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!
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Foreword

In a few words, 2019 can be summed up as “in the face of significant challenges, we made significant progress”, as we continue to deliver on our purpose – to support early career researchers to enhance their scientific capacity. While there is much work to do and there may be further challenges ahead, we end 2019 stronger and better able to perform our usual activities, along with the year-plus development of a new strategy for 2021–2030.

Throughout the year, we reviewed our situation, looked at each area of our activities and determined what worked well, what could have been done better and what opportunities lie ahead. We have captured the essence of the many contributions made over the past year in a cohesive vision for the strategic direction of the organization through 2030. We are implementing part of our new strategy while still working within the ongoing one; a two-month open call in October and November saw record high applications (2,110) received by the deadline. While this demonstrates that there is demand for our new strategy, it also presents the challenge of securing enough funding to give as many grants as we would like.

Today, IFS is better equipped than ever to respond to the requirements of early career researchers. Our 2021–2030 strategy sets out the case for better focusing of our resources on supporting promising early career scientists, who are fundamental to building science capacity in LLMICs, and essential to addressing both national and global challenges. Our job is to focus on what we can control, mainly generating and disseminating scientific knowledge by early career scientists, and enhancing their capacity to influence, lead, network, fundraise and put research into use. We need to manage our costs, rebuild our brand, and do our part to keep IFS moving forward.

We extend our heartfelt thanks to our Board of Trustees, the members of the Scientific Advisory Committees, and our funding and organizational partners. We had our share of challenges and yet together we managed to achieve many milestones because of the commitment, loyalty and passionate dedication that they have for our work. We also thank all the Secretariat staff for their effort in making the organization successful. We welcome the 132 new IFS grantees to our family. Thanks are due too to IFS alumni, many of whom continue to support the mission of IFS.
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+ grants 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

Research Planning
In 2019, IFS was jointly engaged with a variety of strategic partners across a spectrum of topics ranging from research trends in chemical, pharmaceutical, food and agricultural sciences; water and natural resource management; and biodiversity; to agriculture research for development, applied nutrition, and approaches for gainful and impactful research by early career scientists. These activities included four international and national gatherings and three training events.

We supported our alumni to associate and support other potential grantees through training on topics such as biodiversity, scientific information and data modelling. IFS alumni participated in several meetings and conferences and they coached MSc and PhD candidates for IFS’s individual grant applications. In 2019, the IFS Nigerian Alumni Association was launched by former and present IFS grantees.

Research Production
In 2019, we attracted 897 applications for individual research grants. Out of the total proposed projects, 132 grants were awarded, of which 47% dealt with biological resources in terrestrial systems, 35% with water and aquatic resources, and 18% with food security, dietary diversity and healthy livelihoods. Across these three research areas, we highlight 28 projects that are now under way.

Women scientists represented 34% of the individual research grant awardees and men were 66%. In addition to the early career scientists receiving research grants, the other 765 applicants were given feedback by well-qualified IFS reviewers and advisers as part of our capacity-enhancing activities.

We coached, supported and followed up the 153 grantees of 2015 who were finishing their research. These researchers have so far published 160 articles in peer-reviewed scientific journals, and they have made 177 conference presentations and established 352 scientific contacts. Twenty-seven supplementary grants were awarded to grantees to enable them to finish their work. Equipment procurement services were also provided to 50 grantees, with a total of 84 orders processed.

Research Use
We chose 28 impactful projects from the 153 to highlight how grantees’ research is being put into use, representative of topics, countries, regions, women and men. As a part of IFS’s efforts to support research capacity-enhancing, 12 early career scientists received travel grants to increase their international exposure, networking and collaboration opportunities. Grantees reported how this was an opportunity to share results with scientists from around the world, to make contacts with colleagues experienced in their fields, and to learn new methods and approaches.

Looking Back and Looking Ahead
In this year’s Annual Report, we are pleased to recognize the long-standing support of the DFG, the German Research Foundation, one of our institutional partners since 1975. We are also appreciative of Dr Yogeshkumar Naik, a Professor of Ecotoxicology at the National University of Science and Technology in Zimbabwe, for telling the story of how IFS grants played a part in his research career.

In 2019, we engaged in a collaborative and inclusive process to develop our new strategy for 2021–2030, under the theme of Investing in Future Scientists. The strategy represents an evolution in our approach to enhancing research capacity, reflecting changes in the contemporary context. While IFS continues to emphasise the quality and development relevance of the increasing amount of research it funds, the 2021–2030 strategy sets out the case for better focusing of resources on supporting promising early career scientists (no longer defined by age), who are fundamental to increasing science capacity and to addressing both national and global challenges.
Planification de la Recherche
En 2019, IFS a été engagé conjointement avec divers partenaires stratégiques dans un éventail de sujets traitant des tendances récentes de la recherche allant des sciences chimiques, pharmaceutiques, alimentaires et agricoles, gestion de l'eau et des ressources naturelles, biodiversité à la recherche agricole pour le développement, la nutrition appliquée et les différentes approches pour une recherche fructueuse et significative réalisées par les scientifiques en début de carrière. Ces activités comprennent quatre réunions internationales et nationales et trois événements de formation.

Nous avons aidé nos anciens étudiants à mettre en relation et à soutenir d'autres bénéficiaires potentiels par le biais d’une formation sur des sujets tels que biodiversité, information scientifique et modélisation des données. Les anciens boursiers de l’IFS ont participé à plusieurs réunions et conférences et ils ont encadré des candidats titulaires d’un master et d’un doctorat pour les demandes de subventions individuelles à l’IFS. En 2019, l’association des anciens boursiers de l’IFS du Niger a été initiée par d’anciens et actuels boursiers IFS.

Production de Recherche
En 2019, nous avons attiré 897 candidatures pour de subventions de recherche individuelles. Sur le total des projets proposés, 132 subventions ont été accordées, dont 47% concernaient les ressources biologiques dans les systèmes terrestres, 35% portant sur les ressources en eau et les ressources aquatiques et 18% sur la sécurité alimentaire, la diversité des régimes alimentaires et des moyens de subsistance sains. Dans ces trois domaines de recherche, nous mettons l’accent sur 28 projets qui sont actuellement en cours.

Les femmes scientifiques représentaient 34% des boursiers de recherche individuels et les hommes 66%. En plus des scientifiques en début de carrière recevant des subventions de recherche, les 765 autres candidats ont reçu des commentaires par des évaluateurs et conseillers IFS qualifiés dans le cadre de nos activités de renforcement des capacités.


Utilisation de la Recherche
Nous avons sélectionné 28 projets pertinents parmi les 153 pour souligner la manière dont la recherche des boursiers est mise en œuvre, qu’elle soit représentative des thèmes, des pays, des régions, des femmes et des hommes. Dans le cadre des efforts de l’IFS pour soutenir le renforcement des capacités de recherche, 12 scientifiques en début de carrière ont reçu des bourses de voyage pour accroître leur visibilité internationale, leur mise en réseau et leurs possibilités de collaboration. Les bénéficiaires ont indiqué comment ce soutien était l’opportunité de partager des résultats avec des scientifiques du monde entier, de nouer des contacts avec des collègues expérimentés dans leur domaine et d’apprendre de nouvelles méthodes et approches.

Regarder en Arrière et en Avant
Dans le rapport annuel de cette année, nous sommes heureux de reconnaitre le soutien de longue date de la DFG, la Fondation allemande pour la recherche, l’un de nos partenaires institutionnels depuis 1975. Nous sommes également reconnaissants au Dr Yogeshkumar Naik, Professeur d’Écotoxicologie à l’Université Nationale de Science and Technology au Zimbabwe, pour nous avoir permis de dire comment les subventions IFS ont joué un rôle dans sa carrière de chercheur.

En 2019, nous nous sommes engagés dans un processus collaboratif et étendu pour développer notre nouvelle stratégie pour 2021–2030, sous le thème «Investir dans de futurs scientifiques». La stratégie représente une évolution dans notre approche visant à améliorer la capacité de recherche, reflétant les changements dans le contexte contemporain. Alors que l’IFS continue de mettre l’accent sur la qualité et la pertinence du nombre croissant de recherches qu’il finance, la stratégie 2021-2030 plaide en faveur d’une meilleure concentration des ressources dédiées au soutien de scientifiques prometteurs en début de carrière (n’étant plus définis par l’âge), qui sont fondamentales pour accroître les capacités scientifiques et relever les défis nationaux et mondiaux.
Improving planning of research by early career scientists

It is a declared objective of IFS to improve planning of relevant research by early career scientists in low- and lower-middle-income countries. We aim to do this by:

- Providing un-bureaucratic granting opportunities and capacity enhancing support to young scientists to do research in the developing world.
- Recruiting and using numerous independent reviewers.
- Attracting large numbers of applicants.
- Providing all applicants with detailed feedback.
- Holding dedicated training, supporting alumni to associate, supporting others planning research, and empowering other research councils to do the same.
Ms Sanata Traoré, following a focus group discussion with farmers in Baguineda, Mali.
IFS Continues Its Role as a Valuable Scientific Partner

In 2019, IFS was jointly engaged with a variety of strategic partners across a spectrum of topics ranging from research trends in chemical, pharmaceutical, food and agricultural sciences; water and natural resource management; and biodiversity; to agriculture research for development, applied nutrition, and approaches for gainful and impactful research by early career scientists. These events included (descriptions follow):

- The 6th IFS-NRCT-PERCH-CIC Workshops: ASEAN Research and Innovation Initiatives
- Project Design: Writing a Scientific Proposal Training Workshop
- ALTER-NET – EKLYPSE Workshop on Development Cooperation and Biodiversity for Sustainable Development
- Agri4D, Zero Hunger by 2030, Our Shared Challenge! Drivers of Change and Sustainable Food Systems
- Symposium of the Nutrition Third World – The Applied Nutrition Research Paradigm: Challenges, Opportunities and Future Expectations for the Global South
- Sri Lankan Academy of Young Scientist (SLAYS)
- Implementing Research: Methodological and Management Challenges

The 6th IFS-NRCT-PERCH-CIC Workshops: ASEAN Research and Innovation Initiatives, Chiang Mai, Thailand (February)
IFS co-organized these workshops with the National Research Council of Thailand (NRCT) and the Center of Excellence for Innovation in Chemistry (PERCH-CIC), Office of the Higher Education Commission, Ministry of Education. The aim of the workshops was to provide scientists in the region and elsewhere with interactive discussions on scientific methodology and new research trends in chemical, pharmaceutical, food and agricultural sciences, as well as related disciplines. Approximately one hundred participants from Cambodia, Indonesia, Lao, Myanmar, Taiwan and Thailand attended the workshops and contributed to the oral presentations and poster sessions.

Project Design: Writing a Scientific Proposal Training Workshop, Bangkok, Thailand (March)
For this workshop, IFS partnered with the Water and Natural Resources in South-East Asia (WANASEA) project. The main objective of the workshop was to improve the quality of project proposals formulated by WANASEA’s Higher Education Institutions (HEIs) in the field of water and natural resource management (WNRM). More specifically, the training focused on the two complementary sides of project design: scientific and administrative. Articulation of ideas and description of essential steps of a scientific project were taught, as well as concrete and practical tools to identify and answer calls for proposals. Academic and administrative staff involved in scientific activities related to WNRM joined the training. A holistic approach was taken since WNRM issues are clearly connected to their societal environment. In addition, the inclusive approach combined learning about both the scientific and professional aspects of research and teaching activities, with sessions designed to address HEIs’ needs and promote collaboration and institutional commitments among staff.

ALTER-NET – EKLYPSE Workshop on Development Cooperation and Biodiversity for Sustainable Development, Ghent, Belgium (June)
ALTER-NET is a network of research institutions that work on biodiversity and the EU project EKLIPSE is on ecosystem services and biodiversity. Workshop participants were academics, Belgian and European commission officials, and representatives from NGOs including IFS and WWF. The purpose of the workshop was to 1) determine whether the EU biodiversity strategy and policies should give direction to the national development cooperation programmes; and 2) consider if biodiversity mainstreaming in development cooperation has been a priority and identify best practices. One of the aims of the workshop was to determine how it will contribute to a post-2020 biodiversity strategy for the EU.

Agri4D, Zero Hunger by 2030, Our Shared Challenge! Drivers of Change and Sustainable Food Systems, Uppsala, Sweden (September)
IFS organised a session on sustainable landscapes at the Agri4D Conference organised by Swedish University of Agricultural Sciences (SLU) and the Swedish International Agriculture Network Initiative (SIANI). The main aim of the conference was to promote knowledge exchange for improved sustai-
nability and resilience in food systems. This event was for researchers and professionals working with and/or interested in agriculture research for development. Participating in the conference were PhD students and senior scientists, along with experts from social and political sciences; soil, crop and animal sciences; and the fields of economics, forestry, horticulture, natural resources and veterinary medicine.

**Symposium of the Nutrition Third World – The Applied Nutrition Research Paradigm: Challenges, Opportunities and Future Expectations for the Global South, Brussels, Belgium (September)**

IFS was invited to present its programme of support for scientists in low- and lower-middle-income countries. The purpose of the symposium was to discuss challenges, opportunities and expectations of applied nutrition research in the “global south”.

