



INTERNATIONAL
FOUNDATION FOR
SCIENCE

A photograph of a man in a small wooden boat on a body of water. He is wearing a green long-sleeved shirt, brown waders with 'kylebooker' written on the waist, and a white face mask. He is holding a small fish in his right hand. In the background, another person in a bright green shirt is partially visible. The water is calm, and there is a grassy bank in the distance.

IFS ANNUAL REPORT 2020



IFS – DEVELOPING SCIENCE, SCIENCE FOR DEVELOPMENT

The IFS Annual Report has a style which is designed to match our ten-year strategy and includes sections relating to the specific objectives to improve planning of research by early career scientists, increase production of relevant, quality research in low- and lower-middle-income countries, and increase the use of quality research results produced by IFS. We hope you enjoy the report!

IFS Annual Report 2020

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Cover photo: Mr Romuald Hounyeme, Benin, sampling of different fish species at the fishing point Calavi

All photos according to bylines or by IFS

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Foreword

What a year it has been! The whole world was hit by a global pandemic caused by ‘a big disease with a little name’, resulting in unprecedented chaos, protests and riots, online learning, remote work and self-quarantine, the advent of the “1.5m-society” through social distancing, and also of super-spreaders, Zoom and Teams parties, stress and depression, contact tracing and bubbles. Meanwhile, resolute scientists around the world started addressing the pandemic, finding solutions and developing much-anticipated vaccines. However, they also continued working to solve other urgent problems that have been around for some time and still need our attention, such as global warming, climate change and food security. Science did not go into quarantine in 2020, and thus IFS continued its essential work of supporting early career researchers in Low- and Lower-Middle-Income Countries.

As we reflect on the year now ending, we can all feel pride in what we accomplished together, from the uninterrupted efforts to announce the 2020 call, to processing a record number of applications, to a year of transition into our new Strategy 2021–2030, *Investing in Future Scientists*. However, at the same time, like many organisations, IFS has been affected by changes in the development and funding landscape, and we look ahead to more clarity in 2021 as we try to respond and adapt.

As always, our success is possible because of our collaborations with strategic partners, the dedication of our Scientific Advisory Committee members, the hard work of our small and mighty staff at the IFS Secretariat, the scientific passion of our grantees and alumni, and the financial contributions of our donors, and as well as the strong leadership of our Board of Trustees.

The ways in which IFS and other organisations are responding to the COVID pandemic exemplifies how scientific research can make the difference between life and death in countries where this capacity exists. The reality is that the benefits of science remain a distant prospect for many, especially in countries whose scientific talent goes largely untapped. Thus, the work of IFS is now more relevant than ever.



Dr Patrick Van Damme
Chair of the IFS Board of Trustees

A blue ink signature of Dr Patrick Van Damme.

Dr Patrick Van Damme
Chair



Dr Nighisty Ghezae
IFS Director

A blue ink signature of Dr Nighisty Ghezae.

Dr Nighisty Ghezae
Director

Mission statement

The need

Science can be a significant driver of economic and human development. Used properly it can help to strengthen the human condition globally through improved livelihoods, food security, health and wellbeing. The scientists of tomorrow must contribute to securing accessible and affordable food, water and energy for a rising population within a scenario of environmental sustainability, as directed by the 2030 Sustainable Development Goals.

While low-income countries produce a sizeable number of scientists, they experience significantly high rates of brain drain as scientists migrate in search of facilitated conditions in the most developed countries. The International Foundation for Science holds that a sound basis for contributing to the establishment and expansion of developing country science, and to help these countries retain scientific talent, is to identify, select and support promising early career men and women scientists, and offer them opportunities in their home countries to plan, produce and put knowledge and technology into use.

In the next decade, individual and collaborative research conducted by developing country scientists needs to contribute to global efforts to reduce poverty and support sustainable development to deliver on the global Sustainable Development Goals. Support by the International Foundation for Science will strengthen the possibilities for early career men and women scientists to productively engage in innovation and policy domains of relevance and use in their own countries.

Over a period of 48 years, IFS has supported 8000+ grantees from 105 countries, many of whom are now leading scientists or science leaders. Guided by its 2011–2020 strategy, IFS will continue to facilitate research on biological and water resources, with a focus on physical, chemical, and biological processes, as well as relevant social and economic aspects important in the conservation, production, and renewable use of natural resources.

The mission

IFS shall contribute towards strengthening the capability of young men and women scientists in developing countries not only to conduct relevant and high quality research, but to enhance opportunities to put it into use in their home environments.

The strategy

In its 10-year strategy, IFS aims to support excellent individual and collaborative research, to build capability of early career scientists in the developing world, and to facilitate the process of innovation for the sustainable use and management of biological and water resources. An important goal is to enable young scientists to contribute to a global research community that is aiming to reduce poverty and support sustainable development. The primary focus will be the promotion of excellent science through early career research grants and capability-enhancing support to researchers in developing countries. However, the interlinked development challenges that humanity faces increasingly require scientists to work with each other, as well as with other professions and specialists. Therefore, the phased introduction of a collaborative research approach will provide support for research teams, which will combine researchers' strengths, expertise, and experience, to address a broader topic or research issue where more than one discipline is required. A major change in our agenda is not only to aspire to strengthen the capability of those embarking on a research career in the developing world, but also to support young scientists in the actions they undertake to bring about change, in terms of their values and objectives. In other words, to promote the individual agency of men and women scientists, early in their career in developing countries, to put their science into use.

Summary

Looking Back and Ahead

The year 2020 was one of transition from IFS's previous Strategy 2011–2020 to the new Strategy 2021–2030. We began trying out new elements such as revised eligibility criteria, increased Basic Grant amounts, and a new Advanced Grant. Under the theme of *Investing in Future Scientists*, the Strategy 2021–2030:

- > Represents an evolution in our approach to enhancing research capacity
- > Focuses resources on supporting promising early career scientists (no longer defined by age)
- > Reflects changes in the contemporary context, and
- > Provides a foundation for IFS to move into its next chapter.

For this strategic transition year of 2020, we are also changing the way we report on our work so that the impact of how grantees' research is put into use is at the forefront, followed by our capacity-enhancing support activities and grants provision.

Impact: Putting Grantee Research into Use

We supported and followed up with the 112 grantees of 2016 who were finishing their research. We have chosen 13 impactful projects from 2016 to highlight how grantees' research is being put into use, representative of topics, countries, regions, women and men. These scientists have so far published 43 articles in peer-reviewed scientific journals, and they have established 336 national and international scientific contacts.

Through a selection of research results and achievements of grantees, IFS has documented evidence of numerous impacts from its support for the research of early career scientists. IFS grantees are putting their research into use in immediate, near-term and long-lasting ways, in villages, forests, fields, policy discussions, government practices and the global scientific community. For example, in Ghana, data generated from one project's microbiological assessments were considered for the revision of a national standard on food sampling. From another grantee's project in Pakistan, more than 20 lines of wheat cultivars with desired agronomic features were selected to be used in a breeding programme.

Capacity-enhancing Support

In 2020, IFS was jointly engaged with a variety of strategic partners across a spectrum of topics, including communication to a non-scientific audience, COVID, food security, freshwater tenure rights, "soft skills" for scientists, water and agricultural systems, and women in science. These 13 activities took place virtually.

We provided mentoring support to the ongoing research projects of 433 grantees, along with those finishing up 72 individual and 40 collaborative grants from 2016. We also supported our alumni to associate and support other potential grantees through training and coaching. In particular, a webinar series was launched to strengthen the science capacity of early career researchers in Africa in the post-COVID world, and an introductory meeting was arranged with new women grantees.

Grants

In 2020 we attracted a record-high 2,112 completed applications for individual research grants. Out of the total proposed projects, 168 grants were approved for funding, with 116 applicants awarded the grant (including 12 Renewal Grants and 52 pending due to lack of funds). Of those awarded, 45% dealt with biological resources in terrestrial systems, 20% with water and aquatic resources, and 35% with food security, dietary diversity and healthy livelihoods. The IFS Secretariat also processed 47 purchase orders for laboratory equipment and materials.

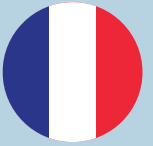
Women scientists represented 40% of the individual research grant awardees and men were 60%. In addition to the early career scientists receiving research grants, the other 1,498 applicants were given feedback by well-qualified IFS reviewers and advisors as part of our capacity-enhancing support.

It was not planned to implement the new Advanced Grant scheme this year, but rather to prepare for it through the development of an application form and guidelines for applicants and reviewers. However, we did not miss the opportunity to pilot the Advanced Grant through a collaboration with Philippines-based SEARCA¹ on a response to the COVID pandemic with a Call for Research on Accelerating Transformation through Agricultural Innovation in Southeast Asia.

IFS's COVID Response

In response to the COVID pandemic, IFS also acted immediately by taking measures to ensure the well-being of our staff, and by contacting grantees to renegotiate expectations and deliverables for around 500 ongoing projects. We also drafted a discussion note so that the IFS Executive Committee, Board and Secretariat can explore the implications – with our funders and strategic partners – for IFS's programming over the next few years. The note is meant to spark discussion, further develop the concepts, and result in a set of follow-up actions for IFS as it both continues with its regular programme and also responds to COVID.

1. Southeast Asian Regional Center for Graduate Study and Research in Agriculture.



Résumé en français

Regard en arrière et en avant

L'année 2020 était celle de la transition entre la précédente stratégie de l'IFS 2011-2020 et la nouvelle 2021-2030. Nous avons commencé à essayer de nouveaux éléments tels que des critères d'éligibilité revus, une augmentation des montants des Subventions de Base et une nouvelle Subvention Avancée. Sous le thème Investir pour les futurs scientifiques, la Stratégie 2021-2030 est déclinée en 4 points:

- Représenter une évolution dans notre approche, visant à améliorer la capacité de recherche,
- Concentrer les ressources pour le soutien de scientifiques prometteurs en début de carrière (qui n'est plus défini par l'âge),
- Refléter les changements dans le contexte actuel, et
- Fournir un point de départ à IFS pour passer à la prochaine phase.

Pour cette année de transition stratégique 2020, nous modifions également la façon dont nous rendons compte de notre travail afin que l'impact de celle-ci, notamment la recherche de bénéficiaires soit mise en œuvre au premier plan, suivi de nos activités de soutien au renforcement des capacités et de l'octroi de subventions.

Impact: mise en pratique de la recherche des boursiers

Nous avons soutenu et suivi les 112 boursiers sur 2016 qui terminaient leurs recherches. Nous avons choisi 13 projets percutants sur les 2016 pour souligner la manière dont les recherches des bénéficiaires sont mises en œuvre, représentatives des thèmes, des pays, des régions, des femmes et des hommes. Ces scientifiques ont jusqu'à présent publié 43 articles dans des revues scientifiques à comité de lecture et ont établi 336 contacts scientifiques nationaux et internationaux.

Grâce à une sélection de résultats de recherche et des réalisations de boursiers, l'IFS a documenté la preuve des nombreux impacts de son soutien pour la recherche de scientifiques en début de carrière. Les bénéficiaires de l'IFS mettent leurs recherches en pratique de manière immédiate, à moyen terme et à long terme, dans les villages, les forêts, les champs, les discussions politiques, les pratiques gouvernementales et la communauté scientifique dans sa globalité. Par exemple, au Ghana, les données générées par les évaluations microbiologiques d'un projet ont été prises en compte pour la révision d'une norme nationale portant sur l'échantillonnage alimentaire. Dans le cadre du projet d'un autre bénéficiaire au Pakistan, plus de 20 lignées de cultivars de blé présentant les caractéristiques agronomiques souhaitées ont été sélectionnées pour être utilisées dans un programme de reproduction.

Soutien au renforcement des capacités

En 2020, IFS a été engagée conjointement avec une diversité de partenaires stratégiques sur un large éventail de thèmes, incluant la communication à un public non scientifique, la COVID, la sécurité alimentaire, les droits fonciers sur l'eau douce, les «compétences générales» pour les scientifiques, les systèmes agricoles et aquatiques, et les femmes dans la science. Ces 13 activités se sont déroulées virtuellement.

Nous avons fourni un soutien de conseiller aux projets de recherche en cours de 433 boursiers, ainsi qu'à ceux qui ont terminé 72 subventions individuelles et 40 subventions collaboratives à partir de 2016. Nous avons également aidé nos anciens boursiers à associer et soutenir d'autres boursiers potentiels par la formation et l'encadrement. En particulier, une série de séminaires en ligne a été lancée pour renforcer la capacité scientifique des chercheurs en début de carrière en Afrique dans le monde post-COVID, et une réunion d'introduction a été organisée avec de nouvelles femmes boursières.

Bourses

En 2020, nous avons attiré un nombre record de 2112 candidatures complètes pour des subventions de recherche individuelles. Sur le total des projets proposés, 168 subventions ont été approuvées pour le financement, avec 116 candidats ayant reçu la subvention (dont 12 Subventions de Renouvellement et 52 en attente en raison d'un manque de fonds). Parmi ceux attribués, 45% concernaient les ressources biologiques dans les systèmes terrestres, 20% l'eau et les ressources aquatiques et 35% la sécurité alimentaire, la diversité alimentaire et les moyens de subsistance sains. Le Secrétariat de l'IFS a également réalisé 47 bons de commande pour de l'équipement et du matériel de laboratoire.

Les femmes scientifiques représentaient 40% des boursiers de recherche individuels et les hommes 60%. En plus des scientifiques en début de carrière qui ont reçu des subventions de recherche, les 1498 autres candidats ont reçu des commentaires d'évaluateurs et de conseillers IFS qualifiés dans le cadre de notre soutien au renforcement des capacités.

Il n'était pas prévu de mettre en œuvre le nouveau programme de « Subventions Avancées » cette année, mais plutôt de s'y préparer en élaborant un formulaire de candidature et des lignes directrices pour les candidats et les évaluateurs. Cependant, nous n'avons pas manqué l'opportunité de piloter la Subvention Avancée grâce à une collaboration avec le SEARCA, basée aux Philippines¹, en réponse à la pandémie COVID avec un appel d'offre en recherche sur l'Accélération de la Transformation grâce à l'Innovation Agricole en Asie du Sud-Est.

Réponse de l'IFS face au COVID

En réponse à la pandémie COVID, l'IFS a également agi immédiatement en prenant des mesures pour assurer le bien-être de notre personnel, et en contactant les bénéficiaires pour renégocier les attentes et les livrables pour environ 500 projets en cours. Nous avons également rédigé une note de discussion afin que le Comité Exécutif, le Conseil d'Administration et le Secrétariat de l'IFS puissent explorer les implications - avec nos bailleurs de fonds et nos partenaires stratégiques - pour la programmation de l'IFS au cours des prochaines années. La note vise à susciter la discussion, à développer davantage les concepts et à aboutir à un ensemble d'actions de suivi pour l'IFS, car il poursuit à la fois son programme régulier et répond également à la situation COVID.

1. Centre régional d'Asie du Sud-Est pour les études supérieures et la recherche en agriculture.

IMPACT

Putting Grantee Research into Use

IFS's Vision is for scientists in Low- and Lower-Middle-Income Countries (LLMICs) to contribute fully to a global research community committed to reducing poverty and supporting sustainable development, both nationally and regionally. It monitors realisation of its Vision through a number of output- and outcome-related metrics, including:

- > Increased numbers of LLMIC early career women and men scientists supported
- > Increased support per scientist, in terms of grant support, mentoring and capacity-enhancing activities
- > Increased numbers of publications, including in more high-impact journals
- > Improved research and research-associated skills, including organisational, communication and interpersonal skills
- > Greater translation of research into use, through involvement in evidence-based decision-making and uptake of STI by society
- > Improvements in science literacy, via the development of research communities, including Alumni Associations, and
- > Improved career pathways.

The online Project Completion Forms capture early career scientists' own assessment of how their skills have developed as a result of IFS support and facilitate the assessment of their development as researchers by scientific peers (i.e., reviewers and SAC members). Data are analysed to identify the aspects of research grant support and complementary activities that can be improved to better support research capacity enhancement and validate the assumptions underpinning the approach. In addition, IFS conducts periodic country-wide surveys with grantees, in particular to understand more clearly about their research and career achievements.





Snail vector hunting in wetlands shared by pastoralists and their livestock. Researcher Dr Ajakaye Remilekun (right) with two field assistants.

A selection of research results and achievements of IFS grantees

IFS grantees are contributing significantly to changes around the world, through their commitment to scientific advancements, their enthusiasm to learn and to work with others, and their attainment in getting their research results put into use at local, national, regional and global levels. As gleaned from 112 grantee responses to a survey question about how their results are being used, numerous impacts are evident from IFS's support for the research of early career scientists, in immediate, near-term and long-lasting ways, in villages, forests, fields, policy discussions, government practices and the global scientific community. These scientists have also thus far published 43 articles in peer-reviewed scientific journals.

At a national level, informed by grantee research results:

- > In Burkina Faso, results on shea tree density and fruit yield per hectare were used in the "Climate-Smart Agriculture Investment Plan for Burkina Faso" initiated by the World Bank, Government of Burkina Faso and their partners.
- > In Ghana, data generated from a project's microbiological assessments were presented and considered for the revision of national standard GS 955:2013 (Microbiological Analysis of Food Sampling Plans and Microbiological Criteria).
- > In Kenya, policy is being shaped for control of camel keds to improve camel health and hence milk and meat production, leading to better lives for marginalised pastoralist communities.
- > In South Africa, a large-scale, country-wide replication was done to test the effect of predation on rodent pests.
- > In Sri Lanka, projects are being carried out to evaluate the dynamics of micronutrients and metalloid accumulation in rice grains and rice-cultivating soils across the country, and
- > In Zimbabwe, generated landuse/landcover change maps highlight hotspots of soil erosion in a lake catchment, useful for public awareness and planning purposes by natural resources managers at the Environmental Management Authority.

Contributions to applied science were seen:

- > In Burkina Faso, where a more in-depth study is coming up with ideotypes that better meet the needs of the population in terms of consumption of amaranth, a crop of nutritional and economic value.

- > In Ivory Coast, where trees were supplied to producers within the framework of a field school programme for the development of agroforestry, including the transferring of grafting technology.
- > In Pakistan, where more than 20 lines of wheat cultivars with desired agronomic features were selected to be used in a breeding programme, and
- > In Thailand, where a re-engineered bivalent SFTI-I inhibitor was shown to have inhibitory activity against cancerous cells.

