



Inspiring stories of
African agriculture, Volume 2

Stories of change featuring
One Planet Laureate Candidates



AgSpirations: Inspiring stories of African agriculture, Volume 2

Stories of change featuring One Planet Laureate Candidates

African Women in Agricultural Research and Development

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Acronyms

ALV	African Leafy Vegetables	SUA	Sokoine University of Agriculture
AST	Advanced Science Training	TARI	Tanzanian Agricultural Research Institute
AWARD	African Women in Agricultural Research and Development	WHO	The World Health Organization
CIAT	International Center for Tropical Agriculture		
CIRDES	International Centre for Research and Development on Livestock Farming in Sub-humid Zones		
CSA	Climate-Smart Agriculture		
EIAR	Ethiopian Institute of Agricultural Research		
FAO	The United Nations Food and Agriculture Organization		
FAW	Fall armyworm		
GDP	Gross Domestic Product		
IAAS	Integrated Agriculture- Aquaculture Systems		
ICGEB	Biopesticide Group of the International Centre for Genetic Engineering and Biotechnology		
IDRC	International Development Research Centre		
IFFN	Ivory Coast Forest Inventory		
INERA	Institute for Environment and Agricultural Research		
IPCC	Intergovernmental Panel on Climate Change		
IRSAT	Institute for Research in Applied Sciences and Technologies		
JICA	Japan International Cooperation Agency		
JKUAT	Jomo Kenyatta University of Agriculture and Technology		
SDGs	Sustainable Development Goals		

Overview

African Women in Agricultural Research and Development (AWARD) is a convener and partner that, among other priorities, invests in building a pool of African researchers leading agricultural research and developing innovations to improve smallholders' productivity. Our mission¹ calls for sustained investments in equipping African researchers with the tools and skills to connect, communicate with, and convince a wide range of stakeholders in agricultural research and development.

That is why, toward our mission, we implement bold solutions to enhance African researchers' visibility, influence, and ability to engage and inspire stakeholders in agricultural research and development.

Communicating in concise, compelling ways has become one of the most critical skills of the 21st century. Storytelling provides a natural method of allowing others to connect with what matters to you – an idea, a process, or a new product. Stories firmly grounded in universal human principles provide an ideal conduit to building coalitions, gathering compatriots, and communicating change.

In April and May 2022, we trained selected researchers participating in the One Planet Fellowship on the art of storytelling to communicate their research. The immersive two-month training course focused on building an appreciation of the foundational skills in the art of storytelling using the Public Narrative methodology. Participants gained practical tools, skills, and confidence to develop and share narratives around their research.

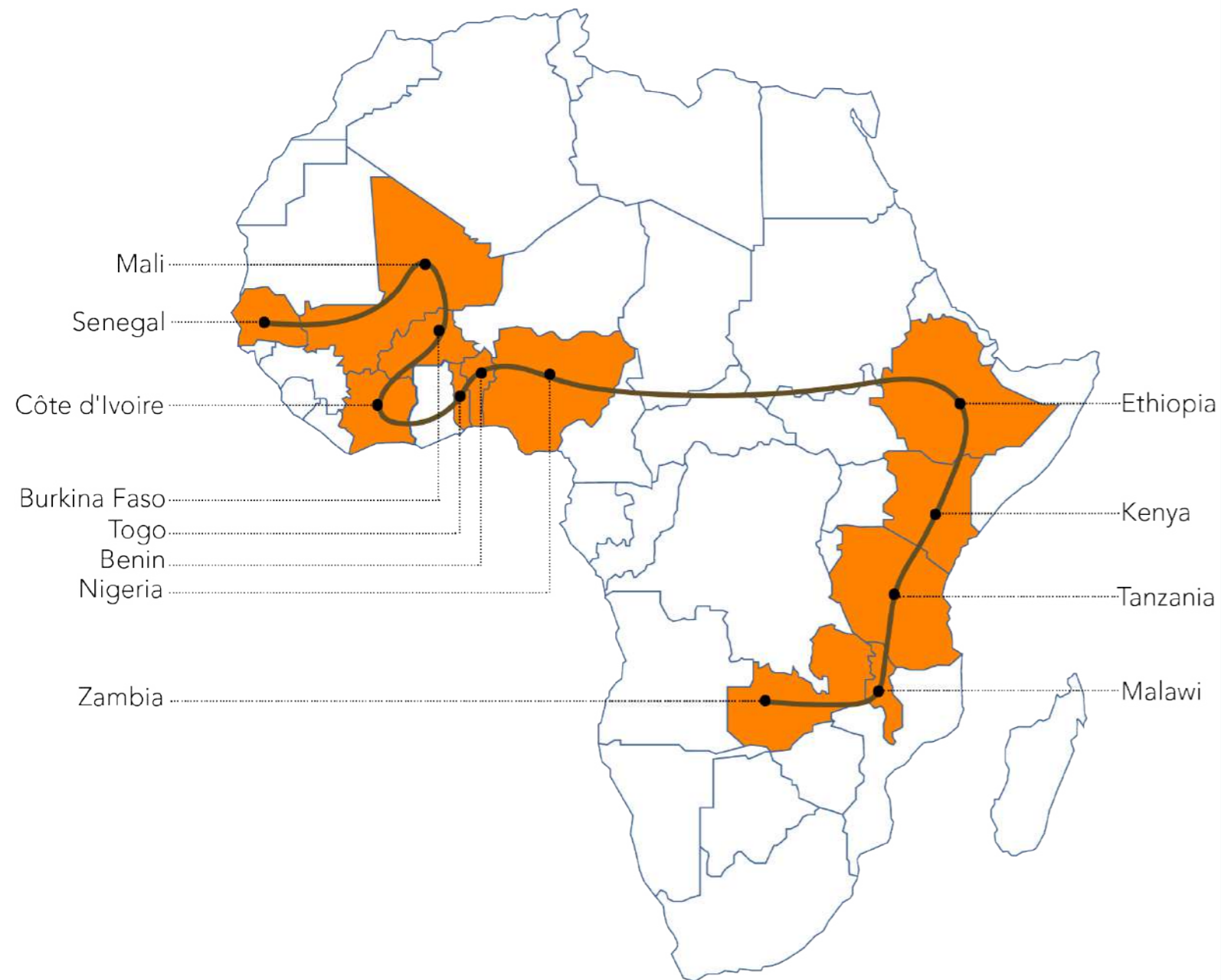
In this publication, we are delighted to share a collection of stories featuring the researchers who participated in the training. These are some of the One Planet Laureate Candidates working to develop solutions to help African smallholders cope with the changing climate and transform the continent's food systems.

These stories will take you on a journey through 12 countries, from Africa's most western point to a land-locked country whose borders are home to one of the world's largest waterfalls. You will meet researchers working to ensure no child goes to bed hungry; develop solutions to improve soils, ensure women fish traders have safer, better processing of their produce, and smallholders are included in research to utilize their knowledge, among others.

We hope you enjoy the stories as you get to discover some of the leading researchers across the African continent.

¹ <https://awardfellowships.org/our-strategy/>

Senegal



A Prickly Solution to Global Environmental Challenges

Mame Sokhna Sarr was born and raised in Saint-Louis, Senegal. A researcher at the Senegalese Institute of Agricultural Research, and a 2019 One Planet Laureate Candidate, Mame, as her friends fondly call her, moved to Dakar, the country's capital, after obtaining her Bachelor's degree in 2001. Every year, Mame travels to Saint-Louis to visit her parents and siblings, not without a stop-over at Ndiébène Gandiol, a picturesque region located 20 kilometers south of Saint-Louis. Like the rest of Senegal, the area has a warm and tropical climate, and the cacti dominate the landscape, which captured Mame's attention during one of her visits.



Mame's curiosity drove her to research the thorny fleshy plants in 2018, and she was amazed by the findings. The prickly pear cactus, as she discovered, not only has the potential to rehabilitate arid land and sequester carbon, it has a wide array of medical benefits, including lowering blood glucose by decreasing sugar absorption in the stomach. Some researchers think it can reduce cholesterol levels. Since then, Mame has committed to researching cacti better to understand its adaptation traits in a hostile climate and promote its use for land reclamation.

The prickly pear cactus has been the subject of numerous studies worldwide. The cactus works well as a bioenergy crop because of its versatility. When not harvested for biofuel, it works as a carbon sink, removing and storing carbon dioxide from the atmosphere. The crop is also used for food and forage by communities in many semi-arid areas worldwide because of its low-water needs compared with traditional crops. The cactus fruit is rich in magnesium, calcium, and vitamin C and can be used for jams owing to its high sugar content. The pads are eaten either fresh or as a canned vegetable. Because the stems are made of 90 percent water, their use as fodder would reduce the water needs of livestock.

With the United Nations classifying 42 percent of the world's land area as arid and semi-arid², cactus has enormous potential for carbon sequestration in abandoned places that may



not suit other crops. The cactus is adapted to dry marginal areas, increasing its possibility of combating desertification and soil erosion. In Senegal, the plant has notable success in fixing dunes. While in Madagascar, cactus cultivation has become an alternative source of livelihood³ for vulnerable communities in arid and semi-arid areas of the country.

Despite little knowledge and research on cacti and their products in Senegal, Mame is glad that some small and medium-sized enterprises are already actively processing and marketing cactus products like seed oil. Today, as humanity grapples with the challenges of global change, research represents a powerful instrument to accelerate the domestication of these stereotyped plants and tap into their numerous benefits.

2 https://www.un.org/en/events/desertification_decade/whynow.shtml

3 <https://www.jstor.org/stable/3774032>

How can Senegalese Women Access Land Rights? Multi-Stakeholder Dialogues can Move the Needle

Marie-Therese, a young scientist passionate about women's contribution to agriculture, advocates and champions dialogues to change mindsets about women's land access and ownership in Senegal. It is undeniable that women are critical actors in every part of the global food system, from research, farming, harvesting, processing, storage, and consumption. Despite their significance, restrictive social norms, discriminatory laws, and rapidly changing technological, environmental, and economic landscape mean their potential is often subdued. A report by FAO⁴ indicates that if women farmers had equal access to resources as the male farmers, they could potentially eradicate malnutrition for 100-150 million people.

The World Bank estimates⁵ women's labor share in African agriculture at 60-80 percent. In Senegal, women are the backbone of the country's agriculture, feeding a population of 16.7 million despite the country lying within the drought-prone Sahel. Yet, the women farmers have limited access to land, financial resources, markets, and skills compared to their male counterparts.

Growing up in Koalack, southeast of Senegal's capital, Marie-Therese Daba Sene, a Ph.D. student at Gaston Berger University and a 2020 One Planet Fellowship Laureate Candidate, experienced first-hand the struggles women and smallholder farmers underwent. During the holidays, she would accompany her father to the village, a trip she dreaded since it meant leaving her friends behind.

Over the years, Marie-Therese noticed her father's active participation in development activities in the village, especially in supporting rural women to farm vegetables for household consumption and as an income-generating activity. This experience informed her decision to focus on women farmers in agroecology while undertaking her Master's degree research.

Marie-Therese notes that women's land access is imperative to enhance food security. She believes that agroecology is a solution for rural women to access land, which she attributes to sustainable development. Although the Senegalese Constitution⁶ provides for equal access to land ownership, cultural practices and customary laws deny women that right. Women's tenuous access to land emerged as a critical issue for Marie-Therese.



She sees immense value in engaging various stakeholders in conversations about the benefits of equal rights to land access and ownership. These dialogues, if sustained, can help unpack the provisions in the Constitution and facilitate the implementation of the policies.

During her field study visits in the southwest region of Fatick, Marie-Therese works with women agricultural associations that request farming land from rural councils. The official records help association members access to credit and receive seeds distributed through different government programs. Marie-Therese highlights this as an avenue to self-sufficiency for the women involved since it provides food security for their households and an additional source of income from the sale of surplus produce.

