.5% of all deliveries, with 1000 – 2000 new cases per year. Regardless of this comparatively high incidence rate of cases, the national capacity for identifying and managing obstetric Fistula remained limited in Burundi.[26] To address this challenge, the Médecins Sans Frontières (MSF) set up a permanent referral centre in 2010.[27] This permanent referral centre was established to manage women with obstetric fistula cases. Unlike the one-time surgical fistulae repair 'camps' commonly pursued as a joint humanitarian venture, the MSF model of obstetric fistula care went beyond simply the technical act of surgical repair. This centre provided a comprehensive package of obstetric fistula care that promoted both the physical and psycho-social recovery frameworks.

While programmes such as the MSF exist across the continent, there is limited published information, especially within the rural African settings.[28] Therefore, APET is suggesting Africans should not only pursue similar models but also incorporate some of the above-mentioned technologies to strengthen capacity and effectiveness. This can also help enhance their visibility across the African continent and help African countries better address and manage the preventative healthcare operational challenges.

In conclusion, APET suggests that utilising smart technologies to support preventative medicine programmes and monitoring preventable diseases such as obstetric Fistula should be pursued and upscaled across the African continent. APET acknowledges that the reduction and eventual eradication of this condition in Africa can be accomplished just as in the developed countries that have managed to. Eradicating the obstetric fistula condition would also enable rapid socio-economic development.

Link: https://www.nepad.org/blog/obstetric-fistula-enhancing-preventative-maternal-healthcare-african-women-using-smart

Blog #8 Published on May 4, 2022

Incentives for Africa's Scientists and Innovators - Towards Enhancing Africa's STI Outputs

The African Union (AU) Agenda 2063 considers Science, Technology, and Innovation (STI) a prerequisite for accomplishing Africa's socio-economic developmental goals.[1] AU's Agenda also recognises that for African countries to address challenges such as poverty, diseases, climate change impact, food security, and efficient healthcare, peace and security, Africa should recognise STI as the epicentre of its socio-economic development. This is well captured in the Science, Technology, and Innovation Strategy for Africa (STISA-2024).[2]

Africa's history in harnessing STI has amassed a net negative impact, as evidenced in the past three industrial revolutions, i.e., the steam engine, the age of science and mass production, and the rise of digital technology.[3] However, the 4th Industrial Revolution (4IR) aptitudes appear different. The 4IR can potentially leapfrog' Africa's economic development and further stir a surge of innovations that could transform Africa. This could lead to achieving the socio-economic development goals across the African continent.[4]

In recent history, Africa has turned to primarily rely on imported technologies developed from other continents rather than develop their own technologies. As such, Africa is generating about 1.1% of the global scientific knowledge. Notably, the African continent has approximately 79 scientists per million inhabitants, as compared to the 4,500 per million people in the United States of America.[5] This is much lower than some European countries, Asian countries, and the Middle East countries. This can be attributable to the limited investments in STI by African countries. Despite continental efforts, currently, African countries invest less than 1% of their Gross Domestic Product (GDP) towards STI.[6]

Unfortunately, the limited investments towards STI-related activities have resulted in other complexes, such as the limited skilled human resources and infrastructure for STI-related activities.[7] The phenomenon commonly referred to as the "brain drain";" - the emigration of top scientists, engineers, and innovators - has further impeded scientific knowledge in Africa.[8] Most of Africa's skilled workforce turn to emigrate to other continents and countries in pursuit of better resources and infrastructure. In addition, African innovators and scientists are frustrated by the limited access to African markets available for their products. This is because most African people prefer imported technologies, goods, and services rather than locally produced ones.[9] Unfortunately, this is significantly reducing Africa's capacity to supply African countries.

Africa has also been criticised for largely focusing on research and development, with minimal emphasis on technological innovation.

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Technological innovation, however, remains key to transforming scientific and technological knowledge into goods and services that can potentially bolster Africa's socio-economic development.[10]

Additionally, there are limited incentives and rewards available for African innovators compared to other regions of the world. This is because the national ecosystems of innovation for most African countries remain underdeveloped[11] despite the fact that numerous innovation activities are currently occurring within local communities and some institutions across the African continent. For example, digital technologies coupled with artificial intelligence technologies and satellite imaging are currently proving crucial information about crop performance for African farmers. This is boosting the continent's food production and crop cultivation. Additionally, there has been incremental utilisation of drone technologies for agricultural and entertainment purposes.

African countries are encouraged by the African High-Level Panel on Emerging Technologies (APET) to increase their incentives to encourage STI-related activities. This can significantly help African countries benefit from 4IR-related socio-economic development.

Incentives are mechanisms and systems established to encourage or induce productivity.[12] In STI, the various incentives can be classified into the following categories: fundamental, institutional, infrastructural, financial, fiscal, budgetary, legal and regulatory, public procurement, honorific, and knowledge-based incentives.[13] The fundamental incentives include market economic incentives such as free competition, private property, openness to the global economy, efficient bureaucracy, and stable democracy.[14] Thus, APET is encouraging the political and economic reforms undertaken by African countries in the last few years.

Furthermore, African countries can pursue institutional and infrastructural incentives such as technological innovation and science parks. This can enable the transfer, extension, diffusion, popularisation, information, networking, and international cooperation. The institutions and infrastructures for research and development should also be modernised, strengthened, and efficiently connected to industrial activities within African countries. Most importantly, the infrastructure for information and communication technologies should be improved to enhance productivity and efficiency substantially. This can significantly support technological transfer, diffusion, and networking. On the other hand, the financing of technological change is particularly paramount as most African countries have limited, well-coordinated and developed financial systems.

African countries are also attracting limited foreign direct investment and commercial credit. Thus, strengthening the privatisation and diversification of Africa's financial systems can enhance the availability of venture capital and credit to farmers and the informal sector.[15] The financial incentives, particularly domestic and foreign direct investment, should be reinforced in view of the globalisation of the economy. This can eliminate the constraints against local equity, local inputs, and repatriation of dividends. In addition, a more positive approach towards multinational corporations should be adopted to contribute to the local and national technological capacity building and strengthening.

Fiscal incentives, including tax benefits, rebates, exemptions and vacations, as well as accelerated depreciation, can be used to foster collaboration between research and development and industry use of technology.

This can assist with training, repatriation of national expatriates, and utilisation of foreign talent/consultants through strategic technological imports.
Some African countries are currently establishing and strengthening Export Processing Zones (EPZ). The zones are coupled with tax incentives and facilities for transferring technologies. This enables African countries' institutions to have more freedom to hire expatriate experts. For example, Mauritius has successfully implemented this incentive, which can serve as an inspiration for other African countries.[16] Through the EPZ, Mauritius incentivised scientists and innovators by affording them income tax relief and other incentives to promote innovation output in their country.

Consequently, this was attractive for innovators and investors, and the country expanded their socio-economic activities rather than the sugarcane-dependent economy. The country has expanded on other industrial activities such as clothing and oil manufacturing.[17] Apart from offering tax incentives, the Mauritius EPZ also provided vast labour and infrastructure necessary for innovation.

Budgetary incentives, except for scholarships, are progressively being regulated by the new General Agreements on Tariffs and Trade (GATT) Agreement.[18] This is in the form of investment allowances, modernisation of grants, industrial subsidies, and export compensations. This can be implemented to the advantage of African countries that cannot compete with the industrialised countries. Furthermore, the legal and regulatory incentives can essentially protect intellectual properties and technologies, administer minimal technological standards, and facilitate the acquisition of essential foreign experts through residence and work permits and tax holidays. Such efforts can enhance the status of African researchers. In addition, the legal and regulatory incentives should be reviewed regularly to adjust to the ever-changing circumstances. For example, technology and innovation progress are progressively being regulated by the market than bureaucratic regulations. However, minimal regulations should be implemented.

Public procurement can deliver essential incentives to local industries by upgrading and strengthening their technological capacity. Even though the new GATT Agreement restricts this policy instrument, it can still benefit indigenous enterprises.[19] On the other hand, honorific incentives, such as prizes and awards, can be utilised as public recognition mechanisms for excellence for Africans. These kinds of incentives have demonstrated cost-effectiveness in encouraging innovation and technological improvement.

APET recommends that these African countries adopt these incentives as they can strengthen their knowledge base, such as basic education. This can also encourage girls to pursue science, technology, engineering, and mathematics disciplines. Such incentives can also promote technical training, apprenticeship, sabbatical leaves, study tours, and optimal participation in international seminars. Regrettably, Africa's education has declined in the last few years because of the rapidly increasing population and declining resources. Thus, African countries should prioritise higher levels of education for their citizens in the next decade.[20]
The advantages of providing incentives to African innovators and scientists were demonstrated when the COVID pandemic hit Africa, as many African countries were facing shortages of personal protective equipment (PPE) such as masks, gloves, and sanitisers. There were reported shortages of antigen testing kits because they were expensive, and these incentives encouraged innovation and manufacturing within African countries. Countries like Malawi experienced challenges of limited PPEs in their fight against the COVID-19 pandemic. However, the country pursued options of locally manufacturing the PPEs. This was substantially enabled and improved by the Malawi government's decision to remove taxes on the raw materials suitable for manufacturing PPEs. Consequently, Malawi managed to manufacture these PPEs much more cost-effectively and were readily accessible to Malawi's local population.[21]

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In conclusion, APET believes that science, technology, and innovation are paramount to sustainable growth for African countries. Thus, enabling and letting innovation and scientific knowledge flourish can systematically and significantly develop the African continent. Thus, by incentivising African innovators, impediments that have derailed innovation can be eliminated. Consequently, Africa will not miss the 4IR train and will improve her socio-economic development and growth within the AU's Agenda 2063 and STISA-2024.

Link: https://www.nepad.org/blog/incentives-africas-scientists-and-innovators-towards-enhancing-africas-sti-outputs

Blog #9 Published on May 17, 2022

Rethinking and Reimagining Education in Post-COVID Africa: A Webinar Report

The COVID-19 pandemic has exhibited enormous disruptions within the African education system as most schools were closed at the onset of the pandemic to curb the spread of the disease. During the pandemic's peak in 2020, approximately 32 million children in Eastern and Southern Africa were out of school. This was the case because most African governments had imposed strict lockdowns to prevent the further spread of COVID-19. To address the disruption caused by the COVID-19 pandemic, many African schools attempted to continue their teaching and learning activities using online means during this period. This was accomplished through e-learning tools such as Blackboard, Google Meet, Microsoft Teams, and Zoom.

The disruptions caused by the pandemic have been felt in education and other economic sectors such as health, agriculture, and trade. In terms of education, particularly schools, the lockdowns have exposed the digital divide in Africa. The pandemic also increased school dropouts in some African countries. For example, South Africa has observed approximately 750,000 students that have dropped out of school due to the pandemic.[1] The pandemic has also exposed the lack of information and communication technology infrastructure investment across the African continent, resulting in limited internet access and reliable broadband.

The COVID-19 pandemic has threatened to derail the objectives of the African Union's Continental Education Strategy for Africa (CESA-2025) of transforming Africa's education and training systems. The CESA-2025 should generate sustainable knowledge, competencies, skills, innovation, and creativity suitable for Africa's socio-economic development and growth. However, at the onset of 2022, most African countries have since reduced their lockdown restrictions.

The pandemic has highlighted the gaps and opportunities in teaching and learning methodologies within African schools. Thus, now that schools are reopening, African countries should adapt to blended learning methodologies to adapt to the "new normal" of teaching and learning post-COVID-19. The African educational system can adapt to the hybrid system of e-learning and restricted physical classes to curb the spread of the pandemic. By doing so, African countries will be accelerating the aspirations of the CESA-2025 framework.

The weaknesses of the African education system were exposed at the peak of the COVID-19 pandemic. Most African schools and universities faced challenges during the pandemic lockdowns, highlighting that Africa's education system should adapt to incorporate technologies. This motivated the African Union High Level Panel on Emerging Technologies (APET) through the Calestous Juma Executive Dialogue (CJED) to organise a webinar to deliberate on rethinking and

reimagining Africa's education in the post-COVID-19 era. This webinar convened various senior policymakers, decision-makers, education practitioners, scientists, innovators, and other relevant stakeholders for knowledge and national experience on how Africa's education can be recalibrated in the post-COVID-19 era.

Experts presented the need to bridge the gap between policy and practice within Africa's education post-COVID-19 era. Notably, African countries have instituted excellent education policies and legal frameworks that can potentially encourage socio-economic and human capital development. Thirty-eight (38) African countries were ranked among the 140 countries with the best education system. This was based on the skills development indicators developed by the World Education Forum. However, the challenge remains whether the education policies are being implemented throughout the African continent.

By efficiently implementing these education policies, African countries can effectively deliver the scientists and engineers needed to build up the continent's socio-economic activities. Therefore, African countries should address the policy implementation gaps, especially within the education system. Notably, this is mainly observed between policy and practice in schools and classrooms. Regrettably, suppose these policy and practice gaps remain unaddressed. There will be limited implementation and coordination of policy frameworks among authorities, leading to limited skills generation and teacher capacity. Thus, there is a need to increase the political will and adequate commitment, enable short-term planning and financing, and enhance the participation and engagement of local stakeholders.

In addition, African countries should provide adequate funding and bridge the technology divide, which remains endemic within the African education system. African schools should also take advantage of emerging teaching and learning technologies such as robotics, artificial intelligence, and digital technologies. This can also improve education leadership in all education sectors and decentralise Africa's education decision-making responsibilities to those close to the students. Most importantly, policymakers and policy implementers should clearly interpret and understand the intended policy frameworks to enable implementation. Additionally, African schools should ensure a relevant and responsive curriculum to the needs of Africa's local communities.

COVID-19 negatively impacted teaching and learning on teacher education in most African countries, especially Ghana. All these countries were equally affected because most schools and universities were closed during the pandemic's peak. To mitigate these challenges posed by the pandemic, schools across the continent had to find innovative approaches through collaborative teaching. The use of emergency teaching methods enabled by national funding and supported by international partners enabled teacher training through online methodologies. Through this programme, Ghana teachers were taught how to utilise online teaching and learning and undertake assessments using tools such as Zoom and Microsoft teams. Consequently, this strengthened teachers' capacity in digital technologies for teaching and learning.

However, in Ghana, it was observed that most teachers and students did not have the required smartphones for online teaching and learning. Furthermore, internet access was limited because data, broadband, and internet connectivity were limited. Therefore, to mitigate these internet access challenges, students were provided with smart drive cards (SD) through which teachers and students could access teaching and learning materials from their smartphone devices. Furthermore, it was highlighted that most teachers had limited access to tablets and smartphones necessary for teaching and learning. However, resource mobilisation enabled approximately 500 teachers to have access to these smartphone gadgets at subsidised prices.

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Physical assessments were conducted in batches to minimise contact and cheating in tests and examinations.
Experts further suggested that practical lessons within the science, technology, engineering, and mathematics (STEM) subjects cannot be delivered effectively through virtual means. Instead, provisions should be made to have physical classes for those practical classes. This can help students acquire basic skills for simple experiential teaching and learning. In addition, efforts should be made to assist students to reacclimatise into physical teaching and learning since most of them are still stuck on online teaching. Provisions for internet access and data should be ensured to enable the blended teaching and learning approach. This will help teachers continue with the blended approach. Therefore, the zero-rated teaching and learning websites and digital technologies should be continued to ensure the blended approach.

Online teaching and learning should not be treated as a contingency plan to manage the pandemic lockdowns but as part of the teaching and learning delivery going forward. Therefore, more investments towards enabling online teaching and learning delivery should be ongoing and increased. African governments should prioritise infrastructural improvements and adjustments to enable blended teaching and learning. Moreover, support should be afforded to students in undergraduate and post-graduate to catch up on their studies. This includes the primary and secondary schooling severely interrupted by the pandemic lockdowns. Thus, social distancing and vaccine mandates should be carefully considered and implemented in schools and universities to better reintegration and normalise teaching and learning.

The recommendations from experts advised that African governments should prioritise innovation in education and capitalise on the recent technological influx of technologies across the African continent. Thus, African governments should invest more in technological infrastructure and investment in teaching and learning technology to ensure the integration of ICT tools in teaching and learning. To this end, there should be strategic budgetary allocation to finance teaching and learning technologies and improve the teacher-pupil ratio through the blended approach to teaching and learning. African countries should also address the underlying infrastructural challenges impeding internet access and reliable broadband and data costs to enable teaching and learning blended approach.

Teacher training contents should be reviewed to reflect emerging technologies in education. i.e., artificial intelligence (AI), adaptive learning, augmented reality (AR), and blended teaching and learning. Hence, African governments should enhance their investments in high-quality online education, educational television, and radio for all Africans. These technologies can sustain learning for students at primary and secondary levels. African governments should also adequately fund Africa's education with more sources and pursue effective educational policy implementation and review. This is because the new technologies in education should enable learners to have independent learning, with teachers facilitating the learning process instead of teacher-centred learning pedagogy.

Since the COVID-19 disruptions have exposed the weaknesses of Africa's educational system, African governments should collaborate to build capacity for teachers for quality education delivery across the continent. Thus, there should be heightened participation and collaboration between teaching institutions and private sector institutions such as telecommunication companies.

Furthermore, educators and education institutions should explore various funding instruments and grants to improve online teaching and learning and upskilling and teacher capacity through various in-service teacher training platforms. Access to the internet through reliable broadband and affordable data charges should

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be pursued to enable a successful blended teaching and learning approach. Thus, African governments should intervene and engage telecommunication companies to improve the ICT infrastructure.

Finally, African countries should carefully develop and implement education interventions. African countries should avoid a one size fits all approach and interventions as different countries and regions within the African countries are at different levels of economic development. Therefore, African countries should deal with these challenges on a country-by-country basis.

Link: https://www.nepad.org/blog/rethinking-and-reimagining-education-post-covid-africa-webinar-report

Blog #10 Published on Jun 14, 2022

Call for Writers: Preparing Africa for the Next Speed through 5G Technology

Digital technologies are gradually creating job opportunities and entrepreneurship for Africans, particularly the youth. Through digital solutions, the continent is addressing poverty, social inequalities, and the production and delivery of goods and services. These solutions can potentially improve healthcare service delivery, doctor-patient interactions, and patient monitoring modalities. Agricultural food production and distribution in African countries are also being improved by digital technology, artificial intelligence, and drones.[1]

The AU Digital Transformation for Africa (2022-2030) reaffirms the concept of digitalising Africa for Africa (2020-2030), aiming to transform African societies and economies by effectively deploying digital technologies and innovation. This can help promote Africa's integration, resulting in inclusive socio-economic growth, job creation, closing the digital divide, and eradicating poverty.[2] It is also ensuring Africa's ownership of modern tools of digital management so as to connect every African citizen to the internet by 2030.[3]

Ideally, in order to harness digital technologies, one must have access to the internet. According to continental frameworks urging African countries to adopt digital technologies in order to improve socio-economic growth, internet usage in Africa is still very low. Internet access in Africa is extremely limited, with just 22% of the population having access. A lack of adequate infrastructure also means that the high cost of data slows down the rapid spread of internet connections in Africa. Africans are thus unable to take advantage of digital services offered by the internet. Because of this, African countries should consider expanding their information and communication technology sector in order to improve internet infrastructure, policy, and human resources.

For example, the Southern African Development Community (SADC), like all regions of the African continent, has been gradually expanding internet access efforts through internet connection access. This is because SADC's internet access rate of 2% is among the lowest in the world.[4] This has prompted SADC countries to transform their internet access in order to facilitate more robust regional integration and economic development. On August 14, 2001, SADC adopted the Declaration on Information and Communications Technology to promote internet development in the SADC region.

The Declaration on Information and Communications Technology formally recognises the socio-economic benefits of affordable and dependable internet access. As a result, the SADC region is strengthening internet infrastructure and speed in order to achieve these goals of accelerating digital technology as a development enabler. For example, most SADC countries use 4th Generation (4G) internet with speeds of up to 100 Megabytes per second (Mbps).

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However, due to unreliable bandwidth, most SADC countries' areas barely use the 100 Mbps capacity. It is even worse for SADC countries that continue to use 3G capacity due to the maximum 14 Mbps speed capacity. As a result, deploying 5th Generation (5G) wireless can improve bandwidth speed and network capacity. The 5G internet connection allows users to access up to 100 Mbps speeds.

The African Union High Level Panel on Emerging Technologies (APET) supports 5G implementation across the region to fully exploit the internet's full capacity and digitally advance Africa. The deployment of 5G technology can accelerate innovation and help SADC countries achieve their digital agendas for socio-economic growth and development. APET believes that by implementing 5G technology, SADC will be able to smoothly implement the Fourth Industrial Revolution and strengthen digital technologies across the region. High 5G connectivity capacity can help African countries implement 4IR technologies.[5] 5G technology can enable high-resolution virtual reality, autonomous vehicle technologies, smart cities via the internet of things, and smart health applications. Furthermore, 5G technologies can improve machine learning, artificial intelligence (AI), 3-D printing, and data analytics, all of which are necessary for socio-economic development.

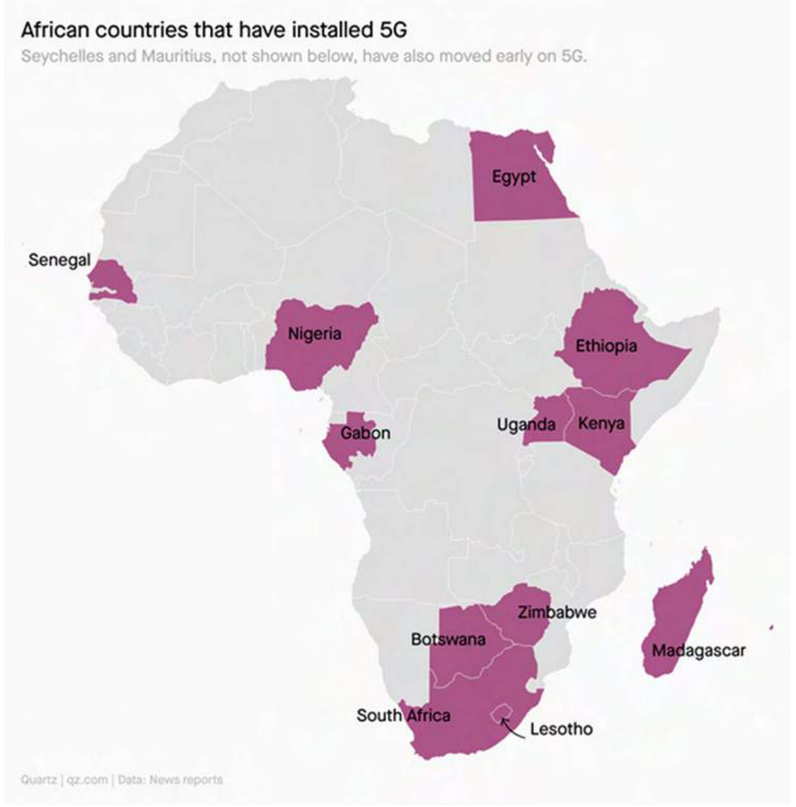

Figure 1: SOURCE: QUARTZ AFRICA (https://qz.com/africa/2168658/which-countries-have-rolled-out-5g-in-africa/)

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Ethiopia has become the latest African country to begin testing a 5G mobile network, following South Africa and Nigeria. As of right now, 12 African countries[6] are either conducting 5G trials or have begun rolling out the technology. However, many of these countries are dealing with issues that could derail their plans for 5G deployments. Spectrum regulation clarity, commercial viability, and deployment deadlines have been the main obstacles to overcome in the past. In Nigeria, the continent's largest economy, 5G spectrum licenses were issued in March, and commercial deployment is expected to begin in August, according to reports. Sonatel and Orange continue their trials in Dakar, Senegal, but the network is still largely inoperative. Citizens in Seychelles are wary of the country's 2020 5G rollout, fearing for their own health. The First East African nation to test the launch of a 5G network with ZTE and MTN was Uganda in January 2020. However, there has yet to be a commercial launch.

Additionally, despite the potential to improve Africa's economic capacity, the adoption of 5G within Africa, not just in SADC, has been plagued by scepticism and myths, resulting in the technology's limited adoption. For example, during the peak of the COVID-19 pandemic in 2020 and 2021, 5G technology was blamed for the global spread of COVID-19. Despite the fact that these theories were false and lacked scientific evidence, many people believed the claim that 5G caused the COVID-19.

Furthermore, there have been growing concerns about the gradual increase in cybersecurity risks. However, cyber security firms are gradually responding to this by tightening security controls and mechanisms. Data can be cryptographically protected across software, network, and storage stack layers with 5G.[7] These cryptographic operations help to support critical digital business operations. Furthermore, 5G technology is mistakenly thought to be limited to mobile phones. However, this technology can be applied to any digital device that requires an internet connection, such as connecting smart cars and smart cities via the internet of things.

Another common misconception is that the high frequencies used by the 5G connection will cause brain damage due to the microwave bandwidth. However, 5G networks, like previous cellular technologies, rely on radio waves to transmit signals. These radio waves are a component of the electromagnetic spectrum transmitted between an antenna and a digital device. This includes television and radio signals, as well as a variety of technologies like mobile phones and natural sources like sunlight. As a result, electromagnetic radiation is always present around humans.
It is worth noting that 5G technology employs higher frequency waves than previous mobile networks. As a result, more internet connections are available, and faster internet speeds are available to multiple digital devices at the same time. However, because 5G waves travel shorter distances within urban areas, significant investments in 5G infrastructure are required. As a result, 5G networks require more transmitter masts than previous technologies, which are located much closer to the ground level.

To improve 5G technology acceptance across the African continent, APET encourages more stakeholder engagements to address and debunk 5G technology-related myths. As a result, APET is challenging all stakeholders in the private and public sectors and African policymakers to clearly articulate how 5G technology can fundamentally transform how people live and work. This can be accomplished by using real-life examples and demonstrations to demonstrate the significance of technology in our daily lives. Thus, stakeholder engagement campaigns emphasising the performance benefits realised by early 5G technology rollouts in other countries will demonstrate the value of 5G technology for the rest of the African continent.

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To meet the rapidly developing economic 4IR advancements, the African continent should pursue 5G technology. To fully realise the potential of 5G technologies, however, local African communities must buy-in and develop trust in the technology. As a result, African governments should address the myths that have been associated with 5G technology. This is because the opportunities presented by 5G technology have the potential to exponentially grow the African continent's economy. African countries should continue communicating the benefits of 5G technology while addressing concerns about the technology.
To increase trust in 5G technologies in Africa, APET recommends that African countries develop a clear and comprehensive framework for infrastructure deployment, use, regulation, and management.[8] This should be put in place in order to standardise the digitised wayleave and right-of-way approval procedures. As a result, agencies and authorities should be strengthened in order to ensure that the relevant 5G technology standards are included in the Official List of Regulated Standards.[9]

African countries should use fixed Wireless Access and Satellite to bridge the digital divide in areas where infrastructure such as optical fibre cannot be installed.[10] These 5G technology-related infrastructure installations have the potential to significantly improve remote working and e-learning activities. Furthermore, the infrastructure associated with 5G technology can improve telemedicine, surveillance and security, agriculture, mining, manufacturing, and financial technology services for African countries.

Furthermore, to enable optimal and high-speed 5G technology services, a minimum contiguous assignment of 80 MHz – 100 MHz spectrum in the mid-bands and 400 MHz to 1GHz in the high bands should be implemented.[11] In addition, APET recommends that African countries defragment and clear the prime bands across all band wavelengths classified for 5G technology.[12] This can ease the bandwidth traffic and data utilisation within these bands to increase optimal speed capacity.

The authorities or agencies should also ensure the renewal of spectrum licences can provide confidence to the industry and expedite well-managed 5G network investment.[13] Spectrum pooling should be implemented to maximise the benefits of available spectrum and increase available bandwidths for all mobile operators. Furthermore, spectrum trading should be pursued to enable cost-effective and efficient spectrum use to maximise the transfer of spectrum rights to users who require the 5G network spectrum the most. This may also aid in lowering auction spectrum prices. The Administered Incentive Pricing (AIP) spectrum formula has been modified to reduce the cost of using large and contiguous blocks of high-bandwidth spectrum.[14]

To accommodate all stakeholders, the 5G band spectrum assignment should be prioritised for industry verticals via well-researched mechanisms. The Authority Agencies can actively facilitate the procurement and establishment of alternative power supply sources to enable 5G networks in communities with limited, intermittent, or no power.[15] This can be accomplished by establishing and strengthening collaboration research hubs. This can also aid in developing comprehensive and coordinated public information campaigns among governments, regulators, the private sector, and civil society stakeholders to combat widespread misinformation and disinformation about 5G technology.[16]

Finally, in order to mitigate cybersecurity risks associated with 5G technology and networks, security policies, regulations, and processes must be developed to screen potential suppliers, assess their risk profiles, and ensure that the risks posed are significantly reduced and effectively managed.