In addition to the impacts that IFS-funded research is having in grantees' own countries and the incremental contributions they are making to specific lines of scientific inquiry, the researchers supported by IFS are also demonstrating how they are fostering societal uptake of science, technology and innovation through:

- > In Burkina Faso, awareness campaigns for rural populations as part of the study on the impact and role of good hygiene practices in the transmission of hepatitis
- > In Burkina Faso, organised days with meat sellers, breeders and consumers to convey useful information about human contamination by pathogenic microorganisms
- > In Kenya, community and public engagement activities with pastoralist communities, and
- > In Madagascar, finding a compromise among farmers, agricultural technicians and scientists to design programmes in agricultural products more appropriate to the local reality.

From the micro-level of human cells, to the ultimate macro-level of satellite remote sensing, IFS grantees are making an impact in tiny and vast environments alike. Difficult though it is to choose which of the 112 projects from 2016 to highlight, presented here are 13 that are representative of topics, countries, regions, women and men, and of all of the many early career scientists who IFS is honoured to include among those who work to support its mission, especially to enhance opportunities to put their own high-quality research into use in their home countries.



DR JOEL LTILITAN BARGUL

Department of Biochemistry, Jomo Kenyatta University of Agriculture and Technology, Kenya

The role of biting flies (genus Hippobosca) in transmission of pathogenic animal African trypanosomes in northern Kenya

Based on our report proposing the use of camel biting hippoboscids (commonly known as keds) in xenodiagnosis of camel haemopathogens, researchers working on camel health at the International Centre of Insect Physiology and Ecology (icipe, Nairobi) commonly collect camel keds to indirectly detect camel pathogens. The ongoing work will shape policy for control of camel keds to improve camel health and hence milk and meat production, leading to betterment of the lives of marginalised pastoralist communities. Through our community and public engagement activities with pastoralist communities, farmers have gained knowledge and skills on vector-borne diseases, their transmission, and use of traps and insecticides to control insect vectors such as camel keds and biting flies such as stomoxys, as well as ticks.



DR LALITH D B SURIYAGODA

Department of Crop Science, University of Peradeniya, Sri Lanka

Diversity of Sri Lankan rice germplasm in storing micronutrients and heavy metals in rice grains and potential of agronomic management in fortifying rice grains with micronutrients

Results of the research have led to national-level projects to evaluate the dynamics of micronutrients and metalloid accumulation in rice grains and rice-cultivating soils in the country. The findings of the current research alone were not adequate

to generate practical impacts as the experiment was conducted in one location and inside a research station. Therefore, more data are needed from across the country to formulate new agronomic packages such as fertiliser application plans.



DR MIAN ABDUR REHMAN ARIF

Nuclear Institute for Agriculture and Biology, Pakistan

Genetic mapping of adult plant stripe rust resistance in novel germplasm of wheat

We have identified several marker trait associations, particularly from the synthetic-derived wheat (SWD) germplasm. After careful analysis of allelic profiles of the germplasm set, and associating it with the phenotypic data collected and analysed during this project, we have selected more than 20 lines with desired agronomic features to be used in our breeding. We have made 20 different crosses by crossing elite but susceptible wheat cultivars with the resistant lines identified during this project. The seeds have been harvested and will be taken in subsequent filial generations to allow segregation of alleles and identify superior genotypes with desired resistance in the new germplasm. Interestingly, two lines from the SDW set proved resistant for stripe, leaf and stem rusts in a national screening nursery. They have also been incorporated in our breeding programme to yield superior cultivars of wheat in future.



DR LAURENT KOUAKOU KOUAKOU

Minor Crop Research Group, University of Nangui Abrogoua, Ivory Coast

Domestication and enhancement of secondary forest products: Induction of early fruiting of Garcinia kola (Heckel) by grafting elite trees

Several plants were either supplied to SODEFOR, the main Ivorian company in charge of forest development, to reforest 7.5 hectares (750 plants), or provided to producers within the framework of a field school programme for the development of agroforestry in Ivory Coast. We are presently in the process of transferring the grafting technology to the producers to prevent them from still depending on us. We believe that the transfer of this technology to rural areas will guarantee the sustainability of this project.



DR LOURENS HENDRIK SWANEPOEL
Department of Zoology, University of Venda,
South Africa

The potential of small carnivore predation on rodent pests as an ecosystem service in rural small holding farms of the Vhembe District, South Africa

Predation by mammalian and avian predators has gained some traction among a broad range of stakeholders. Even though my research did not lead to policy actions, several current projects in Africa have embarked on a large-scale, country-wide replication to test the effect of predation on rodent pests. Similarly, I was also invited to attend the “Expert Meeting on Innovative Control Approaches of Rodent-Borne Epidemic Diseases and Other Public Health Consequences of Rodents’ Proliferation”, hosted by the WHO in Lima in 2019 to discuss biological control of rodent pest, specifically the role of biodiversity.

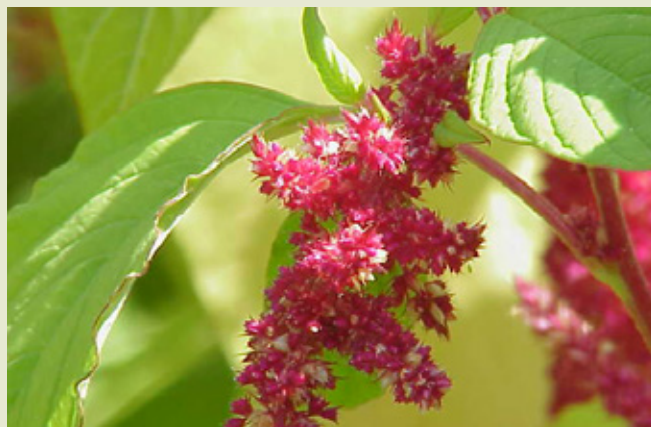


DR LOYAPIN BONDÉ
Department of Biology and Plant Physiology, University of
Ouagadougou, Burkina Faso

Assessment of fruit production and economic value of shea tree

(Vitellaria paradoxa C.F.Gaertn.) for more profitable exploitation in Burkina Faso

Allometric equations developed from my project for estimating fruit and kernel yields of shea tree are widely used by the Ministry of Environment, Green Economy and Climate Change of Burkina Faso to assist local organisations and private companies working in the shea sector to assess the potential production of shea products in their zones. My institution works in collaboration with the ministry to provide technical assistance to shea actors. Results on shea tree density and fruit yield per hectare were used in the “Climate-Smart Agriculture Investment Plan for Burkina Faso” initiated by the World Bank, Government of Burkina Faso and their partners.



DR BOUREIMA SAWADO
Department of Biology and Plant Physiology, University of
Ouagadougou, Burkina Faso

Ethnobotanical and genetic diversity study of leaf amaranth (Amaranthus spp) from Burkina Faso

The ethnobotanical investigation showed that the diversity of amaranth species is well consumed by the population and contributes to poverty reduction, particularly for women. Some accessions with high vegetable potentiality were identified as useable to enhance amaranth consumption and procure income for households. Indeed, agromorphological characterisation has made it possible to identify four species of amaranth cultivated in Burkina Faso, which are currently the subject of a more in-depth study to come up with ideotypes that better meet people’s needs. This will improve the standard of living of the local population through the economic contribution that it will generate and the added value that it will bring to the consumer’s plate.

DR ASSÈTA KAGAMBÈGA
Biochemistry Laboratory, University of Ouagadougou,
Burkina Faso

Prevalence of emerging food-borne pathogens (Salmonella Typhimurium and STEC) and epidemiological surveillance of their resistance to antibiotics in poultry and pigs

The results of our analyses revealed that chickens, oxen, pigs and small ruminants and their meats can be a source of human contamination by pathogenic microorganisms. This allowed us to organise days with the sellers of meats, breeders and consumers to convey useful information.

MR JEAN BIENVENUE OUOBA

Department of Biology and Plant Physiology, University of Ouagadougou, Burkina Faso

Characterisation of the Hepatitis E virus in wastewater and wells, with a view to environmental risk management

Our work focused on finding sources of environmental contamination of Hepatitis E (HEV) by drinking untreated water or by contact with slaughterhouse wastewater. The preliminary results have enabled us to carry out awareness campaigns for populations in rural areas during sample collection and during the socio-epidemiological survey carried out as part of the study on the impact and role of good hygiene practices in the transmission of hepatitis.



DR ANGELA PARRY-HANSON KUNADU

Department of Food Science, University of Ghana, Ghana

Enhancing food safety practices of informal smallholder chicken processing: A case study in Accra, Ghana

The results of the Food Safety Knowledge, Attitudes and Practices (KAP) study and the microbiological assessment have been disseminated to regional representatives of live bird traders, the National Association of Poultry Farmers and Apex Women in Poultry Association, as part of a poultry biosecurity workshop organised by FAO in Accra. Participants were trained in general food safety concepts and hygienic processing of slaughtered birds. I was invited as a member of the Microbiology Committee to review and update the national standard GS 955:2013 (Microbiological Analysis of Food Sampling Plans and Microbiological Criteria). The data generated from the microbiological assessments from my project were presented and considered for the standard's revision.

DR PANUMART THONGYOO

Department of Chemistry, Thammasat University, Thailand

Synthesis and biological activity against human-beta tryptase of bivalent SFTI-I inhibitor

The results from this project have showed clearly that the re-engineered bivalent SFTI-I inhibitor has an inhibitory activity against cancerous cells, and showed a potential scaffold for the

drug discovery. Also, the synthetic development for the peptide syntheses, including particular methodologies gained from this work, have been applied for the advanced organic chemistry laboratory at my department.

DR NASANDRATA RAVONJIARISON

Laboratoire de Radio-Isotopes, University of Antananarivo, Madagascar

Peasant perception and management of soil fertility in relation to carbon sequestration: Case of conservation agriculture in Lake Alaotra, Madagascar

One of the project's objectives was to find a compromise among farmers, agricultural technicians and scientists to design programmes in agricultural products more appropriate to the local reality. The use of new knowledge from my thesis allows the creation of new forms of dialogue among these three entities that are involved directly or indirectly in agricultural soils, and their fertility management. The linking of local knowledge from the study to that of scientists will produce more complex, more adequate actionable knowledge aimed at optimising agricultural production conditions and developing relevant recommendations.



MS PAMELA TENDAUPENYU

Department of Biological Sciences, University of Zimbabwe, Zimbabwe

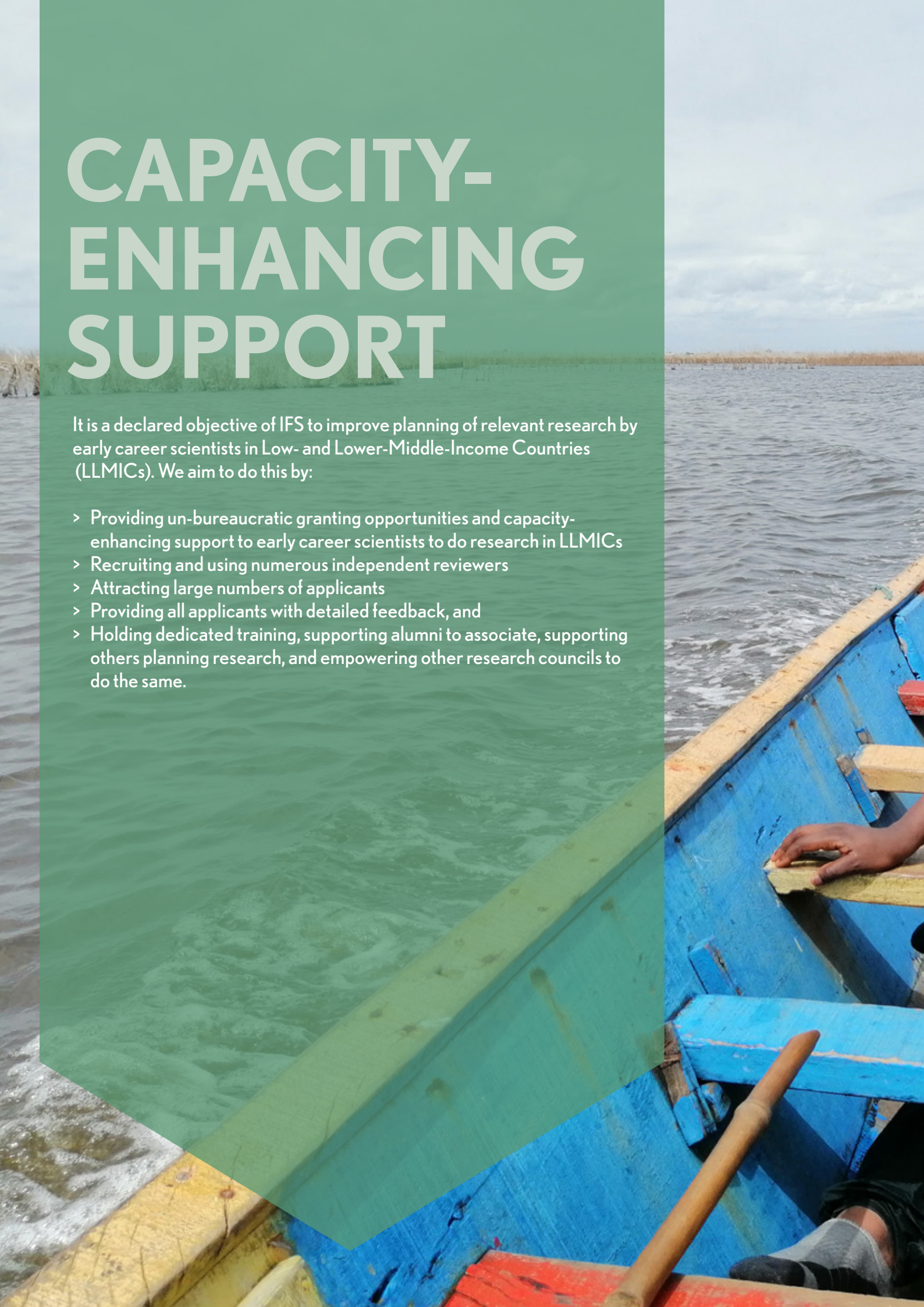
Sedimentation and sediment nutrient fluxes of a hypereutrophic subtropical lake: Lake Chivero, Zimbabwe

The results of sedimentation distribution in the lake enabled the calculation of useful life of the lake, which is a major water supply for Harare, the capital city of Zimbabwe. The stage curves were revised for realistic water budgets for the city water engineers. The generated landuse/landcover change maps highlight hotspots of soil erosion in the Lake Chivero catchment, useful for public awareness and planning purposes by natural resources managers at the Environmental Management Authority. Sediment nutrient maps provide information on the extent of pollution in the lake for managers at the Zimbabwe National Parks and Wildlife Authority for use in their decision-making and policy development. Geo-accumulation of metal results highlighted lake locations that need urgent remediation by responsible authorities.

CAPACITY- ENHANCING SUPPORT

It is a declared objective of IFS to improve planning of relevant research by early career scientists in Low- and Lower-Middle-Income Countries (LLMICs). We aim to do this by:

- > Providing un-bureaucratic granting opportunities and capacity-enhancing support to early career scientists to do research in LLMICs
- > Recruiting and using numerous independent reviewers
- > Attracting large numbers of applicants
- > Providing all applicants with detailed feedback, and
- > Holding dedicated training, supporting alumni to associate, supporting others planning research, and empowering other research councils to do the same.



Mr Romuald Hounyeme, Benin, sampling of different fish species at the fishing point Calavi.



IFS Continues Its Role as a Valuable Scientific Partner

In 2020, IFS was jointly engaged in 13 virtual events with a variety of strategic partners across a spectrum of topics, including communication to a non-scientific audience, COVID, food security, freshwater tenure rights, “soft skills” for scientists, water and agricultural systems, and women in science. In addition, we provided mentoring support to the ongoing research projects of 433 grantees, along with those finishing up 72 individual and 40 collaborative grants from 2016. We also supported our alumni to associate and support other potential grantees through training and coaching. The four events which IFS organised were:

Webinar on Investing in Future Scientists: Supporting Women Grantees (October)

Arranged with the 47 women grantees of the 2020 grant application call, the aim of the webinar was to activate the group and introduce the IFS gender group to them. The participants were congratulated on their grants. We introduced the new strategy and talked about what we hope the online group platform will be used for in the future and encouraged the group to start new initiatives. The IFS Gender Strategy was introduced with some background on why it is important to support women in science and how IFS is pursuing that.

IFS Alumni Webinar on Investing in Future Scientists in Africa Post-COVID-19 (October)

Recognising the importance of designing recovery strategies in a post-COVID world, the IFS Alumni Associations in Africa – together with the IFS Secretariat – are embarking on a series of online consultative meetings, in collaboration with representatives of other regional scientific communities and stakeholders in Africa and globally. (See the Alumni section for more information.)

IFS-OPCW Joint Workshop on Toxic Chemicals in the Environment: From understanding pollution and its impact to removal and verification techniques (November)

IFS grantees from seven African and Asian countries presented their research findings at this workshop co-organised by IFS and one of its partners, the Organisation for the Prohibition of Chemical Weapons (OPCW). Alongside IFS grantees whose research grant had been jointly co-funded by IFS and OPCW, presenters were holders of an OPCW grant, some of whom had received an IFS-OPCW grant earlier in their scientific career

also. Additionally, the meeting was attended by IFS and OPCW scientific advisors as observers and by IFS and OPCW technical staff. The workshop not only offered a unique opportunity for scientists from around the globe to network and to get a glimpse of how similar problems may be tackled differently at local scale in different settings, but it also allowed the two organisations to gain additional ideas on how to develop their partnership.

IFS 1000 STEM Women Workshop (December)

The IFS 1000 STEM Women Workshop brought together 23 IFS women grantees from Africa, Asia and Latin America to develop their science communication skills in an interactive workshop co-organised by IFS and Doane University. The goal of the workshop was to create 90-second videos for the 1000 STEM Women Project, a database of videos created by women working in the fields of Science, Technology, Engineering and Maths (STEM) all over the world, to increase the visibility of women role models for school children. Participants interacted with each other and practiced creating videos using Flipgrid, an online education tool that facilitates asynchronous online discussions. Once finished, participants’ videos were added to the 1000 STEM Women Project.