Gender inequalities in Senegalese land governance can be attributed to the lack

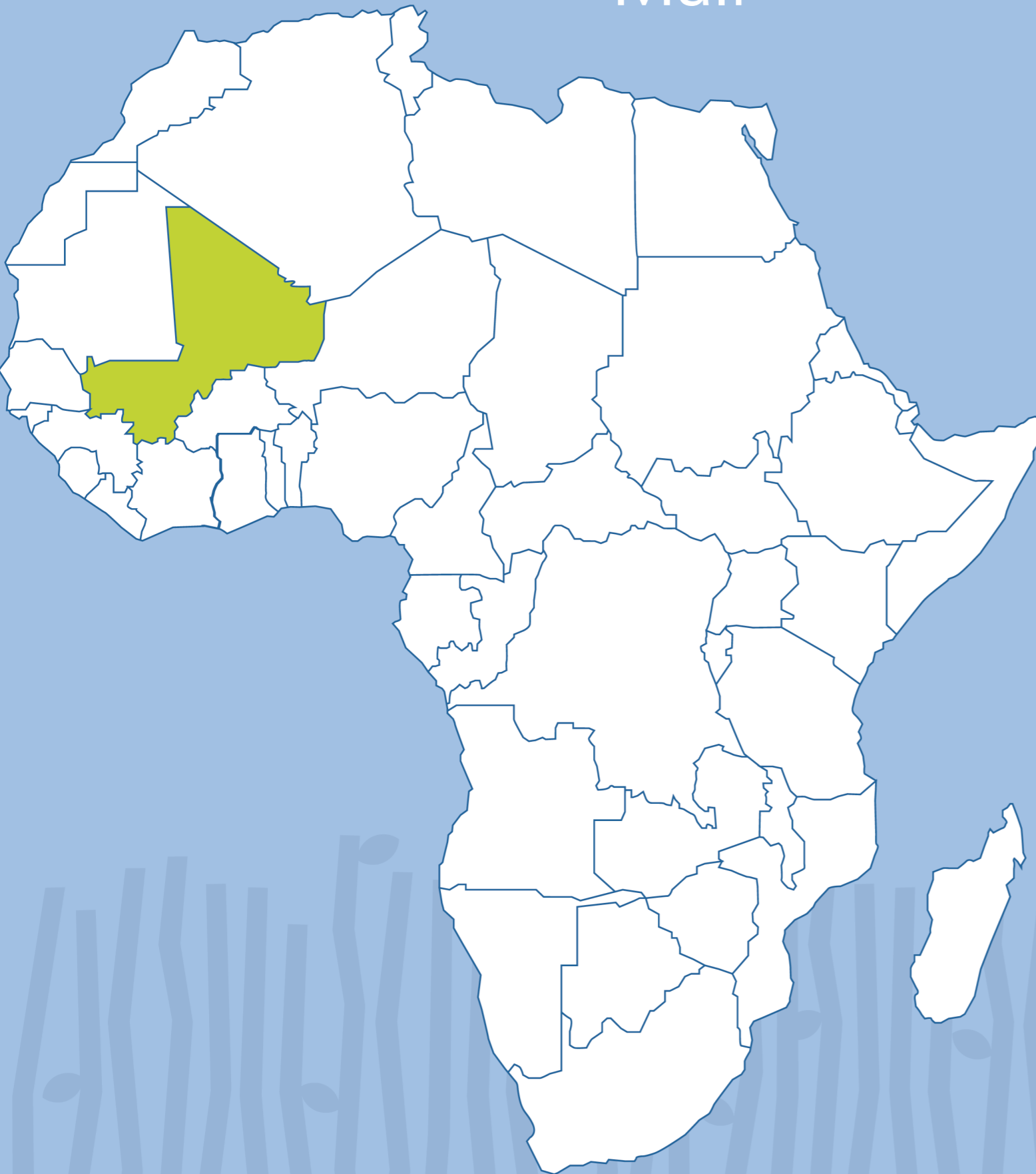
of women's involvement in local decision-making processes about land. Through her interactions with women, Marie-Therese noted that although some are aware of their legal entitlement to land, they often tend not to 'demand their right.' In the numerous participatory workshops she has attended, the shifts in women's and men's positions on land ownership reveal a recognition of the discriminatory customary gender laws and a yearning to change. To this end, Marie-Therese advocates for the need to foster dialogues on land ownership policies through advocacy and awareness campaigns. In her words, "if I don't do it, who will? and if I don't do it now, when will I ever do it?"

4 <http://www.fao.org/news/story/en/item/52011/icode/>

5 <https://www.worldbank.org/en/programs/africa-myths-and-facts/publication/women-agriculture-and-work-in-africa>

6 <https://advocatanmoy.com/2022/06/04/constitution-of-the-republic-of-senegal/>

Mali



Fighting a Modern Enemy Using Indigenous Knowledge and Science

Climate change⁷ is spurring the proliferation of new crop pests that seriously threaten African farmers. From leaf-eating caterpillars to fruit-pricking flies and tree-drilling beetles, these invasive species are a food and financial threat contributing to an estimated loss of 49 percent of annual yields, according to CABI⁸.

Cereals like rice, sorghum, and maize, Africa's most imperative food crops⁹, have not been spared. Maize, which is severely affected by pests, is the continent's most widely grown cereal crop, with over 300 million¹⁰ people in sub-Saharan Africa depending¹¹ on it as a staple food. A further 500 million to 1 billion Africans¹² consume root tuber crops, including potato, yam, sweet potato, and cassava, the latter being the most popular. While cassava is tolerant of drought and other extremes, it is vulnerable to pests. These insect pests can spread into new areas¹³ due to climate change and trade, and the resulting outbreaks can destabilize a country's food security. Climate change facilitates the spread of pests due to the creation of suitable weather conditions and new habitats for growth. The emergence of the fall armyworm is a good example.

The response to these pests has often been haphazard and ineffective. Farmers rely heavily on pesticides over traditional pest control methods, which presents several challenges.

According to scientists like Moussa Kante, a teacher-researcher at the University of Segou, Mali, integrated pest management offers

farmers the prospect of higher profitability and lower production costs. Born in Sougoula Mali, Kante, a 2020 One Planet Laureate Candidate, lived in different countries in the sub-region while growing up, depending on where his father, an agricultural engineer, was assigned to work. The second born of six siblings, Kante has fond memories of growing up with his agronomist father, whom he would often accompany to meet farmers in the fields. This influenced his career path in agricultural engineering.



7 <http://www.nature.com/news/crop-pests-advancing-with-global-warming-1.13644>

8 <http://www.cabi.org/projects/food-security/tackling-pests-diseases/>

9 https://www.afdb.org/fileadmin/uploads/afdb/Documents/Events/DakAgri2015/Cereal_Crops_-_Rice__Maize__Millet__Sorghum__Wheat.pdf

10 <https://wema.aatf-africa.org/project-brief>

11 http://www.vib.be/en/about-vib/plant-biotech-news/Documents/VIB_MaizeInAfrica_EN_2017.pdf

12 <http://blogs.worldbank.org/african/cassava-production-poverty-alleviation-and-intra-regional-trade-in-sub-saharan-africa>

13 <http://www.fao.org/emergencies/emergency-types/plant-pests-and-diseases/en/>

Growing up in different regions exposed him to the everyday challenges farmers experienced, including the effects of climate change, the high cost of inputs, and pest management. He was observant and worried about the farmers' use of pesticides, oblivious of the risks these chemicals posed to them and the consumers. He also noted how expensive the pesticides were and that some farmers had little or no profit after harvesting.

Kante's research focuses on the fight against crop pests using biopesticides, anchored on indigenous knowledge - which he refers to as 'Africulture' - to help smallholder farmers. Integrating indigenous knowledge makes it possible to apply common strategies of problem-solving and thinking. According to Kante, communities have a vital role in safeguarding and preserving nature as they have done for millennia. Using a participatory approach, Kante taps into the farmers' wisdom and skills, which are based on a sophisticated understanding of their local surroundings.

The farmers often prefer repelling pests rather than killing them. This informs Kante's recommendations on using biopesticides from naturally available materials like plants, e.g., neem, chili, tobacco, garlic, acacia, and certain minerals. Natural products have a long history as crop protection agents, and pesticides are usually referred to as 'biopesticides' when formulated using these substances. As nature continuously provides almost unlimited bioactive natural products, today's farming model of exclusively relying on synthetic chemicals is beginning to change. With the help of scientific research, these biopesticides' efficiency has continuously improved.

Kante envisions his research will transform small-scale farming into an economically viable and environmentally sustainable practice for the communities in Mali and Africa. His commitment to helping smallholder farmers, whom he interacts with during field visits, is the ember that keeps his flame burning.



Côte d'Ivoire



Cocoa-Based Agroforestry can Sustain Cocoa Production and Save Côte d'Ivoire's Trees

Chocolate is often referred to as food for the soul. But could your sweet tooth be a contributor to the obliteration of animal and plant biodiversity? Cocoa, the key ingredient in chocolate, is traditionally cultivated in regions with dense and diverse tree canopies, and Côte d'Ivoire is the world's top cocoa producer. The country accounts for nearly half of the world's supply. However, according to the Ivory Coast Forest Inventory (IFFN), the West African country has lost 90 percent of its forest cover over the last 60 years,¹⁴ primarily attributed to cocoa farming. Over the decades, a lack of improved germplasm, inadequate farming inputs, and increased demand for cocoa has seen smallholder farmers clear new forest land every planting season. Did you know that the demand for chocolate means that a West African country is staring at a crisis of rampant

deforestation and increased vulnerability to climate change?

In recent years, a new generation of Ivorians, including Akoua Tamia Kouakou, a landscape ecologist and a Teacher-Researcher at Jean Lorougnon Guédé University, are striving to change a farming sector that has long left cocoa farmers in poverty. Tamia, a 2019 One Planet Laureate Candidate, dreams of a world where vegetation cover and natural resources are respected. Born in the eastern region of Côte d'Ivoire, her passion for the environment started at an early age as she joined her father for gardening sessions on the family farm. Her schooling years also allowed her to travel across the country, discovering the richness of her country's landscape and the different vegetation roles for diverse communities.



Tamia believes that agroforestry could help solve the challenge of deforestation in Côte d'Ivoire and bridge the gap between cocoa production and protecting the country's rainforest. Integrating other tree species and perennial food crops in cocoa plantations would limit deforestation and boost the dwindling tree cover, worsening the effects of an already changing climate. This practice is already in use by some farmers, although in a limited way since the decision of trees to plant is solely guided by their perceived usefulness for firewood production, thus limiting the diversity and density of the trees they grow. There's a need to consider the tree-planting practice beyond merely planting trees. We need to consider the tree species, planting density, and how these trees would complement the cocoa farms.

According to Cocoa Barometer,¹⁵ cocoa agroforestry systems have an extensive range of ecological benefits, including; carbon sequestration, preserving soil moisture,

controlling microclimates, biodiversity conservation, and pest control. However, a vast rift separates agroforestry's current reality and potential in the cocoa production sector.

In Côte d'Ivoire, increased awareness of cocoa's social-ecological impacts is pressuring the cocoa value chain actors to source from sustainably-produced systems that minimize degradation of biodiversity and deforestation and allow smallholder farmers to earn a decent income. Through her research, Tamia seeks to support cocoa producers adopt new cultivation practices, improving the livelihoods of the country's majority. By identifying tree species and ideal planting densities, her research could provide additional economic returns for the farmers, e.g., from selling fruits or timber and increasing food security. In the long-term, these cocoa agroforestry systems may result in higher yields than monocultures.

Tamia believes her experience with the One Planet Fellowship will help her share the knowledge she has gained with colleagues and students and in outreach activities with farmers in her home country.

14 <https://www.ignfi.fr/en/portfolio-item/inventaire-forestier-et-faunique-national-cote-divoire/>

15 <https://stories.mightyearth.org/voice-network-agroforestry-in-cocoa/index.html>

Scientist Turned Entrepreneur's Quest for Safe Crop Protection Options for Côte d'Ivoire Smallholders

Howélé Michaëlle Touré's passion for agriculture started while she was in high school. A native of Côte d'Ivoire, she obtained her Bachelor's degree in Abidjan, where she was born. Her father, a primary school teacher, instilled a love for work and respect for others.

Michaëlle, a postdoctoral researcher at Université Félix Houphouët-Boigny and a 2019 One Planet Laureate Candidate, was shocked to see farmers recklessly using chemical pesticides during a routine field mission. She was perturbed that the farmers were oblivious of the dangers of overusing pesticides and even more disturbed that safer options were not readily available.

Inappropriate application of pesticides can be detrimental to human health. Insufficient knowledge on safe pesticide handling by farmers in developing countries, illiteracy, and ignorance of biosafety measures are among the variables exposing them to the risk of pesticide poisoning. Some of the unsafe practices exhibited by farmers in Côte d'Ivoire and the developing countries, in general, include mixing highly toxic pesticides, unsafe transport and storage, improper disposal of empty pesticide containers, and even reusing the empty containers for food and water storage, and using obsolete pesticides. A study of global data on pesticide poisonings¹⁶ revealed a shocking increase in the number of farmers and agricultural workers harmed by pesticides. The study estimated the total fatalities worldwide from unintentional pesticide poisonings at 11,000 deaths annually.

The more she interacted with farmers, the more Michaëlle wanted to find a solution to curb the reckless use of pesticides among smallholder farmers. Her interest sparked entrepreneurship thoughts, and she set up a company to produce organic alternatives that would be readily available to the farmers. Although her research focuses on a solution for the bacterial blight cassava, Mica, as she likes to be called, has a newfound love of organic agriculture which has taken root. She believes organic agriculture respects the earth's ecological limits while promoting agri-food systems that strengthen food security and improve living conditions.



Only 0.2 percent of agricultural land¹⁷ in Africa is dedicated to organic farming. Challenges such as limited research on organic agriculture, lack of national organic agriculture policies, high cost of certification, and underdeveloped markets in most countries hamper the widespread adoption of organic agriculture in the continent. Although her company is still in the start-up phase, Mica soon expects to provide healthy food to consumers in Côte d'Ivoire. To reduce production costs and put organic products on the market, Mica works with researchers in related fields to prioritize healthy eating for her countryfolk.

¹⁶ <https://pubmed.ncbi.nlm.nih.gov/33287770/>

¹⁷ https://www.researchgate.net/publication/283507768_Organic_Agriculture_and_Food_Security_The_Story_of_Africa

Enhancing an Unassuming Local Staple for Improved Nutrition in Côte d'Ivoire



Attiéké, a dish made from fermented cassava, is the most famous traditional cuisine, but it contains insufficient quantities of proteins and micronutrients.

Studies record that more than half of Côte d'Ivoire's population consumes attiéké at least once daily. So popular is the dish that it dominates mealtimes across the country. However, because of its low nutritional value, most populations suffer severe undernutrition, particularly the poor households that consume attiéké without complementing other foods. According to the Food and Agriculture Organization of the United Nations, almost a quarter of households in rural Cote d'Ivoire suffer from food insecurity and malnutrition.¹⁹ Malnutrition presents significant threats to human health. The World Health Organization (WHO) attributes better nutrition to improved health,²⁰ longevity, and a lower risk of diseases. The significant nutritional challenges that most of Côte d'Ivoire's citizens face are what drove Kouadio Christelle Marina Kouakou, a postdoctoral researcher at the Nangui Abrogoua University in Abidjan and 2020 One Planet Laureate Candidate, to specialize in nutrition and food security.

Christelle's research focuses on widely consumed foods with low nutritional value. Through her research, she established that consuming large amounts of starch and lacking vitamins and minerals in diets made the Ivorians susceptible to nutritional deficiencies.