**Sri Lankan Academy of Young Scientist (SLAYS), Colombo, Sri Lanka (October)**

Under the umbrella of the Global Young Scientist, SLAYS is a multidisciplinary team who believe that young scientists in Sri Lanka should play a key role in producing research for impact and safeguarding the quality of research now and in the future. The annual SLAYS Conference provides a common platform that unifies young scientists spread out across the country, with the intention of promoting and uplifting research culture and attitudes and sharing best approaches for gainful and impactful research. It is the largest national conference for early career researchers in Sri Lanka and is attended by about 150 people every year. As an invited guest speaker, IFS gave a presentation entitled “Empowering young researchers – Tips for winning grants”. Other speakers included senior academics from national institutions, and professionals from foundations, industry and the health sector, touching on subjects such as grant writing, scientific integrity, innovative thinking, work-life balance and public outreach.

**Implementing Research: Methodological and Management Challenges, Phnom Penh, Cambodia (December)**

IFS partnered with the Water and Natural Resources in South-East Asia (WANASEA) project by sharing its vast experience of research grants, capacity enhancing, research topics supported, review process and the new IFS 2021-2030 strategy. The main objective of this training was to address the challenges of effective implementation of a research project in the field of water and natural resources management among WANASEA’s Higher Education Institutions (HEIs). The goals were to strengthen the capacities of young researchers to implement multidisciplinary research activities and to improve the capacities of their institutions to support the implementation of a project. The approach used for the training was inspired by the reverse classroom method, which means that few lectures were given. The knowledge shared was found through the experience of the trainees and also through collective thinking and brainstorming.
Increasing production of research in low- and lower-middle-income countries

It is a declared objective of IFS to improve production of relevant research by early career scientists in low- and lower-middle-income countries. 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 advisers and reviewers evaluating and feeding back to researchers.
• IFS grantees receiving travel grants to increase international exposure, networking and collaboration.
• 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 low- and lower-middle-income countries, and by enhancing capacity to conduct research and engage with others in their research.
Ms Tran Thi Thanh Xuan doing phage plaque assay.
847 individual research applications were received, from which 303 were reviewed. Out of the total proposed projects, 109 grants were awarded, of which 51 dealt with biological resources in terrestrial systems, 20 with water and aquatic resources, and 38 with food security, dietary diversity and healthy livelihoods.
A selection of new individual research grants given in 2019

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 is a complex and difficult issue to balance with social and economic demands; it is about managing people as much as nature.

**MR JOHN OYEWALE, NIGERIA**

*Molecular characterisation of mobile colistin resistance genes in livestock and clinical enteric bacteria in selected states of southwestern Nigeria*

Treatment failures from enterobacterial multidrug resistance are on the rise globally, easily outstripping the development of new antibiotics. Colistin, once a forgotten antibiotic in clinical practice, is now a drug of last resort against such infections. It also has been used for decades in livestock production. A plasmid-borne, transmissible mobile colistin resistance (MCR) mechanism was detected in *Escherichia coli* and *Klebsiella pneumoniae* isolates from livestock and clinical isolates in China in 2015. Since then, MCR genes have been detected on nearly all continents, threatening the long-term efficacy of colistin in multidrug-resistant enterobacterial infection therapy. This study aims to investigate the prevalence of colistin-resistant and MCR-carrying enteric bacteria; assess intra- and interspecific transmissibility of MCR genes; investigate strain relatedness and clonal transmission of mcr-bearing isolates; and analyse the putative MCR proteins.

**MS FLORENCE MAHOUTON ANATO, BENIN**

*Field evaluation of the efficacy and persistence of soil application with cashew nut shell liquid formulations in the control of Tephritid flies*

Fruit damage in mango production by insect pests in tropical Africa is mainly due to fruit flies (*Diptera tephritidae*), of increasing economic importance since the accidental introduction of the notorious species *Bactrocera dorsalis* (*Hendel*) into the continent. Control methods against Tephritid fruit flies target both the juvenile stages in the soil and the adults. Previously, we performed laboratory experiments to evaluate the efficiency of cashew nut shell liquid (CNSL) formulations as potential biopesticides to control late-instar larvae and pupae of *B. dorsalis* in the soil. The alcoholic and aqueous CNSL formulations were tested and the persistence of each formulation was also determined. The findings revealed the susceptibility of the third-instar larvae to the various concentrations of each CNSL formulation applied by contact. We expect that soil application with CNSL formulations could be a promising and effective control of *B. dorsalis* and could be combined with other control methods to provide an effective integrated fruit fly management strategy.

**MR JOSEPH TAMALE, UGANDA**

*Investigating the role soil nutrients play in regulating soil greenhouse gas fluxes and N leaching from two contrasting ecosystems: A nutrient limited tropical forest and an intensively fertilized sugarcane plantation in Uganda*

Soil greenhouse gas (GHG) fluxes and nitrogen (N) leaching are expected to increase significantly in the near future in humid tropical ecosystems due to increased deforestation, atmospheric N deposition and agricultural intensification. However, relatively few studies have investigated these biogeochemical processes in the tropical ecosystems. This study investigates how soil nutrients regulate soil greenhouse gas (GHG) fluxes and N leaching in a nutrient limited tropical forest and an intensively fertilized sugarcane plantation in northwestern Uganda. Our findings will (1) contribute to the scientific discourse on how soil macronutrient (nitrogen, phosphorous, potassium) limitations regulate GHG fluxes in humid tropical forest ecosystems, (2) permit assessment and comparison of land use specific GHG flux budgets to inform policy-makers about the
likely environmental impacts of forest conversion to sugarcane production, and (3) provide insights on nutrient use efficiency in large-scale fertilizer-intensive sugarcane farms, hence forming a basis for optimum fertilizer use.

**MS CORINE SINSIN, BENIN**

Assessing the vulnerability and economic value of mangrove ecosystems to inform their sustainable management in Benin

Mangroves are productive coastal ecosystems that are important to human well-being, including provision, support, cultural and regulation services. However, mangroves are threatened by climate change and their trajectory is still not clear, especially in Africa. Yet this is crucial to guide sustainable management actions. In addition, properly accounting for mangroves in development strategies requires detailed understanding of their economic value, and this has been a challenging task for scholars. Mangroves are also found along the coast of Benin where they play important roles for local communities. There are increasing efforts in the country for mangrove conservation, but still, scientific data are lacking to guide decisions of policymakers, including their vulnerability to climate change and monetary value. This project aims to (i) assess the vulnerability of mangroves to sea level rise and climate change, (ii) assess current and future distribution of mangrove ecosystems in Benin under low and high Representative Concentration Pathways of IPCC4 emission scenarios coupled with different Shared Socio-economic Pathways, and (iii) estimate monetary value of mangroves resources in Benin.

**MR SAMSON SHIMELSE JEMANEH, ETHIOPIA**

Attractiveness of area exclosures carbon sinks and economic valuation under different management systems based on fixed plot analysis in Tigray Region of North Ethiopia

Carbon emission is supposedly the strongest causal factor for global warming. This project aims to estimate the economic value of ecosystem carbon sequestration and soil nutrient restoration obtained through the conversion of degraded grazing lands into exclosures.

It explores the impact of exclosures of areas on the biodiversity and C sequestration of restored vegetation, as well as on soil seed banks, and identifies synergies between them through fixed plot analysis methods. The research informs what exclosures contribute in the battle to mitigate climate change and tries to estimate the economic value of exclosures. A combination of approaches will be taken to obtain data, including paired t-tests, Pearson correlation and step-wise regression analyses.

**MR LOMBART MESMER MAURICE KOUKAKOU, IVORY COAST**

Assessing the risk of invasion in estuarine and coastal environments: A case study of Îles Ehotilés National Park in Ivory Coast

Invasive alien species are major threats to biological diversity, agriculture and human health, jeopardizing native animal and plant species, disrupting ecosystem services and causing biotic changes. In addition, under the effects of climate change, many ecosystems such as estuarine and coastal environments become more vulnerable to biotic changes due to increased temperatures, humidity and the rise of sea level, resulting in salt intrusion and mangroves diebacks. These changes in biological diversity are being worsened because of anthropogenic activities that provide increased opportunities for dispersal and growth of invasive alien species. Îles Ehotilés National Park, in an estuarine area of coastal ecosystems in Côte d’Ivoire, does not escape these environmental problems, and is gradually deteriorating. We hypothesize that Îles Ehotilés is prone to colonization by invasive alien species, particularly with its encroachment by anthropogenic activities. Our project aims to estimate the vulnerability of Îles Ehotilés, using ants as a biological indicator. We expect to provide relevant baseline data which will help policy-makers and local people to conduct management actions.

**MS SEDERA NOROTIANA RASAMBO, MADAGASCAR**

Domestication of tsiperifery, Piper spp., an endemic wild pepper of Madagascar, for sustainable forestry management and conservation

Development and conservation organizations have assumed that increasing the economic value of non-timber forest products (NTFPs) would promote forest conservation. This hypothesis stays controversial. There are cases where exploitation has had negative effects on the forest. Domestication of these species was then proposed as a better alternative. Questions emphasized the ability of domestication to incorporate socio-economic development with forest conservation. In Madagascar, the overexploitation of tsiperifery, an endemic wild pepper, is threatening the species with extinction. A domestication program of this species was then implemented to ensure sustainable exploitation and conservation of its natural habitat. The domestication of wild pepper refers both to the recovery of the resources destroyed in the forest and the agriculture plantation. This study focuses on domestication as a socio-technical innovation in peasants’ involvement in its exploitation. It attempts to understand the policy process of innovation and the impact of change in forest management policy.

**MR MUTINDA JOSPHAT, KENYA**

Examining the role of bacteria in mediating oviposition responses of malaria mosquitoes

Malaria has been recognized worldwide as a serious infectious disease, causing approximately 900,000 deaths each year, the majority in children under five years of age, especially in Sub-Saharan Africa. The success, distribution and reproductive fitness of a mosquito species is largely determined by the choice of appropriate oviposition sites, which is influenced by different physical, chemical and environ-
and non-volatile constituents. However, the contents of these major secondary metabolites in different varieties differ depending on a number of factors, whereas geographical location has an effect. Selecting the right variety is necessary for growing and exploiting this medicinal plant. This study focuses on profiling secondary metabolites from the rhizome extract of *C. longa* varieties using liquid chromatography coupled with mass spectrometry to discriminate metabolic differences between these pure lines which might contribute to the propagation and breeding program, medicinal quality control or optimization of culture conditions of this high-value plant.

**MR UKPE AJIMA, NIGERIA**  
Bioactivity guided isolation and characterization of antimalarial principles from *Landolphia owariensis* leaf extract

*Landolphia owariensis* is a plant whose leaves are being used by traditional medicine practitioners to treat malaria, among other ailments. A major public health burden in the tropics, malaria is a parasitic disease caused by Plasmodium species. Most antimalarial drugs in current use are associated with a variety of shortcomings such as unacceptable side effects and poor pharmacokinetics. Parasite resistance is also a major problem in malaria therapy and there is new evidence of the parasite developing resistance to Artemisinins, the latest weapons in the fight against the disease. It is therefore rational to search for new antimalarial drugs, especially from the rich available biodiversity. The study aims at isolating and characterizing the antimalarial constituents of *Landolphia owariensis* leaves, to contribute to the search for new drugs or leads useful in the treatment of malaria.

**MS KIEU OANH NGUYEN T, VIETNAM**  
Discrimination of secondary metabolite profiles of *Curcuma longa* L. pure lines collected in different regions of Vietnam

*Curcuma longa* L. has long been used worldwide as a food, cosmetic, traditional medicine and natural dye, especially in Vietnam where the cultivated area has increased due to the high amount of phytopharmaceuticals. Curcuminoids and terpenoids have been considered as typical bioactive compounds of this species. Previous pharmacological studies reported antioxidant, anti-inflammation and chemotherapeutic activities of curcuminoids, including curcumin and its derivatives (demethoxycurcumin and bisdemethoxycurcumin), and antibacterial, antineoplastic potentials of terpenoids including aromatic, non-aromatic, volatile and non-volatile constituents. However, the contents of these major secondary metabolites in different varieties differ depending on a number of factors, whereas geographical location has an effect. Selecting the right variety is necessary for growing and exploiting this medicinal plant. This study focuses on profiling secondary metabolites from the rhizome extract of *C. longa* varieties using liquid chromatography coupled with mass spectrometry to discriminate metabolic differences between these pure lines which might contribute to the propagation and breeding program, medicinal quality control or optimization of culture conditions of this high-value plant.

**MR GNEISSONGUI JOSEPH YEO, IVORY COAST**  
Biodiversity of edaphic fauna, and contaminants characterization in the soil biological matrix of the Banco humid forest, Abidjan, Ivory Coast

This investigation aims to characterize the abundance and diversity of edaphic invertebrates as well as the contaminants of the soil biological matrix following changes in the toposequence. Forests, soils and soil organisms play an important role in nutrient cycling, carbon storage and climate change mitigation. Unfortunately, forest systems undergo a profound change with increasing urbanization, forest logging and soil chemical contamination. In Côte d’Ivoire, most studies devoted to contamination relate to the characterization of the aquatic fauna and Akouédo dump. The response of urban forest soil organisms to contaminants deserves a better analysis. Data collection in the urban forest of Banco will take place along six transects of three treatments each. A plot of 30 x 30 m will be bounded on each treatment, where the samples will be taken considering two microhabitats (at the foot of tree trunks, between tree trunks). On the outskirts of the Banco forest, three contaminated sites will also be identified for samplings.
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.