IFS also participated and contributed to nine events organised by others, including (descriptions follow):

- > Resilience of Vulnerable Populations and COVID-19
- > 75th United Nations General Assembly (UNGA) “Transformations Within Reach”
- > Role of Science and of Science Funders in the Time of the COVID-19 Crisis
- > Redirecting Global Agriculture Subsidies for a Sustainable Food Future
- > Whose Water? Global Launch of a 15-Country Analysis on the Status of Indigenous Peoples’, Afro-descendants’ and Local Communities’ Legally Recognised Freshwater Tenure Rights
- > ILRI CapDev Grand Challenge
- > Recovery, Reactivation and Resilience: Sustainable food security in a post-COVID World
- > Scaling Resilient Water and Agriculture Management Practices for Sustainable Rice Intensification in East Africa
- > Seminar Presentation of the Swedish University of Agricultural Sciences’ Vietnam Evaluation

Resilience of Vulnerable Populations and COVID-19 (May)

Organised by the World Resource Institute, this webinar was attended by a diverse group of speakers representing vulnerable frontline communities, international aid agencies and resilience experts, along with the Global Commission on Adaptation. They discussed questions of: How can response and recovery to COVID-19 build longer-term resilience to enable communities and countries to better prepare for future health and climate risks? What actions are needed to help countries and communities build back better to create jobs, improve economic security, and fill development deficits?

75th United Nations General Assembly (UNGA) "Transformations Within Reach" (June-September)

The International Institute for Applied Systems Analysis (IIASA) and the International Science Council (ISC) initiated the Consultative Science Platform to explore the humanitarian and socio-economic crisis triggered by the COVID-19 pandemic and considerations for enabling sustainable development paths during the recovery process. It was hosted by Norway as part of the IIASA-ISC Consultative Science Platform, with a focus on the themes of resilient food systems, sustainable energy, science systems and governance for sustainability. The initiative was guided by an advisory board under the patronage of HE Ban Ki-moon, former UN Secretary General, and chaired by HE Mary Robinson, Chair of The Elders, Patron of ISC and former President of Ireland. IFS was also present at a side event in October at the 2020 Borlaug Dialogue, organised by the World Food Prize Foundation. IFS also gave substantial feedback on the draft report before it was published. It is envisaged that the consultative platforms and the report will stimulate further dialogue to help identify applied research initiatives.

Role of Science and of Science Funders in the Time of the COVID-19 Crisis (June)

This webinar was hosted by the International Science Council, where dialogue took place on identifying critical COVID-related knowledge gaps and fostering potential collaboration and synergies; understanding the impacts of the COVID-19 pandemic on science funders; potential longer-term implications of the pandemic for global science systems; and ways of enabling science to respond more effectively to future similar threats.

Redirecting Global Agriculture Subsidies for a Sustainable Food Future (August)

Organised by the World Resource Institute (WRI), this webinar explored key questions of what is needed and where agricultural subsidies are currently going, and how to put subsidies to better use.

Whose Water? Global Launch of a 15-Country Analysis on the Status of Indigenous Peoples', Afro-descendants' and Local Communities' Legally Recognised Freshwater Tenure Rights (August)

IFS has been contributing to discussions of the report entitled *Whose Water?* on national laws and regulations recognising indigenous peoples', afro-descendants', and local communities' water tenure rights. The analysis stems from a collaboration between the Environmental Law Institute and the Rights and Resources Initiative. The webinar discussed the innovative methodology and comparative assessment on the extent to which the national-level legal frameworks of 15 countries across Africa, Asia and Latin America recognise communities' and community women's rights to use, govern and protect their freshwater resources.

ILRI CapDev Grand Challenge (September)

IFS presented its new strategy in relation to the launching of ILRI's CapDev Grand Challenge, a process to unlock young researchers' and scientists' potential. It is designed to equip young professionals with the requisite leadership and people skills, commonly referred to as soft skills. These will enable them to overcome the major bottlenecks in their future career progression. A new MOU with IFS has been signed to work together on some key challenges hindering young professionals' career progress. Under this new agreement, ten IFS grantees were selected to join the ten-month capacity-enhancing course in 2021.

Recovery, Reactivation and Resilience: Sustainable food security in a post-COVID World (September)

Organised by SIANI/IFAD, this online forum discussed sustainable and food-secure recovery from the COVID-19 pandemic through transformative structural change.

Scaling Resilient Water and Agriculture Management Practices for Sustainable Rice Intensification in East Africa (September)

Organised by the Global Framework on Water Scarcity in Agriculture (WASAG), and hosted by FAO's Land and Water Division, the webinar presented the framework of the research project scaleWAYS (Scaling out Resilient Water and Agricultural Systems), which is being jointly implemented by the International Institute for Applied System Analysis (IIASA), the Lake Victoria Basin Commission (LVBC) and the International Crops Research Institute for Semi-Arid Tropics (ICRISAT), with financial support from the Austrian Development Agency (ADA).

Seminar Presentation of the Swedish University of Agricultural Sciences' Vietnam Evaluation (September)

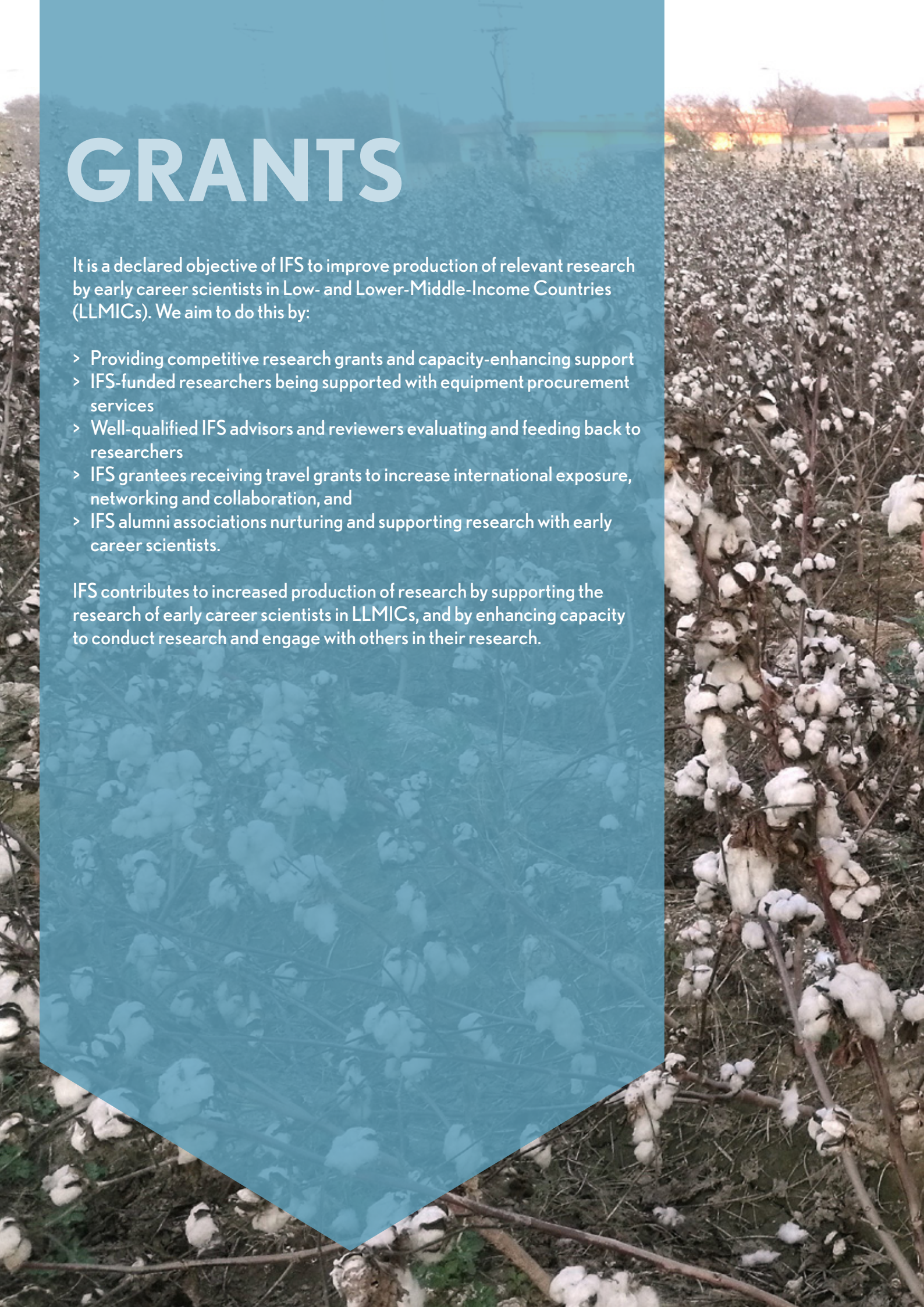
The seminar highlighted results and lessons from Swedish University of Agricultural Sciences (SLU) collaborations in Vietnam from 1977-2018, and also discussed the importance of international collaborations to tackle current global challenges. Participants included Vietnam's Ambassador to Sweden and Sweden's Ambassador to Vietnam, as well as representatives from SLU, and several universities and research institutions in Vietnam.

GRANTS

It is a declared objective of IFS to improve production of relevant research by early career scientists in Low- and Lower-Middle-Income Countries (LLMICs). We aim to do this by:

- > Providing competitive research grants and capacity-enhancing support
- > IFS-funded researchers being supported with equipment procurement services
- > Well-qualified IFS advisors and reviewers evaluating and feeding back to researchers
- > IFS grantees receiving travel grants to increase international exposure, networking and collaboration, and
- > IFS alumni associations nurturing and supporting research with early career scientists.

IFS contributes to increased production of research by supporting the research of early career scientists in LLMICs, and by enhancing capacity to conduct research and engage with others in their research.





Mr Athar Hussain, Pakistan, identifying resistance gene classification in cotton.

A selection of new individual research grants given in 2020

1. Biological Resources in Terrestrial Systems

Researching Biological Resources in Terrestrial Systems helps us to explore sustainable management of such systems. It is not just focused on exploiting nature for the benefit of humankind, but also doing so in a way which will not jeopardise the well-being of future generations. Natural resources and ecological management are complex and difficult issues to balance with social and economic demands; it is about managing people as much as nature. Some of IFS's projects that relate to Biological Resources in Terrestrial Systems are highlighted here.

DR GEOFFREY GABIRI, UGANDA

Land use and climate change effects on terrestrial carbon stocks in Sezibwa Catchment in Lake Kyoga Basin, Uganda

Significant land use and land cover changes have been reported in the central region of Uganda. The proposed project seeks to i) characterise and quantify historical land use and land cover changes in the Sezibwa Catchment from 1986-2016, and ii) inventory and predict terrestrial carbon stocks and fluxes in vegetation and soils in the catchment. The research objectives build on each other to span both basic and applied scientific endeavours with a view to understanding biogeochemical processes and nutrient (re)cycling in central Uganda and their implications for elevated atmospheric CO₂. Historical Landsat images will be interpreted and classified to establish land use and land cover changes. An inventory of terrestrial carbon stocks will be determined and a paired-site sampling scheme will be used to assess C fluxes following land clearing. This will then be integrated in the CENTURY Ecosystem Model to determine the impacts of land change and future climate change on the dynamics of carbon stocks in the catchment.

MR CALVINCE RASHID KAWAWA ABONYO, KENYA

Risk warnings and management counter-measures of alien ornamental plants under climate change in Sub-Saharan Africa: A case study of Nairobi and its environs
Invasive alien plants present a danger to

natural ecosystems, making their management a priority in the global conservation agenda. One of the costly and most difficult adventures in the management of alien species is eradication once they get established in new ranges. This makes the inhibition of new invasions the most feasible management approach. However, among the leading possible invaders, little attention has been devoted to the risk posed by alien ornamental plants, which are currently being used extensively in public green spaces and private gardens for landscaping and beautification. Even though the prevailing climatic and ecological conditions could have prevented these alien ornamental plants from naturalising, the anticipated environmental and climatic changes could widen their geographic ranges. This study will use the flora of Nairobi and its vicinity as a case study. The findings will help to (1) identify the alien ornamental species with the highest risk of naturalisation that should be considered either for elimination or other restrictive actions, (2) potentially inform the development of a strategic policy framework that can be used by city managers to manage alien ornamental plants with the highest threat, and (3) aid in the realisation of Sustainable Development Goal 15 (Life on Land), that strives to reduce the impact of alien invasive species on terrestrial ecosystems.

MS NAKIGULI FATUMAH, UGANDA

Better off in the wild: A comprehensive captive-breeding and soft-release pro-

gramme for conservation and sustainable management of the endangered Barbour's Vlei rat populations in Uganda

Among over 60 *Rattus* species, Barbour's Vlei (*Otomys barbouri*) is the only endemic rat species in Uganda, restricted to their native ecosystem along the slopes of Mount Elgon. Although *Otomys barbouri* plays critical ecological roles in maintaining a balanced food web as primary consumers of plants and fungi, or as a food resource for larger predators, the species population has declined over the last two decades. The rapid decline is caused by species inbreeding depression coupled with increasing habitat fragmentation, climate change-induced extremities and arable farming activities within the species native ecosystem. Currently, the rats are considered endangered by the International Union for Conservation of Nature. The high vulnerability of the population to the aforementioned ecological threats could soon cause the extinction of this species if no drastic conservation measures are taken. This project seeks to rescue a few individuals of the Barbour's Vlei population from their threatened environments. They will be multiplied into mass numbers in the laboratory using conventional captive-breeding protocols. To increase the species populations, the captive-bred rats will be released back into different protected habitats in Mount Elgon and Mabira forest ecosystems under soft-release programmes. The project will afterwards



Girth measurement DBH (Dr Geoffrey G measuring with Chairperson of Nyamwoya Village, Mukono, writing).



Mr Calvin Rashid Kawawa Abonyo, Nairobi, identifying different alien ornamental plants.



Ms Eleanor Magwaza, Zimbabwe, applying manure.

build the capacity of local farming communities in conservation and sustainable management of the wild rat populations.

MS ELEANOR MAGWAZA, ZIMBABWE

Rainwater harvesting and nutrient intensification in maize-legume farming systems in semi-arid Zimbabwe

Agricultural productivity in Zimbabwe is declining mainly due to climate change and inherent poor soil fertility. The situation is worsened by the high cost of fertilisers beyond the reach of many smallholder farmers. In response to these challenges, most farmers are implementing either rainwater harvesting (RWH) or integrated soil fertility management (ISFM). This study seeks to investigate the role of integrating tied-contour RWH (TC-RWH) technique and ISFM on soil moisture, soil fertility, crop growth and subsequent crop yields in semi-arid areas of Zimbabwe. The stu-

dy will also determine the economic benefits of integrating TC-RWH, cattle manure and different N-levels of inorganic fertilisers. Data to be collected include soil moisture, chlorophyll, plant height, root collar diameter, crop yields, soil and plant N. The data will be analysed using Genstat 2019 version. We anticipate that integrating RWH and ISFM will improve smallholder farmers' crop productivity in comparison to where the interventions are implemented separately.

MR HABTAMU DEGEFA DEBELIE, ETHIOPIA

Wetland conversion and greenhouse gas emission in Ethiopia: The case of Cheleleka wetland

Fluxes in carbon and greenhouse gas (GHG) caused by land-use change (LUC) are crucial to understanding drivers of climate change and developing effective mitigation strategies. Cheleleka wetland in southern Ethiopia has been

converted to agricultural land since the 1970s. Such conversion is a global phenomenon and is blamed for the release of GHGs at global scale. Nonetheless, information on carbon and GHG emissions from wetland conversion in Ethiopia is limited. The main objectives of the proposed study are to identify drivers of LUC for Cheleleka wetland and quantify the impact of such conversions on soil organic carbon stocks (SOC) and GHG (CO₂, N₂O and CH₄) emissions. The study will show wetland ecosystem response to LUC and in temporal dimensions, and is expected to inform decision-making in wetland management and overall climate change mitigation.

MR WYCLIFFE LUASI, KENYA

Enhancing blast resistance in finger millet through targeted mutagenesis of ethylene response factor transcription factor gene

Finger millet is a staple food for millions of people in East Africa where it is often

grown on marginal land. Blast disease affects the crop at all stages of growth, causing failure in the grain setting and shrivelling the seeds formed, resulting in yield loss. Development of host resistance has shown to be the most effective strategy of controlling blast. Recently, site-directed nucleases have proven to be robust tools for crop improvement. CRISPR/Cas9 technology has emerged as the best genome editing tool in plants due to its efficiency and cost. This study is designed to enhance blast resistance in finger millet varieties through CRISPR/Cas9-targeted knockout of the plant ethylene responsive factor transcription factor through agrobacterium-mediated transformation. The CRISPR/Cas9 system developed in this project will pave the way for large-scale RNA-guided genome editing in finger millet to enhance its breeding to meet growing agriculture demands. Consequently, the management of blast on finger millet will have an enormous impact on Kenya's

food production, allowing the crop to play a significant role in the fight against hunger and malnutrition.

MR ATHAR HUSSAIN, PAKISTAN

Identification, characterisation and functional analysis of resistance genes in cotton

Resistance (R) genes have become the subject of great concern owing to their contribution in plant immunity. R genes are naturally found in the plant genome and translated into R proteins that conceive plant resistance against pathogens through activation of the plant immune system. Several R genes were functionally characterised that display broad-spectrum disease resistance in different crops including rice, maize, wheat, barley and potato. However, little is known about the cotton plant, one of the most important crops for production of fibre, a raw material in the textile industry. In this study, we will carry out a genome-wide

comparative analysis as well as expression profiling of the resistance gene using high-throughput computing approaches. In addition, based on expression profiling data, further functional analysis will use Virus-Induced Gene Silencing (VIGS) approaches. This study will identify all resistance genes and classify them based on functional domains in three cotton plants. Furthermore, the functional analysis will identify the putative role of R gene under pathogenic stresses. Consequently, this study will help to devise efficient cotton immunity against diseases.

DR BENJAMIN KINGSLEY HARLEY, GHANA

Phytochemical and functional investigations of Ghanaian medicinal plants used in treating human African trypanosomiasis

Human African trypanosomiasis is a disease caused by the parasitic protozoa of the *Trypanosoma* genus. Despite several efforts at chemotherapeutic interven-



Dr María Eugenia Flores-Giubi preparing extracts from *Macrophomina phaseolina* culture filtrate, concentration step with rotary evaporator.



From left: Dr Benjamin Kingsley Harley (Principal Investigator); and Mr Philip Apraku Tawiah and Mr David Neglo (Laboratory Technologists).



Dr Harouna Sore performing in vitro plasmodium parasite culture and antiparasmodial activity assessment of some synthesized compounds.