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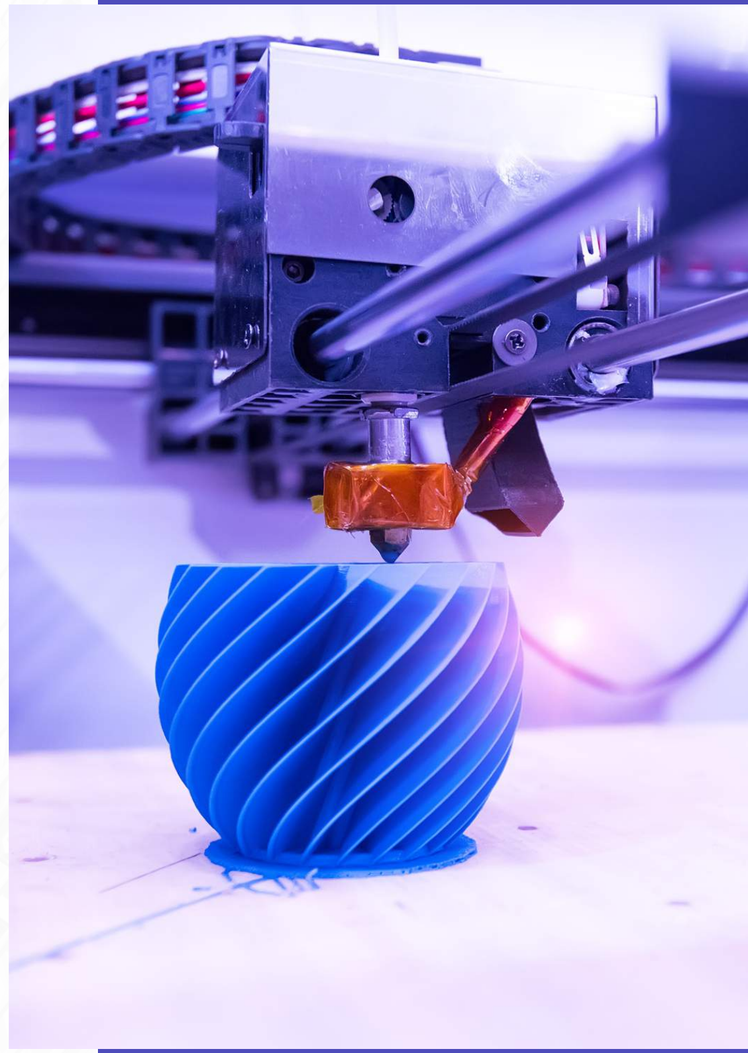
African countries, for example, can use the 5G assurance specifications and 3rd Generation Partnership Project (3GPP) security architecture guidelines, which have proven reliable. Through these efforts, African countries can effectively implement 5G technologies to support their digital technology advancements and improve socio-economic development and growth.

Link: https://www.nepad.org/blog/call-writers-preparing-africa-next-speed-through-5g-technology

Blog #11 Published on Jun 14, 2022

Call For Writers: The Utilisation of 3D Printing Technology in Strengthening the Capacity of Africa's Manufacturing Sector



The African Union (AU) Agenda 2063 identifies manufacturing as a fundamental conduit of socio-economic growth and development for the African continent. Fundamentally, the African Continental Free Trade Agreement (AfCFTA) launch in March 2018 can further bolster the continent's manufacturing development and growth.[1] This is because AfCTA offers a continental market for goods and services in Africa. This can unlock endless innovative manufacturing and potentially facilitate the continent's industrialisation. On the other hand, the African Union Action Plan for the Accelerated Industrial Development of Africa (AIDA) and the United Nations' Third Industrial Development Decade for Africa (IDDA3) are frameworks that distinctly communicate the role of industrialisation in Africa.[2] These frameworks encourage the maintenance and expansion of Africa's manufacturing activities to accomplish inclusive and sustainable socio-economic growth and development.

Despite manufacturing being a backbone and prerequisite for socio-economic development for the African continent, manufacturing still lags behind as characterised by the relative scarcity of manufacturing activities across the African continent. This is attributable to the limited manufacturing capacity of most African countries. Evidentially, the consumption patterns of Africa are predominantly dependent on importing goods from outside of the African continent.[3] Thus, African policymakers across the continent are calling for increased industrialisation and manufacturing.

However, there have been limited manufacturing actions and industrialisation on the ground as a significant development marker. Industrialisation promises the ability to enable prosperity, the creation of jobs, and better wealth generation to alleviate poverty for all African citizens. Yet, the African continent remains limitedly industrialised today as it was four decades ago. In fact, the contribution of Africa's manufacturing to the continent's gross domestic product has essentially weakened from 12% in 1980 to 11% in 2013.[4] Fundamentally, manufacturing has remained stagnant over the past few years, as the United Nation's Economic Commission for Africa reported.

The British business research group, the Economist Intelligence Unit, estimated that Africa contributed approximately 3% of global manufacturing output in the 1970s.[5] However, this percentage contribution has since halved recently. There are warnings that Africa's manufacturing industrial capacity may remain limited and barely expand throughout the remainder of this decade. This is partly caused by the high commodity prices prompted by China's apparent and insatiable appetite for natural resources. This has stimulated the precipitous socio-economic growth in Africa since the 1990s.[6]

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Various African analysts perceived that the boom would bolster Africa's diminishing manufacturing industry. Unfortunately, the expected boost from commodity prices barely grew to meet boom expectations.[7] Furthermore, in attempts to stimulate manufacturing industries, some African countries have used their proceeds from the commodity bonanza to address short-term domestic challenges. This includes increasing the remuneration of civil servants. However, this has barely addressed Africa's development in an acceptable manner. Therefore, value addition and the creation of more products should be pursued.

To this end, adopting new methodologies for the manufacturing sector, such as 3D printing and harnessing digitisation, can strengthen the manufacturing industry in Africa. This is because automated and digitised 3D printing is progressively gaining tremendous traction within the manufacturing sector across the African continent. As such, the African Union High-Level Panel on Emerging Technologies (APET) encourages African countries to expand their manufacturing capacity in 3D printing and automation using digital technology. Thus, African manufacturers should embrace these innovation models by integrating these emerging technologies into their manufacturing protocols and activities.

Notably, 3D printing, sometimes referred to as additive manufacturing, is a process of making three-dimensional solid objects from a digital file using additive processes.[8] The 3D printing process encompasses building up successive layers of material from the ground up until the 3D object is entirely created. This enables people to generate complex shapes of various sizes using fewer materials than traditional manufacturing methods. Therefore, 3D printing technology is timely and cost-effective because the 3D printer is fully automated and requires limited human labour operators.[9]

APET realises that the advancement of 3D printing technology in the African continent can significantly improve self-reliance and local production of goods and services. This can significantly reduce Africa's reliance on importing goods from outside the continent.[10] Notably, in 2016, the total global revenues generated from 3D printing technology systems amounted to more than US$6 billion, representing approximately 17.4% growth in the industry.[11] On the other hand, within emerging markets, 3D printing will grow into a US$ 4.5 billion industry by 2020.[12] In the long term, the range of printable materials may expand 50% of all globally manufactured goods will be printed by 2060.

Worth noting that 3D printing technology is a manufacturing process that can join materials layer-by-layer to produce complex geometric objects with internal cavities from three-dimensional (3D) models. For example, 98% of hearing aids worldwide are fabricated and custom-made using 3D printing.[13] Even though 3D printing is still being strengthened to allow for high-volume manufacturing, the technology enables rapid prototyping in the interim. This is potentially shortening the design to the production time of products. APET notes that this can allow entrepreneurs to manufacture various products that are not locally available speedily.

For example, a joint venture between a consortium of Canadian organisations with the Comprehensive Rehabilitation Services (Kisubi hospital, Uganda) is researching and developing 3D printed prosthetic limbs for amputees.[14] Instead of casting the prosthetic limbs with plaster, using digital scanners, the damaged limbs are digitally scanned to digitally model the prostheses before production. In this way, better-fitting limbs are produced in a cost-effective and timely manner. Furthermore, some entrepreneurs in Togo are using 3D printers that are built from electronic waste. This is making 3D printing much cheaper and affordable.[15]

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APET believes that 3D printing, as part of Industry 4.0, can enable African economies to catapult their industrialisation advancement and bolster their socio-economic development and growth. Worth noting that several African countries have managed to rebuild their limited telecommunications infrastructure and advance their mobile technology capacities. This implies that African countries have the capacity to replicate this approach within their manufacturing capacities. Even though this is not that simple, African countries can pursue sophisticated 3D printers and infrastructure. They can also develop their specialised human resource skills necessary to produce durable and reliable products.

Notably, many 3D-printed products require postproduction steps and tests. These postproduction steps and tests entail specialised knowledge, machinery, and infrastructure. As such, small-scale personal printers may significantly address specific local challenges and may not necessarily adequately address Africa's industrialisation. However, with appropriate investments, 3D printing in Africa can potentially be grown to solve much more significant challenges such as housing and settlement. For example, the School of Civil Engineering at the University of Johannesburg in South Africa has constructed a six-room home in 5 hours using 3D printing technology.[16] Since South Africa is struggling with a vast informal housing problem, 3D printing technology can be adapted to address the housing challenges. However, environmental challenges such as weather and stability should be tested and addressed to enable upscaling of the 3D in construction. Since 3D printing technology can produce real structures using cheap materials, this could potentially provide decent housing for millions of Africans. However, this technology should receive adequate investment support to grow.

Large-scale concrete 3D printing machines can cost more than US$4000 per unit.[17] Such costs may remain a blockage for this technology from becoming widespread if adequate investment and proper management are not availed to enable large scale 3D printing. Furthermore, the University of Johannesburg has estimated that the 3D-printed wall plates and block work utilised to create the 3D printed house structure cost approximately 32% less than conventional building materials.[18]

Currently, the United States of America, Germany, South Korea, and Japan are leading the 3D printing technology.[19] On the other hand, China and India are envisaged to grow this technology as their governments are aggressively promoting technologies associated with Industry 4.0. For example, in 2015, China unveiled their "Made in China 2025" initiative to promote advanced technologies.[20] This initiative emphasises 3D printing technology as an enabler. To this end, the "National 3D Printing Industry Promotion Plan (2015–2016)" was complemented by the new "Additive Manufacturing Action Plan (2017–2020)".[21] In 2017, several Chinese institutions invested approximately US$1.1 billion in 3D printing technology.[22] Therefore, APET calls on African governments to establish similar investment plans for 3D printing technology. This is because the cost of inaction will be much greater for Africa than the cost of investment in the long run if there are limited or no investments towards this technology in the interim.

Notably, 3D printing technology is currently being applied in various economic activities such as jewel making, car parts manufacturing, medical devices, accessories, components, and parts, personal protective equipment manufacturing, medical implants, assistive tools, aerospace parts manufacturing, and medical surgery implants.[23] Furthermore, the importance of 3D printing technology was highlighted during the COVID-19 pandemic because several African countries started 3D printing various personal protective equipment (PPE) such as face masks and face shields instead of importing them from outside the country.[24] Thus, the 3D printing technology enabled African countries to have better access to PPEs which subsequently contributed to job creation and entrepreneurship.

Therefore, manufacturing through 3D printing technology can enable various opportunities for entrepreneurs within the manufacturing value chain.[25] For example, 3D technology can be used to manufacture assistive tools for people living with disabilities. These can be mobility aids such as canes, crutches, prosthetic devices, orthotic devices, hearing aids, and cognitive aids. Some replacement parts of wheelchairs, scooters, and walkers can be 3D printed as well. Therefore, APET believes African countries can leverage 3D printing technology to address various socio-economic challenges.

In addition, digital technologies can also be incorporated into 3D printed technology to facilitate reminiscence-related activities for persons with memory loss (PWMLs). This can help people with memory loss and limited attention challenges. Furthermore, 3D printing technology can enable the availability of computer hardware for digital technologies such as voice recognition, screen readers, and screen enlargement applications. This can assist people living with mobility and sensory impairments. However, most of these devices are currently being imported from outside the African continent and turn to be expensive for ordinary Africans. Therefore, 3D printing can enhance cost-effectiveness and accessibility to these various technologies that are currently being impeded by limited manufacturing strength within African countries. Hence, APET is challenging African countries to harness 3D printing technologies to bolster their manufacturing capacities.

South Africa is progressively utilising 3D printing technology to produce prosthetic devices and limbs. For example, a South African patient recently received a 3D-printed prosthetic leg from the collaboration and workshop between The Arc (Rehabilitation Centre in Johannesburg) and the Science Park Design Department (Vaal University of Technology). To increase compatibility, the 3D-printed socket component was manufactured from carbon for his below-the-knee amputation.[26] However, more upscaling of this technology within South Africa should be initiated to enhance the adoption of the technology. In contrast to 3D printing, manufacturing prosthetics' traditional moulding and casting methodology remains labour-intensive, expensive, and time-consuming. However, the cost of 3D printing is low and affordable.

In The Gambia, young entrepreneurs such as the Make 3D company are utilising 3-D printing to manufacture devices and equipment for healthcare, education, and soap-making purposes.[27] 3D printing makes assistive tools and other forms of 3D printed materials more accessible and cheaper for the Gambian population. For example, Make 3D company is 3D printing cheap and customised prosthetic limbs for people living with disabilities in the Gambia. In addition, Make 3D is also producing spare parts for assistive tools.

The Ministry of Science and Technology in Nigeria, with developmental partners in Israel, has established an innovation start-up hub (Innov8 Hub) to strengthen the capacity of Nigerian innovators, inventors, and researchers.[28] Innov8 Hub is incubating 3D printing technology to manufacture assistive tools as part of its innovation ecosystem.

APET observes that 3D printing can also significantly reduce car parts manufacturing costs. For example, in international car parts manufacturing, for several years now, Volkswagen Auto Europa has been 3D printing custom tools using Ultimaker 3D printers.[29] The technology is enabling the company to generate lightweight jigs and fixtures. These lightweight jigs and fixtures are designed for better functional and comfort design (ergonomics) and improved performance.

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Remarkably, the in-house 3D printing enables Volkswagen Auto Europa to reduce production costs by more than 90% compared to sourcing these tools externally.

There is a rich landscape for 3D printing manufacturing in Africa as Africa's manufacturing sector needs improvement and capacity strengthening.[30] Therefore, APET advises African countries to prioritise 3D printing technologies to accelerate the AU Agenda 2063 through STI. African governments and the private sector should explore 3D printing technologies for automotive, aerospace, healthcare, electronics, manufacturing, education, tooling, food, and construction. This can significantly transform the various socio-economic sectors and bolster industrial production and manufacturing industries. Thus, African countries should invest in infrastructure, educated personnel and industry professionals, and research, development, and innovation institutions to enhance the growth rate of 3D printing technology.

Link: https://www.nepad.org/blog/call-writers-utilisation-of-3d-printing-technology-strengthening-capacity-of-africas

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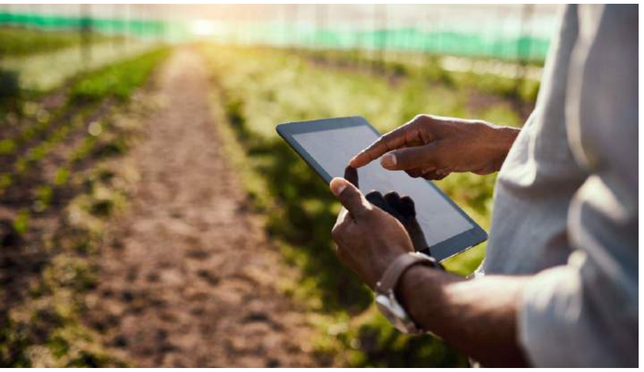

Expanding Agricultural Extension Services for Capacity Strengthening of Africa's Small-Scale and Subsistence Farmers using Technology

Hunger and malnutrition remain major obstacles to socio-economic development and growth for many African countries. Even though Africa has about 60% of the world's available arable land suitable for agriculture, food production has remained limited, barely feeding the African population adequately.[1],[2] The African Union's Agenda 2063 and the United Nation's Sustainable Development Goals (SDGs) are socio-economic developmental frameworks aspiring to address the hunger and malnutrition challenges through sustainable agriculture. This can ensure that all African people, particularly children, have adequate and nutritious food throughout the year and even export some of the food.

African countries have noted that sustainable agriculture can be accomplished by strengthening small-scale farmers to produce crops and vegetables for the African continent maximally. This can be realised by providing and enabling equal access to arable land, technology, capacity strengthening through extension services, and access to the markets.[3] Thus, African countries are progressively eradicating food insecurity as supported by the African Union Summit Decision on Accelerated Agricultural Growth and Transformation Framework.

Food insecurity in most African countries is caused by limited-to-weak agricultural systems and delivery services, the unpredictability of optimal farming schedules due to climate change, limited capacity for irrigation systems and overreliance on rains, growing wars, and conflicts.[4] Currently, African countries are only producing 10% of the world's food output and this causes most African countries to rely on food importation so as to boost their food security. [5] Fundamentally, agricultural activities in Africa have been collapsing since the attainment of independence of most countries, as characterised by the limited growth in agricultural production per capita observed from the early 1960s to the 1970s (Figure 1).[6] This declining agricultural trend contrasts with the food production growth observed in other developing regions and impedes the aspirations of most African countries' efforts toward ensuring food security.

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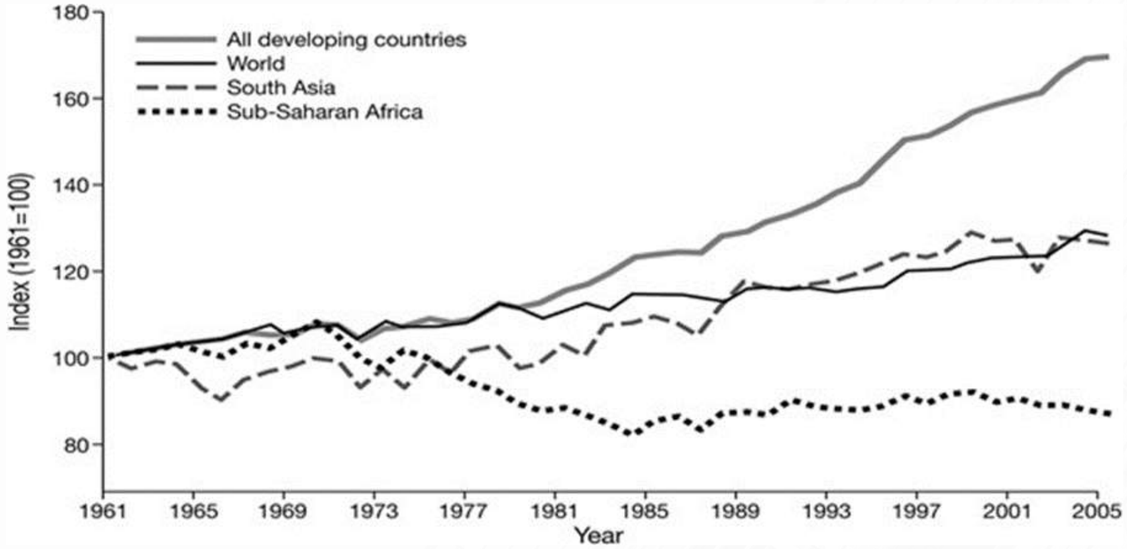

Figure 1. World agricultural production per capita 1961–2005 (index 1961 = 100) (Hazell & Wood, 2008) [7]

Since 30% of the African population remains food insecure, several African governments have been encouraging enhanced subsistence and small-scale farming activities within their countries.[8] Currently, poor households are accessing their food from the market, food generated from subsistence farming, and allocations from public programmes or other households. This contrasts with the expected trends of generating their own food. Despite this, most households and communities increasingly rely on market purchases, up to approximately 90% of their food supplies.[9] Unfortunately, food expenditures account for between 60–80% of their total household income, particularly for low-income households across various African regions.[10] Thus, strengthening the capacity of subsistence and smallholder agriculture can significantly benefit and enhance food security, improve livelihoods, and mitigate the high food price inflations. In addition, the increased productivity of subsistence and smallholder agriculture can ensure long-term food security for the African countries.

Even though most subsistence and small-scale farmers are well trained and knowledgeable after generations of subsistence and small-scale farming, there is still a need for more capacity strengthening to improve their farming capabilities, skills, and sustainability. Farmers can develop crop rotation, rotational grazing, and soil health monitoring methods. These methods can be incorporated into subsistence and small-scale farming to enhance their farming yield in the long term. Nevertheless, to fully accomplish these capacities, farmers should be able to monitor and manage their crops and animals more effectively. This way, they can transform their subsistence and small-scale farming into sustainable job creation and lucrative enterprises.

To monitor these methods, the African Union High-Level Panel on Emerging Technologies (APET) advises that African farmers should employ technologies to transform desecrated natural resources, improve their harvests, and address deforestation and human-wildlife conflicts.

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Thus, access to technologies can enable capacity strengthening to develop climate-smart farming and improve access to drought-resistant crop varieties. This can also enable small-scale and subsistence farmers to manage their farming activities and improve crop yields with well-managed land and water resources. These technologies can also link farmers to markets for their goods to ensure profitability and protection of the natural environment.

Agricultural extension services are usually employed to strengthen Africa's farmers' capacity. These agricultural extension programmes are being implemented across the African continent. Throughout the 20th century, agricultural extension services were primarily implemented by government researchers. This was normally undertaken whenever newly published research was supposed to be disseminated to the masses. In some cases, extension services workers were hired specifically to disseminate agro-information on best practices, research, and technology transfer through a public sector-driven model.[11] However, public sector spending on agriculture has varied widely across the different African regions. In most African regions, limited spending on agriculture impeded the availability of agricultural extension services programmes.

Tanzania has been tackling food insecurity by employing the country's agricultural extension systems. These extension services enable the Tanzanian government to revamp and reform their small-scale farming activities. The country has a population of 55.9 million people, and 25% of the country's gross domestic product is generated from agriculture.[12] Regrettably, 15% of rural households have food insecurities, and the risk of food insecurity threatens an additional 15%. Tanzanian regions such as Dodoma, Tabora, Singida, Mwanza, Kagera, and Manyara observe prevalent food insecurities in 55% of the households and 27% vulnerable to food insecurity.[13] Therefore, improving farming activities within these regions of Tanzania has become a priority for the government. In particular, extension service programmes have been key in bolstering farming productivity and food security.[14]

Historically, agricultural extension programmes enable Tanzanian farmers to access agricultural information to improve their farming capacities. However, these extension services are primarily conducted through face-to-face communication to disseminate information on various farming methodologies and technologies. Through informal education such as rural adult learning, extension programmes assist farmers in developing technical and managerial skills in agricultural-dependent economies such as Tanzania.

Yet, despite the importance of agriculture extension services in Tanzania, the current system of extension services offers limited assistance to farmers because of limited access to these services. This is because a limited number of farmers have direct contact with agricultural field workers due to their dispersed nature and the limited number of extension service providers. For example, one extension field worker is responsible for approximately two villages, which may sometimes translate into approximately 1000 subsistence and small-scale farmers. Consequently, accessibility and the capacity to reach all these farmers become difficult and nearly impossible.

A case in point is a Tanzanian region known as Morogoro which is remote but one of Tanzania's most fertile arable lands.[15] The farming activities in the region result in commercial crops such as sunflower, coconut, sugarcane, sisal, rice, maise, sorghum, cassava, and millet. However, since this region is remote, the farmers are limitedly experiencing timely and effective agricultural extension services. Consequently, this is limiting access to crucial agricultural information that will help farmers of this region improve their farming yields.

In addition, most extension services workers complain about their poor working conditions, such as limited travelling funds and transportation. In some cases, the extension services providers utilise bicycles as modes of transportation to reach hard-to-reach and remote farmers. Such challenging conditions for workers in the extension services programmes lead to the staff profile being male-dominated, without needed gender balance. Unfortunately, this also results in prioritising male farmers over female farmers during engagements as gender representation in capacity building is equally important. Consequently, this ends up impeding female farmers from accessing the extension services offered by their governments, in addition to competing and bureaucratic demands.[16]

APET believes that timely access to essential agricultural information necessitates an effective link between agricultural information sources and farmers. Thus, the employment of various communication technologies is encouraged. Radios and television are the preferred communication technologies as they are readily available and less expensive. This can help African countries better disseminate agricultural extension information to farmers, even in remote areas.

To address its challenges to agricultural extension services access, the Tanzanian government disseminates agriculture extension services through radio and television. By utilising radio and television, Morogoro farmers are accessing agricultural information without the physical presence of the extension workers. Thus, farmers can access information about rain patterns, markets, and pests control information in a timely manner.[17]

The advent of smartphones in Tanzania has also enabled more accessible agricultural extension services for Tanzanian farmers. For example, farmers in the Kilosa District of Tanzania leverage smartphone applications to access timely agricultural extension services and information.[18] Since 2015, in Kilosa District, farmers have been utilising a smartphone application known as Ushaurikilimo. Ushaurikilimo provides agricultural advisory and extension services. The system integrates the farmers' advisory information system and a web-based farmers' advisory system (W-FAIS) through a website or smartphone application.[19] This allows farmers access to information on the best practices on agronomic and post-harvest methodologies for crops, livestock and husbandry operations, veterinary services, and access to community and national markets.

APET notes that the successful government-led extension programmes have had to adapt and, in some way, alter their approach so as to embrace new technologies. For example, the Moroccan government introduced the Green Morocco Plan (Plan Maroc Vert) in 2008 as a multifaceted policy package to encourage significant changes across the country's agricultural sector.[20] As a result, this policy package changed the country's extension services from focusing mainly on production techniques, plant health management, and quality control into a more comprehensive approach. The comprehensive reforms propagated by the Green Morocco Plan integrated other aspects such as professional organisation of farmers, economic and project management, information on state aid and incentives, labelling, branding, marketing, packaging, and food processing.

Furthermore, in partnership with developmental partners, the Moroccan government has facilitated the adaptation of digital technologies to disseminate extension information on agriculture to Moroccan farmers. For example, in 2012, IBM collaborated with the Ministry of Agriculture to exploit a cloud-based system that experts and institutions could utilise to disseminate knowledge and enable experience sharing with local farmers.[21] This platform could also be utilised for training purposes and managing outreach programmes and efforts. This platform also allows various Moroccan government agencies to share information about farming activities.

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Then again, this approach is particularly suitable for Morocco because of its well-managed internet services and access to smartphones. This access also enables small-scale farmers to deal directly with wholesalers and large-scale intermediaries to make the agricultural value chain more efficient. APET notes that this may not be the same for other African countries with limited internet infrastructure. Thus, using traditional technologies such as radio and television becomes useful in such instances.

The Ethiopian Ministry of Agriculture and its Agricultural Transformation Agency (ATA) have also established several initiatives to enhance their farmers' productivity and capacity.[22] This is specially targeted toward the country's priority crops promoting traditional extension service methods such as in-person and smart technology-based training. For example, in 2014, the ATA introduced a hotline that enabled farmers to seek agricultural advice and crop-specific tutorials.[23] This free and voice-based hotline is improving agricultural literacy rates across the country. Furthermore, reports have demonstrated that this service has been well accepted, with approximately one million registered callers during the first year of operation.

Historically, the technology and skills transfer programmes steered by Africa's private sector have primarily focused on export-oriented industries such as sugar, coffee, and tea. Yet, within the non-exported crops, the skills-transfer programmes have been lacklustre and, in some cases, absent.[24] Nonetheless, this is beginning to change as some countries such as Kenya are deliberately and comprehensively strengthening their extension services. Fundamentally, Kenya's private sector is simultaneously strengthening the capacity of its food manufacturing and technology activities. For instance, Kenya's manufacturing enables its farmers to acquire and establish sustainable market linkages.[25] Thus, the country's technological expansion within the country is enabling innovative extension services.

Kenya's dairy giant, Brookside, is amplifying its agricultural extension services. The company has a 44% market share in Kenya's dairy market and currently expanding its export markets throughout East Africa and progressively within the Middle East.[26] To meet these demands, the company relies on approximately 160 thousand small-scale farmers for its milk supply.[27] These small-scale milk suppliers continue to grow due to the company's aggressive outreach programmes with a guaranteed and consistent market for small-scale milk producers. Then again, since the milk product has a short shelf life, the company's extension services are strengthening the capacity of local milk producers' high-quality and technology-based milk production.

Through this campaign, the Brookside company has largely succeeded in addressing inherent challenges with small-scale milk production. These include the seasonality of production, substandard provision of inputs and veterinary services, supply chain disintegration, as well as limited animal husbandry skills and knowledge. To this end, the Brookside company has developed extension services programmes to strengthen the capacity of farmers by training them through regular "field days" to acquire best husbandry practices. These training programmes are also helping farmers learn about the new developments within the dairy industry. Additionally, the Brookside company provides artificial insemination services and facilitates farmers' access to high-quality drugs and feed for their cows. The company has created a team of trained agricultural personnel to build and strengthen the capacity of Kenya's farmers. Interestingly, these extension services are offered to dairy farmers on credit and subsequently taken from their milk revenues to ascertain the sustainability of the extension services.

Furthermore, Kenya's high literacy rates, smartphone access, and the ongoing technology surge have enabled the expansion of domestic smartphone mobile applications. Smartphone applications focusing on agricultural applications have expanded the country's agricultural outputs.

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For example, an application known as "iCow" targets dairy farmers and utilises the internet through short-message services (SMS) and voice-based applications to afford many valuable extension services to farmers. These extension services include tips about breeding and ideas and recommendations on animal nutrition.

