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POLICY BRIEF

The Potential of Gene Drive Technology to Control and Eliminate Malaria in Africa

Key Messages

1 The African Union has prioritised the development of a number of emerging technologies as having the potential to address the continent's health challenges.

2 Among these technologies, gene drive technology has been identified as a potential new option to complement existing interventions to reduce or prevent malaria transmission in line with global malaria targets.

3 The technology can contribute to alleviating Africa's malaria burden if it is soundly developed, tested, deployed and regulated on the continent.

4 To fully realise the potential of gene drive technology for malaria control, countries must focus on strengthening the capacity of African institutions, increasing knowledge sharing, and promoting stakeholders' awareness.

Background

The African continent is disproportionately affected by malaria, with 95% of the world's 241 million cases in 2020 recorded in the region.[1] The fight against malaria has advanced significantly over the past two decades, with a decrease in malaria case incidence from 81 cases per 1,000 population at risk in 2000 to 56 cases in 2019.

Nonetheless, urgent action is needed to reach global malaria targets aiming for at least a 90% reduction in global malaria incidence and mortality rates by 2030.[2] Current strategies for malaria control in Africa rely on vector control and drug therapy, which have proved insufficient to eliminate malaria on the continent.

The African Union (AU) has committed to supporting the adoption of both new and existing technologies to improve health in the region through the Health Research and Innovation Strategy for Africa (HRISA) 2018–2030.[3] To implement this, the African Union High-Level Panel on Emerging Health Technologies (APET) of the African Union Development Agency (AUDA)-NEPAD has prioritised several emerging technologies that have the potential to significantly reduce the disease burden of the continent.

[1]World Health Organization. (2021). *World malaria report 2021*. https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2021
[2]World Health Organization. (2021). *Global technical strategy for malaria 2016–2030, 2021 update.* https://www.who.int/publications/i/item/9789240031357
[3]African Union Development Agency-NEPAD. (2019). *Health and innovation strategy for Africa (HRISA) 2018-2030.* https://www.nepad.org/publication/health-research-and-innovation-strategy-africa-hrisa-2018-2030

Among these technologies are the use of gene drives for the control and elimination of malaria; the use of drones to improve healthcare; the use of microgrids to support the delivery of healthcare; the use of gene editing techniques; and the use of artificial intelligence.

The African Institute for Development Policy (AFIDEP) conducted a study titled "Landscape and Political Economy Analysis of Emerging Health Technologies in sub-Saharan Africa" in March–May 2021. The study evaluated ongoing efforts in the design, development and piloting of priority health technologies in sub-Saharan Africa (SSA) and the stakeholders behind these efforts.

Methodology

A qualitative study was employed to analyse the landscape of emerging priority health technologies in SSA. It drew on an applied political economy analysis approach to examine the regulatory context, as well as the actors involved in developing emerging health technologies and what motivates their behaviours toward such technologies.

The study also identified key players in gene drive mosquito technology, reviewed regional and national policies and regulations, and examined existing advocacy efforts related to this technology in SSA.

Researchers working on health tools and technologies, health sector policymakers, policymakers in charge of regulatory policies and frameworks for health technologies, ethicists, representatives of media networks, and leaders of advocacy groups for or against emerging health technologies were among the groups interviewed using a semi-structured interview guide.

Distribution of interviews by aggregate categories

Category	Number of interviews
Regional policymaking bodies	4
National regulatory bodies	2
Global advocacy networks	4
Research consortia and networks	11
Ethicists	1
Regional CSO networks (SSA)	2
Funding agencies	1
Science media networks	5
Total	**30**

Findings

Several technologies are being developed and tested for use on the continent to address the malaria burden. The AU has identified gene drive technology as a viable new option to support current efforts to reduce or prevent the transmission of vector-borne diseases like malaria.[4] Apart from gene drive mosquito technology, other technologies being explored for malaria control include the malaria vaccine; sterile insect technique; attractive toxic sugar baits (ATSB); ivermectin drug; piperonyl butoxide (PBO) nets; and drones for larvicide control.