Côte d'Ivoire vibrates with the rhythm and flavors of its fertile land. The country's rich cultural heritage is spurred by the more than 60 ethnic groups that call it home. Despite the varying diets, the people of Côte d'Ivoire generally rely on tubers and grains to sustain their diet. Rice and cassava are the two most important staple food crops, with cassava having an annual output of 5,238,244 tons in 2019.¹⁸ The country's widespread cultivation and consumption of cassava are linked to the tuber's high drought adaptability, resistance to pests and diseases, and primary production techniques.

¹⁸ <https://www.selinawamucii.com/insights/market/ivory-coast/cassava/>

¹⁹ <https://reliefweb.int/report/c%3%B4te-divoire/c%3%B4te-divoire-malnutrition-worsens-fao-says>

²⁰ <https://www.who.int/health-topics/nutrition>

Christelle is convinced that the widespread consumption of attiéké in Côte d'Ivoire means that improving the nutrition of the country's population lies in identifying ways of enhancing the popular staple dish.

In developing countries, micronutrient deficiency and protein-energy malnutrition are the most common nutritional problems. Through fortification, the nutritional quality of different foods can be improved.

Christelle's research indicates that the nutritional rate of attiéké can be increased by incorporating other foods rich in vegetable protein and minerals, especially soybeans. The beneficial effects of eating enriched attiéké have been proven,²¹ and the results are promising. Furthermore, her research affirms the need to intercrop and substitute chemical

fertilizers with organic options for increased yields and nutritional quality.

Christelle also notes that promoting the production of soybeans to incorporate into attiéké has a double-edged benefit, as it supports smallholders to improve their soils. Due to their nitrogen-fixing capacity, legumes reduce the need for synthetic nitrogenous fertilization. She believes that scaling up the production of legumes rich in vegetable proteins and cheaper than animal proteins would encourage the population to consume more and fix the country's soils while at it.



²¹ <http://www.sci epub.com/ajfst/abstract/8965>

Burkina Faso

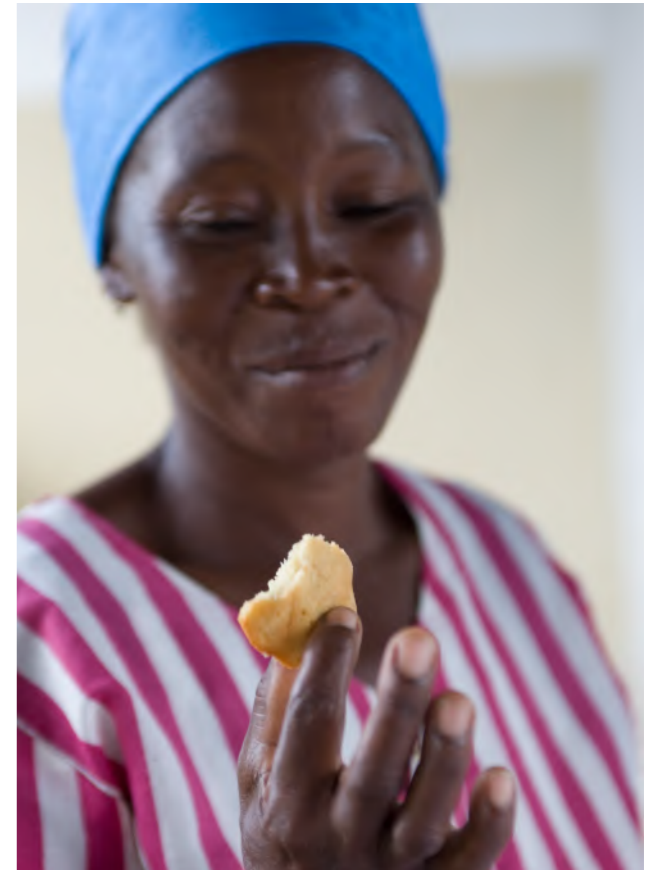


A Touch of Science to Improve a Traditional Condiment, While Lightening Women's Burden

Sumbala, a popular condiment in West Africa made from fermented African locust beans (*Parkia biglobosa*), is not only an essential source of nutrients for low-income households but is also a key income generator for rural and urban women in Burkina Faso. However, the work involved in preparing this traditional delicacy, primarily done by women, is restrictive and arduous. The process consumes significant amounts of firewood and water and takes considerable time. Furthermore, the nutritional benefits of sumbala have led to increased demand, resulting in the adoption of unhealthy practices to facilitate the cooking process, including industrial chemicals. The resulting product is of poor nutritional and health quality.

Driven by her passion for transforming local products for family consumption, Miriam Coulibaly Diakité, a Food Research Engineer at the Institute for Research in Applied Sciences and Technologies (IRSAT) and 2020 One Planet Laureate Candidate, is working to optimize the traditional sumbala production process. Her research focuses on developing an innovative resource-saving production process that will eliminate some of the production constraints. Miriam incorporates science into the traditional preparation to create a process that uses less energy and water, ultimately reducing the processing time.

The traditional sumbala preparation process takes up to five days. It entails cooking the seeds for 18 to 20 hours, which consumes colossal amounts of firewood, and about 40 liters of water to produce one kilogram of sumbala.



This process takes a toll on the women and the environment, given the vast amount of water and firewood required. Diakité's research is improving the working conditions of Burkinabè women and allowing them to produce better quality sumbala. These improvements have made it possible to promote entrepreneurship around this activity among the youth and diversified the forms of sumbala available in the market.

Born into a large family in Bobo-Dioulasso, Miriam recalls watching cooking shows with her father as a child, which perhaps sparked her interest in agri-food engineering.



She hopes to benefit from the One Planet Fellowship’s mentoring program to facilitate the effective transfer of skills from established scientists around the continent. She is keen to compete for the Fellowship’s Advanced Science Training (AST)²² to gain an opportunity to access modern laboratories for the latest technologies in food research and develop fruitful collaborations. Upon completion, she would like to share her experience with colleagues at her institution, which she has already started through discussions with colleagues.

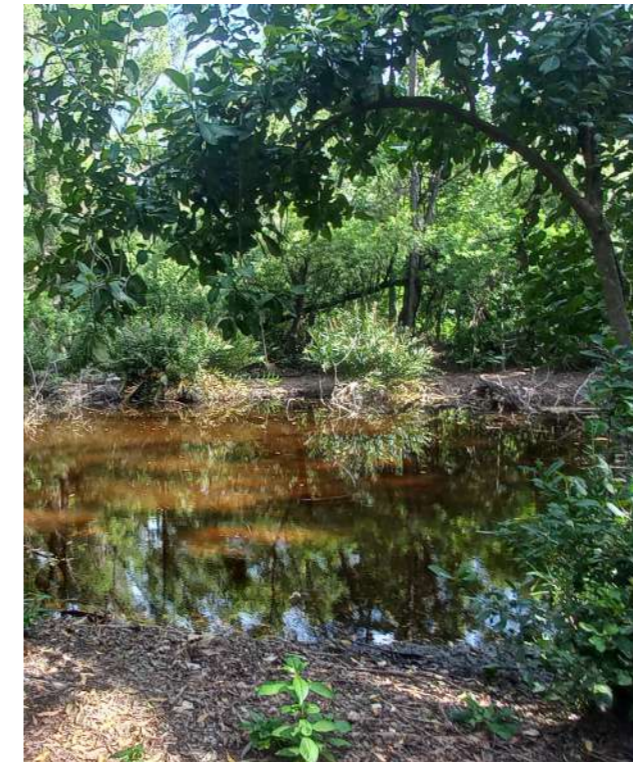
With recent reports painting a gloomy picture of the state of malnutrition in Burkina Faso,²³ Diakitè envisions her research and work on this traditional condiment, packed with nutritional and microflora properties,²⁴ as a solution to a looming nutrition crisis.

22 Advanced Science Training (AST) is a three to nine-month program within the One Planet Fellowship offered to post masters and post-doctoral Candidates for research placements in state-of-the-art European agricultural research institutions

23 <https://reliefweb.int/report/burkina-faso/burkina-faso-acute-malnutrition-analysis-august-2021-july-2022-issued-january>

24 <https://www.journalcra.com/article/process-production-and-valorization-sumbala-african-mustard-review>

Can Review of Women’s Land Rights Improve Adoption of Stormwater Management Options? A Sociologist Dives to Find Out



Born in Burkina Faso to a father who was a forester and a mother who was a nurse, Inès Fabienne Rouamba, a 2019 One Planet Laureate Candidate, would often help her father plant trees around their compound. What she enjoyed the most was watering the trees, and at an early age, she became interested in environmental studies.

At the university, Fabienne joined the sociology faculty because, in her final year in high school, one of the teachers she admired was a sociologist, and she admired his mastery of the course. Additionally, reading Jacques Chevrier’s “African Anthology” book made her

consider studying anthropology. She actualized this dream by enrolling in the faculty of sociology. After obtaining her master’s degree in sociology, she landed a job as a Research Engineer in Rural Sociology at the International Institute of Water and Environmental Engineering (2iE) in Ouagadougou.

In her role, Fabienne works on the development and sustainable management of runoff collection basins (BCER project) for supplemental irrigation in Burkina Faso. This project, also implemented in Mali and Niger, promotes optimized management of stormwater retention basins to strengthen farmers’ resilience to climate change in the Sahel.

In ideal situations, only a small quantity of rainwater becomes surface runoff. This runoff usually flows into the nearest wetland, creek, stream, lake, or river; however, due to the depletion of vegetation cover and degradation of the natural environment, runoff increases and causes flooding. Today, retention basins (ponds that store and filter rainwater from sediment) are commonly used for stormwater treatment. The retention ponds impede the adverse effects of excess stormwater, prevent frequent flooding, and further recharge groundwater.²⁵

Fabienne is responsible for evaluating the social, cultural, economic, and environmental impacts of the construction of stormwater retention basins. Her research entails assessing the basins built in Burkina Faso.

25 <https://sswm.info/water-nutrient-cycle/reuse-and-recharge/hardwares/recharge-and-disposal/surface-groundwater-recharge>

She evaluates the effectiveness of the waterproofing techniques, their degradation (stability, loss of capacity), use of these basins, and any factors constraining and/or facilitating their proper use. Her research further identifies the gender aspects that may influence the adoption of retention basin technology.

In Burkina Faso, she works in the northern Sahel zone, where women, despite their pivotal role in farming and other income-generating activities, have no rights to land ownership. Fabienne has observed that regardless of their involvement in constructing the retention ponds, women have limited access to the farms, thus crippling their ability to fully benefit from the technologies.



Her research findings have made Fabienne appreciate the lack of gender parity in the adoption of sustainable options for stormwater retention and the development hurdles the rural Burkinabe women face. Her desire to contribute to improved living conditions for these women has fueled Fabienne's interest in gender and agriculture. She is conceptualizing a research project to demonstrate how women's ownership and management of retention basins can improve resilience of farming communities in the northern region of Burkina Faso. Through her new project, she will promote the leadership of women farmers in the face of a changing climate. Fabienne identifies capacity building as necessary to encourage more excellent women leadership within farmers' and rural producers' circles. She believes women need access to the latest information on agriculture, production, and coping with climate change. They also need to acquire skills in leadership, marketing, entrepreneurship, and the ability to discuss and negotiate with authorities.

However, all her plans have been put on hold due to the unprecedented crisis in Burkina Faso²⁶. Sadly, the political instability has aggravated the dire situation for women and marginalized communities who are forced to flee their homes and have become even more vulnerable.

Promoting gender equality and women's empowerment in Burkina Faso's farming systems has gained ground and is slowly taking root. Fabienne believes that despite the current situation in the country and the challenges of inequality, the time is ripe for women smallholder farmers to gain recognition for their contribution to agriculture and towards achieving global food security.

26 Burkina Faso has been experiencing escalated political instability following a series of military coups since late 2021 (<https://www.aljazeera.com/where/burkina-faso/>)

A Scientist Living her Dream Includes Smallholders in Research to Boost Innovation Adoption

Inspiration is the impetus to move ahead, and people have sought it from the most unlikely places. Born in a modest family in Ouagadougou, Burkina Faso, Alimata Arzouma Bandaogo, a 2019 One Planet Laureate Candidate, recalls seeing a beautiful house on her daily route to school as a child. She was fascinated by the house's beauty, and upon inquiry, she learned that the owner was an agricultural engineer. Immediately, she told her friends she would be an agricultural engineer too when she grew up. Bandaogo, an agripedologist at the Institute for Environment and Agricultural Research (INERA), Burkina Faso, now lives her childhood dream. She works on, among other things, finding strategies to improve soil production. She also researches improved crop varieties and their introduction in rural areas.

Alimata recalls her allure to trees, animals, water, and nature from an early age. This developed her interest in environmental studies and helped her develop a good

aptitude for science subjects. In 2005, she obtained her General University Study Diploma (DEUG – Diplôme d'Etude Universitaire Générale) at the University of Professor Joseph Ki-ZERBO, where she pursued her dream of becoming an Agronomist Engineer. After passing the entrance test to the Institute of Rural Development, she naturally chose to study agronomy. Her passion for this profession was unwavering, and she sailed through her agronomy engineering degree in 2008.

During her training, Bandaogo comprehended the challenges that plagued her country's agricultural sector, including soil degradation, declining yields, and climate change. Agriculture is the backbone of the Burkinabe economy, and smallholder farmers constitute 80 percent of the country's agricultural community²⁷. The sector is characterized by scarcity of secure arable land and markets, limited access to quality inputs and services, and unavailability of financial services.



27 <https://sswm.info/water-nutrient-cycle/reuse-and-recharge/hardwares/recharge-and-disposal/surface-groundwater-recharge>

High rainfall variability characterizes the climate of this Sahel country, making farming difficult for most smallholders since there is little access to irrigated water supplies. Climate change is compounding this problem, leading to an increase in the magnitude and frequency of extreme weather events and a general decline in rainfall.