The iCow application is also linking farmers to veterinary and artificial insemination services. Most importantly, the iCow application essentially allows farmers to generate a detailed and customised profile for each of their cows.[28] This presents features such as custom-tailored gestation and immunisation scheduling charts to monitor their cows' health, growth, and productivity. Notably, this service costs farmers only three Kenyan shillings (KES) per text (US$0.03). Furthermore, the usage of this application is enthusiastically growing as the subscription base is clearly indicating that the farmers are finding this application valuable. As a result, Kenya's dairy production is becoming more efficient, realising market liberalisation and considerably bolstering domestic milk production for domestic and export dairy demands.[29]

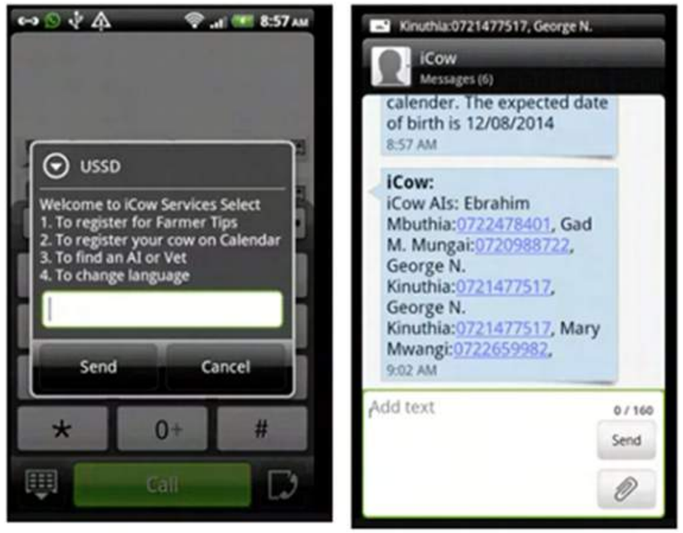

Figure 2: A screenshot of the iCoW app and agricultural extension tools available to Kenyan Farmers

In conclusion, APET is encouraging African governments to actively offer agricultural extension services to their farmers using various technologies. But this can be accomplished by pursuing active investments, public-private partnerships, and the rollout of extension services using affordable technology. APET believes that this can make the provision of extension services easily accessible and subsequently increase private sector participation and interest. On the other hand, APET is also encouraging African farmers and entrepreneurs to harness and exploit the extension services-enabling technologies to improve their decision-making and skills in agricultural production and strengthen post-harvest practices. By so doing, subsistence and small-scale farming can improve in Africa and strengthen nutritional food security in alignment with AU's Agenda 2063 aspirations.

Link: https://www.nepad.org/blog/expanding-agricultural-extension-services-capacity-strengthening-of-africas-small-scale-and

Blog #13 Published on Jul 1, 2022

Leveraging Digital Health Technologies to Strengthen the Fight against Tuberculosis (TB) in Malawi

Tuberculosis (TB) is the world's ninth leading cause of mortality. This disease is one of the top causes of death in Africa and surpasses human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS). Notably, the African continent has reported that TB has infected more than a quarter of all TB fatalities across the world. Furthermore, the upsurge of multidrug-resistant tuberculosis (MDR-TB) has posed a severe health hazard.[1] Thus, putting the advances that have been made against TB at significant risk. Regrettably, Africa has 16 of the world's 30 countries experiencing the highest TB burden.[2]

To address these TB-related infection challenges, the Heads of States and Governments of African countries established the Catalytic Framework to combat and eradicate TB infection cases and deaths in Africa by 2030. Besides the Catalytic Framework to eliminate TB, Malaria, and HIV/AIDS by 2030, the African Union Agenda 2063 and the United Nation's Sustainable Development Goals (SDGs) are also providing strategic methodologies to hasten efforts toward eradicating TB and enhance healthcare systems.[3]

Furthermore, the Southern Africa Tuberculosis and Health Systems Support (SATBHSS) regional project was launched in 2016 so to strengthen the response of the healthcare sector to TB and occupational lung diseases.[4] This project is being implemented in four (4) Southern African Development Community (SADC) Member States, namely, Lesotho, Malawi, Mozambique, and Zambia. The African Union Development Agency – NEPAD (AUDA-NEPAD) and East, Central and Southern Africa Health Community (ECSA-HC) are collaborating to offer technical support in the project implementation of the participating SADC countries.[5] Among other outputs, this project improved the coverage and quality of TB control and occupational lung disease services, strengthened the regional capacity to manage the burden of TB and occupational lung diseases, and strengthened the country-level and cross-border preparedness and response to disease outbreaks.

However, despite these efforts, several African countries have fallen short of accomplishing these goals of ending the TB infections as aspired in these frameworks. Notably, poverty, inequality, and limited healthcare infrastructure have inhibited the capacity of many African countries to attain universal health coverage. Some African countries have even failed to respond to communicable diseases such as TB effectively.

Notably, TB has remained a major public health challenge for African countries such as Malawi. The World Health Organisation reported that in 2020, Malawi recorded approximately 27 000 TB cases, and 4200 of those cases were children.[6] Furthermore, the TB-related mortality death rate was approximately 1400 during the same period.

Additionally, TB infections and deaths have been recorded among people infected with HIV/AIDS. For example, the TB infection rate has been reportedly 6 in every 10 people with people infected with HIV. Thus, TB is one of the priority diseases within Malawi's Essential Health Package (EHP).[7]

The prevention and treatment of TB in Malawi, like in many other African countries, have continued to confront some challenges. These challenges include the late diagnosis of potential TB patients, limited patient adherence to daily TB medication because of the pill burden, and complex delivery modes of medication. Additionally, there are challenges of inadequate financing and prolonged travel time to healthcare facilities, especially in rural Africa. In Malawi, the latter challenge is compounded by the over 50% population that resides outside the recommended 5 km perimeter from nearby healthcare facilities.[8]

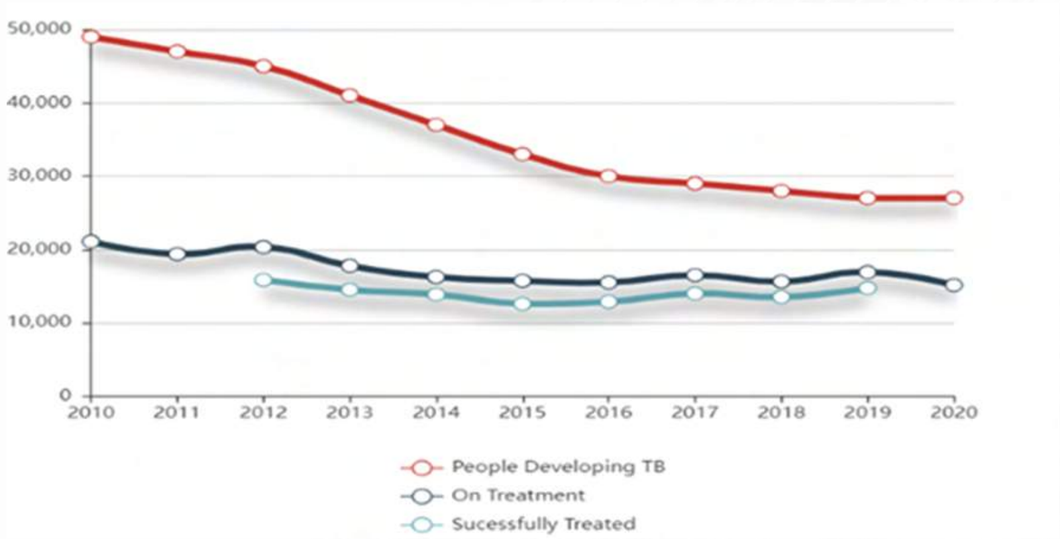

Figure 1. The number of people developing TB on treatment and successfully treated in Malawi between 2010 – 2020.
SOURCE: https://www.stoptb.org/static_pages/MWI_Dashboard.html.

Presently, the TB treatment regimens and strategies such as in-person directly observed therapy have been progressively declining the TB infection rates per year (Figure 1). However, this approach has been described as costly and logistically challenging to administer. This is because the TB programme staff should physically observe the patients to ensure that they ingest the medication in locations that are convenient to the patients.[9] Furthermore, to strengthen the appropriate management of TB, there should be a systematic screening of TB patients among high-risk groups such as older people and those previously treated for TB. However, approximately 29% of new TB cases are unidentifiable, and in some cases, healthcare centres fail to notify the patients officially.[10] This is partly due to the failure of Malawi's healthcare system to actively diagnose TB patients because of the remoteness and inadequate healthcare centres. However, even though most TB deaths are preventable, if detected and treated at an early stage, TB still causes significant deaths in Malawi, as well as in other African countries.[11]

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To accomplish better management systems for TB, the African Union High-Level Panel on Emerging Technologies (APET) is challenging African countries to consider digital health technologies for the care and control of TB. Digital health technologies can be utilised to promote patient healthcare and enable electronic directly observed therapy (eDOT).[12] This can focus primarily on TB screening, diagnosis, and treatment adherence. Primarily, the eDOT focuses on administering, managing, and supporting TB patients to enhance adherence and ensure regular intake of TB medicines. This can also help manage patients in their homes instead of frequent clinic visits.[13]

There has been limited evidence that digital health technologies can enhance TB care. However, more studies of better quality should be undertaken to determine how these technologies can enhance the TB care programme performance.[14] However, APET believes that given the circumstances and challenges of the African continent, digital technologies can be utilised to support TB treatment adherence and treatment protocols. This is because digital technologies are changing healthcare delivery globally, as witnessed by the dramatic growth in such areas as electronic health records, telehealth for “virtual” patient encounters, and teleradiology for remote interpretation of imaging studies.

Digital health technologies can be utilised for surveillance and monitoring to enable health information system management.[15] These systems can be utilised to assess and evaluate the burden of TB disease and death and further monitor drug resistance. It is also important to enhance the TB drugs management programme to enable drug stock management systems, standards development, and training programmes. Most importantly, digital health technologies can enable e-learning using digital media and devices to enhance access to guidance, consultation, and interaction.[16]

APET is recommending that African countries such as Malawi should augment existing treatment regimes with digital health technologies such as short message services (SMS) and smartphone applications to accomplish better TB management systems. Smartphone applications can best manage infectious disease management irrespective of geographical barriers.[17] For example, the National TB Control Programme in Malawi, in collaboration with international partners, after noticing the limited adherence of TB patients to medication which had resulted in significant relapses, developed the Frontline SMS:Medic as a medicine reminder application. This application was developed to enhance adherence to medication in TB patients.

As a case in point, the Namitete Hospital undertook the piloting phase of the Frontline SMS:Medic project in 2009. Within the first five (5) months of its operation, the Frontline SMS:Medic campaign demonstrated significant impact as it enabled hospitals to double their treatment and management capacity of patients.[18] Furthermore, the Frontline SMS:Medic also enabled hospitals to prescribe medication and dosage use. This system enabled the auxiliary health workers to “google” the drug names. In response, the application can automatically respond with information on the dosages and usage of TB drugs. Consequently, this enables healthcare workers to provide and obtain patient status updates. Furthermore, healthcare workers can make follow-up calls for further medical consultations and treatment.[19]

Predominantly, Malawi utilises paper-based medical record-keeping, which has been observed to inhibit easier access to patient records and tracking. In 2001, the Malawian Government introduced the electronic medical record system (EMRS).[20] Consequently, the EMRS addresses the frequent data losses. This is because a majority of patients' hard copy booklets containing their health history can easily be lost through wear and tear.

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Fundamentally, the EMRS system improved patient management protocols, enhanced the integration of TB and HIV healthcare services, and enriched healthcare decision-making.

Furthermore, the EMRS platform was expanded from servicing 19 healthcare facilities in 2012 to 50 healthcare facilities across Malawi in 2021.[21] Notably, as the EMRS is expanding across the country, the system's capabilities are also evolving in response to the progressively growing national information demands. The EMRS platform has incorporated malaria and diabetes records, among other ailments.

In following the progressive successes that have been observed in Malawi, APET recognises that the African continent can significantly benefit from adopting digital health technologies to monitor and manage their TB patients. However, to expand the impact and expedite the adoption of these digital health technologies, APET is challenging African countries to enhance investments in digital health technology-related infrastructure. APET appreciates that African countries are steadily and progressively developing effective TB prevention and treatment techniques, as exhibited by the considerable decline in TB infection and death cases across the African continent. However, the effects are currently not widespread. Thus, APET suggests that to complement the progressive successes, African countries should adopt digital health technologies. Thus, if these technologies can be adopted in their entirety, African countries can effectively eliminate TB cases in a coordinated manner.

Link: https://www.nepad.org/blog/leveraging-digital-health-technologies-strengthen-fight-against-tuberculosis-tb-malawi

Blog #14 Published on Jul 12, 2022

Enhancing Digital Agriculture to Strengthen Entrepreneurial Opportunities for Kenyan Youth

Kenya's agricultural activities account for approximately 33% of the country's gross domestic product and are responsible for approximately 40% of the total employment rate. Approximately 70% of Kenya's rural population works in agriculture. Thus, the agricultural industry generates about 65% of Kenya's export earnings.[1] Worth noting that agriculture is also driving Kenya's manufacturing sector and stimulating other socio-economic activities such as construction, transportation, tourism, and education.
Kenya's agriculture sector's importance is underpinned by the Kenyan Agricultural Policy, promoting enhanced agricultural production and income growth, particularly for smallholder farmers. As a result, this is accomplishing enhanced food security and equity, emphasising irrigation to introduce stability in agricultural output, commercialisation, and intensification of production. This policy also strengthens small-scale farming in Kenya with the appropriate and participatory policy formulation and environmental sustainability.[2] In addition, the Kenya Vision 2030 policy identifies agriculture as a key sector through which annual economic growth rates of 10% can be accomplished.[3]

Notably, most of Kenya's employment is generated through the agricultural value chain. This includes crop harvesting, food preparation and processing, and subsequently selling commodities in local markets and international exports. However, the labour engagements within Kenya have been diminishing in the country's agricultural operations. For example, Kenya's agricultural work had declined to 53.8% of overall employment in Kenya in 2020, as compared to 60.3% in 2010.[4]

The United Nations Development Programme reported that Kenya had enormous unemployment predicaments, especially among the youth.[5] Fundamentally, youth unemployment is significantly higher than adult unemployment and is especially prevalent in cities, particularly among females.[6] For example, Kenya's youth unemployment rate is 65% between the ages of 15 and 35 years, resulting in three (3) out of every five (5) jobless.[7] This is significantly crippling the already weak economy, causing political instability and widespread socio-economic disparities.[8]

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However, Kenya's agricultural sector has been identified as an economic sector that can address Kenya's unemployment, more especially among the youth, if it could be digitalised and automated. In this way, it has been estimated that the approximately 800,000 youth entering the workforce each year could benefit from an augmented agricultural value chain. This can be accomplished if Kenya's infrastructural, social, and cultural challenges are adequately addressed. For instance, the Kenyan people, especially women, can own land, have irrigation infrastructure, and increase market access. Fundamentally, this provision can encourage the participation of Kenyan youth in agriculture.[9]

Increasing youth participation in agriculture should involve making agriculture more attractive and appealing to the youth. This can be accomplished through a well-managed agro-business value chain and changing the cultural innuendos discouraging youth's interest in agriculture. For example, Kenyan learners receive corporeal punishment related to school agricultural activities—consequently, this brands and markets agriculture as a punishment instead of a profitable business venture.[10] Instead, farming should be exhibited and branded as a professional and profitable business enterprise for the youth. This will encourage their participation and inspire interest in agricultural activities.

The African Union High-Level Panel on Emerging Technology (APET) notes that Kenya's agricultural sector can potentially expand food production, address unemployment challenges, and advance the development of emerging technologies. Furthermore, APET believes that the country's agricultural value chain can be enhanced by investing in digital agricultural technologies and enabling policy frameworks to attract the technology-savvy youth into agri-business. Fundamentally, this can increase the country's production through digital consulting and financial services, food processing, marketing, and distribution. The digital-enabled farming can enable and offer better decision-making mechanisms, bolster food production, and improve agricultural entrepreneurs' job creation and employment levels.[11] As such, digital farming technologies can also improve access to farming information, inputs, market, finance, and training.

APET believes that the youth can expand their farming activities through digital technologies to expand their marketing capacity and manage their credit history to enable access to financial and loan instruments from their local financial institutions. Therefore, there is a need to invest in agricultural technology and innovation to amplify this sector with opportunities to enhance job creation and repair food systems. It has been reported access to funding, training through extension services, and agricultural technology to support youth can encourage their participation in agriculture-related pursuits. However, Kenya and other African countries should enhance funding mechanisms and access to training to address the agricultural technology impediments.[12]

APET recognises that the youth can be engaged in agriculture through technological innovation, government support for young farmers, and youth-inclusive agricultural policy implementation. This can help address the barriers to youth engagement in agriculture, such as the limited access to land, technology, and training because of inadequate or non-existent extension services. Smallholder farmers can improve their farming technology literacy, increase access to information, and enhance affordability to embrace technological innovation. In addition, African farmers can have adequate access to information about adverse weather conditions, insects, pests, and diseases to effectively improve their farming efficiency and production.

Notably, the coronavirus outbreak in 2020 has negatively impacted agricultural-related business activities.[13] Therefore, improving the financial capital to grow agricultural businesses can provide financial capital, capacity building, and access to land to enhance the youths' interest in agriculture.[14]

Furthermore, access to technology and innovation can alter and transform the perception and mindset of youth about the agricultural sector. The limited adoption of technology is also observed among young farmers as characterised by their predominant utilisation of short messaging service (SMS) technology.[15] To address the limited adoption of emerging technologies among young farmers, capacity strengthening through adequate training programmes should focus on introducing farmers to agricultural technology applications and innovation to enhance their yields, production, and income. Hence, an emphasis on the application of technology can inspire farmers to adopt emerging technologies in their farming activities. Thus, addressing access to capital, regulatory, and policy environments can persuade agricultural businesses and youth technology developers to exploit and expand innovative solutions for the agriculture sector.[16]

Commonly, rural smallholder farmers have limited access to smartphones and internet access. Thus, APET suggests availing weekly SMS on available market prices and best input bargains to farmers.[17] Furthermore, African countries, institutions, and the private sector can also develop well-managed training and mentoring programmes for young farmers. These training and mentorship programmes can incorporate exchange programmes and internships. This can encourage mentoring programmes with agriculture and business start-up experience mentors to strengthen well-structured and youth-based agricultural programmes. Furthermore, the training should collect in-depth data and promote localised and evidence-based innovation. This can create agriculture technology solutions and enable prototyping of these technology and innovation solutions before their full adoption.

APET observes that although agriculture contributes significantly to the Gross Domestic Product (GDP) of many African economies and employs more than half of the rural population, the sector remains unappealing to Africa's youth.[18] Many young Africans consider agriculture a futile venture, socially immobile and technologically unremarkable due to the limited agricultural land, loan instruments, and innovations. Thus, African governments should design and establish capital grants, financial assistance, and patronages for the youth interested in agriculture.[19] Such instruments can render agriculture more feasible and sustainable for the youth. Furthermore, African countries should address the agricultural-related challenges such as poor governance and limited investment instruments.[20] This can be accomplished by increasing access to fertilisers, availing superior seed varieties, enhancing farming mechanisation, and addressing weather unpredictability due to climate change, among others.

The approximately 90% smartphone penetration in Kenya[21] provides an opportunity for agricultural technologies to bolster their inclusive agricultural growth, nutrition, and food security.[22] For instance, Kenya is utilising digital technologies to enhance the country's precision agriculture to afford agri-businesses profitability, efficiency, safety, and environmental friendliness. The Internet of Things (IoT) ecosystem, encompassing sensors, connectivity, data analytics, workflow automation platforms, and applications, offers significant technological solutions to the country's agricultural activities.[23]

The IoT technology is potentially augmenting agricultural productivity to meet food demand. Smart agriculture will utilise IoT-based technologies, and solutions are potentially augmenting agricultural operational competence, maximising yields, and minimising food wastage.[24] This enables real-time field data collection, data analysis, and implementation of control mechanisms. For example, Twiga's Takuwa farms in Kenya are utilising Liquid Intelligent Technologies to deploy precision agricultural IoT systems to enhance farming outputs and production.[25] The IoT technology system incorporates four agriculture sensors to provide a comprehensive and functional weather station, soil moisture and temperature probes, borehole water meters, and sensors for assessing irrigation water acidity and salinity. This system exploits Liquid Intelligent Technologies' extensively low-powered and wide-area IoT network using 0G Sigfox technology.[26] This IoT technology system covers 85% of Kenya's population cost-effectively.[27]

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APET notes that IoT technology provides essential data to enable the Twiga agronomy team to assess and evaluate their farm's temperature, humidity, rainfall, and wind speed in real-time. Such essential data benefits the farm managers with accurate farming decision-making and management mechanisms to effectively determine their irrigation protocols and application of pesticides.[28] Furthermore, the water quality sensors provide the farm managers with specific metrics to help optimise their irrigation and fertiliser applications. In addition, the installed soil probes can measure the moisture levels and temperature at various depth levels in the soil. This is also affording farmers with precise soil quality and moisture levels to determine the necessary irrigation requirements at the roots of crops. Consequently, this IoTs technology has significantly improved Takuwa farming methods and has enhanced their crop yields for Twiga Foods.[29]

Precision agriculture allows for soil remediation to be minimal, cost-effective, and targeted, or even to treat individual plants differently. Notably, IoT-based soil monitoring systems can help farmers monitor soil quality in order to prevent degradation, control erosion, compaction, salinisation, acidification, and contamination. As a result, crop yields may increase significantly and food security may improve. This also implies that farmers can now use precision irrigation, fertiliser application, and pesticide spraying. Furthermore, IoT technologies enable precision livestock farming by utilising real-time monitoring of production, as well as livestock healthcare and welfare to optimise yield. For example, in Western Kenya and Nyanza, an IoT network has been set up to monitor freshwater fish populations. This has been done in collaboration with Kisumu's Lakehub Innovation and various local fish producers.[30] Various sensors have been deployed to monitor fishponds' water temperature and pH levels, improving fishery production outputs.

APET observes that farming is progressively changing, and the incremental use of technology provides agricultural advantages to improve productivity and reduce the utilisation of water, fertiliser, and pesticides. Subsequently, this reduces food prices and encourages sustainable natural ecosystem conservation. [31] Adopting technologies is also making the agricultural sector more attractive to the youth. This is consequently improving sustainable job creation and employment opportunities.

Therefore, APET is challenging African countries to improve their policy implementation programmes by rolling out youth-friendly technologies for agricultural activities. For example, the Kenyan government has developed several policy frameworks to brand agriculture more attractive to enhance youth employment in agriculture. As such, the Agricultural Sector Transformation and Growth Strategy (2019–2029), the Kenya Youth Agribusiness Strategy (2018–2022), the Kenya Vision 2030, Medium Term Plan III, and the President's Big Four Agenda are some of the policy frameworks that have encouraged Kenyan youth participation in agriculture.[32] This was mainly focused on bolstering Small-to-Medium Enterprises and digital technologies. This is positively influencing the agricultural production in Kenya farming and encouraging the participation of the youth in agriculture.[33] Thus, other African countries could develop their own policy frameworks and implement them to improve agricultural outputs.

Finally, APET also notes that just like other African countries, Kenya ascribes to the United Nation's Sustainable Development Goals, African Union Agenda 2063, and the Comprehensive Africa Agriculture Development Programme, focused on enhancing agricultural value chain opportunities and strengthening food security. Thus, APET believes that by adopting and implementing these continental policy frameworks, African countries can exploit their youthful, innovative, and creative population to enhance food security and job creation.

Link: https://www.nepad.org/blog/enhancing-digital-agriculture-strengthen-entrepreneurial-opportunities-kenyan-youth

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Exploring Blockchain-Enabled Technologies to Strengthen Africa's Continental-Wide Trade Systems

The African Union's 18th Ordinary Session of the Assembly of Heads of States and Governments (January 2012) adopted the establishment of the African Continental Free Trade Area (AfCFTA). In addition, the summit endorsed the Action Plan on Boosting Intra-Africa Trade (BIAT), aimed at improving trade policy, trade facilitation, productive capacity, trade-related infrastructure, trade finance, trade information, and factor market integration.[1] Primarily, these frameworks bolster intra-African trade by enhancing extensive and mutually advantageous trading possibilities for exporters and importers within and between African Union Member States. This is anticipated to increase and expand Africa's intra-continental trade and partnerships.

AfCFTA seeks to connect approximately 1.3 billion people across 55 African countries with a combined gross domestic product (GDP) valued at approximately US$3.4 trillion.[2] This agreement covers the trade of goods, services, investments, intellectual property rights, and competition policy among African countries.[3] Therefore, AfCFTA presents a significant potential for African countries to elevate approximately 30 million people from severe poverty because of access to the African markets. Furthermore, this can improve the remuneration of a further 68 million people living below $5.50 per day. Hence, it is envisaged that implementing AfCFTA is potentially transforming African markets and the continent's socio-economic development and growth. This can, in turn, boost production, manufacturing, and value addition to the continent's natural resources.

Despite the potential of the trade agreement to enhance the implementation of the African Union Agenda 2063 and Africa's industrialisation aspirations through effective exports and imports, AfCFTA faces several impediments. Unfortunately, these hurdles may derail the effective implementation of the trade agreement. For example, there is a limited infrastructural capacity to manage the trade agreement across the continent. As such, these trade ineptitudes are derailing and impeding essential components of trade such as acquiring and processing trade support documents, accessing trade information, and financing across African Union Member States.

Regional and continental integration can effectively enable Africa's digital economy expansion to improve connectivity, data accessibility, and innovation. Since African countries are historically fragmented in trade, participation, and movement, there is a need to consolidate the trade systems to improve collaboration and partnerships. Therefore, to successfully implement AfCFTA, African countries are being challenged to invest in technologies such as broadband connectivity, e-commerce, integrated payment systems, and integrated digital identity systems.[4] However, underlying technologies such as blockchain, big data, and artificial intelligence can enable these operational technologies. As such, these underlying and innovative technologies such as blockchain can significantly benefit AfCFTA by enhancing trade applications such as customs procedures, certification processes, transportation, logistical applications, and insurance management, among others.

For instance, blockchain technology can introduce distributed ledger technology (DLT) instead of relying on an inefficient paper-based management system. The DLT refers to the protocols and supporting infrastructure that enables computers in various locations to propose and validate transactions and further update records in a synchronised manner across the network.[5] Fundamentally, the DLT can enable and improve verification processes, further reducing the cost of doing business in Africa.[6] This is because the DLT system operates as a distributed database ledger that can be shared among various computer nodes. This enables the storage of electronic data in a digital format. The DLT system also contains the capacity to maintain a secure and decentralised record of transactions in an immutable digital ledger. Essentially, the DLT system can securely store information such as one cannot alter, hack, or trick the system. However, this information can be written and viewed by anybody, even though it cannot be deleted.

The African Union High-Level Panel on Emerging Technologies (APET) believes that implementing blockchain-enabled technologies can securely accelerate and improve the free trade area's administration of border procedures and national single windows. These national single windows can be utilised as a point of entry through which African traders can submit their documentation and information to complete their customs procedures. Therefore, blockchain-enabled technologies can strengthen African countries' national single windows and border procedures. In this way, African countries can utilise blockchain technologies to create efficient and transparent data management systems and secure and accurate trading data.

Furthermore, the inherent qualities and features of the DLT systems facilitate business-to-government (B2G) and government-to-government (G2G) processes at the national and regional levels.[7] Furthermore, blockchain technology is also optimising the processes of goods identification, guaranteeing secure payments and financing, enabling the verification of digital origin certifications, and allowing real-time sharing of information at different trade stages. In this case, blockchain technology is facilitating trade and enhancing safety, security, and fair revenue collection. In addition, blockchain-supported technologies are enabled by other emerging technologies such as the internet of things, data analytics, and artificial intelligence to operate effectively and efficiently.

APET proposes that African countries should digitise their trade systems to completely benefit from blockchain-enabled AfCFTA systems. Thus, adopting innovative solutions such as blockchain technology can make trading easier since all the security processes are linked to a single technological and operational system.

For instance, through the DLT systems, small-to-medium scale farmers and other upstream participants, particularly the unbanked businesses, can access funding and investment instruments to establish equitable supply chains.[8] Fundamentally, these businesses can utilise mobile banking technology supported by blockchain and artificial intelligence technology to provide digital identities. These digital identities can provide African businesses with reliable transactional histories and reduce banking risks while expanding access to finance.[9]

Therefore, APET encourages African governments to significantly invest in digital infrastructure to expand blockchain-related solutions and opportunities. APET also encourages African countries to standardise their interoperable planning of blockchain systems into current or upgraded systems. This can ensure that the emerging blockchain technologies are integrated and remain compatible with African trading and customs systems.

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African countries such as Ghana have adopted blockchain technologies to enhance their trading activities and increase operational systems' interoperability. To this end, Ghana's Central Bank has established a regulatory sandbox to enable banking institutions, businesses, and government agencies to develop and test their innovative blockchain-based solutions for merchant payments and remittances systems.[10] This platform effectively addresses the interoperability challenge of the various systems and enhances the compatibility of systems.[11] In addition, ensuring the blockchain technology's interoperability can enable adequate streamlining through standards across sectors and industries. This can also improve the capacity for businesses to utilise blockchains in a timely industry-wide standard system.

One of the solutions blockchain technology offers is addressing the challenge of land ownership and disputes. For example, more than 80% of landowners in Ghana have limited official title deeds with the Land Commission of Ghana. Most of the land is customarily held through oral agreements.[12] As a result, the Ghanaian start-up Bitland is addressing this by using blockchain technology to establish and digitalise official title deeds. This enhances the integrity of the land records to support the Land Commission of Ghana.[13] After their land has been clearly captured and registered using the DLT systems, the landowners may subsequently apply for loan and mortgage instruments with their respective banking institutions.[14]

Furthermore, the Land Layby Group, a Kenyan real estate company based in Nairobi, allows individuals to acquire property in Ghana securely.[15] This is accomplished by accurately mirroring the Government Land Registry systems in the blockchain network. As a result, the potential land purchasers can effectively review, assess and analyse the accuracy of the ownership records from the Government Land Registry systems on a tamper-proof digital form. The Land Layby Group enables the online publication of blockchain-based land records.[16] Consequently, the threat of multiple land titles for the same piece of land is eradicated and addressed. In addition, a similar business model has been launched by a Ghanaian-based start-up known as BenBen.[17]

APET notes that Africa is swiftly expanding blockchain-related technologies such as cryptocurrency markets among the developing economies.[18] As such, the utilisation of cryptocurrency in the continent has been reported to be the third fastest-growing market globally. Since this technology highlights a model that can be expanded across the continent to improve transferring of money within the AfCFTA systems, for example, M-PESA has transformed financial services by enabling the transfer of money across 30 million users across 10 African nations. For instance, Vodafone reported that M-PESA observed over 6 billion transactions, and the 51 million customers are generating over US$314 billion transactions per year through M-PESA.[19]

Digital Frontiers researchers reported that approximately 200,000 women had been lifted from the low-income and labour-intensive agricultural sector to more prosperous small businesses because of M-PESA.[20] Therefore, APET believes that incorporating systems similar to the blockchain-enabled technological systems such as M-PESA into the intra-continental trade can fast-track transactions within the trading system. Thus, blockchain enables financial inclusion and unlocking transactional participation across African regions.