**Water and Aquatic Resources**

Fish diversity in Rwanda is poorly described due to notorious difficulties in identifying some species. Lake Kivu is one of Rwanda’s ichthyogeographic sub-units. Of 82 species belonging to 12 families known in Rwandan waters, only 28 are from Lake Kivu and its effluents: 19 cichlids and nine non-cichlids. All species were identified with traditional taxonomy, which is difficult due to lack of incongruent characters in many species and characters instability especially during the fish development. Integration of morphological and molecular characters, particularly DNA barcoding, are more reliable during identification. Assessment of a recent biodiversity crisis is leading to correct delineation and discovery of different taxa of fishes and other organisms in general. This is important for biodiversity and disease management, conservation and decision-making. The aim of this study is to integrate morphological and molecular data, especially 16S and COI gene of mitochondrial DNA, to correctly characterize Lake Kivu fishes.

**MS Tran Thi Thanh Xuan, Vietnam**

In-vivo efficacy of phage therapy against the white spots in the internal organs disease in striped catfish Pangiasianodon hypophthalmus

Sustainable striped catfish production in the Mekong Delta in Vietnam (MKDVN) has been negatively impacted by antibiotic resistant diseases, which were found more seriously in fish farms, and also by antibiotic residues in exported striped catfish products. In such circumstances, phage therapy is now considered an alternative to antibiotic therapy. It is the therapeutic use of phages (viruses infecting only bacteria) to prevent and treat pathogenic bacterial infections. Recently, my research group has isolated phages against *Edwardsiella ictaluri* that cause the white spots in the internal organs in striped catfish. In this study, efficacy of phage therapy against the disease in striped catfish will be investigated. First, stability of the phages to factors such as temperature, pH and organic solvents is conducted. Second, the selected phages will be used in in-vivo trials for prophylaxis of infected catfish at laboratory scale. The project’s outputs are expected to enhance the value chain of striped catfish and to reduce risks for fishermen and the fisheries industry in the MKDVN.

**Mr Dennis Gitundu, Kenya**

Multi-hydrological model approach to flash floods risk assessment in Enkare Narok River basin

Since the 1990s, Narok town has experienced flash floods during the rainy season, leading to loss of life and property. Mitigation measures such as construction of check dams have so far been insufficient. In addition, there are changes in the flood environment and increased vulnerabilities due to dynamics associated with population pressure, land use change and climate variability. This study is aimed at managing flash flood risks in the Enkare Narok River basin. A prerequisite for flood management is in-depth knowledge of prevailing hazards and risks. However, this catchment is data scarce due to the limited number of river gauges and weather observation stations. An automatic weather station was installed at the head waters of two sub-catchments while river gauges were installed to monitor stream flow for hydrologic and hydraulic modeling. Future land use and land cover will be modeled, taking into account population growth, local government policies and proposals in current urban plans, for understa-
MS ELLEN KAYENDEKE, UGANDA

Impact of land use changes and irrigation water withdrawals on the hydrology of tropical papyrus wetlands

Papyrus wetlands support community livelihoods through provision of water for domestic use, crop irrigation, water purification and flood regulation. However, there is increased pressure on wetlands because of agricultural expansion, leading to frequent floods and drought incidents within affected catchments. Previous research demonstrated that the papyrus root-mat compresses in response to increasing water level, which increases the wetlands’ water storage capacity. The research proposed that rather than encroaching on the wetlands, the stored water can be utilized for irrigation of small-scale agriculture, therefore increasing farmer adaptation to climatically induced water shortages. However, there is a need for continued monitoring of the wetlands’ hydrological regime for a better understanding of the variation in stored wetland water at different spatial and temporal scales. The study will lead to quantification of water storage capacity of papyrus wetlands and information on the timing and duration.

MR MUHAMMAD SHAHID, PAKISTAN

Putting waste into use: Recycling of textile industry wastewater for use in agriculture

Industrialization has increased demand for clean water by putting stress on declining water resources, not only for human and animal consumption but also for agriculture. Textile industries are the largest consumers of water and producers of huge amounts of wastewater. In Pakistan, about 65% of the textile industry is located in Faisalabad, comprising about 55% of exports. This large industry is also a great source of wastewater, stressing the already limited supply of clean water for the agriculture sector, the backbone of Pakistan’s economy. Large amounts of textile wastewater loaded with heavy metals and azo dyes are released into watercourses without effective pretreatment. There is a need for cheaper natural means of wastewater treatment to prevent groundwater contamination and make it available for irrigation.

This research aims at the application of two promising metal-tolerant and azo dye-degrading Bacillus spp. strains in single and mixed inoculation forms for bioremediation of actual textile wastewaters, followed by the utilization of this bio-treated wastewater for irrigation purposes.
Food Security, Dietary Diversity and Healthy Livelihoods

Food security exists when people have access at all times to sufficient, nutritious food in order to be able 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 of IFS’s projects dealing with these aspects.

**MR SYLVESTER OCHWO, UGANDA**

Understanding the epidemiology and economic loss due to lumpy skin disease in selected disease hotspots in Uganda

Lumpy skin disease (LSD) is a viral disease of cattle that is characterised by fever, increased nasal secretions, nodules on skin, mucous membranes and internal organs, enlarged lymph nodes, edema of the skin and sometimes death. It causes severe production loss and irreversible damage to cattle hides, therefore affecting livestock farmer incomes. LSD is endemic in Uganda, with annual outbreaks in all regions of the country, although in varying incidences. Potential endemic hotspots for LSD outbreaks have been identified, highlighting the need for risk-based surveillance in these areas to establish the actual disease prevalence and risk factors for maintenance of the disease. This study will determine the true prevalence of the disease, and circulating viral genotypes, and estimate the economic loss incurred by farmers due to treatment of wounds caused by LSD virus and vaccination during outbreaks. The outcome will contribute to informing livestock farmers and the Ugandan government on an effective control strategy for LSD.

**MS MUNKHJARGAL TSERENDORJ, MONGOLIA**

Prevalence and genetic analysis of filarial nematode in camels of Mongolia

Cameline filariasis is an infectious disease that has an economic impact in camel-rearing areas of the world. The status of the hemoparasitic disease, dipetalonemiasis, among the camel population in Mongolia was not clear in the past. However, a previous study indicated the presence of *Dipetalonema evansi* in Bactrian camels of Mongolia. This study will determine the prevalence of dipetalonemiasis in camels and generate a genetic analysis of the filaroid nematode *D. evansi* in indigenous camels with traditional husbandry management in the Gobi regions of Mongolia. Based on the results of the project, the current status of dipetalonemiasis and the relationship and diversity of *D. evansi* in Mongolia will be determined. This data could be used as base information for initiating prevention and control programs for this parasite. In addition, a countrywide surveillance program will be designed and recommended to the government.

**MR HOSPICE SOSSOU, BENIN**

Assessment of Kersting’s groundnut (Macrotyloma geocarpum) seed systems and quality seed production technologies in Benin

Improving farmers’ access to quality seed is fundamental for the development of effective value chains of neglected crop species (NCS). Kersting’s groundnut (*Macrotyloma geocarpum*) is a nutritious and economically important NCS threatened with disappearance in Africa because of lack of effective seed systems and technologies for quality seed production and distribution. This study is designed to improve farmers’ access to quality seed of Kersting’s groundnut (KG) by facilitating commercial and community seed production and distribution. Farmers and seed dealers will be surveyed across the major growing areas of KG in Benin to evaluate existing seed systems and traditional KG seed management practices. Following field experiments, traditional conservation methods used to store KG seed will be evaluated for their effectiveness to keep KG seed quality. The ground will be then set to promote efficient KG seed systems and improve its production.

**MR OLUWADUROTIMI AWORUNSE, NIGERIA**

Ethnobotany and genetic diversity assessment of Telfairia Occidentalis Hook F. (Fluted Pumpkin) in Southern Nigeria

Telfairia occidentalis (fluted pumpkin) is a cucurbitaceous vegetable widely consumed in Nigeria for its nutritious and medicinal leaves, seeds and succulent stems. Its production constitutes a major source of revenue in many rural communities. However, limited knowledge on genetic diversity, ethnobotany and uncharacterized morphotypes is a major constraint to improving yield in fluted pumpkin. Ethnobotanical studies and a genetic variability assessment will be conducted to document relevant ethnobotanical information on indige-
nous knowledge and local use pattern variation of *T. occidentalis* in different traditional settings of Southern Nigeria, to collect accessions and passport data from different agro-ecological zones in Southern Nigeria, and to evaluate genetic variability in the collected accessions using morphological and molecular markers. Findings from this research will identify fluted pumpkin accessions that could be used in heterosis crossing to produce superior hybrids, which can further be utilized in breeding and improvement programmes to develop superior genotypes. Local knowledge and use pattern variation of fluted pumpkin that may not have been reported will be documented.

**MS EMINSÉDÉ AUDE KELOMEY, BENIN**

*Genomic characterization of viral pathogens of bees associated with *Apis mellifera* and its parasite mite Varroa destructor in the apiaries of Benin*

Bees are important not only for the pollination of local flora and crops but also for other hive products such as honey, propolis, pollen, wax and royal jelly. Beekeeping has positive impacts on agricultural production and rural household income. Like all animals and humans, bees are also susceptible to bacteria, viruses and parasites. The presence of viruses and their relationship with bee mortality are a topic of concern that is being studied around the world. The Varroa parasite affects honeybee colonies and causes the decline of the bee population with a loss of biodiversity. This study assesses the influence of viral pathogens on bee colony mortality and their relationship with the parasitic mite of bees, *Varroa destructor*. It will help to
preserve the biodiversity of bee populations in Benin and increase crop and apiculture yields.

**MS SANATA TRAORÉ, MALI**

Wastewater irrigated vegetable production in Bamako and its peri-urban settlements: Contamination pathway of microorganisms and heavy metals

In Mali, inadequate and inappropriate urban sanitation infrastructure has led to untreated wastewater ending up in water bodies used for irrigation in urban and peri-urban agriculture. Smallholder farmers in search of irrigation water and manure to increase crop yield end up using water from untreated wastewater drains, with negative impacts on public health and the environment. Local authorities do not allocate funds for wastewater treatment for vegetable production since it is not a realistic option and banning its use will threaten livelihoods, urban vegetable supply and poverty alleviation. This study assesses the characteristics of wastewater-irrigated vegetable production in Bamako, Kati and Baguida to address post-harvest contamination and decontamination of wastewater-irrigated vegetable crops, including value-chain actors, foodborne pathogens and heavy metals of agricultural inputs used in vegetable production, common household washing treatments in reducing microbial levels on lettuce, quality of lettuce produced using manure, different soil types and two sources of water.

**MS THI NGOC HA LAI, VIETNAM**

Effects of post-harvest UV-B irradiation on antioxidant phenolic profile and cell wall-degrading enzyme activity of Rhodomyrtus tomentosa fruit during storage

Sim (Rhodomyrtus tomentosa) has long been used in folk medicine in Southeast Asia and is classified as one of 240 neglected and underutilised crop species of Vietnam. The ripe fruit is a berry with a purplish black color and an astringent taste due to the presence of anthocyanins and tannins, respectively. Sim is an important source of piceatannol, a promising health-promoting stilbene shown to have potent biological activities, including antioxidant, anti-cancer, anti-inflammatory and anti-obesity properties. Light intensity and quality are recognised as factors in the biosynthesis of secondary plant metabolites, cell wall metabolism and microbial quality of fruit. The objective of this study is to determine the effect of UV-B treatment on the change of phenolic profile, fruit softness and microbial quality of sim during storage. The results can suggest a good way to have sim with higher biological activity and longer storage time.

**MR YAMONEKA JUSTE, DEMOCRATIC REPUBLIC OF CONGO**

Investigating the use of native and modified fats of Irvingia gabonensis seeds and Dacryodes edulis pulp to formulate food emulsions, to compare with existing commercial emulsions and understand their potential industrial applications

*Irvingia gabonensis* seed and *Dacryodes edulis* pulp are important sources of fat not exploited on an industrial scale. Previous work on these fats have shown their potential in various applications in the food industry. The modification made on these two fats (with binary blend and enzymatic interesterification) showed that it is possible to diversify their uses. Some mixtures based on *I. gabonensis* showed melting and texture behavior similar to commercial margarines. A cocoa butter substitute prepared after enzymatic interesterification (of a mixture based on *I. gabonensis* and *D. edulis*) demonstrated its potentialities in confectionery industries. It is now important to promote oil food formulations to initiate the valorization of these fats on an industrial scale. This study will formulate and characterize food emulsions such as creams and margarines. Characterization of emulsions (i.e., physicochemical and technofunctional properties), and their stability to temperature variation (and in time), will be realized. A comparative study is envisaged between formulated and commercial emulsions.

