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Common name: Speckled emperor moth
Scientific name: *Gynanisa maja*

ANNUAL REPORT 2018

April 2019



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Support *icipe*: www.icipe.org/support-icipe

April 2018

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Cover photo: Healthy maize harvested from thriving Push-Pull, fall armyworm-free demo plots at the *icipe* Duduville campus, Nairobi, bearing witness to the effectiveness of this technology in controlling the pest, among many other benefits.

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FOREWORD



Lukas Bertschinger
Chair, *icipe* Governing
Council

In November 2018, *icipe* Director General, Dr Segenet Kelemu, completed her first, five-year term. By coincidence, this milestone was followed closely by the finalisation of the *icipe* Periodic External Review (IPER) for 2013 – 2017. These two events presented key occasions for learning and growth.

The IPER, conducted by a Review Team of three international experts, concluded that *icipe* is a well-managed and highly productive research Centre, and provided guidance for future strategic positioning of the institution.

Dr Kelemu reflected:

“Alongside the entire *icipe* community, I am heartened by this feedback. It endorses our intricately vigilant approach that has taken into account the past, the present and the future.”

Indeed, over the past five years our goal has been to safeguard *icipe*’s rich and unique legacy, making adjustments to learn from past

challenges, seizing new opportunities as they arise, while fortifying the Centre’s growing importance in a fast changing local and global environment.

As a result, we can attest to the validity of the ideal of a centre of excellence in insect science; the benefit of a multidimensional approach to scientific excellence; and the advantage in building and maintaining partnerships. Further, our reflection demonstrates *icipe*’s success in nurturing scientific capacity and leadership in Africa, while expanding presence on the continent. We have also boosted our resource mobilisation, communication and dissemination, as well as the ability to reach end-users. The Centre also notes the need for alertness for alignment to regional and international development agendas, for example through new research initiatives and directions while also further strengthening *icipe*’s core competence in insect physiology and ecology. We also know that our work will not be successful if we do not

maintain a highly motivated team and look after the bricks and mortars of our institution.

In general, we recognise the need for sustained, strategic investment in research for development, and approaches that rise beyond the perpetual, jaded refrain of Africa’s constraints.

These insights provide us with momentum for the future, with two upcoming key events: the development of *icipe*’s new vision and strategy in 2019, and the commemoration of the Centre’s golden jubilee in 2020.

“ WE BELIEVE THAT WE HAVE A SOLID BASIS OF KNOWLEDGE, CAPACITY AND PARTNERSHIPS TO BE BOLD AND DETERMINED, TO EMBARK ON THE ROAD LESS TRAVELLED, AND CONTRIBUTE TO BREAKING AFRICA’S CYCLE OF WOES AND GLOBAL WELL BEING ”

PREFACE



Segenet Kelemu
Director General, *icip*e

“
EVERY
ACCOMPLISHMENT IS
A TESTAMENT OF
TEAMWORK AND
PARTNERSHIPS;
AND EVERY PLAN
IS A COMMITMENT
FOR CONTINUED
EXCELLENCE
”

The preparation of the *icip*e annual report is always a stimulating process for the Centre – we see it as an opportunity to comprehensively curate our accomplishments while also scanning the horizon in view of our specific research goals, and in line with the Centre’s mission and vision. In that spirit, this publication presents *icip*e’s achievements in 2018 through 11 chapters that fit into four categories.

The first chapter, **Management and Leadership**, forms one category focusing on centrewide activities like resource mobilisation and donor engagements, new partnerships, landmark moments such as new initiatives, scientific publications and communications. These events are presented chronologically, as they occurred throughout the year.

The second concentrates on research highlights clearly indicating: the aim, in terms of envisioned solutions for the problem being addressed; progress made in 2018; and the next steps. The

content is presented in five chapters as per the Centre’s four themes: **Human Health, Plant Health, Environmental Health** and **Animal Health**; and the emerging **Insects for Food and Feed** programme. It is worth noting that this information also includes contributions by the *icip*e research units: Behavioural and Chemical Ecology; Molecular Biology, Bioinformation and Biostatistics; Biosystematics; Geo-Information Unit; Arthropod Pathology; and Animal Rearing and Quarantine.

The third category in this report revolves around *icip*e’s commitment to create leadership, capacity and ability to produce and use scientific knowledge, to enable the most effective outcomes for communities and different stakeholders in Africa and across the world. And it consists of three chapters on **Capacity Building and Institution Development, Social Science** and **Impact Assessment, and Technology Transfer** units.

Over the past several years, *icip*e has become a true player in Africa’s concerted goals of achieving inclusive and sustainable development through the use of innovative bioscience research knowledge and technologies, and ultimately, the creation of a bioeconomy. The Centre’s contribution in this regard is the focus of the fourth category, contained in two chapters on: **BioInnovate Africa Programme**, one of Africa’s largest regional innovation-driven science initiatives; and the **Regional Scholarship and Innovation Fund (RSIF)** of The Partnership for skills in Applied Sciences, Engineering and Technology (PASET), both being managed by *icip*e.

In presenting this report, we are aware of two issues: that every accomplishment is a testament of the teamwork and partnerships amased through the Centre; and that every articulated plan is a commitment for the future, one we aim to achieve, with your continued support.

MANAGEMENT AND LEADERSHIP

icipe CORE DONORS

Swiss Agency for Development and Cooperation (SDC), Switzerland

Swedish International Development Cooperation Agency (Sida), Sweden

UK Aid, Government of the United Kingdom

Ministry of Higher Education, Science and Technology, Kenya

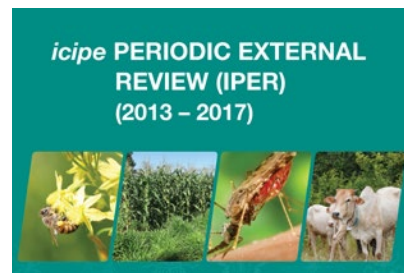
Government of the Federal Democratic Republic of Ethiopia

MANAGEMENT AND LEADERSHIP

2018 IN PICTURES



We interacted with our donors and partners at our Centre and field sites...



Marked key milestones including signing new funding agreements, hosting key fora, launch of new initiatives and reviews...



and our teams won and accorded a range of recognitions.

MANAGEMENT AND LEADERSHIP

IN 2018, WE:

SIGNED new donor
agreements totalling
USD 46,030,308



* US\$ XE Currency converter live rates, 2 January 2019. These figures represent the total value of contracts signed and under review during this reporting period and will typically cover multiple years of research.



HAD **737** news
items published

RECEIVED **3685**
media mentions

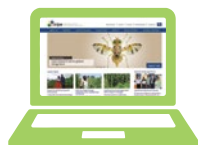


WITH POTENTIAL reach of
367.5M people



AND ADVERTISING value
of **USD 2,095,197**

SIGNED
11 new
partnerships



HAD APPROXIMATELY
36,000 visitors and
144,000 page views
on our website



HAD a POTENTIAL
reach of **24.4M**
people on
Twitter

MANAGEMENT AND LEADERSHIP

IN 2018, WE:



PUBLISHED
13 book chapters



PRESENTED **11 conference papers**



DEVELOPED **7 toolkits and fact sheets**



PUBLISHED **151 peer reviewed journal articles** (58 with impact factor of >2.0; 78 in open access, and 83 with postgraduate scholars as lead authors).



DEVELOPED
9 technical manuals

PREPARED
6 thematic summaries and case studies



DEVELOPED
71 scientific posters

MANAGEMENT AND LEADERSHIP

icipe DG, **Dr Segenet Kelemu** was one of five '**heroes in the field**' selected by leading philanthropist, **Bill Gates**, for using their talents to fight poverty, hunger and disease, while providing opportunities for the next generation.

JANUARY

icipe, CABI and the International Institute of Tropical Agriculture (IITA) with support from the Swiss Agency for Development and Cooperation (SDC) convened a **stakeholder workshop** to guide collective action on **tackling invasive species in Africa**. The forum brought together **122 participants from 26 countries** across the world, including researchers, policymakers, representatives of national institutions, pan-African institutions and regional economic communities, private sector, and donors.

FEBRUARY

The Governing Council of *icipe* commissioned the ***icipe* Periodic External Review (IPER)** for 2013–2017. The review was conducted by a team of three international experts, Drs. John Lynam (Chair), Bruce Pengelly and Serap Aksoy.

MARCH

The **Federal Democratic Republic of Ethiopia**, through the Ethiopian Agricultural Research Council (EARC), signed a memorandum of understanding (MoA), with *icipe*, to grant the Centre **unrestricted core funding** for five years (2018 – 2022).

APRIL

icipe obtained approval for **registration** of the blend used in the Centre's **tsetse repellent technology** from the Kenya Pest Control Products Board paving the way for **commercial production and distribution**.

MAY

A European Union Delegation to Ethiopia including: Dominique Davoux, Team Leader, Rural Transformation & Resilience; Erik Habers, Head of Cooperation and Eshetu Mulatu, Operations Officer, visited *icipe* beekeeping sites in Ethiopia, accompanied by H.E. Dr Gebregziabher Gebreyohannes, State Minister, Ministry of Agriculture and Livestock Resources, Ethiopia, and an *icipe* team led by the Director General, Dr Segenet Kelemu, and colleagues from Ethiopia Country Office.

JUNE

MANAGEMENT AND LEADERSHIP

icipe was **selected to manage** the Partnership for skills in Applied Sciences, Engineering and Technology (PASET) **Regional Scholarship and Innovation Fund (RSIF)**, an initiative aimed at strengthening doctoral training, as well as research and innovation in applied sciences, engineering and technology in Africa.

icipe **honoured** the Centre's **former DG, Dr Hans Herren**, for his commitment to the Centre's vision of science-led sustainable economic transformation in Africa. This recognition is denoted in the dedication of the administration building block at *icipe* Thomas Odhiambo campus, on the shores of Lake Victoria, to Dr Herren.

JULY

AUGUST

The **IPER report** was received, having gone through reviews and comments by *icipe* management and the Review Team.

icipe DG, **Dr Segenet Kelemu**, was featured in *The CEO Magazine* as one of exceptional leaders from around the world, breaking ground and shattering the glass ceiling.

icipe held an **information sharing session** on the management of the fall armyworm in Africa for ambassadors and representatives of governments, national research systems, international organisations and members of the press.

icipe **commissioned solar photovoltaic (PV) power plants** at its campuses. The USD2.5 million system is **funded by the Swiss Agency for Development and Cooperation (SDC)** and it is part of the greening of *icipe* initiative.

SEPTEMBER

OCTOBER

A delegation from **The Rockefeller Foundation** consisting of Dr Roy Steiner, Managing Director Food, accompanied by Betty Kibaara, Associate Director and Rafael Flor, Director YieldWise Initiative, visited *icipe* to discuss possible collaborative initiatives.

The **renovation** of the *icipe* **R & D building** commenced

icipe **signed an agreement** with the World Bank and the government of Korea for the Centre to manage the **Regional Scholarship and Innovation Fund (RSIF)**.

NOVEMBER

DECEMBER

The **European Commission Directorate for International Cooperation and Development (DEVCO)**, committed to provide financial support to *icipe* for a Euro 7.0 million project, a figure that is inclusive of 20% contribution from the Centre's core funds, to strengthen the Centre's efforts in the **management of the fall armyworm**.

MANAGEMENT AND LEADERSHIP

Donor: Max-Planck Gesellschaft represented by Max-Planck Institute for Chemical Ecology, Germany

Project: Partnership to initiate Partner Group of the MPI for Chemical Ecology at *icipe*.

Donor: BMZ/GIZ

Project: Integrated pest and pollinators management (IPPM) to enhance productivity of avocado and cucurbits in East Africa.

Donor: Biovision Foundation

Project: Controlling aflatoxin, fall army worm and napier stunt disease.

Donor: GIZ/Centre for International Migration and Development (CIM)

Project: Equipment for CIM integrated experts to the Nematodes Research Group.

JANUARY

FEBRUARY

Donor: Food and Agriculture Organization of the United Nations (FAO)

Project: Establishing an Emergency Community based Fall Armyworm Monitoring Forecasting Early Warning and Management System (CBFAMFEW) in eastern Africa.

MARCH

Donor: Federal Democratic Republic of Ethiopia

Core funding contribution to *icipe*

Donor: Biovision Foundation

Three diseases, One Health; A one health participatory approach to combatting a complex of zoonotic diseases in northern Kenya.

APRIL

Donor: BMZ/GIZ (sub-award from AVRDC)

Project: Combating *Tuta absoluta* and other agricultural crop diseases.

MAY

Donor: Biovision Foundation
Project: Push-Pull for Sub-Saharan Africa

Donor: International Atomic Energy Agency (IAEA)

Project: Diversity of endosymbionts and entomopathogens of dipteran pests and their impacts on dipteran mass rearing for sterile insect technique applications.

JUNE

Donor: Norwegian Agency for Development Cooperation (Norad)

Project: Combating Arthropod Pests for Better Health, Food and Resilience to Climate Change (CAP-Africa)

Donor: German Academic Exchange Service (DAAD)

Programme: 2018/2019 DAAD In-Country/In-Region Programme Scholarships

MANAGEMENT AND LEADERSHIP

Donor: THRiVE Consortium through DELTAS Africa Initiative grant

PhD fellowship: Understanding tick-borne zoonotic disease epidemiology within nomadic pastoral systems in Kenya.

Donor: THRiVE Consortium through DELTAS Africa Initiative grant

Career Development Award: Investigating role of sandflies in the circulation of arboviruses in Kenya.

Donor: UNEP/GEF

Submitted by WHO regional office for Africa. Integrated vector management for disease prevention and control.

JULY

Donor: Bill & Melinda Gates Foundation Global Grand Challenges

Project: Crowd-sourcing approach to large scale monitoring of pests to smallholder farmers.

Donor: UNOPS EIF

Project: Scaling up quality honey productivity and fair trade project (2017-2020):

Donor: LEAP-Agri

Project: Sustainable intensification of fruit production systems through innovative pest biocontrol technologies.

SEPTEMBER

Donor: Rockefeller Foundation

Project: Testing business models for scaling insect-based protein feed for use in poultry farming and aquaculture in Kenya (SiPFeed).

Donor: DFG - German Research Foundation

Project: Identification of virus transmission networks to control key arboviral diseases in Kenya.

NOVEMBER

AUGUST

Donors: World Bank, Korean Government, African Governments

Project: The PASET Regional Scholarship and Innovation Fund (RSIF)

Donor: IDRC/Cultivate Africa's Future Fund 2

Proposal development: IPM for alien invasive fruit flies in southern Africa.

Donor: BBSRC/GCRF:/ Keele University

Project: Biological control of fall armyworm.

Donor: U.S. Department of Agriculture - Research, Education & Economics

Project: Identification of semiochemicals for regulation of potentially invasive pests in the the U.S

Donor: USAID/Virgina Polytechnic Institute and State University

Grant modification - IPM for Rice, Maize and Chick pea in East Africa;

OCTOBER

Donor: IFAD

Project: Alternative Livelihoods for Food and Income Security in four Indian Ocean Island Nations (Mauritius, Seychelles, Comoros and Madagascar) and in Zanzibar (United Republic of Tanzania)-Phase 2

Donor: Cultivate Africa's Future Phase 2 (IDRC & ACIAR)

Project: INSFEED2: Insect feed for poultry, fish and pig production in sub-Saharan Africa.

DECEMBER

Donor: European Commission Directorate for International Cooperation and Development (DEVCO)

Project: management of the fall armyworm in Kenya, Ethiopia, Rwanda, Tanzania and Uganda.

Donor: African Union

Project: Promote sustainable management of Tuta absoluta, an invasive pest of Solanaceous vegetables for food and nutritional security in East Africa

MANAGEMENT AND LEADERSHIP





Pictured during the launch of the *icipe* solar PV plants (l-r): Dr Daniel Davies, General Manager, Solarcentury Africa; Mr Donald Kaniaru, Member, *icipe* Governing Council; Dr Yves Guinand, Senior Thematic Advisor Rural Development, Federal Department of Foreign Affairs, Swiss Agency for Development and Cooperation (SDC); Dr Segenet Kelemu, Director General, *icipe*; Eng. Samson Kasanga, Deputy Director in charge of Solar Unit, Ministry of Energy, Kenya, representing the Cabinet Secretary; Dr Thomas Oertle, Head of Cooperation, Embassy of Switzerland in Kenya.