Yet, to date, blockchain-enabled technologies have remained glaringly underfunded. The African continent represents less than 0.5% of global blockchain funding.[21] However, APET notes that there has been incremental funding for supporting blockchain technologies in Africa. This is demonstrated by the 1,668% increment funding from the 1st quarter of 2022 against the same period in 2021.[22] The rapid growth rate highlights African blockchain start-up enterprises' incremental venture capital funding in 2022 against 2021. For example, venture capital has shown a 149% increment, demonstrating an 11 times growth.[23]

Worth noting that African systems that are negatively impacted by the older legacy systems are struggling with red-tape inefficiencies.[24] Thus, the blockchain and cryptocurrency technologies successfully allow the legacy systems to be circumvented entirely and, in some cases, create the means to diminish the predominant frictions.[25]

Blockchain technology can also be used to address microfinancing and claim insurance providers. Farmers are losing their insurance claims because of bureaucracy in the crop insurance systems. However, blockchain technology solutions are reconciling these challenges through distributed ledgers.[26] For example, a blockchain company called Etherisc is improving crop insurance in Africa and across developing economies. In this case, the company is enabling parametric insurance implementation.[27] As such, Etherisc has successfully provided drought insurance policies to farmers in the fields of Sri Lanka, South Asia, in partnership with Oxfam and Action.[28] Therefore, similar blockchain-enabled approaches and solutions can be pursued in the African context. The Global Innovation Laboratory for Climate Finance reported that Etherisc's smart contract technology could decrease the necessary policy costs by approximately 41% and render the premiums affordable.[29] This transparent system is also markedly lessening the claim cycles to less than the usual 3 months. Further to this, this system creates transactional confidence because of the automatic claims that are paid out in alignment with the transparent terms and conditions.

APET notes that several technical challenges are impeding the widespread uptake and adoption of blockchain-related technologies across the various economic sectors, including trade. This is crucial because of the magnitude of potential continental transactions within the blockchain-enabled trade systems for African businesses. Thus, African countries should enable scalability to strengthen the transactional capacity that can be executed per time unit, as most blockchain technologies remain limited. African researchers and innovators are encouraged to improve the size limitations of individual new blocks on the chain and the redundancy of previously linked blocks that reduce the transaction processing speed.

Furthermore, African countries should address the privacy concerns associated with blockchain-generated transactions. For example, major public blockchain distributed ledgers can publicly and permanently divulge data and metadata. Several private and permissioned blockchain distributed ledgers can sometimes allow some form of privacy depending on that blockchain consortium. Unfortunately, private and permissioned blockchains may not provide adequate trust and immutability as the system relies substantially on its off-chain governance structure. Thus, both private and public blockchains should strengthen privacy based on the zero-knowledge proofs. APET believes that this is especially crucial for trading systems across African countries.

Most importantly, African countries should improve the infrastructure of the blockchain-based system. Blockchain technology currently relies on the availability of operational and dependable infrastructure, including internet connectivity. Even though some blockchain-enabled technologies may lighten this precondition, infrastructure remains crucial in blockchain technology implementation, especially in Africa.

Furthermore, blockchain technology requires technical characteristics and contextualisation in the real world. Thus, the blockchain systems should specifically have the digital representation of assets, usually referred to as an oracle problem.[30] This means the blockchain data should be digitalised to solve the context-specific traceability of assets in supply chains such as fashion, pharmaceutical drugs, and agricultural goods. In addition, the data quality should ensure data integrity, quality, and accuracy. On the other hand, to enable smart contracts, the automation of blockchain technology can allow for the code to be directly programmed on-chain in their own caveats.

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Thus, to obtain high-quality software development standards, African countries should integrate blockchain technology within existing system landscapes to enhance technical design choices and compatibility.

In conclusion, APET suggests African countries adopt blockchain technology to strengthen Africa's socio-economic activities. The successful implementation of AfCFTA will tremendously advance Africa's economic growth and render Africa a global trade leader. APET believes African countries can significantly benefit from a decentralised digital ecosystem supported by blockchain technologies.

Link: https://www.nepad.org/blog/exploring-blockchain-enabled-technologies-strengthen-africas-continental-wide-trade-systems

Blog #16 Published on Jul 22, 2022

Promoting Youth Participation in Innovative Entrepreneurship to Enable Access to Clean Water in Tanzania

It is worth noting that access to clean, affordable, and safe drinking water is a fundamental human right recognised by Goal 6 of the United Nation's Sustainable Development Goals[1] and essential to accomplishing the African Union's Agenda 2063 socio-economic development goals and aspirations.[2] Yet, approximately 783 million African people have limited access to clean and safe drinking water, a majority located in Sub-Saharan Africa.[3] It has been reported that 1 in 3 Africans is confronted with water insecurity[4] necessitating innovative solutions to deficient management of water resources and services to tackle Africa's water stress.[5]

Among the most affected African countries by water scarcity is Tanzania. Tanzania has a population of approximately 4 million people with limited access to clean and potable water. The country is one-third in arid to semi-arid conditions, making it difficult for people to access clean drinking and sanitary water. This is even more difficult for people that do not reside close to the three major lakes that border the country.[6] Furthermore, over 29 million Tanzanian people have limited access to sanitation.[7] Women and girls have to walk for long distances to obtain clean and safe drinking water. Furthermore, water-borne diseases such as malaria and cholera account for more than half of all diseases afflicting the population of Tanzania.[8]

Due to the high demand in Tanzania for clean drinking water and sanitation, there is a high market for water products such as storage tanks, pipes, and rain harvesting facilities.[9] The suppliers of these facilities appear to be optimally exploiting the growing digital finance sector to capacitate the impact of their facilities and water treatment innovations and technologies in Tanzania.[10]

The country has to its advantage youth population resources as indicated in the country's developmental blueprint, namely "National Development Vision, 2025". [11] The development plan places an emphasis on the youth's innovative potential in addressing societal issues such as the dearth of accessible clean water. Part of this effort involves constructing resilient infrastructure in which young people of the country can feel safe enough to experiment and create.

To best meet the demand for clean water, the African Union High Level Panel on Emerging Technologies (APET), in its capacity as an advisory body to African Union Member States on innovation and emerging technologies, encourages African countries like Tanzania to leverage youth entrepreneurship and innovation. APET also advises African countries to take advantage of the education-entrepreneurship nexus in order to capitalize on the creativity of Africa's youth and create the skilled human capital required to foster healthy communities and stimulate innovation.

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Engaging youth as change agents in technology and innovation can greatly promote a platform for their participation in designing sustainable and locally appropriate innovations and technologies to improve the outlook of their community.

The focus could be on creating youth-based and local solutions for water innovation and relevant, cheap, and accessible initiatives. For example, the Water Resources Integration Development Initiative (WARIDI) is building and strengthening the capacity of youth to utilise cost-effective, innovative water treatment and management technology.[12] Such technologies include smart metering and installing cheap water disinfection and filtration systems to provide clean water for local and rural communities. Local government authorities are also implementing national sanitation campaigns that are youth-based in helping the youth identify, scope, design, and implement water projects. As a result, by 2021, these interventions and initiatives improved water access and basic sanitation services for approximately one million Tanzanians.[13]

WARIDI benefited from several community-based collaborations that maximised platforms for knowledge and experience sharing, information exchange, and mutual learning, especially among the youth. Further, the Tanzanian people developed dependable and cost-effective water treatment technologies specifically tailored to the demands of resource-constrained settings.[14]

Having grown up in a remote village struggling with access to clean water, a local chemical engineer, Dr Askwar Hilonga, has developed a cheap and customisable water filtration system to provide clean water to rural Tanzania.[15] This water filtration system utilises sand filters and nanomaterials such as sodium silicate and silver to eliminate heavy metals, such as copper, fluoride, and other chemical contaminants from water. Notably, the patented filtration system enables the contaminated water to first pass through the sand and subsequently the nanomaterials to specifically target and eliminate region-specific pollutants.[16]
In some instances, the lack of accessible potable water for most of Africa's remote communities is usually a governance and management issue rather than water availability or contamination. For example, Tanzania has many non-functional clean water points challenged with mismanaged revenue collection systems. Consequently, the maintenance and upkeep of some of the country's public wells and faucets remain difficult as they require proper management with a steady source of income for maintenance purposes. For example, a functional water tap should be properly monitored to reduce possible future complications and mismanagement challenges.

To address this challenge, the Catholic Relief Services (CRS), Grundfos LIFELINK A/S, and the Diocese of Mbulu Development Department (DMDD) are collaboratively tackling Tanzania's water governance and management challenges through an innovative ATM for water solution. This ATM for water solution is a prepaid water system that self-manages the accounts of users, as well as revenue collection and water data.[17] The CRS' Revolutionizing Remittance Recovery in Water (R3W) Project in Tanzania is implementing Grundfos' AQTaps, sometimes referred to as "water ATMs".[18] These systems are for rural and peri-urban communities that Tanzanian families can utilise to access safe and clean drinking water.[19]

The AQTaps can accept smart cards, a form of mobile money, to enable the users to utilise the water dispenser. These smart cards act as reusable gift cards after reloading credit through the AQTap account from a local water vendor.[20] This account can also be recharged through a mobile money transfer system compatible with a simple mobile phone. At any time once the smart card has depleted the water credit, families can easily reload the water credit. As soon as the smart card has sufficient funds, it can be swiped at any nearby AQTap system.

Interestingly, the technology can instantaneously collect revenue and transaction data when swiping the AQTap smart card through an online database management system. The AQTap system is linked to a clean water tank that receives potable water from solar-powered boreholes that CRS funds. The water flows through the AQTap dispenser unit to pour into the user's water container. This happens after the user has swiped their smart card and chosen the amount of water they need to be dispensed. The money is collected to enable continual and timely repairs and a functional system once the CRS partnership ends. APET notes that similar digital and blockchain-enabled technologies can be developed and tailored toward the youth. Consequently, these digital applications can provide jobs and entrepreneurial opportunities for youth.

It has been identified that rural and urban residents perceive existing water services as specifically for poor societies.[21] Fortunately, the proposed prepayment and solar innovations can significantly enhance transparency, accountability, and convenience for Tanzanians. However, the perceived challenges that should be addressed with the proposed innovations should include the disenfranchisement of vulnerable populations and technical difficulties. To this end, the Government of Tanzania is proposing the implementation of prepaid water meters and solar power technologies soon.[22] Accordingly, APET notes that it remains essential to integrate user perceptions onto these technologies' suitability, viability, and scalability prior to large-scale implementation.

Between May 2016 and October 2017, the Water Mission-Tanzania (WM-T), in partnership with the World Bank, executed investigational field trials in Tanzania to explore the feasibility and sustainability of solar-powered piped water supply systems and smart water metering technologies.[23] These mechanisms can be utilised to enhance financial accountability for rural and urban water schemes. This data could also provide evidence for the potential application of smart water dispensers (SWDs) and solar pumping in both rural and urban water sectors. Harnessing this technology can encourage sustainable and affordable water delivery services in Tanzania.

The World Bank reports that stakeholders and community members in Tanzania are overwhelmingly supporting the installation of solar-powered water systems and smart water dispensers with mobile prepayment services.[24] This could potentially improve the availability of reliable and adequate water sources, reduce the queuing time, and improve the functionality of the water point.

Solar-powered water supply systems equipped with prepaid water meters can viably and systemically improve water services in Tanzania.[25] However, capacity strengthening through training and long-term support for community-led management can improve collaborations and integrate cloud-based water management systems into the larger water sector management infrastructure. This can significantly improve the consistent availability and affordability of water services and prepaid water meter technology.

APET notes that most of these projects are predominately government-led and implemented in collaboration with international developmental partners. Provisions and access to these funding mechanisms and opportunities for local, youth-based, and start-up companies in Tanzania can significantly strengthen entrepreneurship in water-related technologies and innovation.

Currently, limited youth-based innovations and technology projects have been reported in Tanzania.[26] This is attributable to the systematic unavailability of technical and funding support. Therefore, improving funding and investment mechanisms can enhance the participation of local people in developing competitive

water solutions and technologies.[27] APET notes some efforts of the government of Tanzania to strengthen local youth capacity. However, more systematic interventions should be implemented.

It has further been identified that youth-based innovations and entrepreneurship encounter several hurdles when creating and investing in Tanzania and throughout the African continent. These challenges include limited access to capital funding, insufficient infrastructure, and a limited skilled labour market. Furthermore, young innovators face challenges in accessing markets and the necessary bureaucratic approvals from corruption, inhibitive policy and regulatory frameworks, and cultural disparities throughout Africa. Some local cultures within African societies impede youth and women's participation in innovation and entrepreneurship.[28] APET recommends that for African countries such as Tanzania to promote youth participation in providing solutions towards accessing clean water, African countries should address the barriers hindering innovation and entrepreneurship.

Government interventions and collaboration to assist youth entrepreneurs and innovators within the water sector is essential. These collaborations and funding mechanisms can be availed through governmental water departments, universities, research institutions, and non-governmental organisations dealing with water management and treatment affairs. This can develop better water-focused, scientifically accurate, sustainable, and environmentally friendly innovation and technology solutions to improve public trust.

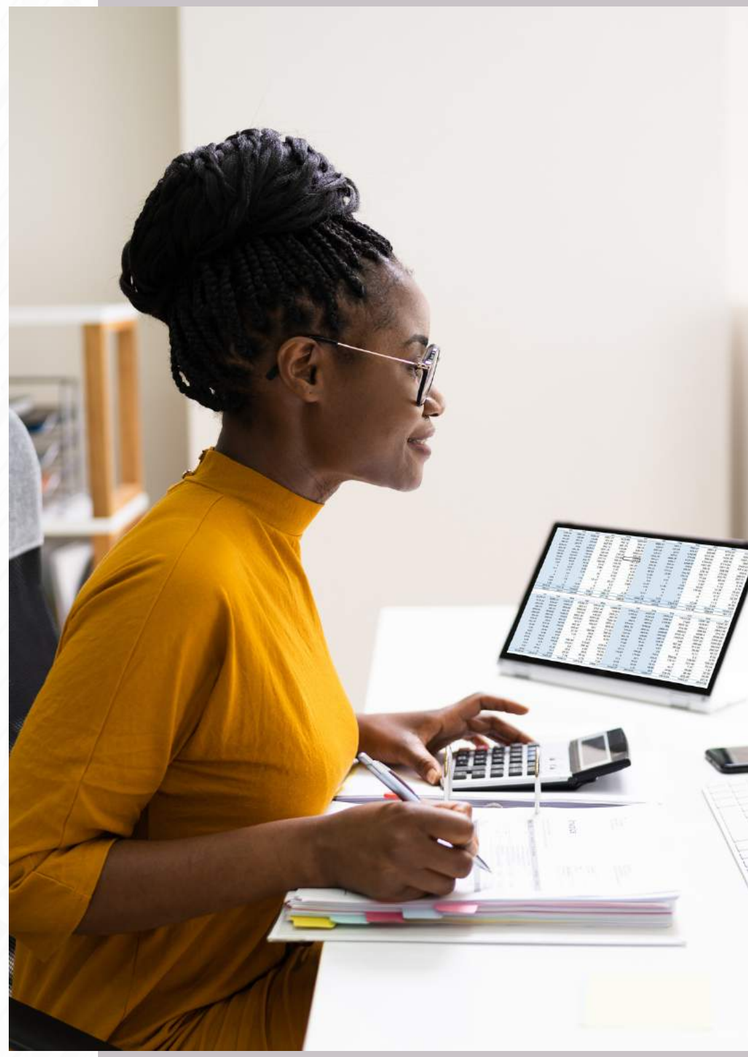
APET also recommends that African countries should establish an enabling innovation entrepreneurship environment. This can support suitable investment efforts and enable taxation frameworks for start-up companies. African governments should also encourage and recognise youth-based innovations and entrepreneurship. This support can include establishing enabling markets, platforms, and incentives for local innovation and emphasising buying local products from the young Tanzanian innovators. Such policy recommendations can also be replicated in other African countries to avert the looming water crisis in Africa.

In conclusion, APET recognises the water crisis in Africa. To this end, APET advises that African policymakers and decision-makers should strategically collaborate with the youth to leverage their innovation, creative ideas, and skilled labour resource. Africa should also deliberately promote local water entrepreneurship and innovation to provide sustainable solutions for local challenges, with the potential to scale up these innovative activities to national, regional, and continental levels. This can be accomplished through strategic, deliberate, and systematic youth developmental projects and funding mechanisms to enhance youth innovation and entrepreneurship, especially within the water sector. African countries can also enhance engagements with young innovators and entrepreneurs to strengthen and build their capacity. This can help African innovators and entrepreneurs conceptualise and implement high-impact transdisciplinary research-based innovation projects to address Africa's water supply priorities.

Link: https://www.nepad.org/blog/promoting-youth-participation-innovative-entrepreneurship-enable-access-clean-water-tanzania

Blog #17 Published on Jul 22, 2022

Enhancing Africa's Tax Collection and Management Mechanisms using Smart Technologies



Taxation is the process through which the government of a country can collect money from its people to pay for the country's expenditures.[1] Paying taxes is a prerequisite for socio-economic development as it generates coffers for governments to fund and build infrastructural, policy, and developmental projects. Tax fosters a conducive climate for businesses and wealth generation as it influences the governmental budgetary strength and development plans. Furthermore, governments can sufficiently support economic activities such as public health and education, agriculture, generating electricity, and building roads and airports, among other developmental aspirations.

Comparatively, most African governments are able to collect approximately 15% of their GDP in taxes against the 40% that is being collected by European, Asian, and North American countries.[2] However, given the massive demands of developing African countries, this low level of tax collection jeopardises the African continent's socio-economic developmental progress. Low taxes generated and collected by these African countries are partly attributable to the underdevelopment of African countries' tax management systems. These inefficiencies are impeding efficient tax collection and management.

One other of the several factors that limit the collection of adequate domestic taxes in Africa is the predominant and massive informal economic sector that can barely be taxed. The International Labour Organization estimated that approximately 85.5% of Africa's labour is within the informal economic sector, whilst the World Bank has reported that this share of informal economic activities is approximately 90% within the Sub-Saharan African countries.[3] This is common in Africa because the informal economic sector and independent businesses are barely registered as companies and in tax revenue agencies. As a result, self-employed Africans will rarely contribute to their country's taxes and social security.

Corruption, money laundering, tax evasion, and misappropriation of funds are other crucial factors that have impeded the realisation of the collected tax targets across the African continent.[4] For instance, within the extractive economic sector, the revenue losses at the expense of their citizenry are attributable to the corrupt acts across the extractive value chain. Regrettably, the proceeds from these corruptive acts are subsequently hidden through money laundering and tax evasion. These factors have been described as significant impediments to sustainable socio-economic development and growth for the African countries of mineral, oil, and gas.

Unfortunately, some African government agencies have inadequate capacity to address these challenges because of their lack of transparency, excessive secrecy, and limited institutional responsiveness to well-coordinated and well-structured tax

collection and management processes. Thus, the impact of corruption, money laundering, and tax evasion are intertwined with illicit financial flows and bribes that result in capital outflows to tax havens to hide embezzled payments and syphon off the revenue intended for the fiscus. In addition, these corruption acts are not only reducing the tax-to-GDP ratio but also harming the economic strength and capacity by discouraging investment, expanding the underground economy, distorting tax arrangements, and corroding taxpayer morale. Thus, the economy's long-term revenue-generating potential is substantially impeded.[5]

The African Union High-Level Panel on Emerging Technologies (APET) realises that many African governments have been eagerly adopting emerging digital technologies to address these tax collection and management challenges in the last decade. These smart technologies are meant to address these difficulties and streamline tax collection and management systems to positively impact local tax revenue generation and management. For example, Rwanda and South Africa have developed and implemented digital systems such as point of sale devices (POS) and e-tax filling systems to simplify the tax remittance systems and provide greater convenience for taxpayers.[6]

Consequently, these technological investments and advancements, combined with tax changes, have exhibited impressive early results. This includes the significant increment of Rwanda's tax-to-GDP ratio and the substantial boost of the country's position in the World Bank's ease of doing business ranking.[7] This is particularly observed in tax payments, collection, and management. Specifically, Rwanda's tax-to-GDP ratio improved by 4.5 percentage points in 2004 to 16.6% by 2016. Furthermore, Rwanda moved from 67th place to the 38th in the World Bank's ease of doing business report of 2020.[8] This was the second-highest score for a Sub-Saharan African country. Rwanda has also gained 22 places to 38th in the category of Paying Taxes since 2010. In 2010, this is when the country's tax digitisation project was still being implemented.[9]

South Africa adopted a computerised tax return filing referred to as e-filing. The e-filing system has enhanced the tax payment captures and expanded the tax management procedures.[10] For instance, the e-filing system increased the tax returns filing from only 1.6% that were handled within 48 hours in the year 2007 to 34% in 2008.[11] This trend was subsequently observed in the coming years.[12] On the other hand, the Kenyan Revenue Authority (KRA) generates the Taxpayer Identification Numbers (TINs) certificates by using an online method.[13] The taxpayers can receive their online TINs certificates using an iTax system. The iTax system utilises an electronic registration module and can be carried out in the comfort of the taxpayer's home, without the need for tax consultants.[14] Tunisia uses an online filing and payment system that minimises the frequency of payments. This is done promptly, minimising the burden on taxpayers and potentially discouraging tax evasion.[15] Reports have demonstrated that tax collection and payments reforms have decreased tax evasion and expanded the overall tax revenue collection. For instance, Tunisia's tax collection increased from 12.3% of GDP in 2007 to 19% in 2008.[16]

APET notes that the digital transformation of the world economy, including the African economy, has significantly benefitted from the advances in the digital economy over the past few years. As such, a wide variety of socio-economic sectors such as financial services, trade, healthcare, transportation, and education have substantially altered the way companies do business and introduced more efficient and far-reaching business models.[17] For example, online platforms such as Google, Facebook, and Amazon and platform-enabled services such as Uber and Airbnb have expanded in the last few years in Africa. Furthermore, the trade in electronic transmissions that include online delivery of software, music, e-books, films, and video games, as well as mobile technology and applications such as money transfer, borrowing, and saving services, has expanded across the African continent. Because of this digitalisation, companies are able to conduct business in places where they previously couldn't.

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For the purposes of international tax law, a company's location in one country is a primary factor in determining its tax obligations. As a result, taxing the digital economy is difficult. Taxing digital commerce is, therefore, a major concern in African countries.[18] This has led to the introduction of digitalised business models of international tax to define the taxable presence and the allocation of business profits for multinational enterprises (MNEs) among the diverse jurisdictions in which they operate.

Notably, APET observes that the exceptional development of the digital economy has heightened the complexity of mobilising tax revenues from national and transnational transactions. Even though the obscure nature of digital transactions propagates tax evasion and avoidance, these untapped revenues can be minimised by drawing and implementing strategic policy and regulatory frameworks for collecting revenues from these economic activities. Thus, African governments, policymakers, academics, tax bodies, and development organisations could consider strategic digital tax policies to impose and undertake direct and indirect taxes on digital transactions. However, APET advises that African countries should amalgamate around their already existing tax collection and management structures to improve adherence to the standards of taxation opportunities and address implementation challenges and consequences.

APET also believes that the tax collection technologies being developed by African countries should address the legislative and administrative structures of digital service taxes as per the canons of taxation. Thus, APET proposes that the technologies surrounding the principles of taxation should be linked to the variations of the economic, political, and social contexts of the varied African countries and between developed and developing countries. Most importantly, APET recommends that African countries tap into the digital service taxes of the tax revenues from the digital economy by ensuring equity, neutrality, economy, and efficiency to balance their fundamental roles in tax policy.

The challenge for most businesses, more especially small businesses, is data management and collection to consolidate financial reports for tax reporting and compliance. Therefore, by enhancing data collection on transactions, businesses can easily consolidate their domestic and international transactional activities to compile their financial reports.[19] Thus, digital technologies can help easily formulate financial reports when reporting their tax returns, particularly among businesses. Therefore, a smartphone registration application can be introduced through digital tax collection methods to improve tax collection, management, and reporting.[20]

For example, employing comprehensive and next-generation procurement software solutions such as PLANERGY can provide essential financial technology components for procurement and accounts payable, including financial reporting.[21] This technology uses artificial intelligence (AI), robotic process automation, and advanced data analytics. Additionally, establishing these digital technologies can provide immediate centralised cloud-based data management and optimisation systems of procure-to-pay processes to improve precision, speed, and transparency.[22]

Notably, digital tax collection technology can allow African governments to collect taxes from their informal economic sector. For example, some African countries, such as South Africa, are promoting the Regulation of Interception of Communications and Provision of Communication-Related Information Act (RICA) to regulate the interception of communications and associated processes such as applications for and authorisation of interception of communications.[23] Similar laws are being implemented in other African countries such as Nigeria and Kenya.

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Such provisions can enable African countries to track their business activities and encourage tax compliance from digital transactions. For example, with the know-your-customer verification provisions, tax authorities can subsequently deliver the facilitated compliance nudges to the taxpayers' phones.[24] In addition, the information collected from the SIM cards can be used by taxpayers who can repopulate the tax returns paperwork collected from their smartphones to simplify the tax payment and audits.[25]

APET also encourages African countries to respond with various strategies to reverse the trends of tax noncompliance. Thus, strengthening the capacity of digitalisation can simplify tax payment and compliance. Further, APET underscores that implementing these computerised systems for reporting and collecting taxes can enable African governments to enhance their efficiency by reducing compliance costs, minimising leakages, and expediting the tax collection processes. This can also enhance Africa's tax capacity through digitalised formal and informal enterprises and further broaden their tax bases. Thus, African countries should develop strategic interventions and initiatives to promote access to financial services, as well as business support services and training for entrepreneurs.

Finally, APET challenges African countries to invest and create an enabling environment through digital policy and infrastructure to enhance domestic and transnational tax collection and management. This can enhance the incorporation of digital technologies in collecting and managing taxes across all African countries. Thus, by integrating smart technologies into their taxation systems, African countries can improve tax compliance and management mechanisms.

Link: https://www.nepad.org/blog/enhancing-africas-tax-collection-and-management-mechanisms-using-smart-technologies

Blog #18 Published on Aug 1, 2022

Unlocking The Potential of Africa’s SME’s using Emerging Technologies in Africa

Small-and-medium size enterprises (SMEs) are crucial towards contributing to Africa's inclusive socio-economic development and growth. This is because SMEs are generating work opportunities, income, and wealth creation, and thereby, enhancing poverty reduction. Notably, there is no standard international definition of small and medium-sized enterprise (SME) that exists. SMEs are variably defined in the legislation across countries. This is because the dimension “small” and “medium” of a firm is dependent to the size of the domestic economy.[1]

The Organisation for Economic Co-operation and Development (OECD) refers to SMEs as companies that are employing up to 249 people. Micro employs between 1 to 9 people, small refers to hiring 10 to 49 people, and medium ranges between 50 and 249 people. [2] This consideration and definition can enable the best comparability given the varying data collection practices across countries, as various countries are using different conventions.

SMEs account for approximately 80% of jobs in Africa and this makes SMEs a significant mechanism for socio-economic growth.[3] For example, within Sub-Saharan Africa, there are approximately 44 million SMEs.[4] In addition, the African Continental Free Trade Area (AfCFTA) is promising to expand access to regional and continental-wide export markets for SMEs.[5] Further to this, the Sustainable Development Goals and the African Union acknowledges that Africa’s drivers of economic growth and long-term sustainability for emerging markets are dependent on the potential of the effective development of the SME business model.[6]

The presence of SMEs in all sectors of the African economy are signifying their vital role in steering the socio-economic development and growth of the African continent. In the context of Africa, SMEs are essentially contributing towards job creation and employment for a large populace. For example, up to 90% of the population in African countries such as Uganda, Ethiopia, and Kenya are employed within SMEs.[7] This is because SMEs are essentially enabling invention, innovation, and the creation of new ideas and technologies. Fundamentally, SMEs are providing for pre-incubation, incubation, introduction, and commercialisation of innovation and technology into the market. This provides a platform for creating and testing new products before they can be upscaled and disseminated into larger industry through the macroeconomic systems.

In addition, SMEs are attributed and accredited for identifying and creating new markets and serving as the foundation for new companies. This is consequently providing a source of income for millions of Africans. Thus, SMEs are enabling wealth creation by driving the demand for goods, services, investments, innovation, technology, and trade.