The study zeroed in on the status of ongoing efforts focused on gene drive mosquitoes for controlling and eliminating malaria in Africa, including the stage of technology development; the activities and interactions of stakeholders involved in these efforts; the knowledge and participation of key stakeholders in these efforts; and the views and concerns of key stakeholders regarding the technology. The study also focused on ways and mechanisms through which a wide range of stakeholders in SSA can be effectively involved in the entire development process.

Status of ongoing efforts on the development of gene drive mosquito technology for malaria control

Data from the study shows that research on gene drive technology for malaria control and elimination in Africa is at the very initial stage in Burkina Faso, Uganda and Mali and has only been developed and tested under laboratory conditions. Most recent exploratory work is ongoing in Tanzania, Cape Verde, Sao Tome and Principe, and Comoros. Ecological observatory work is being done in Ghana. Notably, it might take about a decade before the technology can be used across the continent.

[4]APET. (2018). *Gene drives for malaria control and elimination in Africa.* AUDA-NEPAD. https://www.nepad.org/publication/gene-drives-malaria-control-and-elimination-africa

Critical issues in the development of gene drive technology

Challenges facing the development of this technology include regulatory bottlenecks, as well as limited knowledge sharing and awareness among government leaders, the general public, and science journalists.

Findings revealed that due to the novelty of gene drive technology in SSA, the regulatory framework governing it is inadequate. The regulatory environment of countries in SSA also varies considerably with regard to the adoption of biotechnology products. Therefore, governing the deployment and use of gene drive technology is the primary problem, not the science underlying the technology.

Most countries draw their biosafety governance framework from the *Cartagena Protocol on Biosafety to the Convention on Biological Diversity*.[5] The Protocol is an international agreement aiming to ensure the safe handling, transport and use of living modified organisms resulting from biotechnology.

The country with the highest advancement in this area is South Africa, which as of 2017, has commercialised three biotechnology crops (Bt maize, Bt cotton and Bt soybean). Three other countries that have achieved significant strides are Burkina Faso which has commercialised Bt cowpea, and Kenya and Sudan which have commercialised Bt cotton. Eleven countries have enacted biosafety legislation and have had confined field trials on biotechnology crops. These are Ghana, Cameroon, Kenya, Malawi, Mozambique, Eswatini, Egypt, Nigeria, Ethiopia, Uganda, and Tanzania. Togo, Tunisia, Zambia, Senegal, Mali, Namibia, Côte d'Ivoire, and Zimbabwe all had biosafety regulations in place as of 2017, but they had not yet started conducting confined field trials. The remaining African countries had not passed biosafety legislation or begun confined field trials on any biotechnology products.

Notably, while national biosafety authorities in several SSA countries have expertise in regulating genetically modified crops, few have such experience with genetically modified insects, and none have it at the moment with gene drive mosquitoes.[6]

These variances in regulatory environments from country to country in Africa slow the introduction and scale up of new biotechnology tools for health. The regulatory agencies in Africa are also under-resourced and overburdened, which impedes their ability to adequately oversee the development and use of these new health technologies.

Data suggests that a regional approach to regulating this technology is necessary given its transboundary nature and the differences in regulatory frameworks among SSA countries. To effectively regulate this technology, countries must harmonise regional instruments. However, even with this harmonisation, policymakers still need to grapple with the continuous enforcement of adopted instruments.

Furthermore, those involved in policymaking have little knowledge of gene drives and there is a lack of information-sharing efforts focused on gene drive technology in SSA, apart from a few initiatives that target a small number of stakeholders and have a considerably narrow scope.

Additionally, the funding for developing gene drive technology is mainly from Europe and the United States. In contrast, funding for health research and development in Africa is below the pledged 1% of the GDP by each AU member state and below the 2% of the national health budget for research.[7] This poor funding weakens SSA's bargaining power in the development and use of the technology, leading to external funding agencies wielding considerable influence in determining the continent's research agenda.

