How innovation led to a catnip plant-based mosquito repellent to fight malaria in eastern Africa

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Key messages

- **With adequate support and using local know-how and biodiversity, African scientists and entrepreneurs can make significant contributions in preventing malaria on the continent.**
- **Incubation and bio-innovation platforms such as BioInnovate Africa are pivotal in forging links among key actors and getting innovations to market and making a development impact.**
- **The short funding cycles of many bilateral aid and public R&D programs, which often emphasize immediate tangible results, are not well aligned with the longer timelines required for innovation processes.**
- **Upscaling and commercialization present challenges to bio-based health R&D and innovation in most parts of Africa.**
- **Lack of capital and funding is a major barrier for all innovation systems in East Africa.**

Malaria cases were estimated to affect 249 million people worldwide in 2022, according to the World Malaria Report (WHO, 2023), of which nearly a tenth occurred in East Africa (Osborne et al., 2024). In 2021, the WHO announced the rollout of the first-ever vaccine for children between 2023 and 2025, but most efforts are oriented towards prevention (WHO, 2024), including pesticide-treated mosquito nets and other repellents that keep the insects that carry the malaria virus away from people.

In many parts of Africa, including East Africa, multiple prevention techniques have been developed over the years to control mosquitoes and protect humans from mosquito bites. Many of the existing prevention techniques have harmful toxic side effects, have limited preventative effects, or are not adapted to the biting patterns of Anopheles mosquitoes. Mosquitoes usually target people at night or in the early morning; personal protection, especially with repellents, can reduce bites and disease transmission.

Different repellent-based products have been commercialized for prevention of mosquito bites. However, the process of moving from R&D through innovation to commercialization is extremely challenging in sub-Saharan Africa. To study local innovation using local bioresources and knowledge to combat malaria, we focused on the project "Plant extracts to prevent malaria in eastern Africa", hereafter called the catnip project, developed and supported through the BioInnovate Africa platform. This project was aimed at developing and commercializing plant-based mosquito repellent in soap, sprays and lotions for eastern African countries, with the main active ingredient derived from locally grown catnip plants.

This brief, based on a recent scientific publication (Ayoub et al., 2024), discusses the following questions:

- What are the key components constituting a functional bio-based innovation system for developing malaria repellents in eastern Africa?
- To what extent can local bio-entrepreneurs benefit from business incubation, knowledge support and regional cooperation?
- What are the main barriers and challenges for upscaling and commercializing bio-based health R&D and innovation efforts in eastern Africa?

The innovation system and results of the catnip project

To answer these research questions, we mapped the different stakeholders and the innovation system components of the catnip project. In addition to using articles, reports and websites, we conducted interviews with a wide range of actors involved in the project. The innovation actors in the catnip project are described in Table 1.

Table 1. Catnip project innovation actors

Actors	Roles and responsibilities in the catnip project
Karire Products, Burundi	Karire Products, managed and driven by Ginette Karirekinyana, the principal investigator of the catnip project. Karire Products is a social enterprise and the first to introduce a plant-based malaria repellent made from catnip to Burundi. Their duties included cultivating the catnip plants along with local communities, extracting catnip and other vegetable oils, and transforming these into commercial products.
University of Burundi	The University of Burundi coordinated teams at the Faculty of Pure Sciences (Chemistry, Biology) on ethnobotanical, ecological and herbal R&D, as well as the sustainability of growing and harvesting biological active substances of catnip plants.
Gudie Leisure Farms, Uganda	Gudie Leisure Farms is a social enterprise and was responsible for coordinating the catnip project in Uganda and collaborating on aspects related to value chain development.
Jicho Communication, Tanzania	Jicho Communication was responsible for coordinating the media outreach and marketing of the plant-based repellent in the East African region, including in Tanzania.
icipe (International Centre of Insect Physiology and Ecology), Kenya	Based in Nairobi, *icipe* focused on cultivation and propagation of the catnip plant, and the efficacy, formulation and durability of the active antimalaria metabolic compound in the catnip plant extract.
BioInnovate Africa, Kenya	BioInnovate Africa is a regional bioscience and bioeconomy innovation platform and bio-business incubator in eastern Africa, linking biologically based research, inventions and technologies for business and the market.

Source: Authors' own

The catnip project was able to produce an environmentally friendly product with high potential to contribute to malaria prevention in East Africa. At the time of data collection for this study, the product was still to be registered by the Burundi Bureau of Standards and Quality Control. The funding of the catnip project from BioInnovate Africa was also coming to an end, and the project was not able to fully commercialize and get a market response on the catnip antimalarial product during the project period.

However, as of November 2024, these catnip-based products were approved for commercial release and on the market in Burundi. In addition, a factory in Burundi has been developed by Karire Products, with processing equipment for large-scale production of bio-based health products.

Analysis of the catnip project innovation system

Innovation systems can be analysed using a range of different tools and models. The analysis in this study was guided by a technological innovation systems (TIS) framework. Central to the understanding of the TIS methodology is the analysis of the activities and functions executed by the various actors, to identify an innovation system's key characteristics, such as weaknesses and strengths. Applying the TIS framework to our case study enables us to conduct an analysis of its function, to identify the principal ingredients of the technical system under study and how well it is performing.