MANAGEMENT AND LEADERSHIP

icipe scientist appointed Head of a Max Planck Partner Group: <http://www.icipe.org/news/icipe-scientist-appointed-head-max-planck-partner-group>

icipe Director General among Bill Gates' 'heroes in the field': <http://www.icipe.org/news/icipe-director-general-among-bill-gates%E2%80%99%E2%80%98heroes-field%E2%80%99>

JANUARY

FEBRUARY

EU delegation visits icipe: <http://www.icipe.org/news/eu-delegation-visits-icipe>

icipe research earns global recognition: <http://www.icipe.org/news/icipe-research-earns-global-recognition>

Plans for a strategy on invasive species in Africa advance: <http://www.icipe.org/news/plans-strategy-invasive-species-africa-advance>

MARCH

APRIL

Government of the Federal Democratic Republic of Ethiopia to provide core funds to icipe: <http://www.icipe.org/news/government-federal-democratic-republic-ethiopia-provide-core-funds-icipe>

Tribute to Prof. Jerrold Meinwald: <http://www.icipe.org/news/tribute-prof-jerrold-meinwald-16-january-1927-%E2%80%93-23-april-2018>

Celebrating World Bee Day: <http://www.icipe.org/news/celebrating-world-bee-day>

icipe Director General honoured: <http://www.icipe.org/news/icipe-director-general-honoured-0>

MAY

JUNE

Jona Mutasa: Self motivated Push-Pull farmer and trainer: <http://www.icipe.org/news/jona-mutasa-self-motivated-push-pull-farmer-and-trainer>

Thought leadership column by Director General, Dr Segenet Kelemu: Time for a Bioeconomy: icipe e-bulletin Vol 8 Issue No 2 and 3: <http://www.icipe.org/publications/newsletters>

MANAGEMENT AND LEADERSHIP

Beekeeping in Ethiopia: *icipe*-EU partnership: <http://www.icipe.org/news/beekeeping-ethiopia-icipe-eu-partnership>

***icipe* Push-Pull in Rwanda:** <http://www.icipe.org/news/icipe-push-pull-rwanda>

***icipe* honours Dr Hans Herren:** <http://www.icipe.org/news/icipe-honours-dr-hans-herren>

All about nematodes: Review offers hope for breaking soilborne curse in Africa: <http://www.icipe.org/news/all-about-nematodes>

JULY

AUGUST

***icipe* Periodic External Review 2013 – 2017:** <http://www.icipe.org/news/icipe-periodic-external-review-2013-%E2%80%93-2017>

***icipe* in Uganda:** <http://www.icipe.org/news/icipe-uganda>

Creating opportunities for youth: <http://www.icipe.org/news/creating-opportunities-youth>

Thought leadership column by Director General, Dr Segenet Kelemu: Girls' Education. *icipe* e-bulletin Vol 8 Issue No 3

From our partners by Andreas Schriber: Biovision Foundation's partnership with *icipe*. Vol 8 Issue No 3. <http://www.icipe.org/publications/newsletters>

SEPTEMBER

OCTOBER

Fall armyworm information sharing session: <http://www.icipe.org/news/fall-armyworm-information-sharing-session>

Launch of the new phase of the Pan African Regional Scholarship and Innovation Fund: <http://www.icipe.org/news/launch-new-phase-pan-african-regional-scholarship-and-innovation-fund>

New edible cricket species discovered in Kenya: <http://www.icipe.org/news/new-edible-cricket-species-discovered-kenya>

NOVEMBER

DECEMBER

Combating the fall armyworm in Africa – The European Union (EU) provides new funding to *icipe*: <http://www.icipe.org/news/combating-fall-armyworm-africa-%E2%80%93-european-union-eu-provides-new-funding-icipe>

Thought leadership column by Director General, Dr Segenet Kelemu: reflection first term: *icipe* e-bulletin Vol 8 Issue No 4: <http://www.icipe.org/publications/newsletters>

From our partners by Yves Guinand, Swiss Agency for Development and Cooperation (SDC). More than 20 years of Swiss support to *icipe*: Vol 8 Issue No 4: <http://www.icipe.org/publications/newsletters>

HUMAN HEALTH THEME

DONORS AND PARTNERS

Donors: Biovision Foundation for Ecological Development, Switzerland; Bill & Melinda Gates Foundation; German Academic Exchange Service (DAAD); Federal Ministry for Economic Cooperation and Development (BMZ); Foundation for the National Institutes of Health (FNIH), USA; German Doctors e.V., Germany; German Research Foundation (DFG), Germany; Global Environment Facility (GEF)/United Nations Environment Programme (UNEP); Government of Kenya; Innovative Vector Control Consortium, UK; Kenya National Research Fund; National Institutes of Health (NIH), USA; National Science Foundation (NSF), USA; Norwegian Agency for Development Cooperation (Norad); R. Geigy Foundation, Switzerland; Swedish International Development Cooperation Agency (Sida); Swiss National Science Foundation (SNSF); Swiss Agency for Development and Cooperation (SDC); The Swedish Research Council, Sweden; The World Academy of Sciences – Organization for Women in Science for the Developing World (OWSD); UK Aid from the UK Government; Wellcome Trust, UK; World Health Organization–Regional Office for Africa (WHO–AFRO).

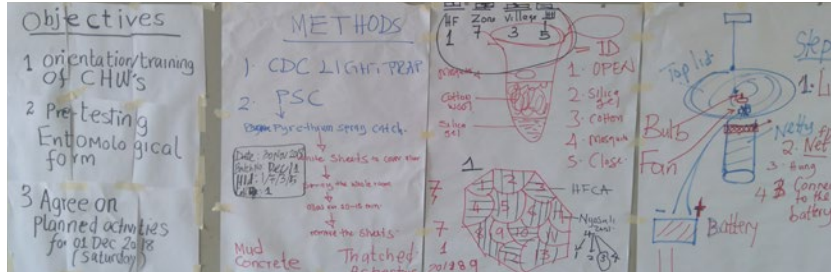
Partners: Addis Ababa University (Aklilu Lemma Institute of Pathobiology), Ethiopia; agricultural research institutes, non-governmental organisations, private sector partners, farmers and farmer groups; Canterbury Christ Church University, New Zealand; CEVA, France; Dabaso Tujengane Self Help Group – Watamu Marine Association, Kenya; Duke University, USA; Durham University, UK; Egerton University, Kenya; Elimination 8 Programme; Free University of Berlin and Charité—Universitätsmedizin, Berlin, Germany; Helmholtz Centre for Environmental Research (UFZ), Leipzig, Germany; Ifakara Health Institute, Tanzania; International Livestock Research Institute (ILRI); Johns Hopkins University, USA; Kenya Medical Research Institute (KEMRI); Kenya Wildlife Service (KWS); KTH Royal Institute of Technology in Stockholm, Sweden; Liverpool School of Tropical Medicine, UK; London School of Hygiene & Tropical Medicine (LSHTM), UK; Millennium Institute, USA; Ministries of Health in Kenya and Ethiopia; Ministry of Agriculture, Livestock and Fisheries, Kenya; Ministry of Public Health and Sanitation (Division of Disease Surveillance and Response), Kenya; Mosquito Control in Nyabondo (MOCON) community group, Nyabondo, Kenya; national malaria control programmes of Botswana, Mozambique, Namibia, Swaziland, Zimbabwe and Zambia; National Museums of Kenya (Institute of Primate Research); Ohio State University, USA; Pennsylvania State University, USA; Punguza Mbu na Malaria Malindi (PUMMA) community group, Malindi, Kenya; Radboud University, Netherlands; RWTH Aachen University, Germany; Sumitomo Chemical, Japan; Swedish University of Agricultural Sciences (SLU); Swiss Tropical and Public Health Institute, Switzerland; The KEMRI – Wellcome Trust Research Programme, Kenya; Ultimate Products (Aust) Pty Ltd, Australia; Umeå University, Sweden; University of Bonn, Germany; University of Glasgow, UK; University of Greenwich (Natural Resource Institute), UK; University of Nairobi, Kenya; University of Pretoria, South Africa; United States Department of Agriculture (USDA), USA; Wageningen University, The Netherlands; Wellcome Sanger Institute, UK; World Health Organization–Regional Office for Africa (WHO–AFRO).

HUMAN HEALTH THEME

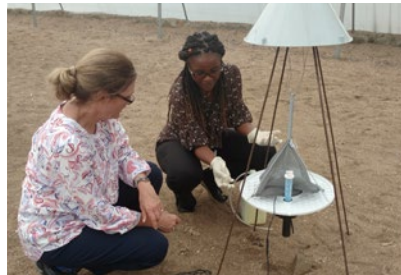
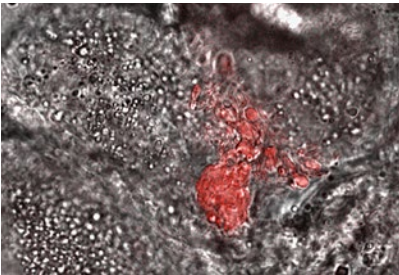
2018 IN PICTURES



We conducted research on the most efficient vectors of emerging, infectious and neglected tropical diseases...



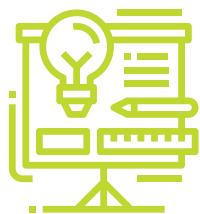
...through laboratory and field based studies, and capacity building of stakeholders at all levels...



...and continued to find solutions like microbiomes, traps and plant based larvicides.

HUMAN HEALTH THEME

IN 2018, WE:



IMPLEMENTED
20 projects

HAD
12 postgraduate students
in progress



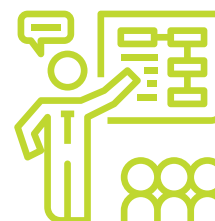
PUBLISHED
25 peer reviewed
journal articles



WORKED WITH
30 partners and collaborators



RECEIVED
funding support from
10 donors



CONDUCTED
2 trainings

HUMAN HEALTH THEME

MALARIA RESEARCH

Goal

Develop a mosquito push-pull strategy

Targeted malaria control through active entomological surveillance

Progress in 2018

We conducted studies towards using **spatial repellents** to push away mosquitoes from peri-domestic areas, and attractants to pull them towards odour-baited traps.

Laboratory based experiments showed that proposed **technology can reduce mosquito biting** in people **by more than 50%**.

We examined the role of *Anopheles funestus* mosquitoes in contemporary malaria transmission in Kenya through analysis of bionomic traits (species composition with *plasmodium* infectivity with blood meal sources) and genetic structure of *An. funestus sensu stricto* (*s.s.*) specimens from multiple major malaria endemic areas in Kenya.

Findings revealed **a previously unreported potential malaria vector** in the *Funestus* group, which was found to be infected with the *Plasmodium* parasite, and displayed high potential to feed on people. *Anopheles funestus s.s.* was found to be **subdivided into three unique genetic clusters** in Kenya, with genotypes mirroring the degree of *Plasmodium* infectivity and thus, malaria endemicity in Kenya. We uncovered occurrence of more species in the *An. funestus* group than previously documented in Kenya: *An. funestus s.s.*, *An. rivulorum*, *An. vaneedeni*, *An. lesoni*, *An. parensis* and for the first time *An. longipalpis* C. Infection of *An. longipalpis* C with the malaria parasite, *P. falciparum*.

Way forward

A smallscale field trial of the technology has been initiated in Ahero, a rice irrigation scheme in western Kenya.

These findings underscore the importance of active surveillance through application of molecular approaches to unravel novel parasite- vector associations and their genetic structure with important implications for effective malaria control and elimination.

The results provide baseline data in support of malaria control operations by understanding the genetic and ecological drivers that influence malaria transmission especially at local scales.

HUMAN HEALTH THEME

MALARIA RESEARCH

Goal

Progress in 2018

Way forward

Develop malaria diagnosis tools status

Previous studies have shown that infection by malaria parasites induces changes in host odours that influence vector attraction, which might yield robust biomarkers of infection. **We analysed skin volatiles from people with high rates of malaria infection in Kenya and established:**

Effects of malaria infection on **human volatile profiles** and distinctness between symptomatic and asymptomatic infections.

Identified asymptomatic infections with 100% sensitivity even in low-level infections that are not detectable by microscopy far exceeding the performance of currently available rapid diagnostic tests in this regard.

Identified a set of individual compounds as important predictors of infection status.

Anopheles mosquito symbionts for Plasmodium transmission-blocking

Isolated *Microsporidia* sp. microbes of considerable interest as they **can block and prevent the malaria mosquito** (*Anopheles gambiae*) from successfully transmitting the malaria parasite. Results showed that *Microsporidia* sp. symbionts exhibit both vertical and horizontal transmission.

The findings highlight the potential use of volatile biomarkers for malaria infection diagnosis as a non-invasive method under field conditions.

We are currently investigating the mechanistic basis of protection (and potential synergy between the two symbionts) and also planning to develop a project to study symbiont dissemination under semi-field conditions.

HUMAN HEALTH THEME

MALARIA RESEARCH

Goal

Progress in 2018

Way forward

Integrated vector management in southern African countries

We demonstrated the potential benefits of integrating currently readily available but not-widely used vector control tools, namely winter-larviciding and house screening, in Botswana, Namibia, Swaziland, Mozambique, Zambia and Zimbabwe, that are attempting a final push at malaria elimination.

Helped finalise **countries-specific protocols** and **received ethical clearance** to implement project activities in Namibia, Swaziland and Zambia, and provisionally in Botswana.

Trained in-country teams on methods for entomological, epidemiological and socio-economic assessments conducted in Namibia, Swaziland, Zambia and Botswana.

Mosquito larvicidal product

Uzimax (*icipe*-Med-Plant-11), a **plant-derived mosquito larvicidal** product for vector control developed by *icipe* was submitted for registration to the Pesticides Control Products Board (PCPB) of Kenya.

The Board approved summary dossier and independent testing reports combining toxicity, efficacy and physical chemical properties for *Uzimax*, and recommended issuance of a registration certificate.

Conduct household surveys and baseline data collection starting in early 2019.

Uzimax will undergo large-scale field trials to confirm effects on non target organisms and residual activity of the larvicide, determine operational and community acceptance, and initiate commercialisation.

HUMAN HEALTH THEME

MALARIA RESEARCH

Goal

Understand association between agriculture and malaria transmission

Progress in 2018

Study has shown that areas with extensive agriculture practiced throughout the year have increased densities of malaria vectors. Available data indicate that the study areas in which agriculture is extensively practiced have more densities of malaria vectors as compared to study areas where little or no agriculture is practiced. However, the higher mosquitoes do not experience most malaria in children 1-14 years of age. Members from the community trained on use of mosquito sampling tools and administration of questionnaires to households to collect household demographic and socio-economic data.

Way forward

Collection of additional routine data to adequately understand linkages between agriculture and malaria.

NEGLECTED TROPICAL DISEASES

Find solutions for Tungiasis, a parasitic skin disease that affects millions of people in Sub-Saharan Africa

We analysed a tungiasis risk factor study ; implemented randomised controlled trial of a locally-made, herbal remedy (neem & coconut oil) for treatment of tungiasis (jiggers).

We conducted statistical risk factor analyses of secondary household and school data on tungiasis; completed RCT implemented and data collection completed; worked with independent clinical trials monitor to appropriately implement and close-out the study; regular update of the Clinical Trials registry nationally and pan-African; comprehensive data analysis of clinical data implemented.

Work with civil engineers, material scientists and architects to develop sustainable flooring solutions for communities to interrupt sandflea life cycle and prevent disease. Establish interdisciplinary collaboration to determine tungiasis in East Africa in a One Health approach. Collaborate in a national task force on ectoparasitic diseases.

HUMAN HEALTH THEME

NEGLECTED TROPICAL DISEASES

Goal

Conduct eco-toxicological investigations of freshwater pollution in regard to schistosoma host snails in freshwater streams

Progress in 2018

Schistosomiasis, an acute and chronic parasitic disease caused by trematode worms of the genus *Schistosoma*, is a neglected tropical disease. Despite the significant role of snails in disease transmission malacological studies are rare. We hypothesize that pesticide pollution may favour the development and spread of host snails.

We conducted comprehensive statistic data analysis of extensive and complex ecological data collected over a three months field sampling period.

Implemented field sampling and dose response tests to assess the acute sensitivity of *Schistosoma*-host snails and associated tropical macroinvertebrate species to representative insecticides relevant in freshwater bodies of western Kenya.

Way forward

We have submitted a research protocol for ethical clearance from Kenya Medical Research Institute (KEMRI) Scientific and Ethical Review Unit, for authorisation to screen school children for acute Schistosomiasis infections and collect *Schistosoma* eggs from stool and urine samples.

HUMAN HEALTH THEME

IN CONVERSATION WITH MARGARET MENDI NJOROGI, PHD SCHOLAR

Host project and funding: East African Collaboration of Mosquito Push Pull (EACoMoPP).

Registered: at Wageningen University, the Netherlands.

Mentors: Dr Ulrike Fillinger (*icipe*) and Dr Alex Hiscox (Wageningen University).

Background: I was born and raised in Eastlands, Nairobi, Kenya.

Favourite subjects in primary and secondary school: Mathematics and science.

Most influential individual: My late father, Mr William Njoroge, a former teacher, who tutored me, especially in mathematics and science, and provided the foundation for my studies.

As a young student, I excelled academically, was a class representative, cross-country

runner, and President of two clubs: Peoples, Places and Plans and Debate club.

Quote to live by: My 'O' level physics teacher, Mr Pius Odida, once told us: "If you want to understand something, become genuinely interested in it and the rest will follow".

Reasons for choosing science at university: I found science interesting and I was fascinated by questions like: how do we dream; what happens inside our brains before an action takes place; and what function do seemingly ordinary like hair, saliva and tears, play in our bodies?

Degrees obtained: Biomedical Sciences and Technology, specialising in Medical Biotechnology, obtained in 2004 Maseno University, Kenya.

Why this specific course: Primarily, the desire to work towards a career in medical research, specifically drug development. As I advanced, my interest broadened to research in general.

Previous positions held: Programme Officer, African Academy of Sciences, Research

Associate, Institute of Primate Research

Future career plans: I have always worked in malaria control first on the parasite, then vaccine research and currently focusing on the vector. I eventually want to integrate these various angles of attack and multidisciplinary designs in creating tools towards malaria control.

Person you admire: I have a special appreciation for Dr Ulrike Fillinger (Scientist, Human Health Theme, *icipe*), who has provided something valuable; mentorship, gently steering me towards excellence by helping me exploit my strengths while guiding me to work around my weakness and seeing opportunities for growth and empowerment.

“
MY LATE FATHER
REMAINS THE MOST
INFLUENTIAL
PERSON IN
MY LIFE
”





Ganatra Akbar conducting field research on freshwater pollution and transmission of schistosomiasis.

ANIMAL HEALTH THEME

DONORS AND PARTNERS

Donors: Biovision Foundation for Ecological Development, Switzerland; Consortium for National Health Research (CNHR), Kenya; European Union; Federal Ministry for Economic Cooperation and Development (BMZ); German Research Foundation (DFG); International Atomic Energy Agency (IAEA); Max Planck Institute, Germany; National Science Foundation (NSF), USA; Swedish International Development Cooperation Agency (Sida); The Wellcome Trust, UK; UK Aid from the UK Government; United States Agency for International Development's Partnerships for Enhanced Engagement in Research (USAID-PEER) grants program.

Partners: African Union Inter-African Bureau for Animal Resources (AU-IBAR); county governments of Marsabit and Isiolo, Kenya; Director of Veterinary Services (DVS), Kabete Veterinary Research Laboratories, Nairobi, Kenya; Kenya Livestock Producers Association (KLPA); Kenya Tsetse and Trypanosomiasis Eradication Council (KENTTEC); Kenya Wildlife Service (KWS); Marsabit County Livestock Office, Kenya; Max Planck Institute for Chemical Ecology, Jena, Germany; Ministry of Agriculture, Livestock & Fisheries and Department of Veterinary Services in Kwale County; Mount Kenya University, Kenya; National Museums of Kenya; Smithsonian Institution, USA; Sokoine University of Agriculture, Tanzania; Tanzania National Parks; Tanzania Wildlife Research Institute (TAWIRI); University of Maryland, USA; University of Würzburg, Germany; Yale School of Public Health (USA).

ANIMAL HEALTH THEME

2018 IN PICTURES



We made progress in the management of various livestock vectors in a variety of agroecologies, and on wild animals in relation to zoonotic diseases...



...through laboratory and field based studies, and the development of technologies...



...which were disseminated through a number of participatory pathways, leading to impact on livelihoods.