To improve Burkina Faso's agriculture sector and uplift the livelihoods of vulnerable households and communities, the focus should be on revamping agriculture production by promoting best practices that integrate sustainable use of natural resources and climate risk management. In this spirit, Alimata changed her research focus to extend innovative and climate-smart production systems, including organic manure, crop rotation, soil conservation, and integration of high-yield crop varieties. Working closely with the farming communities, she co-designed these systems to enable better adoption. Her solutions were met with genuine enthusiasm from the farmers, who gladly adopted the new technologies. Her most successful work involved optimization of the use of nitrogen in irrigated rice farming with Deep Placement of Urea (DPU) supergranules technology to manage the different nitrogen loss mechanisms. She conducted the experiments at INERA in Burkina Faso's three central irrigated plains and trained producers to use DPU through field schools and guided tours.

Thanks to this project, the adoption of DPU technology has surpassed expectations on the rice plains of Burkina Faso. Because of community involvement in the planning and execution, the chance of continuous implementation going forward is greater. The yields have increased by 25 percent, and the farmers are still working together to achieve the common good.

Although Alimata's work produces the desired results, many more challenges remain in the Burkinabè agricultural sector. Through national policies, concerted efforts are required to

provide safe and nutritious food, improve market systems, and reduce smallholder farmers' vulnerability to climate-related risks.



Exploring Research-based Solutions to support Artisanal Fisheries

For as long as he can remember, Toundji Olivier Amoussou has been passionate about fish. Born in the commune of Savalou in Benin, Olivier, a 2019 One Planet Laureate Candidate, began his primary studies in Parakou. After attaining his bachelor's degree, he enrolled at Abomey-Calavi's Polytechnic School to study livestock production. In the second year of his master's degree, he obtained an internship at the International Centre for Research and Development on Livestock Farming in Sub-humid Zones (CIRDES) in Bobo-Dioulasso Burkina Faso, where he is currently a Post-Doctorate Researcher.

It contributes to job creation, poverty alleviation, and food security.

Unfortunately, most of Burkina Faso's aquatic resources are being degraded and are under imminent threat by multiple human-induced pressures. The principal stresses on these resources include wetland encroachment, development of agricultural projects along water sources, and unregulated water abstraction from underground and surface water tables. Pollutants such as pesticides, heavy metals, and sediment degrade wetlands and affect water quality.

During his master's fieldwork in the village of Bama, 20 kilometers from Bobo-Dioulasso in Burkina Faso, Olivier had an epiphany about how the livelihoods of the fishing community in this region would benefit from his research. The Kou Valley Lake in Bama is a critical source of livelihood and nutrition for the communities. However, the lake is gradually decreasing due to the conversion of its perimeters for agricultural activities, including rice fields and banana plantations.

By integrating with the Burkinabe fishing communities, Olivier has navigated complex social-ecological challenges and integrated their traditional knowledge into his research to ensure they fully adopt the learnings. His scientific approach aims to find innovative solutions for managing fishing communities while preserving the natural environment. The study focuses on the conservation and environmental sustainability of aquatic genetic resources - plants and animals.



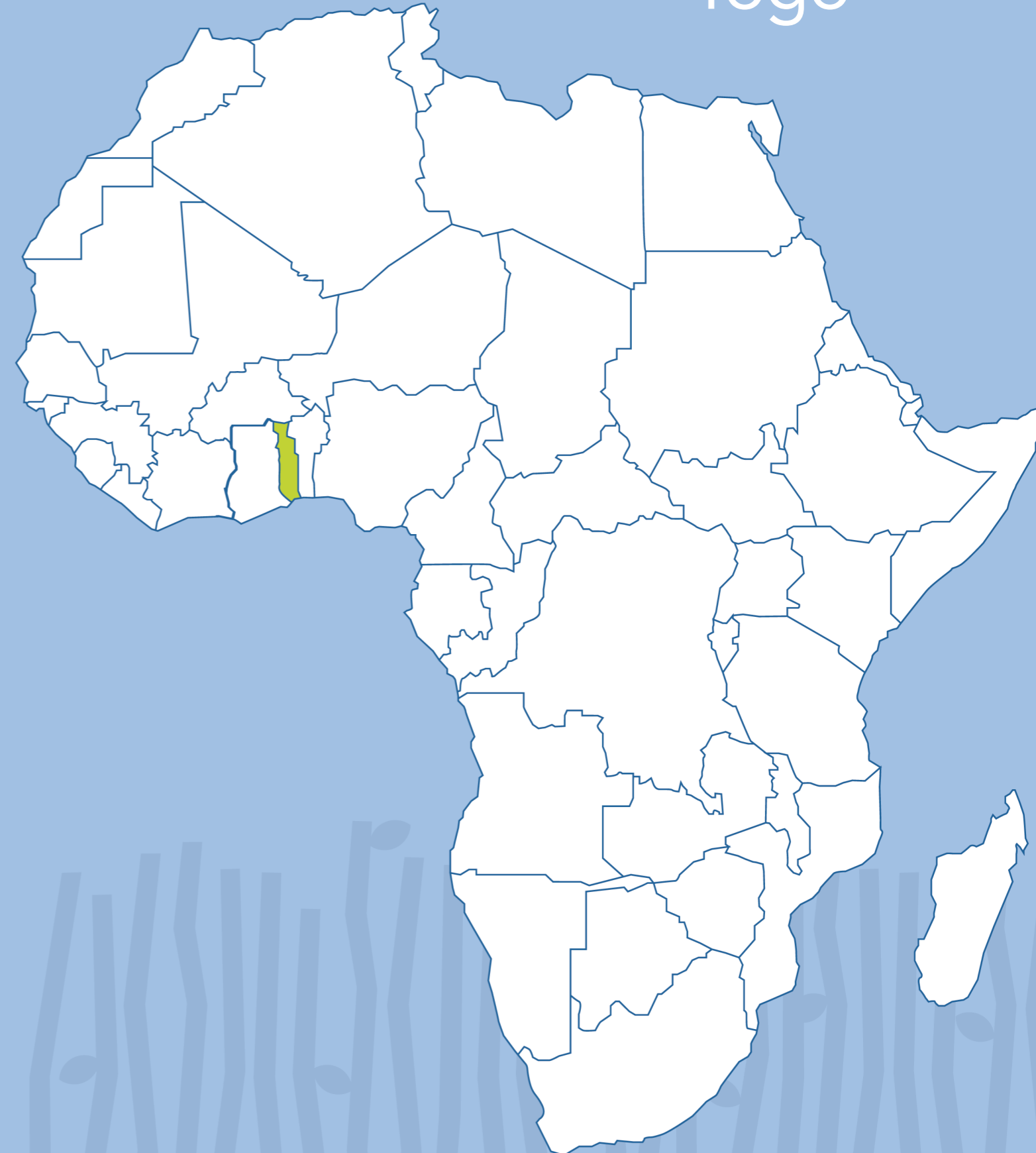
Olivier's vision of improving the lives of rural fishing communities has always been his driving force. Burkina Faso's artisanal fishing value chain is extensive - from farming, and input production, to processing and marketing. This chain has the potential to generate employment for many youths and enormous profits for business people.

Olivier notes that more effort is required to develop an ecosystem services framework that articulates social and ecological benefits. The unifying goal of his research is to balance the ecosystem and human needs so that aquatic resources are sustainably managed for the benefit of future generations.

Toundji Olivier Amoussou is among a growing number of candidates selected to participate in the One Planet Fellowship - a career development initiative that builds a robust pipeline of highly connected, inter-generational scientists equipped to use a gender lens to help Africa's smallholder farmers cope with climate change. He believes the Fellowship will offer him an opportunity for personal development and integration into a network of African researchers. He notes that the scientific and proposal writing skills garnered from the Fellowship will contribute to improving project writing and increase his funding opportunities. Additionally, lessons learned from his European peers during Advanced Science Training will provide the tools to impact the fishing communities he's passionate about.



Togo



Incentivizing Communities to Participate in Forest Fires Management

Bush fires are a significant threat to forests worldwide. Research in the West African savannas²⁸ indicates that aside from the commonly cited reasons - hunting, paving the way for farmland, and improving grazing grounds – communities set up fires to increase the supply of particular forest products and deter wild animals. In Togo, poor forest resource regulations, insufficient knowledge on sustainable land management and conservation, and a lack of awareness by the local communities have increased bushfire occurrences. A report by Global Forest Watch²⁹ states that Togo lost 63 hectares of tree cover between 2001 and 2021 due to the fires.

In the last decade, bush fire outbreaks in the West African country have become a considerable challenge to soil fertility, biodiversity conservation, and the development of the agricultural sector. This is because the fire outbreaks have destroyed vast tracts of farmland and forests, leading to the loss of farm produce and the loss of property, and lives in some cases.

Dahan Kueshi Sémanou, a Ph.D. student at the University for Development Studies in Ghana and a 2019 One Planet Laureate Candidate, has encountered the devastation caused by bushfires in his home country Togo. Growing up in Ahlon-Tinipe, a small village in Togo's plateau region, he witnessed his communities' suffering from the annual bush fires that often destroyed everything in their wake during the dry season. This experience informed his research area - fires, plant dynamics, climate

change, forests, and remote sensing - and a drive to find probable solutions to stop or reduce this disaster. One of his research areas explores the socio-economic and sociocultural aspects that fuel bushfires and the environmental conditions that catalyze their spread.



Dahan's research also analyzes the damage caused by the fires to determine the most affected landscape entities. These fires also significantly impact the environment in the form of air pollution since they release millions of tons of carbon dioxide and other greenhouse gasses into the atmosphere, contributing to climate change.



His research recommends establishing policies for monitoring and raising awareness of at-risk areas while incorporating all stakeholders, particularly the local communities. Additionally, he calls for increased attention to the impacts of bushfires on the communities and other stakeholders in the country, including the Regional Directorate for the Environment and Forest Resources, whose role is to protect the country's forests.

Passionate about natural resources and the need to preserve them, Dahan decided to investigate the local communities' stake in natural resources and how best they can participate in their management.

Dahan advocates for community training in small-game farming, which will help communities obtain meat products and a source of income that will reduce hunting and bushfire practices. Training the locals in beekeeping and installing the beehives within forested areas will also oblige them to protect the forests. He also notes that training the

communities in sustainable farming techniques will avoid using bushfires for land clearing.

Dahan believes that only through political commitment and prioritization of these actions under sustainable development policies will such measures be effective in tackling this recurring phenomenon.

28 https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjZ9Yy1_8v5AhVQt6QKH-Q8sBpg4ChAWegQIIBAB&url=https%3A%2F%2Fd-nb.info%2F1010148869%2F34&usg=AOvVaw0EnOriTKDPj_oQxqTQj4Ac
29 <https://bit.ly/3wERPIp>

Benin



Mission Possible: Seeking Safer Pest Control by Weaving Indigenous Knowledge Into Science



The widespread use of synthetic pesticides in the early 20th century revolutionized the farming industry across the world.

In Africa, agricultural pesticides have increased production in livestock and crop enterprises since farmers now have the upper hand in the fight against pests and parasites. With an estimated population of 1.3 billion and expected to double by 2050³⁰, there is enormous pressure on African food systems, often inundated by low productivity. The continent is rapidly developing dependence on pesticides for crop protection, especially among smallholder farmers who account for over 75 percent of food production on the continent³¹.

For the West African Republic of Benin, the consumption of pesticide residues through contaminated food products receives little

attention, which has brought to light the alarming pesticide practices in the country³². Laura Estelle Yêyinou Loko, a Senior Lecturer at the National University of Sciences, Technologies, Engineering, and Mathematics in Benin, and a 2020 One Planet Fellowship Laureate Candidate, seeks to secure agricultural production in the country by merging indigenous knowledge and science for pest control. During her thesis research, a field visit informed Estelle's interest in pest control. She was perturbed by the massive post-harvest losses farmers faced caused by insect pests, which led to their use of highly toxic pesticides. During one of the field visits in Northern Benin, she learned about an entire family wiped out due to food poisoning linked to the consumption of yams treated with synthetic pesticides.

30 <https://www.worldometers.info/world-population/africa-population/>

31 https://www.researchgate.net/publication/242759117_Smallholder_Agriculture_in_East_Africa_Trends_Constraints_and_Opportunities

32 https://www.ishs.org/ishs-article/1007_44

“Learning that an entire family died because of hunger since the only way they could respond to hunger was by consuming contaminated cassava was devastating. I knew I had to do something. I found my purpose then. That is why I have committed myself to develop alternative biological control methods that respect human health and the environment for post-harvest protection”, shares Estelle.

Estelle believes that farmers embody plenty of valuable knowledge, which can be harnessed to provide safer pest control solutions. Recalling her childhood memories in the small town of Kribi in Cameroon’s equatorial forest, she remembers observing nature and realizing that insect pests have natural enemies, which she refers to as “farmers’ friends.” Her research includes finding strategies to utilize these natural enemies in managing crop pests. These strategies combine scientific practices with traditional knowledge acquired by Beninese farmers over many centuries, like using oils and powders from certain plants with pesticide properties. Estelle seeks to promote the use of these methods, which are quickly being replaced by harmful pesticides. She scientifically evaluates each strategy to ascertain its effectiveness.

Estelle and her team are ambassadors of sustainable and organic agriculture. She firmly believes that organic farming is a powerful way for farmers to develop resilience against climate change. The extensive use of pesticides has dramatically degraded the soil, resulting in the desertification of large land areas. Organic farming can counteract this challenge and increase agricultural productivity.

Another component of her work is to teach farmers the best agricultural practices and raise their awareness about the negative impact of the abusive use of pesticides on human health and the environment. Through the One Planet Fellowship, she has gained skills that have improved her interaction with farmers as she continuously spreads knowledge across local communities in Benin.



With the advent of climate change, Estelle has begun focusing on the proliferation of new pests in her home country. Her work is fundamental to Benin’s future and exemplifies how science, traditional knowledge, and sustainable practices can be combined to change a country’s food systems.