Lastly, concerns about gene drive technology revolve around risks to human safety and ecological considerations, intellectual property rights, equity, and power and justice in its governance.

AUDA-NEPAD spearheads efforts to address these gaps. The development agency has recommended several actions to put the AU recommendations into practice, including the establishment of a network of researchers and technology developers with a presence in Africa who can register their work, self-regulate, share knowledge, and undertake peer reviews of all ongoing work in the region.

Policy implications

The high burden of malaria in Africa requires the need for continuous research and innovation on new tools and technologies to reduce the burden. Gene drive technology for malaria control and elimination is already being explored in several African countries, but despite its potential to alleviate the continent's malaria burden, the importance of the technology is not consistently reflected in national and regional health policies.

[5] Convention on Biological Diversity. (n.d.). *The Cartagena Protocol on Biosafety.* https://bch.cbd.int/protocol

[6] James, S., Collins, F.H., Welkhoff, P.A., Emerson, C., Godfray , H.C.J., Gottlieb, M., Greenwood, B., Lindsay, S.W., Mbogo, C.M., Okumu, F.O., Quemada, H., Savadogo, M., Singh, J.A., Tountas, K.H., Touré, Y.T. (2018). Pathway to deployment of gene drive mosquitoes as a potential biocontrol tool for elimination of malaria in sub-Saharan Africa: Recommendations of a scientific working group. *The American Journal of Tropical Medicine and Hygiene, 98*(6_Suppl), 1–49. https://doi.org/10.4269/ajtmh.18-0083

[7] African Union Development Agency-NEPAD. (2019). *Health and innovation strategy for Africa (HRISA) 2018-2030.* https://www.nepad.org/publication/health-research-and-innovation-strategy-africa-hrisa-2018-2030

The limited awareness and knowledge of gene drive technology may be a contributing factor to the dearth of policies, regulatory frameworks, and guidelines in SSA. This therefore necessitates ramping up information-sharing efforts and increasing the capacity of all stakeholders at the national and regional levels. Raising public awareness of the ongoing work on gene drive technology can encourage engagement that supports democracy and justice, mutual learning, shared decision-making, and identification and assessment of potential benefits and harms.[8]

The regulatory framework for gene drive technology may include and build on existing biotechnology regulatory frameworks. Increased local investments and capacity development of researchers, particularly by health departments and ministries at the regional and national levels, will give Africans greater agency in determining the research agenda with regard to gene drive technology that takes into account and fully addresses the needs and challenges of the continent. It will also ensure a long-term and adaptive approach to changing local contexts as countries aim to reduce the burden of malaria and achieve global targets.

Policy Recommendations

To fully realise the potential of gene drive technology for malaria control and elimination in Africa, the following are recommended:

- ☑ Countries in SSA should increase national funding for health research and development and ensure adequate allocation of resources for gene drive technology development, testing and deployment.
- ☑ Countries should implement mechanisms to address knowledge gaps among key policymakers, which is critical for developing the relevant frameworks to govern gene drive mosquito technology.
- ☑ Countries should review existing policies and regulatory frameworks governing gene drive technology development and field-testing.
- ☑ Given its transboundary nature, regional and sub-regional health bodies should develop harmonised regulatory instruments to govern gene drive mosquito technology.
- ☑ Ministries of health should prioritise capacity development for local researchers on gene drive mosquito technology.
- ☑ Ministries of health should work with AUDA-NEPAD and other non-state actors to build countries' capacity for risk assessment.
- ☑ Sub-regional health bodies should build surveillance mechanisms to monitor the gene drive mosquitoes upon their release when proven safe and effective.

[8] Committee on Gene Drive Research in Non-Human Organisms: Recommendations for Responsible Conduct; Board on Life Sciences; Division on Earth and Life Studies; National Academies of Sciences, Engineering, and Medicine. (2016). Engaging communities, stakeholders, and publics. In *Gene drives on the horizon: Advancing science, navigating uncertainty, and aligning research with public values.* National Academies Press. https://www.ncbi.nlm.nih.gov/books/NBK379287

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