ANIMAL HEALTH THEME

IN 2018, WE:



IMPLEMENTED
7 projects

HAD
8 postgraduate students
in progress



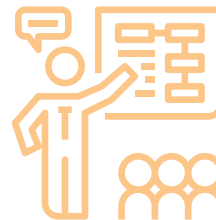
PUBLISHED
10 peer reviewed
journal articles



WORKED WITH
7 partners and collaborators



RECEIVED
funding support from
4 donors



RECEIVED registration
approval for
1 repellent blend

ANIMAL HEALTH THEME

TSETSE INTEGRATED VECTOR MANAGEMENT

Goal

Progress in 2018

Way forward

Upscale tsetse repellent collar technology

Registration approval for the tsetse repellent blend received from the Kenya Pest Control Products Board, and certificate awarded in May 2018. A **licensing agreement** was made with Innova Biologicals Ltd, a Kenyan company, for the commercialisation of the repellent blend and collar.

Two new prototype dispensers of the repellent (canvas-based and plastic material-based) were developed.

Strategies used include:

Community Owned Resource Persons (CORPs) trained to trap and identify tsetse; and to use Global Positioning System (GPS) units and mobile devices for data collection.

A **novel mobile phone application was developed** linking farmers to retailers of the repellent technology and providers of other veterinary products and services. CORPs were trained to use it. The application has been submitted for trademark registration.

A **possible novel technology** for sampling *Glossina fuscipes fuscipes*, the species that transmits human African trypanosomiasis has been identified. **Sticky small panels** made of blue and black material can trap more tsetse than the commonly used biconical traps. Knowledge has also been generated on how colour differently influences the choice by female and male tsetse on where to land on the panels.

icipe will proceed with commercialisation plans including licensing agreements.

Scaling out activities will be conducted in Kenya, Ethiopia and Zambia.

The two prototype dispensers will be evaluated.

Integrated tsetse management strategies (tsetse repellent collar technology, traps etc)

Develop novel tsetse trapping technology

This knowledge could be used in targeted biological control of the flies.

The technology will improve tsetse catches even at low densities and enhance monitoring of the flies.

ANIMAL HEALTH THEME

CAMEL TRYPANOSOMIASIS

Goal

Management of biting flies and trypanosomiasis in camel

Progress in 2018

The activities built on previous *icipe* research that showed:

Trypanosomiasis is the **number one constraint** of camel health accounting for 77-90% of the mortality.

Camel trypanosomiasis is the **most significant disease**, probably caused by a complex of trypanosomes species (i.e. *Trypanosoma evansi*, *T. vivax* and *T. congolense*).

Potential surra vectors include *Hippobosca camelina*, *Pangonia ruppellii*, *Tabanus spp.*, *Stomoxys calcitrans*, and Chrysops species.

In 2018:

Attractants of surra vector were identified and synthesized.

An **optimal long lasting dispenser** was selected and evaluated for packaging and dispensing the attractants.

Nano-polymer beads were found to be better in releasing attractants and repellents steadily and more effectively, catching or repelling more flies, while also maintaining the compounds stability for long periods.

Way forward

The identified repellent and attractant will be further evaluated and piloted. The dispenser will be adapted to fit into the already existing camel “collar” that pastoralists use to keep track of their animals.

Monoconical and khaki coloured sticky trap baited with attractant in Nano-polymer dispenser will be deployed around camel bomas and watering point for mass trapping. The technology will be evaluated in randomised complete block design experiment. Socio-economic impact of the technology will be assessed considering abortion rates, vector borne disease prevalence, domestic animal mortality, quality and yield of milk, income of the family and treatment cost.

ANIMAL HEALTH THEME

VECTOR, PATHOGEN, INVASIVE SPECIES

Goal

Analysis of the diversity and abundance of vectors and pathogens in the Maasai Mara National Reserve

Use of time-series remotely sensed data sets from different satellite

Progress in 2018

Studies on mosquito, tick, and tsetse fly species, as well as of the pathogens (arboviruses, trypanosomes, tick-borne) pathogens they harbour advanced steadily. Results showed:

Clear association of ***Sodalis endosymbiont infection*** with increased frequencies of trypanosome infection in tsetse flies.

High rates of **tsetse feeding on hippopotamus**.

High rates of *Theileria parva* (the causative agent of East Coast fever) in questing *Rhipicephalus appendiculatus* ticks in the Reserve.

Tick species-specific *Coxiella endosymbionts* are ubiquitous among sampled specimens.

Produced the **first comprehensive map on two invasive plant species** (*Prosopis juliflora* and *Parthenium hysterophorus*) in western Somaliland (eastern Africa).

Demonstrated that vegetation phenological/seasonality variables from satellite imagery together with machine learning analytical tools can **map the spread and distribution of invasive plant species** in a dryland ecosystem.

Way forward

These findings underscore the importance of active surveillance through application of molecular approaches to unravel novel parasite-vector associations and their genetic structure.

Arbovirus screening and bushmeat analyses are ongoing.

ANIMAL HEALTH THEME

IN CONVERSATION WITH MERID GETAHUN, SCIENTIST

Background: I was born and raised in East Shewa, Oromia Region, Ethiopia.

Favourite subject in secondary school: Chemistry

Influential individuals in your youth: Several teachers: My English teacher, Yilma, and physics teacher Yohannes, and my elementary teacher, Bizunesh, who encouraged me, then a good but very shy student, to express myself more confidently.

Quote to live by: “Ok aybelam doke” (if you are educated you do not have to eat doke) by my older brother, which was my motivation to excel in high school.

Reasons for course option: Biology and chemistry, because I am fascinated and motivated to understand mechanisms, and I like to ask questions and to debate scientific

issues. I enjoyed reading my science and mathematics books, and also asking questions, debating with friends, family. I was and I still am amazed by the complexity of the biological system.

Degrees obtained: Msc in Insect Sciences from Addis Ababa University, in 2002; PhD (2013) in Chemical Ecology/Neuroethology from Max Planck Institute for Chemical Ecology, Germany.

Previous positions held: Postdoctoral Fellow at Max Planck Institute for Chemical Ecology, Biology teacher, Ginnir High school, Research Associate, Addis Ababa University.

Person you admire most: Albert Einstein, because he made his discoveries without sophisticated laboratory equipment, and for his intellectual dedication, philosophy and motivation.

Career influences: I follow my interests and what I perceive to be gaps in knowledge production. I like the interface between neurobiology-chemistry-behaviour, and I have identified the need for electrophysiologist.

Key moments of satisfaction: Acceptance of a peer reviewed paper or proposal, and watching the evolution of students.

Future career plans: I want to expand neurobiology studies, an area that is in its infancy in Africa, and its application, through research and by mentoring Msc and PhD students. I will strive to increase my own competence and that of *icipe* in neurobiology and chemical ecology focusing animal diseases and vectors. I would also like to be a college professor.

“
I HAVE ALWAYS BEEN
AMAZED BY THE
COMPLEXITY OF
THE BIOLOGICAL
SYSTEM.”





We are conducting studies to understand tick-borne zoonotic disease epidemiology within nomadic pastoral systems in Kenya.

PLANT HEALTH THEME

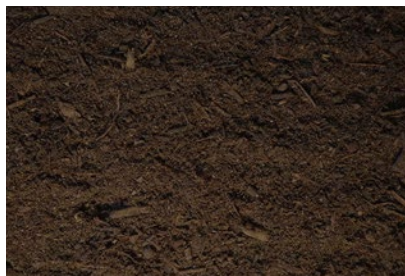
DONORS AND PARTNERS

Donors: Biotechnology and Biological Sciences Research Council (BBSRC), UK, through Rothamsted Research and Keele University (both in the UK); Biovision Foundation for Ecological Development, Switzerland; Canadian Government through International Development Research Centre (IDRC) and Grand Challenges Canada (GCC); European Union; Federal Ministry for Economic Cooperation and Development (BMZ), Germany; Food and Agriculture Organization of the United Nations (FAO); Government of Kenya; Humidtropics CGIAR Research Programme led by International Institute of Tropical Agriculture (IITA); International Atomic Energy Agency (IAEA), Austria; International Fund for Agricultural Development (IFAD), Italy; Liechtenstein Development Service (LED), Principality of Liechtenstein; McKnight Foundation, USA; National Commission for Science, Technology and Innovation, Kenya; Norwegian Agency for Development Cooperation (Norad); Research Institute of Organic Agriculture (FiBL), Switzerland; Russell IPM Ltd, UK; Swedish International Development Cooperation Agency (Sida); Swiss Agency for Development and Cooperation (SDC); The Office of U.S. Foreign Disaster Assistance (OFDA); UK Aid from the UK Government; United States Agency for International Development (USAID), USA through the IPM Innovation Lab.

Partners: A to Z Textiles Limited, Arusha; African Conservation Tillage Network, Malawi and Zambia; Agrarian Systems Ltd, Uganda; Agricultural Research Corporation (ARC), Wad Medani, Sudan; Agroscope, Switzerland; Anglican Development Services, Kenya; Anglican Development Services Eastern (ADSE), Kenya; Austin Investment Ltd; Avocado Growers Association, South Africa; Transformation Agency, Ethiopia; Biocontrol Research Laboratories, India; Bioversity International; CABI Africa; University of Bonn, Germany (Center for Development Research – ZEF); Citrus Research International, South Africa; Conservation Farming Unit (CFU), Zambia; Division of Plant Industry, Florida Department of Agriculture and Consumer Services, USA; Dudutech Ltd, Kenya; East African Seed Co. Ltd; Elephant Vert; Embu University, Kenya; Ethiopian Institute of Agricultural Research (EIAR); Farmer groups and mango growers; Farmtrack consulting Ltd; Forum for Agricultural Research in Africa (FARA); Hawassa University, Ethiopia; Heifer International – Kenya and Tanzania; Horticultural Research and Training Institute–Tengeru (HORTI Tengereu), Tanzania; HottiServe East Africa Limited; Humboldt–Universität zu Berlin, Germany; Institute for Sustainable Development (ISD), Ethiopia; Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic; International Center for Tropical Agriculture (CIAT); International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); International Institute of Tropical Agriculture (IITA); International Livestock Research Institute (ILRI); International Maize and Wheat Improvement Center (CIMMYT); International Potato Center (CIP); International Water Management Institute (IWMI); Jaramogi Oginga Odinga University of Science and Technology (JOUUST), Kenya; Jomo Kenyatta University of Agriculture and Technology (JKUAT); Julius Kühn–Institut (Institute for Biological Control), Germany; Kasisi Agricultural Training Centre, Zambia; Keele University, UK; Kenya Agricultural and Livestock Research Organisation (KALRO)–Horticulture Research Institute; Kenya Biologics Ltd; Kenya Institute of Organic Farming (KIOF); Kenya Organic Agriculture Network (KOAN); Kenya Plant Health Inspectorate Service (KEPHIS); Kenyatta University, Kenya; Lake Zone Agricultural Research and Development Institute (LZARDI), Tanzania; Lasting Solutions; Leibniz Universität Hannover, Germany; Lilongwe University of Agriculture & Natural Resources (LUANAR), Malawi; Makerere University, Uganda; Maseno University, Kenya; Mikocheni Agricultural Research Institute, Tanzania; Ministries of Agriculture in Botswana, Namibia, Zambia and Zimbabwe; Ministry of Agriculture and Natural Resources, Ethiopia; Ministry of Agriculture, Animal Industry and Fisheries, Uganda; Ministry of Agriculture, Food Security and Cooperatives, Tanzania; Ministry of Agriculture, Forestry, Cooperatives and Rural Development, South Sudan; Ministry of Agriculture, Livestock and Fisheries, Kenya, and County Departments of Agriculture; Agricultural Sector Development Support Programme, Kenya; Moi University, Kenya; National Agricultural Research Organisation (NARO), Uganda; National Crops Resources Research Institute (NaCRRRI), Uganda; National Museums of Kenya; National Potato Council, Kenya; Norwegian Institute for Bioeconomy Research (NIBIO); Nutreal Ltd, Uganda; One Acre Fund, Kenya and Uganda; Royal Museum of Central Africa, Tervuren, Belgium; Sanergy Ltd; Tanzanian Pesticide Research Institute, Tanzania; The New Zealand Institute for Plant & Food Research Ltd; Plant Research International, Wageningen University and Research Centre (WAU), The Netherlands; The Poverty Alleviation Department, Office of the President, Uganda; Real IPM Ltd, Kenya; Research Institute of Organic Agriculture (FiBL), Switzerland; Rothamsted Research, United Kingdom; The Seed Control and Certification Institute of Zambia; Seed Co. Zimbabwe Limited; Send a Cow; farmers' groups; Sokoine University of Agriculture, Tanzania; Texas A&M University, USA; Tigray Agricultural Research Institute (TARI), Ethiopia; Total LandCare, Malawi and Zambia; Treasure Industries Ltd; Tropical Soil Biology and Fertility (TSBF) Institute of CIAT; Ugachik Ltd, Uganda; Unga Feeds Ltd, Kenya; University of Hohenheim, Germany; University of Nairobi, Kenya; University of Pavia, Pavia, Italy; University of Sousse (Higher Agronomic Institute of Chott–Mariem), Tunisia; University of Tschang, Cameroon; University of Zambia; WeRATE; World Agroforestry Centre (ICRAF).

PLANT HEALTH THEME

2018 IN PICTURES



We conducted studies that confirmed the impact of our Push-Pull technology on soil healthy and maize safety, and addressed pests of its intercrops...



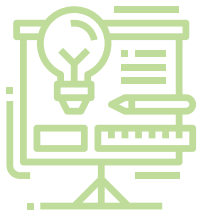
...we discovered and implemented strategies to tackle the invasive fall armyworm including the Push-Pull technology, biopesticides and natural enemies...



...and found solutions for numerous other pests of staples and horticultural crops.

PLANT HEALTH THEME

IN 2018, WE:



IMPLEMENTED
14 projects

HAD
26 postgraduate students
in progress



PUBLISHED
71 peer reviewed
journal articles



WORKED WITH
70 partners and collaborators



RECEIVED
funding support from
16 donors



CONDUCTED
374 trainings
(including training of trainers
workshops, farmers field days)

PLANT HEALTH THEME

PUSH-PULL TECHNOLOGY <http://www.icipe.org/research/plant-health/push-pull-ipm-technology>

Goal

Progress in 2018

Way forward

Demonstrate superior performance of Push-Pull technology in improving soil health

Desmodium, one of the key intercrops of Push-Pull:

Significantly **improved seasonal nitrogen** availability by up to 107% compared to 21% achieved through other food legumes.

Enhanced soil phosphorus availability by up to 67% compared to up to 46% decline resulting from other food legumes.

Boosted soil organic matter content by up to 25% after five cropping seasons.

Advancing climate smart Push-Pull, while also developing management strategies for red spider mites.

Drought resistant *Brachiaria* species are integral to the climate smart Push-Pull.

However, **spider mite, *Oligonychus trichardti***, has recently been reported as a major pest of the plant in the region.

The **first documentation** of interactions between *O. trichardti* and different *Brachiaria* genotypes was completed.

Indicators of ***Brachiaria* resistance to pest damage** were assessed, including leaf damage, chlorophyll content reduction, plant height, leaf area, number of tillers and shoot biomass.

Findings indicated that the **amount of rainfall** plays a role in reducing mite infestation and increasing biomass yield of the genotypes.

We are determining the role of Push-Pull in climate change mitigation through improved soil's ability to sequester more carbon.

We propose these genotypes as potential candidates for improved forage yields in areas prone to *O. trichardti* infestation in Africa.

We are packaging a more adaptable Push-Pull system by incorporating the selected mite resistant *Brachiaria* germplasm.

PLANT HEALTH THEME

PUSH-PULL TECHNOLOGY <http://www.icipe.org/research/plant-health/push-pull-ipm-technology>

Goal

Impact of Push-Pull cropping system on maize ear rots and mycotoxins.

Progress in 2018

Fusarium, *Aspergillus* and *Acremonium* spp. were found to be the **most prevalent fungal general in maize** samples from both Push-Pull and non-Push-Pull cropping systems.

The population of *F. verticillioides* and *A. flavus* was **significantly lower** in maize samples from Push-Pull fields, with all the samples having aflatoxin **levels below the threshold in Kenya**.

The proportion of maize samples with high fumonisin levels above the European Commission threshold that Kenya has adopted, was **significantly lower in samples from Push-Pull plots**.

Way forward

We are elucidating the mechanisms by which Push-Pull controls ear rots and mycotoxins to allow for its optimisation for improved food safety.

FALL ARMYWORM MANAGEMENT

Habitat management and diversity of maize cropping systems for the management of fall armyworm

Push-Pull farmers in Kenya, Uganda and Tanzania were surveyed for their perception on impact of the technology in controlling the pest.

Push-Pull farms **have recorded 82.7% reduction in fall armyworm** incidence as compared to monocropped farms.

Push-Pull, maize-edible legume intercropped, and maize monocropped farms in Uganda confirmed the impacts of Push-Pull **with more than 60% reduction in FAW incidence**.

Intercropping with edible legumes such as bean, soybean and groundnut can provide more than 35% reduction in fall armyworm incidence.

We are elucidating the mechanisms by which habitat management approaches control fall armyworm to allow for targeted deployment for managing the pest in Africa and beyond.

PLANT HEALTH THEME

FALL ARMYWORM MANAGEMENT

Goal

Progress in 2018

Way forward

Development of biopesticide for fall armyworm management

21 fungal isolates from three different genera (*Metarhizium*, *Beauveria* and *Isaria*) were assessed against the egg stage of fall armyworm.

Results showed good performance of isolates of *M. anisopliae*, *ICIPE* 78, *Icipe* 40 and *ICIPE* 20.

icipe 78, which has already commercialised as Mazao Achieve® against spider mites by Real IPM Ltd., could be used as a potential biopesticide to suppress fall armyworm in Africa.

Natural association of indigenous parasitoids on fall armyworm in East Africa.

Surveys for **indigenous natural enemies attacking fall armyworm** were undertaken in Ethiopia, Kenya and Tanzania.

One native egg parasitoid (*Chelonus curvimaculatus*) and four native larval parasitoids (*Charops ater*, *Coccigydium luteum*, *Palloxantha zonata* and *Cotesia icipe*) were found to have formed new associations with fall armyworm in Africa.

Among these parasitoids, *Cotesia icipe* was found to be widely distributed.