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However, despite their positive influence towards the development of the African continent, SMEs are still facing tremendous and restrictive obstacles that are impeding their long-term survival and contribution to the development of Africa. As a result, the mortality rate of SMEs among African countries stands at an astonishing rate of 5 out of 7 businesses failing in their first year.[8] For example, in Uganda, one-third of new company start-ups fail within the first year of their operation.[9] On the other hand, South Africa has a failure rate of start-up companies that ranges between 50% and 95%, depending on the industry.[10]

African SMEs are bearing a disproportionate share of the burden of institutional and market failures. This is most noticed as observed from the limited access to finance and credit. Additionally, impediments to the growth of SMEs across the African continent include inadequate institutional and physical infrastructure, political instability, exploitation, and a burdensome regulatory environment. The Enterprise Surveys of the World Bank observed that limited access and affordability to finance are the predominant constraints against the growth of the SME sector in Africa.[11]

In Africa, SMEs are usually informal because they are not properly established as firms. Consequently, this makes access to finance and funding challenging and difficult for SMEs. Notably, only one-third to one-fifth of SMEs in Sub-Saharan Africa (SSA) have access to financial instruments such as bank loans and lines of credit.[12] Further to this, an estimated 28.3% of SMEs in SSA are entirely credit-limited.[13] This is particularly a significant concern for African SMEs because this impedes their capacity and ability to develop and grow without sufficient operating capital.

Furthermore, SMEs are also challenged by their capacity to afford loan instruments because of the high bank interest rates varying between 20% and 25%.[14] Alternatively, financial providers and supporters such as microfinance organisations and internet lenders would normally charge even higher interest rates, ranging between 40% to 50%.[15] Fundamentally, the high-interest rates can sometimes thwart SMEs from even attempting to obtain credit. Thus, the absence of accessible funding can severely impede the expansion of Africa's SMEs.

Several financial and banking institutions acting as lending institutions in Africa find it hard to lend capital finance to SMEs. This is because most of Africa's SMEs can barely have the prerequisite information such as credit history that is necessary and essential for lending, limited financial statements and reports, and inadequate land and building ownership for collateral purposes. Thus, there is a need to enable tools that can be utilised to collect and manage transactional data that can be used to easily create financial reports and statements.

Therefore, the African Union High-Level Panel on Emerging Technologies (APET) is accentuating the digitalising of financial data and transactional history through innovation and emerging technologies. This provision can substantially enable appropriate reporting of financial statements and history. Such information and well-organised data can enable access and diversification of financing for SMEs in Africa.

APET notes that the utilisation of online applications and the automation of underwriting, due diligence, loan servicing, and regulatory compliance duties may enhance the conventional lending processes. This can increase productivity while lessening the operational expenses for the banking institutions to make loan processing affordable. SMEs, when seeking loan instruments from financial institutions, can easily provide the necessary data about their business operations and transactions from well-organised data-capturing mechanisms and management systems. Such digitalised data can streamline business activities and subsequently make SMEs easily become eligible for credit.

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APET further observes that these digital technologies that can be employed include cloud-based accounting, digital payments, and the automation of invoicing and settlement procedures. This kind of information can substitute the need for bank statements and costs associated with compiling financial statements and reports. Furthermore, the enhanced availability of financial data, along with alternative smartphone data, can also enhance loan eligibility screening and credit evaluation. APET recognises that can subsequently decrease the risk and default for financial service providers. In this way, digital loan applications can offer simplicity and convenience, and this is suitable for SMEs that have limited administrative and managerial capacities.

For example, the African banking sector presents abundant terrain for digitalisation to expand Africa's financial markets. Statista has reported that Africa's e-commerce industry is envisaged to expand at a compound annual growth rate of 24.7% between 2017 and 2024. [16] In 2017, the industry's annual revenue was approximately US$7.7 billion and envisaged to increase up to US$42.3 billion in 2024. Fundamentally, the yearly income stands will expand by nearly 500% in seven (7) years.[17] The consumer preferences are favourable for emerging technology breakthroughs in Africa as demonstrated by the world's largest mobile money deployment.

APET observes that these breakthroughs are substantially improving the business mechanisms and management systems for Africa's SMEs. For example, digital technology has enabled access to finance for SMEs in Kenya by using the mobile money applications. This has substantially bolstered the quantity of digital loan applications and approvals. Consequently, these digital loans have surpassed the approval rate of traditional loan instruments.[18] The Reserve Bank of Kenya has acknowledged that the adoption of the Loans Information Sharing System (CIS) is broadening financial inclusion in Kenya.[19] Furthermore, this system is making it simpler for SME borrowers to acquire extra growth credit.[20] Notably, this has since expanded over the last several years because of the improved credit ratings as supported by the CIS system. This has enabled the digital lenders such as M-Shwari, Tala, and Zenka to offer essential finance to Kenya's SMEs that were seeking swift short-term loans.[21]

Finally, APET advises African governments to invest towards their citizens' capacities. This can be accomplished by investments towards digital physical infrastructure and digitalising financial systems across the African continent. Digitalisation can significantly enhance financial inclusion, most particularly for unserved and underserved enterprises, such as SMEs. In addition, APET notes that to reap these digital benefits, capacity strengthening of human capital development towards fundamental financial and digital literacy skills, should be bolstered in Africa. Most importantly, African countries should strengthen their infrastructural capacity of mobile networks so to participate fully in the world's technological boom and address Africa's socio-economic challenges.

Link: https://www.nepad.org/blog/unlocking-potential-of-africas-smes-using-emerging-technologies-africa

Blog #19 Published on Aug 1, 2022

Safeguarding Food Security through Composting Waste Materials into Organic Fertiliser in Africa

The application of fertiliser can enhance agricultural productivity and food security in Africa.[1] Reportedly, African farmers progressively applied fertilisers from an average of 8.5 kg per hectare of land in 2006 to an average of 17 kg of fertiliser per hectare of cropland in 2018.[2] The progressively incremental utilisation of fertilisers in Africa to ensure food security places the commodity at the apex of modern technologies to ensure the production of fertilisers.

The leading causes of food insecurity in Africa have recently included pandemics that can disrupt the food value chains. Since the Russian invasion, global food prices have increased significantly. The Food Price Index of the United Nation's Food and Agriculture Organization (FAO) increased 12.6% from February to March 2022, when the Russia-Ukraine conflict commenced.[3] The March index was the highest since the measure's inception in the 1990s.[4]

In Africa, the conflict between Russia and Ukraine in 2022 has equally exacerbated food insecurity, placing more Africans at risk of acute starvation.[5] Ukraine's key food exports, such as wheat, barley, and sunflower oil, provide calories to supply approximately 400 million people worldwide. Together, Russia and Ukraine provide over 40% of Africa's wheat supply.[6] Yet, Ukraine's key ports, such as Odesa, through which 98% of the grain exports typically pass, are being blockaded by Russia.[7]

Currently, Africa is encountering grain shortages, cooking oil and essential organic fertilisers that can be utilised in food production.[8] The price of inorganic fertiliser is also continually escalating. For example, the price of urea fertiliser has risen by up to 32%, while that of diammonium phosphate increased by 13% by March 2022.[9] Can African countries establish autonomous systems to provide fertilisers for their farming activities to nurture the agricultural potential of the African continent sustainably?

Inorganic fertilisers containing a variety of nutrients, including nitrates, magnesium, phosphorous and potassium, are essential for improving the soil quality and crop yield, thereby ensuring food security in Africa.[10] Due to land degradation in some parts of Africa, fertilisers can replenish the nutrients the crops have removed from the soil. Thus, crop yields and agricultural outputs would be markedly lowered if fertilisers were not applied.[11]

Some farmers often utilise fertilisers containing 19% potassium, 15% nitrogen, and 14% phosphorus. However, the disadvantage of these inorganic fertilisers is that the nitrogen, phosphate, and potassium-based synthetic fertilisers can leach into groundwater bodies. This can, in turn, escalate their toxicity, causing substantial water pollution. Such fertilisers that leach into streams, rivers, lakes, and other bodies of water can upset and unsettle the aquatic ecosystems.

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Additionally, even though inorganic fertilisers produce remarkably quick results on commercial farms, where growth equals profit, the substantial and unrestrained use of these synthetic compounds can result in fertiliser pollution. Inorganic fertilisers can also increase the nitrate levels of soil, which can, in turn, produce nitrites that can react with the haemoglobin in the bloodstream. Consequently, this could lead to the production of methemoglobinaemia, which can potentially damage the vascular and respiratory systems. Such complications may result in suffocation and even death in extreme cases, especially when the blood methaemoglobin level is 80% or more. In addition, plants that grow in overly fertilised soil are deficient in iron, zinc, carotene, vitamin C, copper, and protein.

Between the pollution caused by fertiliser and the limited supply across the continent, African farmers are encouraged to explore organic fertiliser alternatives to apply to their crop production. This can be accomplished by using already existing food waste to create compost fertiliser containing organic matter. Notably, the food waste fertiliser is processed by simply breaking down food waste in the presence of air and water, using microorganisms and small insects present in nature. Food waste composite fertilisers can decrease the solidity of soil and bulk density by enhancing the soil's porosity and aeration. It can also improve saline water leaching and decrease soil acidity, as well as soil's humus content and allows for beneficial microbes to grow. Food waste fertiliser is also environmentally friendly and cost-effective.[12]

The African Union High-Level Panel on Emerging Technologies (APET) notes that generating compost fertiliser from waste in Africa is not necessarily new. Nevertheless, an emergent circular economy is responsible for linking entrepreneurs with smallholder farmers in Africa to manufacture fertiliser as a value-added product to support agricultural activities. For example, young Ghanaian entrepreneurs founded a Sabon Sake project to develop a small bio-compost fertiliser plant in the South Volta region in 2018.[13] These young entrepreneurs are using biotechnology to generate bio-compost fertiliser from sugarcane waste. Notably, this fertiliser is improving the soil quality as well as crop yields and competing with a market that utilises a lot of chemical fertilisers.

In most cases, Ghanaian farmers turn to burning their crop waste in the fields immediately after their harvest. Consequently, this causes pollution, and this subsequently damages the soil quality. Thus, through capacity strengthening, Ghana has brought a network of 30 sugarcane farmers to produce organic fertiliser for their fields using sugarcane waste. The plan is to scale up the project to support vertical and urban farmers as well. Moreover, the Ghanaian people are known to grow a lot of fruits and vegetables in the backyards of their homes, and they can potentially turn the waste from their fruits and vegetables into bio-compost fertiliser for more farming activities.[14]

The Moroccan Compost Systems specialises in the biological treatment of waste. As a result, Compost Systems have built a composting plant for organic agricultural waste to serve as the pilot phase for a regional composting project.[15] This project is utilising the regional composting platform to add value to the organic agricultural waste in the Sous-Massa region of Morocco. Notably, this region generates approximately 1.87 million tonnes of organic agricultural waste annually. Even though the project is still in an experimental phase, the future facility is anticipated to generate up to 100,000 tonnes of fertiliser per year from the waste.[16] Remarkedly, improving the agricultural yields through bio-compost fertiliser can strategically strengthen the 12% of the GDP and the 15,000 people employed in the agricultural sector of Morocco.[17] Thus, the small venture in the Sous-Massa plant will decrease organic agricultural waste and contribute to Morocco's socio-economic development.

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In July 2021, Gambia's Kanifing Municipal Council (KMC) inaugurated a project to decrease the size of the organic waste usually dumped into the local landfills. In this project, the waste is converted into fertiliser and biomass briquettes.[18] The current arrangement is that the waste gets collected from the Kanifing and then deposited into an unregulated landfill located near Serekunda. This is the largest city in the Gambia. However, under the KMC project, the organic waste is collected from crops and vegetable markets and subsequently converted into fertiliser. Female vendors then sell the fertiliser for profit to farmers across the country. As such, APET is encouraging other African countries to effectively replicate this model in their context to supply fertiliser to their local farmers. Young African entrepreneurs can be supported to scale up such projects for their local communities.

Furthermore, deforestation remains a severe challenge in the Gambia, as the country lost over 100,000 hectares of forest between 1998 and 2008.[19] This loss was attributable to commercial logging and firewood. Entrepreneurs are manufacturing biomass briquettes from municipal organic waste to address this deforestation challenge. Local households utilise such biomass briquettes for cooking instead of using wood. APET observes that this biomass reclamation project is mitigating deforestation and reducing carbon dioxide (CO2) emissions.

With the assistance of development partners such as the Japan International Cooperation Agency (JICA) and the United States of America-based company known as Sanergy, Kenya has invested about US$2.5 million into the circular economy.[20] Within this circular economic activity, a factory was built in 2021 in Nairobi to produce one of the largest insect feeds in East Africa. This factory collects human excreta and organic waste from slums. Subsequently, this waste is transformed into insect feed, organic fertiliser, and biofuel.[21] This is undertaken in collaboration with the Black Soldier Flies (BSF). The Black Soldier Fly Larvae (BSFL) are utilised to compost and alter waste into animal feed.[22] The fly larvae are efficiently converting biomass into feed. The global market for BSF is envisaged to expand at an annual rate of 34.7% over the next 10 years, reaching approximately US$3.4 billion.[23]

The population of Kenya's capital, Nairobi, is envisaged to reach approximately 5.94 million by the year 2030.[24] Waste volumes in the city are expected to increase to approximately 3,990 tonnes per day by 2030.[25] Notably, approximately half of Nairobi's waste is illegally dumped into unauthorised and sometimes undesignated landfills. For example, about 1.8 million cubic metres (m3) of waste is brought into the waste disposal sites that can only process only about 500,000 m3.[26] On the other hand, only 12% of Nairobi is linked to the Kenya sewer grid system, and human waste is substantially challenging the city.[27] This results from the limited sanitation capacity, negatively impacting the health of the Kenyan people in slums such as Kibera. However, repurposing the waste from these communities can improve sanitation, create wealth, and enhance fertiliser production for agricultural purposes.

In some African villages, approximately a third of the population is hungry because over a quarter of the harvested food is lost due to spoilage. Besides, hundreds of millions of livestock across the African continent are responsible for degrading approximately half of the cropland, making up over one-third of overgrazed lands worldwide. However, uneaten food, manure, and other forms of waste can be utilised by farmers to produce fertiliser, fuel, and food. For example, South Africa is diverting about 2% of organic matter from its landfills generated in Cape Town, and 15% in Johannesburg, through composting.[28] Notably, some municipalities in South Africa are operating smaller-scale composting facilities. Then again, Uganda has nine (9) municipalities that have established composting plants through the support of the World Bank.[29]

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APET observes that composting food waste reduces the pressure on landfills while generating a cost-effective nutrient-rich soil amendment that farmers can utilise to enhance their soil fertility. This is because the compost complements the soil's organic matter, enhances the soil's water-holding capacity, facilitates root penetration, and makes soil nutrients available for crops over time. Notably, subsistence farmers have conventionally depended on composting and livestock manure to improve soil nutrition. For example, the Ibo tribe of Nigeria has traditionally utilised branches from trees for mulching, employed goat dung to individual plants, and composted human waste.[30] Alternatively, the Zimbabwean, South African, Mozambiquan, and Eswatini subsistence farmers have customarily grazed their cattle during the day and confined them in pens at night so to collect the manure and scatter it over their farms.

To strengthen capacity for compositing, various projects across the continent are being implemented to enhance farmers' capacity for composting and improving the quality of compost being generated. For example, a participatory radio show in the Zégoua region of Mali has resulted in a 64% incremental household adoption of composting.[31] Conversely, Kenya has established a demonstration project to turn waste from households, vegetable markets, and an avocado processing plant into compost that farmers can utilise to boost their crop yields and profits. Further to this, Pelungu farmers in Ghana are constructing goat shelters with sloppy floor surfaces to transport the goats' dung into a central location using gravity. The resultant manure is subsequently composted for farming purposes.[32]

APET observes that some African farmers use manure and agricultural waste for fish food. For example, Tanzania established an "integrated fish management" system in 2005 that could generate fish from farm waste and fertiliser from fish waste.[33] This was accomplished by incorporating the production of catfish and tilapia with poultry, corn, rabbit, and vegetable production. The chickens are made for walking on stalks, enabling their nitrogen-rich excreta to fall directly into the fishpond.[34] Subsequently, the enriched fishpond water is then utilised to irrigate crops. These crops can then be utilised to feed livestock as well.

APET is challenging African countries to upscale compost fertiliser production from food waste. Such projects can help repurpose food wastage and develop small-scale fertiliser production for local farmers within African communities. Furthermore, African governments can upscale these fertiliser projects together with capacity strengthening programmes of fertiliser production for African farmers. This can help enhance the quality of the compost production. Most importantly, APET underscores the critical importance of resiliently and sustainably transforming Africa's food systems using food waste as fertiliser. African communities can utilise mechanisms that will ensure that Africa accomplishes food self-sufficiency.

Link: https://www.nepad.org/blog/safeguarding-food-security-through-composting-waste-materials-organic-fertiliser-africa

Blog #20 Published on Aug 16, 2022

Boosting the Safety and Security of Mobile Money Transfer Transactions in Africa

Africa has a wealth of economic potential in nearly every socio-economic development sector. As a result, Africa's young population presents enormous opportunities for harnessing digital technologies and underscores the necessity for Africa to prioritize digital technologies. This is due to the fact that digital transformation is a driving force behind inclusive, innovative, and long-term socio-economic growth. By making goods and services easier to obtain and more widely available, technological advancements and digitalization are helping Africa's economy create jobs and combat poverty while also reducing inequality. In essence, this is helping to achieve the Agenda 2063 of the African Union and the Sustainable Development Goals of the United Nations.[1]

Digital technologies can promote Africa's economic integration, generate inclusive economic growth, stimulate job creation, bridge the digital divide, and eradicate poverty.[2] Furthermore, the African Union (AU) has labelled digital technologies as one of the enablers to leapfrog Africa into sustainable and inclusive socio-economic development and growth. For example, the African Union's Digital Transformation Strategy for Africa (2020-2030) has characterised the utilisation of digital technologies and innovation as a prerequisite to transforming African societies.[3]

Financial technologies (fintech) applications are one of the domains digital technologies have revolutionised across the African continent. Fintech is effectively augmenting, streamlining, and digitalising the conventional structure of financial services.[4] These applications have established financial ecosystems that are providing solutions to address some of the gaps in the provision of financial services. Consequently, fintech is progressively growing and changing the financial services value chain and boosting financial inclusion to encourage socio-economic development and growth.[5] This also enables various financial operational mechanisms such as depositing payments, paying bills, and obtaining financial assistance. For example, these are executed through mobile money banking, mobile payment, crowdfunding platforms, insurance technology, blockchain, and cryptocurrency.[6]

Fintech applications such as mobile money are potentially expanding access to financial services to approximately 300 million unbanked and underbanked Africans.[7] The upsurge of fintech firms and substantial banking investments into digitalisation has further enhanced innovation, strengthened local economies, and catalysed equitable,

inclusive economic development and growth across Africa.[8] There were about 548 million registered mobile money accounts by the end of 2020, with approximately 150 million active users every month.[9] However, safety and security challenges associated with these technologies should be addressed for better absorption and enhanced trust and confidence in their applications from African users.

Notably, mobile money transfers are transactions involving money transfers between individuals, such as remittances, social benefits, reimbursements and all sorts of transfers which can occur between two persons. There are also payments from individuals to companies and vice-versa, such as purchases, subscriptions, bills, insurance contributions, taxes, and payments to suppliers. Mobile money systems facilitate emergency payments and electronic money transfers to adjudicate domestic financial matters. This is demonstrated by the number of global mobile users, which has increased from 0.8 billion in 2014 to 1.8 billion in 2019.[10] In Africa, the East African Community has reported an increase in mobile money transactions ranging between 33 billion Uganda Shillings in 2009 and 32,506 billion Uganda Shillings in 2015.[11]

The mobile money transfer service is vulnerable to fraud through a virus to execute fraudulent financial transactions targeting online banking customers. In such cases, the malware can be spread to retrieve data and authentication information from various personal accounts.[12] Subsequently, the malware can then perform some money transfers from the user's account to a mule's account. This kind of attack is usually undetectable for traditional anti-viruses without the capacity to jointly analyse events linked to the network and the susceptible mobile money applications. To address these safety and security challenges, appropriate mobile money security and detection features for these services should be formulated and implemented.

Some of the safety and security of financial technology-enabled transactions challenges include identity theft, authentication, phishing, vishing, SMiShing, personal identification number (PIN) sharing, and agent-driven fraud.[13] Thus, the application of mitigation measures such as better access controls, customer awareness campaigns, agent training on acceptable practices, strict measures against fraudsters, high-value transaction monitoring by the service providers, development of comprehensive legal documents to operate mobile money services should be implemented. There are other challenges, such as eavesdropping and weak cryptography. However, modern data networks and smartphones are offering substantive opportunities for improvement.

The opportunities for African countries to address these challenges on mobile money applications include user security measures, server-side practices, and the policy environment. These opportunities include addressing the critical vulnerabilities to enhance the protection of user credentials and the payment history that may essentially result in the fabrication and modification of transactions.[14] Some android-based mobile money applications can correctly validate the transport layer security (TLS) certificates through default certificate verification systematic mechanisms.[15] On the other hand, some mobile money transfer developers have adopted the utilisation of keys to encrypt the user PIN to enable a secure authentication process for the service.

In some cases, the protected TLS certificate validation is effectively enabled through the crypto implementation in money on mobile, and the messages are sent over plaintext HTTP. This enables the systems to safeguard user data confidentiality and transaction integrity through user authentication of transactions. However, when these systems are attacked, the user may pay the price of limited security. This is because certain security aspects, such as fraud detection algorithms, can be costly. The server configurations should also be patched through user-biased cryptographic technologists.[16]

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It has been reported that the limited applications of mobile money transactional applications involve some characteristic privacy and safety policies associated with the technology. Sometimes, the privacy policies are cryptic and rarely outlined in the most common languages that are commonly used within the country. In other instances, the mobile application does not identify the user from whom the data being utilised was collected. Consequently, this presents vulnerabilities in the misappropriation and misuse of mobile money services in some African countries. The African Union High-Level Panel on Emerging Technologies (APET) advises that it remains essential and crucial to establish well-written and well-outlined privacy policies.

For example, these loopholes may even provide some criminals with a significant platform to undertake cybersecurity crimes. Unfortunately, the hasty expansion of this application presents African countries with limited time to formulate thorough law enforcement mechanisms against such cybersecurity acts and regulatory mechanisms.[17] Notably, mobile money cybersecurity challenges may arise from various mobile money value chains such as network providers, vendors and agents, customers, and employees. Because of the limited policy and regulatory frameworks governing the utilisation of the technology, APET observes that it becomes difficult to enforce and, in some instances, even apply law enforcement mechanisms to protect the various stakeholders along the mobile money value chain.

Some prevalent crimes within this value chain include fraudulent top-ups using compromised or stolen credit cards, identity and subscription fraud, dealer and agent fraud, commissions fraud, internal employee collusion fraud, social engineering fraud, SIM swaps and roaming fraud.[18] Therefore, despite the immense benefits of enhancing access to financial services, the acceptance of the usage and the implementation of mobile money transfers have significantly remained limited due to security challenges related to the system. There have been some research studies have been conducted to understand mobile money security, particularly in Africa, India, and South America. However, APET suggests more research to understand and formulate better implementation mechanisms and frameworks to inform policy development and implementation.

With the increased mobile money transactions taking place in Africa, there is a need to protect the systems against information breaches and abuse. APET notes that this is even more important in the complex and changing environment with emerging stakeholders with varying interests and objectives. Fundamentally, most African countries do not have straightforward policies specifically addressing information security roles and responsibilities and overlaps.[19] Therefore, APET is challenging African countries to explore and strengthen their existing information security management policies, procedures, practices, and standards. African countries are also encouraged to constantly investigate and regulate the vulnerabilities and limitations of the existing information security management policies, procedures, practices, and standards, particularly regarding mobile money transactions.

APET is also advising African countries to develop and recommend information security management frameworks for mobile money systems and validate the information security management frameworks developed. In such cases, a multi-case qualitative strategy can be adopted to formulate well-structured mobile money systems that can address user information security challenges and concerns.[20] The mobile money agents can efficiently register mobile money end-users, manage mobile money information, and implement mobile money systems. Fundamentally, the data collection can entail observation, face-to-face interviews, and incorporate review processes of existing policy, procedural, regulatory, and practical mobile money services. This can result in coordinated n and efficiently managed mobile money activities.

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Despite the benefits of mobile money systems, reports are exhibiting that the existing policies, procedures, regulations, and standards of mobile network operators are not well-equipped to address information security oversight challenges.[21] This limits the capacity to safeguard financial information in mobile money systems efficiently. This is because the information security management roles are not shared among all mobile money stakeholders. Furthermore, the anonymous and non-registered mobile phone users allowed to access mobile money services are potentially posing an information security risk to mobile money users. Moreover, privacy is not prioritised in mobile money transactions. For example, third parties are allowed access to customers' financial information, yet there are insufficient compliant monitoring and controls systems. As a result, this gap provides a suitable environment for information infringements and manipulations of mobile money transactions.

Therefore, APET advises African countries to improve their information security management frameworks for mobile money systems. This can strengthen the existing mobile money regulations, policies, procedures, and practices and allow mobile money payments to operate based on trust. Furthermore, mobile money operators should introduce identification procedures for mobile money recipients when withdrawing their money to enable tracing and verification of illegal mobile money transfers.

A mobile money cybercrime attack was observed in Uganda in 2020, where an estimated US$3.2 million was stolen by hackers using over 2,000 SIM cards.[22] There are also reports that Kenya's M-PESA mobile application has utilised money laundering, bribery, and ransom payment during kidnapping and extortion activities.[23] To address these challenges, APET advises that cyber security and personal data protection frameworks can provide credible frameworks for such cybersecurity activities in Africa. These can be monitored through electronic transaction organisation, personal data protection, cybersecurity promotion, e-governance, and cybercrime fight.

APET believes that mobile money cybercrimes can be prevented by incorporating machine learning and artificial intelligence-enabled real-time monitoring and visualisation technologies to secure financial transactions. To further strengthen mobile money transactions, APET advises that additional features such as risk classification, anti-money laundering (AML) watchlists, and activity monitoring can adequately safeguard mobile money transactions from potential criminal activities and fraud incursions.

Interestingly, some African countries such as Rwanda and Nigeria are strengthening their regulatory and supervisory technological solutions to strengthen mobile money's safety and security. For instance, the National Bank of Rwanda utilises an automated electronic data warehouse to streamline reporting and supervisory processes of more than 600 financial institutions such as banking and microfinance institutions and savings and credit cooperative organisations.[24] In such cases, mobile money data is automatically retrieved daily to monitor mobile money transfer operations.[25] As a result, this enables efficient tracking and identifying potential money laundering activities.

The Nigerian Central Bank and Nigeria Inter-Bank Settlement System are creating a "data stack" incorporating data warehouses and dashboards to enhance risk-based and immediate financial supervision.[26] This also provides information for developing new policy frameworks to strengthen regulatory interventions and financial inclusion provisions on mobile money transactions.

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Thus, APET encourages African countries to replicate such approaches to secure the applications for mobile money transfers in Africa.[27]

In conclusion, APET advises that African countries formulate anti-money laundering controls and specifically establish mobile money controls to safeguard mobile money and value transfers. APET realises that it is difficult to balance financial integrity and financial inclusion; however, the risk-based approach can enable African governments to implement adequate safety and secure anti-money laundering measures. This can effectively preserve the financial integrity of mobile money transactions and enhance financial inclusion ambitions.

Link: https://www.nepad.org/blog/boosting-safety-and-security-of-mobile-money-transfer-transactions-africa

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Leveraging Smart Technologies to Tackle Gender-Based Violence in Africa

Gender-based violence (GBV) is defined as harmful acts committed against a person based on their gender. This could result in physical, sexual, and psychological harm. Whether occurring in public or private life[1],threats, coercion, and arbitrary deprivation of liberty constitute gender-based violence. Notably, both men and women are experiencing and being affected by gender-based violence. However, the majority of victims of gender-based violence have been women and girls. In Africa, gender-based violence is one of the numerous obstacles preventing women from exercising their fundamental rights to life, human dignity, peace, justice, socio-economic development, and political advancement.[2]

Frameworks such as the African Union's Agenda 2063, the African Union's Strategy for Gender Equality and Women's Empowerment[3], the Maputo Protocol[4] to the African Charter on Human and People's Rights on the Rights of Women in Africa, and the Solemn Declaration on Gender Equality in Africa (SDGEA) ensure Africa's commitment to gender equality[5]. This is accomplished through the resolution and abolition of violence against women and girls, as well as increased access to resources such as finance, land, education, health, information services, science and technology, and decision-making in socio-political governance and commercial ventures[6]. The framework for Gender Equality and Women's Empowerment also envisions equal participation in African country advancement and the development of people-driven economies[7].

Nevertheless, despite the adoption of these progressive policies and legal frameworks to eradicate gender-based violence, this phenomenon remains the most pervasive violation of human rights in Africa[8]. Notably, approximately 736 million women aged 15 or older around the world have experienced some form of gender-based violence at least once in their lives, and one-third (30%) have experienced it more than once.[9] As a result, gender-based discrimination poses health risks, particularly for women and girls in Africa, and significantly contributes to the morbidity and mortality of women in Africa.

Africa remains one of the regions with the highest prevalence of gender-based violence, with approximately 36% of women having experienced it[10]. In some instances, these women are subjected to pervasive and enduring gender-based violations, such as child marriage and female genital mutilation[11]. Notably, at least one-third of women between the ages of 20 and 24 were forced into marriage before the age of 18 in 19African nations. Additionally, at least one-third of women between the ages of 15 and 49 have undergone female genital mutilation. Notably, the prevalence of GBV in Africa can be attributed to fostered patriarchy, cultural gender norms, low literacy levels, poverty, wars, regional and tribal conflicts, and limited levels of information[12].

The high prevalence of gender-based violence in Africa has resulted in widespread public support for the abolition of gender-based violence[13]. African governments have initiated and implemented some efforts to end gender-based violence.