Fishing Innovative Options to Promote Fish Farming

In much of rural Africa, fishing tends to be overshadowed by agriculture and livestock keeping, despite not being a marginal sector. On the continent, fishing provides a direct income for over 10 million people³³ and contributes to the food supply of over 200 million more people. Data from the WorldFish Centre³⁴ indicates that 22 percent of animal protein for Africans is from fish and the rate is as high as 60 percent in some countries. Fish is also a great source of essential minerals, fatty acids, vitamins, and other nutrients necessary for a healthy diet. Fishing is also a significant economic contributor. According to the UN Food and Agriculture Organization (FAO)³⁵, fish products constitute over 10 percent of the total value of national exports in 11 African countries. However, under the current fishing practices, Africa’s inland fisheries and marine are reaching their limits.

Data from the Japan International Cooperation Agency (JICA) indicates that Benin’s fishing industry employs about 15 percent of the working population³⁶ and provides 30 percent of the animal protein consumed in the country. Yet, domestic fisheries production provides only 45,000 tons of products annually, about half of the consumption; imports of frozen fish products fill the gap. This situation calls for a need to increase the productivity of domestic fisheries, stimulate domestic producers, and curb the outflow of foreign currency.

Growing up in rural Benin, Rodrigue Pèlèbè Edéya Orobiyi, a Research Assistant at the University of Parakou and a 2021 One Planet

Laureate Candidate, recalls how his mother would always include fish in his meals. Like many Beninese people, fish was the first source of animal protein as a child. Unfortunately, in recent years, several threats, including climate change, still weigh on national fishing and fish farming production, which is not enough to meet domestic demand. Rodrigue is a well-equipped specialist in innovative, resilient fish farming and fishing practices. His research interests include aquaculture, aquatic ecotoxicology, molecular identification and population genetics of fish, and smart, sustainable climate change-resilient fish farming and fishing practices.



33 <https://www.un.org/africarenewal/magazine/april-2006/africa-starts-fishing-%E2%80%98revolution%E2%80%99>

34 <https://www.worldfishcenter.org/research/aquatic-food-systems>

35 https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwil_MGdpcz5AhVD2KQKHVWkCvAQFnoEC-BUQAQ&url=https%3A%2F%2Fwww.fao.org%2F3%2Fca9229en%2Fca9229en.pdf&usq=AOvVaw3PIAwXGatLz6C3Y0z0NS0M

36 <https://www.jica.go.jp/benin/english/activities/development.html>

Working closely with fish farmers, his research evaluates different fish farming systems in the country, creating a repertoire of practices that adapt to the effects of climate change while improving the productivity of fish farming. He also studies the different socio-economic reasons why fish producers adopt these practices.

Rodrigue envisions a time when local fish farmers will meet Benin's domestic demand and adopt fish farming systems documented through his research. The One Planet Fellowship has provided a platform to develop collaborative networks with other scientists and researchers across Africa and Europe. Although research funding is still a massive obstacle in his career path, he believes that when researchers and farmers share their common language, they can mitigate the effects of climate change in the fishing sector and contribute to Benin's food security.



Nigeria



A Scientist's Quest to Empower Women in the Fishing Community in a Nigerian Lagoon

Oceans and other natural water bodies are often perceived as natural resources that can never be depleted and are invulnerable to collapse. Still, they have taken a pummeling and face three major threats: pollution, climate change, and overfishing. Research shows³⁷ that oceans could drastically change, within our lifetimes, if we do not stop.

Growing up in Epe, a small community in Lagos State, Nigeria, Toyosi Fadekemi Igejongbo, a 2021 One Planet Laureate Candidate, has first-hand experience of the drastic changes our oceans are experiencing. Though tiny and rural, Epe is a world-renown seafood export collection point and is popularly known as the fish basket of Lagos State. Fishing is the primary occupation for the community here, and the Epe lagoon is their lifeline.



Epe lagoon is connected to the Atlantic Ocean via the Lagos lagoon, and due to its geographical position, the lagoon is rich in different fish species. Toyosi is filled with fond memories of her childhood in Epe. She recalls always going home to different meals like dried shawa fish and fried prawns prepared by her mother. She would even cook egusi ijebu (Melon soup) with giant crabs freshly caught in the lagoon. During the weekends, her father would take the family to the lagoon's adjoining beaches, where they would relax and relish in the serenity

Toyosi enjoyed accompanying her mother to the market to purchase fresh fish off the boats. Along the way, they would interact with the women trading on the lagoon shores, and she reminisces two particular women; Iya Nura and Iya Nofisat. She was intrigued by their hard work, going offshore to fish and spending entire nights processing the fish while tending to their children. Women are the primary occupants of the market at various levels of the value chain.

Epe was home and fun, but Toyosi knew she had to leave one day. She left Epe for her university studies in Akure, a city in the southwestern part of Nigeria. During her enrollment, Toyosi was offered a course in animal science and fisheries management, against her choice, but she studied through her first and second degrees as a fisheries scientist. During her Ph.D. studies, Toyosi struggled to get into the world of academia.

She faced backlash from society, which prescribed that because she was a woman, she did not have the tenacity to pull through academics.

"All these comments made me reminisce about women like Iya Nura and Iya Nofisat working tirelessly back home at Epe Lagoon, and I was more determined."

Toyosi did her Ph.D. fieldwork in Epe Lagoon with the rationale of giving back to the community that raised her. During her research, she made some intriguing discoveries about the lagoon – it was diminishing. The physical and chemical parameters of the lagoon were gradually becoming unhealthy for aquatic life sustenance due to climate change and human activities. The diversity of seafood Epe was once known for was progressively reducing. Upon completing her Ph.D. research, Toyosi felt obliged to provide solutions to the challenges.

Over the years, her research has focused on working with fishing communities to mitigate the threats to aquatic biodiversity, identifying threatened species to ensure their continued existence, and helping manage fishing economies. In managing these economies, Toyosi believes it is essential to honor and amplify the struggles of women like Iya Nura and Iya Nofisat. They play a significant role in small-scale fishing communities.



She believes it is time to give women at the lower end of the fish value chain a voice and involve them in the decision-making. It is time to place them as significant stakeholders in the fisheries sector. It is time to create access to technology that could ease and improve their work and carry out research not oblivious of their existence.

This is Toyosi's clarion call to empower women in fisheries for sustainable livelihoods. She believes it can be done together because there is no reason to fear the wind when the root is deep.

37 <https://www.nhm.ac.uk/discover/will-the-ocean-really-die.html>

No Child Should go to Bed Hungry: A Scientist's Motivation to Reduce Food Waste

"No child should go to bed hungry. As a child, I grew up on a farm surrounded by yam, cassava, fruits, and vegetables, yet I experienced food insecurity. The fact that my parents were subsistent farmers did not mean we always had adequate food," Bolarinwa Islamiyat Folashade, a Food and Nutrition Scientist, recalls her childhood. Bolarinwa is also a 2020 One Planet Fellowship Laureate Candidate.

Bolarinwa says her family's story is replicated each day where she lives, Oyo State, Nigeria, and across the country.

In sub-Saharan Africa, food losses are estimated to be worth \$4 billion annually³⁸, posing a considerable threat to food security. In Nigeria, the estimated annual loss stands at a staggering \$12 billion³⁹, adding more pressure to a country widely known as the world's poverty capital.

Nigeria's government has responded⁴⁰ in many ways to improve its citizens' living standards by promoting technology in food production, agricultural research, and supporting initiatives that empower rural women.

Beyond that, individual scientists like Bolarinwa are leading transformative innovations toward boosting Nigeria's agricultural production. "If we want to be closer to ending hunger by 2030, then we must work as a collective," she says.

Her research focuses on food and nutrition security, specifically post-harvest management, to help farmers extend their food products'

shelf life, especially fruits and vegetables. She affirms that the research will lead to the resilience of small-scale farmers by increasing the availability of nutritious foods and helping reduce post-harvest loss, thus alleviating hunger.

"This study is particularly close to my heart. I remember the losses my parents would incur while attempting to get our farm products to the market, like transport and drying issues. That is why my research is not only looking at nutrition but also market opportunities," she emphasizes.

Bolarinwa explains that she has worked on value addition to preserve vegetables and fruits outside the season to enrich children's diets. She has also developed new nutrient-rich staple foods and snacks from underutilized



food crops that are cheap, readily available, and drought-resistant to ensure that safe food is available for everyone.

Bolarinwa's research aligns with indicator 12 of the Sustainable Development Goals (SDGs)⁴¹ on reducing post-harvest loss and the environmental impact of organic waste. "I am so glad that this SDG exists because it encourages other scientists with similar experiences to re-imagine and produce working solutions to reduce post-harvest loss," she reiterates.

Finally, she points out that given that we are all facing current harsh realities like high food prices, the COVID-19 pandemic, and uncertain weather patterns, it is more incumbent to ensure that food from the farm makes it to the plate and market. She emphasizes that these interventions should not represent farmers' efforts and livelihoods that had gone to waste.

"Today, my story is no longer unique. We must collectively come together and act to make food available for millions across the continent. No child should go to bed hungry," she concludes.

38 <https://www.unep.org/thinkeatsave/get-informed/worldwide-food-waste#:~:text=In%20Sub%2DSaharan%20Africa%2C%20pos-t,of%20the%20total%20crop%20harvested.>

39 <https://www.ripplesnigeria.com/nigerias-annual-post-harvest-loss-hits-12bn/>

40 <https://www.devex.com/news/opinion-beyond-covid-19-addressing-food-insecurity-in-nigeria-98658>

41 <https://www.fao.org/sustainable-development-goals/indicators/1231/en/>

Ethiopia



A Plant Pathologist Draws on Colleague's Expertise to Help Farmers Battle Plant Diseases

Plant pathologist Tajudin Aliyi Mohammed has an ambitious plan to improve Ethiopia's crop production and productivity by minimizing the risk of plant pathogens causing diseases. The 2021 One Planet Laureate Candidate is determined to enhance agricultural productivity to improve the lives of farmers like his parents, whose lives and their children's futures depend on agriculture. Tajudin says that his family appreciates hard work and determination. Despite the lack of schools in his vicinity while growing up, his parents (farmers) ensured he got access to the best education they could afford. Tajudin says that the foundation of his success comes from that drive displayed by his parents.

"Agriculture is the backbone of Ethiopia, and yet agricultural research is not advanced," he says. Currently, as a researcher at the Ethiopian Institute of Agricultural Research (EIAR), he is working on plant protection, which encompasses plant pathology, agricultural entomology, and weed science.

While working with a team of mycology researchers, Tajudin says he had the opportunity to carry out additional essential and applied scientific research to identify pest management techniques to minimize food wastage.

"Most farmers are using pest management techniques like crop rotation, but to be able to control the situation effectively, we need more viable control strategies for plant diseases need to be advanced," says Tajudin. There is a vast untapped opportunity in multi-disciplinary collaboration.



The possibilities are endless when different experts come together to address a common goal. Tajudin adds.

Together with his mycology research team, they have conducted different research experiments with smallholder farmers regarding managing various diseases to improve their experiences. They have examined Turicum leaf blight on maize, Fusarium head blight on wheat, potato leaf blight prediction model development, and Faba bean gall disease.

The research has resulted in technologies like early warning systems for wheat rust, a smartphone app for timely alerts, technical manuals, and leaflets to create awareness among farmers. The outputs have reached far and wide, changing the lives of several farmers.



However, Tajudin says they still have a long way to go. “We have developed some technologies to manage plant disease, but some of our laboratories and plant disease diagnostic reagents are not as advanced. We have a long way to go,” he says.

True to his determination, Tajudin has decided to advance his studies to understand plant diseases better and create better workable solutions. He is currently studying for a Ph.D. in Plant Pathology at EIAR, researching fungal diseases in wheat crops. Tajudin has also participated in collaborative research with scientists across the globe.

As a recipient of the One Planet Fellowship, Tajudin hopes to advance his science training through the Advance Science Training (AST) program by extending his research to better-equipped laboratories and technologies.

Advanced Science Training is a crucial component of our efforts to strengthen African scientists’ scientific research skills.

The One Planet Laureate Candidates are selected to participate in research placements with partner institutions worldwide. AST placements are only open to the very best of our Post Masters and Post-Doctoral AWARD Fellows.

A Scientist’s Commitment to Simplify Research Findings for Smallholder Farmers’ Understanding

Wuletawu Abera Worku is a postdoctoral scientist working with the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT) in Ethiopia. Over the last five years, he has pondered how to support farmers to make better climate change and resilience decisions.

His research aims to improve estimation procedures of ecosystem variables and their error quantification. These processes are even more challenging under the changing climate, which requires Wuletawu to use various tools such as biophysical models, big data analytics, artificial intelligence, geographical information systems, and remote sensing, plus a combination of different in situ and satellite data.

“My focus is not just to understand the biophysical and socio-economic system, but also package the state of science into decision support tool,” he says. Wuletawu explains that he is very intentional with his research. “It is exciting for me when a research model fits the actual processes because it allows the generation of data to help decision-making by smallholders. For example, soil water and fertilizer requirements can be made for crops and shared with farmers. This can improve their farming practices and their lives,” he states.

However, he is also aware that most of the time, the research findings are not packaged and availed in formats that farmers can comprehend. He is concerned that this situation almost renders the research useless because the farmers cannot relate. Wuletawu emphasizes the importance of research that

connects with the farmers. In collaboration with his colleagues, he is designing research practices with farmers’ inputs and how a change in the landscape fits their interests. He explains that they are developing tools by combining big data and advanced modeling solutions to predict river flows so that farmers know when to plant, guide irrigation to improve water management, and even package organic fertilizers and provide alternatives.

“In this era of the food crisis, sight and context-specific agricultural advice are key. This is not just about the smallholder farmers but about the continent and the world. Africa needs to produce more food; thus, appropriate information and data for inputs need to be customized and contextualized to the local audience,” he states.