PLANT HEALTH THEME

STEMBORER MANAGEMENT

Goal

Community composition and functioning of Lepidopteran maize stemborers with the recent invasion of fall armyworm.

Biological control of maize stemborer pests of maize and sorghum.

Rice, maize and chickpea IPM for East Africa

Progress in 2018

Three species of Lepidopteran stemborer (*Busseola fusca*, *Sesamia calamistis* and *Chilo partellus*) inhabit cereal crop either as single or as mixed species.

Our preliminary observations show that **fall armyworm is starting to interact and compete strongly** with lepidopteran stemborer communities particularly at the early larval instars when the **stemborers** are mostly leaf feeders and occupying the same niche as *S. frugiperda*.

We investigated the existence of two populations of *Cotesia sesamiae* in Kenya with a variation in host acceptance and parasitism success towards *Busseola fusca*, important stemborer pest of maize and sorghum.

Discovered a new braconid species, *Cotesia typhae*, with ecological speciation on the stemborer *Sesamia nonagrioides* (Lepidoptera: Noctuidae) in Kenya.

Over 2,000 farmers are directly involved in demonstrating rice, maize and chickpea IPM technologies in Ethiopia, Kenya, Tanzania. The **technologies being promoted** include: Push-Pull; biopesticides; botanical extracts; and seed dressing, soil water drainage.

Way forward

Studies are ongoing to investigate the potential competitive displacement of stemborers and their associated parasitoids by fall armyworm in two agroecological zones in Kenya.

This knowledge allow us to initiate a study on the identification of candidate genes involved in host acceptance by *Cotesia sesamiae*.

We plan to develop a classical biological control programme in France to use this new *Cotesia* against *Sesamia nonagrioides* which is an important pest of maize in mediterranean countries.

PLANT HEALTH THEME

FRUITS IPM <http://www.icipe.org/research/plant-health/fruit-fly-ipm>

Goal

Upscaling *icipe* fruit fly integrated pest management (IPM) technologies in Kenya and Ethiopia

Progress in 2018

IPM starter packs (consisting of traps, male annihilation techniques, and biopesticides) provided to 1500 farmers.

Trials using *icipe* **Fruit fly Mania®**, which is being commercially produced through a facility established by Kenya Biologics Ltd, completed with the Pest Control Products Board (PCBP).

We developed **parameters for postharvest treatment** for mango, and through a partnership with Kibwezi Agro Limited, Kenya started to establish a postharvest treatment facility.

Establish efficacy of *Metarhizium anisopliae* biopesticide in the control of fruit flies.

Introduced, mass produced and **released parasitoids** to biologically control fruit flies in Kenya and Ethiopia.

Developed **female biased fruit fly attractants**.

Identified **Fruit fly endosymbionts** that can control fruit flies.

Strengthened **capacity of national agricultural research partners and other partners** in the transfer of fruit fly IPM technologies.

Established **40 IPM learning sites** were used for dissemination with **40 lead/ model farmers and 96 Extension officers trained**.

Way forward

Intensive trainings, for example through the establishment of more learning centres, training of more extension officers, and awareness creation on IPM strategies.

Complete the establishment of a hot water treatment plant in Nairobi for dis-infesting mangoes of fruit flies, towards enabling smallholder farmers access export markets in Europe and the Middle East.

PLANT HEALTH THEME

FRUITS IPM <http://www.icipe.org/research/plant-health/fruit-fly-ipm>

Goal

Management of the invasive Asian citrus psyllid *Diaphorina citri*.

Progress in 2018

In 2015, the Asian citrus psyllid *Diaphorina citri*, which transmits the devastating Huanglongbing or citrus greening disease, was detected in Tanzania. A year later, *icipe* researchers detected the same pest in coastal Kenya and Zanzibar.

If uncontrolled the pest could ruin citrus production in Africa. Indeed, the citrus industry in Florida, USA, is greatly affected by invasion of *D. citri* and citrus greening disease.

icipe is working closely with relevant regulatory authorities and providing them with methods, tools and technologies (traps, attractants, sampling design and methods) **to monitor and detect the pest early to guide intervention and minimize spread.**

Way forward

In December 2018, a pan-African, task force spearheaded by *icipe* was formed to develop an action plan for the containment and prevention of further spread of the Asian citrus psyllid and Huanglongbing.

VEGETABLES IPM <http://www.icipe.org/research/plant-health/vegetable-ipm>

Integrated pest and pollinators management (IPPM)

icipe and partners in Kenya and Tanzania launched a new three-year project aimed at **enhancing productivity of avocado and cucurbits in East Africa.**

Cucurbits (cucumber, butternut and pumpkin), and avocado are economically important crops in East Africa, which are also highly dependent on pollination services and are severely affected by several insect pests.

The IPPM project is built on the premise that environmental services such as pollination and IPM are key drivers, and two components that can interact in a variety of ways, resulting in healthier agricultural landscapes and improved food security.

PLANT HEALTH THEME

VEGETABLES IPM <http://www.icipe.org/research/plant-health/vegetable-ipm>

Goal	Progress in 2018	Way forward
Management of the bean flower thrips (<i>Megalurothrips sjostedti</i>) in Africa.	<p>We discovered chemical odours that could be exploited to develop technologies for trapping bean flower thrips (<i>Megalurothrips sjostedti</i>) in Africa.</p> <p>The study identified aggregation pheromones released by male bean flower thrips that attract male as well as female thrips.</p> <p>The pheromones cause bean flower thrips to assemble in a focal point on the plant, and can therefore be used to lure insects.</p> <p>This study provides the first information regarding the aggregation pheromone among the thrips belonging to the <i>Megalurothrips</i> group in Africa.</p>	Building on this knowledge, <i>icipe</i> and partners intend to continue research to develop innovative integrated thrips management strategies in Africa. Moreover, a pheromone trap for indigenous African species would be useful in detecting the arrival of exotic pests.
Management of <i>Tuta absoluta</i>	<p><i>icipe</i> and GIZ Somalia conducted joint activities on combating major plant pests.</p> <p>The initiative is focusing on <i>Tuta absoluta</i>, the invasive pest of tomato and other crops; and white flies, which attack tomato and water melon and spider mite, pests of papaya.</p> <p>Conducted workshops and practical trainings and demonstrations; identified the extent of <i>T. absoluta</i> infestation; undertaken an assessment of knowledge and practices regarding the pest among growers and other stakeholders; and evaluated the application of phytosanitary measures in the field.</p>	

PLANT HEALTH THEME

NEMATODES

Goal

Tackling the potato cyst nematode (PCN) a quarantine pest of potato that was first reported in Kenya in 2015.

'Wrap and Plant' technology for the management of PCN

Progress in 2018

We:

Characterised the PCN species present in Kenya.

Started to **elucidate the pest's biology** under Kenyan conditions.

Screened **potential biological control agents** and **trap crops**.

Isolated naturally occurring **fungal antagonists**.

Conducted **field trials** to develop practical management options.

Created awareness amongst farmers and plant health workers and increased technical capacity in Kenya.

icipe and the International Institute of Tropical Agriculture (IITA) are partners in a project led by North Carolina State University, USA to develop a biodegradable matrix made from banana fibre (banana paper) that acts as a carrier for effective application of micro-dosages of nematicides.

The study seeks to elucidate the underpinning principle of the banana paper from a chemical ecology perspective. Findings indicate that the banana paper: **absorbs and adsorbs PCN hatching factors**; significantly **reduces PCN hatch**, by 37% with the abamectin treated paper and 35% with untreated paper; and **slows down PCN development**.

Way forward

Increase production of certified seed including resistant varieties

Promote crop rotation practices that include tackling diseases and pests; Improve diagnostic services for PCN. Continue research on the basic biology, behaviour, and population dynamics of PCN in the region under different cropping systems and climate.

A combination of all these mechanisms could result in late invasion and development of PCN, enabling a banana paper wrapped potato to act as a 'trap crop' for PCN.

PLANT HEALTH THEME

NEMATODES

Goal

Use of semiochemicals to manage plant parasitic nematodes

Progress in 2018

Established that the host infective stage (**microscopic second stage juveniles**) of the root knot nematodes, *Meloidogyne incognita*, **were more attracted to the root volatiles** from tomato and pepper but not spinach relative to the control.

Identified various chemical classes of root volatiles mediating second stage juveniles attraction.

Additionally, **specific non-volatile metabolites** involved in second stage juveniles attraction to the site of root penetration in tomato plant were identified.

Way forward

Combined, these findings provide insights into root knot nematodes-host plant interactions, creating new opportunities towards the management of these pests.

PLANT HEALTH THEME

COFFEE IPM

Goal

IPM tools, strategies and implementation for major coffee pests and diseases in East Africa based on a better knowledge of their bioecology

Progress in 2018

The **thermal requirements** of 3 major pests of coffee in East Africa, the Antestia bugs, the coffee berry borer and the coffee stem borer were elucidated.

Based on this new knowledge, **risk maps** were developed to predict the distribution of coffee pests in the context of climate change.

The **chemical ecology** of the Antestia bug, *Antestiopsis thunbergii* was elucidated. Candidate **semiochemicals** from coffee berries and conspecifics were identified and incorporated as lures in a **trapping system** currently tested in coffee plantations with promising results.

IPM best practices are implemented for coffee pests and diseases in Uganda through the achievement of the triple certification scheme (organic, fair trade and geographical indication).

Way forward

Temperature-based development models will be used to assess the risk of pest occurrence on coffee in Africa, and at a world scale for the coffee berry borer *Hypothenemus hampei*.

A trapping system for coffee Antestia bugs will be tested at large scale in different countries of East Africa. The trap will be used as a monitoring tool to elucidate the pest population dynamics in different coffee agrosystems and as a training tool to enhance coffee farmer awareness about this important pest of coffee.

Propose triple certification as a model for coffee value chain development in East Africa, with improved IMP strategies and climate smart practices.

PLANT HEALTH THEME

IN CONVERSATION WITH DR FATHIYA KHAMIS, SCIENTIST

Background: I was born and raised in Mombasa, coastal Kenya.

Favourite subject in primary and high school: Biology.

Why science: My class 6 teacher who was also the science teacher ignited my interest into science.

Describe yourself as a young student: I was a very cooperative and respectful student. I performed well academically, and I loved to assist others. As a result, I gained the respect of my peers and teachers.

Degrees obtained: BSc in Biochemistry (Zoology) from Jomo Kenyatta University of Agriculture and Technology (JKUAT) in 1999; MSc in Biochemistry from JKUAT in 2004; PhD in Molecular Biology from Kenyatta University, Kenya, in 2009.

Reasons for course choice: I had hoped to study medicine, but I did not qualify, so I opted for a science related course.

Positions held: Research Scientist, *icipe* (2016 – present); Postdoctoral Fellow, *icipe*; Lecturer, Department of Biochemistry, Kenyatta University, Nairobi; Tutorial Fellow, Kenyatta University.

Influential individuals: After completing my undergraduate degree, I returned home to Mombasa. It was difficult obtaining a job in the city. Moreover, I come from a very conservative community where belief in early marriage is deeply rooted. With a degree in hand, no job and being of a certain age, I was at a high risk of an arranged marriage. I had to make a very fast decision in my life. Prof. Mabel Imbuga, Dean, JKUAT, encouraged me to enrol for an MSc. I believe that her concern and support changed the course of my life.

There are many past and present colleagues at *icipe*, far too many to mention, that have shaped my career. The highlight has been under the mentorship of Dr Sunday Ekesi, currently Director of Research and Partnerships, *icipe*. He also connected me with Prof. Anna Malacrida, a guru in fruit

fly molecular genetics, who has become a mentor and “my mother in molecular biology”. Furthermore, the *icipe* Director General, Dr Segenet Kelemu was extremely motivational at a critical point of my career. In addition, Prof. M. S. Rajab, Vice Chancellor Pwani University, and Prof. Eucharist Kenya, Deputy Vice Chancellor, University of Embu, both in Kenya, who introduced me to the art of science teaching and mentorship.

“

I WANT TO REACH THE
PINNACLE OF MY SCIENTIFIC
CAREER AND BE AN
EXAMPLE TO OTHER
WOMEN

”



ENVIRONMENTAL HEALTH THEME

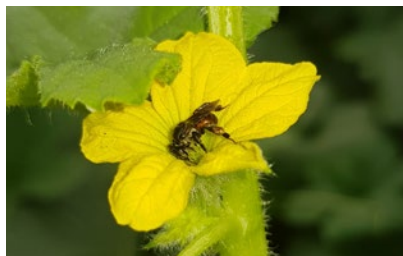
DONORS AND PARTNERS

Donors: AIRD (French Inter-institution Agency for Research and Development); Bayer Bee Care, Germany; Biovision Foundation for Ecological Development, Switzerland; European Union (EU); Federal Ministry for Economic Cooperation and Development (BMZ), Germany; Fellowship from Swiss National Science Foundation (SNSF); International Fund for Agricultural Development (IFAD); JRS Biodiversity Foundation, USA; Ministry for Foreign Affairs of Finland; Ministry of Higher Education, Science and Technology, Kenya; National Geographic Society, USA; Newton Fund Institutional Links – 2016 call; Swedish International Development Cooperation Agency (Sida); SWITCH Africa Green; Swiss Agency for Development and Cooperation (SDC), Switzerland; The MasterCard Foundation; UK Aid from the UK Government; World Trade Organization (WTO) – Enhanced Integrated Framework (EIF).

Partners: Addis Ababa University; African Union Inter-African Bureau for Animal Resources (AU-IBAR); Agricultural Sector Development Programme, Zanzibar, Tanzania; Aklilu Lemma Institute of Pathobiology; Biovision Africa Trust; Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), France; East Usambara Farmers Group; Faculty of Agriculture, University of Kinshasa (DR Congo); Federal Ministry of Health, Ethiopia; Food and Agriculture Organization of the United Nations (FAO); German Centre for Integrative Biodiversity Research (iDiv), Germany; Holeta Bee Research Centre, Ethiopia; Infonet-Biovision, *icipe* Duduville; Institut national de la recherche agronomique (INRA), France; Iziko South Africa Museum, South Africa; Jimma University, Ethiopia; Kenya Medical Research Institute (KEMRI); Kenya Agricultural and Livestock Research Organization (KALRO) (National Sericulture Research Centre); Kenya Marine and Fisheries Research Institute (KEMFRI – Nyabondo); Ministry of Agriculture (MoA-Nyabondo); Ministry of Public Health and Sanitation (Nyabondo); Martin-Luther-Universität Halle-Wittenberg, Germany; Milba Brands Associates Limited; Millennium Institute; Ministry of Agriculture Botswana; Ministry of Agriculture, Livestock and Fisheries (Directorate of Livestock Production), Madagascar; Ministry of Agriculture, Ethiopia; Ministry of Agriculture, Fisheries, Environment and Urban Planning, Comoros; Ministry of Agriculture, Liberia; Ministry of Agriculture, Natural Resources, Livestock and Fisheries, Zanzibar; Ministry of Agro-industry and Food Security (Entomology Division), Mauritius; Ministry of Animal Resources and Fisheries, Burkina Faso; Ministry of Livestock, Fisheries and Animal Industries, Cameroon; Ministry of Health & Municipal Council of Malindi, Kenya; Muliru Farmers Conservation Group (MFCG), Kenya; Museum für Naturkunde, Berlin, Germany; National Agriculture and Food Research Organization, Japan; National Beekeeping Station, Kenya; National Museum, Bloemfontein, South Africa; National Museums of Kenya; Pangani Basin Water Board, Tanzania; Pennsylvania State University, USA; Royal Museum for Central Africa, Tervuren, Belgium; Ruhr-Universität Bochum, Germany; Schmalhausen Institute of Zoology, Ukraine; Seychelles Agricultural Agency; Smithsonian Institution, USA; Smithsonian National Museum of Natural History, USA; Sokoine University of Agriculture, Tanzania; Stellenbosch University, Department of Conservation Ecology and Entomology, South Africa; Strand Life Sciences, India; Taita Environmental Research and Resource Arc (TERRA), Kenya; Tanzania Farmers Conservation Group (TFCG); Tropical Entomology Research Center, Viterbo, Italy; Tuscia University, Viterbo, Italy; United States Department of Agriculture (USDA), USA; University of Bonn, Germany; University of California, Davis, USA; University of Dar es Salaam, Tanzania; University of Helsinki, Finland; University of Kansas, USA; University of Liverpool, UK; University of Umea, Sweden; University of Wuerzburg, Germany; University of York, UK; Wageningen University and Research Centre (Resource Ecology group), The Netherlands; Yeungnam University, South Korea.

ENVIRONMENTAL HEALTH THEME

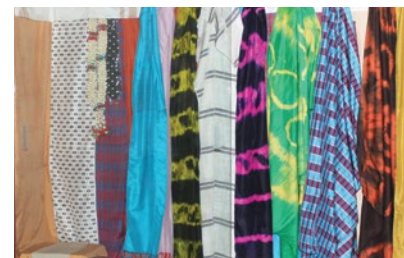
2018 IN PICTURES



We conducted research on commercial and beneficial insects including African and stingless bees and silkmooths, climate change and medicinal plants...



...developed and disseminated technologies in collaboration with communities across Africa...



...leading to the development of commercial enterprises and increased agricultural yield.