**MS THI THANH LOAN LE, VIETNAM**

Consumers’ perception of food safety risk and risk reduction strategies: Evidence from self-provisioning of vegetables in cities of Vietnam

Vietnamese consumer concerns about food safety, particularly vegetables, are growing, as they have observed farmers’ reliance on pesticides. The perception of health risk has motivated urban consumers to grow vegetables for family consumption, becoming the norm in many cities in Vietnam where population density is high and land is scarce. This has contributed to improvement of household food security and food safety. Despite this implication, there is no research on how risk perception and other factors influence consumer decision-making toward self-provisioning of vegetables. The study investigates the determinants of consumer intention and behavior, and draws out policy implications to support urban farming and food safety risk reduction. This is the first research to employ an applicable theoretical framework like Protection Motivation Theory to explain a particular risk reduction strategy. The findings will be useful for government, the food industry and consumers in Vietnam.
MS UGYEN YANGCHEN, BHUTAN
Is Bhutan ready for 100% organic agriculture?

In 2006, Bhutan declared a policy of 100% organic agriculture by 2020, as the country’s development approach is guided by a concept of Gross National Happiness (GNH). Organic farming is in line with the four GNH pillars of good governance, sustainable use of natural resources, protection and conservation of environment and preservation, and promotion of cultural heritage. However, concurrent strategies to create an enabling environment for implementation, such as pricing, certification, marketing and availability of organic inputs, and management strategies, are limited. Moreover, it is not known whether Bhutanese farmers are in favour of converting to organic agriculture. Further, there has been no study done on consumers’ perceptions of organic products and their willingness to pay a premium price. The study draws on adoption and diffusion of an innovations model and takes the extensive literature on farmers’ and consumers’ decision-making with regard to organic agriculture as a starting point for identifying relevant factors. The results will be useful for strategies to motivate farmers to convert to organic and consumers to buy organic produce.

MR RICARDO ENRIQUE GRADOS TORREZ, BOLIVIA
Evaluation of biological activity of alkaloids in Lupinus mutabilis as metabolic regulators and its role in c-HDL/LDL levels and insulin secretion

Obesity is a chronic disease that leads to complications such as type 2 diabetes mellitus (T2DM). In Bolivia, the number of overweight and obese people has increased markedly in the last 15 years, as has the prevalence of T2DM. Many Andean grains (cereals and pseudo-cereals) have beneficial nutritional properties, from macronutrients to various alkaloids with biological activity. For example, plants of the genus *Lupinus* contain quinolizidine alkaloids, which have a chemical structure similar to synthetic drugs such as Torcetrapib that inhibits Cholesterol Ester Transfer Protein favoring c-HDL increase. Phase 2 clinical studies conducted with healthy, overweight and T2DM patients indicate that Andean grains used in a nutraceutical product have the ability to increase serum levels of c-HDL and insulin. However, it is necessary to perform more sophisticated molecular biochemical tests together with bioinformatics tools to determine the mechanisms of alkaloids present in *Lupinus*, to use these natural drugs optimally with greater activity and selectivity and with fewer side effects and less toxicity.
Increasing use of research results produced by IFS

It is a declared objective of IFS to improve planning of relevant research by early career scientists in low- and lower-middle-income countries. We aim to do this by:

- IFS-funded research being accepted for presentation, or researchers funded by IFS grants being invited speakers at international conferences.
- IFS-funded researchers being recognized as experts in their fields and being invited to policy meetings or expert groupings.
- Well-qualified IFS-funded grantees becoming IFS experts, advisers and reviewers.
- IFS grantees disseminating their approved IFS-funded research results in popular form (TV, radio, workshops, policy briefs, booklets/cartoons).
- IFS grantees’ research results contributing to innovation by being used in new products, services or policies.

IFS contributes to innovation through supporting research of early career scientists in low- and lower-middle-income countries, enhancing capacity to share research and engage with policy processes, and building linkages to those who can support the use of their research.
Ms Bathé Diop, hydroponic screening for iron toxicity with technicians in Senegal.
Putting research into use

Knowledge of the sustainable management of biological, water and energy resources is not enough. To help reduce poverty and attempt to solve some of the environmental challenges that we face, we also need to take action. That is why IFS undertakes a range of initiatives that can contribute to innovation and also why the IFS mandate includes not only enhancing capacity but also the agency of early career researchers to put their results into use.

Linkages between IFS initiatives that contribute to our innovation approach
Travel grants

IFS travel grants are a highly-valued source of support for our grantees to enable them to present papers in their subject areas at conferences. The grants reflect IFS’s acknowledgement of the importance for career and intellectual development of attending and presenting at conferences, making contact with other scholars in their fields, and exchanging ideas. In 2019, we were pleased to fund 12 scientists from Bangladesh, Burkina Faso, Cameroon, Ghana, Senegal and Tunisia to travel to professional gatherings in France, Italy, the Netherlands, South Africa and Spain. These excerpts from some of their trip reports offer a glimpse into their experiences.

Mr Slim Ben Jemaa, Tunisia
37th International Society for Animal Genetics Conference, Lleida, Spain
I presented a poster summarizing work that was recently published in the journal Animal Genetics, entitled “Inferring the population structure of six North African sheep breeds using a medium-density SNP chip”. During an interesting discussion with the editor of Animal Genetics, he proposed merging with other research groups to encompass more ovine breeds, allowing us to produce an interesting paper with greater international visibility. I also established potentially fruitful contacts with a post-doctoral fellow from the International Livestock Research Institute (Nairobi, Kenya) and a member of the medicine and health sciences faculty at the University of Nottingham. I was delighted when the latter colleague told me that he knows me through my work on Tunisian native cattle (Thanks, IFS!).

Ms Assèta Kagambèga, Burkina Faso;
Assistant Professor Md Sazedul Hoque, Bangladesh; Ms Angela Parry-Hanson Kunudu, Ghana
Global Harmonisation Initiative (GHI) 1st World Congress on Food Safety and Security, Leiden, The Netherlands
Ms Assèta Kagambèga: In the microbiology parallel session, I presented the results of my IFS project on Salmonella spp. and Campylobacter spp. in poultry faeces and carcasses in Ouagadougou, Burkina Faso, and I described how we run training workshops for small poultry businesses. This was an opportunity to share my results with scientists from more than 40 countries, to make contacts with colleagues experienced in food safety, and to learn new methods and approaches. As outputs from my IFS projects, I have had seven articles published in international journals. In addition, the strains isolated during the research will add to a Fulbright project on Salmonella characterisation using whole genome sequencing.

Assistant Professor Md Sazedul Hoque:
The congress was useful in terms of learning, discussing and networking on global food safety and security issues with the executives of GHI. I presented the results of my project on formalin in fish in two paper sessions and also as a poster. In addition, I attended a talk by presenters from the publisher Elsevier, where I learned how to prepare an article to be accepted in their journals. The congress also opened the scope for several potential collaborations among IFS grantees from different countries in the field of food safety.

Ms Angela Parry-Hanson Kunudu:
I presented the results of my project on Salmonella and Campylobacter prevalence in chicken in Accra, Ghana. This congress heightened my consciousness of food safety as an integrated process requiring a multidimensional approach. I had been unaware of a global interest in food safety harmonization, and learned about different facets of food safety, regional approaches and challenges, and ways forward to achieving global food safety. Being a small conference, I had the opportunity to interact with academics, representatives of industry giants, international consultants and representatives of international organizations such as EFSA, UNIDO and WHO.

Mr Seumo Tchekwagep Patrick Marcel, Cameroon
70th Annual Meeting of the International Society of Electrochemistry (ISE), Durban, South Africa
Alongside my poster presentation, I had the opportunity to discuss with the 2016 Nobel Laureate in Chemistry, Sir James Fraser Stoddart. He gave me some tips to overcome some issues that I face in my early career development. He advised me to look for a post-doctorate to have further experience in my research field. He also advised me to look for a collaboration with China, since it is becoming a growing and powerful country with great influence in Africa. One outcome of attending the meeting is that I will become a member of ISE in 2020.

Mr Dioumacor Fall, Senegal
4th World Conference on Agroforestry, Montpellier, France
I gave a presentation on the theme of soil fertility and yield of associated cowpea in an agroforestry system in northern Senegal. My participation in this important conference allowed me to publicize our research activities on agroforestry, deepen our knowledge of the research activities carried out in other countries, and above all, to forge collaborative relationships with other researchers. I also met some IFS staff and grantees to discuss with them about the new IFS strategy.

Mr Olfa Frikha-Gargouri, Tunisia
4th International Symposium on Biological Control of Bacterial Plant Diseases, Viterbo, Italy
I was able to take advantage of this symposium by representing my country, giving an oral presentation and establishing new collaborations. This participation also allowed me to have an abstract published in Journal of Plant Protection. During the symposium, I met several people whom I only knew through their publications and others whom I did not know.
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 153 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.

In pathogen studies, a causal agent was discovered in mycotic diseases in fish, leading to prevention and control measures in Bangladesh. Antifungal agents were developed for control of gray mold on crops in Egypt, and strategies were refined for aflatoxin control in maize-based food across Africa.

IFS grantees are concerned about the global threat to pollinating bee populations. They have identified swarm bees to establish a research apiary in Kenya and also contributed to changes leading to the entry of Benin honey into the EU market.

Genetics studies have become increasingly prominent among grantees’ projects. Genetic improvements were made for tolerance to iron toxicity in rice in West Africa; recommendations were made to Tunisian sheep breeders based on genotyping; Kenyan farmers adopted a maize hybrid for reduced pesticide application; and a genetic diversity collection of taro species samples was established in Togo. In Asia, avian E. coli was genotyped to develop vaccines in Pakistan; rice blight pathogens were haplotyped for improved breeding in Bangladesh; and interactions were described between genetically-modified corn and pests in China.

In the areas of forestry and reforestation, plant species were identified for rainforest restoration in India; a management and conservation tool for mangroves was developed in Madagascar; and arid ecosystems were regreened with acacia species in Senegal. Taking advantage of digital technologies, data sets were generated on biomass litter to populate the African Forestry Database; and data from remote sensing and GIS were used to evict illegal occupants of a national park in Burkina Faso.

The research findings of IFS grantees are having an impact on agricultural extension and production in numerous ways. Being disseminated widely are findings on food safety in chicken processing in Ghana, and on farmers’ grazing management strategies in Benin. Training based on research results was conducted in Kenya with farmers interested in jackfruit cultivation, while planners were trained on ecosystem services in Cambodia. In Benin, demonstration home gardens were established in low-income communities; a no-till seed drill was manufactured; and an awareness campaign was organized on organic waste for market gardeners. Farmer awareness was also raised of the importance of small grains in Zimbabwe, and in Ethiopia showcase events were organized on gully erosion treatment.

IFS research project results continue to make their way into the government sphere, for example, the publication of a policy brief on control of Newcastle poultry and bird disease in Kenya, and the informing of policy decisions on rice cultivation in South Sudan.

From the micro-level of genotyping, 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 impactful projects from 2015 to highlight, presented here are 28 that are representative of topics, countries, regions, women and men, and of all of the many early career scientists who IFS is honored 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.
MR MOHAMMAD NASIF SAROWAR  
Department of Fisheries Biology and Genetics,  
Bangladesh Agricultural University, Bangladesh  
Towards understanding diseases in aquaculture in Bangladesh:  
Molecular approach to characterization of the causal agents

Fish farmers used to think that mycotic diseases were linked to  
bacterial infection. As a result, antibiotic usage was a common  
practice with limited or no effect on disease control. The con-  
firmation during the project of the causal agent led to sustain-  
able prevention and control measures.

MR FELICIEN AMAKPE  
CENAD-ONG Nature and Development Circle Natural  
Resources Management Institution, Benin  
Study of the impact of the seasons on artificial queen rearing of  
the benino-soudanian Apis mellifera adansonii ecotype in the  
Republic of Benin (West Africa)

By proving that our honeys are free of pesticide residue and  
that our honeybees are free of regulated diseases, Benin honey  
is now accepted into the European Union market. The sup-  
porting NGO also entered into agreements with Rotary Inter-  
national and beekeeper associations to sell beekeeping equip-  
ment in the Democratic Republic of Congo and the Republic  
of Togo.

MR SLIM BEN JEMAA  
National Institute of Agronomic Research of Tunisia, Tunisia  
Identification of the genetic structure in Tunisian sheep breeds  
and Genome Wide Association mapping of genes responsible for  
infertility phenotype in the Barbarine sheep

By genotyping rams from the D’man sheep breed on the Il-  
lumina OvineSNP50 chip, we found that three animals were  
purebred. These rams were used extensively to inseminate  
the state flock which is used as a selection base for D’man  
breeding. We therefore advised the managers of the state farm  
against using these rams as sires in the future. As a result of  
studying the effect of the FecLL mutation on the prolificacy  
of the D’man sheep, we made useful recommendations to the  
breeders with whom we collaborated.