However, these efforts have been hampered by ineffective and incompetent coordination, as well as limited budgetary provisions for prevention and services. In South Africa, for example, political changes and limited funding mechanisms[14] have made it difficult for the National Council on Gender-Based Violence (NCGBV) council to draft, cost, and implement the national strategic plan to prevent gender-based violence. As a result, improved mechanisms for facilitating and coordinating preventive measures against gender-based violence should be developed and implemented.

To that end, the African Union High-Level Panel on Emerging Technologies (APET) advises African countries to consider adopting smart technologies to eliminate gender-based violence in Africa. APET believes that African countries' current methodologies and mechanisms to combat gender-based violence could be supplemented with smart technologies to strengthen the fight against gender-based violence. The spread and implementation of digital technologies can open up new avenues for addressing gender-based violence in novel ways and ensuring easier access to information and services needed to prevent gender-based violence. This can particularly enhance the impact of interventions and address gaps and challenges inherent in the delivery of traditional gender-based violence mitigation mechanisms.

When assisting victims of gender-based violence, certain gender-based technological solutions can assist African nations in enhancing safety and privacy standards and bolstering the foundations of ethical norms and regulations. APET acknowledges that substantial barriers prevent marginalised groups experiencing gender-based violence and impoverished women from gaining access to information and communication technologies. As a result, barriers such as cost, illiteracy, cultural norms, safety, and limited awareness of available communication tools exacerbate the digital divide in Africa.

APET advises African governments to improve gender equality through the use of smart technologies strategically. This can improve the technological resources available to law enforcement and prevent perpetrators of gender-based violence from monitoring, harassing, threatening, intimidating, impersonating, and stalking existing and potential victims. These smart technologies can also be used to prevent cyberbullying by enhancing the preventative cyberbullying law enforcement mechanisms and controls.

For example, South Africa's departments of Communications and Digital Technologies and Social Development, in partnership with the United Nations Children Fund (UNICEF), launched an online gender-based violence engagement platform known as the GovChat.[15],[16] This GovChat platform is a zero-rated progressive online application that connects gender-based violence victims to the gender-based violence governmental command centre to enable better reporting and response mechanisms. This application can be viewed and utilised from any internet browser. As such, this platform is leveraging data analytics to reduce gender-based victims and enable the platform users to access assistance resources anonymously. This is accomplished with real-time reporting and interactive mechanisms.

The GovChat is cutting-edge technology and data-driven platform to enable victims and their families to access information about social service provisions. This is also enabling the South African government to enhance gender-based violence visibility and mitigation efforts, especially in high-risk geographical locations, time zones, and peak periods.[17] The platform can also be used to collect gender-based violence data analytics to enhance governmental policymaking and evaluate governmental gender-based policy intervention programmes.

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In Lesotho, a Nokaneng application is sensitising users on the various kinds of gender-based violence, as well as their rights, available support services, and safety tools, including an alert sound and emergency SMS options. The Nokaneng application teaches women and men how gender-based violence can be punishable by law and the extent of protection from the different forms of gender-based violence.[18] On the other hand, the Helpio application enables Nigeria's gender-based violence access to timely assistance such as counselling, medical professionals, activists, and legal counsel.[19] The software is also teaching non-victims how to defend their family members from potential gender-based violence and dangers.

APET also notes that while digital technologies are bringing huge advantages to socio-economic development and growth, they can also facilitate violence. As such, women and girls are the most vulnerable targets of online violence, including physical threats, sexual harassment, bullying, stalking, sex trolling and exploitation. Regrettably, this trend aggravated during the COVID-19 pandemic as internet usage grew by up to 50% to 70%.[20] This incremental usage of the internet caused an upsurge in the sharing of non-consensual images that were intended to intimidate, humiliate, and control women and girls. Fundamentally, the online sexual exploitation and abnormal usage of children reached crisis levels, with girls featured in most online abuse materials.[21]

As a result, there is an urgent need to combat this kind of online harassment and assault through the use of cutting-edge technological solutions aimed at reducing and responding to gender-based violence. APET emphasises the need for strategic partnership with women and girls in order to advance the development of secure technology to combat gender-based violence. Therefore, the rights, needs, and wishes of women and girls who have experienced gender-based violence should be central to the design, and the design should not put them at risk. To give an example, if other people can access the evidence of a survivor of gender-based violence communicating with an online support service using their smartphones, the survivor may be put in a more dangerous situation. Smart technology solutions, in the opinion of APET, should bolster the extensive and dependable organisation of preventative efforts based on ethical standards and protocols of the gender-based violence community and also meet the digital safety and privacy standards.

Therefore, smart technologies can be used to create applications and digital platforms to end gender-based violence and promote gender equality. For example, digital technologies can be used to create preventive technology solutions to enhance awareness and mitigate the user's risk of violence. For instance, the Safetipin application utilises crowdsources and maps real-time data from mobile application users to offer public safety information.[22] The mobile application uses the location safety scores to assist the users, particularly women and girls, in scheduling their routes and obtaining safe places to stay. This application is utilised by approximately 100,000 people in 65 cities, including Jakarta and other cities in Indonesia.[23]

Additionally, the Safetipin data can be utilised to improve the safety of public spaces by improving developmental policies and civilisation projects. For example, the city government of Delhi in India collects data to address the city's areas with poor safety scores. Consequently, the city installed 5000 streetlights and improved police patrols in such areas.[24] A similar smartphone Ec Shlirë (Walk Freely) application was developed by Girls Coding Kosovo to enable users to report instances of sexual harassment discretely.[25] Notably, the reports can be visualised through an interactive map and shared with authorities.

Furthermore, in September 2015, Safetipin consorted with Uber to enable reporting of Uber harassment by female users.[26] In Delhi, Uber has since installed outward-facing cameras on the dashboards of cars so to photograph the various parts of the city.[27] This is also enabling authorities to map out areas that are well-lit and determine their population to collate safety scores.

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In partnership with Uber, the Safetipin application is expanding to 50 cities across Africa, Asia, and South America.[28] Innovative technology is being utilised to tackle the risks of sextortion and online harassment. This technology utilises an AI-powered chatbot and fictional character that was developed by Caretas in Brazil.[29] In addition, smart technologies can be used as a gender-based violence e-pocket guide app to enable humanitarian practitioners to support survivors when there is no gender-based violence expert and service available. For example, Malaysia adopted this e-guide during the COVID-19, even for people living with disabilities, and translated it into Bahasa Malaysia and Mandarin by UNICEF to assist grassroots women's organisations with local expertise and trust.[30]

Smart technologies are also enabling enhanced gender-based violence service provision, reach and response quality. For example, the Primero/GBVIMS+ is an open-source technology solution for gender-based case management.[31] As such, the system, including a mobile application, is significantly enhancing the quality of care for survivors in emergency contexts. This application enables safety and confidential data collection, electronic case referral, and remote collaboration between caseworkers and supervisors. This platform has been implemented in Timor Leste and Indonesia.[32] In addition, the Remote Offered Skill Building Application (ROSA) enables vital training and knowledge exchange for staff that is assisting gender-based violence victims.[33] On the other hand, the Medicapt mobile application can capture court-admissible forensic evidence from sexual violence survivors and securely transmit this data to the police, lawyers, and judges.[34] The VictimsVoice application enables gender-based violence survivors to record legally admissible incidences of abuse in a safely and securely manner.[35]

Finally, APET observes that there are numerous opportunities for smart technologies to improve online safety, mitigate risks, and respond to cases of gender-based violence in a timely and efficient manner. As a result, APET challenges African countries to close the digital gender gap while also ensuring that technology remains safe and accessible to women and girls. Consequently, the technology industry should be involved and held accountable for improving access to well-managed violence prevention and strategic response initiatives. APET also recommends that the development of technology solutions include strong user-centred design processes in order to accurately incorporate the lives, risks, and realities that women and girls face. Due to this, girls and women should be at the forefront of technological development, investing in safe, smart technology and seeking innovative ways to eliminate gender-based violence. Furthermore, Africa should investigate and capitalise on public, private, and institutional partnerships and collaborations to raise awareness and find viable solutions to gender-based violence.

Link: https://www.nepad.org/blog/leveraging-smart-technologies-tackle-gender-based-violence-africa

Blog #22 Published on Sep 6, 2022

Preserving the Lungs of Africa: Leveraging on Briquettes from Agricultural Waste as an Alternative Fuel Source

The Africa Union's Agenda 2063 considers climate-resilient communities and economies as principal to supporting renewable energy, energy efficiency, and nature-based solutions to focus on biodiversity through sustainable land management, forestry, oceans, and ecotourism.[1] This includes pursuing resilient agriculture through inclusive economic development and green jobs. This is establishing green and resilient cities to address water management and treatment and provision of renewable energy sources through information, communication, and technology. The African continent is generating plenty of agricultural waste material that can be repurposed into fuel for cooking.

To this end, Africa's decreasing forest ecosystems can be preserved irrespective of climate change.[2] The African Union Climate Change and Resilient Strategy and Action Plan (2022-2032) frameworks are imperatively addressing deforestation in Africa because of the urgency of climate change and global warming.[3] It has been reported that deforestation is a major driver of climate change.[4] Notably, the repercussions of climate change have been severe for African countries. This is because they have resulted in unpredictable weather conditions that have substantially destabilised agricultural activities; thereby, threatening food security.[5]

Africa is the world’s third largest continent for global forest area constituting 26% of land in Africa classified as forest and a home for approximately 43 billion trees.[6] Regrettably, it has been reported that African forests are being demolished at a rate of about 4 million hectares per year. This is almost as twice as fast as the global average of forest destruction.[7] The Food and Agriculture Organization (FAO) reported that more than 10% of Africa’s total forest cover was lost between 1980 and 1995.[8] This trend has also persisted since then in the last few decades.

Trees and forests are balancing the biological variation in the form of flora and fauna in terrestrial and aquatic environments. Forests are also enabling access to clean water, air, shade, and shelter. Furthermore, numerous animals live in forests, in complex communities of flora, insects, fungi, viruses, and bacteria. Most importantly, forests are lowering the ozone depletion rates and subsequently reducing the rate of global warming and climate change.[9] Standing forests address the impacts of climate change by absorbing greenhouse gases, as well as regulating the water flows, and protecting the coastal communities from extreme events and sea level rises.[10] Additionally, forests are providing migrating plant and animal species routes and stable habitats. Therefore, cutting down trees substantially reduces the forest’s capacity to absorb carbon dioxide to produce oxygen and generate rainfall.[11] Consequently, this is exposing African territories to severe droughts and worsening the ongoing water crisis that is progressively increasing in Africa.

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The causes of deforestation in Africa comprise the need to expand agricultural areas for farming and civilisation areas residences, cities, and roads amongst others. For example, the World Cocoa Foundation (WCF) and Mighty Earth, between 2001 and 2014 reported that 10% of Ghana's trees and 25% of Côte d'Ivoire's forests were cleared for cocoa production.[12] Furthermore, approximately 40% of Ivorian plantations were constructed illegally inside protected areas.[13] Additionally, commercial logging and failing government policies have also resulted in massive deforestation. For example, only 24% of African forests are managed and protected for long-term preservation. Unfortunately, there have also been illicit mining, logging, and consequently the exploitation of timber in most African places.[14]

To provide energy, the production of charcoal has significantly contributed to Africa's deforestation. Here, this readily available resource serves as the primary source for cooking fuel for African populations. Furthermore, as these populations expand and the demand for charcoal rises, deforestation worsens. In addition to wood waste, the manufacturing of charcoal results in significant carbon emissions. Notably, more than one-fourth of the primary energy source in Africa is provided by wood and charcoal. Therefore, between 70% and 90% of the African people are reportedly cook using wood as a major source of energy for cooking. [15]

Thus, the African Union High—Level Panel on Emerging Technologies (APET) is challenging African countries to consider turning agricultural wastes into fuel sources. However, agricultural waste is known to burn so rapidly, thereby, making it difficult to maintain and control a steady fire and combustion process. Furthermore, the agricultural waste does not fit in the shape and construct of traditional coal pots and stoves. Even though recycled wood wastes had found some applications in retrofitted industrial boilers, however, the direct burning of unfastened and bulky agricultural wastes remains inefficient and ineffective. This is because the loose agricultural waste material has limited energy value per volume, thereby, uneconomical. In addition, agricultural waste causes challenges in collection, transportation, storage, and handling.

Therefore, to improve and efficiently utilise agricultural residues, they can be densified into solid fuel pellets, sometimes referred to as briquettes. Worth noting is that the creation of fuel pellets involves reducing the size by pressuring the bulky biomass together.[16] Consequently, the resultant solid fuel briquette, usually in log form, with specific weight improves its storage and transportation. This makes the briquette attractive for use at home and in industry. Contrasting to the loose and bulky form, the combustion of briquettes can be made more uniform. Thus, the briquette materials can be burnt directly as fuel, in the same way, the fuel wood and coal in stoves and ovens are used.

APET notes that briquetting is an existing technology and innovation that is substantively enhancing the handling properties of the combustible material by boosting the volumetric value. This makes the briquettes applicable for a variety of domestic and industrial purposes. The briquettes can not only utilise agricultural wastes, but also a combination of varied materials such as waste wood, sawdust, agro-industrial residue, plastic, and rubber. This is possible for all forms of combustible material if they can be compressed by industrial press machines. In this way, APET recognises that African countries adopt this technology into their systems as the uptake of briquette fuel has been limited.[17] Notably, briquetting can reduce insects,decrease the volume of waste materials, generate efficient solid fuel of high thermal value, require limited energy to produce, protect the environment, and provide job opportunities. This is carrying limited demonstrable risks and hazards. The raw materials suitable for generating briquettes include rice straws, wheat straws, cotton stalks, corn stalks, sugar cane waste (bagasse), and fruit branches, among others. Thus, since briquettes are generated from waste materials, APET believes that they are more sustainable and

energy efficient. Consequently, APET observes that this can significantly reduce the pressure on forests and lower pollution levels in urban areas. APET also observes that within the strategic circular bioeconomy, the briquettes cannot only decrease biomass waste materials, but can also promote more sustainable bioresources and market-based activities. This can significantly boost African entrepreneurship and strengthen the manufacturing industry. For example, the African market for cooking and heating fuel has demonstrated significant potential in establishing briquette production facilities across rural Africa.[18] For instance, the Rwandan Government is promoting briquette fuel as an alternative to wood and charcoal for cooking purposes. The target is to decrease the dependency on charcoal use from 79% down to 42% of the population by 2024.[19] This can consequently reduce pressure on Rwanda's forests.[20] For example, the Coopérative pour la conservation de l'environnement (COOCEN) is producing and supplying briquettes to prisons and schools in Kigali.[21] Fundamentally, the COOCEN's briquetting project is preventing the burning down of 1,800 tonnes of firewood per year or the cutting of at least 9,000 trees per year. Such reductions are significantly decreasing the deforestation of approximately 9 hectares of forest plantation.[22] Consequently, this is estimated to reduce approximately 297 tonnes of carbon dioxide emissions per year.

Kenya is producing tea in Africa and the tea factories are utilising ample firewood to dry the tea. Regrettably, the process of drying tea aggravates deforestation as the factories are cutting down millions of trees each year to keep up with the demand for production. For example, estimations are showing that tea factories are currently utilising up to approximately 1 million cubic meters of firewood annually.[23] As a result, using firewood to dry tea is substantially leading to deforestation in Kenya. To address this challenge of drying tea, Kings Biofuels, a briquette-making company, in partnership with the Kenya Tea Development Authority, is producing more than 200 tonnes of sawdust briquettes per month. Consequently, this is saving the destruction of millions of trees when drying tea in Kenya.[24]

The Zambian Emerging Cooking Solutions (ECS) is selling clean cooking stoves and pellets as fuel. This is enabling a unique cooking system by utilising an economical, plentiful, and essentially untapped source of energy for cooking in the form of a mix of pine and eucalyptus sawdust, and peanut shells. This sawdust is waste material generated from local sawmills that receive their wood from state-owned plantations. Notably, there are no pristine and/or indigenous trees that are utilised to produce briquette fuel. In addition, the ECS also utilises a variety of biomass such as rice husks, maize, and straw, among others. They are primarily utilising agricultural and forestry waste so the original forests can be spared. Notably, the clean-burning and micro-gasifying stoves for homes and restaurants are using the ECS briquette pellets from below market price of the equivalent in charcoal.

In conclusion, APET believes that the African continent possesses immense potential for adopting cleaner energy. Thus, an adoption of the briquette fuel can substitute charcoal utilisation and effectively benefit millions of lives. This can effectively create thousands of cleaner and healthier communities with the help of governments, civil society, and private sector entrepreneurs. In this way, African countries can reduce the pressure on forests and promote green technology. As an alternative source of fuel, green energy is promising to grow in the next few years. However, African countries should actively participate to increase the uptake of such existing and emerging technologies. Such efforts can lead to the accomplishment of the aspirations of the various frameworks on the green technology-enabled socio-economic development plans.

Link: https://www.nepad.org/blog/preserving-lungs-of-africa-leveraging-briquettes-agricultural-waste-alternative-fuel-source

Blog #23 Published on Sep 7, 2022

Enhancing Maize Production in Zimbabwe by Utilising Climate Smart Technologies

Maize is the world's most prevalent grain crop and a staple crop for most African countries. Notably, maize is a staple food for over 1.2 billion people in Africa and Latin America.[1] In Africa alone, it is estimated that maize is the primary food crop for more than 300 million people.[2] In 2018, Africa produced over 75 million tonnes of maize, accounting for 7.5% of global maize output.[3] Maize accounts for approximately 24% of cropland in Africa, with an average output of nearly 2 tonnes per hectare annually.[4] All parts of the crop can be utilised to generate food to feed people and animals.

Like other African countries, Zimbabwe regards maize as a staple food and a strategic commodity. This is because the crop contributes over 50% of the country's calories for approximately 13.1 million people.[5] Not only is maize used as human food, but it is also in the animal feed industry. This accounts for between 47% and 75% of total energy consumption to support the production of 37 million broilers and 1.5 million laying chickens per year.[6] This is also supporting 17 thousand units of pigs and the dairy herd of approximately 23 thousand, among other livestock dependent on manufactured maize feeds.[7]

To meet these demands, Zimbabwean farms maize in more than 90% of the country's 1.3 million farming families.[8] Maize occupies more than 60% of the total cropped area and covers between 80% and 90% of the entire land area under cereals.[9] It also utilises approximately 50% of the fertilisers purchased within Zimbabwe.[10] Consequently, maize contributes nearly 14% of Zimbabwe's national Gross Domestic Product.

Despite having enough arable land to plant and harvest adequate maize to feed the Zimbabwean population, the country has persistently remained food insecure in Africa. Reports in Zimbabwe demonstrated that between August 2021 and September 2021, the number of people with inadequate food grew by 100,000 from 5.6 million to 5.7 million.[11] Consequently, the number of people using crisis level and negative coping techniques grew by 500 000 to 8.53 million in August 2021. This was from 8.48 million by the end of August 2021.[12] Reports also showed that approximately 27% of rural Zimbabweans were food insecure during the lean season of January to March 2022.[13] Numerically, this equates to about 2,95 million people who require a total of 263 thousand metric tonnes of maize to feed.[14]

Reports have characterised the main drivers of food insecurity in Zimbabwe, including the worsening droughts and recurring cyclones due to global warming and the COVID-19 pandemic.[15] Notably, the pandemic has amplified the number of Zimbabweans struggling with malnutrition and micronutrient deficiencies, as well as increased poverty levels, interrupted public health and school feeding programmes and weakened nutrition programmes such as food fortification.[16]

Furthermore, the high cost of farming inputs in Zimbabwe due to the devalued local currency has complicated farming activities such as purchasing fertilisers.[17] The drive toward food security in the 21st century has resulted in various African countries, including Zimbabwe, establishing and implementing food security policies as part of the government's top agenda. These Zimbabwean food security policies are expanding agricultural production and activities through the National Nutrition Strategy and National Policy on Drought Management frameworks.[18] These strategic policies have identified the utilisation of existing and emerging farming technologies as innovative farming tools to accomplish self-food sufficiency and security.

The African Union High-Level Panel on Emerging Technologies (APET) supports utilising existing and emerging technologies and innovation to achieve food self-sufficiency and security. APET argues that implementing innovation-led and technology-based tools to support farming activities can effectively strengthen agricultural activities such as planting, harvesting, and post-harvesting activities to enhance agricultural outputs and minimise food losses.

APET advises that African countries can adopt and implement technologies suitable for effective planting, monitoring and management of crops, and the storage and conservation practices of crops, as well as value-added manufacturing, to increase the value of harvested products. This can be accomplished by optimally enhancing the deployment of maize storage technologies and techniques, using drones to monitor the fields, and using climate-smart technologies. These technological practices can help farmers accomplish higher maize production yields. However, these technological practices should be carefully adopted to suit local settings, from the production to the consumption value chain.

Between 10% to 20% of the maize harvest in Zimbabwe is lost through post-harvest handling due to pests and diseases.[19] To address this challenge, Zimbabwean farmers have been progressively utilising hermetic storage facilities to effectively prevent post-harvest maize losses.[20] The hermetic storages include Metal Silos, GrainPro Super Grain Bags, and Purdue Improved Crop Storage (PICS) bags.[21] These storage methods are known to suppress insect pest build-up, insect grain damage, and weight loss in stored maize grain.

Furthermore, maize crop inspection is labour intensive, especially in large hectares of fields. Thus, the use of drone technology is potentially reducing the labour and the expensive data collection from maize fields by at least 10%.[22] Maize farmers in Zimbabwe are progressively adopting drone technology to collect data from the field accurately. This enables effective maize field management and fertiliser applications. In addition, this enables crop inspection and is used to spray insecticides in maize fields much faster than hand-held sprayers.[23]

Droughts are also a serious concern in Zimbabwe's maize production. Therefore, transforming agricultural mechanisms into smart climate technologies is being considered in Zimbabwe. Zimbabwean farmers are progressively adopting smart climate technologies to address the threats posed by droughts due to global warming and climate change. These smart climate technologies include the wetting front detector, often known as the "full stop". The full stop is a funnel-shaped sensor placed on the ground to irrigate crops in water-scarce areas. Notably, the sensor can detect the amount of water and nutrients available in the soil and automatically provide as per the information available. In this case, the funnel indicates the surface to communicate when there is limited soil wettability in the crops' root zone. It can also collect soil samples to determine salinity and nutrient levels.[24] In this way, the farmers can apply fertiliser more accurately.

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Zimbabwe tested and deployed an instrument called the chameleon for soil monitoring purposes. The chameleon comprises three or four short cords in different colours with sensors at their terminal end. The cords are inserted into the soil at different depths. A hand-held reader will effectively show a blue light if the soil is wet, green if the soil is moist, and red if the soil is dry. This enables farmers to economically and timely irrigate their crops to prevent overirrigation and fertiliser leaching. Since the device shows the fertiliser content of the soil, it is helping Zimbabwean farmers prevent fertiliser wastage and enabling micronutrient management. Such data enables farmers to know the nutrient contents to determine the timely application of limited nutrients in the soil, assist with water irrigation management, and promote crop management decision-making to enable high crop yields.

Rural farmers are utilising conservation agriculture as a crop management system. This system is based on minimum soil disturbance, crop residue retention mulching, and crop rotations. Furthermore, there are campaigns of experience sharing to promote climate-smart feed production and water conservation initiatives being implemented.[25] Some farmers are also experimenting with techniques to help preserve moisture and enhance soil fertility.[26] These farmers are utilising plastic and organic mulch, conservation agriculture basins, and tied ridges without mulch or with either plastic or organic mulch.[27] Other farmers are engaged in intercropping and farming drought-tolerant maize varieties, quality protein maize, and pigeon pea.

APET notes that climate-smart agriculture in Zimbabwe comprises farming practices that enhance farm efficiency and profitability, support farmers in acclimatising to the negative effects of climate change and alleviate climate change effects. The climate-smart practices, such as localised conservation agriculture, are conserving soil moisture, preserving crop residues for soil fertility, minimally disturbing the soil, and diversifying through rotation or intercropping. For example, farmers practice soil carbon sequestration to decrease greenhouse gas emissions.[28]

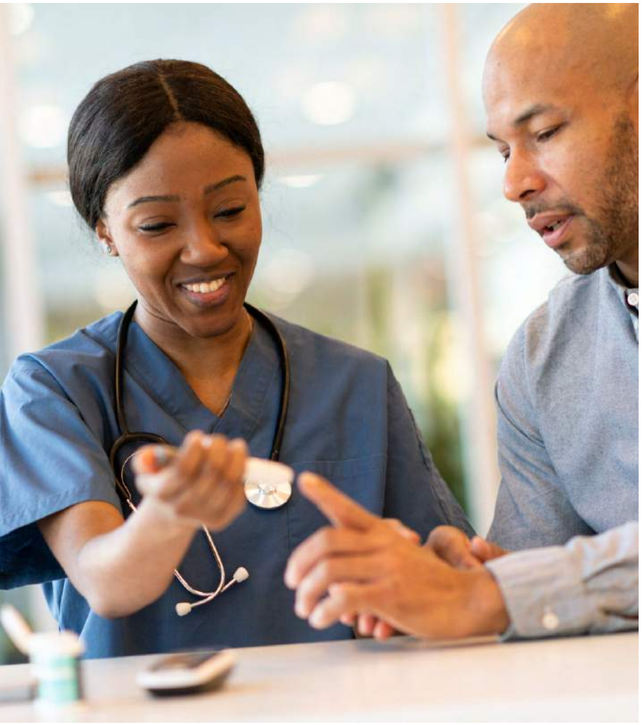
Even though maize production in Zimbabwe faces numerous challenges, APET believes deploying modern maize farming innovations and technologies can ensure food security. Thus, African governments are encouraged to adopt and implement agricultural technologies to achieve food security in Africa. However, African countries should enhance their policymaking and implementation to cater for emerging technologies such as drone technologies and innovation.

Link: https://www.nepad.org/blog/enhancing-maize-production-zimbabwe-utilising-climate-smart-technologies

Blog #24 Published on Sep 15, 2022

Strengthening Africa's Healthcare through Solar-Powered Mobile Health Clinics

A prosperous Africa based on inclusive growth and sustainable development is envisioned in the African Union Agenda 2063 aspirations. For Africa to realise these aspirations, there is a need to safeguard the citizenry's healthcare and food security. Therefore, sufficient investment should be made to enhance access to high-quality healthcare for every African citizen. Achieving universal healthcare access should be prioritised as a key development urgency. Regrettably, Africa's healthcare systems have barely addressed the capacity of institutional integrity, adequate human skills resources, barely improved financial and technical capacity, and hardly monitored the policy implementation milestones to improve the deployment of the healthcare system.[1]



The COVID-19 pandemic has exposed the weaknesses of Africa's fragile healthcare system. Reports have demonstrated that Africa has a heavy load of chronic diseases and roughly twice as many diseases per person as the rest of the world.[2] In addition, transmissible diseases such as HIV/AIDS and tuberculosis further destabilise the healthcare system. Notably, malaria remains predominant among the causes of death among the African people. Mother and child mortality rates are also four times greater in Africa than in the rest of the world.[3] At the same time, the World Health Organisation has reported that some African countries can barely afford the minimum basic health care of US$34 to US$40 per person per year.[4] This makes Africa's healthcare system fragile and incapacitated to cater for its citizens adequately.[5]

Accomplishing comprehensive and efficient healthcare coverage across the African continent remains a priority for easier access to healthcare services and facilities. Regrettably, most Africans, mostly in rural Africa and hard-to-reach places, which is at least one-sixth of the African population, live more than two hours away from a public hospital and do not have access to healthcare services and facilities. Additionally, only one in eight lives more than one hour away from the closest healthcare facility. Therefore, due to the distance barrier to accessing healthcare facilities, many diseases and illnesses disproportionately affect certain African populations. This is due to disparities in healthcare access and social determinants of healthcare access. Thus, access to healthcare facilities and services needs to be improved in Africa. This can enable African residing in rural and hard-to-reach places to have access to healthcare facilities and services effectively and sustainably. Thus, considerations toward adopting mobile health technology should be made to enhance access to healthcare services.

The African Union High-Level Panel on Emerging Technologies (APET) believes that innovative healthcare delivery strategies such as Mobile Health Clinics (MHCs) can potentially reduce healthcare disparities for the Africa’s most vulnerable populations. The MHCs significantly enhance emergency healthcare, conducting preventative health screenings and managing chronic illnesses. APET believes that MHCs can also provide specialised, high-impact, and cost-effective healthcare services. In addition, the MHCs can be localised to address the local community's changing healthcare needs.

This can be accomplished by opening their doors directly into communities and leveraging and strengthening the existing community resources.[6] Thus, mobile clinics can provide adaptable and practical choices for treating vulnerable and isolated communities that cannot access healthcare facilities easily.

However, the limiteded access to electric power is the impeding factor for applying MHCs in isolated and hard-to-reach places. This limited electricity access impedes storage, lighting, and clinical operations. Consequently, healthcare workers fail to safely deliver their healthcare services, such as emergency obstetric care and other medical procedures. In addition, the capability to refrigerate vaccines, which are saving countless millions of lives annually, depends on having access to dependable electricity. APET notes that electricity is also needed to prevent and treat non-communicable illnesses through vaccinations and temperature-specific medicines, and the demand for cold storage space is needed.

Furthermore, APET realises that the underdevelopment of the energy capacity with both power generation and distribution is impeding the electricity supply and barely keeping up with the demand. Some African countries are experiencing power outages 50% of the time.[7] As a result, the prevalent incapacity to access electricity from the national grid compels many clinics to rely on diesel-powered generators.[8] Unfortunately, these generators remain unreliable, expensive to operate, and environmentally unfriendly. Additionally, the backup generators cannot counteract the sudden blackouts that potentially damage the delicate medical machinery and disrupt medical procedures, endangering the patients' lives.