Dr Mayuri Napagoda tracking bioactive molecules in plant extracts by Liquid chromatography.

tions, the disease poses serious health and economic concerns to humans and livestock in many Sub-Saharan African countries. Several indigenous Ghanaian medicinal plants have been shown to possess anti-trypanosome properties. However, for a majority of these plants, the active metabolites and the mechanisms of their anti-trypanosomal action remain unknown. This project seeks to isolate the bioactive compounds from six such plants with known anti-trypanosomal activities and determine their in vitro effects and mechanisms against *Trypanosoma brucei brucei*. The results of this project will unearth lead molecules for drug discovery of novel therapeutic agents in African trypanosomiasis.

DR MAYURI NAPAGODA, SRI LANKA

Green synthesis of metal nanoparticles using invasive plant species in Sri Lanka for the development of effective disinfectants to nosocomial infections

The emergence of multi-drug resistant microorganisms is a global problem that demands the development of alternative antimicrobial remedies from natural sources. Metals and metalloids have been widely employed in medicine for thousands of years owing to their antimicrobial properties. In recent times, metals were found to be even more effective in antimicrobial activity at their nanoscale. The synthesis of metal nanoparticles is conventionally approached via physiochemical methods that utilise expensive and hazardous chemicals. Therefore, this study focuses on the synthesis of metal nanoparticles using non-toxic aqueous extracts of three invasive plant species in Sri Lanka. Thus, the preparation of metal nanoparticles with disinfecting properties by a greener route would be an eco-friendly, cost-effective and low-toxicity approach and also contribute to the management of invasive plant species by utilising potential commercial products.

MR HAROUNA SORE, BURKINA FASO

Synthesis and development of antimalarial transmission blocking natural products, Lophirone E and analogues for the control of malaria

Most of the drugs currently used for malaria case management are effective on



Mr Étienne Sodre (to the right) monitoring the cultivation of fodder crops on the farm of Mr Hema Aboubacary (to the left), in Tarfila (5km from Banfora). The *Brachiaria ruziziensis* fodder at the back is in the pre-drying phase. It will then continue to dry in the shade for 48 hours before being baled and stored in the hayloft (open door on the right in the photo).

parasite asexual stages but are inactive against the transmissible stages of mature gametocytes. The need to expand the arsenal of transmission-blocking drugs is widely recognised by the scientific community. Bioassay-guided fractionation of the organic extract obtained from stem barks of the African plant *Lophira lanceolata* has led to the isolation of seven biflavonoids. Among the isolated compounds, the bichalcone *lophirone E* was identified as a potent gametocytocidal agent with an IC₅₀ value in the nanomolar range against mature gametocytes and negligible cytotoxicity. *Lophirone E* proved to be about 100 times more active against *P. falciparum* stage V gametocytes than on asexual blood stages, thus exhibiting a unique stage-specific activity profile. A synthetic approach of *lophirone E* could allow the preparation of analogues to further improve the potency and optimise the drugability parameters of the compound.

DR MARÍA EUGENIA FLORES-GIUBI, PARAGUAY

*Evaluation of the effect of Macrophomina phaseolina and its metabolites on the sesame (*Sesamum indicum*) hormonal response*

Charcoal root rot of sesame (*Sesamum indicum* L.) caused by the phytopathogenic necrotrophic fungus and polyphagous *Macrophomina phaseolina*

(*Tassi*) *Goid* is a disease of economic importance that can significantly reduce production yield. Despite being a fungus that affects crops worldwide, the study of the pathogenesis mechanism has been poorly addressed.

DR YOUAN CHARLES TRA BI, COTE D'IVOIRE

Valorisation of pig manure into biogas and determination of microbiological and chemical risks related to the use of digestate as a bio-fertiliser in the peri-urban areas of Abidjan District

Côte d'Ivoire is a country lacking in animal protein. Measures to fill this gap have led to the intensification of the pig sector in the peripheral areas of Abidjan District, accounting for about 90% of Ivorian pig production. This breeding generates a large amount of manure that emits significant amounts of greenhouse gases into the environment. Raw manure is used by market gardeners as a biofertiliser without being granulated safe. It is therefore a potential health risk for the environment, animals, consumers and market gardeners. This project therefore aims to enhance the value of pig manure in Abidjan District and to identify associated health hazards. The research involving the livestock, renewable energy and culture sectors will be carried out in collaboration with a consortium of researchers from three laboratories.



Dr Manyando Simbotwe, Zambia. Sample collection.



Dr Kerfua (far left) and a district veterinary staff (far right) inspecting a cow's mouth cavity for any signs of lesions that are classic for foot-and-mouth disease.



Harvesting a Ngu tsetse fly trap in Turkana County, Kenya. Left to right: Kenya Wildlife Service ranger, Naftali Ogari, Dr Christopher Magut, Dr Winnie Okeyo.

MR ÉTIENNE SODRE, BURKINA FASO

Exploration of ways to improve milk production in Banfora's dairy basin in western Burkina Faso by codesigning with livestock farmers some innovative and agro-ecological feeding options for milking cows

Burkina Faso is struggling to meet its growing demand for milk and dairy products. Despite the diversity of resources, cows' feeding needs are not met year-round and the almost inevitable forage deficit on almost all dairy farms in the dry season leads to a dramatic drop in milk production. This project addresses this concern by co-designing innovative and agro-ecological options for feeding dairy cows in the Banfora dairy basin. Innovations will be based on the adoption of adapted forage crops in livestock farmers' crop rotations and the balanced feeding of lactating cows with rations based on cultivated forage and other locally available food resources. In the long

term, the project will strengthen the dairy production capacities of farmers by offering them forage varieties and rationing strategies to cover the optimal production needs of dairy cows.

MR MAURICE AHOZONLIN, BENIN

Diversity and resilience of Lagune cattle production systems and development of local institution frameworks for conservation and sustainable use of Lagune breed in southern Benin (West Africa)

The small-sized Lagune cattle population is widely acknowledged to be increasingly replaced by or crossbred with large zebu cattle, compromising the sustainability of cattle production in the region. Furthermore, the geographical distribution of this breed is unknown. While a few previous studies have assessed the productivity of this breed in traditional farming, they did not take

into account the potential effects of agroecological variability and of various breeding practices on performance. The in situ conservation of Lagune cattle necessarily involves the creation of a smallholders' platform for community-based management. The objectives of the current study are to (i) analyse the diversity and resilience of Lagune cattle population systems; (ii) compare the demographic parameters, productive and reproductive performance of Lagune cattle across various smallholder production systems; (iii) provide an update of the geographical distribution of Lagune cattle breed in South Benin; and (iv) promote the implementation of local institutional frameworks for conservation and sustainable use of the Lagune breed.

DR MANYANDO SIMBOTWE, ZAMBIA

Serological anthrax surveillance in wild-

life, livestock and humans in the wildlife-livestock interface areas of Zambia

Anthrax is a neglected and re-emerging zoonosis that threatens public health, biodiversity and animal populations. An estimated 63.8 million livestock farmers and 1.1 billion livestock (cattle, sheep, goats, pigs, buffalo) in Africa, Asia and Europe are at risk, and most of these are in remote and poor communities in endemic areas. Although anthrax affects a wide animal host range, it is unknown whether wildlife, livestock and humans are frequently exposed to anthrax infection and whether anthrax exposure and host immune response determine the duration and varying patterns of anthrax outbreaks. This project addresses these questions by developing and evaluating a non-species-specific *Bacillus anthracis* protective antigen enzyme-linked immunosorbent assay to detect antibodies in humans, livestock and wildlife. Findings from the cross-species comparisons of the seroprevalence of protective antigen antibodies will give novel insights into anthrax exposure patterns and immune responses of various hosts. The study will also offer an inexpensive tool that can be used in resource-limited settings.

DR WINNIE OKEYO, KENYA

*Population structure of *G. pallidipes* in Turkana and West Pokot counties in Kenya*

Tsetse flies are the main insect vectors responsible for transmission of the trypanosome parasite, causative agent of Human (HAT) and Animal African Trypanosomiasis (AAT). Both diseases cause economic losses owing to the morbidity and mortality of humans and animals. To date, no vaccines exist against HAT and AAT, while available drugs for HAT treatment are expensive and difficult to administer. Vector control of the diseases has proven viable, as shown by the success on Zanzibar Island, owing to genetic isolation of this population. This has informed the need to understand the dynamics of genetic diversity of *G. pallidipes*, the most widely-spread tsetse species in Kenya. Previous work concentrated on populations along the Kenya-Tanzania border. However, *G. pallidipes* populations in Northern Kenya have not been analysed to create a clear picture of the genetic connectivity of *G. pallidi-*

pes Kenya-wide. This study will update what is known about the current genetic structure of *G. pallidipes* in Kenya and will inform the mandated control bodies on the best strategy to employ control efforts for most effective control.

DR DEBORAH RUTH AMULEN, UGANDA

Using molecular profiling of the bee gut microbiome for evidence-based honeybee health and nutritional management in Uganda

Beekeeping offers numerous benefits, such as additional income, food and medicines. However, Ugandan beekeepers have only been able to exploit 1% of their honey production potential. Limited beekeeping husbandry knowledge and honeybee diseases, as well as unexplained honeybee colony declines, are reported as barriers to increased honey production. Hence, the need to understand drivers for bee colony declines in Uganda is critical to boosting bee-related activities. This study aims to document the status of honeybee gut microbes through characterisation of beneficial and pathogenic honeybee microbes, and comparison of abundance level and diversity across areas of high-risk agrochemical use and near-natural environments. This knowledge will provide baseline data on the microbial communities, and potential pathogens found in Ugandan honeybees, with the aim of developing honeybee health and nutritional management plans which beekeepers can adopt.

MS SUSAN DIANA KERFUA, UGANDA

Evaluation of immune response of 6-12 month-old calves to serotype O strain of the foot-and-mouth disease trivalent vaccine used in Uganda

Highly-contagious foot-and-mouth disease (FMD) affects cloven-hooved animals with serious economic consequences for farmers and governments. The Aphthovirus exists in seven serotypes that do not cross-protect. Uganda has had up to six serotypes in circulation with serotype O being the most prevalent. The vaccine currently used has only serotypes O, SAT 1 and SAT 2, while cross-protection between strains

within a serotype can be incomplete. The Government of Uganda spends US\$ 58,000 to 1,088,820 per annum on vaccination and the country is at stage 2 of the Progressive Control Pathway for FMD (PCP-FMD). However, the efficacy and effectiveness of vaccines used in the country have not been extensively studied, even though antigenic differences between the FMDV strains in the trivalent vaccine have been detected compared to recently circulating Ugandan viruses. This study will characterise the post-vaccination antibody responses of 6-12 month-old calves over an eight-month period to determine what protection can be expected.

MR AUGUSTINO CHENGULA, TANZANIA

Surveillance and molecular characterisation of Marek's disease virus (MDV) strains circulating in Tanzania

Marek's disease (MD) is an oncogenic viral disease of poultry responsible for economic loss due to both mortality and depressed performance. The evolution of Marek's disease virus (MDV) has been reported at alarming rates in poultry houses, overcoming even the vaccinated poultry and leading to disease. The aim of this research is to improve the control of MD in Tanzania through proper selection of vaccine matching to the circulating MDV strains. This will be accomplished by detecting and characterising all the MDV virulent strains circulating in the country by using molecular techniques and comparing them with the vaccine currently in use. This information will be useful for vaccine manufacturers and users.

A selection of new individual research grants given in 2020

2. Water and Aquatic Resources

According to the World Bank, 2.8 billion people live in areas of high water stress, which takes many forms. At least 1.2 billion people do not have access to safe water, and pollution of water affects not just people but whole biological communities. Some of IFS's projects that relate to good water management are highlighted here, as well as projects related to sustainable use of natural aquatic resources.

MS NOOR UL AIN, PAKISTAN

Fabrication of novel plant-based copolymers and their scrutinisation as xenobiotic remediators for pharmaceutical and textile wastewater effluents

Industrial wastewater effluents are enriched with excess levels of xenobiotic compounds that in turn cause serious environmental issues if disposed of untreated. In Pakistan, the situation is alarming, with a rapid decline in water quality. There is a need to devise economical and effective wastewater treatment strategies that could be implemented for removal of xenobiotics from pollution-causing pharmaceutical and textile effluents before being discharged in water bodies.

DR CHUKWUEBUKA EMMANUEL UMEYOR, NIGERIA

Development and quality evaluations of nanoemulsions of Moringa oleifera seed extracts for water purification

Clean water is an essential human daily need for drinking, cooking and sanitation. The availability and supply of potable water remains elusive, especially in Sub-Saharan Africa, where life-threatening health risks due to consumption of contaminated water kill about 485,000 people annually. Since chemical disinfection of water is expensive and is associated with substantial systemic toxicity and undesirable effects, the use of inexpensive, safe and readily available seed extracts of *Moringa oleifera* (known for

its high content of hydrophilic cationic coagulant protein) for water purification becomes exciting. Therefore, the aim of this project is to develop nanoemulsions of seed extracts of *M. oleifera* and carry out quality evaluations for their use in water purification. It is expected that stable nanoemulsions of *M. oleifera* seed extracts with desirable physicochemical properties will be formulated, and purified water that meets WHO standards will be obtained.

DR LEVY MICHAEL OTWOMA, KENYA

To assess the effect of overfishing on the genetic diversity of commercially important reef fishes in Kenya

Despite increasing evidence that the effects of overfishing can contribute to shifts in species diversity and abundance, few empirical studies have documented the consequences of overfishing on genetic diversity of marine species. This is risky, because the effective population of marine fishes can be much lower than their census abundance. Differences in exploitation rates of wild marine fishes provide an opportunity for comparing genetic diversity of overexploited and underexploited species that are closely related. Because genetic diversity is expected to be similar in such species, close relatives that have not been overexploited can provide a baseline for historical genetic diversity. In this project, we use microsatellites to compare the genetic diversity and connectivity of overexploited reef species (*Siganus*

sutor and *Lethrinus lentjan*) with their underexploited congeners (*Siganus rivulatus* and *Lethrinus harak*). Overall, this study seeks to provide compelling evidence by showing the effects of overfishing on genetic diversity of commercially important reef fish species.

DR MOUSSA DJAOUA, CAMEROON

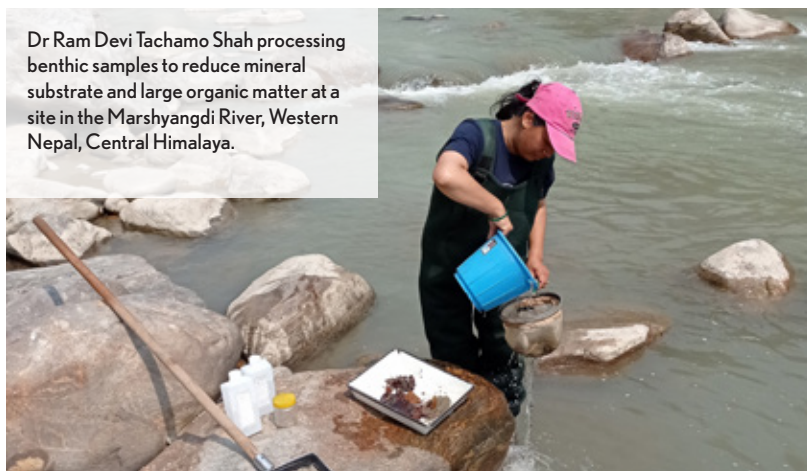
Monitoring water sources for environmental reservoirs of Vibrio cholerae with its O1 serogroup and toxigenic subpopulations in the cholera endemic areas of north Cameroon

This project will investigate water sources in the cholera endemic areas of north Cameroon for contamination with *Vibrio cholerae* O1 with pathogenic potential, to highlight their role in disease transmission. The recurrent cholera outbreaks in north Cameroon point to the existence of hotspot cholera potential reservoirs, including polluted surface water and groundwater. The question is how the persistence of pathogenic *V. cholerae* O1 in the water sources determines the cholera outbreaks in the region. In a prior research project, we showed that some well and stream water sources of the region are positive for culturable *V. cholerae*. All the collected isolates were *V. cholerae* non-O1. However, it was found that non-O1 environmental strains are both attached to particles or hosts as well as free living and readily culturable, while pandemic-related *V. cholerae* O1 are mostly as particle/host-associated

Ms Noor Ul Ain, Pakistan.
Adsorption kinetics of biopolymer-treated wastewater by UV-Visible Spectrophotometer.



Dr Ram Devi Tachamo Shah processing benthic samples to reduce mineral substrate and large organic matter at a site in the Marshyangdi River, Western Nepal, Central Himalaya.



Dr Levy Michael Otwoma, Kenya. A fisherman's catch composed of the study target species *Lethrinus lentjan* and *Lethrinus harrak*.



Dr Chukwuebuka Emmanuel Umeyor in his institution's Natural Products Laboratory preparing dried *Moringa oleifera* seeds for extraction of oil and protein.

and in a non-culturable state. Since the epidemiology of cholera is closely linked to the ecology of *V. cholerae* in the environment, an understanding of the conditions that support its persistence and multiplication is crucial for public health protection. The urgency of this project is that at this particular moment the influx of Nigerian refugees is affecting the management of water resources and this allows us to point out environmental niches of toxigenic *V. cholerae* O1 in real time to better prevent cholera outbreaks.

DR DJIDJOAH MATHIEU MAURICE AHOANSOU, BENIN

Ecohydrological modelling for the understanding of pollutants transfer dynamics in Hlan River Basin, Southern Benin

Increased agricultural and urban development has increased chemical pollutants and sediment fluxes in many watersheds worldwide. High pollutant concentrations could negatively affect water quality in

aquatic systems, adversely affecting ecosystems through eutrophication, acidification and ground water contamination, all of which subsequently lead to a loss of biodiversity. In Hlan River Basin, deforestation due to agricultural activities and increasing demand for settlement in the upper Hlan catchment were observed as threats to water quality in the Hlan River system. Furthermore, existing food industries in the catchment are polluted by discharging wastewater. There is an urgent need to identify the major pollutants and their sources, and to analyse the pollutant and contaminant behaviour in the Hlan River Basin with regards to its hydrological processes for better natural resources conservation. The main objective of this research is to understand the dynamics of water quality parameters using in situ measurement and a semi-distributed modelling approach, with a particular accent on the filter role of wetland where anthropogenic activities are important. This project will study the role of hydrological processes in

the transport of pollutants and sediment and also the filter role played by wetlands and swamp forest.