ENVIRONMENTAL HEALTH THEME

IN 2018, WE:



IMPLEMENTED
17 projects

HAD
27 postgraduate students
in progress



PUBLISHED
20 peer reviewed
journal articles



WORKED WITH
67 partners and collaborators



RECEIVED
funding support from
13 donors



CONDUCTED
40 trainings

ENVIRONMENTAL HEALTH THEME

BEE RESEARCH

Goal	Progress in 2018	Way forward
Understanding of African bees resistance to <i>Varroa</i> mites	<p>Previous <i>icipe</i> research showed that African bees are resistant to <i>Varroa</i> mites. Current research contributed knowledge on the reason for this resistance.</p> <p>Higher rate of grooming in African bees compared to European bees, attributed to the hygienic behaviour of bee colonies.</p> <p>African bees are able to detect <i>Varroa</i> infested brood cells, open them and remove the mites without harming the developing bee pupa.</p>	<p>Studies for inferring whether the traits have a genetic basis will be conducted.</p>
Study stingless bee species discrimination	<p>Use of morphological features in the identification of stingless bees in the genus <i>Hypotrigona</i> is extremely difficult, due to many similarities among species, resulting in taxonomic ambiguity.</p> <p>We used a combination of traditional morphometrics and DNA barcoding for the identification of three <i>Hypotrigona</i> species (<i>H. gribodoi</i>, <i>H. ruspolii</i> and <i>H. araujoii</i>) from Kenya.</p> <p>Morphometric analysis separated <i>H. gribodoi</i> and <i>H. ruspolii</i> from <i>H. araujoii</i> although there is an overlap between <i>H. gribodoi</i> and <i>H. ruspolii</i>. DNA barcoding separated the three species. The high genetic distance or intraspecific distance within <i>H. gribodoi</i> strongly suggests cryptic speciation within this species, and that the <i>H. gribodoi</i> collected from eastern Kenya is a putative new species.</p>	<p>To study the nesting ecology, genetic diversity and phylogeny of African stingless bee species with emphasis on species discrimination based on mitochondrial DNA and wing geometric morphometrics.</p>

ENVIRONMENTAL HEALTH THEME

BEE RESEARCH

Goal	Progress in 2018	Way forward
Research on gut microbiome in bees	<p>Characterisation of gut microbiome of Kenyan honeybees was completed.</p> <p>Two members were highly conserved among samples in contrast to results found in Northern Hemisphere studies.</p>	<p>The functional relevance of differences in gut microbiome composition will be targeted in follow-up experiments.</p>
Knowledge on pollinator/ nectar microbes	<p>Elucidated the nectar chemistry and nectar-dwelling microorganisms before and after visitation by different bee species on cucumber (<i>Cucumis sativus</i>) and green pepper (<i>Capsicum annuum</i>) plants. The studies:</p> <p>Showed floral nectar composition of cucumber plant to be dominated by sucrose whereas both fructose and sucrose are dominant in green pepper plant.</p> <p>We observed visitation of floral nectar by different bee species (<i>Dactylurina schmidt</i>, <i>Plebeina hildebrandti</i>, <i>Hypotrigona gribodoi</i> and <i>A. m. scutellate</i>) which may potentially affect nectar chemistry.</p> <p>Different bacterial and fungal communities that inhabit floral nectar of male and female flowers of cucumber plant were found.</p>	<p>Studies will be conducted on other stingless bee species and crop species.</p>

ENVIRONMENTAL HEALTH THEME

BEE RESEARCH

Goal	Progress in 2018	Way forward
Pollination efficiency of stingless bee species on horticulture crops	<p>We compared bee foraging behaviours and pollination efficiency in fruit production and seed quality of sweet melon.</p> <p>African honey bee (<i>Apis mellifera scutellata</i>) and seven stingless bee species were tested.</p> <p>Female flower excluded from any pollination did not set fruits.</p> <p>Heavier and voluminous fruits were obtained from female flower pollinated by hand cross-pollination and three stingless bee species.</p>	<p>Focus on other greenhouse horticulture crops of economically importance in Africa; e.g. green pepper, cucumber, egg plants, watermelon.</p>

COMMERCIAL AND BENEFICIAL INSECTS

Create income generation opportunities for youth through the Young entrepreneurs in silk and honey (YESH) project	<p>In its third year, the YESH project:</p> <p>Enrolled 4,000 additional youth in apiculture areas and another 1,100 youth in sericulture.</p> <p>Expanded to 11 new project sites (districts), in addition to the existing six districts where the project has been operating.</p> <p>Altogether about 5,100 youth (39% females) have been engaged and trained and provided with starter kits.</p> <p>Eleven model apiculture sites have been initiated to serve as training and demonstration sites. Additionally, about 728 youth groups/enterprises and 8,722 youth members have directly benefitted.</p>	<p>Continue to develop and test viable operational and business models for generating employment opportunities for disadvantaged youth and women in inclusive commercial beekeeping and silkworm farming.</p>
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ENVIRONMENTAL HEALTH THEME

COMMERCIAL AND BENEFICIAL INSECTS

Goal	Progress in 2018	Way forward
Improve resilience and livelihoods of vulnerable rural communities through beekeeping and environmental rehabilitation	<p>A pilot beekeeping project supported by Biovision Foundation i was launched in Wag Himra Zone, Ethiopia.</p> <p>A total of 300 youth were recruited and supported to establish 30 youth beekeeper enterprises, and operations have started as planned.</p>	<p>Draw lessons from implementation of the pilot phase to inform the design and implementation of a planned beekeeping commercialisation cluster financed by the Government of Ethiopia in Tekeze valley.</p>
Generate knowledge on wild silkmoths species	<p>We conducted studies to understand the biology of Eri silkmoths, <i>Samia cynthia ricini</i> and <i>Philosamia cynthia ricini</i>, and their subspecies. We found:</p> <p>Eri silkmoths and subspecies are closely related despite different morphological features in their larval stages.</p> <p>Eri silkmoths may not be well differentiated using mitochondrial markers, hence the need to use nuclear makers.</p>	<p>Focus on other wild silkmoths, <i>Gonometa postica</i>, <i>Argema sp.</i>, <i>Anaphe sp.</i> and <i>Epiphora sp.</i>, from different ecological zones in Kenya, to understand genetic variation.</p> <p>Development of strains and identification of hybrids with productive merit.</p> <p>Silkworm biotechnology research and diversification of silkworm products using silk 3Fs: Fabric, Food and Feed.</p>

ENVIRONMENTAL HEALTH THEME

THE ADAPTATION FOR ECOSYSTEM RESILIENCE IN AFRICA <http://chiesa.icipe.org/index.php/aboutaferia>

Goal	Progress in 2018	Way forward
<p>Disseminate and communicate research results from the <i>icipe</i>-led Climate Change Impacts on Ecosystem Services and Food Security in eastern Africa</p>	<p>Maize stemborer parasitoid releases completed in Murang'a, Central Kenya.</p> <p>1500 economic trees and 1400 indigenous tree seedlings distributed in Murang'a, Taita Hills (coastal Kenya) and Mt. Kilimanjaro region (Tanzania).</p> <p>3 awareness raising campaigns conducted in 3 locations directly reaching 829 participants. Training of trainers sessions in 3 locations of 92 farmers on the importance of beekeeping in climate change mitigation, modern beekeeping using Langstroth hives and standard maintenance for quality honey production.</p> <p>7 beekeeping demo plots established using Langstroth hives established in Moshi, Muranga, Taita Hills.</p> <p>4 long-lasting nursery structures available, with a capacity of 12000 seedlings each. 100 participants trained on nursery set up and management.</p> <p>Approximately 5600 farmers will benefit from improved coffee varieties. 17000 smallholder coffee farmers to benefit directly from nursery structures by 2021.</p> <p>200 people are benefitting from installed drip irrigation kits and roof rainwater harvesting systems in Taita and Kilimanjaro. 3 ToTs on fall armyworm involving 47 participants conducted.</p>	<p>Continued disseminating fall management tools in other countries, particularly for fall armyworm .</p> <p>Implement more activities on beekeeping and coffee nurseries maintenance.</p> <p>Enhance efforts towards awareness and policy engagement in matters pertaining to climate smart technology and communication of research results to citizens.</p>

ENVIRONMENTAL HEALTH THEME

IN CONVERSATION WITH KIATOKO NKOBA, SCIENTIST

Background: I was born in Lubumbashi, Democratic Republic of the Congo (DRC). As a child, I lived in the USA for four years before returning to DRC.

Influential individual in your youth: Father Lommel who was the Dean of College MAELE, in Kisangani, DRC, where I attended high school. He always encouraged me to do better and go far in education.

Describe yourself as a young student: I was very friendly and helpful to everyone. As a result, the priests who managed the school invited me to reside in the parish, to assist in supervising some school activities. Academically, I was always eager to learn, understand science principles and look to create new things.

Degrees obtained: PhD (2012), Applied Agricultural Entomology, as a DAAD sponsored ARPPIS scholar registered at Kenyatta University, Nairobi, Kenya; MSc (2004)

Aquaculture, University of Liege, Belgium; BSc (2000), Agricultural Engineering, Option: Zootechny, University of Kinshasa, DRC; Diploma (1998), General Agriculture, Institut Facultaire des Sciences Agronomiques de Yangambi, DRC.

Why did you opt for science: I have always been interested in natural sciences. I was fascinated to see on television scientists developing technologies for various purposes. The idea that amazing discoveries were going on in the world triggered my desire to become a scientist. I desired to contribute knowledge in the domestication of wild small terrestrial mammals, insects and aquatic animals. This is because in DRC, a huge section of the population depends on forest and aquatic resources (e.g. bush meat, insects, wild plants, fish) for food, animal feed and general livelihood needs.

Person you admire: Many people. One is Dr Sunday Ekesi, whose rise from an APPRIS student at *icipe* to become a respected scientist in plant health and to currently hold the position of the Centre's Director of Research and Partnership, is inspirational to say the least. I also admire Prof. John Mweke, my

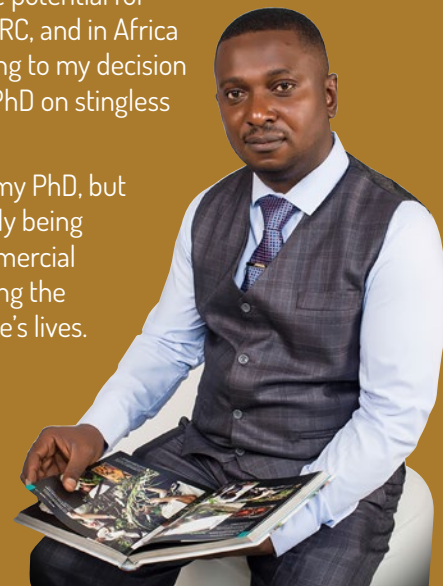
PhD supervisor; an extremely supportive and encouraging person, who was very patient with his students.

Defining moment: Until 2004, I knew very little about bees, I was all set to continue my PhD on other living organisms.

So when I was invited to a beekeeping and sericulture training programme at *icipe* in 2006, I was sceptical and mused. 'What do I have to do with bees?'. But that event changed my life. I saw the potential for beekeeping in DRC, and in Africa in general, leading to my decision to undertake a PhD on stingless bees.

Highs: Earning my PhD, but more importantly being involved in commercial insects and seeing the impact on people's lives.

“
I WANT TO
CONTRIBUTE
TO MAKING
MELIPONICULTURE
AN INCOME
GENERATING
ACTIVITY IN
AFRICA
”





icipe is supporting smallholder farmers living around highland ecosystems, like the Taita Hills shown in this picture, to adapt to the impacts of climate variability and change.

INSECTS FOR FOOD AND FEED PROGRAMME

DONORS AND PARTNERS

Donors: Australian Centre for International Agricultural Research (ACIAR) and International Development Research Centre (IDRC) through the Cultivate Africa's Future (CultiAF) programme; Bioinnovate Africa; BLE – German Federal Agency for Food and Agriculture; BMZ – German Federal Ministry for Economic Cooperation and Development through GIZ; DANIDA; Netherlands Organization for Scientific Research (NWO); The Rockefeller Foundation.

Partners: Agrarian Systems Ltd., Uganda; Egerton University, Kenya; Farm Radio International (FRI), Uganda and Kenya; Food Security Centre, University of Hohenheim, Germany; Jaramogi Oginga Odinga University of Science and Technology (JOOUST), Kenya; Jomo Kenyatta University of Agriculture & Technology (JKUAT), Kenya; Kenya Agricultural and Livestock Research Organization (KALRO), Kenya; Kenya Bureau of Standards (KEBS), Kenya; Kenya Marine and Fisheries Research Institute (KMFRRI); Kenyatta University (KU), Kenya; Lasting Solutions Ltd, Kenya & Uganda; Makerere University, Uganda; National Fisheries Resources Research Institute (NaFIRRI), Uganda; National Livestock Resources Research Institute (NaLIRRI), Uganda; Nutri Africa Ltd., Kenya; Nutreal Ltd., Uganda; Nyendo Grasshopper Association, Uganda; Old Masaka Basenene Association, Uganda; Sanergy Ltd., Kenya; Solidaridad Eastern & Central Africa Expertise Centre (SECAEC), Kenya; Technical University of Munich, Germany; TechnoServe, Kenya; Treasure Industries Ltd., Kenya; Uganda National Bureau of Standards (UNBS), Uganda; UGACHIK Ltd., Uganda; Unga Feed, Kenya; United States International University (USIU), Kenya; University of Bonn, Germany (Center for Development Research – ZEF); University of Copenhagen, Denmark; University of Hohenheim (UoH), (Food Security Center), Germany; University of Nairobi, Kenya; Wageningen University, The Netherlands; GAEA Foods Ltd; Sigma Feeds Ltd; Eden Spring Farm; Ecodudu Ltd.

INSECTS FOR FOOD AND FEED PROGRAMME

2018 IN PICTURES



We conducted research on numerous insects on their nutrient components and rearing...



...produced rearing protocols and policy guideline; created awareness through the media and dedicated events...



...and contributed to the development of small and medium enterprises.

INSECTS FOR FOOD AND FEED PROGRAMME

IN 2018, WE:



IMPLEMENTED
6 projects

HAD
11 postgraduate students
in progress



PUBLISHED
11 peer reviewed
journal articles



WORKED WITH
37 partners and collaborators



RECEIVED
funding support from
3 donors



CONDUCTED
2 training
of trainers sessions reaching 27
government extension officers

INSECTS FOR FOOD AND FEED PROGRAMME

NEW KNOWLEDGE

Goal

Mass production of crickets and grasshoppers for food and animal feed

Improve rearing of black soldier fly *Hermetia illucens* Linnaeus

Progress in 2018

We discovered a new edible cricket species from Africa.

The species, collected and reared for experiments at the *icipe* campus, has been named ***Scapsipedus icipe* Hugel & Tanga nov. sp.**

Scapsipedus icipe is widely farmed across Kenya. Until now its **true scientific information** was unavailable, and it was erroneously mistaken for a cricket species known as *Acheta domesticus* L.

The *icipe* led study highlights the species' habitat, molecular and morphological characterisation, acoustic behaviour, including male's call and courtship song, nutritional profile of the cricket species, and current distribution, in Kenya.

The **nutritional attributes** of black soldier fly reared **on 19 commonly available feedstock** recipes in farmers' fields has been established in Kenya and Uganda.

The **crude protein levels** ranged between **38.5–62.7%** and **14.0 – 39.2% fat content**, depending largely on the substrate used.

Further combinations of various waste substrate recipes for enhanced nutrient-rich black soldier fly biomass production are currently being undertaken.

Way forward

Generate knowledge for safe commercial production of insects and their use as an important component in food fortification.

Develop and test gender inclusive insect feed and food supply models and build capacity along the value chain.

Fine-tune and deploy insect rearing technologies under small- and medium-scale on-farm conditions to meet national and regional demand for insect-based protein as alternative to the expensive fishmeal in animal feeds and biofertiliser production.

INSECTS FOR FOOD AND FEED PROGRAMME

IMPACT ASSESSMENTS

Goal

Understand effect of substituting the costly fishmeal with black soldier fly larvae meal as protein source in exotic chicks, growers and layer diets.

Assess dietary minerals and vitamins of fresh and processed edible insects in east Africa. Grasshoppers and crickets as compared to the saturniid caterpillar.

Progress in 2018

Higher growth performance and **egg production** at lower inclusion levels of insect-based protein feeds (25 50 and 75%) compared to control diet (fishmeal).

A **higher cost-benefit ratio** and **better return on investment** was recorded when the birds were reared on the highest inclusion of black soldier fly meal, in regard to weight gain, feed intake, compared to conventional diet.

Results indicated that the **Saturniid caterpillars** and **edible crickets** have significantly **higher levels** of calcium and magnesium as compared to long-horned grasshopper, *Ruspolia differens*.

Dietary iron and **copper contents** were significantly **higher** in the edible insects, as well as key vitamins such as β -carotene, β -cryptoxanthin, lutein, zeaxanthin and riboflavin (Vitamin B2).

Way forward

The potential of black soldier fly meal as a high-quality ingredients in poultry feeds.

This knowledge will enable development of proper, better rearing techniques, and ultimately the effective incorporation of the species as a component in food and feed.

INSECTS FOR FOOD AND FEED PROGRAMME

IN CONVERSATION WITH CHRYSANTUS TANGA, SCIENTIST

Background: I was born and raised in Limbe, South West Region of Cameroon.

Favourite subject in primary and secondary school: Mathematics and Biology.

Influential individual: My mathematics teacher, Mr Njoh Molombe. He was intelligent and skillful in his teaching style. He provided an amazing foundation that prepared me for a science career.

Describe yourself as a young student: I had a very good relationship with my teachers, which has had a positive and long-lasting implication in my academic, professional and social development.

Interesting anecdotes: I was the shortest guy in my class, but probably the one with the biggest dreams. I wanted to become a medical doctor. My classmates often mockingly told me that doctors were not short people. These jokes

became a driving force for me to work hard towards my goal.

Degrees obtained: BSc and MSc (Zoology) from the University of Buea, Cameroon obtained in 2000 & 2003, respectively), PhD from the University of Pretoria, South Africa (2012).

Reasons for course choice: I did not qualify for medical school, so I had to refocus my vision towards general sciences. Although, I still held on to my burning passion for medicine, the wide range of science topics soon lured me completely. In addition, while undertaking my undergraduate studies, I developed a strong passion for research. Moreover, during my MSc studies my supervisor, Prof. Samuel Wanji, exposed me to all facets of research in medical entomology, and I remember submitting my thesis with a strong sense of fulfilment. Due to limited financial support in medical entomology, I was inspired by Prof. Helen Kimbi to pursue a career in crop protection, a field that I have found to be diverse and full of opportunities.

Career influences: The desire for excellence and dedicated mentorship from my supervisors and current mentors at *icipe*, Dr Sunday Ekesi and Dr Samira Mohamed.

Highs: *icipe* has provided me with a unique platform to contribute to several national and international research fora. I have also gained experience in the dissemination of innovative technologies in crop protection and insects for food and feed.

“
I INTEND TO
CONTINUE TO TRAIN
STAKEHOLDERS
ACROSS THE
INSECTS FOR
FOOD AND FEED
VALUE CHAIN
”



CAPACITY BUILDING AND INSTITUTIONAL DEVELOPMENT

DONORS AND PARTNERS

Donors: DAAD; L'Oreal UNESCO; Mawazo; Students also received project funding from ; Netherlands Organisation for scientific Research; THRIVE-2 Fellowship; German Ministry of Economic Cooperation and Development (BMZ); PEER-BUSHMEAT; EU-IBCARP; USAID Feed the Future IPM Innovation Lab, Virginia Tech; DANIDA on EntoNTURI Project; Swiss Agency for Development and Cooperation (SDC); Newton fund, IFAD; Norwegian Agency for Development Cooperation (Norad); French Agricultural Research Centre for International Development (CIRAD); USAID; United States Department of Agriculture/Agricultural Research Service (USDA/ARS); International Institute of Tropical Agriculture; Wellcome Trust; International Development Research Centre (IDRC), Canada; The Swedish Research Council; Australian Centre for International Agricultural Research (ACIAR); JRS Biodiversity Foundation; EU (Fall Armyworm); French Development Agency (AFD); National Institute of Health, USA.