Thus, by providing adequate, reliable, renewable electricity, mobile health facilities can operate over extended hours. This can allow medical practitioners to consult with more patients daily and offer emergency medical services around the clock. Currently, mobile health clinics cannot operate after hours because of limited access to essential medical tools and lighting sources. These clinics significantly rely on paraffin lamps, candles, and hand-held torches to address these challenges.[9] Unfortunately, such light sources affording the facilities provide poor light quality, emitting hazardous and interfering gases and may pose a significant fire risk.

MHCs are designed to provide primary and community-level services in remote places with low energy consumption and limited connectivity to the electricity grid. Since the grid extension to these places is difficult to construct and maintain because of costs, APET proposes adopting off-grid MHCs that can be powered by renewable energy such as solar and wind energy.[10] This offers cost-effective options for powering remote off-grid healthcare facilities. However, the challenge with the solar system is power storage. Therefore, APET is recommending using next generation batteries such as lithium batteries to address the electricity storage challenge.[11]

APET, through the reports, namely, "Micro-Grids – Empowering Communities and Enabling Transformation in Africa"[12] and an upcoming APET report, namely, "Let There Be Light: Next-Generation Batteries for Africa's Energy Needs" to be published in 2022, have challenged African countries to consider the great potential generating off-grid renewable energy through solar, wind, and even hydropower. Worth noting is that the costs essential for installing these sustainable power sources are continually dropping. For example, solar panel prices have declined by approximately 80% over the 10 years.[13] APET recognises that renewable energy can offer mobile clinics economical, cost-effective, dependable, and autonomous sources of electricity that can substantially expand and enhance healthcare access and delivery where electric power remains challenging — especially in remote rural areas.[14]

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APET observes that small photovoltaic (PV) solar power systems are currently being utilised across Africa.[15] These solar systems enable healthcare workers to deliver care and diagnoses, charge cell phones for communication and safeguard vaccines and other medications in portable cooler units.[16] On the other hand, large PV solar arrays are utilised to provide electricity to a range of critical devices such as lights, water pumps, cell phones, and refrigerators. They are also powering laboratory equipment and a host of essential medical devices.

Despite this substantive potential to address the healthcare system, APET observes the limited application of renewable energy in African mobile healthcare facilities. These facilities remain underfunded and can barely afford the installation costs for renewable energy.[17] To address this challenge, APET challenges African countries to pursue public-private initiatives. This is because multinational companies operating in Africa can support and fund the essentials of primary healthcare in local communities, such as electricity.[18]

There are currently funded projects on big hospitals and clinics implementing renewable energy, such as solar power, to power their various activities. For example, Enel Green Power (EGP) works with St. Luke Hospital in Wolisso, Ethiopia, located about 110 kilometres southwest of Addis Ababa. Wolisso has more than 60,000 people, and the hospital serves a patient base of over a million people.[19] St. Luke is suffering frequent power outages despite its significance to the community. Consequently, this compels the hospital to resort to diesel generators to safeguard a consistent power supply. However, EGP has designed and built an innovative solar hybrid system for St. Luke hospital to power its operations during power outages. The solar power panel comprises a photovoltaic plant and lithium batteries. As a result, the hospital can sustainably deliver over 320 kWh of electricity.[20] Interestingly, the renewable energy plant can also manage the flow of energy in real-time to ensure a continuous power supply. This ensures that the hospital can provide sustainable healthcare to approximately 79,000 outpatient visits, 15,000 hospitalisations, and 4,000 births annually.[21]

Worth noting is that the incorporation of solar power has proven cost-effective and efficient. It provides savings—money that the hospital can reinvest into the community's healthcare services. Therefore, this demonstrates the powerful nexus between energy and health care in Africa by promoting access to electricity as a key enabler of access to healthcare. However, this addresses a big hospital; APET believes this can also be translated into mobile healthcare clinics for remote places. To this end, some African countries have adopted the utilisation of renewable energy to power their mobile clinics.[22] For example, Samsung and South Africa have established and launched mobile Solar Powered Health Centres in remote rural areas.[23] These mobile clinics are intended to eradicate the economic and geographic barriers that impede people across Africa from accessing quality medical treatment. Notably, South Africa has approximately 20% of the population having access to private medical schemes. This leaves the public healthcare sector battling to serve the remaining 80% of the population.[24] Thus, South Africa, in partnership with Samsung, has been installing Solar Powered Health Centres from 2015 to reach one (1) million people.[25] These mobile healthcare centres are part of Samsung's broader Corporate Social Responsibility goal to positively impact the lives of five million people in Africa from 2015.[26]

Essentially, the Solar Powered Health Centre is a seven-metre truck comprising a fully equipped ear, eye, and blood clinic and dental surgery.[27] The facility focuses on screening people to determine medical conditions such as diabetes, high blood pressure, tooth decay, and cataracts. In addition, as part of capacity building, the facility also focuses on educating communities about health issues and persuading people to undertake medical tests as preventative measures. For example, the eye and blood clinic is situated at the front of the truck. This unit consists of a reclining chair for the patients, a sink, and a mirror. This also has high technology equipment, including a blood analyser and a spectacle repair kit. It also has a "Reichert PT100 portable NCT", a non-contact tonometry test to

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determine the pressure inside the eye. The X-ray unit constitutes an air motor, mobile suction unit, water distiller, and needle incinerator. Furthermore, this mobile clinic has a station for testing for HIV, malaria, and other medical conditions. A dental clinic is also equipped with the usual chair and overhead light. https://www.nepad.org/blog/strengthening-africas-healthcare-through-solar-powered-mobile-health-clinicsAPET appreciates and encourages the private sector participation in providing healthcare solutions for the public sector. Notably, the Department of Health in South Africa, pharmaceutical companies, and Samsung are participative in this project.[28] Other partners include medical universities, and organisations that are involved in health care such as World Vision, and Doctors without Borders. In June 2013, Samsung incorporated a mother-and-child clinic with the capacity for 4D ultrasound scans and delivering babies.[29] Furthermore, APET calls for the incorporation of power sources that will be reliable as such projects are expanded throughout the African continent.

In 2007, the partners of the Department of Health in Malawi initiated the Abwenzi Pa Za Umoyo (APZU) in the rural Neno district using solar energy.[30] APET observes that the value of this mobile clinic cannot be paralleled because the initiative was established to provide comprehensive, community-based care to a catchment area of approximately 125,000 people.[31] In October 2013, the mobile clinic was executed to expand and enhance access to quality healthcare services to marginalised, remote, and underprivileged populations in Malawi's rural Neno district.[32] Notably, the clinic has accomplished the overarching strategic intentions of PIH Malawi of providing healthcare accompanied by socio-economic support. For example, the clinic provides antenatal services for pregnant women, immunisation, growth monitoring for children under 5, family planning for women of childbearing age, HIV testing and counselling, rapid malaria test, and rapid typhoid test.[33] Furthermore, medication prescriptions and distributions are also part of the mobile clinic process.

However, one of the main challenges encountered, especially during the deployment of COVID-19 vaccines in rural Africa, was the limited capacity to refrigerate the vaccines. Thus, cold storage of medicines and vaccines remain difficult, irrespective of the weather conditions in some African countries. To address this challenge, the African Medical and Research Foundation (AMREF) utilised solar-powered mobile clinics to distribute COVID-19 vaccines in Kenya to enhance their immunisation efforts.[34] APET recognises that the solar-powered clinics have enabled the organisation and administering of COVID-19 vaccines in areas with limited or no electricity.

In addition, Zimbabwe has an erratic electricity power failure system, which negatively impacts healthcare delivery in rural areas. Zimbabwe's rural villages, such as the Goromonzi district, approximately 40 kilometres northeast of Harare, have created mobile clinics in the form of a car that has been transformed into a mobile health clinic.[35] This mobile health clinic comprises a wind turbine and solar panels to power a freezer where vaccinations may be stored.[36] Consequently, the clinic has managed to provide vaccines to previously disadvantaged communities around the Goromozi district.
Finally, to accomplish the AU's Agenda 2063 and United Nation's Sustainable Developmental Goals (SDGs), APET is challenging African countries to prioritise expanding healthcare access to their citizens by deploying solar-powered mobile health clinics. This will enable all Africans to access healthcare facilities irrespective of geographical location. However, investments in renewable energy as an alternative source should be made to enable the deployment of these mobile clinics. APET is challenging innovators and policymakers to enhance mobile clinics with renewable energy to improve the healthcare of the African continent. Thus, investments and policy implementation toward enhancing mobile healthcare clinics should be pursued and expanded. This will strengthen healthcare delivery in a cost-effective manner, especially in the most remote and hard-to-reach places in Africa.

Link: https://www.nepad.org/blog/strengthening-africas-healthcare-through-solar-powered-mobile-health-clinics

Blog #25 Published on Sep 15, 2022

Digitalising the Poultry Industry in Africa

Agriculture is an important economic activity since nearly two-thirds of Africans rely on the agricultural value chain for their income. This makes agriculture key to socio-economic development and growth.[1] Worth noting is that agriculture contributes to an average of 30% and 60% of each African country's Gross Domestic Product and approximately 30% of the value of exports.[2] Furthermore, more than 60% of Africa's agricultural activity relies on smallholder farming.[3] Yet, Africa's full agricultural potential remains untapped as Africa is still negatively impacted by hunger and malnutrition challenges. Studies are estimating that Africa's agricultural potential could be 2 or 3 times more productive if African countries could leverage the capacity of agriculture.[4]

Chicken farming in Africa is progressively growing as the global demand for chicken meat and eggs is rising at an exponential rate. For example, the total revenue of production and exporting of the chicken meat market was estimated at US$ 11.4 billion in 2018.[5] This increased by 6.1% from the previous year. As such, the market value progressively increased by an average of 1.8% per annum between 2013 and 2018.[6] Africa's chicken meat market may steadily grow to 11 million tonnes by 2030.[7] Lucrative poultry business opportunities include egg production, meat production, chick incubation, and chicken meat processed products.

Africa's poultry business is booming because of the continent's growing population and socio-economic expansion as Africans source their animal protein from chicken and eggs. Despite the poultry industry boom, chicken poultry production has remained low compared to other regions of the world. Notably, Africa produces only 4% of the world's chicken poultry products.[8] Thus, there is a need to enhance Africa's poultry production to match the rising consumption rates. This is because the African continent is continually importing poultry.[9] For example, between 2001 and 2021, poultry imports expanded from 0.33 million metric tonnes to 1.96 million. Unfortunately, this trend is envisaged to increase to approximately 2.54 million metric tonnes annually by 2031.[10] South Africa, Ghana, and Angola account for more than half of the region's chicken imports.

Several hurdles must be addressed to enhance poultry production in Africa and the nutrition status of Africans. For example, the poultry's immunity, health, and productivity should be enhanced to strengthen the poultry industry's future growth across the African continent. Furthermore, consumer confidence, product quality and safety, product types, and vaccinations and medicines for poultry diseases should be adequately addressed as a strategy to strengthen the economic viability of the poultry industry.

The African Union High-Level Panel on Emerging Technologies (APET) suggests that African countries should build innovation and technological capacity to tackle these poultry-related challenges.

This can extensively expand the production capacity of poultry production across Africa. APET suggests that poultry production systems should be adjusted to enhance energy usage and resource efficiency. This can be accomplished through innovation and technologies with a low carbon footprint. However, this advancement should be sustainable infrastructural development across the poultry value chain, which includes breeding, hatching, production, processing, and consumption.

APET encourages poultry farmers to utilise innovative approaches and technologies such as automatic water dispensers, robotics, and automated feeders are emerging as key technologies to improve poultry farming in Africa. During meat production, robots can be utilised to separate chicken meat from bones to streamline manufacturing operations. In addition, automation of some of the routing processes of growing chickens, such as controlling litter, administering immunisations, and evaluating the welfare of the birds, can also strengthen production and enable employees to focus on processing and decision-making.[11]

Technologies such as remote sensing can be used for data collection to enable precise poultry production by quantifying weight and monitoring chicken uniformity.[12] Thus, data collection can easily process and enable farmers to automate and streamline poultry production. For example, farmers can collect video and audio files to enable users to have better interactive monitoring tools for the flock's health and behaviour and further utilise image recognition software and robot "nannies". This can augment connect feed programmes to enable farmers to determine the cost-effective nutritional diets for the chickens.[13] Such technologies can also augment farm management software for swine and develop digital solutions for the poultry market.

As part of artificial intelligence, machine learning can strengthen data collection and processing to enable decision-making with minimal human intervention. Machine learning can integrate photographic, video, and audio data to formulate new solutions for poultry operations. For example, the ChickTrack model is a digital tool that enables science-based animal husbandry practices and consequently promotes positive welfare for poultry in animal farming.[14] Furthermore, as part of artificial intelligence, machine vision can be utilised to assess eggs and identify flaws such as cracking and internal blood spots. The scanning of eggs enables farmers to determine fertile and infertility of eggs during incubation. For instance, by day five of incubation, the system can accurately predict fertility by over 98%.[15]

Modernising poultry production can be accomplished through flock breeds, feeds, healthcare, and marketing innovation. This can improve meat and layer breeds by introducing rearing systems to include cheap and semi-automated local hatcheries for raising chicks for one to 21 days.[16] This can enhance delivery and reduce mortality. Furthermore, the full-time containment within poultry houses can offer lighting, continuous water supply, and efficient utilisation of feed. Since feeds constitute a bigger share of poultry raising, an intensified production can enhance affordable feeds at different meat and egg production stages.[17]

Poultry health should also be improved by availing universal vaccination of chicks against diseases such as Newcastle viruses and boosting their health with preventive antibiotics. Therefore, wider access to veterinary services should be prioritised for poultry as they may pose human biosecurity in Africa. Poultry farmers can access these veterinary services through digital technologies to improve promptness and efficiency. Furthermore, commercialised poultry production should involve staggering production batches, the slaughter of poultry to industrial standards, mechanised de-feathering, and reliable egg grading. As such, larger-scale producers should expand beyond first-stage processing of the whole bird and offer poultry parts.

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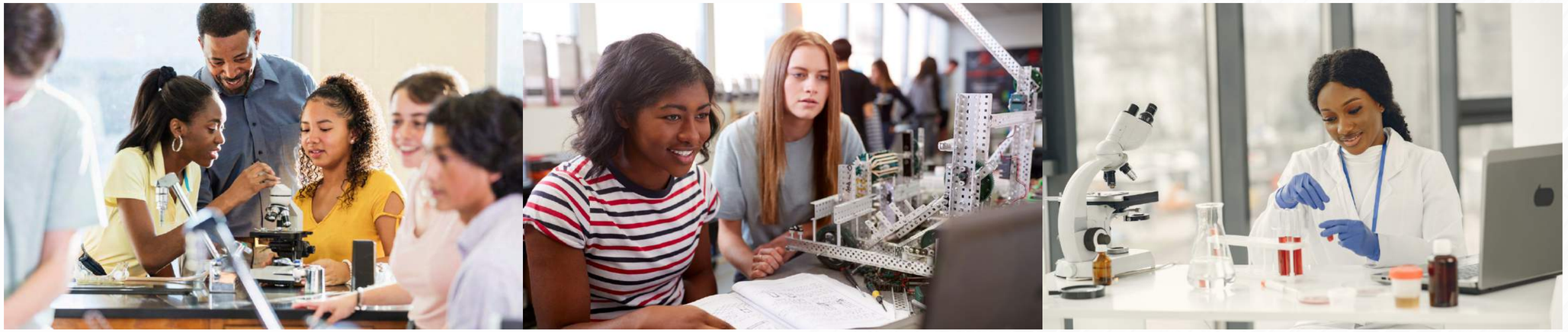
To access more markets, small-scale poultry farming operations should be organised into production and marketing hubs. This can substantially benefit the production scale and perform collective sales. This poultry production can also be digitalised to encourage the participation of African youth-led entrepreneurship. Furthermore, poultry manure can be converted into commercialised organic and nutrient fertiliser. This resource can be processed in such a way as to decrease gaseous loss to the atmosphere.

In conclusion, APET notes that limited technologies are dedicated to poultry farming. This impedes the progress of poultry farming and effectively scales up the poultry business. Thus, digital technologies can help African countries best manage poultry farming and related business. To meet the demand for chicken meat and egg production in Africa, production efficiencies can improve to meet the needs of the African continent. However, African countries should enhance an enabling environment for farming innovation and technologies through strong investments, policies, and regulations. This can enable Africa to accomplish nutrition and food security.

Link: https://www.nepad.org/blog/digitalising-poultry-industry-africa



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Heightening the Participation of African Women in Science, Technology, Engineering, and Mathematics Career Paths

Science, technology, and innovation (STI) are prerequisites to accomplishing the African Union's (AU) Agenda 2063. The complexity of challenges facing Africa is impacting the continent's socio-economic development and growth and impeding the full potential of the standard of living for most Africans. However, this can be addressed by encouraging local innovations, technological breakthroughs, and advancements.[1] Regrettably, the lack of investments in science, technology, engineering, and mathematics (STEM) has impeded Africa's skills development to steer the continent's socio-economic transformation. Fundamentally, African countries are missing the requisite scientific and technological capabilities to apply STI for meaningful innovation-led and knowledge-based socio-economic development effectively.

The advent of the 4th industrial revolution (4IR) presents immense potential for the African continent to leapfrog its STI potential. However, despite this enormous potential for Africa to excel in STI-related socio-economic development and growth, African women remain underrepresented. This has further derailed the full exploitation of STI development and growth in Africa. Notably, a strong involvement of women and girls in STEM at all educational levels is necessary for Africa to harness 4IR-enabled socio-economic development and growth effectively. Unfortunately, despite making up half of the population, women are still underrepresented within STEM fields.[2]

In efforts to enhance the participation of women in Africa's STI-enabled socio-economic development and growth, the AU has augmented some empowerment programmes toward gender equality. For example, the AU proclaimed 2015 the Year of Women's Empowerment and Development Towards the African Union's Agenda 2063.[3] Furthermore, the AU has adopted frameworks such as the Science, Technology, and Innovation Strategy for Africa (STISA-2024) to boost the participation of women in STI-enabled socio-economic development and growth.[4] For example, efforts such as affording women and girls equal opportunities to pursue STEM-related career paths can substantively benefit Africa. This can potentially close the gender pay gap, improve women's economic security, ensure a diverse and competent STEM workforce, and prevent biases in these disciplines and the products and services they generate.[5]

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A high proportion of African women researchers are exhibiting and experiencing concerning inequalities. For example, as an indicator of gender inequalities, the overall rate of women's participation inequalities in STEM research was 34% in 2016 across the African continent.[6] However, 52% of researchers in Cape Verde were reported to be female. But this is higher than the 47% participation of women in STEM in Tunisia and 40% of South African and Ugandan women. On the other hand, Guinea has only 6% of female researchers, Ethiopia with 7.6%, Mali with a rate of 10.6%, and Côte d'Ivoire at 16.5%.[7] Notably, Senegal is experiencing a similar pattern, with women being underrepresented in the scientific community and the institutions' decision-making bodies.[8]

The limited gender equity and gender-supporting practices in many research and academic institutions are some of the obstacles women in science face. Other obstacles include the implicit gender bias towards men during the hiring process, inadequate institutional oversight of women's representation in STEM activities, and limited institutional initiatives to facilitate work-life balance for females in STEM. Additionally, women experienced longer delays in finishing their postgraduate studies, such as Masters' and Doctoral degrees. Some women struggle to build a solid publishing record due to societal and gender conventions.[9]

The African Union High-Level Panel on Emerging Technologies (APET) advises African Union Member States to create an enabling environment to ensure the full participation of women and girls in STEM-related activities. This includes establishing STEM-related policy frameworks such as increased funding for training and mentorship required to pursue leadership positions in scientific fields. In addition, APET advises that it remains critical to offer STEM personnel an enabling workplace that promotes work-life balance. This can be accomplished by establishing and implementing gender-friendly policy frameworks, such as offering childcare services at the place of employment and career re-entry programmes. This can motivate women scientists to continue working even after interruptions such as starting a family and having children.

Additionally, APET emphasises the need for additional efforts to incorporate gender equity into STEM education by empowering female STEM teachers. This can encourage young girls to enrol in STEM-related career paths. In addition, role models and mentorship programmes should be promoted to encourage younger girls to pursue STEM-related career paths. Deploying role models can boost girls' participation in STEM education and have the role models act as mentors to tell their success stories to motivate young girls. The role models can also act as catalysts for the young girls to discover their STEM career path interests earlier in their career trajectories.[10]

APET further advises African countries to implement learning resources that can positively portray the girl child in STEM-related careers. Most textbooks currently feature a male scientist-biased curriculum and only depict women in non-essential and less skilled STEM career paths. For example, women will be expected to be secretaries instead of executive directors and chief executive officers, laboratory assistants instead of laboratory managers, and nurses instead of medical doctors within the medical field.[11] However, women are capable of these jobs as they are as talented and capable of such responsibilities as men. Such positive and empowering depictions can help African countries cultivate interest in STEM education much earlier in their career. Since males are encouraged early enough to seek jobs in STEM, early interventions remain essential for addressing the gender-based gaps in STEM.[12]

Building and strengthening the capacity of STEM teachers should be a top priority for African policymakers. African countries should specifically provide tools and capacity to strengthen STEM teachers to promote peer-to-peer education, hands-on activities, and role models mentorship programmes. Furthermore, changes to classroom dynamics that are teacher-attentive and gender-responsive should be implemented and address gender stereotypes.

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African countries should adequately address STEM barriers to empower young girls and women in STI. APET suggests that African countries should formulate and implement purposeful policy frameworks for equitable opportunities for females in STEM-related opportunities. This includes enhancing STEM-related competencies from early childhood until higher education to keep pace with the prevalent and rapidly expanding global digital technology economy.

For example, strategic gender equality in STEM policy and implementation should nurture equality in scientific careers, guarantee gender balance in decision-making processes and bodies, and incorporate the gender dimension in research and innovation content.[13] APET suggests that this can be accomplished by establishing a legal and policy environment that can afford incentives to eradicate legal and other barriers to the recruitment, retention, and career progression of female STEM researchers, teachers, administrators, and innovators. The enabling environment can also address gender imbalances in decision-making processes and support the gender dimension in research and innovation programmes and activities.[14]

APET is also encouraging African countries to partner with funding agencies, research and innovation institutions and universities to promote and advance cultural and institutional changes in gender inclusivity. This can reward charters, performance agreements and awards. This includes ascertaining that at least 50% of women can participate in committees involved in recruitment and career progression and creating, implementing, and evaluating research and innovation programmes.[15] Therefore, APET suggests that African countries and institutions should foster sustainable cultural and institutional changes within their strategic national action plans to influence the outputs of research and innovation institutions. As such, the AU Member States can facilitate research funding institutions that can provide incentives to promote higher education institutions and research organisations to amend and modify their gender-mainstreaming strategies with adequate resources.[16]

Finally, APET encourages African countries to appoint women to decision-making bodies in STEM, such as scientific and administrative boards, recruitment and promotion committees, and evaluation panels. This will allow for gender equality in positions of leadership and decision-making. This will improve the gender balance of full professors in higher education institutions while also assisting in the monitoring and evaluation of appropriate indicators for implementing gender policies and actions at the institutional, national, and AU levels. Gender awareness and capacity-building tools should also be available to achieve institutional changes and create flexible and family-friendly working conditions and arrangements for both men and women. Finally, gender bias should be eliminated in performance reviews and assessments for researchers and innovators.

Link: https://www.nepad.org/blog/heightening-participation-of-african-women-science-technology-engineering-and-mathematics

Blog #27 Published on Oct 3, 2022

Creating a Science Culture to Influence an Innovation-Led and Knowledge-Based Socio-Economic Development in Africa

Aspiration 1 of the African Union's Agenda 2063 envisions a wealthy Africa based on equitable growth and sustainable development through significant human capital investments emphasising science, technology, and innovation (STI).[1] The Science, Technology, and Innovation Strategy for Africa (STISA-2024) positions STI at the epicentre of the continent's socio-economic development and growth.[2] STISA-2024 encourages African countries to strategically pursue STI-enabled socio-economic development to drive Africa's transformation and foster innovation-led and knowledge-based economic growth. This framework also emphasises the impact of STI on socio-economic activities such as water management and purification, natural resources and mining activities, agriculture and food security, and environmental management and conservation, among others.[3]

African countries and cultures have benefited significantly from STI-driven socio-economic development and growth. For example, there have been STI-enabled industrial advancements in infrastructural development, energy generation, manufacturing industry, healthcare, education, information and communication, finance, entertainment, transportation, agriculture, and environmental protection. [4] However, these advancements have not been predominately African-led but rather imported from across the globe. Unfortunately, despite the potential economic growth and development, Africa is still lagging in STI-led socio-economic development and growth because of limited skilled human capital within the continent.[5] The limited skills within the continent have been lost through emigration, known as the "brain drain", to other parts of the world in search of better opportunities.[6] In this way, African countries are missing the possible STI-enabled economic advancement.

Notably, this phenomenon has profoundly resulted in the stagnation of the socio-economic development of the African continent. The limited STI skilled human resources limit African countries' capacity to solve African challenges using localised STI-inspired solutions.[7] Furthermore, Africa's science education curriculum barely provides adequate skills for African children to address everyday realities and challenges but remains abstract and irrelevant.[8] Worth noting that most African countries' curricula remain significantly westernised and colonial and barely localised to enable local solutions for the African people.[9]

The emphasis on the calls has been on African governments revising and implementing their education policies to make education more STI-inclined, thereby improving the culture of science. There have been calls to review the current curriculum to generate graduates with the relevant skills to address African challenges and advance the continent's socio-economic development and growth.[10] The implementation of the STI-inclined policy frameworks can progressively advance technology and innovation in Africa by providing relevant skills that can be used to solve African challenges. This can prevent the ad hoc, and mostly imported solutions that have proven unsustainable once the international partners have exhausted their participation—as such, transferring projects from international development partners to local partners has proven difficult to implement.[11]

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Amongst a plethora of reasons for the mismatch, unskilled human capital is among the leading causes of such failures. African countries are encouraged to enhance their investment in technology and accompanying infrastructure. Worth noting is that the global countries that have greatly benefitted and advanced their STI-enabled socio-economic industrialisation have allocated approximately 2.6% of their gross domestic product (GDP) towards their scientific and technological research and innovation. Regrettably, most African nations have undertaken limited investments, resulting in mixed STI-enabled advancements.[12] This can help grow the culture of science in solving African challenges through the appropriate skills and culture of solving societal challenges.

With the rapid growth of African peoples' social, intellectual, and material, the culture of science should be integrated into everyday life. This requires African society to internalise the science culture into their shared traditions and customs. Through these efforts, Africa can socialise their citizenry toward a science culture within their standard enculturation mechanisms to effectively enhance localised technological advancements and innovation.[13] Currently, within the African culture, superstition remains, and failure to investigate challenges and methodically foster scientifically driven solutions. Unfortunately, the imported solutions turn out to be more expensive and exploitative than local solutions. Therefore, this significantly limits the capacity of African countries to advance their economic activity and effectively take care of their citizens.

African countries can utilise the scientifically cultured skilled human capital to develop Africa's scientific basis and dominate the world of STI-enabled development and growth. Notably, the development of science and technology is known to co-evolve with the formation of science culture. Therefore, the African Union High-Level Panel on Emerging Technologies (APET) is advising that African countries should develop a culture of science much earlier in the curriculum to foster the culture of science earlier on in the educational and training programmes. This can be accomplished by funding and strengthening STI-based curricula in African schools. Since STI is key to the African Union's Agenda 2063 towards supporting socio-economic development and growth in Africa, African countries should strengthen their Science, Technology, Engineering, and Mathematics (STEM) skills capacities to produce the necessary skills for STI activities. [14] APET further recommends that STEM skills capacity development be prioritised to support diverse socio-economic activities such as agriculture, food production, product commercialisation, industrialisation, manufacturing, and urbanisation.

APET suggests that African countries should inculcate the culture of science as part of the foundational curricula up to tertiary levels to enable long-term learning and absorption of scientific knowledge. This can be accomplished through STEM literacy within the sciences, numeracy, basic scientific principles, and experiential learning.[15] Additionally, African countries can include scientific approaches to humanities, arts, and social sciences even outside the traditional STEM subjects. This can also help improve STEM subjects by introducing the art component into STEAM.[16] Thus, by incorporating teaching and learning in the science culture as early as the pre-primary education level, African countries can adequately train the next generation of researchers and innovators early enough to solve African challenges through a scientific research approach.[17]

APET notes that through scientific, methodical experimentation and research, African researchers and innovators can address the challenges in the transportation networks, rates of exchange, types of investments, the efficiency of factories, food security and farming challenges. This can also create technologies that can adequately address climate change-related challenges. Therefore, by identifying these challenging issues, Africans can formulate new solutions enabling economic networks to become more diligent, dynamic, and beneficial to all Africans.

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Furthermore, APET observes that science and technology can contribute to African society by generating new knowledge, which can bolster the continent's socio-economic development and advancement and resolve the various persistent societal issues.

It is worth noting that innovation and technology are developed based on natural philosophy supported by people's intellectual inquisitiveness. However, technological and innovative advancements should be supported by adequate scientific advances in scientific research as so to develop new technological solutions. Furthermore, the various industrial revolutions should be supported by advancing science and technology and linking scientific results to real-life issues to strengthen the impact of technology and innovation. At the same time, science is drifting from being the business of the intellectual world, but the scientific results are currently pioneering the frontiers of socio-economic development and growth. Essentially, science is progressively influencing values and driving the societal progress of civilisation.