DR RAM DEVI TACHAMO SHAH, NEPAL

Development of assessment tool for evaluating the impacts of hydropower dams on aquatic biodiversity

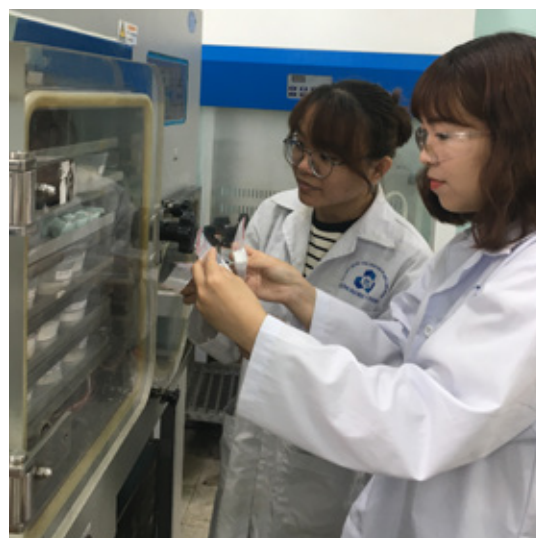
Today, river ecosystems are largely fragmented due to dams or diversion schemes to supply water for drinking, irrigation, industrial uses and energy production. Over three-quarters of large global rivers are modified and nearly no free-flowing rivers remain in developed nations. With abundant water resources, Nepal is not an exception, where the government has prioritised water resources development as key for economic growth. As a result, many rivers are either dammed or in the process of being dammed, maximising human benefits and altering flow regimes and river characteristics that imperil aquatic habitats



Analysing parameters in-situ in the field (water temperature, pH, DO, salinity) and collecting water samples for lab analysis. Left to right: Le Huu Hiep, Dr Luu Duc Dien, Nguyen Van Ba (farmer).



Dr Emmanuel Delwin Abarike and assistant inspecting fish to be used for stocking in culture tanks.



Dr Ngoc Do Queyen Chau and student discussing conditions for making aerogels, with freeze-drying machine in background.

and biodiversity, with potentially irreversible and unquantifiable costs. Therefore, timely interventions to preserve the aquatic biodiversity and to maintain river health are imperative. In this regard, a bioassessment tool can evaluate the impacts of infrastructure on river health and aquatic biodiversity. Among others, macroinvertebrates are considered as good bioindicators because their abundance and diversity change with the intensity and frequency of impacts on river systems. The majority of sensitive macroinvertebrates are reophiles whose assemblages depend on fast flowing water. The developed method will help water developers and conservationists ensure the ecological integrity of river ecosystems. This tool will be instrumental for policy formulation to achieve sustainable water resources management in Nepal.

DR CYRUS RUMISHA, TANZANIA

Genetic analysis to improve management and conservation of the endangered East African wedgefishes and their habitat

Due to rapid human population growth in recent decades, the price and demand for fish in East Africa have increased dramatically. This has led to increased pressure on fishery resources and increased incidences of illegal fishing, overfishing and habitat degradation. Hence, fish stocks have declined and the important species are disappearing. Since they grow slowly, produce few young, and their fins hold the highest value of all fins in international markets, the populations of the whitespotted wedgefish (*Rhynchobatus djiddensis*) and the bottlenose wedgefish (*Rhynchobatus australiae*) have declined by more than 80% in the last three decades. Although they should not be

traded internationally without CITES permits, processed products of these fish are still supplied illegally to international markets since they cannot be easily identified by law enforcement due to the lack of key morphological identification features. Also, East African countries are increasing the number of marine protected areas (MPAs) in areas occupied by these fish but the stock structure and the patterns of genetic connectivity among the MPAs are largely unknown. Hence, it is not known whether these fish should be managed as a single randomly-mated stock or if there are genetically isolated stocks that should be treated as separate management units. This project will use molecular markers to expose the illicit trade networks and identify appropriate management units and the priority areas for fish sanctuaries.

MR ROMUALD HOUNYEME, BENIN

Modelling by bayesian networks of the ecological resilience of a tropical hydro-system with multifactorial vulnerabilities: The case of Lake Nokoué

Much current research on continental hydrosystems refers to the concept of the stability of the functioning of aquatic ecosystems and their resilience. This study will infer the structure of a Bayesian network whose parameters are the proven functional diversity needed to provide information on the processes operating within the ecosystems and the synergistic interaction of cumulative impacts of anthropogenic pressures. The different nodes of this network will be represented by multiple variables perceptible to various types of anthropogenic degradation, testifying to the diversity and ecological functioning of the environment. The aim of the research is to associate bioinformatics with ecology to better understand the functioning of Lake Nokoué, a lake ecosystem in a highly disturbed tropical zone. It will include i) studying the dynamics of functional diversity of fish and macrobenthic communities and their potential roles in the functional stability of the studied hydrosystem; ii) highlighting the effects of cumulative impacts of pressures on resilience; and (iii) modeling of ecological resilience capacity, centered on various functional interactions of communities in relation to the cumulative set of different pressures described. Beyond the important scientific, environmental and societal issues involved in this project, it will provide future managers of aquatic and halieutic resources with a rational management tool for the lake.

MR WORKIYIE WORIE ASSEFA, ETHIOPIA

Development of macroinvertebrate-based multimetric wetland index of biotic integrity for assessing wetland ecosystems health in Upper Blue Nile Basin (West Gojjam), Northwest Ethiopia

Little is known about aquatic macroinvertebrate assemblage in the wetlands of the Upper Blue Nile Basin despite their important ecology services and value as ecosystem health indicators. The sustainability of wetlands will not be

ensured unless continuous monitoring is conducted using fast, integrative and cost-effective ecological indicators such as macroinvertebrates. Therefore, the objective of the study is to develop a multimetric wetland index of biotic integrity (W-IBI) and to investigate the spatial and temporal dynamics of macroinvertebrate assemblages. The outputs of this study will contribute to the sustainable management of wetland ecosystems, and to the development of taxonomic keys and guides for macroinvertebrate identification in Ethiopia.

DR LUU DUC DIEN, VIETNAM

The interaction between integrated rice-shrimp ponds with adjacent waterways in Bac Lieu Province, Vietnam

Rice-shrimp farming in Vietnam's Mekong Delta is under rapid development. However, there are serious warnings about organic pollution in some high-density culture areas which may threaten sustainable development of rice-shrimp farming and normal functioning of the river. Therefore, it is important to study the type, level and origin of organic pollution from integrated rice-shrimp ponds (IRSPs) to maintain sustainable development of rice-shrimp farming, since the IRSPs themselves are dependent on the health of the Mekong River. This project aims to assess (i) the impact of waste discharge from IRSPs on the health of the water environment in Bac Lieu Province, and (ii) the dependency of rice-shrimp farming practices on adjacent waterway quality. This research will help to understand more clearly the nature of organic pollution in the IRSPs in Bac Lieu Province so that the responsible agencies will be able to assess organic pollution at incipient levels, allowing for timely action.

DR EMMANUEL DELWIN ABARIKE, GHANA

Contribution of a mixture of extracts of guava, bitter and pawpaw leaves in improving growth, hematology, immunity and resistance to Streptococcus agalactiae outbreaks in Nile tilapia (Oreochromis niloticus)

The production of Nile tilapia (*Oreochromis niloticus*) in recent times has suffered losses from pathogenic infection

(particularly *Streptococcus agalactiae*), reported to cause up to 70% mortality in fish stocks. However, with associated undesirable effects of antibiotics and hormonal use in controlling diseases in fish, herbs such as guava leaves (GL), pawpaw leaves (PL), and bitter leaves (BL) have been reported to be suitable alternatives to combating pathogenic diseases. Although studies have been conducted on GL, PL and BL in fish culture, still necessary are studies geared towards determining (1) the possibility of synergistic effects using herbal mixtures, (2) the influence of herbs on physiology and histological parameters, and (3) the optimal dose of herbal mixtures for use in fish culture. It is hoped that the findings of this study will be communicated to fish farmers, and fish feed and fish drug producers, to help promote research and the application of these herbs to improve tilapia production. It is expected that the mechanism of action and optimal dose of a mixture of GL, BL and PL in promoting growth, hematology, immune function and disease resistance will be ascertained.

DR NGOC DO QUYEN CHAU, VIETNAM

Advanced fabrication of aerogel from graphene oxide and cellulose for wastewater treatment

Heavy metals are known to be highly toxic and non-biodegradable, and to cause organ damage and cancer in humans. There is an urgent need to eliminate heavy metals from contaminated water sources before they are released into the environment. In addition, with the growth of the petroleum industry and the necessity of marine transportation, oil spills have become a greater threat to the water ecosystem. Moreover, organic dyes are also pollutants in wastewater due to the development of the textile and garment industry in recent years. Therefore, our research focuses on the fabrication of aerogel from graphene oxide, a suitable material for water treatment, in combination with cellulose-based materials from agricultural waste. The result of this research will contribute significantly to the treatment of oil, organic dye and heavy metal ions that contaminate water in Vietnam.

DR HO HUU LOC, VIETNAM

Evaluating and mapping of ecosystem services associated with sustainable urban drainage systems (SUDS): A case study in Ho Chi Minh City, Vietnam

Ho Chi Minh City (HCMC) is frequently prone to flood risks emerging from both natural factors such as high tides and heavy rainfall, and human activities such as urbanisation leading to the degradation of drainage capacity. The city has seen an increase in its impervious surface area in the central districts, dramatically reducing the surface infiltration capacity. The risks are expected to be exacerbated by climate change. Besides mega-investments in flood control infrastructure, HCMC has started to explore SUDS, the focus of this project. In addition to flood mitigation, SUDS consider environmental, social and economic pillars in the design process, thus simultaneously achieving multiple benefits alongside flood mitigation. These

include removing pollutants from runoff, cleansing the ambient air, reducing urban heat island effects, enhancing aesthetics, and even supporting urban wildlife habitat and biodiversity. SUDS benefits are harder to measure and associate with the primary function of flood reduction. This study will develop a framework to evaluate SUDS benefits using the ecosystem services approach, which is an established method to measure nature-derived human benefits using a mixed-method approach. The project outcomes will benefit HCMC residents by acknowledging the benefits of SUDS while providing valuable research experience for those involved.

MS FLORA CHIRIKONA, KENYA

Adsorption of perfluoroalkly acids from wastewater onto water hyacinth-based nanofibers: Thermodynamics, kinetics, isotherms and mechanisms

Conventional wastewater treatment

technologies have been shown to be inefficient in removing toxic perfluoroalkly acids (PFAAs). This study will investigate the efficiency of water hyacinth-based TiO₂ and MgO impregnated nanofibres in adsorption of perfluoroalkly acids from wastewater and to study the thermodynamics, kinetics, isotherms and mechanisms. The study will further compare adsorption abilities of water hyacinth nanofibre adsorbents to commercial powdered activated carbon and also determine levels of PFAAs in Nairobi River water basin. The findings will inform and provide alternative green technologies for sustainable management of toxic PFAAs. The utilisation of water hyacinth will help in sustainability of surface water resources as well as to control the weed.

DR NGÔ ANH DÀO HỒ, VIETNAM

Study on removal of Natural Organic Matter (NOM) from surface water by



Mr Dawit Hawaria, Ethiopia, conducting larval survey.



Ms Flora Chirikona, Dr Kimosop and Emily after sample collection in Nairobi river.



Dr Ho Huu Loc, Vietnam. Water quality sampling.



Dr Ho Huu Loc, Vietnam. Air quality sampling.

using coagulation and flocculation to mitigate the formation of chlorine disinfection by-products: A case study of Thu Duc Water Treatment Plant, Ho Chi Minh City, Vietnam

The reaction between natural organic matter (NOM) in water and chlorine during disinfection poses a threat to form trihalomethanes, which are commonly classified as a carcinogenic disinfection by-product (DBP). In Vietnam, most water treatment plants use traditional technologies for the process and the issue of DBPs has not been considered. Thus, this study will investigate the removal of NOM from surface water collected from the raw water intake station of Thu Duc Water Treatment Plant in Ho Chi Minh City by using Jar-test experiments as a simulation of coagulation and flocculation. A detailed comparison in terms of technical and cost aspects of three coagulants is expected to result, useful as data for local authorities in the control and assessment of water quality before distribution into the water supply network.

MR DAWIT HAWARIA, ETHIOPIA

The impacts of water source development on the malaria vector bionomics and diseases transmission, Ethiopia

Irrigated agriculture is key to increasing agricultural productivity and ensuring food security in Sub-Saharan Africa. Construction of dams and irrigated farms have been widely recognised as solutions to promoting food security and alleviating poverty. In Ethiopia, a number of dams and irrigated farms have been developed in the past decade, with many under construction and more being planned. Such development projects are anticipated to cause major changes in the ecology of malaria vectors and disease epidemiology. However, how the vector ecology changes alter disease transmission dynamics has not been investigated for many newly-established irrigation developments. Ideally, what is needed are new intervention approaches that can effectively suppress malaria transmission while simultaneously increasing agricultural productivity. Thus, the objective of this project is to examine the impact of environmental modifications from water source development projects

on vector ecology and malaria transmission at the newly-established Gidabo irrigation scheme in Ethiopia. The project will provide important information on the impact of environmental modifications on malaria vector species composition, population dynamics, vectorial capacity, and quantify transmission intensity at the study site. The study results will provide baseline information for the development of improved disease intervention approaches while implementing development projects that ensure food security.

DR ETEFA GUYASSA DINSSA, ETHIOPIA

Interaction between exclosure and hydrological processes in dryland mountainous environments: Perspectives for irrigation stormwater runoff on reforested areas, northern Ethiopia

Recovery of degraded land through the establishment of exclosures (areas set aside from human and livestock interference to restore natural resources and ecological restoration) has become a key process in the improvement of forest ecosystems. Despite the extensive period of their establishment, vegetation growth in exclosures is constrained in northern Ethiopia. In addition, limited investigations are available on their linkages with catchment hydrological processes. Hence, this project will 1) assess exclosures that are suitable for spate irrigation with stormwater runoff diverted from streams, 2) create relationships between exclosure characteristics and hydrological processes, and 3) examine net primary productivity of exclosures with different characteristics and stormwater management. Data will be produced to understand the dynamic interaction between restoration and catchment hydrology, and the effects of management on the productivity of exclosures in northern Ethiopia and in dryland environments in general.

A selection of new individual research grants given in 2020

3. Food Security, Dietary Diversity and Healthy Livelihoods

Food security exists when people have access at all times to sufficient, nutritious food in order to lead active and healthy lives. There are many angles to food security – food safety, nutrition, and simply securing entitlement to food. Below are some projects from the IFS research area on Food Security, Dietary Diversity and Healthy Livelihoods.

DR MARIAMA NGOM, SENEGAL

Restoration of the fertility of degraded arable lands in Senegal by integrating Casuarinaceae nitrogen-fixing trees into agricultural crops

Land degradation is a global environmental issue with devastating consequences for food production and human well-being. Senegal faces a serious problem of arable land degradation due, among others, to long periods of monoculture with no fallow periods and strong anthropogenic pressure on natural resources. Given that arable land represents only 19% of the national territory and that the Senegalese population has almost tripled in 50 years, there is a need to restore the fertility of these degraded soils and ensure livelihood security in rural areas. Agroforestry practices in which nitrogen-fixing trees are integrated into agricultural crops are one of the sustainable strategies to restore the fertility of degraded land. Fast-growing nitrogen-fixing trees belonging to the *Casuarinaceae* family are pioneer plants, able to colonise disturbed soils and increase their fertility, thanks to their capacity to establish symbiotic associations both with mycorrhizal fungi (arbuscular and ectomycorrhizal) and the nitrogen-fixing bacteria Frankia. In Senegal, *Casuarinaceae* are mainly used for sand dune stabilisation and the rehabilitation of salt-degraded land. This project will (i) study the effect of *Casuarinaceae*-crop intercropping on the growth and productivity of associa-

ted agricultural crops, (ii) evaluate the impact of intercropping on the physico-chemical properties and microbiome of the soil, and (iii) assess the effect of intercropping on the biological quality of the soil using nematodes as bio-indicators.

MS ONJA HASINAHARY RATSIAIOSIKA, MADAGASCAR

Intensification of soil ecological functions to enhance the resilience of rainfed rice cropping systems to rainfall reduction

Agroecology is based on the intensification of ecological processes in agrosystems. In tropical regions where smallholder farmers develop their crops on fragile and poor soils, with low available chemical inputs and under climate change, agroecological transition is particularly important. Agroecological practices optimising functional biodiversity aboveground are widely recognised as beneficial to mitigate climate change, whereas little information is available about belowground (soil) biodiversity and functions. However, soil organisms have high potential to promote multiple ecological functions, enhancing ecosystem services and resistance, and resilience of agrosystems to agricultural shocks. In the context of climate change predicting a rainfall reduction in most tropical regions, it appears crucial to optimise soil ecological functions to reintegrate sustainability and to develop crop resilience in rainfed agricultural systems. Recently, an on-going research project allowed testing

in real field conditions of the rehabilitation of soil ecological functions in rice rainfed systems through practices co-designed by farmers and scientists. Besides measuring agronomic and ecological performances of those practices, our aim is also to measure their resilience to climatic stress. Thus, we propose to develop a rainfall exclusion system to measure the resilience of soil function restoration practices to climatic stress to identify best practices to suggest to farmers.

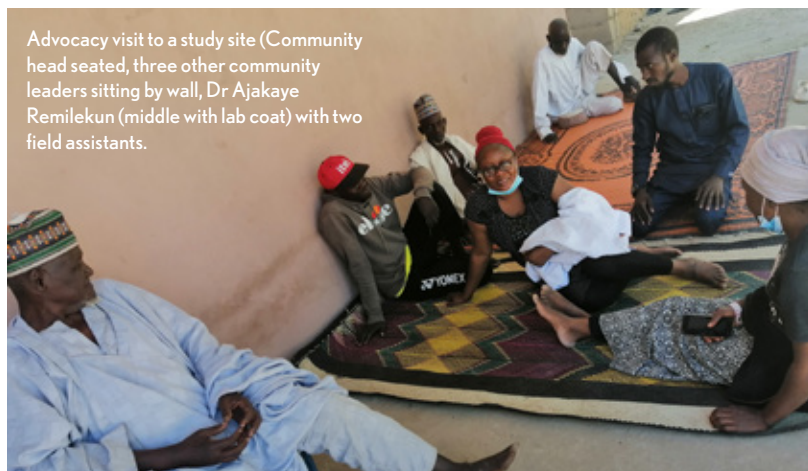
MS BAL KUMARI OLIYA, NEPAL

Evaluation of genetic diversity using molecular and phytochemical marker, anti-cancer activity and in vitro propagation of Paris polyphylla Smith in Nepal

Paris polyphylla Smith is a well-known herbal medicine with proven therapeutic potential and listed as vulnerable by the IUCN. The rhizome of this herb is widely used in traditional medicine to treat fever, headache, back pain and bleeding, and for poison neutralisation. Steroidal saponins are the main chemical constituents of this plant's rhizome, which account for more than 80% of the total compounds. Steroidal saponins isolated from this herb showed structural diversities with proven bioactivities including antitumor, hemostatic, immunotropic, anti-inflammatory and analgesic properties. Since there exists variability in the active constituents of the same plants growing under different environmental conditions, understanding genetic di-



Dr Ruth Lindizyani Mfune doing serology analysis (screening serum for brucellosis using the Rose bengal test).