Bolstering Smallholders' Response to Climate Change by Involving them in Innovation Selection

Climate change is registering its impacts on the world differently, from disrupting the value chain to agricultural yields. The 2021 Intergovernmental Panel on Climate Change (IPCC) report⁴² highlights the key risks of climate change in Africa: stress on water resources, reduced crop productivity, and greenhouse gas emissions. The severity of these challenges is predicted to increase with rising temperatures.

The report indicates that the intensity of these challenges needs more than just mitigation measures but adaptation strategies to ensure a sustainable future. Terfa Meseret Tesema, an Associate Professor of agriculture in the College of Agriculture at Hawassa University, Ethiopia, and 2020 One Planet Laureate Candidate, notes that the most urgent thing we can do in the current environment is to protect the environment. She highlights that implementing intentional adaptation approaches, including on-farm options, can significantly increase Africa's resilience.

Meseret is evaluating plant and community resilience to climate change. Her research focuses on plant adaption to stress, particularly root adaptation to water stress, and how crops like sorghum and maize adapt to climate change. She is applying a multidimensional approach to understand Ethiopia's socio-economic, agroecological, and agrobiodiversity factors affecting smallholder farmers' food and nutrition security. Meseret is convinced that Africa's agriculture urgently needs Africa-led revolution and creativity.



"As African researchers, we have heard a lot of narratives dismissing our research efforts. But I believe we are best placed to create solutions to our problems. We are the best change agents to drive the transformation we want," she says.

She adds that Africa has the most resilient farmers. She explains that because of the unusual weather patterns, Ethiopia has experienced more extended drought periods and floods, increasing its food insecurity over the last decade.

"In 2017 alone, farmers lost a lot of livestock due to prolonged droughts. Land degradation in semi-arid areas is even more pressing. But, the smallholders bounced back. They must bounce back because it is their livelihood. As research scientists, our contribution to the bounce is crucial. We must support smallholders adequately so that when they bounce back, they are better equipped," she asserts.

Meseret states that involving farmers in research is to validate the research process. "It is the only way to determine whether my adaptation strategies are practical," she adds. For her, farmers must participate in trials because their knowledge of the production systems enriches the conduct of the research.

Meseret emphasizes that it is crucial to equip farmers with enough knowledge to help them increase their production. While on the field, farmers who do not attend her training

sessions or on-farm demonstrations are usually slow to adopt new adaptation options. Some do not adopt them at all. This usually leads to different yield results as the farmers typically receive the lowest income per unit. That is why Meseret is passionate about involving all smallholders in the research process.

"We must transform Africa's agriculture system, develop climate resilient technologies and tools and build our knowledge database. I believe that African agriculture scientists are here to change the narrative, bring change, innovate, and build a better future for African smallholder farmers," she concludes.



42 <https://www.ipcc.ch/site/assets/uploads/2018/03/wg2TARchap10.pdf>

Kenya



Exploring the potential of underutilized crops to boost nutrition and food security

Rebecca Jerop, an agricultural economist, comes from Nandi County in Kenya. The county is well known for its rich farmland and extensive tea plantations. While working at her first job at a tea plantation, she observed that farmers had neglected indigenous crops like sorghum, finger millet, yams, and cassava. Instead, they had opted for crops like white maize. According to Rebecca, the farming practices were not adaptive to the environment. "I knew that this would not be profitable in the long run. Not to mention the agrochemicals and artificial fertilizers that would spoil the soil," she says.

Since then, Rebecca decided to bring attention to neglected crops. Her work involves developing environmental-friendly innovations that foster the productivity of underutilized cereal crops, specifically finger millet. Rebecca says finger millets are more nutritious and resilient to unpredictable agroecological conditions than maize. She adds that improving their productivity and commercialization could foster food security and reinforce climate resilience. "Finger millet is nutrient-dense, which may be useful in diversifying diets and addressing micronutrient deficiencies in poor rural communities in the face of climate change," she states.

Rebecca adds that many strategies currently focus on the genetic improvement of underutilized crops to improve productivity, quality, and resilience to climate change. However, farmer adoption of these interventions remains very low. "Kenya needs interventions that go beyond promoting staple crops. We need to promote neglected crops to



cushion our nutrition deficit, especially in rural areas," she says.

Rebecca conducted a study among farmers to determine the factors influencing finger millet adoption and found that extension and farmer training were significant contributors to the uptake. She also investigated what motivates the commercialization of orphan crops and found that farmers are more likely to participate in crop marketing because of the yields.

Rebecca is using the skills she acquired during her Fellowship journey to improve the outputs of finger millet. She is working with her colleagues to expand her knowledge and expose her to new developments in her area of research. She is also training farmers to increase awareness of adopting neglected crops.

Shaping a Climate-Smart Agricultural Future for Smallholder Farmers

Over the years, climate change has evolved from an environmental problem to a significant development challenge whose impact ripples across all economic sectors. Climate change's adverse effects on agriculture have adversely affected developing countries, particularly those in sub-Saharan Africa, and Kenya is no exception. According to the Kenya Climate-Smart Agriculture Strategy – 2017-2026⁴⁴, the agricultural sector is a crucial economic and social driver of development in the country, directly contributing about 25% of Kenya's GDP and accounting for over 65% of the country's exports. The increased occurrence and intensity of extreme weather events like El Niño and La Niña have resulted in declined agricultural productivity and the loss of crops, livestock, and investments in agriculture.



The changes in climate and weather patterns have exposed the country's farming systems to more climate-related vulnerabilities, predisposing farming communities and smallholder farmers to food insecurity and poverty. About 98% of Kenya's agricultural systems are rain-fed and highly susceptible to variability and climate change. This susceptibility will likely threaten the sector's contribution to the national economy. Therefore, transformative and innovative measures are urgently required to assist stakeholders across the agricultural value chains in coping with the effects of current and projected changes in climate patterns.

Climate-Smart Agriculture (CSA) has been identified as a viable approach to improving agricultural sector productivity while addressing the impacts of changing climate.

CSA is music to Miriam Karwitha's ears, a 2019 One Planet Laureate Candidate and crop protection scientist. Born and raised in the eastern part of Kenya, Miriam's interest in studying crops dates back to her high school days. Brought up in rural Kenya to farming parents, Miriam and her siblings provided labor on their family farm like many other children back then. From a young age, she experienced the devastating effects of perennial drought and diseases on her family's coffee farm. This fueled her desire to develop sustainable solutions, further informing her to study plant pathology at Masters and Ph.D. levels.



Today, Miriam's research work identifies and promotes sustainable crop production techniques to enhance smallholder farmers' adaptation to climate change. She also documents indigenous knowledge on climate change adoption while building the farmers' capacity to implement agroecosystem-friendly management practices. Her research contributes to enhanced agricultural productivity and builds the resilience of smallholder farming communities in Kenya towards climate change.

Miriam is currently working with 4,000 smallholder farmers to implement climate-smart agricultural technologies at the farm level. She uses farm demonstrations to showcase the most appropriate and ideal technologies and coordinates farmer exchange visits for peer learning. Through these efforts, bean production in Kenya's Laikipia and Nyeri counties has risen from 1.5 bags per acre to 5 bags per acre. Additionally, 80% of the farmers in the bean value chain adopted good agronomic practices and integrated sustainable pest and disease management practices. Further, Miriam's efforts have led to the coordination of farmers into six producer organizations and one cooperative society where the farmers can jointly procure farm

inputs and sell their produce.

Aside from working with farmers, Miriam has a passion for youth in the agricultural sector stemming from the high youth unemployment rate in Kenya vis-à-vis the low food production in the country and the continent by extension. She works with undergraduate and graduate students researching agriculture and youth venturing into agriculture as a business.

Miriam views agriculture as a lifeline that provides food for everybody, affords income sources, and enhances farmers' livelihoods and a country's economic status.

"Agriculture has the potential to contribute to the sustainable development goals and reduce the impact of climate change. Let's embrace it," states Miriam.

44 <https://www.adaptation-undp.org/resources/plans-and-policies-relevance-naps-least-developed-countries-ldcs/kenya-climate-smart>

Can Safe Pest Control Methods Enhance Smallholders' Resilience to Climate?

Elizabeth Wangeci Njuguna is a Postdoctoral Research Fellow at the Biopesticide Group of the International Centre for Genetic Engineering and Biotechnology (ICGEB), South Africa. She holds a Ph.D. in Biochemistry and Biotechnology from Ghent University, Belgium.

Her passion for life science motivates her to be a policy advisor. She aims to be a key scientist whose work contributes to solving some of the immediate food security and environmental challenges facing sub-Saharan Africa while improving people's livelihoods on the continent.

Elizabeth believes that intentional research is vital to improving the economy and the livelihoods of families whose lives are dependent on agriculture. "I believe in creating a healthy environment where smallholders can thrive," she says.



Her research focuses on promoting safe and sustainable means of pest control by enhancing the use of biopesticides. She is developing pesticides that are safe for humans and the environment. Her research interest is informed by the fact that many biocontrol agents have been identified and isolated over the years.

"In 2016, when fall armyworm struck Africa, I was intrigued. Immediately, I wanted to develop biopesticides because a solution would have broad applicability in sub-Saharan Africa and significantly impact food security in the region," she recalls.

Elizabeth is aware that several safer solutions can be deployed on a wide scale on pests, providing quicker solutions than molecular techniques. "How do you accommodate life when it throws you curve balls? Climate change presents us with such uncertainties," she states.

That is why she ensures that her work significantly impacts climate change mitigation. As such, her ongoing research on fall armyworm involves evaluating potential phytochemical compounds to identify promising botanical agents that can work against the pest.

Elizabeth has ambitious aspirations. She intends to be a policy advisor on agricultural biotechnology. Elizabeth recognizes that she needs to advance her studies and widen her network of opportunities to be in a position where she can directly influence policies. She notes that the One Planet Fellowship is an excellent opportunity to help prepare and expose her to such platforms.

The One Planet Fellowship seeks to build a vibrant, highly connected, and intergenerational network of African and European scientist leaders equipped to lead next-generation research on helping Africa's smallholder farmers adapt to a changing climate.

She explains that she is transitioning from working in research labs to finding a professional space in Kenya's policy sector. She reveals that she is excited about her new leadership and communication skills. She explains that they will allow her to connect with the research community in and out of her institution, creating opportunities to share knowledge and research collaborations.



Tapping on Indigenous Vegetables' Secret Weapon to Enhance Food Security

African Leafy Vegetables (ALV) have a secret weapon. It is their most substantial advantage. Studies have shown that these vegetables can withstand harsh climatic conditions and fight diseases better than their exotic counterparts.

Too many households in Kenya, indigenous vegetables or African Leafy Vegetables are a more significant part of their lunch or dinner plates⁴⁵. Not just because of their high nutritional value but also because it is readily available to many households, mainly rural households.

"I grew up on indigenous vegetables. My mother's small garden was full of different varieties of indigenous vegetables such as nightshades, slender leaves, amaranths, and spider plants," says Elias Mibei, a Lecturer-Researcher at Jomo Kenyatta University of Agriculture and Technology (JKUAT) and a 2020 One Planet Laureate Candidate.

Elias grew up in Kenya's Rift Valley region, an agricultural region with long rainy seasons and short dry seasons. He recalls the surplus production during the rainy seasons and scarcity during the dry season, exposing them to food insecurity. Additionally, they did not have proper preservation and post-harvest techniques, increasing wastage surplus during rainy seasons.

He mentions that while studying for his undergraduate degree at JKUAT, he was bothered by the neglect and underutilization of indigenous vegetables in favor of exotic varieties.



This triggered the trajectory of his study. He dedicated himself to studying how plant biodiversity, particularly the indigenous crops, offers solutions to significant environmental, health, and food insecurity challenges.

In the 1990s, Kenyan Scientists observed that ALVs were rapidly disappearing⁴⁶ as they were considered less fashionable. Many Kenyans were missing out on vitamins and minerals lacking in primary staple foods. The dietary shift also meant that many vulnerable households risk losing nutritional security. Elias is out to change that.

"My research has unraveled the secret behind the indigenous leafy vegetables. Besides being nutritionally and medicinally important, they are also resistant to drought stress," says Elias.

His research seeks to understand traditional leafy vegetables' nutritional composition and adaptive mechanisms. He processes them using various drying methods and analyzes their nutritional value to determine the best processing methods and the highest state of the nutrients.

Elias' research also explores heavy metal accumulation in vegetables grown along polluted rivers using molecular techniques to determine how accumulation occurs, particularly in traditional vegetables. He adds that identifying the transporters will allow him to make breeding recommendations that curtail heavy metal transportation.

Elias mentions that one thing that excites him about his research is that he can work directly with the farmers, thus accelerating the uptake of best farming practices. He explains that the inclusive approach has exposed the farmers to simple post-harvest management and preservation techniques such as solar drying

and packaging fresh and dried vegetables, thus increasing their yearly harvest "I have championed for awareness of the importance of indigenous vegetables, availability of seeds, and improved agronomic and post-harvest technologies. This has promoted their cultivation, consumption, and conservation, thus mitigating the unfavorable impacts of climate change in Kenya," Elias explains.

Elias highlights that the One Planet Fellowship has given him a platform and support for achieving his vision to improve the livelihoods of smallholder farmers across Africa through a gender-responsive approach. He aims to continuously engage with his peers in the Fellowship in collaborative initiatives to advocate for collective action and provide ambitious solutions to tackle climate change.



45 <https://alliancebiodiversityciat.org/stories/traditional-vegetables-recognized-unesco-kenya>

46 <https://www.biodiversityinternational.org/research-portfolio/markets-for-diverse-species/african-leafy-vegetables/>

Using Participatory Research to Champion Sustainable Land Reclamation and Management

Esther Mwende is a Soil Scientist investigating the performance of various food crops on titanium mined-out soils that have been treated with manure and inorganic fertilizers. Esther observes that land exploitation without proper compensating investments in soil and water conservation leads to severe land degradation, loss of rural livelihoods, diminished water supplies, and threatened wildlife habitats.