Fundamental scientific progress has substantively influenced the sense of values and progressively changed the nature of society itself. Thus, APET is encouraging African countries to encourage the culture of science to enhance the outputs of STI-related solutions in addressing African challenges. For example, the 4th Industrial Revolution is challenging African countries to participate in the developments of various technologies such as computing, machine learning, and advances in artificial intelligence and the internet of things. Additionally, the invention of the internet of things and advances in information and communications technologies are improving people's convenience and modes of behaviour. Consequently, the lives of Africans are progressively being altered to influence the nature of societal dimensions in education, medical and welfare, transport, finance, and manufacturing sectors.[18] Furthermore, material science and nanotechnology advances have enabled the interpretation and manipulation of the phenomena of materials at the atomic and molecular levels. This is helping the globe strengthen its innovation and technological advancement significantly.

In conclusion, APET notes that to accomplish these advancements, African countries should foster a scientific-cultured curriculum within their youth to rapidly influence the diffusion and absorption of skills needed for progressive scientific and technological advancements. The scientific advancement based on indigenous knowledge systems can substantially benefit African society. Notably, their inclusion into the science culture can ensure that African science is localised and easily understood by Africans.[19] However, an enabling environment for such advancements should include changing current restrictions impeding various communities from advancing their STI-enabled socio-economic progression. This includes intentionally and deliberately stimulating and supporting scientific and technological activities such as research and development, STI governance and regulatory frameworks. This can create new technologies, effectively manage STI-related resources, and develop competitive economic advantages.

Link: https://www.nepad.org/blog/creating-science-culture-influence-innovation-led-and-knowledge-based-socio-economic

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Strengthening the Capacity of Africa's E-Commerce Systems using Digital Technologies: A Case of Zambia

Trade expands economic efficiency, thereby reducing poverty, increasing job opportunities, enhancing entrepreneurship, and strengthening economic activities. However, there has been some divide and mismatch between product producers and traders accessing the markets.

Trading via digital technologies has the potential to improve market access for Africa in order to achieve the African Union's Agenda 2063[1]. By providing trade and market access platforms, digital technologies such as information and communications technology (ICT) can significantly promote socio-economic advancement and growth[2]. After products and services have been produced through value addition such as farming, food processing, and manufacturing, digital enterprises can strengthen their distribution to reach previously inaccessible markets[3].

Some African countries have increased broadband penetration and investments in order to attract venture capital to the continent's ICT, entrepreneurship, and innovation. This is intended to bring Africa up to speed with the rest of the world as an information and integrated e-economy society. The African Union's Digital Transformation Strategy for Africa has emphasized the importance and significant potential of e-commerce for Africa's economic development (2020-2030).[4] This strategy seeks to provide a comprehensive strategic framework to transform Africa across numerous areas digitally.[5] For example, the African Continental Free Trade Area (AfCFTA) has provisions for African countries to develop harmonised regulatory approaches to issues such as data governance and electronic transactions to support e-commerce trade facilitation and management systems.[6]

Africa has made significant strides towards facilitating the buying and selling of goods and services by enabling technological payment systems such as e-wallets, M-PESA, and mobile money, among others.[7] These financial and payment systems facilitate the transmission of funding, finance, and data over an electronic network. Thus, it is envisaged that by 2025, Africa will have more than half a billion e-commerce traders and users.[8] This represents a market with a consistent Compound Annual Growth Rate (CAGR) of 17%.[9] This remarkable development is attributable to several factors, including Africa's youthful population and a sizable digital market.

Fundamentally, the various digital payment platforms implemented across the African continent demonstrate observed e-commerce and incremental usage. Furthermore, the widespread use of smartphones and other mobile devices has increased internet penetration. As a result, the continent's mobile e-commerce and online shopping have grown.[10]

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The advent of the COVID-19 pandemic has further exposed the need to enhance e-commerce in Africa. Due to the pandemic and lockdowns, people had limited movement. As a result, they adopted e-commerce platforms for purchasing products and services.[11] Therefore, the cumulative exposure to e-commerce platforms during this period influenced Africa's progress and development and the need to strengthen the continent's e-trade and e-commerce systems. This effectively enhances Africa's Gross Domestic Product and increases market access.[12] On the other hand, the United Nations estimated that over 30 million African people might experience poverty and acute food insecurity if economic activities such as agriculture, healthcare, education, and manufacturing are not boosted and strengthened.[13] Thus, by facilitating e-commerce platforms, African countries can enhance the transfer of products from one side of the continent to another and enhance job creation.

The African Union High-Level Panel on Emerging Technologies (APET) believes that channeling fiscal and monetary mechanisms to boost the liquidity of small-to-medium-enterprises (SMEs), households, and informal workers, particularly in the most vulnerable economies, can help Africans strengthen their e-trade and e-commerce responses. These provisions can assist African countries in better managing and facilitating trade systems. For example, the African Continental Free Trade Area (AfCFTA) implementation has been delayed as a result of the COVID-19 disruptions. As a result, progress in AU Member States' national plans to liberalize goods and services to establish and accelerate implementation processes has stalled. However, by implementing e-commerce, this process can be accelerated, intra-continental trade systems can be adopted, and information and data sharing based on e-commerce trade activities can be improved.

APET encourages partnerships between African institutions and local entrepreneurs with international communities, development partners, and governments to strengthen e-commerce and e-trade systems and coverage. This can help accelerate progress toward subsequent phases of AfCFTA implementation, such as investment, competition policy, and intellectual property rights. This can also help the innovation transformation program, especially in terms of regional integration and digitalization. Such frameworks can also reduce the system's vulnerability to peripheral trade and commodity price shocks, expand the region's beneficial transformation, and foster human, societal, and economic resilience.

Additionally, APET notes that inefficiencies in African borders negatively affect cross-border trade activities between African countries.[14] This is also deterring internal and external business transactions as the border inefficiencies reduce the mobility of goods and services across African countries.[15] For example, African countries such as Zambia have re-strategised their trading mechanisms since the COVID-19 pandemic to significantly grow their e-commerce platforms and systems, especially domestic retail, wholesale, utility, and mandated government payments. As such, the Zambian Information Communications Technology Agency (ZICTA) reported that the total number of active internet subscriptions increased from 10.3 million at the end of 2020 to 10.4 million by the end of 2021.[16] This represented a growth rate of 1.3% and an internet penetration rate of 56.7 per 100 inhabitants.[17] The improved internet networks, reasonably priced data services, and the expansion of networks by operators vigorously competing for clients contribute to the incremental subscription from only 7.9 million in 2018.[18]

Financial institutions such as banks and telecommunication companies are exploiting the benefits of the e-commerce market.[19] Since people are purchasing goods and services online through varied financial transactions, banking and telecommunication institutions are profiting from utilising mobile devices, ATMs, credit cards and debit cards. Furthermore, to encourage the utilisation of e-commerce beyond the COVID-19 pandemic, the Zambian government has enhanced communication infrastructure, such as satellites to house base stations, resulting in expanded data access coverage.[20]

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The Zambian government is enabling a business-to-business (B2B) portal with a database of suppliers and buyers. Electronic tools accompany this to enable buyers to submit their bids and receive responses from service providers.[21] The website intends to promote trade between major businesses and neighbourhoods in small and micro businesses.[22] The private sector's participation, such as mobile telecommunication operators, also provides unstructured supplementary data services to support key industrial activities.[23] Financial institutions such as banks communicate through short messaging services (SMSs) to Zambian citizens to provide access to accounts for purchasing goods and services and process payments to service providers. This enables Zambians to process their government tax collection facilities and their pension from respective agencies.[24] They can additionally purchase electricity and water utilities and process their cable television and insurance subscriptions. All these mechanisms enable sustainable e-commerce platforms and enhance business activities.

APET realises there has been rapid growth over the past several years in Zambia's telecommunications sector. This was attributable to the progressive regulatory approach and robust competition that Zambia has adopted to enable growth within the e-commerce sector. To this end, this approach has enabled several private sector providers and legacy telecommunication parastatals to offer consumers and businesses competitive data and voice services.[25] For example, Zambia is currently implementing the Information and Communication Technologies Act Number 15 of 2009 to regulate the telecommunication sector in the country.[26] On the other hand, Zambia Information and Communications Authority (ZICTA) is an independent ICT sector regulator. This enables oversight and competitive considerations for the public and businesses to facilitate safety and protection from data breaches and abuse.[27]

APET observes that such liberal policies and regulatory provisions are growing Zambia's e-commerce market. The growth rate is higher for smartphone-enabled e-commerce. This is because, since the outbreak of the COVID-19 pandemic in Zambia, the utilisation of smartphone-enabled e-commerce has significantly increased.[28] Particularly, this was observed within the domestic payments in retail, wholesale, utility, and obligatory payments to the government. As mentioned earlier, the total number of active internet subscriptions increased exponentially during COVID-19. This was attributed to the enhanced data networks, inexpensive data services, and the expansion of networks by operators aggressively competing for customers.[29]

Furthermore, the various Cyber Security and Cyber Crimes Act that has established the extra-territorial reach has allowed for law enforcement interception of communications without notification of private citizens. This provision allows for cybersecurity inspection access to prevent cybersecurity offences and hate speech in any form of communication, including social media.[30] Thus, the penalties for hate speech and Data Protection Act are enhancing the primary data privacy and protection legislation in Zambia. Furthermore, data localisation requirements for sensitive data and the establishment of the Office of the Data Protection Commissioner have enabled regulation control, data processors and licensing data auditing.[31] This is essentially encouraging local data usage and data centres to enable Zambia to have better control of the locally generated data. To this end, the active revisions to the Data Protection Act will potentially relax the data localisation requirements and compel steep costs for accessing offshore data centres.

Domestic e-commerce has seen the majority of Zambians purchase electricity tokens and digital TVs, pay their water bills, and conduct cardless transactions using e-wallets. As a result, Zambia has seen an increase in the use of smartphone-enabled e-commerce channels for credit and debit card purchases and other financial transactions, as well as automated teller machines (ATM) bill payments, kiosk payments, and mobile devices. [32] Furthermore, cross-border e-commerce has also observed incremental online purchases from the United States of America's eBay and Amazon platforms, the United Kingdom's eBay, and China's Alibaba.

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This enables the trade of various products range such as electronics, footwear, clothing, and accessories to motor vehicle spare parts and motor vehicles. Additionally, it is envisaged that there will even be greater growth in the region once Amazon is launched in South Africa.[33] However, there are inherent risks to online purchases, such as receiving defective or low-quality merchandise and products advertised with false information. Other difficulties include limited contact information, withdrawal rights, non-receipt of the purchased item, non-standard or unclear terms and conditions, and additional costs from service providers such as customs duty, value-added tax, and import declaration fees. However, these issues can be addressed by implementing user- and customer-friendly policy and regulatory frameworks. In addition, APET notes that Zambia has established an e-commerce Intellectual Property Rights (IPR) Office as well as a Patent and Company Registration Office to address awareness and compliance issues. These agencies, however, are not involved in enforcement. Furthermore, while these agencies do not issue official guidelines on what constitutes e-commerce IPR violations or how to file complaints, they do provide assistance to e-traders.[34]

Some examples of financial technologies and platforms include Kazang Pay. Kazang Pay is Zambia's biggest point of sale (POS) terminal network responsible for selling various prepaid products and services.[35] Fundamentally, this system can accept card payments from a single POS device. On the other hand, the Timpa X POS can accept SASSA, Visa, Mastercard debit and credit cards. Furthermore, customers can deposit their money into their bank accounts using Kazang.

Additionally, iShop Zambia and Dot Com Zambia are shopping platforms that enable users to purchase goods online from Zambia. This can be utilised by international retailers even when located outside the country, such as in the United Kingdom, the United States of America, South Africa, and China. Furthermore, common payment methods for Zambia's e-commerce and online transactions include mobile money, credit and debit cards, ATM and kiosk payments, and websites.[36] For example, pay www.bills.co.zm is a payment service that enables customers in Zambia to settle their utility bills and television subscriptions and purchase airtime using VISA, and MasterCard means.

Zambia has also introduced and adopted some digital marketing houses hosted on various websites to offer free space for advertising. Even though these websites do not guarantee viewing benchmarks, they allow companies to purchase airtime on big digital screens located at major city intersections.[37] This enables viewers to see the products as they walk or drive by those intersections. In addition, there has been an incremental usage of social media, especially in areas with sufficient mobile data coverage. As such, this mode of advertising remains a popular form of advertising in larger cities.

Furthermore, most Zambians are incrementally utilising social media to watch and read the news and events and access marketplaces. This is improving business networking and socialisation and providing voice and video calls. Notably, Facebook and YouTube tend to attract a youthful audience, and WhatsApp is commonly utilised among all age groups. However, neither Twitter nor Instagram is widely utilised in Zambia.[38]

APET encourages African countries to maintain the momentum gained on e-commerce platforms during the COVID-19 pandemic's peak. This has proven to create a favorable trading environment and ensure affordable market access. As a result, African countries should create an enabling environment for e-commerce by ensuring lower transactional costs, faster customs clearance protocols and time frames, and improved supply chain management systems. An enabling environment like this can help e-commerce businesses reach new and emerging markets, as well as gain access to previously difficult-to-find customers. This will increase productivity, inclusiveness, and consumer choice.

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Consequently, APET observes that e-commerce can potentially enhance the exports of products when domestic companies are successful in breaking into export markets as well as regional and intracontinental markets. This can help Africa establish more effective connections in national and regional markets and enhance continental supply chains for the African Continental Trade Agreement (AfCTA). This provision also decreases the negative impacts of the geographical limitations currently impeding successful trade between African countries.[39] APET also notes that e-commerce can potentially increase the current 18% intra-African trade rate and the less than 3% share of the world trade if well adopted and implemented.[40]

APET is encouraging African countries to address the digital divide caused by inadequate ICT infrastructure and use, underdeveloped finance and payment systems, and limited ICT literacy. This can particularly bolster the capacity of e-commerce capabilities, enhance purchasing power and customer confidence, and strengthen the national legal systems.[41] Thus, APET challenges African countries to create a more enabling and favourable regulatory climate and strengthen the necessary infrastructure to efficiently employ and deploy e-commerce systems and mechanisms across the African continent.

Finally, APET encourages African countries to mitigate the risks associated with e-commerce while capitalizing on the opportunities presented by e-commerce. This includes youth self-employment, increasing use of artificial intelligence, internet of things technologies, and blockchain-enabled technologies. However, African countries should manage job losses by creating a conducive environment for potential job creation through entrepreneurship, market access, and affordability, as well as providing incentives to entrepreneurs, such as tax breaks. This can effectively improve enabling financial regulations and African businesses' competitiveness, as well as bridge the structural gap in intra-continental trade systems. Such frameworks can also improve Africa's online retail and accelerate African economies' digitalization

Link: https://www.nepad.org/blog/strengthening-capacity-of-africas-e-commerce-systems-using-digital-technologies-case-of-zambia

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Improving Food Security in Africa through Water Harvesting Technologies

Agriculture remains a critical sector in Africa's socio-economic development and growth. This is because smallholder farming in Africa accounts for more than 60% of Africa's population and approximately 23% of Africa's gross domestic product (GDP).[1] Water availability and access are vital inputs for agricultural production and food security. As such, crops, vegetables, and animal rearing require water to enhance essential food production.[2] However, in many parts of the African continent, there is persistent limited access to quality water. Furthermore, the quantity of clean water remains limited due to management and treatment incapacities becoming a fundamental impediment to farmers' development.[3]

Water impacts every element of human life, including health, agricultural production, food security, technological advancement, and state economies.[4] Water scarcity and water quality issues are particularly significant in Africa because many African countries have underdeveloped water management systems. Worth noting is that poor water supplies are commonly linked to poverty in these areas.[5] Most water utilised for agricultural purposes across the African continent is primarily obtained from rainfall. For example, some African countries rely on rainfed cultivation accounts, accounting for up to 95% of their agricultural activities.[6] Unfortunately, due to highly irregular and sporadic seasonal rainfalls in Africa, rainfall barely sustains crop management requirements.[7] This results in decreased crop yields and food insecurities in most African countries.

In many parts of the continent, most raindrops evaporate before they can cause run-off. As a result, only a small portion of the rainfall reaches rivers, lakes, and groundwater bodies. Furthermore, most farms are located far from rivers, limiting their ability to use river bodies for irrigation. Notably, the majority of the African continent is made up of deserts and semiarid savannahs. Unfortunately, the majority of these areas receive insufficient surface run-offs of less than 100 millimetres per year.[8] This is too little to support the cultivation of maise, corn, rice, millet, and sorghum, serving as staple foods for most African communities.[9]

Climate change has also changed the rainfall distribution by causing unpredictability to the timing of rainfall per season and has also significantly reduced the amount of rainfall towards drought conditions in recent years.[10] This has a significant impact on the reliability of rainfall, particularly for agricultural purposes. Droughts, for example, are expected to become more common in Africa as a result of climate change and global warming. As shown in figure 1, global warming has gradually contributed to increased and prolonged heat waves, as well as a tripling of droughts in Africa since the 1970s. The slightest increase in global warming poses a significant risk to the continent by increasing heat waves, droughts, and crop failures, exacerbating food insecurity across the continent.[11]

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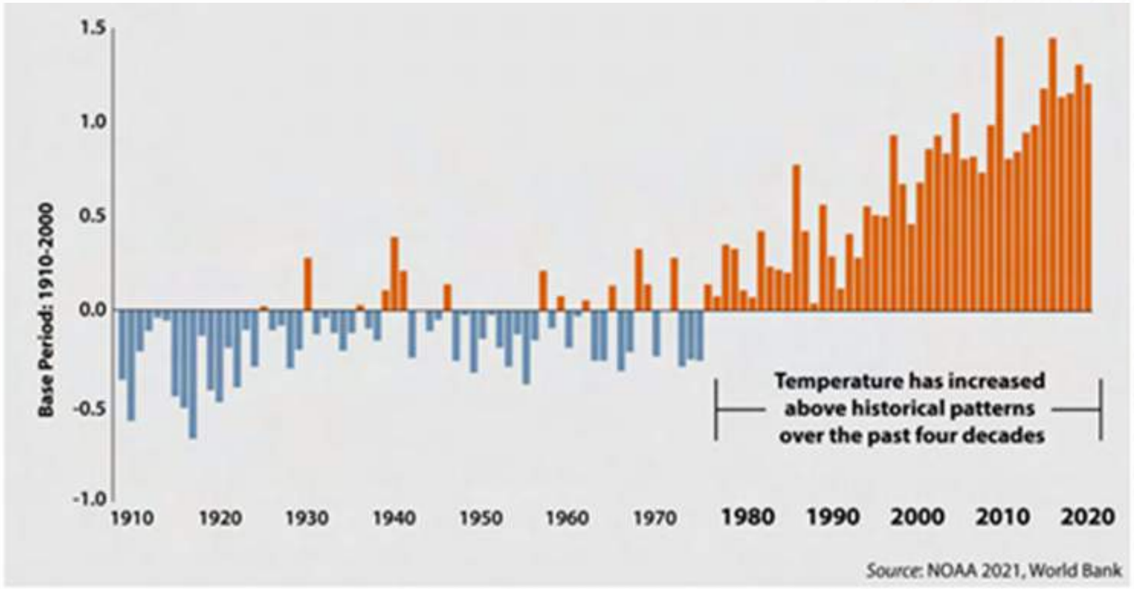

Figure 1: Africa's temperature anomalies, 1920 – 2020 (degrees Celsius)
SOURCE: https://africacenter.org/spotlight/how-global-warming-threatens-human-security-in-africa/

It is important to note that when crops fail, it is usually due to an extended dry spell during a critical period of the growing cycle, such as the flowering phase, rather than a lack of rainfall. Rainless spells of several weeks are common and can occur at any time of year. However, if they occur at a critical stage of the crop growth cycle, they can have disastrous consequences. During these dry spells, therefore, continuous provision of water irrigation becomes critical.

The limited utilisation of irrigation in Africa and over-dependence on rain-fed agriculture has accounted for the limited agricultural productivity across the continent, among other factors.[12] This is especially true in the continent's rural arid and semiarid areas. Currently, agricultural productivity is highly constrained by variable rainfalls and frequent dry spells. Consequently, this makes rainfed farming a risky undertaking. An estimated 70-85% of the rainfall on African dryland farms is lost through non-productive evaporation, surface run-offs, and deep percolation.[13] Therefore, solutions to manage rainfall water caption and storage, existing water sources, artificial recharge of groundwater, and water treatment should be developed and implemented.

The African Union High-Level Panel on Emerging Technologies(APET) encourages African countries to harness smart technologies and innovations to heighten the management of existing water bodies and exploit rainfall run-offs. To exploit the rainfalls for small-scale farming purposes, APET advises creating more effective water resource capture techniques. This can be accomplished by increasingly focusing on climate-smart technologies to reduce risks from extreme weather patterns due to climate change and global warming. APET recognises that water management should be effective and efficient, especially in rain-fed agriculture. This can be accomplished by pursuing water conservation and management systems through smart water harvesting technologies.

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APET advises African countries to adopt green-water measures such as soil and water conservation and harvesting techniques. These techniques are gaining popularity in locations where irrigation is impracticable. Notably, water harvesting involves the collection of rainstorm-generated run-off from a specific region of a catchment to obtain water for human, animal, or crop consumption. For example, surface run-off harvesting and roof-top rainwater gathering are the two most common types of rainwater harvesting practised in Africa. Rainwater that falls on the ground is collected in an underground tank or roof catchment and stored in a tank. The collected water can subsequently be utilised for irrigation purposes. In some cases, the collected water can be stored in above-ground ponds and subterranean reservoirs such as cisterns or shallow aquifers for later use.[14] Water harvesting has been successfully practised in African countries such as Kenya and Tanzania to improve crop yields and food production.[15]

The Green Science for Revolution in Africa and the World Agroforestry Farmers are implementing a water conservation programme in the Nyeri region, Kenya. This programme enhances fruit orchard management after years of declining fruit harvesting due to erratic weather conditions.[16] For example, the use of water harvesting for crop production has enhanced the yields from 1 tonne per hectare to 3–4 tonnes in areas where rain harvesting occurs.[17] Mango and citrus plantations have been enhanced by up to 100,000 Kenyan shillings ($900) per year, a previously unachievable sum. Fundamentally, water harvesting is assisting farmers transition from traditional crop farming to commercial agricultural businesses.[18]

The Majaruba System is progressively being adapted in most surrounding areas due to spontaneous acceptance. The Majaruba Water Harvesting Collecting Method is being utilised in Tanzania as it is allowing farmers to store adequate water and generate yields, especially during periods of low local rainfall. This is enabling irrigation in regions with limited rainfalls and enhances cultivation in previously unproductive lands. Consequently, this has substantially boosted the productivity of household assets and improved rural livelihoods.

However, there is a need for an enabling environment, including profitable marketplaces and the availability of land for agricultural purposes. This has particularly proven to be an important requirement for the system's spontaneous uptake and expansion.[19] Thus, APET encourages African countries to invest in rainwater harvesting infrastructures such as sand, charcoal, sponge filers, ponds, concrete tanks, galvanised tanks and plastic tanks once harvested. This can significantly strengthen water harvesting catchment, harvesting, and storage.

APET notes that using rainwater harvesting technologies to irrigate farming significantly enhances local agricultural activities. More funding, however, is required for African countries to improve rainfed agriculture across the continent. To increase farming productivity, investments in water harvesting infrastructure for smallholder farmers should be pursued. This will assist local farmers in increasing crop production, animal feeding, and farming productivity in order to improve food and nutrition security in accordance with the African Union's Agenda 2063 aspirations.

Kenya has an annual supply of renewable freshwater that is less than 1,000 cubic meters per capita because most farming activities are concentrated in arid and semiarid regions[20]. Farmers who are water-stressed usually wait for the rainy season. This allows for two growing cycles per year for food crops like maise, beans, and sorghum. It is worth noting that Kenya has been experiencing a drought in recent years, resulting in domestic food insecurity[21]. Despite the fact that the situation is gradually improving, several farmers have been gradually adopting water harvesting and storage technologies. This innovation allows rainwater to be stored instead of being drained into rivers that empty into the Indian Ocean.

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APET recognizes that because rains are infrequent and sometimes insufficient, water harvesting and storage can help farmers generate an adequate harvest. In Kenya, some farmers growing citrus fruits alongside pulse crops and maise have carved inlets to direct water run-off from the roadside into their gardens. As such, the run-off water can be stored in basins that have been prodded throughout the garden. These basins can be filled with mulch that can absorb and store the water throughout the year. In such cases, the citrus fruits can naturally absorb water from these basins for months after the rainy seasons are long gone. This can also be adapted for growing a variety of pulses, pumpkins, sorghum, and livestock.

APET realises the high cost associated with investing in water harvesting. For example, setting up a water harvesting management system for an 8-acre farm can require an infrastructure that can cost approximately US$2,500, and most African farmers may not afford it.[22] Thus, African countries are challenged to support their farmers as they currently rely on developmental partners for funding.

Furthermore, APET recognises that climate change has shifted the rainfall patterns feeding into rivers and lakes. However, lakes have been shrinking significantly since the 1960s.[23] For example, Lake Chad has been a vital source of water and food for millions of people in Nigeria, Cameroon, Niger, and Chad. In 1963, the lake's surface area was 26 000 square kilometres; today, it is less than 1 500 square kilometres. Regrettably, since chronic droughts' inception in the 1970s, the lake has shrunk by 90 per cent over the last 60 years (see figure 2), resulting in an approximately 60% decline in fish production[24]. The condition has drastically deteriorated due to the region's fluctuating climate, which has increased food and nutritional insecurity[25]. Furthermore, the quality of the surrounding land has also declined, thereby decreasing livestock productivity and biodiversity. This is being experienced by the surrounding Sahel region and across Africa.[26]

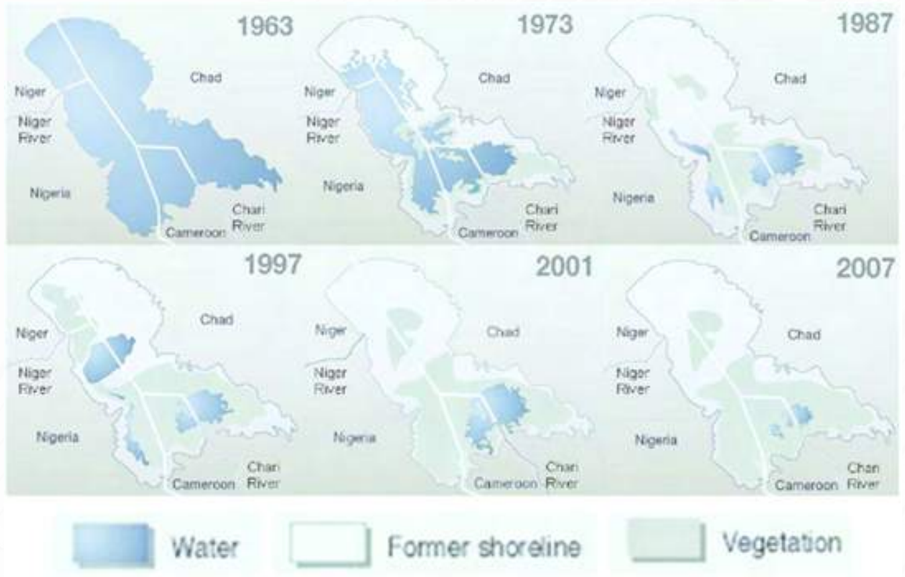

Figure 2: The shrinking of Lake Chad from 1963 to 2007 [27]

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Unfortunately, soil degradation and enormous losses of rainwater from fields occurring through evaporation significantly contribute to the huge yield gaps in crop production. Nonetheless, experimental water-harvesting innovation and precise fertilisation in African countries such as Kenya, Tanzania, Burkina Faso, Niger, and Ethiopia have exhibited the substantial potential to double the agricultural output of smallholder farming.[28] APET recognises that such solutions are essential to enhancing food security and addressing farming challenges, including climate change and land degradation.

Especially in the Sahel region, small-scale farming is becoming unsustainable through conventional farming practices because of declining soil fertility and climatic extremes. There is also progressively decreasing land access due to population pressure, leaving approximately 12 million small-scale farmers persistently susceptible to food and nutrition insecurity.[29] Even during good rainfall, many farmers adopt risky coping mechanisms such as taking on more debt, eating fewer daily meals, and selling their assets. At the same time, scientists have predicted that by 2050, a reduction in agricultural production of millet and sorghum will drop by 13% in Burkina Faso, 25.9% in Mali, and 44.7% in Senegal due to global warming characteristics of climate change.[30] Hence, developing innovation to manage these losses remains crucial for African countries.

Finally, APET challenges African countries to improve their irrigation systems in order to modernize Africa's agriculture and replenish depleting water reserves. Notably, water infrastructure is frequently associated with socio-economic development, whereas more traditional practices, such as rainwater harvesting, are viewed as backward and inefficient. Similarly, irrigation and excessive blue water extraction can quickly deplete available water sources and have irreversible negative effects on local ecosystems. As a result, Africa's irrigation opportunities remain limited, as rain-fed agriculture accounts for 95 percent of Africa's food production. Simultaneously, only 5.5 percent of arable land is suitable for irrigation due to limited water availability and accompanying landscape topographies that make irrigation difficult and costly. Africa contains roughly 60% of the world's uncultivated arable land, and much of it remains uncultivated. Climate-smart innovations and technologies, on the other hand, may present opportunities for enabling farming in these lands. As a result, African countries must improve water management techniques in order to conserve and store water for African farmers.

Link: https://www.nepad.org/blog/improving-food-security-africa-through-water-harvesting-technologies

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