Advocacy visit to a study site (Community head seated, three other community leaders sitting by wall, Dr Ajakaye Remilekun (middle with lab coat) with two field assistants.



Ms Gaby Monteiro, Mozambique. Cell culture inspection of the flasks for cell monolayer confluency.



Ms Iqra Sarfraz, Pakistan. Microscopic observation with lab fellow Farzana Sharif for the identification of histopathological alterations in mouse tissues for toxicological evaluation of PKM2 inhibitors.

versity and population structure of this vulnerable plant species is important for assessing extinction risk, setting up conservation plans and use in sustainable global development. Therefore, the objective of this project is to understand the linkage between phytochemical and genetic variation, screen phytochemically potent germplasm, investigate anticancer activity, and develop a protocol for in vitro propagation.

MS IQRA SARFRAZ, PAKISTAN

Transforming fruit waste biomass into health dietary supplements for cancer treatment

The development of cancer-specific therapeutics has been limited because most healthy cells and cancer cells depend on common pathways. Recent evidence suggests that targeting cancer metabolism may offer selectivity in cancer treatment. Thus, therapies targeting novel modes of action are greatly needed. Targeting

tumour metabolism may offer a selective and effective anti-cancer therapy because metabolic enzymes could be easier targets as correlated to signaling proteins and transcription factors. It may be likely to identify inhibitors to achieve broad therapeutic windows for the treatment of cancer as correlated to conventional chemo-therapies. A promising novel anti-cancer drug target is Pyruvate Kinase M2 (PKM2), which predominantly over-expresses in a number of tumour types, and its inhibition results in decreased tumour growth and metastasis. Therefore, the aim of this project is to identify potent inhibitors of PKM2 from fruit waste biomass, prepare the enriched extracts of PKM2 inhibitors by using green chemistry approaches, and demonstrate their therapeutic value for cancer treatment. These enriched extracts of PKM2 inhibitors with other therapeutic drug combinations will counteract drug resistance and maximise clinical efficacy. This drug discovery approach represents

a paradigm shift to develop new therapeutics, ultimately addressing concerns of cost, toxicity, non-selectivity and resistance of available chemo drugs, which have restricted their widespread application and efficacy.

DR RUTH LINDIZYANI MFUNE, ZAMBIA

Characterisation of human and bovine Brucella species in Southern and Western Provinces of Zambia

Brucellosis is an infectious zoonotic disease that affects humans, domestic livestock and wildlife, ranking 10th among diseases that impact poor people. In Zambia, brucellosis is prevalent in traditional cattle in Southern (14-22%) and Western (17.9-22.18%) Provinces as well as in humans (5.03%). There is scarce information on which *Brucella* species and strains are circulating in humans and animals in Zambia because most of the studies have focused more

on seroprevalence in cattle and wildlife than humans. The study will estimate seroprevalence, undertake phenotypic and genotypic characterisation of the *Brucella* isolates from humans and cattle, compare the isolates' genetic relatedness, and evaluate the antimicrobial susceptibility status of the human isolates to the WHO-recommended antibiotics for treatment of brucellosis. At the end of this study, the *Brucella* species and biovars circulating in Zambia will be identified, and their genotypic relationship with those existing in the region and internationally will be known.

DR OLUWAREMILEKUN AJAKAYE, NIGERIA

Molecular investigation of hybridisation between livestock and human schistosomes parasites in wetlands used by pastoralists in Nigeria

Nigeria has the highest prevalence of the neglected tropical disease schistosomiasis, caused by *Schistosoma* species of parasitic worms. Reports of hybrid human-livestock *Schistosoma* species infecting patients have increased interest in schistosomiasis research. The evolution of *Schistosoma* hybrids is of public health concern due to its potentially significant impact on diagnosis, degree of virulence, drug resistance and host specificity. Different factors such as climatic change, increasing demand for water and increased animal production have resulted in the sharing of water bodies by both livestock and humans and this practice has been incriminated in the evolution of *Schistosoma* hybrids. Pastoral wetlands are ideal foci for hybridisation of schistosome parasites in Nigeria due to increasing usage of wetlands as water sources for both humans and livestock during the dry seasons characterised by a shortage of food. The WHO's goal to eliminate schistosomiasis as a public health problem in multiple countries in Africa by 2020, and globally by 2025, can be hampered by significant gaps in epidemiological data. For the first time in Nigeria, this study will use DNA sequencing techniques to investigate the occurrence and transmission dynamics of hybrid *Schistosoma* species among pastoralists, their livestock, intermediate snail hosts and environmental DNA in wetlands in Nigeria. It is expected that

this study will provide an insight into the molecular epidemiology of hybrid *Schistosoma* parasites in Nigeria.

MS MULEMBA SAMUTELA, ZAMBIA

Carriage and characterisation of Staphylococcus aureus from pigs and humans in Lusaka Province of Zambia

Staphylococcus aureus is a commensal opportunistic pathogen present in both healthy and diseased humans and animals. It causes several diseases including pneumonia, septicemia, and skin and soft tissue infections. Its medical importance has been heightened by the emergence of resistance to antibiotics resulting in methicillin-resistant *Staphylococcus aureus* (MRSA). MRSA is among the important causes of hospital- and community-acquired infections worldwide. Recently, MRSA emerged among livestock and has been described as Livestock-associated-MRSA (LA-MRSA). Studies of LA-MRSA have shown that it is prevalent in a wide range of animal species and significantly colonises and causes infection in farmworkers and other individuals with professional contact with livestock. These persons are presumably the source of LA-MRSA transmission to household members and their associates. However, there is sparse information about LA-MRSA strains circulating in African countries, including Zambia. Therefore, this study will determine the phenotypic and genotypic characteristics of *Staphylococcus aureus* isolated from pigs, farmworkers and other high-risk individuals in Lusaka Province. The results of this study will give an insight into the epidemiology of *S. aureus* in pigs and high-risk individuals. This will make it possible to trace the zoonotic potential of *S. aureus* (including MRSA) among these individuals, thereby strengthening the control and prevention strategies of *S. aureus* infections in Zambia.

MS GABY MONTEIRO, MOZAMBIQUE

Development and validation of a novel virus neutralisation test for Rift Valley Fever diagnoses

Zoonotic vector-borne diseases such as Dengue, Chikungunya and Rift Valley Fever (RVF) have emerged in Mozam-

bique, related to deforestation, intense globalisation, unplanned urbanisation and global warming. This project focuses on RVF Virus (RVFV), a neglected infectious disease in Africa. The real threat posed by RVFV, coupled with the fact that there are no effective licensed vaccines for human use, clearly illustrate the need for more RVFV diagnosis and vaccine research. This project will study the potential of an attenuated virus as an alternative resource for Serum Neutralisation Test, the gold standard test for RVFV confirmation diagnoses. The classical VNTs make use of a virulent RVFV and therefore have to be performed in BSL-3 laboratories. This project will develop a novel VNT that is based on the attenuated recombinant RVFV. This novel test can be performed in a BSL-2 laboratory, making it suitable for other virology laboratories in Mozambique and Sub-Saharan Africa. The results from this project will contribute to building capacity in diagnosis and consequently increase our preparedness for prevention and control of RVFV in the event of an outbreak. In addition, this study will open new perspectives for research on RVFV and other vector-borne diseases.

DR JULIUS MUGWERU, KENYA

*Population genetics of Honeybee (*Apis mellifera*), and the bacterial disease American Foulbrood in bee farming areas of Embu, Kenya*

The rate of decline of honeybees is alarming given their vital role in the ecosystem. They are threatened by a myriad of diseases that are caused by bacteria, fungi or viruses. Among the bacterial pathogens, American Foulbrood (AFB) is the most pernicious bacterial disease of honeybees that results from the extreme persistence of the endospores of the causative agent *Paenibacillus larvae*. It exclusively infects the honeybee at the larval stage as early as 12 hours after hatching during capping. The honeybee larvae are infected when they are fed by nurse bees on feed that is contaminated with *P. larvae* spores. Although subtyping techniques and molecular characterisation have been used in differentiating the *P. larvae* strains, no efforts have been made to genotype the *Paenibacillus larvae* in Kenya. Within the *P. larvae*, four

genotypes have been identified using the Enterobacteriaceae repetitive intergenic consensus primers on the basis of repetitive element PCR designated as ERIC I-IV. These genotypes also show phenotypic differences that include their virulence. Kenyan bee farmers have reported a decline and collapse of bee colonies, but the cause is not clear. Furthermore, the abundance and distribution of bees, as well as their pathogens in Kenya, are yet to be mapped out. This information is important if remedial measures are to be developed to deter further population declines and avert potential food crises.

DR AGGREY GAMA, MALAWI

Integrating quinoa into the African diet

Quinoa has been recognised by the FAO as a useful crop in global efforts to eradicate hunger and malnutrition because of its high nutritive value and ability to adapt to different ecological and climatic conditions. As a result, quinoa has been introduced in Africa. In some African countries like Malawi, quinoa varieties have already been released, and yield is even much higher than that of maize. Therefore, incorporating quinoa into the diet of most Africans (maize-based stiff porridge) can help in achieving food and nutrition security. However, this could be possible only if the stiff porridge containing quinoa is acceptable. Therefore, this study will determine the extent to which quinoa flour can be incorporated into maize-based stiff porridge without compromising consumer acceptability. The study has the potential of promoting production and consumption of quinoa in Africa, which may eventually help in reducing prevalence rates of malnutrition in the region. The study will also provide more insights into the personality traits of consumers to guide appropriate food consumption-related promotional strategies, not just for quinoa but also many other food sources like bio-fortified crops.

DR STELLAH BYAKIKA, UGANDA

Starter culture development and improvement of safety of commercially produced Bongo, a fermented dairy product from Uganda

Bongo is a traditional fermented drink from Uganda made by spontaneous fermentation of cow's milk, responsible

for its inconsistent quality and short shelf life. It is also noteworthy that some processors use un-boiled milk which also comprises consumer safety. Bongo, originally consumed in rural areas, is gaining popularity among urban dwellers. Consequently, there is increasing haphazard production of the product in Uganda. Moreover, the food safety regulatory agencies neither monitor its production nor have a relevant quality standard. Currently, literature on Bongo is limited, so a comprehensive study on evaluation and improvement of its quality is required. This study will examine the quality of commercially produced Bongo, by isolating, developing and preserving starter cultures for the product. Consequently, this research will contribute to improvement of the dairy sector in Uganda. There will be an upgrade in the quality of Bongo on the market and this will in turn generate more income for processors.

MS AMENAN FABIENNE N'ZI, CÔTE D'IVOIRE

Characterisation of Bacillus cereus group species isolated from artisanal infant flours in Côte d'Ivoire

To contribute to the safety of infant flours, WHO recommends foods of both nutritional and sanitary quality for breast-milk supplements. Because of their weak economic situations, populations resort to artisanal infant flours which generally have insufficiencies. Although efforts are increasingly being made to correct nutritional deficiencies, this is not always the case in terms of their health characteristics. Different pathogens and especially sporulating bacteria such as *Bacillus cereus* can be found in flours and cause harm to children. The aim of this project is to reduce the risk of *Bacillus cereus* food poisoning linked to the consumption of home-made infant flour in infants and young children in Côte d'Ivoire. To do so, an investigation will be conducted in three different towns to determine infant flour production systems as well as practices that promote contamination by *B. cereus*.

DR ROLI KAROLE TSATSOP TSAGUE, CAMEROON

*Spray drying of indigenous fruit juices of *Lannea microcarpa* and *Carissa edulis**

with carrier agents (carbohydrates, gums) of Cameroonian plants

Currently in the north Cameroon, the consumption of fruits of *Lannea microcarpa* and *Carissa edulis* has increased due to their nutritional and therapeutic value. However, there is a problem with spoilage of these seasonal indigenous fruits. Thus, value addition of the product by drying suggests a greater scope for elevating the utilisation of fruits and vegetables into development of quality products. This study will look for the best air-drying and spray-drying process conditions for the formulation of powders of *L. microcarpa* and *C. edulis*.

A Strategic Evolution for Impact: Individual, Collaborative and Advanced Research through Capacity-enhancement and Mentorship

IFS has recognised the importance of support to individual researchers for five decades and will continue to provide Basic and (now) Advanced Grants to individual early career scientists. However, the development challenges that face humanity increasingly require scientists to work together, uniting different disciplines, countries and regions, in collaborative teams of specialists. Through the phased introduction of an interdisciplinary collaborative research approach within the IFS Strategy 2011–2020, IFS supported researchers to combine strengths, expertise and experience, to address larger research issues where more than one discipline was involved. Three pilots were carried out from 2012 to 2019, with a total of 115 individual grants.

Neglected and Underutilised Species – First Pilot in Africa

The first pilot project took place from 2012–2013 and resulted in the awarding of ten collaborative research grants to small teams of early career researchers (a total of 36, with 19 women and 17 men) in the five eligible countries of Ghana, Nigeria, South Africa, Tanzania, and Uganda, with a research focus of neglected and underutilised species. It was financed by the Carnegie Corporation and the Carolina Mac Gillavry Fund.

Biodiversity – Second Pilot in Africa

In 2014, IFS offered collaborative research grants to nine small teams totaling 35 researchers (17 women and 18 men) through the second pilot project in the eight eligible countries of Benin, Burkina Faso, Côte d'Ivoire, Ghana, Nigeria, South Africa, Tanzania and Uganda within a broad research scope of biodiversity. The second pilot was backed with multi-donor support from the Belgium Science Policy Office, the Carnegie Corporation, and the Carolina MacGillavry Fund.

Climate Change Adaptation and Mitigation – Third Pilot in Asia

The third pilot (2015–2019) commenced with an agreement between IFS and the Philippines-based Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA). The project was limited to the nine Southeast Asian countries of Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar,

Philippines, Thailand, Timor-Leste, and Vietnam, and the research focus was climate change adaptation and mitigation (as related to regional agriculture and rural development). This pilot was backed by financial contributions from the Carolina MacGillavry Fund and SEARCA. It included an opening collaborative research workshop (with six former grantees from the two Africa pilots participating as resource persons, or peer-mentors) and a mentoring workshop in which the 12 twelve teams (21 women and 20 men) were supported by ten established regional and international scientists.

IFS-SEARCA Mentorship Programme for Advanced Grants

The collaborative research pilots that IFS (and later SEARCA) implemented have shown the important role that mentorship plays in an early career scientist's learning about becoming a more advanced researcher. IFS's Strategy 2021–2030 brings together mentorship with Advanced Grants, now being implemented in a project with SEARCA on Accelerating Transformation through Agricultural Innovation in Southeast Asia. Individual scientists from Cambodia, Indonesia, Lao PDR, Myanmar, Philippines, Timor-Leste and Vietnam will be researching food security issues in the context of the impacts and consequences of the COVID pandemic.

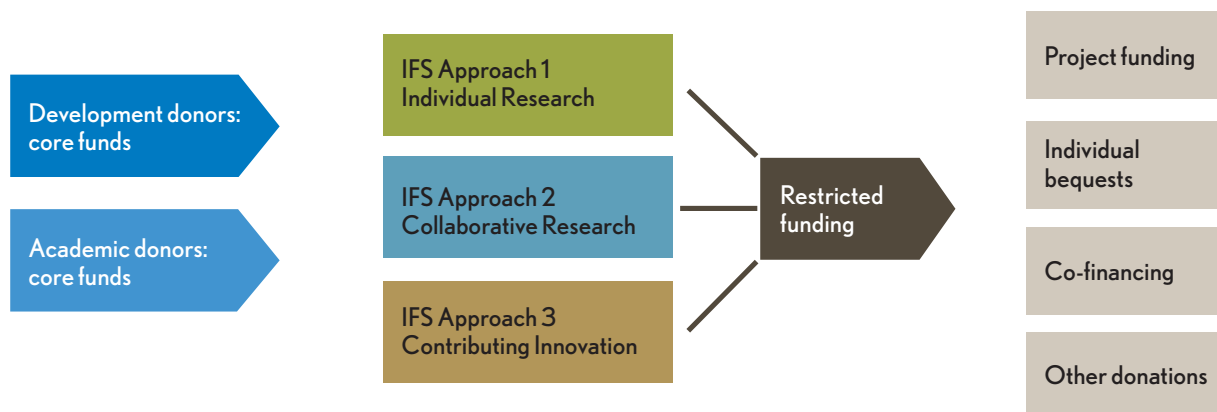
The purpose of the IFS-SEARCA Advanced Grants is to support not only further research, thereby strengthening research skills, but also the development of a wider suite of skills essential to being a scientist. This includes helping foster an awareness of the role of Information and Communication Technology in society by requiring applicants to elaborate both a Theory of Change and a research-into-use plan in the application process. On completion of an Advanced Grant, evidence will be requested of development of skills in networking, collaborative research, web presence, producing media pieces for general audiences, conference presentations, influencing (e.g., involvement in policy development) and science leadership (e.g., membership in science committees, leadership of research teams). Successful grantees will also be supported by mentors in areas such as experimental design, data collection, analysis and interpretation, and publication.



Dr. Mariama Ngom transplanting
Casuarinaceae nitrogen fixing plants
in the field.

The support of IFS

A range of donors and funders support the work of IFS, or parts of it.



Among the many ways of describing the role of IFS in the world is that it serves as a bridge between countries and agencies that are committed to supporting scientific research and individual early career scientists who are committed to the development of their home countries.