Our TIS analysis of the various functions of the catnip project's innovation system showed mixed results, with good scores for "entrepreneurial activity" and "building legitimacy", but poor scores for other functions, as summarized below.

Strong components of the innovation system

The evaluation of this innovation system shows that it is characterized by strong entrepreneurial activity. An entrepreneur, Ginette Karirekinyana (principle investigator of the catnip project), successfully convened various types of actors (scientists from different disciplines, government agencies, funders and social businesses) to create the innovative startup project and carry out the implementation of innovation activities.

Moreover, through the work of Karirekinyana and project partners, the company Karire Products spearheaded the commercialization of the bio-based malaria repellent. They also assisted in the development of national norms and regulations, previously non-existent, to receive approval for the antimalarial catnip product.

Ginette Karirekinyana of Karire Products displayed bio-based antimalarial products at the Global Bioeconomy Summit 2024 in Nairobi.
Photo: Courtesy of Ginette Karirekinyana

The project also had a strong legitimacy-building function, in that the project was accepted as fair and rightful by the local community and by Burundian government authorities. The project built its legitimacy by creating jobs and by including local community stakeholders, such as smallholder farmers and women , in catnip production and processing.

Another strong function of the project included knowledge development and diffusion. The project actively engaged in conducting successful R&D activities. The project moved forward in the innovation process, demonstrating the viability of the catnip repellent, a functional value chain and product development pathways.

The project also made visible the importance of collaboration with different actors to develop the necessary knowledge and diffuse it in order to enhance the adoption and commercialization of the product. This study shows that innovation in the case of the catnip antimalarial can be based on local R&D, challenging the conventional belief that innovation in least-developed countries is mostly an imitation of existing knowledge and innovation from developed countries. The project also initiated the process of establishing a certification standard with the Burundi Bureau of Standards and Quality Control for registering bio-based health products for various purposes.

The role of *icipe*, the International Centre of Insect Physiology and Ecology, was vital in the project, as the organization provided know-how on various technical aspects of the catnip malaria repellent and its product formulation. Based in Nairobi, Kenya, this center is a regional resource.

The BioInnovate Africa secretariat, also in Nairobi, was also central in linking and supporting project actors, ensuring that they were able to play their complementary roles. It also backstopped building capacity for the management of the catnip project innovation consortia.

BioInnovate Africa has been crucial in funding the project and ensuring linkages at the regional level between public sector, market and international research institution actors, which catalysed the innovation process. However, BioInnovate Africa could not support in the scaling up and commercialization of innovative products.

Weak components of the innovation system

The project had weaker aspects regarding (i) mobilization of financial resources and the lack of venture capital and affordable credit; (ii) policy guidance, such as an enabling policy and regulatory environment and (iii) market creation through the development of a demand for a specific product, through actions such as strong commercial marketing or public procurement. Moreover, the weakness of these functions also underlines the importance for countries in Africa to develop an enabling investment environment, as well as standards and norms to guide the implementation of new innovative projects. It also shows the need for a clear commercialization strategy to encourage the adoption and diffusion of a new product.

Barriers and challenges for R&D and innovations

Innovation is a complex process that is highly dependent on policies, institutions, and financial and human resources. Countries in East Africa are in the process of developing a more enabling policy environment for innovation. At the same time, private companies and public R&D institutions are increasingly engaging in innovation. However, coordination is often lacking between different branches of government in the development of policies, regulations and funding regimes, which stifles innovation.

In this study based on the catnip project, we identified several gaps and barriers affecting the ability of innovation systems in East Africa to further expand and make a significant development impact, such as for achieving SDGs. These can be clustered under the following categories:

- Weak capacity of entrepreneurs and academia to establish links with market actors and lack of incubation mechanisms that ensure all actors are interlinked and supported to play complementary roles. This highlights the role of incubators such as the BioInnovate Africa platform to convene actors, enabling the innovation process and increase the chances of making a development impact.
- Lack of conducive policies and inadequate capacity to upscale, create market demand and commercialize bio-based health R&D and innovation efforts.
- Lack of capital and funding to move products from R&D to the market.
- Short funding cycles and focus on immediate results by aid agencies and public programs do not match the longer timelines needed for innovation.

Recommendations for supporting bio-based innovations in Africa

There is no one-size-fits-all solution for successful technological innovation in biosciences and for producing bio-based health products. Indeed, there may be several possible pathways to success for such innovation systems. As shown in the catnip project, innovation on bio-based health products in East Africa can be done successfully. However, there are serious barriers for upscaling and commercializing promising innovations in the region.

To address these barriers, and for bio-based health products to have an impact and contribute to better health and livelihoods in the region, a range of actions are crucial, such as:

- Linking R&D and innovation actors with market actors, building businesses, and identifying market segments and potential for upscaling. Here, continuous feedback between the market, knowledge development and entrepreneurial activities are needed, ensuring that actors in the innovation system can adjust the product or technology to market demands.
- Supporting business bio-incubators and innovation platforms by pooling expertise and facilitating functional collaboration between academia, entrepreneurs and the private sector.
- Developing funding models for sharing innovation costs and raising venture capital for upscaling and moving innovations to the market. Given that venture capital is very limited in Eastern Africa, governments can assist in mobilizing support for innovation from government sources and development banks. The donor community may also play an important role by providing funding to complement and strengthen investments from other actors.

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