CAPACITY BUILDING AND INSTITUTIONAL DEVELOPMENT

2018 IN PICTURES



We welcomed new students, continued to mentor ongoing teams through various skill building strategies; hosted a variety of training sessions



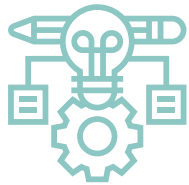
for external participants; supported our young researchers to attend international conferences



...and our several of them won prestigious awards.

CAPACITY BUILDING AND INSTITUTIONAL DEVELOPMENT

IN 2018, WE:



IMPLEMENTED
5 projects/ programmes



PUBLISHED
83 peer reviewed journal articles
co-authored by postgraduate
and postdoctoral fellows

HAD
59 MSc students and
80 PhD students in
progress



WORKED WITH
37 partners and collaborators



RECEIVED
funding support from
24 donors



CONDUCTED
22 trainings

CAPACITY BUILDING AND INSTITUTIONAL DEVELOPMENT

POSTGRADUATE AND POSTDOCTORAL TRAINING

Ongoing scholars

80 PhD scholars were ongoing at *icipe*:

8 African Regional Postgraduate Programme in Insect Science (ARPPIS) and **34** Dissertation Research Internship Programme (DRIP).

59 MSc scholars (under the DRIP programme)

12 postdoctoral fellows

80 research interns

Gender representation

Women formed:

45% of all postgraduate scholars.

17% of all postdoctoral fellows.

68% of research interns were women.

Publication outputs

Twenty Nine (29), i.e. 55%, of the 52 peer-reviewed papers published or in press by *icipe* during the reporting period were first-authored or co-authored by postgraduate and postdoctoral fellows.

ARPPIS PhD scholarships 2019

icipe was once again selected to participate in the **German Academic Exchange Service (DAAD) PhD In Country/In Region scholarship programme**. DAAD has offered up to **6 new PhD scholarships** for the ARPPIS programme in 2019.

CAPACITY BUILDING AND INSTITUTIONAL DEVELOPMENT

POSTGRADUATE AND POSTDOCTORAL TRAINING

Country diversity

16 African nationalities (Benin, Burkina Faso, Cote d'Ivoire, Cameroon, Ethiopia, Ghana, Kenya, Nigeria, Rwanda, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe) and **two non-African nationalities** (Germany, Oman) were represented in the **postgraduate and postdoctoral programmes** during the reporting period.

The **internship programme** hosted interns from **10 African countries** (Burundi, Cameroon, DRC, Ethiopia, Kenya, Nigeria, Rwanda, Tanzania, Togo, Uganda); and **6 non-African countries** (Cambodia, Germany, Netherlands, Philippines, USA and UK).

Completion of studies

4 ARPPIS PhD scholars, **10 DRIP PhD** scholars and **15 DRIP MSc** scholars **defended their thesis or graduated** during the reporting period.

Conferences

21 postgraduate scholars presented papers at **international conferences**, including five ARPPIS PhD scholars who presented at the 34th International Society of Chemical Ecology (ISCE) meeting in Budapest, Hungary (12-18 Aug 2018).

CAPACITY BUILDING AND INSTITUTIONAL DEVELOPMENT

OTHER TRAININGS

Training courses,
workshops and
conferences organised by
CB&ID

A total of **425 participants (54% women)** from 18 countries (Benin, Botswana, Burundi, Cameroon, Ethiopia, Ghana, Ivory Coast, Kenya, Nigeria, Rwanda, Sudan, South Africa, Tanzania, Togo, Uganda, United Kingdom, Zambia and Zimbabwe) were trained.

Highlights:

Statistical methods and data analysis with R training.

Research proposal presentations by class of 2017 PhD scholars in African Regional Postgraduate Programme in Insect Science (ARPPIS) and Dissertation Research Internship Programme (DRIP).

The Vector Ecology and Disease Workshop delivered by *icipe*, and faculty from Ohio State University, the University of Nairobi, Kenya, and the Kenya Medical Research Institute (KEMRI).

The organization for Women in Science for the Developing World (OWSD) Africa Regional Conference, 2018.

Science Writing and Publishing Workshop conducted by the African Population and Health Research Centre (APHRC).

Grant Proposal Writing Workshop conducted by the African Population and Health Research Centre (APHRC).

Australia Awards Africa Short Course – Increasing the Development Impact of Agricultural Research.

A series of ARPPIS introductory courses.

CAPACITY BUILDING AND INSTITUTIONAL DEVELOPMENT

IN CONVERSATION WITH GLADYS MOSOMTAI PHD SCHOLAR

Research title: influence of landscape structure and composition on coffee pests and diseases under the various farming systems practiced by smallholder farmers in the face of climate change.

Background: I was born and raised in Mogotio, a small town in Baringo County, Rift Valley, Kenya.

Interesting anecdotes: I was in high school when the late Prof. Wangari Mathai won the Nobel Peace Prize (in 2004). My father, in his capacity as parent representative of my class, was invited to give a talk. He focused on Prof. Mathai's achievement and urged us to follow her footsteps. From that day I developed an interest in environmental issues, a shift that later influenced my degree choices for my undergraduate studies.

Degrees obtained: Bachelor of Environmental Planning and Management (2012) from Kenyatta University; MSc in Geospatial Information Science and Remote Sensing (2017) from Dedan Kimathi University of Technology, both in Kenya.

Reasons for course options: Growing up in a semi-arid region, I had first-hand experience of the impacts of climate change. I witnessed community members chop down trees for charcoal burning.. A river that I used to be terrified of crossing on my way to school was almost non-existent by the time I completed high school. These factors inspired my undergraduate project and my entry into the world of research. Using satellite technology, I identified anthropogenic activities linked to the decline of water quality and quantity in the only permanent river in my hometown. Coming up with recommendations on how to safely guard the river and identifying relevant stakeholders opened my eyes to the power of science in influencing change.

Person you admire: At the top of my list is the *icipe* DG Dr Segenet Kelemu and, my MSc supervisor Prof. Rosemary Sang, a scientist at the Centre. I also admire Dr Wanjiru Kamau-Rutenberg, Director of African Women in Agricultural Research and Development, and my Aunt Dr Jayne Binott.

Highs: Winning the L'Oréal-UNESCO For Women in Science fellowship in 2018 is my highest achievement so far, and one that has opened many opportunities, like speaking to the French President during his visit to Kenya, and being featured on several media platforms.

“
I WANT TO LEAD RESEARCH ON
LANDSCAPE ECOLOGY
AND ITS APPLICATION
IN EPIDEMIOLOGY IN AFRICA
”





This award is presented to
TERESIAH N. NJIHIA
as the Overall Winner of
icipe's Governing Council
Research Award
for a
Published Paper
November 2018

During its Annual General Meeting held in Addis Ababa, Ethiopia, in November 2018, the *icipe* Governing Council, that consists of globally renowned scientists, honoured six outstanding postgraduate scholars, currently undertaking their research at the Centre. Teresia Njihia received the Best Paper award for her publication on Ripe coffee berry volatiles repel second instar nymphs of *Antestia* bugs (Heteroptera: Pentatomidae: *Antestiopsis thunbergii*) <https://doi.org/10.1007/s00049-018-0259-3>. IF 1.642

SOCIAL SCIENCE AND IMPACT ASSESSMENT UNIT

DONORS AND PARTNERS

Donors: Australian Centre for International Agricultural Research (ACIAR); Biovision Foundation for Ecological Development, Switzerland; Boris Mints Institute for Strategic Policy Solutions to Global Challenges, Israel; European Union; German Federal Ministry for Economic Cooperation and Development (BMZ); German Research Foundation (DFG); International Development Research Centre (IDRC), Canada; MasterCard Foundation; Norwegian Agency for Development Cooperation (Norad); Partnership for Economic Policy (PEP); Swedish International Development Cooperation Agency; Swiss Agency for Development and Cooperation; United States Agency for International Development (USAID); UK Aid from the UK Government; and Wageningen University and Research Centre, The Netherlands.

Collaborators/Partners: Tel Aviv University; Wageningen University; University of Zürich; ETH Zurich, Switzerland; International Food Policy Research Institute (IFPRI); International Maize and Wheat Improvement Centre (CIMMYT); Partnership for Economic Policy (PEP); Virginia Polytechnic Institute and State University, USA; Norwegian University of Life Sciences, Norway; University of Geneva; Luleå University of Technology, Sweden; CIRAD, France; Egerton University, Kenya; Kenya Agricultural and Livestock Research Organisation (KALRO); Kenya Plant Health Inspectorate Service (KEPHIS); Kenyatta University, Kenya; Ministry of Agriculture, Food Security & Cooperatives, Tanzania; Moi University, Kenya; University of Bonn (Center for Development Research-ZEF), and Medical Center, Germany; University of Nairobi, Kenya; World Vegetable Center (AVRDC).

SOCIAL SCIENCE AND IMPACT ASSESSMENT UNIT

2018 IN PICTURES



Our goal is to come up with the most effective strategies to ensure that *icipe* technologies have the most effective outcomes for communities across Africa.

SOCIAL SCIENCE AND IMPACT ASSESSMENT UNIT

IN 2018, WE:



IMPLEMENTED
13 projects



HAD
13 postgraduate students
in progress

PUBLISHED
6 peer reviewed
journal articles



WORKED WITH
12 partners and collaborators



RECEIVED
funding support from
13 donors



CONDUCTED
3 trainings

SOCIAL SCIENCE AND IMPACT ASSESSMENT UNIT

PUSH-PULL AND WOMEN EMPOWERMENT IMPACT

Study

Results

Impact of Push-Pull technology adoption on gender specific resource allocations and gender roles

Push-Pull technology adoption significantly reduces labour requirements during ploughing, weeding and threshing but significantly increases harvesting labour.

In comparison to men, women save more labour hours during weeding and threshing period but less during ploughing.

Adoption of Push-Pull technology increases child education investment and shifts household expenditures towards goods associated with female consumption preferences.

Women empowerment in Kenyan agriculture

Has a positive and significant effect on women and households dietary diversity scores regardless of Push-Pull technology adoption status.

Enhances the positive effects of Push-Pull technology on women and household dietary diversity scores.

Adoption of Push-Pull technology has a positive nutrition effect regardless of empowerment status and nutrition indicators, but its effect is stronger for households with empowered women.

Individual and household welfare could be enhanced to a greater degree through interventions that promote women's empowerment and technology adoption simultaneously rather than separately.

SOCIAL SCIENCE AND IMPACT ASSESSMENT UNIT

INSECTS FOR FEED IMPACT ASSESSMENT

Study

Putting dollars to climate-smart poultry farming

Results

Replacing conventional protein sources by 5-15% of black soldier fly larvae feed (BSFLF) in the entire poultry sector of Kenya increases the national gross domestic product (GDP) by 0.04-0.12% (US\$26-77 million) per year. This reduces the number of poor people in the country by 0.12 – 0.36 million.

Adopting 5-15% of BSFLF in the commercial poultry industry (CPI) alone has the potential to lift national GDP by 0.02-0.05% (US\$ 12-35 million) annually and assist 0.05-0.16 million people to move above the poverty line.

Adopting BSFLF by 5-15% in the CPI alone increases foreign currency savings by US\$ 1.3-4.0 million per year and increases number of people to consume fish and maize by 0.43-1.3 million under current maize and fish per capita consumption in Kenya.

BSFL contributes to foreign currency savings through reducing importation of conventional protein sources and chemical fertilizers as they can be replaced by organic fertilizers produced as a by-product of insect rearing.

Black soldier fly farming could create job opportunities to 700-2,000 people if only the CPI adopts BSFLF. This figure increases considerable (4, 000-13, 280 jobs) if the entire poultry sector uses BSFLM.

DEVELOP WEB-BASED DATA COLLECTION SYSTEM

Goal

Develop a system to capture *icipe's* technology dissemination and capacity building activities.

Progress

A web-based data collection system has been designed to enhance data access efficiency, value of data and decision making.

The system has been pilot tested and will soon be rolled out for use.

SOCIAL SCIENCE AND IMPACT ASSESSMENT UNIT

IN CONVERSATION WITH BEATRICE MURIITHI, POSTDOCTORAL FELLOW

Background: I was born in Nyandarua, central Kenya.

What was your favourite subject in primary and high school: Mathematics

Most influential individual: Our secondary school headmaster-cum-mathematics teacher; a firm disciplinarian, who imbued in me the ambition and commitment to perform well in the subject.

Describe yourself as a young student: Socially, I was an introvert, disciplined, compassionate and dependable. Academically, I was focused and a good student.

Interesting anecdotes: My passion for agriculture started in my primary school. I was the prefect of the 4K ('Kuungana, Kufanya, Kusaidia Kenya', Swahili for 'Coming together, to Act, in order to Help Kenya') club; a learning

and practical platform. We established demonstration gardens in school to show various agricultural practices, and reared animals like rabbits and chicken.

Degrees obtained: PhD, 2013 in Agricultural Sciences Development Economics from Bonn University, Germany; Masters in Agricultural and Applied Economics (CMAAE) from Egerton University, Kenya; 2008 from the University of Pretoria, 2006; BSc in Agricultural Economics (2005) from Egerton University, Kenya.

Reason for course choice: First, I wanted a course that combined my favourite subjects – mathematics and agriculture. Second, having been born and brought up in the rural areas, I knew the importance of agriculture.

Persons you admire: Prof. Wangari Maathai and Prof. Olive Mugenda, former Vice Chancellor, Kenyatta University, Kenya.

Previous positions held: Junior Researcher/ PhD fellow. Center for Development Research (ZEF b), University of Bonn; Agricultural Economist, Research Assistant, International

Livestock Research Institute (ILRI).

Future career plans: To advance in the scientific hierarchy, develop strong and strategic partnerships and networks to empower African smallholder farmers to transform agriculture to commercially oriented enterprises.

“
I AM DRIVEN
BY THE DESIRE
TO MAKE A
POSITIVE
CHANGE IN
PEOPLE'S
LIFE
”



TECHNOLOGY TRANSFER UNIT

DONORS AND PARTNERS

Donors: Biovision Foundation for Ecological Development Switzerland.

Partners: Food for the Hungry (FH) Rwanda; Kushereketa Rural Development Organization (KURDO); Rwanda Agricultural and Animal Resources Board (RAB); Total Land Care (TLC) Malawi and Zambia; Zambia Agricultural Research Institute (ZARI) Zambia; Institut de l'Environnement et Recherches Agricoles (INERA); Institute of Agronomic Sciences of Burundi (Burundi) ISABU; Kasisi Agric Training Institute (KATC) Zambia; Conservation Farming Unit (Zambia).

TECHNOLOGY TRANSFER UNIT

2018 IN PICTURES



We used different pathways to create awareness and address constraints in dissemination of the Push-Pull technology...



including trainings, field visits, printed materials, high level meetings, the media and agricultural shows...



...leading to effective adoption of the technology and enhanced food and livestock productivity.

TECHNOLOGY TRANSFER UNIT

IN 2018, WE:



IMPLEMENTED
1 project and SUPPORTED
3 other projects

HAD
2 postgraduate students in progress



RECEIVED
funding support from
1 donor




WORKED WITH
38 partners and collaborators



CONDUCTED
32 training of trainers
events and an additional 350 training events
through various partners and collaborators

TECHNOLOGY TRANSFER UNIT

Strategy	Goals	Progress in 2018	Way forward
Upscaling Push-Pull technology beyond East Africa. 	Create strategic partnerships Ensure availability of seeds	Supporting local seed production of Push-Pull companion plants through community engagement, private sector partners and model farmers in Rwanda, Zambia and Zimbabwe.	The project is now being scaled out to eight countries (Zambia, Malawi, Zimbabwe, Rwanda, Burundi, Ghana, Senegal and Burkina Faso).
	Enhance dissemination pathways	Dissemination pathways used include: establishment of learning sites, field days, use of cascade models with lead farmers, training of trainers and media.	With the proven ability of Push-Pull to control the invasive fall armyworm, the demand for the technology has increased tremendously.
	Conduct monitoring and evaluation	Monitoring and evaluation assessed agronomic parameters, socio-economic drivers and landscape level intervention with the mapping of Striga and livestock production.	TTU will respond to requests to extend Push-Pull to Côte d'Ivoire, Democratic Republic of Congo, Eritrea, Mali, Mozambique and Niger.

TECHNOLOGY TRANSFER UNIT

IN CONVERSATION WITH RACHEL OWINO, TECHNOLOGY TRANSFER OFFICER

Background: I was born in Oyani Maasai, a small village in Migori County, western Kenya, and I have lived in different parts of the region.

Favourite subjects in primary school: Agriculture and biology.

Influential individual during your youth: My mother has always been extremely influential in every area of my life. In addition, my music teacher, Mr Onuonga, who strengthened my skills, as well as the love for music and the performing arts.

Describe yourself as a young student: I was very social and active in drama and music clubs. Academically, I was intelligent and creative.

Influencing factors for your current role:

A visit to Manor House Agricultural Centre, an institution in Rift Valley, Kenya, which was established in 1984 in response to a three-year drought that caused severe hunger in many areas of the country, precipitating the need for new approaches to farming. This occasion contributed to my interest in pursuing a career in agriculture. I was particularly inspired by the sustainable agriculture practices they promoted.

Degrees obtained: Diploma in Agricultural Education and Extension (2004), from Egerton University, Kenya, and a BA (2018) in Sociology and Community Development from Rongo University, Kenya.

Reason for course choices: My desire to establish a model farm where other farmers could learn and improve their farming, which required an understanding of the social milieu.

Career choices influences: When growing up I loved music and drama and wanted to be a musician, an actor or a news anchor. But I lacked the mentorship necessary for such careers. Eventually, a friend advised me to pursue a course in agricultural extension as he thought I would make a good “teacher”. This is

how I ended up in a job that I love waking up to every morning.

Highlights: Witnessing communities across Africa improve their livelihoods as a result of *icipe* interventions is very fulfilling.