As we reach the conclusion of the Strategy 2011–2020 and embark on our new Strategy 2021–2030, we say Thank You to each of the 32 donors IFS has partnered with over the past ten years:

- > African Academy of Science (AAS), Kenya
- > Belgian Science Policy Office (Belspo), Belgium
- > Carnegie Corporation of New York, USA
- > Carolina MacGillavry Fund (Koninklijke Nederlandse Akademie van Wetenschappen), The Netherlands
- > Department for International Development (DFID), United Kingdom
- > Deutsche Forschungsgemeinschaft (DFG), Germany
- > European Commission, Research Directorate-General, Belgium
- > French Ministry of Foreign Affairs, France
- > International Centre of Insect Physiology and Ecology (icipe), Kenya
- > International Livestock Research Institute (ILRI), Kenya
- > International Organisation for Chemical Sciences in Development (IOCD), Belgium
- > International Science Program (ISP), Uppsala University, Sweden
- > Institut de Recherche pour le Développement (IRD), France
- > INASP/AuthorAID, United Kingdom
- > John D and Catherine T MacArthur Foundation, USA
- > National Research Council of Thailand (NRCT), Thailand
- > National University of Rwanda (NUR), Rwanda
- > Norwegian Agency for Development Cooperation (Norad), Norway
- > Organisation for the Prohibition of Chemical Weapons (OPCW), The Netherlands
- > Organisation of the Islamic Conference Standing Committee on Scientific and Technical Cooperation (COMSTECH), Pakistan
- > PODIO Project Management Software Citrix System Inc
- > PROTOS, Benin
- > Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), Uganda
- > Society of Environmental Toxicology and Chemistry (SETAC) Asia-Pacific
- > Technical Centre for Agricultural and Rural Co-operation (CTA), Netherlands
- > Biosciences eastern and central Africa – International Livestock Research Institute (BeCA-ILRI) Hub, Kenya
- > Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), Philippines
- > Swedish International Development Cooperation Agency (Sida), Sweden
- > Swiss National Science Foundation (SNSF), Switzerland
- > Syngenta Foundation for Sustainable Agriculture (SFSA), Switzerland
- > Western Indian Ocean Marine Science Association (WIOMSA), Tanzania
- > World Agroforestry Centre (ICRAF)/CGIAR Gender & Diversity Program, Kenya

We look ahead to the possibilities of working together as we implement our new IFS Strategy 2021–2030.

Impact of IFS on my life

– Professor Beatrice Opeolu

“The International Foundation for Science: The Spring in My Feet”

I was born in Imasai, a small town in Ogun State of Nigeria. After attending the local primary school, I left to obtain my high school certificate in Lagos State. The profiles of both my schools indicate my humble beginnings in terms of my family's socio-economic class. My first degree was in Environmental Management and Toxicology [Federal University of Agriculture, Abeokuta (FUNAAB)], while my MSc and PhD degrees were in Environmental Biology (University of Ibadan) and Environmental Toxicology (FUNAAB). I was privileged to be appointed a Graduate Assistant in my alma mater after my National Youth Service. I rose through the ranks to Lecturer I position before I left FUNAAB in 2010.

My doctoral research had many setbacks due to issues of access to literature, infrastructure and funding. In 2006, I first heard about IFS during a workshop on writing grant-winning proposals organised by the Research and Development Centre at FUNAAB. The focus of the workshop was to inform young researchers of the many opportunities available for career growth, such as research visits, overseas training, travel grants and fellowships, among others. I applied for an IFS grant immediately after the workshop. Although it was the first time that I had heard about IFS, I was inspired by the stories of my senior colleagues who were former IFS grantees. I gave the application my best based on the knowledge that I had then. I even asked for support from two of my senior colleagues, one in my discipline and the other, a former IFS grantee in another field. I was optimistic that I had the grant in my pocket after the submission. I was proud of my accomplishment. However, the outcome was disappointing because I did not get the grant.

At the time, IFS also supported the training of promising applicants when funding allowed. I was offered the opportunity to train with a senior scholar for guidance and mentoring prior to a re-submission. I jumped at the opportunity and had a two-week visit to Prof Michael Horsfall's laboratory at the University of Port Harcourt, Nigeria. This motivated me to apply for two travel grants from Israel's Agency for International Development Cooperation (MASHAV) and the Netherlands Fellowship Programmes (NFP), which I used for training in two other countries. The visit connected me with a leader in my field and another colleague from Zimbabwe whom Prof Horsfall hosted at the same time. The three of us have still interacted in various ways since 2006.

My re-submitted application was successful and it made a lot of difference in my work as an emerging researcher. I was



Professor Beatrice Opeolu.

“Although it was the first time that I had heard about IFS, I was inspired by the stories of my senior colleagues who were former IFS grantees.”

able to procure basic laboratory essentials for my work (e.g., oven, water deionizer, computer, printer, glassware and other consumables). I could conduct my research without borrowing against my salary. The IFS grant kickstarted my research journey and ignited my passion for world class science.

I migrated to South Africa in 2008 as a Postdoctoral Fellow at the Cape Peninsula University of Technology (CPUT). I had a research fellowship to study endocrine-disrupting chemicals in water systems, funded by the South African National Research Foundation. In 2011, I was appointed as the Coordinator of the Faculty of Applied Sciences' Extended Curriculum Programmes. I have continued my teaching and research activities in this position since 2011. In 2015, I was appointed as the Leader of the Environment, Climate Change and Sustainability Research Focus Area for CPUT. Since 2011, I have received a total of about ZAR

4 million in research grants as the principal investigator and another ZAR 2.3 million as a member of collaborative research grants, excluding funds that I accessed for travel and other training opportunities.

My research career has been fulfilling and rewarding. I was promoted to Associate Professor in 2014 and attained full professorship in 2018. I am now an established researcher (NRF C3-rated) and I enjoy visibility in my professional circle. This positions me as a leading scientist in the field of water science in South Africa. I am the current president of the Society of Environmental Toxicology and Chemistry (SETAC) Africa, and I represent Africa in the SETAC World Council.

In 2008, I attended a workshop at Egerton University in Kenya on research management and leadership skills for women in agricultural and natural sciences. It was co-organised by IFS,

the United Nations University and the Institute for Natural Resources in Africa. It was the first of several workshops that started preparing me for leadership roles in higher education. I am eternally grateful to IFS and the staff who facilitated the training. IFS gave me a leap in my research career progression, and that first IFS grant enhanced my confidence and ability to attract other research funds.

My research career is my passion and it is at the core of my teaching and community engagement activities. For me, it is a call that I answered to inspire a boy or girl child from my community that it is possible to achieve one's goals with determination. The resources will eventually become available if one is committed and diligent. It is satisfying to know that my journey as a researcher will continue to motivate young Africans from disadvantaged backgrounds towards excellence.

IFS Alumni Network

Recognising the importance of its alumni network, IFS provides support for individual alumni, associations of alumni which have been founded in several countries in Africa, and informal initiatives launched by alumni in Asia, and Latin America and the Caribbean. Our past grantees represent a source of mentoring, networking and collaboration in their respective countries, offering a range of services that benefit members, aspiring researchers, grant applicants and IFS. Examples include support for new applicants, advice to prospective grantees through seminars and talks, publicising IFS grant calls, collaborating with other alumni associations, and informing IFS of relevant local and national activities. IFS always tries to find ways to mobilise our existing resources to activate, support and strengthen our alumni.

African IFS Alumni Associations Launch a Webinar Series on Investing in Future Scientists in Post-COVID-19 Africa

Recognising the importance of designing recovery strategies in a post-COVID world, the IFS Alumni Associations in Africa – together with the IFS Secretariat – are embarking on a series of online consultative meetings, in collaboration with representatives of other regional scientific communities and stakeholders in Africa and globally. The purpose of the meetings is to engage in intensive and targeted deliberations on improved interventions to strengthen the science capacity of early career researchers

in Africa in the post-COVID world, by deliberating on issues such as how:

- > COVID-19 has had an impact on the work of early career researchers in Africa
- > Our understandings of COVID-19 help us to define a pathway forward as Africa grapples with addressing the human and socioeconomic concerns, rebuilding societies and avoiding stress on the environment
- > Governments promote policies and strategies that are science-based to address the compound risks facing Africa, and
- > To bring 'normalcy' to our lives as lessons are learned to enhance our resilience to future threats of various sorts.

The webinar series will enable the IFS Alumni Associations in Africa to act together with regional initiatives to identify which barriers should be reduced and which enablers should be reinforced to strengthen the science capacity of early career researchers in a post-COVID world. The resulting recommendations are expected to lead to strong endogenous research capacity, to develop more contextualised innovations and practices driven by local demands, and to promote targeted, purpose-driven regional and global collaboration.

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Ms Jill Wallin, Office Manager, Purchasing Manager and Administrator

AMBASSADORS

Since its establishment in 1972, and as a result of its support of early career scientists across the world, IFS has generated and nurtured professional and personal goodwill among thousands of people. Many of them have arrived at places in their own careers where they have a voice and influence on matters of importance when it comes to the support of scientific endeavors of all kinds.

The IFS Secretariat will invite volunteers to be Ambassadors from among past and present Trustees and Scientific Advisors, and the growing numbers of alumni, who themselves are now forming into associations in particular countries.

STATEMENT OF INCOME AND EXPENSE (in thousands SEK)

	1 January- 31 December 2020	1 January- 31 December 2019
Programme Revenue		
Core and Restricted Contributions	25 772	26 577
Grants Withdrawn	1 168	353
Other Programme Revenue	10	5
Total Programme Revenue	26 951	26 935
Programme Expense		
Programme Services	23 529	25 221
Fundraising and Partnership Building	1 506	2 165
Management and General	1 805	1 679
Total Programme Expense	26 840	29 065
Programme Income less Expense	111	-2 130
Result from financial assets		
Income from other investments held as fixed assets	884	634
Interest Income	19	23
Exchange gain / loss	-344	-72
Asset Income less Expense	559	585
Net Income less Expense	670	-1 545

BALANCE SHEET (in thousands SEK)

	31 December 2020	31 December 2019
Assets		
<i>Fixed Assets</i>		
Tangible Assets		
Equipment, Furniture and Fixtures	81	40
Financial Assets		
Other long-term investments	16 808	15 924
Long-term Donor Receivables	84	95
Total Fixed Assets	16 973	16 058
<i>Current Assets</i>		
Current Receivables		
Donor Receivables	1870	1064
Other Current Receivables	797	763
Prepaid Expense and Accrued Income	701	647
Total Current Receivables	3 368	2 474
Cash and Bank Balances	11 229	24 737
Total Current Assets	14 597	27 211
Total Assets	31 569	43 270
Equity and Liabilities		
<i>Designated funds</i>		
Board Designated Fund for Contingencies	11 711	11 107
Carolina MacGillavry Fund	16 410	15 115
Total Designated Funds	28 122	26 221
Balanced capital		
Balance, 1 January	-4 921	-1 476
Net Income less Expense for the Year	670	-1 545
Total Balanced Capital	-4 251	-3 020
Total Equity	23 871	23 201
<i>Current Liabilities</i>		
Research Grants Payable	5 412	8 463
Deferred Restricted Contributions	573	573
Accounts Payable	0	83
Other Current Liabilities	633	699
Accrued Expense and Prepaid Income	1 081	10 250
Total Current Liabilities	7 699	20 069
Total Net Assets and Liabilities	31 569	43 270

AFFILIATED ORGANISATIONS

NATIONAL ORGANISATIONS

ARGENTINA

Academia Nacional de Ciencias Exactas, Físicas y Naturales (ANCEFN)
Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)

AUSTRALIA

Australian Academy of Science (AAS)

AUSTRIA

Fonds zur Förderung der Wissenschaftlichen Forschung (FWF)
Österreichische Akademie der Wissenschaften (ÖAW)

BANGLADESH

Bangladesh Council of Scientific and Industrial Research (BCSIR)

BELGIUM

Académie Royale des Sciences d'Outre Mer (ARSOM)
Académie Royale des Sciences des Lettres et des Beaux Arts de Belgique
Koninklijke Academie voor Wetenschappen, Letteren en Schone Kunsten van België (KVAB)

BOLIVIA

Academia Nacional de Ciencias de Bolivia (ANCB)

BRAZIL

Academia Brasileira de Ciencias (ABC)
Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPQ)
Fundação Oswaldo Cruz (FIOCRUZ)

BURKINA FASO

Ministère des Enseignements Secondaire, Supérieur et de la Recherche Scientifique (MESSER)

CAMEROON

Ministry of Scientific and Technical Research

CENTRAL AFRICAN REPUBLIC

l'Enseignement Supérieur et de la Recherche Scientifique

CHAD

Direction de la Recherche Scientifique et Technique, MESRS

CHILE

Academia Chilena de Ciencias
Comisión Nacional de Investigación Científica y Tecnológica (CONICYT)

CHINA

Chinese Academy of Sciences (CAS)

COLOMBIA

Academia Colombiana de Ciencias Exactas, Físicas y Naturales (ACCEFYN)
Centro para la Investigación en Sistemas Sostenibles de Producción Agropecuaria (CIPAV)
Instituto Colombiano para el Desarrollo de la Ciencia y Tecnología (COLCIENCIAS)

CONGO (BRAZZAVILLE)

Direction Générale de la Recherche Scientifique et Technique, MENRST

COSTA RICA

Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT)

CÔTE D'IVOIRE

Académie des Sciences, des Arts, des Cultures d'Afrique et des Diaporas Africaines

CUBA

Academia de Ciencias de Cuba (ACC)
Ministry for Foreign Investment and Economic Cooperation

DENMARK

Akademiet for de Tekniske Videnskaber (ATV)
Det Kongelige Danske Videnskabernes Selskab (RDVS)

ECUADOR

Fundación para la Ciencia y la Tecnología (FUNDACYT)

EGYPT

Academy of Scientific Research and Technology (ASRT)

EL SALVADOR

Consejo Nacional de Ciencia y Tecnología (CONACYT)

ETHIOPIA

Ethiopian Science and Technology Commission (ESTC)

FINLAND

Delegation of the Finnish Academies of Science and Letters

FRANCE

Académie des Sciences
Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)
Institut National de la Recherche Agronomique (INRA)
Institut de Recherche pour le Développement (IRD)

GERMANY

Deutsche Forschungsgemeinschaft (DFG)

GHANA

Council for Scientific and Industrial Research (CSIR)

GUINEA

Direction Nationale de la Recherche Scientifique et Technique

GUINEA BISSAU

Instituto Nacional de Estudos e Pesquisa (INEP)

GUYANA

Institute of Applied Science and Technology

HONDURAS

Consejo Hondureño de Ciencia y Tecnología (COHCIT)

INDIA

Indian National Science Academy (INSA)

INDONESIA

Lembaga Ilmu Pengetahuan Indonesia (LIPI)

ISRAEL

The Israel Academy of Sciences and Humanities

JAMAICA

Scientific Research Council (SRC)

JORDAN

Royal Scientific Society (RSS)

KENYA

Kenya Agricultural Research Institute (KARI)
Kenya National Academy of Sciences (KNAS)

KOREA DPR (NORTH)

Academy of Sciences of DPR Korea

KOREA R (SOUTH)

National Academy of Sciences (NAS)

KUWAIT

Kuwait Institute for Scientific Research (KISR)

LATVIA

Latvian Academy of Sciences (LAS)

LESOTHO

The National University of Lesotho (NUL)

LIBERIA

University of Liberia (UL)

MADAGASCAR

Académie National Malgache

MALAWI

National Research Council of Malawi (NRCM)

MALAYSIA

Malaysian Scientific Association (MSA)
Ministry of Science, Technology and Innovation

MALI

Centre National de la Recherche Scientifique et Technologique (CNRST)
Comité National de la Recherche Agricole (CNRA)

MEXICO

Consejo Nacional de Ciencia y Tecnología (CONACYT)

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The Nigerian Academy of Science (NAS)

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Pakistan Council for Science and Technology (PCST)

PANAMA

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Universidad de Panamá

PAPUA NEW GUINEA

The University of Papua New Guinea

PERU

Consejo Nacional de Ciencia y Tecnología (CONCYTEC)

PHILIPPINES

National Research Council of the Philippines (NRCP)

POLAND

Polish Academy of Sciences (PAS)

SAUDI ARABIA

King Abdulaziz City for Science and Technology (KACST)

SENEGAL

Délégation aux Affaires Scientifiques et Techniques, MRST

SEYCHELLES

Seychelles Bureau of Standards (SBS)

SIERRA LEONE

Institute of Agricultural Research (IAR)

SOUTH AFRICA

National Research Foundation (NRF)

SRI LANKA

National Science Foundation (NSF)

SUDAN

National Centre for Research (NCR)

SWEDEN

Ingenjörsvetenskapsakademien (IVA)
Kungliga Skogs och Lantbruksakademien (KSLA)
Kungliga Vetenskapsakademien (KVA)

SWITZERLAND

Council of the Swiss Scientific Academies (CASS)
Swiss National Science Foundation (SNSF)

TANZANIA

Tanzania Commission for Science and Technology (COSTECH)

THAILAND

National Research Council of Thailand (NRC)
Thailand Research Fund (TRF)

TUNISIA

Direction Générale de la Recherche Scientifique et Technique, MES

UGANDA

National Agricultural Research Organisation (NARO)
Uganda National Council for Science and Technology (UNCST)

UNITED KINGDOM

The Royal Society
Natural Resources Institute (NRI)

URUGUAY

Programa de Desarrollo de las Ciencias Básicas (PEDECIBA)

USA

American Academy of Arts and Sciences (AAAS)
National Academy of Sciences (NAS)
New York Academy of Sciences (NYAS)

VENEZUELA

The Ministry of Popular Power for Science and Technology

VIET NAM

Ministry of Science and Technology (MOST)

ZAMBIA

National Institute for Scientific and Industrial Research (NISIR)

ZIMBABWE

Scientific and Industrial Research and Development Centre (SIRDC)
University of Zimbabwe

REGIONAL ORGANISATIONS**AFRICA**

Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)
Association of African Universities (AAU)
Centre Régional pour l'Eau Potable et l'Assainissement à faible coût (CREPA)
Institut du Sahel (INSAH)
The African Academy of Sciences (AAS)
West and Central African Council for Agricultural Research and Development (WECARD/CORAF)
Western Indian Ocean Marine Science Association (WIOMSA)

LATIN AMERICA AND THE CARIBBEAN

Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)
The Caribbean Academy of Sciences (CAS)
Caribbean Agricultural Research and Development Institute (CARDI)

INTERNATIONAL ORGANISATIONS

BioNET (The Global Network for Taxonomy)
International Organisation for Chemical Sciences in Development (IOCD)
International Union of Forest Research Organisations (IUFRO)
The Academy of Sciences for the Developing World (TWAS)
Consultative Group on International Agricultural Research (CGIAR): CGIAR Secretariat
Biodiversity International
Centro Internacional de Agricultura Tropical (CIAT)
Centre for International Forestry Research (CIFOR)
International Centre for Agricultural Research in the Dry Areas (ICARDA)
International Centre for Research in Agroforestry (ICRAF)
International Water Management Institute (IWMI)
World Fish Center