MR SYED MASHKOOR MOHSIN GILANI  
Institute of Microbiology, University of Agriculture, Pakistan  
Study on clonal groups, virulence genes, and antibiotic resistance  
of avian pathogenic Escherichia coli (APEC) from poultry birds  
and their zoonotic potential

Data regarding virulence genotyping and antimicrobial sus-  
ceptibility of avian pathogenic Escherichia coli (APEC) isolates  
from Pakistan have been produced from this study. Multiplex  
polymerase chain reaction (PCR) schemes targeting five or  
more virulence genes of APEC simultaneously were optimized.
and this can be used for the diagnosis of APEC. In this study, the possible drug resistance and susceptibility to drug of choice for colibacillosis has been determined. Poultry farmers have been advised to avoid using colistin sulphate as this leads to antimicrobial resistance. As far as we know, this is the first study on the detection of virulence-associated genes (VAGs) and multidrug resistance among APEC isolates in Pakistan. The strains with the predominant set of VAGs can be used for colibacillosis diagnosis and as a potential vaccine candidate.

**MS IRENE NAFULA OGALI**  
Veterinary Research Institute, Kenya Agricultural and Livestock Research Organization, Kenya  
*Molecular diversity of Paramyxovirus in domestic poultry and wild birds in Eastern and Coastal Kenya*

The results and recommendations of the study are being compiled into a policy brief for use by the Directorate of the Veterinary Department to advise the Cabinet Secretary in-charge of the Ministry of Agriculture, Livestock, Fisheries and Environment in Kenya. This brief will entail recommendations on the control of Newcastle disease in Kenya.

**MR BOSSIMA IVAN KOURA**  
Zootechnics Laboratory, University of Abomey-Calavi, Benin  
*Grazing lands in the peri-urban area of Southern Benin: Characteristics and farmers’ management practices*

The study identified sustainable ruminant production systems and disseminated them to farmers after validation. Feeding strategies involving by-product supplementation were also recommended to farmers to improve their management strategies.

**MS RASHIDUL ISLAM**  
Department of Plant Pathology, Bangladesh Agricultural University, Bangladesh  
*Molecular and phenotypic characterization of Xanthomonas oryzae pv. oryzae races from Bangladesh*

The study identified the major races and haplotypes of the bacterial blight pathogen, *Xanthomonas oryzae* pv. *Oryzae*, which have been used in experiments including rice germplasm screening and other practical applications. In addition, potential resistant genes were identified against the major races of *X. oryzae* pv. *oryzae* in rice so that resistant genes can be deployed in the national rice breeding program. Also identified were major haplotypes of *X. oryzae* pv. *oryzae* with their copy numbers, useful in identification of new avrBs3 family genes in *X. oryzae* pv. *oryzae* and host targets.

**MS YINGHUA SHU**  
Department of Ecology, South China Agricultural University, China  
*Effects of secondary herbivorous pests on genetically modified Bacillus thuringiensis (Bt) corn, and effects of their interactions on pest natural enemies*

The results obtained from this study had important theoretical and practical significance for the interactions between genetically modified *Bacillus thuringiensis* (Bt) corn and non-target pests, such as the aphids *Rhopalosiphum padi* and *Rhopalosiphum maidis*, and the spider mite *Tetranychus urticae*. In addition, the effects of Bt corn on the pest natural enemies, including ladybeetle predators (*Propylea japonica, Harmonia axyridis*) via prey were investigated.
Mr N Richard Hodomihou  
Department of Environmental Planning and Management,  
University of Abomey-Calavi, Benin  
Heavy metal contamination in vegetables and soils from suburban agricultural area of Dakar, Senegal  
The experimental study revealed that different doses of sewage sludge and poultry manure application increased the concentrations of anthropogenic heavy metals (Zn, Cu, Pb and Cd) according to the organic waste doses applied on the Arenosol and the Fluvisol from the suburban agricultural area of Dakar. To limit the anthropogenic heavy metals contamination risks of vegetables produced in these soils, awareness campaigns were organized for market gardeners on the rational use of organic wastes and good agricultural practices to ensure the sustainability of these suburban agriculture systems.

Mr Maurice L Mogga  
Department of Crops Research, Ministry of Agriculture, Forestry, Cooperatives and Rural Development, South Sudan  
Genetic improvement of yield and grain quality in upland rice (Oryza sativa L.) in South Sudan  
The study created awareness of farmers’ choices and preferred attributes of a rice variety, and also informed policy choices and provided guidance on the direction of rice breeding efforts in South Sudan. The results showed a need for integration of farmers’ and stakeholders’ preferences in the variety development process and the desirability of releasing site-specific rice cultivars across major rice growing areas of South Sudan.

Mr Jairos Rurinda  
Department of Soil Science and Agricultural Engineering, University of Zimbabwe, Zimbabwe  
Simulating productivity of food crops in response to climate change and adaptive farm management options in Zimbabwe  
Over 1,000 farmers actively participated in the evaluation of on-farm experiments to test agronomic performance of maize relative to small grains (sorghum and finger millet) under adaptive management of fertilizer use and planting date. Farmers recognized the importance of small grains for enabling nutritious household food security, as malnutrition is one of the biggest challenges in Zimbabwe and Sub-Saharan Africa. They also noticed that production of small grains requires judicious application of fertilizer because traditionally farmers have not fertilized small grains.

Mr Damigou Bammite  
Department of Botany, University of Lome, Togo  
Assessment of the agromorphologic and genetic diversity of taro (Colocasia esculenta (L.) Schott) in Togo  
From the collected samples, a core collection of C. esculenta (26 accessions) and X. mafaffa (101 accessions) was established in Togo and conserved at the experimental site of the Togolese Institute of Agronomic Research.
MR EPHRÈME DOSSAVI DAYOU  
Higher School of Agronomic Sciences, University of Antananarivo, Benin  
*Design, production and evaluation of a no-till seed drill*

The physical and mechanical characterization of soils makes it possible to choose the types of tools to be used on each soil type depending on its mechanical constraints. The determination of resistance following the depth is a practical method of detection of ploughing soils. The characterization of grains is used not only for the calibration of seeds but also for food processing based on the mechanical characteristics. The availability of the designed planter allows for intensive direct seeding, which is faster than the manual method.

MR DANIEL MUNYAO MUTYAMBAI  
Department of Biology, South Eastern Kenya University, Kenya  
*Effects of oviposition-induced secondary defence metabolites on cereal stemborer in smallholder maize farming systems*

One maize hybrid (SC Duma 43) was shown to have oviposition-induced indirect defense and direct defenses for herbivores through reduced larval feeding. This is being adopted by smallholder farmers in Kenya, resulting in increase in yield with reduced pesticide inputs.

MS BATHÉ DIOP  
Department of Plant Breeding, Senegalese Institute for Agricultural Research, Senegal  
*Genomic study of iron toxicity tolerance in West African rice cultivars*

Identified sources of tolerance to iron toxicity are being used for the genetic improvement of susceptible to moderately tolerant elite varieties. Identified contrasting parents under both hydroponic and field screening are being used in population development.

MR ROHIT NANIWADEKAR  
Eastern Himalaya Program, Nature Conservation Foundation, India  
*Understanding impacts of hornbill loss on plant-disperser networks in Northeast India*

The Nature Conservation Foundation has a rainforest restoration program on the same site where this study was carried out. Statistically-derived species information is now being fed into the restoration program to enable identification of important plant species for rainforest restoration. These species attract either a diverse array of frugivore species or a unique assemblage of frugivores, both of which are important for quickening ecological restoration.
**MR RODRIGUE CASTRO GBEDEMON**  
*Faculty of Agronomic Sciences, University of Abomey-Calavi, Benin*

Assessing seasonal variation and effectiveness of home gardens in conservation of phytogenetic resources in Benin

Priority food species, their distribution and cultural importance were defined for a project to establish home gardens in low-income communities in Benin to improve the nutritional status of poor rural people. About 600 enumerators were trained on how to investigate and understand the structure and functioning of home gardens and their contribution to food security.

**MS HASINA (VOLAHASINA) TSILAVINA RANOELISON**  
*Department of Water and Forests, University of Antananarivo, Madagascar*

Dynamics and vulnerability of mangrove groups facing the exploitation of their resources by the local community: The case of Maintirano and Morondava (Madagascar)

One of the expected results of this study was to identify the different uses of the mangrove resource which leads to its degradation, thus making it possible to find a participative management and conservation tool. This tool is easy to handle and will ensure the sustainability of the existence of mangrove resources. It is intended for grassroots communities and environmental actors in the study area. The discussion carried out with these actors was fruitful during the field study because they are ready to apply the results of this investigation in their activity for the coming year.

**MR A CEDRIC GOSSANOU**  
*Applied Ecology Laboratory, University of Abomey-Calavi, Benin*

Estimation and monitoring of litterfall carbon fluxes in Lama forest reserve

The results of the study were used to establish a forest reference level which was presented at COP24 in Katowice, Poland, by an official representing the Republic of Benin, an example of Benin’s effort to respect our commitment to international agreements on climate change and emission reductions. The data set that was established on litter from aboveground biomass has been identified as important information to populate the African Forestry Database.

**MR BOALIDIOA TANKOANO**  
*Natural Systems, Agro-systems and Environmental Engineering Laboratory, Polytechnic University of Bobo-Dioulasso, Burkina Faso*

Contribution of remote sensing and GIS to the development and sustainable management of protected areas in Burkina Faso: The case of Deux-Balé National Park

The results obtained have been put into practice in the field. For example, land use maps are used by the services responsible for monitoring the Deux-Balé National Park. The vulnerability card is also a precious tool today for the park’s protection and conservation service. This study also revealed a level of human settlement on the south side of the park, and the political
authorities were alerted. From this alert, an operation to evict the illegal occupants was envisaged in 2019. The development project underway in the park is based on our results for the master plan for development and sustainable management of the park. In addition, we continue to explore possible solutions to limit the phenomenon of anthropization.

**MS REDEMTOR AWUOR OJWANG**  
Department of Biochemistry, University of Nairobi, Kenya  
The compositional, phytochemical and genetic characterization of Jackfruits (Artocarpus heterophyllus, Lam) found in selected areas in Kenya and Uganda

A protocol was optimized for faster germination of Jackfruit seeds, with the seedlings obtained distributed to individuals, which will help in the popularization and utilization of the fruit in Kenya. A number of people were taught how to germinate the seeds. Given its high nutritional benefits, the propagation of Jackfruit will contribute to reducing food and nutrition insecurity in Kenya and will also economically empower farmers who can sell the fruit and improve their standards of living.

**MS ANN GATHIGIA NGARI**  
School of Pure and Applied Sciences, Karatina University, Kenya  
Chemical composition of attractive blends in selected Ocimum species traditionally used to lure honey bees

Ocimum species volatiles identified as swarm lures in this study are currently being used to establish a research apiary with the purpose of offering training and extension services to local beekeeping communities. There is on-going research aimed at the development of a synthetic lure based on chemical composition of the lead blend identified in the study.

**MS ADJA MADJIGUENE DIALLO**  
National Center for Forest Research, Senegalese Institute for Agricultural Research, Senegal  
Are polyploid and diploid Acacia senegal interfertile? Controlled crosses between diploid and tetraploid trees of A. senegal in Sahel

Some of the study results have been used for the development and implementation of a program that aims to regreen arid eco-

**MS HASHIM AYAT**  
Plant Pathology Research Institute, Agricultural Research Center, Egypt  
Eco-friendly copper-silica nanomaterials: Synthesis, characterization, DNA binding profile and evaluation of their antifungal activity against Phytophthora infestans

The study confirmed that only one application of chitosan or silica NPs, at version stage, was able to reduce gray mold of table grape. The promising results from the research may represent systems such as Dahra, through the diffusion of high-yielding and adapted diploid and tetraploid Acacia senegal species, while also improving gum production and the resilience of rural people. Results from the evaluation of interaction between diploid and tetraploid in terms of phenology (flowering time) will be considered in designing the layout of plantations being planned.
some nanomaterials such as silica and chitosan NPs as effective antifungal agents for the control of gray mold. In addition, preliminary results have been obtained about late blight disease caused by *Phytophthora infestans* on potato.

**MR CHANSOPHEAKTRA SOVANN**  
Department of Environmental Science, Royal University of Phnom Penh, Cambodia  
*Quantifying the economic value of a wetland’s ecosystem services for sustainable stormwater management*

Results from the study are being used as supporting information for training materials and sharing of lessons learnt about how to mainstream ecosystem services in land use planning in Cambodia. The case study in Beoung Cherr Ek provided local and contextual evidence of how ecosystem services can be studied and linked to benefits for human well-being. It is a practical example for provincial officials to study and apply in land use planning.

**MR MESERET ADDISIE**  
School of Civil and Water Resources Engineering, Bahir Dar Institute of Technology, Ethiopia  
*Assessment on hydrological and geotechnical factors on the evolution and control of gully erosion in the humid northern Ethiopian highlands*

One of the study objectives was to evaluate the effectiveness of gully erosion treatment practices at the watershed scale. Rural communities outside the watershed, development agents, and natural resource managers at district, regional, state and national levels participated in showcase events. The practice was accepted by the Amhara regional state natural resource management department to replicate at ground by selecting sample districts. The practice also got media coverage and printed copies of briefing notes were disseminated to experts and local farmers.

**MR ANGELA PARRY-HANSON KUNADU**  
Department of Food Science and Nutrition, 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 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. The dissemination was done as part of a poultry biosecurity workshop organized by the Food and Agriculture Organization of the United Nations in Accra. Following dissemination of the study findings, participants were trained on general food safety concepts and hygienic processing of slaughtered birds. The data generated from the microbiological assessments in the study were presented and considered for the revision of the Ghana standard on Microbiological Analysis of Food Sampling Plans and Microbiological Criteria.