Future plans: I have enrolled for an MSc in sustainable rural development.

Person you admire most: Jo Luck, former president and CEO of Heifer International, where I worked for nine years, due to her active involvement and commitment to Heifer’s mission of ending hunger and poverty while caring for the earth; and how she influenced a shared vision among staff globally.

“
MY BEST MOMENTS
ARE THOSE SPENT
LEARNING
TOGETHER
WITH THE
FARMERS
”





The *icipe* Technology Transfer Unit is disseminating technologies using different pathways while ensuring gender representation.

BIOINNOVATE AFRICA PROGRAMME

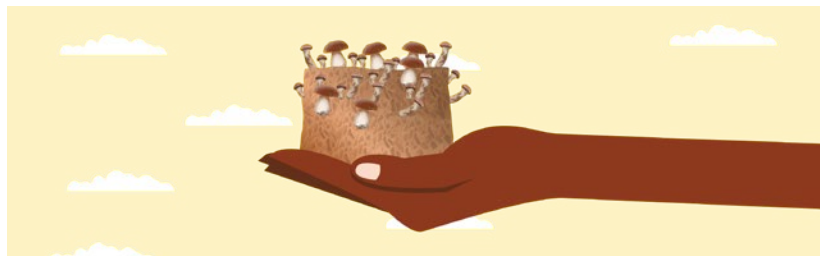
DONORS AND PARTNERS

Donors: Swedish International Development Cooperation Agency (Sida), Sweden.

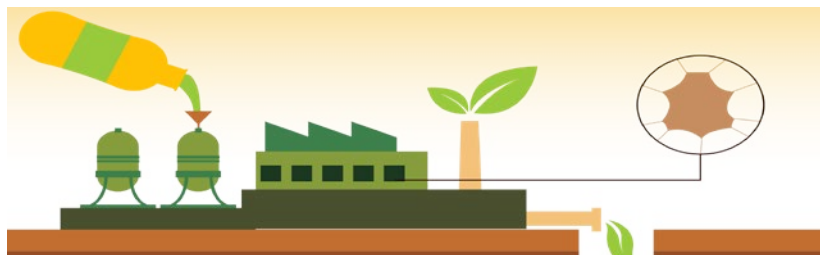
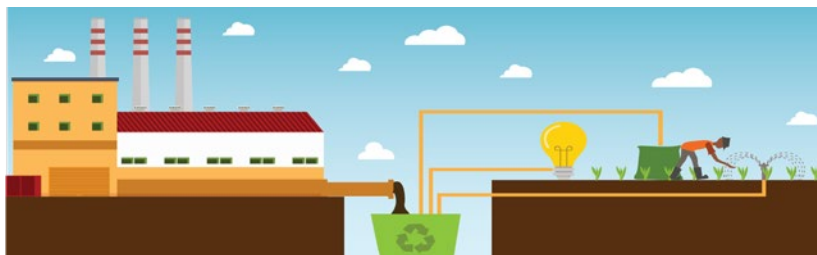
Collaborators/Partners: Addis Ababa University (AAU), Ethiopia; Agri Seed Company Limited, Kenya; Busitema University, Uganda; East Africa Nutraceuticals Ltd (EAN), Kenya; Food and Nutrition Solutions Ltd (FONUS), Uganda; GLOBAL AGRO CONCEPT Limited, Rwanda; Green Enzyme Technologies Ltd (GETL), Kenya; Guavay Company Limited, Tanzania; Hawassa University, Ethiopia; Hottiserve East Africa Limited, Kenya; International Centre of Insect Physiology and Ecology (*icipe*), Kenya; iTEC, Tanzania; Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya; Kenya Biologics Limited, Kenya; Kenya Industrial Research and Development Institute (KIRDI), Kenya; Kibwezi Agro Limited, Kenya; Lasting Solutions Limited, Uganda; Makerere University (MAK), Uganda; Maseno University, Kenya; Mikocheni Agricultural Research Institute (MARI), Tanzania; MIMEA International Kenya Limited, Kenya; Ministry of Trade, Industry and Cooperatives, Uganda; National Agricultural Research Organization (NARO), Uganda; National Semi Arid Resources Research Institute (NASARRI), Uganda; Nelson Mandela African Institution of Science and Technology (NM-AIST), Tanzania; OKOA Society, NGO, Tanzania; Pwani University (PU), Kenya; Rwanda Agricultural Board (RAB), Rwanda; SENAI Farm Supplies Limited, Uganda; Sokoine University of Agriculture (SUA), Tanzania; Sulma Foods Limited, Uganda; Tanzania Commission for Science and Technology (COSTECH), Tanzania; Tanzania Industrial Research and Development Organization (TIRDO), Tanzania; The Real IPM Company Limited, Kenya; TONNET Agro-engineering company Limited (TONNET), Uganda; Treasure Industries Limited (TIL), Kenya; Tursam Investment Limited (TIL), Uganda; University of Dar es Salaam (UDSM), Tanzania; University of Nairobi (UoN), Kenya; W.E. Tilley Fish Processors, Kenya.

BIOINNOVATE AFRICA PROGRAMME

2018 IN PICTURES



We provided support to enable transformation of biosciences based innovations in eastern Africa...



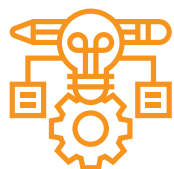
into commercially viable enterprises...



...through technical capacity building, refining of pathways, gender inclusion and engagement with stakeholders including policymakers.

BIOINNOVATE AFRICA PROGRAMME

IN 2018, WE:



IMPLEMENTED
20 projects

(11 projects in progress and
9 new projects were launched)

HAD
16 postgraduate students

in progress (4 PhD and 12 MSc;
9 Male and 7 female)



WORKED WITH
**92 partners
and collaborators**



SELECTED
12 women scientists

to participate in the BioInnovate Africa
Fellowship for Women Scientists



TRAINED a total of
19 people



CONDUCTED
3 trainings

(Gender integration, business incubation model
development workshop, bio-business boot camp)

BIOINNOVATE AFRICA PROGRAMME

Strategy	Goals	Progress in 2018	Way forward
Grants	Award grants, supported by the Swedish International Development Cooperation Agency (Sida), to enable scientists, researchers, innovators and entrepreneurs in eastern Africa turn innovative ideas and technologies, based on biological sciences, into viable businesses.	<p>A total of 37 grant agreements signed with implementing partner organisations in cohort 2. BioInnovate Africa has now signed a total of 78 grant agreements making the Programme possibly the largest regional innovation-driven bioeconomy platform in Africa.</p> <p>A total of 12 women scientists from Burundi, Ethiopia, Kenya, Uganda and Tanzania were awarded fellowships. They will be attached to selected BioInnovate Africa funded projects outside their home countries for four months. The fellows will advance their skills, innovation capacity and overall career progression.</p> <p>Several training workshops on business incubations, private sector engagement, gender integration and importance of bioeconomy, biobusiness boot camps held.</p>	Continue supporting the first cohort of project teams to establish early commercial leads for their innovative products or processes; support the second cohort of project teams to commence their activities, and deepen networking and stakeholder engagement for policy impact.
BioInnovate Africa Fellowship for Women Scientists	Enhance gender participation in the African bioeconomy.		
Refining pathways to market innovative products	Streamline expectations from researchers and business leaders in project implementation. Contribute to strengthening commercialisation capacities of participating firms. Harmonise roles and responsibilities as co-developers, overall boosting the potential of sustainably introducing products into the market.		

BIOINNOVATE AFRICA PROGRAMME

IN CONVERSATION WITH **SHIRA MUKIIBI,** BUSINESS DEVELOPMENT MANAGER

Background: I was born and raised in Kampala, Uganda.

Favourite subject in primary/secondary school: Mathematics.

Influential individual: My primary school class teacher, Mr Ismail Tonda Serumunye, because he believed in my ability to excel academically even when I was still a mediocre student. This belief ignited my confidence and leadership capabilities. I performed exceptionally well in my final grade exams and I was also appointed Student Leader, a position that had been by boys for five years in a row.

As a young student, I was very social and actively participated and won various accolades in music, dance and drama events.

Interesting anecdotes: In 6th grade, my teachers used to assign me the task of compiling class logs for over 100 pupils, with no computers and just a few hours to complete such assignments. This responsibility prepared me to become a planner, creative-thinker and problem-solver; skills that relate beautifully with my current work in innovation.

Degrees obtained: BSc, Civil Engineering (2004) from Makerere University, Uganda; MBA (2013) from Nanyang Technological University, Singapore.

Reasons for selecting the courses above: Engineering, because of the opportunity to apply mathematics, and a desire by my parents to have an engineer in the family! Although I did not pursue the course further, I appreciate the good foundation it has laid for me in terms of technical skills and knowledge, which I constantly use in my current work. I chose MBA because I was inspired by the success stories of business conglomerates in Asia, for example Samsung among others. My motivation was based on the assignment I was given at the time to manage the process of establishing a renewable energy startup.

Previously held positions. Operations and Loans Officer, Solar Energy Uganda Limited; Assistant Projects Manager – Sobetra Construction Company Limited; Start up Manager, Solar Assembly Plant for African Villages; Manager, Renewable Energy Business Incubator, Makerere University

Career influences: The desire to contribute to socio-economic transformation in Africa; and to influence others to excel.

Highs: Through BioInnovate Africa Programme, interacting with innovators; learning about their unique technologies and supporting to take innovations to the marketplace.

“
I HAVE A PERSONAL
DESIRE TO PUSH
MYSELF **BEYOND**
MY OWN
ABILITIES
”





REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

DONORS AND PARTNERS

Contributions from African governments: US\$ 2 million each received from governments of Kenya and Rwanda, and US\$ 1 million from the government of Côte d'Ivoire.

Contributions expected from Ethiopia and Senegal as members of PASET.

The World Bank has provided US\$ 15 million and the Government of South Korea has contributed US\$ 9 million.

Funding is expected to grow to >US\$ 65 million by 2024 through contributions to the general fund and the endowment fund from African governments, other donors, the private sector and philanthropies.

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

2018 IN PICTURES



icipe was selected through a competitive process to manage RSIF, a role that the Centre has fully embraced.

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

AS OF 2018:



icipe was SELECTED the
**Regional Coordination
Unit** of RSIF



The **World Bank** has
provided US\$ 15 million and the
**Government of South
Korea** has contributed US\$ 9 million



US\$ 2 million has been received
from governments of **Kenya**
and **Rwanda** (each), and US\$
1 million from the government
of **Côte d'Ivoire**



The first four RSIF **Host Universities**
were competitively selected from
the World Bank-funded Africa higher
education Centers of Excellence. A
further six RSIF Host Universities will be
competitively selected in 2019



RSIF funding is expected to grow to >**US\$ 65
million** by 2024 through contributions to the
general fund and the endowment fund from
African governments, other donors, the private
sector and philanthropies



**16 postgraduate
students**
were in progress

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

TRANSFORMATIVE TECHNOLOGIES AND AFRICA'S FUTURE

Why should Africa embrace transformative technologies?

For Africa, there is no better time than the present to **enhance the use of science, technology and engineering** to **accelerate socio-economic transformation**.

There is also definite recognition at the highest possible levels that, in order for **sustainable and inclusive growth** to be achieved in Africa, the continent's economic structure must diversify from simple resource extraction towards **value-added manufacturing of high standard, globally competitive products**.

Transformative technologies can contribute to **solving many of Africa's most urgent challenges**, including food security, energy, infrastructure and health sectors, and the impacts of climate change.

Strengthening science, technology and innovation is in line with national objectives, continental aspirations (**STISA 2024 and Agenda 2063**) and the **sustainable development goals** (SDGs).

Ultimately, heightened use of science, technology and engineering will contribute to faster integration of all sections of the community, including **women and the youth**, into the economy.

The pursuit of transformative technologies provides an opportunity for Africa to **reverse the continent's global reputation and reality in terms of knowledge production and leadership**.

“

Africa will by 2063 be a continent of shared prosperity, which finances and manages its own growth and transformation – meaning that... well educated citizens and skills revolution underpinned by science, technology and innovation for a knowledge society will be broad-based...

”

Agenda 2063 of the
Africa Union.

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

TRANSFORMATIVE TECHNOLOGIES AND AFRICA'S FUTURE

Current situation

Many African countries now recognise the rising role of science, technology and innovation, evident in:

Increases in research and development budgets;

Leveraging of private capital through technology and innovation hubs and incubators.

However, SSA still lacks a critical mass of applied scientists, engineers and technologists. The region:

Has just 1.1% of the world's scientific researchers, with less than 92 scientists per one million inhabitants compared to the global average of 1083.

Contributes just 1.4% of global scientific publications.

Spends a mere 0.41% of its gross domestic product (GDP) on research and development (R&D),

Is the destination of 0.8% of R&D-related projects financed through foreign direct investment.

Against this background, a regional approach that complements country specific initiatives to enhance skilled technical and scientific capability, as well as the nurturing of innovators and entrepreneurs, is critical.

“

If everyone is to enjoy a future of peace, dignity and opportunity, then science, technology and innovation need to be at the heart of the race to reach the 17 Sustainable Development Goals by 2030.

”

UN Forum held on 25
June 2018

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

PASET AND RSIF

The Partnership for skills in Applied Sciences, Engineering and Technology (PASET)

The Regional Scholarship and Innovation Fund (RSIF)

PASET:

Was launched in 2013 by the governments of **Senegal, Ethiopia and Rwanda** with facilitation by the **World Bank**.

Is currently led by the education and **higher education ministries of Ethiopia, Côte d'Ivoire, Kenya, Rwanda and Senegal**.

So far, **more than 20 African countries** have indicated interest to join the initiative. Representatives of **Brazil, China, India and Korea** have participated in various activities of PASET.

RSIF is an initiative of PASET, launched in **response to the need for a highly skilled scientific and engineering workforce in the region**.

The RSIF is:

Aligned to national, continental and global development initiatives like Agenda 2063 of the African Union and the United Nations Agenda 2030 and its 17 Sustainable Development Goals (SDGs).

Increasing sustainable funding for PhD training research and innovation, with an endowment fund supported by African governments, and which is also open to private sector partners.

Supporting all levels of capacity building from doctoral and postdoctoral, to research and innovation and institutional strengthening, with excellence at the core.

Aims to:

Address systemic gaps in skills and knowledge in sub-Saharan Africa's priority ASET fields.

Build the capacity of African education and training institutions to train high-quality technicians, engineers and scientists to meet the demands of the economy.

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

PASET AND RSIF

The Regional Scholarship and Innovation Fund (RSIF)

Building a cadre of **women PhD holders** in ASET fields in SSA.

Linked to socio-economic transformation initially targeting five priority sectors.

Fully Africa-led by ministries of education, science and technology in participating countries.

Managed by an African institution, *icipe*, an organisation reputed for strong processes and systems, governance, world-class research and development, research commercialisation, and demonstrated experience in capacity building in Africa.

RSIF is a unique and far-reaching initiative, driven by African governments to accelerate the creation of a skilled and high quality labor force to propel Africa's socioeconomic transformation.

RSIF invests in five priority thematic areas



ICTs including big data and artificial intelligence



Food security and agribusiness



Minerals, mining and materials engineering



Energy including renewables



Climate change

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

RSIF AIMS

RSIF aims to:



Strengthen research, development and innovation capacity in selected Host Universities



Support the use of transformative technologies to tackle the continent's most pressing challenges



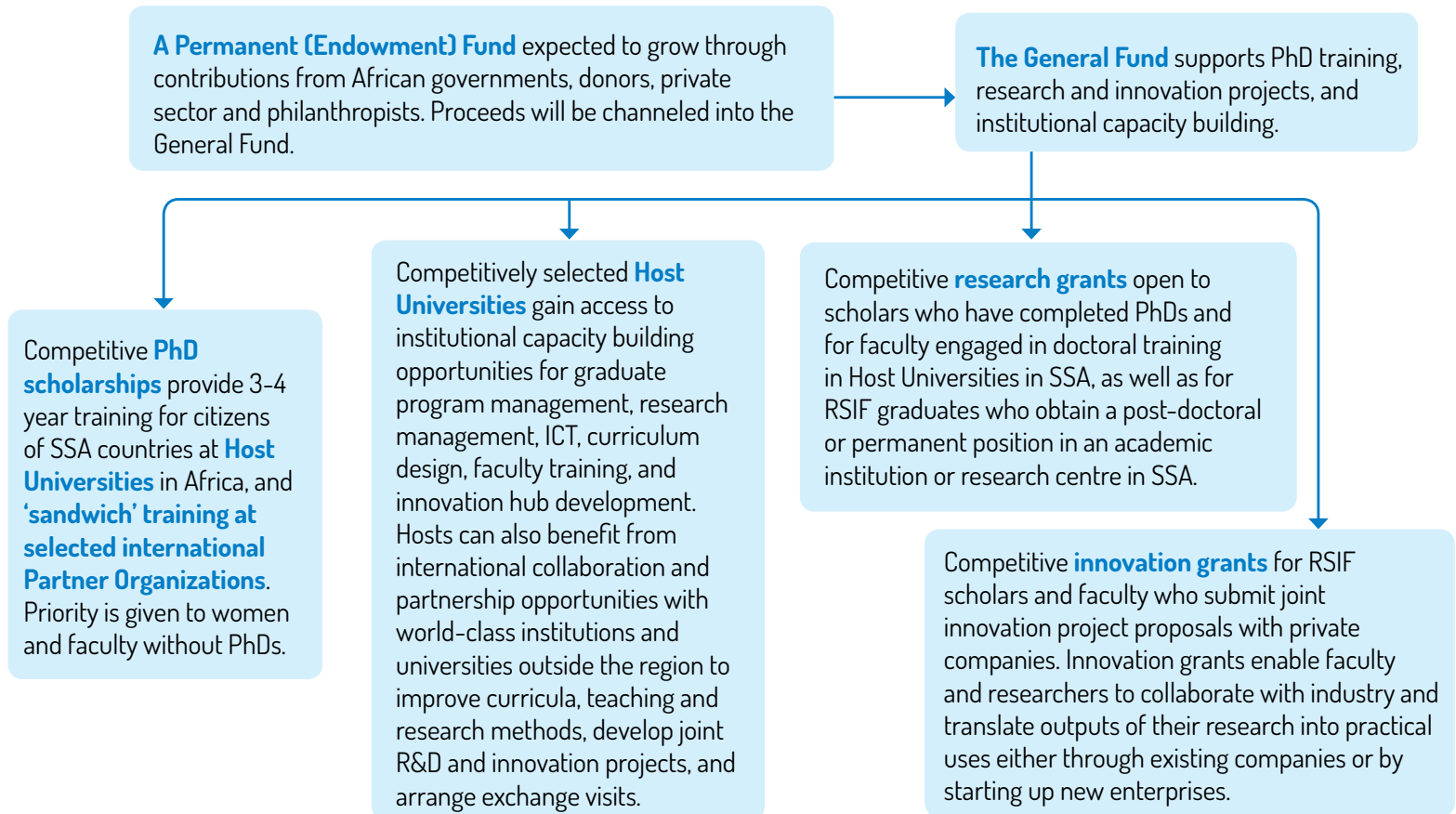
Provide a model for inter-Africa study, pan African collaboration and knowledge exchange



Build a critical mass of highly skilled science and engineering leaders, innovators and entrepreneurs

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

RSIF DESIGN



REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

WHY JOIN PASET?