Her research is geared toward the profitable use of post-mined land to contribute to food security and improved livelihoods within the region through crop production as a land-use option.

“Mining alters the natural landscape and discharges large volumes of waste that pose serious environmental pollution hazards. The ecosystem defines our socialization and makes us who we are. Applying mitigation measures like recycling, capacity building, conservation, and policy formulation ensures sustainability,” says Esther.

Kenya is an agricultural nation, with over 12 million people residing in areas with degraded lands⁴⁷. Esther mentions that Kenya lacks adequate data on land degradation issues. Hence, farmers are not sufficiently educated on the dangers of post-mined land.



47 https://link.springer.com/chapter/10.1007/978-3-319-19168-3_16#ref-CR4



Esther reveals that before this realization, she had done two studies on phosphorus management in agricultural ecosystems and biogas technology as an alternative energy source. Still, her findings did not reach the farmers.

The discovery provided the impetus for her focus on training farmers and community groups in climate-smart agriculture, environmental management, and water resource management using an experimental learning approach.

The need to conduct research with farmers and their adoption of the research outputs in mind has been well-documented. There is widespread recognition of the need to design interventions to facilitate and accelerate farmers' adoption of research-driven innovations to improve agricultural productivity.

“I decided to get out of my laboratory and started reaching out to farmers and empowering communities through experiential learning,” says Esther. Currently, she researches in three counties—Nyandarua, Nyeri, and Taita

Taveta—and features on-farm trials and farmer training.

Esther says that sustainable land restoration can be achieved through a collective call to action by those immediately responsible for managing resources. The desired collective action requires an inclusive environment that empowers farmers and other local decision-makers to reap the benefits of good land use decisions.

“Researchers have a bigger role in advising society on the best management approaches. Which cannot be achieved effectively in laboratories and boardrooms,” she concludes.

Tanzania



Harnessing Farmers' Knowledge to Investigate the Effect of Climate Change on The Occurrence of Harmful Algae

2019 One Planet Fellowship Laureate Candidate, Offoro Kimambo, was born and raised in Kilimanjaro, Tanzania. A lecturer at Sokoine University of Agriculture (SUA), Offoro, examines climate variation, ecohydrology, and the effect of climate change on harmful algal blooms (HABs).

Offoro explains that due to climate and hydrological variations and nutrient inputs, the algae are overproducing and thus sometimes releasing harmful toxins. He adds that the algae are detrimental to aquatic life as they deplete water oxygen.

"With the pressure from the extreme weather events and changing climate, it is safe to assume that these challenges are not ending

soon. We desperately need local and relatable solutions to build the economy and strengthen smallholder farmers' resilience to climate change," he says.

Climate change is predicted to change many environmental conditions⁴⁸ that could affect the natural properties of fresh and marine waters. An increase in the occurrence and intensity of harmful algal blooms will negatively impact the environment, human health, and the economy.

In response, Offoro shares that his research is designed to work closely with small-scale fish farmers to gather honest feedback and combine them with lab findings to create lasting working solutions.



48 <https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms>

He expounds that throughout his research, he has learned that farmers know about what they are doing. Thus, researchers must start from what farmers know.

He says that he is inspired by the words of France's former president François Hollande: "we have a single mission to protect and hand on the planet to the next generation." Offoro states that researchers must not assume that they have all the answers to farmers' problems.

Offoro urges that we must create a sense of urgency to curtail the environmental impacts of climate change. "The current environment dictates that we must involve the farmers in our research. Otherwise, our findings will waste our best resources while the harmful climate trends continue," he says. Offoro aspires to be a vibrant researcher in environmental science and climate change. He wants to use his position to improve the capacity of farmers to fight the

challenges presented by climate change.

Offoro Kimombo is one of the candidates selected to participate in the One Planet Fellowship, a career development initiative building a robust pipeline of highly connected, inter-generational scientists equipped to use a gender lens to help Africa's smallholder farmers cope with climate change.



A Crop Scientist's Relationship with Common Bean Motivates her Research

As a second born out of seven children, 2021 One Planet Laureate Candidate Edith Kadege is no stranger to the responsibilities of taking care of a big family. She started taking care of her siblings from a young age. Her father was a civil servant, while her mother was a farmer whose jobs demanded longer hours outside the home.

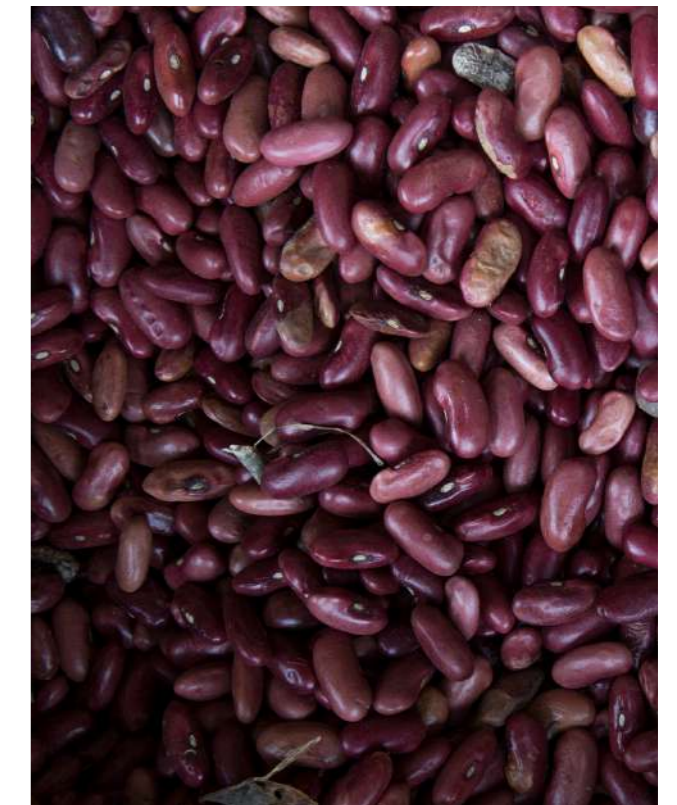
She grew up in a remote village where the staple food was Ugali (a starchy dish made from maize flour) with common beans. "Every morning, I made common beans in preparation for lunch and dinner," she states. But they were frequently faced with a dwindling harvest every cropping season. "It was challenging for my parents; specifically, my mother found it hard when beans would dry out during heavy rains," she states.

Common bean (*Phaseolus vulgaris*) plays an integral role in nutrition security in many households in Tanzania. Evidence⁴⁹ indicates that common bean accounts for 78 percent of harvested legumes, while over 75 percent of rural households in Tanzania depend on beans for daily subsistence.

For Edith, helping her parents find a way to increase production was a priority. When she joined secondary school, she learned of other farmers who faced similar problems as her parents. She also discovered that the problem facing her parent's joint bean production was a disease attack. This was the beginning of her interest in crop science. "With every piece

of new knowledge, I understand how it all fits together, kicking off my passion for crop research for better yield," she notes.

Her quest for answers prompted her to study agriculture and later work with the Tanzanian Agricultural Research Institute (TARI) as a researcher developing common bean varieties resistant to fungal diseases. Since 2015, in collaboration with other researchers, she has conducted different common bean research and released 43 disease-resistant varieties. Edith adds that the common bean varieties are



48 https://www.crs.org/sites/default/files/analysis_yellow_bean_corridor_in_tanzania_.pdf

“We managed to increase certified seed production by 34 percent, which enabled us to increase grain yield by 59. percent per hectare,” Edith confirms.

Edith emphasizes that more research is still needed to develop disease-resistant varieties of beans to increase productivity and income. She adds that researchers also need to investigate ways of helping smallholders cope with the changing climate. “Because of climate change, fungal diseases attacking the common bean are now spreading to the newly released varieties,” she says.

To this end, she is currently enrolled for a Ph.D. in sustainable agriculture, focusing on molecular plant pathology. The study aims to develop fungal-resistant common bean varieties preferred by men and women farmers in Tanzania.

“For women like my mother, whose livelihoods and ability to feed their families rely on this common bean, we must find sustainable solutions to improve food security,” says Edith.

Her research also includes creating awareness among men, women, and youth farmers.

“When I say common beans have been part of my life since I was born – perhaps you now see why,” She states.



Advocating Alternative Clean Energy Solutions to Restore Women’s Dignity and Health

In Tanzania, wood fuel provides about 90 percent of Tanzania’s cooking energy supply⁵⁰. Charcoal is mainly consumed in urban areas, the cheapest fuel for most households, while firewood is used in rural areas. Charcoal has been linked to various environmental and social problems, including deforestation, forest degradation, increased morbidity resulting from indoor air pollution, and political violence. Tanzania uses 500 tons of charcoal annually, which translates to a 350 hectares daily loss of forest cover⁵¹.

The use of firewood and charcoal has also put pressure on women and girls in rural areas who, in most cases, are the primary caregivers in the household—collecting firewood from forests limits women’s earning potential and hurts their well-being. Elibariki Raheli Nazayoeli an environmental scientist from Tanzania, recalls the constant claims about back pains and exhaustion women used to complain about whenever she went back to her village in Kilimanjaro for a visit.

To minimize forest degradation, the government of Tanzania has partnered with several institutions and organizations to introduce alternative clean energy⁵² to charcoal and firewood fuel. Different research scientists have also heeded the call and are introducing farmers to biomass briquettes to conserve the environment and make life easier.

Elibariki is among the research scientists working to make briquettes a primary fuel source in Tanzania.

A Research Officer with the Tanzania Industrial Research and Development Organization, Elibariki, uses crop residues to produce biomass briquettes. Her research addresses the dangers of cooking over an open fire, deforestation, and the risks of sexual harassment when women travel long distances in search of firewood.



“There are many dangers associated with the long distance covered by rural women searching for firewood. I am looking to save women time fetching firewood to concentrate on agricultural production. Thus, I want to make superior quality briquettes specifically for rural women,” she says.

50 https://www.ctc-n.org/system/files/dossier/3b/annex_f_grassroots_manual_sustainable_woodfuel_tanzania_22.10.18_english_finalb.pdf

51 https://www.ctc-n.org/system/files/dossier/3b/annex_f_grassroots_manual_sustainable_woodfuel_tanzania_22.10.18_english_finalb.pdf

52 <https://www.worldfuturecouncil.org/wp-content/uploads/2017/05/Policy-Roadmap-Tanzania.pdf>



Already, her efforts have yielded some results. She reveals that she has influenced over 100 women to move from wood-based energy sources and start investing in briquettes. “The women are not only making briquettes for their household use, but they have learned to make extra to sell at the market,” she says.

Elibariki has also identified over 18 local producers of biomass briquettes in different regions of Tanzania and collected 15 samples for laboratory testing to improve the quality of the biomass briquettes.

“The number of smallholder farmers in Africa is increasing daily. Thus, we must tighten our food waste management systems to help boost food production. With increasing gas prices, briquettes are quickly becoming an alternative source. I want to be part of providing that alternative option while also saving our environment,” she says.

Malawi



A Malawian Scientist 'Fixing' the Soil Using Legumes to Increase Maize Productivity in the Country

Agriculture is the mainstay of Malawi's economy, and maize is its staple food crop. According to the Food and Agriculture Organization of the United Nations⁵³, Malawi's food self-sufficiency largely depends on maize harvested in a season. An estimated 84% of Malawians live in rural areas, where many carry out subsistence farming. Low yields mean these farmers do not adequately sell their crops, limiting their financial capacity to purchase adequate inputs for subsequent seasons. In Lilongwe district, Malawi's dominant cereal-producing region, lower yields have become the norm every harvesting season⁵⁴ due to soil loss and soil infertility due to droughts and floods that have ravaged the country in recent years.



Declining soil fertility continues to be one of the leading causes of food insecurity among smallholder farm households in Malawi. The situation is further exacerbated by deforestation and land degradation, which undermine the livelihoods of farming communities. In such a situation, options for soil fertility replenishment should be considered if the natural resources' capital base is restored. Austin Phiri, a Chief Agricultural Research Scientist with the Ministry of Agriculture Irrigation and Water in Malawi and a 2019 One Planet Laureate Candidate, addresses this problem by promoting inoculants to enhance legume productivity and combined use of manure and micro-doses of fertilizers.

One of the effects of drought on soil health is the lack of nutrient uptake by crops, as water is the principal medium for moving nutrients into plants. Increased soil temperature associated with lack of moisture impacts microbial activities and nutrient processing, essential for biomass and grain production plant use. Advancing food security requires an integrated soil fertility management approach that maximizes crop production while minimizing the degradation of soil's physical and chemical properties. Such soil fertility management practices include using fertilizers, crop rotation with legumes, organic inputs, and knowledge on how to adapt these practices to local conditions.

For many of Malawi's smallholder farmers, mineral fertilizers are beyond their purchasing power, which was one of the triggers for Austin's research. He recently studied improving nitrogen efficiency through intercropping pigeon peas, groundnuts, and maize. The study produced excellent results on improved soil fertility by indicating increased nitrate-nitrogen in the soil due to legume cropping over the years, which improves maize yields. The abstract of his work was published in the 7th World Sustainability Forum⁵⁵.



Austin is currently part of a project aiming to upscale select technologies that enhance the soil's organic matter to facilitate water retention and promote fertility. The expected result is that smallholder farmers will have increased crop productivity even in a changing climate. The intercropping system with maize and legumes has proved beneficial in multifaceted aspects. Intercropping results in higher yield and greater utilization of available resources improves the management of weeds, pests, and diseases, and fixation of biological nitrogen by the legumes.

It also controls soil erosion by covering a large extent of the ground area.

Austin has appreciated the considerable burden women and marginalized groups shoulder in agricultural production through the One Planet Fellowship, yet their needs and challenges are not addressed. They toil year in and year out, yet their effort goes unrecognized without any reward. He appreciates that this is a heavy burden, and they need not carry it independently.