**MR MARTIN EPAFRAS KIMANYA**  
School of Computational and Communication Science and Engineering, Nelson Mandela African Institute of Science and Technology, Tanzania  
*Exposure assessment for multiple mycotoxins in maize-based complementary foods in Tanzania*

The Partnership for Aflatoxins Control in Africa (PACA) has been using the results to refine its strategies to mitigate aflatoxins control in Africa. In the East African Community, the results have been used as reference for harmonisation of aflatoxins and fumonisins standards, adopted in February 2014. Also, the African Union used the results of two projects to successfully defend a maximum limit for fumonisins of 1000ppb for maize and maize products.
The support of IFS

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

As an individual or a representative of an organisation, if you share the mission of IFS, and wish to help, please contact us about: core funding of IFS, financing general or themed research calls, supporting capability building, collaborating on approaches or projects, co-funding our work, commissioning us to deliver research calls or capability building events, providing or sponsoring travel or placements for grantees, tools, equipment or software licences.

To make a bequest or legacy in your will is a valuable and enduring way of assisting and a personal investment to benefit early career scientists in the developing world. If you or someone you know would like to make a bequest of financial support to IFS, please contact, in the first instance, the IFS Director.

IFS donors/sponsors in 2019:

- Belgian Science Policy Office (BELSPO)
- Carolina Mac Gillavry endowment, The Netherlands
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- Ministère des Affaires Étrangères (MAE), France
- Organisation for the Prohibition of Chemical Weapons (OPCW), The Netherlands
- Organisation of Islamic Cooperation Standing Committee on Scientific and Technological Cooperation (COMSTECH), Pakistan
- Podio Project Management Software Citrix Systems Inc.
- Swedish International Development Cooperation Agency (Sida), Department for Research Cooperation, Sweden
- Swiss National Science Foundation (SNSF), Switzerland
Donor Highlight:

DFG, the German Research Foundation

An institutional partner of IFS since 1975, DFG is the central, independent research funding organisation in Germany, serving all branches of science and the humanities by funding research projects at universities and other institutions. DFG promotes excellence by selecting the best research projects on a competitive basis and by facilitating national and international collaboration among researchers. Its mandate also includes encouraging the advancement and training of early career researchers, promoting gender equality in the German scientific and academic communities, providing scientific policy advice, and fostering relations among the research community, society and the private sector.

DFG and IFS have worked together throughout the years in several ways to support early career researchers through grants and training workshops. To date, DFG has contributed about 84 million Swedish krona in support of around 8000 grants to researchers in 105 countries. In addition, over the years DFG provided IFS with a secondment of one Scientific Secretary and several German scientists who have been representatives on IFS's governing bodies such as the Board of Trustees and the IFS Donor Group. In addition to its partnership with DFG, IFS has collaborated with more than 50 scientists from various German research and academic organizations, who have served as scientific reviewers or as members of IFS Scientific Advisory Committees. These Germany-affiliated colleagues have been instrumental in safeguarding IFS's scientific quality assurance processes and in contributing to high-quality scientific feedback to IFS grant applicants. Also, a small number of IFS grantees have done their IFS research projects in connection with their PhDs at German institutions.

While its core support is continuing through 2020, DFG and IFS are discussing new modalities for partnership and collaboration. Science is clearly needed more than ever in an uncertain and turbulent world, as research findings and applications guide societies toward sustainable futures. Over the past few years, there has been an amazing increase in awareness of global environmental change in general and climate change in particular. It has become apparent that solutions to such problems cannot be achieved if organisations work alone. IFS and DFG have long collaborated to unleash the potential of early career researchers. We believe it is possible to solve today's most pressing problems within the next couple of decades. Our ambition and optimism stem from working with early career researchers and enhancing their capacity to bring real, affordable solutions to global challenges.

IFS wholeheartedly thanks DFG for its generous support and confidence for 45 years. We need to do even more to address global challenges and where possible, transform them into opportunities. Through continuing our partnership, IFS and DFG have roles to play in bringing together the best thinking and adequate resources to support early career researchers in our collective efforts to create knowledge and solve problems for the betterment of humanity and the planet.
Impact of IFS on my life – Dr Yogeshkumar Naik

“If you want to go fast, go alone. If you want to go far, walk together.”

Having obtained a BSc in Chemistry (1980), I continued my studies with an MSc in biochemistry and a PhD focussed on biochemical pharmacology. My PhD supervisor was patient, supporting and helping me to navigate my research endeavours. With her assistance, I was exposed to international workshops and post-doctoral opportunities in Sweden and Australia. Most of the activities in Sweden were supported by grants from the International Science Program (ISP) at Uppsala University. Here, I benefited from exceptional mentors. I also learned that achievements can bring humility and I had the opportunity to develop my academic and mentorship skills.

During my early years as a scientist in the 1990s, much was known about the effects of chemical pollutants on mammals and humans, but little was known about their environmental effects on organisms such as fish, snails and birds. So, I was able to pursue several techniques in toxicology for monitoring environmental chemical pollution. After moving back to a new university in my hometown of Bulawayo, Zimbabwe, I decided to pursue research in freshwater organisms in a field later known as ecotoxicology — research that involves the ‘interplay’ between cellular molecules (e.g., proteins, lipids, DNA) of organisms in the environment.

With my interest in ecotoxicology, I was able to set up a research group in my department thanks to a mentor and two enthusiastic postgraduate students. Needless to say, this could not have happened without the financial resources of a renewal grant from IFS in 1997. The process was challenging as there were limited facilities and support for a new university where teaching was emphasised over research. Still, the students’ dedication helped to drive the initiative. A ‘win’ came when the new director of ISP decided to support my initiative on environmental toxicology and chemistry with a new grant in 1998. With this additional funding, from 1999 I was able to set up a lab ‘from scratch’ and begin to attract more students who subsequently completed their BSc, MPhil or PhD degrees. The funding from ISP ultimately led to the establishment of a fully-fledged lab exploring topics in ecotoxicology research for Southern Africa.

In 2008 I became the Director for Research and Innovation at my current institution, the National University of Science and Technology (NUST), and I continued to supervise and support early career researchers through creation of postgraduate workshops and training (on topics that included proposal development, data analysis, manuscript preparation and conference presentations). I have also had the privilege of serving on several professional committees (nationally, regionally and internationally). These have influenced my growth as a scientist and later as a research administrator, and also exposed me to the ‘politics of science’. Recently, I was appointed Professor of Ecotoxicology in the Department of Environmental Science and Health at NUST.

I have come to realise that research in developing countries should address the United Nations Sustainable Development Goals. While basic science (‘blue skies science’) is certainly needed globally, those of us in ‘less economically developed countries’ need to focus on applied research that will contribute to solving challenges for our local society. I have had the privilege of a fascinating journey from biomedical to environmental research and then to research management. I have been fortunate to meet a diverse set of individuals, with different views, strengths and values. I believe that to have a successful career as a scientist one should:

- Focus – have a ‘set agenda’ and create direction for yourself and your research group.
- Persevere – when funders reject an application, or when editors reject a paper.
- Learn to disseminate! Your research is important to policy-makers and society.
- Think in other terms and also be open to the opinions of others.
- Network and collaborate. To quote an African proverb: *If you want to go fast, go alone. If you want to go far, go together.* This is so true in science. As you wean yourself off a research grant you need to collaborate and form networks. Funders want to support collaborative and interdisciplinary research.
- Nurture your students – they are your best asset since they bring new ideas and a fresh perspective. Cultivate their views, grow their ideas and your research will thrive.
- ‘Pass on the baton’: Your students will be the next leaders.

While I now have considerable experience as a scientist and research administrator, it all began with a small grant application with IFS. This launched my career in ecotoxicology and helped me to establish myself as a researcher in the field. The grant allowed me to pursue my own interests as a fledgling researcher, and then later to mentor and support other early career scientists. I recognize that IFS has also had a significant role in establishing and strengthening research across Africa. For instance, within Zimbabwe, and at NUST alone, IFS grants have provided the foundation for the scientific careers of one vice chancellor and three deputy vice chancellors (including myself). Without my first IFS grant, I could not have laid the ground for my scientific career, gone on to obtain larger grants to follow my research interests, or help develop a new generation of ecotoxicologists.
The IFS Nigerian Alumni Association is Launched

An inauguration event for the launching of the International Foundation for Science (IFS) Nigerian Alumni Association was organized by former and present IFS grantees in Nigeria, held on 9 November 2019 in Abuja. Among those in attendance were a number of former grantees, undergraduate and postgraduate students, serving Nigerian Youth Service Corp members, staff of the Department of Traditional, Complementary and Alternative Medicine in the Federal Ministry of Health and the National Institute for Pharmaceutical Research and Development. The inauguration was organized following agreement between IFS representatives and Nigerian alumni at a meeting hosted by Dr Oludare Agboola and chaired by Prof John Igoli on 7 May 2019 at the University of Lagos, leading to the formation of an interim executive to coordinate the process, comprised of the two aforementioned colleagues as Chairman and Vice Chairman, respectively, and Dr Adedotun Onoyinka Afolayan as Secretary. The Alumni Association’s inauguration plan then kickstarted immediately after this meeting with the opening of a WhatsApp group to which all consenting Nigerian alumni were added. The WhatsApp group had 72 IFS alumni from which a three-member Local Organizing Committee (LOC) was constituted with Dr Aliyu Ibrahim Dabai, Dr Obiageli Umeugochukwu and Mrs Ifeoma Ezenyi.

At the IFS-NAA inauguration, Prof John Igoli gave a welcome address, followed by an opening prayer, self-introduction by all attendees, and a reading of the draft notes of the 7 May alumni meeting. The keynote address was given by Pharmacist Zainab Ujudud Shariff, who is a Director in the Federal Ministry of Health, and Head of the Department of Traditional, Complementary and Alternative Medicine in the Ministry. In her talk entitled “Translating research from bench to market and industry”, she charged scientists to conduct marketable and commercially viable research rather than the sort that ends up in cupboards and on shelves. Prof John Igoli then gave a short presentation on the essence of research collaboration and the need for the inauguration of the IFS-Nigerian Alumni Association. Dr Afolayan read an inauguration message from the Director of IFS, Dr Nighisty Ghezae, in which she said:

IFS’s relationship with Nigerian early career researchers is one of our deepest and most enduring. To date, more than 309 Nigerians have received an IFS grant (69 women and 240 men). The link is strong on many levels. With present IFS grantees, we have daily contact as we support them in their ongoing research, or arrange mentors who can help with their research activities, and with former IFS grantees, who are now working in various universities or government agencies, our link is on both the scientific and policy levels. IFS alumni are working in scientific advisory roles and are helping to assess research applications to IFS. On the policy level, we are working hard with former IFS grantees to try to influence science and technology policies. In addition, IFS works to increase the pool of young researchers in Nigeria by organizing capacity enhancing training for potential IFS grantees.
We believe that the IFS investment in supporting early career researchers on biological, water and energy resources, through both natural and social science perspectives, is a contribution to the larger agenda of meeting global challenges and exploiting future opportunities, including: building human capability, investing in an enabling research environment including infrastructure, promoting innovation, stimulating entrepreneurship and improving the governance of innovations on a sustainable basis. You will no doubt agree that long-lasting personal and professional relationships are formed among colleagues during their time doing research in their institutions. This and subsequent alumni association meetings will offer wonderful opportunities to renew those friendships and to forge new ones. I trust that the establishment of the alumni association will provide a regular channel of communication, further networking among you, and facilitate cooperation and exchange of views, scientific information, experiences and ideas with regard to the challenges faced by Nigeria.

An election was then held to appoint executive members to replace the interim ones, as below:

- Chairman: Prof John Ogbaji Igoli, Department of Chemistry, University of Agriculture, Makurdi
- Vice Chairman: Prof Bernard Iorwuese Babatunde, Department of Animal and Environmental Biology, University of Port Harcourt
- Secretary: Dr Adedotun Onoyinka Afolayan, Tissue Culture Unit, Biotechnology Department, National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan
- Assistant Secretary: Mrs Adeola Agbeleye, Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan
- Treasurer: Mrs Ifeoma C Ezenyi, Department of Pharmacology and Toxicology, National Institute for Pharmaceutical Research and Development, Abuja
- Interim Public Relations Officer: Dr Abosede O Olufunso, Federal University Otuoke, Bayelsa State
- Youth Mentorship Manager: Dr Aliyu Dabai Ibrahim, Department of Microbiology, Usmanu Danfodiyo University, Sokoto

A Board of Trustees was suggested to be comprised 50% from policy-makers – including representatives from both Federal Ministry of Science and Technology and Nigerian Academy of Science – and 50% from IFS Nigerian alumni. Pharmacist Zainab Ujudud Shariff was chosen as the first member of the Board of Trustees.

The meeting concluded with an agreement to carry out the following tasks before March 2020:

- Open a website for the Association; Prof Bernard Babatunde pledged to pay for the website design and hosting.
- Open a bank account for the Association.
- Draft a constitution for the Association, and
- Register the Association with the Corporate Affairs Commission (CAC).