African governments who join PASET and invest in RSIF will:

Become part of a regional approach that complements their country initiatives to increase technical and scientific capability.

Have advantage in accessing opportunities being provided by RSIF, including strategies to address a range of long standing issues like inadequate numbers and retention of PhD holders, and poor representation of women in ASET fields.

Reduce costs for collaborative research and training through regional investments, addressing fundamental dis-economies of scale through lower administrative costs.

Access partnerships with global and national private sector and world-class institutions across the globe.

Connect their institutions with a broad range of partners, including private sector actors, centers of excellence across Africa, and world-class institutions from around the globe.

Expand their regional and global network by collaborating with a growing system of African scholars and institutions within and beyond RSIF.

Broaden, deepen and focus knowledge generated by their researchers to national and regional priorities.

Enhance the diversity of their research communities and institutions through knowledge exchange opportunities.

PASET was needed to harness and harmonize regional and national initiatives to build Africa's scientific and technological capacity, to address specific priority sector needs.

RSIF is a unique and far-reaching initiative, driven by African governments to accelerate the creation of a skilled and high quality labor force to propel Africa's socioeconomic transformation.

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

icipe AS THE RCU OF RSIF

Role, mandate and responsibilities

icipe shares with RSIF the vision of bolstering research and development capacity and excellence in Africa; the ambition of innovation for sustainable and inclusive growth; increasing representation of women in science and technological fields; and the ideal of a regional approach to Africa's developmental challenges. The Centre's near 50-year history stands as a testament of unrelenting commitment to science and innovation-led development in SSA.

As the RCU, *icipe*'s mandate includes overall coordination planning, monitoring and evaluation of RSIF activities.

Specifically, *icipe* will manage the two RSIF funds; strengthen the capacity of universities and partnering institutions to manage PhD scholarships, and to conduct research and innovation in the priority sectors.

In addition, *icipe* will facilitate the creation of partnerships with governments, universities and national and international research organisations for research training, for example through sandwich training and collaboration with centres of excellence.

icipe will receive the IDA grant funds and is expected to coordinate future contributions from governments, the private sector and other sources, administering them under the oversight of the PASET governance bodies.

“

icipe was selected through a competitive process due to the Centre's strong processes and systems, governance, record of world-class R&D and demonstrated experience in PhD and institutional capacity building in Africa, and its excellent record of research commercialisation.

”

Prof. Botero Alvarez, Lead
Education Specialist at the
World Bank

REGIONAL SCHOLARSHIP AND INNOVATION FUND (RSIF)

IN CONVERSATION WITH **MOSES OSIRU,** MANAGER, RCU-RSIF

Background: I was born in Uganda just after Idi Amin assumed Presidency. Most of my early years were spent in Kenya and Nigeria.

Favourite subjects: Mathematics, although I also enjoyed history because of the interesting information on Africa.

Influential individual: My O level teacher who took me in when I was in Grade 12 and did not have anywhere to stay. Due to his support, I was able to complete high school.

Describe yourself as a young student: I was very active in academic and extra-curricular activities. I particularly enjoyed tennis and swimming.

Interesting anecdotes: When I first moved to Bamako, Mali, I was taken around to look for houses. I was excited to find an apartment at the top of the building, only to realise later

why it was vacant. The immense heat from the direct sunlight during the summer months made this location unbearable in the night. This incidence taught me the importance of indigenous knowledge.

Degrees obtained: PhD (Pathology) and MSc (Breeding/Pathology) from Makerere University, Uganda.

Reason for course choices: I enjoyed science subjects, and since I knew early on that I was not cut out for medicine (the sight of blood made me queasy) I opted for agriculture. In addition, my father is an agriculturalist and educator, and he served as an important inspiration in my course choice.

Previous positions held: Deputy Executive Secretary, Regional Universities Forum for Capacity Building in Agriculture (RUFORUM); Regional Plant Pathologist, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) West Africa; eastern and southern Africa.

Person you admire: I am indebted to many people, but I would single out Prof. Adipala

Ekwamu, Executive Secretary, RUFORUM, who mentored me to be a diligent worker. My parents implanted in me the values of truth and honesty.

“
I ENJOY WORKING
WITH YOUNG
TALENTED
AFRICAN
SCIENTISTS TO
CONNECT THEM TO
OPPORTUNITIES
”



ANNEX 1

2018 AWARDS, RECOGNITION, AND NOMINATIONS

Scholar Awards

Teresiah Njihia (ARPPIS PhD) won a Mawazo 2018 PhD Scholarship.

Tatenda Chiuya (ARPPIS PhD) received an award to attend the Molecular Data for Infectious Disease course, Institute of Tropical Medicine (ITM), Antwerp, Belgium, 7-28 Feb 2018.

ARPPIS PhD scholars **Olabimpe Olaide** and **Teresiah Njihia** won student travel awards to attend the annual meeting of the 34th International Society of Chemical Ecology (ISCE) meeting in Budapest, Hungary (12-18 August 2018).

ARPPIS PhD Scholars **Pamela Odhiambo**, **Bester Mudereri**, **Abdelmutalab Gesmalla** (ARPPIS) received support from DAAD to attend the training workshop GeoTraining- Environmental and Remote Sensing Data Analysis via Geospatial Technologies in Research and Teaching, Goethe-University Frankfurt, Germany, 2-28 Sept 2018.

Edith Chepkorir (ARPPIS) received support from DAAD to attend a training workshop on Enhancing Academic Qualifications in Teaching and Research in Public Health, Heidelberg University, Germany, 1-28 Aug 2018.

Yosef Hamba Tola (ARPPIS PhD) and **Daniel Ouso** (DRIP MSc) received partial travel grants to attend CODATA-RDA Research Data Science Advanced Workshop on Bioinformatics at the International Centre for Theoretical Physics (ICTP), Trieste, Italy, 20-24 Aug 2018.

Justice Kwaku Addo (DRIP PhD) received an Award for Outstanding Research by the University of Cape Coast, South Africa, for his PhD research (June 2018).

Gladys Mosomtai (ARPPIS PhD) received a L'Oréal-UNESCO For Women in Science Africa doctoral fellowship award in December 2018. Only 14 fellowships were awarded from 480 applicants across SSA. http://www.cssr.uct.ac.za/sites/default/files/image_tool/images/260/files/Press%20release%20FWS%20Africa.pdf

Best Oral Presentation: **Hillary Kirwa** (DRIP MSc), 18th Horticultural Association of Kenya (HAK) Workshop 26-30 November 2018, at Taita-Taveta. Title: "Root knot nematode herbivory of tomato *Solanum lycopersicum*, is influenced by root exudate chemistry"

Tatenda Chiuya (ARPPIS PhD) was awarded a bursary to cover university fees from the University of Pretoria where he is registered for his PhD.

Margaret Mendi Njoroge, a PhD scholar, received the first prize for the best poster at the Pan-Africa Mosquito Control Association (PAMCA) conference, Zimbabwe, 24-26 September 2018 for a poster entitled "Repellent treated eave wraps as a tool in the arsenal against residual malaria transmission".

Staff recognition

Dr Elfatih M. Abdel-Rahman of the Geo-Information Unit received the European Space Agency best paper award (Joint Second) at the African Association of Remote Sensing of the Environment (AARSE18) conference, held at Alexandria, Egypt 25-29 October 2018.

Segenet Kelemu, selected as one of five Bill Gates' "Heroes in the Field", selected by leading philanthropist, Bill Gates, for using their talents to fight poverty, hunger and disease, while providing opportunities for the

next generation. The 'heroes in the field' have been featured in a **Time** magazine article (<http://time.com/5087356/this-ethiopian-scientist-is-saving-lives-by-studyinginsects/>) guest edited by Mr. Gates; a short video (<https://www.youtube.com/watch?v=3rTidBE32g&t=5s>) that he has narrated; on his blog (<https://www.gatesnotes.com/About-Bill-Gates/These-Heroes-Are-Saving-the-World>); on the Bill & Melinda Gates Foundation Facebook page (<https://www.facebook.com/gatesfoundation/videos/10156388914603072/>), and through a series of tweets from Mr. Gates: https://twitter.com/BillGates?ref_src=twsrc%5Egoogle%7Ctwcamp%5Eserp%7Ctwgr%5Eauthor.

Segenet Kelemu, featured in **The CEO Magazine** as one of the exceptional leaders from around the world, breaking ground and shattering the glass ceiling. (http://www.icipe.org/sites/default/files/leadingbusinesswomen_EU1018_segenet-icipe.pdf)

Segenet Kelemu, one of the recipients of the 2018 Women of the Decade award, the highest recognition conferred by the Women Economic Forum (WEF) for outstanding leadership in the Natural and Sustainable Ecosystems category during 26 April – 1 May 2018 at New Delhi, India.

Segenet Kelemu, selected as a member of the Advisory Board of Bill & Melinda Gates Foundation (BMGF)-Africa Plant Health Initiative (APHI) with the following tasks: (i) in the short-term, provide strategic guidance to members of the BMGF Agricultural Team and the consultants leading a landscaping effort to identify critical organizations and institutions that could be a part of APHI; (ii) in the longer-term, to help guide and inform the development of APHI; and (iii) in the future, to serve on the Board to provide important continuity during the early start-up phase of APHI.

Segenet Kelemu, selected as member of the Program Advisory Board Ceres 2030: Sustainable Solutions to End Hunger, a joint Cornell University,

International Food Policy Research institute (IFPRI) and International Institute for Sustainable Development (IISD) project.

Sunday Ekesi elected Fellow of the Royal Entomological Society (FRES) in 2018 for his contribution to entomological R&D and capacity building in Africa and globally.

Baldwyn Torto, recipient of the 2018 Research Article of the Year and Lectureship Award of the Journal of Agricultural and Food Chemistry (AGRO DIVISION), at the 256th American Chemical Society National Meeting, 19th-23rd August 2018, Boston, Massachusetts, USA.

Baldwyn Torto, Panel Chair, UK-Global Challenges Research Fund (GCRF) to assess proposals in response to the call on "Interdisciplinary Research Hubs to Address Intractable Challenges Faced by Developing Countries", 15-16th January 2018.

Baldwyn Torto honoured by the University of Cape Coast, School of Graduate Studies, Ghana, for his commitment and outstanding mentorship to Justice Kwaku Addo, who is graduating from the University with a PhD in chemistry.

Beatrice Muriithi awarded the Science by Women fellowship by the Women for Africa Foundation, a Spanish private entity aimed at contributing to the sustainable development of Africa through the drive of its women. The fellows spend six months at a Spanish Centre of Excellence, where they receive training and integration in a dynamic, multidisciplinary and highly competitive work team, and are able to develop their research projects and acquire complementary competences, empowering them to transfer their research results to tangible social and economic benefits. Beatrice was hosted by Barcelona School of Economics.

Oscar Mbare awarded the American Society of Tropical Medicine and Hygiene (ASTMH) Travel Award to give a presentation at the 67th ASTMH

Annual Meeting on October 28 – November 1, 2018 in New Orleans, Louisiana, USA.

Workneh Ayalew, YESH Project coordinator accepted as fellow of the Ethiopian Academy of Sciences.

Michael Lattorff appointed as Associate Editor for the *International Journal of Tropical Insect Science* on 5 January 2018.

Michael Lattorff selected as a reviewer for a BBSRC proposal on resistance of *Varroa mites* towards conventional pesticides.

Robert Skilton invited to serve on the selection panel for the L'Oreal UNESCO For Women in Science Fellowships – Africa.

Arnold Mwanu awarded the 2018 International Federation of Library Associations and Institutions (IFLA) – Online Computer Library Center (OCLC) Fellowship for a four-week program at OCLC headquarters in Dublin, Ohio, USA, providing professional development.

icipe Governing Council Awards – 2018

Best science paper award

Teresiah N. Njihia (ARPPIS PhD) won the first prize for her paper *Ripe coffee berry volatiles repel second instar nymphs of Antestia bugs (Heteroptera: Pentatomidae: Antestiopsis thunbergii)*, published in *Chemoecology*.

Beatrice T. Nganso (ARPPIS PhD) received the second prize, for her paper *Low fertility, fecundity and numbers of mated female offspring explain the lower reproductive success of the parasitic mite Varroa destructor in African honeybees* published in *Parasitology*.

Nelson L. Mwando (DRIP MSc) was awarded the third prize for his paper

Maize chlorotic mottle virus induces changes in host plant volatiles that attract vector thrips species published in the *Journal of Chemical Ecology*.

Best science poster award

Juliet Ochola (DRIP MSc) won the top prize for her poster 'Wrap and Plant' technology: *elucidating the mechanisms of banana fiber paper in the management of Potato Cyst Nematodes*.

Olaimpe Olaide Yewande (ARPPIS PhD) won the second prize for her poster: *Zebras as potential sources of potent repellents for savannah tsetse fly control*.

Hillary Kirwa (DRIP MSc) took the third prize for his poster: *The plant hormone Zeatin identified in tomato root exudate elicits attraction in the root knot nematode, Meloidogyne incognita*.

icipe internal awards

Outstanding Employee of the Year (2018); Philip Kinyua, in recognition of his timely and regular provision of Information and Communication Technology (ICT) end-user support to the Centre.

Outstanding Partner of the Year (2018); Swedish International Development Cooperation Agency (Sida); for the long-standing and solid relationship with *icipe*, both as a donor and as a partner since 1972. Sida's support to *icipe* with core funds has ensured that the Centre delivers on its research-for-development mission to its constituency. Beyond core funds, Sida has been at the forefront of funding *icipe*'s Locust Research Programme from 1988 to 2008, and various capacity building and institutional development efforts of the Centre at graduate, postgraduate and postdoctoral levels. Sida's recent support to *icipe*'s Behavioural and Chemical Ecology (BCE) Unit with state-of-the art instrumentation has ensured that the Unit's activities remain at the cutting edge of insect

science with global recognition for its outstanding achievements. Sida's support to the *icipe*-led BioInnovate Africa Programme (which continues to serve as a research-for-development platform where scientists, policy makers and industry partners collaborate to develop and translate bioscience research ideas and technologies into products for the market and end users) is much appreciated.

Outstanding Professional Staff of the Year (2018); Gatigwa Kimana, Director of Finance and Administration, for establishing and maintaining financial and accounting standards and controls of the highest level at *icipe*.

Outstanding Publication of the Year (2018): Host plant forensics and olfactory-based detection in Afro-tropical mosquito disease vectors. PLOS Neglected Tropical Diseases 12(2), e0006185. <https://doi.org/10.1371/journal.pntd.0006185> Nyasembe V.O., Tchouassi D.P., Pirk C.W.W., Sole C.L. and Torto B. (2018). The global spread of vector-borne diseases remains a major public health threat, thus necessitating the development of new combat strategies for vector control. The research paper by Vincent Nyasembe as first author provides a critical insight into the chemical communication that underpins mosquito-plant interactions and presents a unique opportunity for advancing of plant-based mosquito control strategies. The investigators have demonstrated the importance of molecular approaches in identifying specific vector-plant associations that can be exploited for control of Afro-tropical mosquito vectors of dengue, Rift Valley fever and malaria.

Outstanding Support Staff of the Year (2018); Robert Weru; Executive driver in the Director General's Office, for his dedication, commitment, excellent knowledge of road traffic regulations and systems, use of safe driving techniques and punctuality.

Outstanding Team of the Year (2018); Duduville International Guest Centre (DIGC) for their outstanding quality of service. The team under the able leadership of Franceen Amutallah has demonstrated efficiency and reliability to *icipe*, its guests and visitors.

Institutional recognitions

October 2018: On the occasion of the 20th Anniversary of the Borlaug-Ruan International Internship Programme, the World Food Prize Foundation awarded *icipe* a certificate to extend its profound gratitude for exceptional commitment to the Borlaug-Ruan International Internship Program thus carrying forward the legacy of Dr Norman E. Borlaug and John Ruan, Sr. *icipe* has hosted an intern for 20 consecutive years in the Push-Pull Programme.

On 15 July 2018, *icipe* honoured the Centre's former Director General, Dr Hans Rudolph Herren, for his enduring commitment to supporting the Centre's mission; and his vision of the role of science led development for sustainable, socio-economic transformation in Africa. This recognition is denoted through the dedication of the main administration building block at *icipe* Thomas Odhiambo campus.

In April 2018, the current Ministry of Agriculture and Livestock Resources of Ethiopia awarded *icipe* Ethiopia office certificates of excellence for pioneering and scaling push-pull technology for integrated management of cereal stem borers, Fall armyworm and striga and also for strong partnership and outstanding contribution to modern beekeeping and sericulture in Ethiopia.



Common name: Nsenene
Scientific name: *Ruspolia differens*

For more details about *icipe* and its activities, contact:

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ANNUAL REPORT 2018

icipe was established in 1970 in direct response to the need for alternative and environmentally friendly pest and vector management strategies. Headquartered in Nairobi, Kenya, *icipe* is mandated to conduct research and develop methods for pest control that are effective, selective, non-polluting, non-resistance inducing, and affordable to resource-limited rural and urban communities. *icipe*'s mandate further extends to the conservation and utilisation of Africa's rich insect biodiversity.

icipe focuses on sustainable development, including human health, as the basis for development, and the environment, as the foundation for sustainability. Working through a holistic and integrated approach through the 4H paradigm – Human, Animal, Plant and Environmental Health – *icipe* aims at improving the overall well-being of communities in tropical Africa by addressing the interlinked problems of poverty, poor health, low agricultural productivity, and degradation of the environment.

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Support *icipe*: www.icipe.org/support-icipe

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