INDIVIDUAL RESEARCH GRANTS AWARDED IN 2020*

BENIN

ADJIBADE Kayode Nambil

The impact of "Malian-barrier traps", a barrier fishing method, on fisheries and food security in the Niger River at Benin

AGOYI Eric

Towards release of high yielding white-grained kersting's groundnut [*Macrotyloma geocarpum* (Harms) *Maréchal & Baudet*] varieties in Benin

AHOHOUENDO Fanou Alain

Biocontrol potential of local *Trichoderma* isolates against plantain Black Sigatoka in southern Benin

AHOUANSOU Djidjooh Mathieu Maurice

Ecophysiological Modelling for the understanding of pollutants transfer dynamics in Hlan River basin, Southern Benin

AHOZONLIN Maurice

Diversity and resilience of Lagune cattle production systems and development of local institution frameworks for conservation and sustainable use of Lagune breed in southern Benin (West Africa)

AKPOVO V Abel Henrick

Using ethnobiology, population biology and species distribution modeling to inform *Ricino-dendron heudelotii* conservation in Benin

ALLAKONON Marsanne G B

Maize deficit irrigation to improve crop productivity and reduce water loss and soil nutrient mining in Northern Benin

DANDJLESSA Judicaël

Evaluation of the fertilizing and allelochemical constituents of *Chromolaena odorata* L. compost in Benin

DIMON Elodie

Perception and adaptation of women small ruminant farmer to climate change in northern Benin

HOUNNOU Fèmi

Role of weather services in farmer's adaptive strategies to cope with climate change effects in Benin

HOUNYEME Romuald

Modelling by bayesian networks of the ecological resilience of a tropical hydrosystem with multifactorial vulnerabilities: The case of lake Nokoué (RAMSAR 1018 Site)

KANLINDOGBE Cyrille

Evaluation of growth and yield performances; and molecular characterization of new varieties of fonio (*Digitaria exilis*, Stapf) obtained by homogenization and mass selection in Benin

KOURA Bossima Ivan

Performances and environmental impacts of peri-urban cattle production in southern Benin

SOTONDJI Amoussou Fernand

Evaluation of the larvicidal effect of three vegetable oils and Cashew Nut Shell Liquid, in the management of *Plutella xylostella* L. (*Lepidoptera*, *plutellidae*), and *Helicoverpa armigera* (Hübner) (*Lepidoptera*: *Noctuidae*) in market gardening in Benin

THOTO Frejus

Understanding the profiles of agricultural entrepreneurs and their formalization dynamics in Benin

BURKINA FASO

ABDOULAYE Tyano

Allometric equations for below-ground and above-ground biomass of three key shrubs species in the northern Sudanian zone of Burkina Faso

KIEBRE Mariam

Evaluation participative des espèces du genre *Corchorus* consommées au Burkina Faso pour une meilleure valorisation de leur potentialité nutritionnelle

MOUSSA Ganame

Indigenous knowledge, ecology and habitat suitability modelling of *Kigelia africana* (Lam.) Benth., a neglected and threatened species in Burkina Faso: implication for sustainable management

OUILIS Amidou

Distribution of post-harvest fungi and assessment of mycotoxin contamination in bambara groundnut and cowpea produced in Burkina Faso

SODRE Etienne

Exploration of ways to improve milk production in Banfora's dairy basin in western Burkina Faso by codesigning with livestock farmers some innovative and agro-ecological feeding options for milking cows

SORE Harouna

Synthesis and development of antimalarial transmission blocking natural products, *Lophirone E* and analogues for the control of malaria

TRAORE Kuan Abdoulaye

Evaluation of the contamination by *hepatitis E virus* (HEV) in ready-to-eat vegetable fresh fruits and vegetables taken from irrigation crop plots

CAMEROON

DJAOUA Moussa

Monitoring water sources for environmental reservoirs of *Vibrio cholerae* with its O1 serogroup and toxigenic subpopulations in the cholera endemic areas of north Cameroon

DJUIDJE Peguy

Identification of *Streptomyces* sp. PERM2 and PFK4 antagonist to *Phytophthora myriophyllum*, causal agent of root rot disease of cocoyam (*Xanthosoma sagittifolium* L. Schott) and characterization of their bioactive compounds"

EMEGAM Nadege Kouemou

Effect of aqueous extract of *Dichrocephala integrifolia* on alcohol-induced behavioural and cognitive deficits in mice

NEMG SIMO Fredy Brice

Study of Chikungunya virus inhibitors from *Entandrophragma cylindricum* and *Poga oleosa*: Phytochemical approach and antiviral mechanism

TSAGUE Roli Karole Tsatsop

Spray drying of indigenous fruit juices of *Lannea microcarpa* and *Carissa edulis* with carrier agents (carbohydrates, gums) of Cameroonian plants

CONGO, THE DEMOCRATIC REPUBLIC

AHANAMUNGU MAKELELE Isaac

Responses and resilience of central Congo basin forests to a changing environment

COTE D'IVOIRE

ADJOUMAN Yao Désiré

Development of a biodegradable film with bioactive components for the packaging of "attieke".

AKISSI Dogbo Marius

Shelf-life extension of palm wine using lactic acid bacteria as bioprotective strains

KOFFI Kouame Fulgence

Find the best fire season to stop tree encroachment in a West African humid savanna (Lamto, Côte d'Ivoire): contribution of fuel flammability

KONE Mamadou

Describing the structure of termite assemblages in highland ecosystems: a case study in the Mount Nimba slopes located in western Côte d'Ivoire

* 1 applicant selected for grant award has not fulfilled the conditions yet and 1 did not fulfil the conditions.

N'ZI Amenan Fabienne Anne-Julie
Characterization of *Bacillus cereus* group species isolated from artisanal infant flours in Côte d'Ivoire

SIKA-KADJI Andrée Emmanuelle
Screening for the probiotic activities of lactic acid bacteria isolated from the gastrointestinal tract of broilers and indigenous poultry in Côte d'Ivoire and their zootechnical performance on broilers

TRA BI Youan Charles
Valorization of pig manure into biogas and determination of microbiological and chemical risks related to the use of digestate as a bio-fertilizer in the peri-urban areas of the Abidjan district.

ECUADOR

PAREDES-MONTERO Jorge
Endosymbiont meta-communities associated with the *Bemisia tabaci* vector species in Ecuador

ETHIOPIA

ABEBE Tsega Adego
Socio-economic and environmental impact of farmland conversion to Industrial parks: implication on smallholder farmers and the aquatic organisms in Hawassa area, Ethiopia

ASSEFA Workiyie Worie
Development of Macroinvertebrate-Based Multimetric Wetland Index of Biotic Integrity for Assessing Wetland Ecosystems Health in Upper Blue Nile Basin (West Gojjam), Northwest Ethiopia

DEBELIE Habtamu Degefa
Wetland conversion and greenhouse gas emission in Ethiopia: the case of Cheleleka wetland

HAWARIA Dawit
The impacts of water source development on the malaria vector bionomics and diseases transmission, Ethiopia

GUYASSA DINSSA Etefa
Interaction between exclosure and hydrological processes in dryland mountainous environments: Perspectives for irrigation stormwater runoff on reforested areas, northern Ethiopia.

MEHARI Abrehet Kahsay
Identifying potential sedimentation area using sediment plumes monitoring in Lake Tana to improve its management

REGASSA Yohannes Gelan
Climate change resilient ecological agriculture for smallholder farmers in Ethiopia: through diverse cropping system and smart agronomic practices approaches

SHIFERAW Ejigayehu D
Integrated Assessment of Ecosystem Services and Dis-services of Urban Green Infrastructure to Inform Sustainable Urban Planning: the case of Dire Dawa City

GHANA

ABARIKE Emmanuel Delwin
Contribution of a mixture of extracts of guava, bitter and pawpaw leaves in improving growth, hematology, immunity and resistance to *Streptococcus agalactiae* outbreaks in Nile tilapia, *Oreochromis niloticus*

AHMED Abubakari
Tale of three cities: comparative assessment of food and energy securities in secondary cities of the semi-arid region of Ghana

DUFAILU Osman Adamu
Genetic Diversity and Antimicrobial Susceptibility of *E. coli* Isolates from Household Water Sources in Northern Ghana

HARLEY Benjamin Kingsley
Phytochemical and Functional Investigations of Ghanaian Medicinal Plants Used in Treating Human African Trypanosomiasis

THOMFORD Nicholas
Purification, Molecular and Functional Characterization of HIV Latency Reactivating and Immunomodulatory Compounds from 3 Ghanaian Medicinal Plants

KENYA

CHIRIKONA Flora
Adsorption of perfluoroalkyl acids from wastewater onto water hyacinth based nanofibers: thermodynamics, kinetics, isotherms and mechanisms

KARUMA Anne
Effect of watering regimes on taro (*Colocasia esculenta*) yields in Kabete, Kenya

KAWAWA ABONYO Calvince Rashid
Risk warnings and management countermeasures of alien ornamental plants under climate change in sub-Saharan Africa: A case study of Nairobi city and its environs.

LUASI Wycliffe
Enhancing blast resistance in finger millet through targeted mutagenesis of ethylene response factor transcription factor gene.

MANDILA Brexidis
Benefits and Invasive Potential of Cultivating Selected Bamboo Species in Drylands of West Pokot County, Kenya

MUEMA Jackson
Metabolomics inspired optimization of juliprosopine and columbamine for development of potent target-specific malaria transmission-blocking agents

MUGWERU Julius
Population genetics of Honey Bee (*Apis mellifera*), and the bacterial disease, American Foulbrood in bee farming areas of Embu-Kenya

OGALI Irene Nafula
Generation of a Live-Attenuated Newcastle Disease Virus Vaccine Based on Currently Circulating, Kenyan Strains

OTWOMA Levy Michael
To assess the effect of overfishing on the genetic diversity of commercially important reef fishes in Kenya

OKEYO Winnie
Population structure of *G. pallidipes* in Turkana and West Pokot counties in Kenya

WAITITU Julius Maina
Development of a mapping framework for *lantana camara* L. invasive species in forest habitats.

MADAGASCAR

RAMIFEHIARIVO Nandrianin
Soil fertility mapping of main rice production areas in Madagascar

RATSIATOSIKA Onja Hasinahary
Intensification of Soil Ecological Functions to enhance the resilience of rainfed rice cropping systems to rainfall reduction

RAZANATSOA Estelle
Palaeoecology and modeling of the dry forests' responses to climate and human land use in western Madagascar over the last 2000 years and in the near future 2030 and 2060

MALAWI

GAMA Aggrey

Integrating quinoa into the African diet

MOZAMBIQUE

MONTEIRO Gaby

Development and validation of a novel virus neutralization test for Rift Valley Fever diagnosis

NEPAL

BARAL Janaki

Quest of anticancer compounds from *Zanthoxylum armatum* DC. and *Sarcococca wallichii* Staph

BHANDARI Sushil

Toxicity (*Embryonic, Teratotoxicity*) study of medicinal plants from Himalayan region of Nepal using zebrafish embryos

TACHAMO SHAH Ram Devi

Development of assessment tool for evaluating the impacts of hydropower dams on aquatic biodiversity

OLIYA Bal Kumari

Evaluation of genetic diversity using molecular and phytochemical marker, anticancer activity and in vitro propagation of *Paris polyphylla* Smith in Nepal.

NIGER

ZANGO Oumarou

Quality and establishment of a pollen bank of date palms in Sahel area

NIGERIA

AJAKAYE Oluwaremilekun

Molecular investigation of hybridization between livestock and human schistosomes parasites in wetlands used by pastoralist in Nigeria

BORISADE Omotoso

Development of native entomopathogenic fungi as a component of Integrated Pest Management (IPM) System for the control of whitefly, *Bemisia tabaci* (*Hemiptera: Aleyrodidae*) in Nigeria

EMERAGHI Mary

Conferment of durability on local Maize (*Zea mays* L.) cultivars in Benin for streak disease resistance and drought tolerance by gene pyramiding using marker-assisted selection

OLUGBAMI Jeremiah

Inhibition of cancer metastasis by natural products via selective targeting of drivers of actin cytoskeletal remodelling and immunoboosting

OMOTORIOGUN Taiwo Crossby

Sperm morphology and genetic diversity in colonial breeding subpopulations of Village Weaver *Ploceus cucullatus* in Tropical Africa

SHITTA Ndenum Suzzy

Genotyping-by-Sequencing of African yam bean (*Sphenostylis stenocarpa* Hochst (Ex A. Rich) mapping population for reduced cooking time

UMEYOR Chukwuebuka

Development and quality evaluations of nanoemulsions of *Moringa oleifera* seed extracts for water purification

PAKISTAN

AIN Noor Ul

Fabrication of novel plant-based copolymers and their scrutinization as xenobiotic remediators for pharmaceutical and textile wastewater effluents

DITTA Allah

Transcriptome profiling and characterization of cotton germplasm for salt tolerance in Pakistan

HUSSAIN Athar

Identification, characterization and functional analysis of resistance genes in cotton

ISMAIL Hammad

Bioassays guided isolation and identification of anti-Alzheimer compounds from *Berberis lyceum*

KHAN Fahim

Exploring Genetic Variation of *Fusarium* Head Blight Resistance for Marker-Assisted Breeding in Pakistani Wheat Gene Pool

KHAN Tariq

Evaluation of combined effects of plant-derived compounds and antibiotics to combat multidrug resistance

SARFRAZ Iqra

Transforming fruit waste biomass into health dietary supplements for cancer treatment

ZARIF Bina

Nano-nutraceuticals for sustainable food enrichment: a step to target Hidden Hunger

PARAGUAY

FLORES-GIUBI Eugenia

Evaluation of the effect of *Macrophomina phaseolina* and its metabolites on the sesame (*Sesamum indicum*) hormonal response

SENEGAL

NGOM Mariama

Restoration of the fertility of degraded arable lands in Senegal by integrating *Casuarinaceae* nitrogen-fixing trees into agricultural crops

SRI LANKA

DIAS Chamila

Transition from flooded rice to dry rice cultivation: Impacts of altered flooding regime on yield, water balance and gas exchange of paddy fields in Sri Lanka.

JAYASINGHE Madhura

Development of low glycemic cane sugar and wheat bread, incorporated with selected natural plant ingredients.

NAPAGODA Mayuri

Green synthesis of metal nanoparticles using invasive plant species in Sri Lanka for the development of effective disinfectants to nosocomial infections.

UKUWELA Kanishka

Diversity and Conservation of the little-known lizard fauna (*Scincidae* and *Gekkonidae*) of Sri Lanka

TANZANIA UNITED REPUBLIC

CHENGULA Augustino

Surveillance and molecular characterization of Marek's disease virus (MDV) strains circulating in Tanzania

RUMISHA Cyrus

Genetic analysis to improve management and conservation of the endangered East African wedgefishes and their habitat

TOGO

ADOM Médétissi

Spatial Distribution and Seasonal Occurrences of the False Codling Moth on chili pepper and eggplant in Southern Ghana.

AKAKPO Agbémébia Yawovi

Development of nanoemulsion oil formulation from *Cymbopogon citratus* essential oils and application into fresh soymilk and tiger-nut milk produce in Burkina Faso

AYEKI Kaina

Sustainability of fuelwood production systems and supply chains in the central region of Togo

UGANDA

AMULEN Deborah Ruth

Using molecular profiling of the bee gut microbiome for evidence-based Honeybee health and nutritional management in Uganda

BYAKIKA Stellah

Starter culture development and improvement of safety of commercially produced Bongo, a fermented dairy product from Uganda

FATUMAH Nakiguli

Better off in the wild: A comprehensive captive-breeding and soft-release program for conservation and sustainable management of the endangered Barbour's Vlei Rat populations in Uganda

GABIRI Geofrey

Land Use and Climate Change Effects on Terrestrial Carbon Stocks in Sezibwa catchment in Lake Kyoga Basin, Uganda

KERFUA Susan Diana

Evaluation of immune response of 6-12 month old calves to serotype O strain of the foot-and-mouth disease trivalent vaccine used in Uganda

KUBIRIZA Godfrey Kawooya

Harnessing the antioxidant potential of rosemmary and water hyacinth to stabilize fresh Nile perch oils for safe fish feed production in Uganda (NipDiet).

NAIGA Resty

Determinants of Performance of Community-Based Water Management system in rural Uganda

OBAKIRO Samuel Baker

Evaluation of the *Mycobacterium tuberculosis* growth inhibitory and / or killing potential of isolated chemical compounds from selected medicinal plants of Fabaceae family (*Erythrina abyssinica*, *Entada abyssinica* and *Albizia coriaria*)

VIETNAM

CHAU Ngoc Do Quyen

Advanced fabrication of aerogel from graphene oxide and cellulose for wastewater treatment

DIEN Luu Duc

The interaction between integrated rice-shrimp ponds with adjacent waterways in Bac Lieu province, Vietnam

HO Ngo Anh Dao

Study on removal of Natural Organic Matter (NOM) from surface water by using coagulation and flocculation to mitigate the formation of chlorine disinfection by-products: a case study of Thu Duc Water Treatment Plant, Ho Chi Minh City, Vietnam

LOC Ho

Evaluating and Mapping of Ecosystem Services associated with Sustainable Urban Drainage Systems (SUDS): a case study in Ho Chi Minh City, Vietnam

NGUYEN PHAM Huyen

Bacteria isolation and characterization of calcium carbonate precipitation performance for the potential application in soil improvement and stabilization in Mekong Delta of Vietnam

NGUYEN Thi Hong Minh

The 3D scaffold containing tamarind seed polysaccharide sulfate: a new biomaterial for bone tissue engineering

PHAM Thi Anh Ngoc

Economic analysis of technological innovations to improve the sustainability of Vietnamese beef cattle production.

ZAMBIA

MFUNE Ruth Lindizyani

Characterization of human and bovine *Brucella* species in Southern and Western provinces of Zambia

SAMUTELA Mulemba

Carriage and Characterisation of *Staphylococcus aureus* from Pigs and Humans in Lusaka Province of Zambia

SIMBOTWE Manyando

Serological anthrax surveillance in wildlife, livestock and humans in the wildlife-livestock interface areas of Zambia

ZIMBABWE

GWANDU Tariro

Soil health improvement technologies to enhance drought and nutrient resilience in urban agroecosystems in Zimbabwe

MUTSAMBA-MAGWAZA Eleanor

Rainwater harvesting and nutrient intensification in maize-legume farming systems in semi-arid Zimbabwe

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