Recommendations from the meeting included:

1. Mentorship of upcoming researchers who are IFS grantees
2. Raise awareness among young scholars on the role of IFS
3. Be a stronger voice to policy-makers
4. Foster collaboration among IFS grantees, and
5. Organize workshops for mentorship and research outcome presentations.

Prof Bernard Babatunde appreciated the efforts of Prof J Igoli, Dr Adedotun Afolayan and Dr O Agboola and the LOC, who worked tirelessly to ensure that the inauguration of the IFS-NAA was successful. Altogether, twenty-four alumni registered for the meeting and twenty attended it. Then, the meeting wound up with a vote of thanks by the newly-elected public relations officer, Dr Abosede Olufunso.

### OTHER ACTIVE ASSOCIATIONS IN AFRICA

Benin, Ghana and Kenya also have active associations of IFS alumni. Their activities are exemplified by the seven seminars and three training courses held in Benin in 2019 by former IFS grantees, on topics as diverse as History and Biodiversity of the African Equatorial Forest – What Does the Genetics of Forest Tree Populations Tell Us?, Techniques for Searching Scientific Information and Managing Bibliographic References, and Introduction to Infectious Diseases and Data Modelling.

### ALUMNI NETWORK

Recognizing 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, publicizing IFS grant calls, collaborating with other alumni associations, and informing IFS of relevant local and national activities. IFS always tries to find ways to mobilize our existing resources to activate, support and strengthen our alumni.
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)

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<th>1 January–31 December 2019</th>
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<td><strong>Programme Revenue</strong></td>
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<td>Core and Restricted Contributions</td>
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<td>Grants Withdrawn</td>
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<td>Other Programme Revenue</td>
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<td>Fundraising and Partnership Building</td>
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<td><strong>Total Programme Expense</strong></td>
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<td><strong>Programme Income less Expense</strong></td>
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<td><strong>Result from financial assets</strong></td>
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<td><strong>Net Income less Expense</strong></td>
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### BALANCE SHEET (in thousands SEK)

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<td><strong>Fixed Assets</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tangible Assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment, Furniture and Fixtures</td>
<td>40</td>
<td>94</td>
</tr>
<tr>
<td>Financial Assets</td>
<td></td>
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<tr>
<td>Other long-term investments</td>
<td>15 924</td>
<td>15 290</td>
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<tr>
<td>Long-term Donor Receivables</td>
<td>95</td>
<td>260</td>
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<tr>
<td><strong>Total Fixed Assets</strong></td>
<td>16 058</td>
<td>15 644</td>
</tr>
<tr>
<td><strong>Current Assets</strong></td>
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<tr>
<td>Current Receivables</td>
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<td>Donor Receivables</td>
<td>1 064</td>
<td>1 151</td>
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<tr>
<td>Other Current Receivables</td>
<td>763</td>
<td>814</td>
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<tr>
<td>Prepaid Expense and Accrued Income</td>
<td>647</td>
<td>613</td>
</tr>
<tr>
<td><strong>Total Current Receivables</strong></td>
<td>2 474</td>
<td>2 578</td>
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<tr>
<td>Cash and Bank Balances</td>
<td>24 737</td>
<td>25 130</td>
</tr>
<tr>
<td><strong>Total Current Assets</strong></td>
<td>27 211</td>
<td>27 708</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td>43 270</td>
<td>43 351</td>
</tr>
<tr>
<td><strong>Equity and Liabilities</strong></td>
<td></td>
<td></td>
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<tr>
<td>Designated funds</td>
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<tr>
<td>Board Designated Fund for Contingencies</td>
<td>11 107</td>
<td>14 635</td>
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<tr>
<td>Carolina MacGillavry Fund</td>
<td>15 115</td>
<td>12 223</td>
</tr>
<tr>
<td><strong>Total Designated Funds</strong></td>
<td>26 221</td>
<td>26 858</td>
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<tr>
<td>Balanced capital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance, 1 January</td>
<td>-1 476</td>
<td>-2 123</td>
</tr>
<tr>
<td>Net Income less Expense for the Year</td>
<td>-1 545</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total Balanced Capital</strong></td>
<td>-3 020</td>
<td>-2 113</td>
</tr>
<tr>
<td><strong>Total Equity</strong></td>
<td>23 201</td>
<td>24 746</td>
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<tr>
<td><strong>Current Liabilities</strong></td>
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<td></td>
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<tr>
<td>Research Grants Payable</td>
<td>8 463</td>
<td>15 367</td>
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<tr>
<td>Deferred Restricted Contributions</td>
<td>573</td>
<td>573</td>
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<tr>
<td>Accounts Payable</td>
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<tr>
<td>Other Current Liabilities</td>
<td>699</td>
<td>642</td>
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<tr>
<td>Accrued Expense and Prepaid Income</td>
<td>10 250</td>
<td>1 921</td>
</tr>
<tr>
<td><strong>Total Current Liabilities</strong></td>
<td>20 069</td>
<td>18 606</td>
</tr>
<tr>
<td><strong>Total Net Assets and Liabilities</strong></td>
<td>43 270</td>
<td>43 351</td>
</tr>
</tbody>
</table>
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 (OAW)

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)
Fundaçao Oswaldo Cruz (FIOCRUZ)

BURKINA FASO
Ministère des Enseignements Secondaires, 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)

KWUWAIT
Kuwait Institute for Scientific Research (KISR)

LATVIA
Latvian Academy of Sciences (LAS)

LESOTHO
The National University of Lesotho (NUL)

LIBERIA
University of Liberia (UL)

MALAGASY
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 Tecnologia (CONACYT)

Mongolia
Mongolian Academy of Sciences

Morocco
Centre National de Coordination et de Planification de la Recherche Scientifique et Technique (CNR)
Institut Agronomique et Vétérinaire Hassan II

Mozambique
Universidade Eduardo Mondlane (UEM)
The Scientific Research Association of Mozambique (AICIMO)

Nepal
Royal Nepal Academy of Science and Technology (RONAST)

Netherlands
Koninklijke Nederlandse Akademie van Wetenschappen (KNAW)

Niger
Université Abdou Moumouni

Nigeria
Federal Ministry of Science and Technology (FMST)
The Nigerian Academy of Science (NAS)

Norway
Det Norske Videnskaps Akademi (DNVA)

Pakistan
Pakistan Council for Science and Technology (PCST)

Panama
Secretaria Nacional de Ciencia y Tecnologia e Innovacion (SENACYT)
Universidad de Panama

Papua New Guinea
The University of Papua New Guinea

Peru
Consejo Nacional de Ciencia y Tecnologia (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
Délegation 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 Basicas (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 Regional 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
Bioversity 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
**BENIN**

**AGONHA, Parfait**
Habitat use, food preferences and conservation status of preferred food resources of elephants in the Pendjari National Park, Benin: Implications for conservation and management

**AHOOY, Carlos Cédric**
Evaluation ethnobotanique et de la disponibilité naturelle des plantes utilisées en médecine traditionnelle contre le paludisme en zone humide du Bénin (Afrique de l’Ouest)

**ALOWANOUL, Géorcelin**
Evaluation of nutraceutical effects of Mitragyna inermis (Willd) in sheep production in Benin (West Africa)

**ANATO, Florence Mahouton**
Field evaluation of the efficacy and persistence of soil application with Cashew Nut Shell Liquid formulations in the control of Tephritid flies

**ASSANI SEIDOU, Allassan**
Validation et simulation des résultats du projet IFS 5824-1 pour la gestion durable de la transhumance et des ressources pastorales dans la Forêt Classée de l’Alibori Supérieur au Nord du Bénin

**DABADE, Déley Sylvain**
Mathematical modeling tools to enhance brackish river prawn (Macrobrachium macrobrachion) quality management in West Africa

**DIANDA, Oumarou Zoéyandé**
Distribution, diversity, population structure and richness of bats on the Himalayan route in western Bhutan

**DIJJOOHKPIN, Donald**
Distribution, structure and dynamique of populations and utilization durable of the Strechchos spp. L. (Loganiaceae): Impact des récoltes d’organes au Bénin

**DIKOO, Aliou**
Assessing reproductive biology and genetic diversity of Lophira lanceolata (Ochnaceae) populations in Benin (West Africa)

**EDIKOU, Koba Ulrich Spéro**
Caractérisation physico-chimique, biochimique, microbiologique et organoleptique des viandes de poulets grillés au Bénin

**FACHINAN, Ruline**
Mécanisme d’action du jus de fruit de Momordica charantia sur la sécrétion d’insuline et sur la sensibilité

**GNAWE, Marcelline**
Caractérisation moléculaire et biochimique des différents morphotypes des 3 espèces de gombo (Abelmoschus spp) cultivé au Bénin et leur adaptation aux zones climatiques

**HOUNSOU-DINDIN, Guillaume**
Impact de la qualité de l’eau de boisson sur la santé des ménages dans la commune de Sô-Ava

**KELOMEY, Eminsédé Aude**
Caractérisation génomique des pathogènes viraux des abeilles associés à Apis mellifera et à son parasite acarien Varroa destructor dans les ruchers du Bénin

**PADONOU, Elie**
Abiotic and biotic determinant of spatial variability of termite mounds on bowé in Benin, West Africa

**SANSI WOROGO, Sorébou Hilaire**
Applying companion modeling for approaching perceptions, innovations and sustainable community-based in situ conservation strategies for the Borgou cattle breed in northern Benin

**SINSIN, Corine**
Assessing the vulnerability and economic value of mangrove ecosystems to inform their sustainable management in Benin

**SOSSOU, Hospice**
Assessment of Kersting’s groundnut (Macrotyloma geocarpum) seed systems and quality seed production technologies in Benin

**TOHOUN, Jesupégo Roméo**
Assessing biotic and abiotic factors determining seedling diversity, density, survival and growth in two biodiversity hotspots of Benin

**TOKLO, Placide Mahougnan**
Caractérisation des composés bioactifs d’une plante à propriété anthelminthique

**YAOVI, Comlan René**
Caractérisation physique du couvert végétal et des services écosystémiques des aires protégées au Sud du Burkina Faso (Afrique de l’Ouest)

**BHUTAN**

**BOLIVIA, PLURINATIONAL STATE OF**

**GRADOS TORREZ, Ricardo Enrique**
Evaluation of biological activity of alkaloids in Lupinus mutabilis as metabolic regulators and its role in c-HDL/LDL levels and insulin secretion

**BURKINA FASO**

**DIANDA, Oumarou Zoéyandé**
Caractérisation de Lasiodiplodia spp associées au dessèchement du manguier en vue de l’évaluation des stratégies de lutte contre la maladie au Burkina Faso

**DOUAMBA, Soultongonna Arnaud Michel**
Caractérisation et identification de sources de résistance au virus de la nécrose à rayure du riz pour une gestion durable au Burkina Faso

**ISSOUF, Dao**
Inventaire des insectes vecteurs et plantes hôtes adventices des Xanthomonas oryzae dans les conditions de riziculture au Burkina Faso

**MOHAMED, Cisse**
Using native plants’ leaf litter to develop agro-ecological production for smallholder farming system of Southern Burkina Faso

**OUILLY, Judicaël**
Toxicités dermique et occulaire et mecanisme anti-inflamatoire du lanneakol et de ses dérivés isolés de l’huile fixe de Lannea kerstingii

**BURUNDI**

**NDAYIZEYE, Liévin**
Distribution, abundance and saisonnalité de Bactrocera latifrons (solanum fly) dans les différentes zones agro-écologiques du Burundi

**CAMEROON**

**DIANKOU TCHOFFO, Madeleine**
Etude phytochimique et évaluation des activités insecticides des composés phénoliques, triterpènes et des combinaisons de ces composés issus de deux plantes utilisées au Cameroun dans la conservation des denrées stockées

**FEMOE MEMBE, Ulrich**
Evaluation of the protective and immunomodulatory activities of two Cameroonian medicinal plants on Schistosoma mansoni-infected and immunocompromised mice

**LIBALAH, Moses**
Scale-dependent assessment of tree species rarity and commonness in relation to functional traits and environment
MANGA ESSOUMA, François
Effets du champignon Beauveria bassiana (Bals.) Vuill. et des extraits de poudre de graines de Thevetia peruviana Metsch. et Azadirachta indica A. Juss sur le scorlyte des baies de café Hypothemenus sp.

MARCELLE FRANCA, Meguem Mboujda
Syndrome de domestication chez Dacryodes edulis (Burseraceae): Analyse comparée des populations sauvages et domestiquées, perspectives pour la gestion durable des ressources de l’espèce au Cameroun

NGO LEMBA TOM, Esther
Effets de Harungana madagascariensis sur les affections cardioréspiratoires: Implication des muscles cardiacue, trachéal et vasculaire

SANDRINE AIMEE, Y oute Fanche
Optimisation de l’inhibition de la croissance des moisissures ochratoxinogènes par les lactobacilles pour la biopreservation du fromage

CONGO
BOUKA DIPELET, Gaël Ulrich
Écologie comparée et caractérisation morphologique de deux espèces d’acajous d’Afrique (Khaya, Meliaceae) dans une zone de contact au nord de la République du Congo

NGUILA BAKALA, Melain Merland
Modélisation du diamètre des arbres à troncs irréguliers en Afrique Centrale

CONGO, THE DEMOCRATIC REPUBLIC
JUSTE, Yamoneka
Essai de formulation des émulsions alimentaires (du type margarine et crème) à base de la lactobacille pour la préservation des feves de cacao

KASALI, Félicien Mushagalusa
Evaluation de l’activité antidiabétique de Chenopodium ambrosioides L. et Physalis peruviana L., remèdes à base de plants utilisés en médecine traditionnelle congolaise

KASEKETE, Désiré
Étude de l’influence des facteurs biotiques et abiotiques sur la structure et la productivité des plantations ligneuses autour du Parc National des Virunga, République Démocratique du Congo

COTE D’IVOIRE
ABRE, Marina
Selection et caractérisation des souches de bacteries lactiques pour la biopreservation du poisson fermenté traditionnel ‘adjuevan’

AHUI, Sangai Dieudonné Jean-Luc
Contribution des paysages d’anacardier (Anacardium occidentale) du centre de la Côte d’Ivoire à l’amélioration de la qualité physico-chimique et biologique du sol et leur implication dans la lutte contre le changement climatique

ALIKO, Yédé Jean
Vers une gestion agro-écologique d’Apate terbrans Pallas, 1772 (Coléoptère, Bostrichidae), un insecte ravageur majeur de l’anacardier en Côte d’Ivoire

AMOIKON, Simon
Analyse des risques sanitaires liés à la production et à la consommation des boissons fermentées traditionnelles de Côte d’Ivoire

KONE, Foundiére
Utilisation des sols de termitière comme amendement des cultures maraîchères dans la région de Lamto: Test sur la production de piment, d’aubergine et évaluation de la pérennité de la méthode

KOUAKOU, Lombart Mesmer Maurice
Assessing the risk of invasion in estuarine and coastal environments: A case study of National Park of “Iles Ehotilés” in Côte d’Ivoire

YEO, Gnenissongui Joseph
Biodiversité de la faune édaphique et caractérisation des contaminant de la matrice biologique des sols de forêt humide du Banco, Abidjan, Côte d’Ivoire

EGYPT
HAIKAL, Rana
Novel cost-effective durable adsorbs for treatment of industrial wastewater via removal of toxic heavy metal ions and organic dyes

ROHAIM, Mohammed
Establishing field data-driven universal influenza vaccine platform in poultry: Step towards poverty alleviation and food security in Egypt

ETHIOPIA
ABDISSA, Negera
Natural products from traditionally used Ethiopian medicinal (kniphofia and related) plants towards the management of malaria

ABDULAIHI, Mohammed
Modelling impacts of climate change and grazing on above ground biomass and soil organic carbon in the Afroalpine landscapes, Southeast Ethiopia

ABEBE, Shiferaw
Status and role of the bamboo forests for climate change mitigation in lower Beles River basin, Ethiopia

ASMARE, Birtukan
Farm pest management knowledge, perception and practices: The situation of female and male headed smallholder farmers of the Amhara region, Ethiopia

GEBRETSADIK, Tesfamariam
Development of polyaniline functionalized sisal bio-composite mat for defluoridation media of groundwater

JEMANEH, Samson Shimelse
Attractiveness of area excluosis carbon sinks and economic valuation under different management systems based on fixed plot analysis in Tigray region, northern Ethiopia

NEGASA, Daniel
Evaluation of the effect of spacing and age of eucalyptus woodlots on soil properties, surface runoff and sediment loss in central Ethiopia

SIRAW, Zewdu
Community-based watershed development and its implication for household food security: Evidence from the northwestern highlands of Ethiopia

TEGEGNE, Tatake
Impacts of climate and land use/land cover change on soil erosion and streamflow in Muga watershed, Upper Blue Nile basin, Ethiopia

TEWELDEBRHIAN, Meseret
Socio-hydrology of abbay/Blue Nile River basin: The case of Dihadhessa River basin

TIRUNEH, Mengie Belayneh
Quantification of soil erosion and impacts of conservation practices: A case study of Gumara watershed, northwestern Ethiopia

GHANA
LARBI, Isaac
Environmental change scenarios impact on the future climate and water resources of the Tano basin, West Africa

OSEI-GYAN, Francis
Using predictive models to safeguard endangered amphibian species habitat in Ghana

PARRY-HANSON KUNADU, Angela
Hazard characterization and food safety risk associated with salmonella on dressed chicken carcasses in Accra, Ghana

TENGEY, Theophilus
Introgression of leaf spot resistant QTLs into West African-adapted and US high-oleic peanuts

KENYA
AKHWALE, Juliah
Evaluation of bacteriophages for biocontrol of tomato bacterial wilt disease

GITUNDU, Dennis
Multi-hydrological model approach to flash floods risk assessment in Enkare Narok River basin
JOSPHT, Mutinda
Examining the role of bacteria in mediating oviposition responses of malaria mosquitoes

MBARU, Emmanuel
Understanding social network processes to increase adoption and diffusion of conservation interventions

WAFLUL, Eluid
Using natural lactic acid bacteria to improve nutrition, safety and quality of African indigenous leafy vegetables

MADAGASCAR
RASAMBO, Sedera Norotiana
La domestication du tisipériery (Piper spp.) dans la gestion durable de la forêt
d
RANAMIRINDRA, Verohanitra
Comportement des mauvaises herbes du riz pluvial et du riz en submersion en fonction des conditions agro-écologiques et gestion d’enherbement dans la zone d'Anosy Be Flanja (Région Itasy-Moyen Ouest de Madagascar)

SOLOFO NASANDRATA, Ravonjiarison
Etudes des savois locaux comme stratégies agricoles durables à Madagascar

MALI
TRAORÉ, Sanata
Wastewater irrigated vegetable production in Bamako and its peri-urban settlements: Contamination pathway of microorganisms and heavy metals

MONGOLIA
TSERENDORJ, Munkhjargal
Prevalence and genetic analysis of filarial nematode in camels of Mongolia

MOROCCO
BELABESS, Zineb
Occurrence and distribution of virus and virus-like diseases of citrus and potato in North-East region of Morocco

NEPAL
MAHARJAN, Menuka
Impact of agroforestry intervention on soil fertility and carbon sequestration in mid-hills of Nepal

SHRESTHA, Mitesh
Antibiogram and molecular characterization for carbapenem-resistant bacteria isolated from fresh produce collected from local markets in Kathmandu, Nepal

NIGERIA
ABIODUN-SOLANKE, Ayojesutomi
Effects of traditional preservatives, packaging materials and methods on the storability of African catfish (Clarias gariepinus) and Nile tilapia (Oreochromis niloticus)

AJIMA, Ukpe
Bioactivity guided isolation and characterization of antimalarial principles from Landolphia owariensis leaf extract

AWORUNSE, Oluwadurotimi
Ethnobotany and genetic diversity assessment of Telfairia occidentalis Hook F. (fluted pumpkin) in southern Nigeria

DINGWOKE, Emeka John
Proteomic and toxicovenomic studies of medically important Nigerian elapid (Naja haje, Naja katiensis) and viper (Causus maculatus, Echis leucogaster) snake venoms

OGUNSUYI, Opeyemi
Effect of dietary inclusions of African eggplant (Solanum macrocarpon L) and black nightshade (Solanum nigrum L) leaves on transgenic drosophila melanogaster model of Alzheimer’s disease

OYENIYI, Femi
Effects of heat stress on physiological response and reproductive parameters in sexually mature West African dwarf goats of different coat colours

OYEWALE, John
Molecular characterisation of mobile colistin resistance genes in livestock and clinical enteric bacteria in selected states of southwestern Nigeria

POPOOLA, Michael Olakoluwa
First inventory of the ichthyofauna biodiversity of the eastern rainforest block of the lower Cross River, Nigeria

PAKISTAN
AHMED, Ishiqq
Prevalence of Chlamydia abortus, Coxiella burnetii and associated fetoplacental pathology in small ruminants in Jhang District, Punjab, Pakistan

AHMED, Kamal
Groundwater sustainability assessment over Pakistan for adaptation to changing environment

KEYANI, Rumana
Enhancement of oxidative stress tolerance in wheat by exploiting antioxidant enzymes

MAJEED, Saima
Health risk assessment of multiple mycotoxins by wheat consumption in Pakistan

SHAHID, Muhammad
Putting waste into use: Recycling of textile industry wastewater for use in agriculture

ULLAH, Najeeb
Exploring the etiology of urdbean leaf crinkle disease of mungbean and identification of its insect vector(s) in Pakistan

YOUASAF, Igra
Localization of dsRNAs against aphids through chloroplast transformation in potato

ZEB, Iftikhar
Co-digestion of animal and agro-industrial waste for improved biogas and biofertilizer production in Pakistan

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HAKIZIMANA, Jean Nepomuscene
Understanding the epidemiology and socio-economic impact of African Swine Fever in Rwanda

MUKAMUGEMA, Jane
Molecular and biochemical characterization of microorganisms linked with coffee potato taste defect

NYIRAGATARE, Alliance
Integrated taxonomy of fishes from Lake Kivu, Rwanda

TANZANIA
MARCIALE, Chrian
Investigation on the effectiveness of Trichoderma asperellum, Bacillus subtilis and Gnidia eminii in management of tomato fusarium wilt and root knot nematodes in Tanzania

NG’UMB, Gladys Zacharia
Assess impacts of land use change in Tarangire catchment area and implications on flow dynamics of Tarangire River, Tanzania

TOGO
BAMMITE, Damigou
Improving the supply of planting materials and selecting new varieties for the production of taro (Colocasia esculenta) and new cocoyam (Xanthosoma malaffa) in Togo

KOIFFI, Djima
Inventory on the natural factors that affect the fall army worm populations in Togo

KOUBODANA HOUTETA, Djan’a
Modeling the impacts of climate, land use changes and dam management on floods hazard in the Mono River basin, West Africa

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Potential of moringa leaf extract in improving quality of two green leafy vegetables

BESSALAHL, Salma
Epidemiology of rotavirus and coronavirus infection in camel calves (Camelus dromedarius) from Tunisia
Use of pistachio (Pistacia vera) by-products in feed blocks with waste date (Phoenix dactylifera L.) or pomegranate (Punica granatum L.) waste to feed lambs from southern Tunisia: Effects on feed intake, growth and carcass performances and meat quality

HAJJ, Hadhami

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BIIRA SALAMULA, Jenipher
The distribution and status of East African sandalwood (Osyris lanceolata, (Hochst & Steudl, 1832)) in Karamoja sub-region, Uganda: Implications for management and conservation

BUNALEMA, Lydia
Toxicological evaluation and pharmacological interactions of acridone alkaloids as potential anti TB drugs

BWAMBALE, Bosco
Understanding the role of indigenous practices in enhancing hydro-meteorological risk management in the Rwenzori Mountains

KAYENDEKE, Ellen
Water storage potential of tropical papyrus wetlands

MOHAMMED, Ssemwanga
Using integrated conservation management approaches for rescuing, regeneration and restoration of the critically endangered Bothriocline auriculata plant species in Uganda

OCHWO, Sylvester
Understanding the epidemiology and economic loss due to lumpy skin disease in selected disease hotspots in Uganda

TAMALE, Joseph
Investigating the role soils nutrients play in regulating soil greenhouse gas fluxes and N leaching from two contrasting ecosystems: A nutrient limited tropical forest and an intensively fertilized sugarcane plantation in Uganda

WERE, David
Soil organic carbon stocks and fluxes of CO2 and CH4 in a tropical freshwater wetland under varying vegetation communities: Implications for climate change mitigation

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DOAN, Xuan Nam
Transgenerational effects of extreme temperature and predators on tropical copepods

LAI, Thi Ngoc Ha
Effects of post-harvest UV-B irradiation on antioxidant phenolic profile and cell wall-degrading enzyme activity of Rhodomyrtus tomentosa fruit during storage

LE, Thi Thanh Loan
Consumers’ perception of food safety risk and risk reduction strategies: Evidence from self-provisioning of vegetables in cities of Vietnam

MAI, Hanh
A low-cost, reliable method of detecting and removing antibiotics from water in Vietnam

NGUYEN, Anh Vu
Electrolyzed fertilizer solution (EFS): A potential approach to support antagonists application and mitigate the damage caused by pathogenic fungi Fusarium Oxysporum f. sp. cubense to Vietnamese banana industry

NGUYEN, Bao
Screening and evaluation of novel conopeptides for mosquitocidal activity against lethal mosquitoes (Aedes aegypti, Anopheles stephensi, Culex quiquefasciatus)

NGUYEN, Dang Cuong
Vulnerability assessment of the protected area to forest landscape restoration and climate change mitigation: A case study from Vietnam

NGUYEN, Thi Thuy Hang
Examination of saltwater intrusion behavior in the lower Dong Nai River system with consideration of the upper reservoir control

NGUYEN, Thi Thuy Tien
Lectin-producing streptomyces strains from tropical soil samples

THI THANH XUAN, Tran
In-vivo efficacy of phage therapy against the white spots in the internal organs disease in striped catfish Pangasianodon hypophthalmus

TRAN TRUNG, Thanh
Larval and juvenile fishes occurring in surf zones of Gulf of Tonkin in Vietnam: Implications for resources conservation

Three grantees who were awarded a grant have not fulfilled their conditionality.
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