53 <https://www.sciencedirect.com/science/article/pii/S2405844021012330#bib17>

54 <https://www.nature.com/articles/srep36241>

55 https://www.researchgate.net/publication/263416237_Insitu_assessment_of_soil_nitrate-nitrogen_in_the_pigeon_pea_groundnut_intercropping-maize_rotation_system_Implications_on_Nitrogen_management_for_increased_maize_productivity

Improving Marginalized Communities' Participation and Benefits in Fish Value Chains

James John Banda is a Research Scientist specializing in food science, quality management, fish, and fisheries products. His research approach is based on demand-driven innovations to address the challenges of fish value chain actors, especially women and the youth in Malawi.

He mentions that his choice of research dates to 15 years ago, when, as a fishmonger's child, he observed his mother's struggle with preparing fish for the market. He reveals that his mother often faced challenges when handling fish, like sudden heavy rains and dust contaminating the fish and compromising their quality. This meant that she lost a substantial amount of her profits which trickled down to the household finances. Moreover, he adds that they often sold for less than their value when she finally salvaged the little she could.

James notes that fisheries and aquaculture production has been steadily declining as the country's population grows alongside the demand for natural resources. Home to the third-largest lake in Africa (lake Malawi), the country's population consumes significant amounts of fish and fish products. It is recorded that fisheries and aquaculture contribute 70 percent of the animal protein intake in Malawi⁵⁶. His childhood experience and the staggering statistics on the country's fisheries and population stirred his love for exploring the fish value chain. Upon his Bachelor's degree graduation, James joined Malawi's Department of Fisheries, Research division, where he made additional discoveries. He reveals that



while researching fish handling techniques, he discovered that many fish farmers had been using unimproved methods like open drying resulting in a quality loss due to cross-contamination. He reveals that while researching fish handling techniques, he discovered that many fish farmers had been using unimproved methods like open drying resulting in a quality loss due to cross-contamination.

James found a solution to this problem. "I improved their drying technology with a solar tent dryer, a climate-smart technology governed by the principle of convection current," he proudly divulges. James explains that the solar tent dryer is rain-proof and continuously operates even in bad weather. He adds that drying fish in an enclosed environment protects the products from dust and insect infestation, yielding better-quality outcomes. "The innovation has a direct impact on fish quality and value addition as a means of promoting the adoption of best practices while enhancing the quality of fish and fishery products," he states.

Youth and women are amongst the marginalized communities in the fisheries value chain. In addition to climate change, they are faced with the challenges of decision-making in the absence of proper guidance. James explains that the solar tent dryer is easy to use to ease the labor constraints faced by vulnerable communities. "Women dominate the post-harvest processing, but they also face numerous challenges. My innovation is meant for women like my mother, whose livelihoods depend on fish farming. I want to make their lives and that of their children easier and avail to them options I never had growing up," he notes.



James is currently working as a Research Officer in the Department of Fisheries under the Ministry of Forestry and Natural Resources in Malawi. He heads the safety and quality management section. James mentions that his aim is not just to study but also to monitor product quality along the value chain. "Consumers are looking for quality products," he says.

56 <https://www.fao.org/3/cc0461en/online/sofia/2022/executive-summary.html>

A Crop Scientist's Quest for Safe Control of Fall Armyworm

Maize farming is essential for food security, income generation, and a source of employment for nearly 208 million people in sub-Saharan Africa⁵⁷, being the main staple crop. But for the past six years, farmers have watched in horror and devastation as their farms are destroyed by the invasive crop pest, fall armyworm (FAW).

"For most smallholder farmers, their farms are their primary source of food and income. If the rains fail, there will be no food, soil fertility declines, crop yield will go down, and if pests and diseases attack, crop disaster could strike", says Trust Kasambala, a Crop Protection Scientist from Malawi.

Since its detection in 2016, FAW has spread into 44 countries in Africa, devastatingly impacting yield and farmers' income. It is reported that FAW can feed on over 80 crops⁵⁸, including sorghum, rice, millet, sugarcane, vegetable crops, and cotton, but it prefers maize. With millions of hectares of maize crops infected, the threat to food security is dire. CABI estimates that the pests could cause maize yield losses ranging from 8.3 to 20.6m tonnes per annum⁵⁹, in the absence of any control methods, in just 12 of Africa's maize-producing countries.

"FAW perpetuates food insecurity and poverty among smallholder farmers. The pest attacks all stages of maize crops. Severe infestation of the maize cob means no harvest to the smallholder farmer. Infested maize cobs are also poorly developed and therefore not

marketable either as fresh green maize or dried grains," states Trust.

As global interventions call for policymakers, governments, private sectors, and research organizations to rethink and reorient African food systems, developing local innovations and technologies could play a far more significant role in helping the continent fight against FAW and achieve sustainable development.



Harnessing the experience and expertise of local talents like Trust can advance inclusive agricultural transformation on the continent. She is conscious of the high dependence on agrochemicals such as inorganic insecticides, which are hazardous and kill beneficial organisms like birds and affect farmers' health.



These factors drove her to find environment-friendly ways to deal with insects and pests.

Trust's research aims to evaluate the resistance of commonly grown maize varieties to FAW and identify natural enemies of the FAW that can be used in the biological control of the pest. She wants to develop eco-friendly pesticides to control harmful pests and reduce the effects of chemicals and has already done some exciting work in that area.

She recently won a USD 100,000 research grant from the European Union (EU)⁶⁰ to support her research on FAW bioecology in Malawi. The project will evaluate the resistance of commonly grown maize varieties to FAW, identify natural enemies that can be used in the biological control of the pest, and find a viable alternative to synthetic pesticides to control FAW.

Moreover, in 2016, she led the first project in Malawi to identify local species of entomopathogenic fungi to improve pest management. Her research produced commercially affordable fungal-based biopesticides that are easily accessible to rural

farmers. She emphasizes that fungal-based biopesticides are easier to use and do not require complicated handling equipment. Therefore, improving resilient farming systems. In addition, she has further intensified her efforts to combat pest diseases by leading a team of researchers in Malawi that identified several pesticide plants that effectively control insects and pests in stored beans.

"I have always had an affinity for biology. Although, after observing the workings of a clinic, I knew nursing was not for me as I had originally planned on my grandfather's advice. But I cherish the time and effort I put in the lab and educating farmers on best crop management practices", she states.

Trust's focus on sustainable pest control is underpinned by her awareness of what she terms "the big focus on increasing yields through plant breeding, improving soil fertility, and using synthetic fertilizers, making the whole process resilient; and increasing farmers' vulnerability."

57 https://www.afdb.org/fileadmin/uploads/afdb/Documents/Events/DakAgri2015/Cereal_Crops-_Rice__Maize__Millet__Sorghum__Wheat.pdf

58 <https://www.fao.org/fao-stories/article/en/c/1104446/>

59 <https://www.cabi.org/cabi-publications/fall-armyworm-impacts-and-implications-for-africa-2/>

60 <https://awardfellowships.org/news/malawian-one-planet-fellowship-laureate-wins-usd-100000-to-solve-fall-armyworm-infestation/>

Also close to her heart is attention to the gender component of pest control. "In Malawi, women provide 70% of farm labor, and men are involved in spraying chemicals. This means that both men and women are vulnerable to ailments associated with the chemicals. Men from the direct contact and women as they store them in their living spaces or use the containers for household purposes," Trust underscores.

AWARD is working to develop the capacity and increase African researchers' visibility and influence agricultural policies and priority settings best equipped to overcome obstacles to food security in the continent. The AWARD Fellowships⁶¹ have equipped 661 scientists with the confidence and ability to lead research teams, develop innovations and participate in crucial decision-making.



Through the One Planet Fellowship⁶², in which Trust is an inaugural Laureate Candidate, AWARD is building homegrown talents capable of developing inclusive local solutions for smallholders to adapt to a changing climate.

Further, the African researchers gain new skills and confidence to lead transformative innovations through tailored capacity

development interventions⁶³. For Trust, the courses made a massive difference while writing her EU-winning proposal. She became more self-aware and improved her science writing skills.

She also mentions that the leadership training has made communicating to farmers about natural products to manage pests easier. She believes the Fellowship will strengthen her research skills and provide networking opportunities to realize her dream. "I want to become an expert in tropical insect science focusing on biological pest management and conservation of biodiversity in agricultural systems," she says.

Zambia



61 <https://awardfellowships.org/fellowships/>

62 <https://awardfellowships.org/the-one-planet-fellowship>

63 <https://awardfellowships.org/training/#about-courses>

Could the Answer to Sustainable Farming Systems be in Integrating Aquaculture and Agriculture?



Worldwide, there is increased pressure on the seafood industry to be environmentally and socially sound. With expanded guidelines for selling seafood products in several global markets, the sector requires sustainable solutions. According to the Food and Agricultural Organization of the United Nations⁶⁴, global consumption of aquatic foods increased at an average annual rate of three percent from 1961 to 2019, almost twice that of yearly world population growth for the same period. By 2030, aquatic food production is forecast to increase by a further 15 percent. One way producers are improving their sustainability is through the adoption of integrated aquaculture systems. This system links two or more farming activities, one of which is fish farming.

Today's farming systems will soon not meet projected food needs. The ways farmers use their land and water can no longer meet human demand for food, let alone the need for environmental conservation. The world requires more research that combines production knowledge and ecology and integrates many diverse farm-level enterprises. New farming methods that feature biological diversification and nutrient recycling to regenerate the environment are now an urgent imperative.

Eva Nambeye, a lecturer at the University of Zambia and a 2020 One Planet Laureate Candidate, believes that integrating aquaculture into agriculture-based farming provides an appropriate starting point for designing regenerative farming systems. Growing up in Lusaka, Zambia, Nambeye's childhood ambition, like many children, was motivated by the desire to save her family from the harsh economic times they were going through. When she enrolled in university, she was disappointed to miss a medical engineering course. She took up agricultural sciences as an alternative and surprisingly performed beyond her expectations. She would later graduate top of her class and progressed to a Master of Science degree in aquaculture.

When Eva started her professional career as a lecturer and researcher in Integrated Agriculture- Aquaculture Systems (IAAS), the urgency to resolve the challenges facing the farming and aquaculture sector in Zambia made her realize she had a bigger purpose of fulfilling for her society.

She no longer restricted herself to only helping her family; she now belonged to a larger community that faced similar challenges.

Eva works with farmers, fishing communities, and policymakers and teaches the next generation of scientists at the University of Zambia. During her farm visits, she noted the valuable agricultural resources farmers have but do not know how to utilize. Such opportunities have also enlightened her to empower farmers on efficient water harvesting techniques which reduce water loss and make good use of the available amounts. Over the years, her research has evolved into initiatives that advance the development of sustainable, nutrition-sensitive, and climate-smart food production systems.

Eva's research shows that IAAS can positively impact society through poverty alleviation, enhanced income, food security, and water availability.

When integrated with other crops in IAAS, fish farming diversifies farmers' enhanced income, food security, and water availability. When integrated with other crops in IAAS, fish farming diversifies farmers' livelihoods and builds their resilience to climate change. These systems' comparatively low production costs make them less dependent on well-established fish markets and infrastructure and provide a design that can operate in more remote areas.

Eva has realized that many people grow up with expectations of personal fulfillment, not realizing how these connect to the larger societal needs. She is grateful that she has found fulfillment in her double-edged career through which she earns a living while contributing to a larger goal for the planet's good.



64 <https://www.fao.org/3/cc0461en/online/sofia/2022/executive-summary.html>

Exploring the Potential of Modeling to Improve Soil Health and Agricultural Productivity

Soil plays an essential role in agriculture, from influencing productivity to dictating the impacts of climate change and reducing climate change. Agriculture and agricultural productivity start with the soil. If the soil is not good, then the productivity will be low no matter how good the seeds and rains are. So critical is soil to food security that experts have acknowledged that 'healthy soils are the foundation of the food system.'

However, soil quality (globally) continues to be under threat, owing to the over-reliance on agriculture and farming systems that continue to mine nutrients from the soil.

"Rural communities in Zambia practice shifting cultivation to sustain their families, but poor soil fertility is affecting the crop productivity resulting in low harvests," says Miriam Makungwe.

Makungwe Miriam is a Soil Scientist and a 2020 One Planet Laureate Candidate, working on applying spatial statistical models to predict soil properties. Accurate predictions of soil properties are fundamental because they allow stakeholders to understand the state of soils, how they are changing and the pressure placed upon their quality.

Like most African countries, Zambia relies heavily on outdated general fertilizer recommendations, which significantly contributes to low crop productivity⁶⁵.

"I have worked with smallholder farmers for seven years on several projects to address

production constraints, and I have come to learn that soil degradation is one of the main challenges hindering Zambia's food security," she says.

Miriam says it has become crucial to provide alternative and transformative production approaches that offer smallholders the tenacity to maintain viable productivity under the current circumstances. That is why she has made it her goal to apply scientific models to generate knowledge that can enhance soil productivity and improve rural communities' livelihoods.



Miriam mentions that the fight against climate change requires collective action. She engages farmers in her research through capacity-building initiatives that create awareness about transformative farming practices. Miriam also mentions that she is working with the farmers to grow trees that help restore nutrients into the soil, potentially increasing their harvests.

"I started in the village, and when I am in the rural area working with smallholder farmers, I see myself in the little children walking to school, I see my grandmother in the old women, my mother in the women trading agricultural products and my father in the men working to provide for their families. These are the lives I want my work to influence and help improve their livelihoods," she states.

Miriam notes that the demand for agricultural products is surging in Zambia and worldwide, calling for economies to leverage all their resources, including soils, to sustain the pressure on agriculture.

"We need to improve our ability to produce food beyond rainy seasons. Meaning, better irrigation schemes, efficient technologies, and better farming practices," Miriam concludes.



⁶⁵ https://www.jstage.jst.go.jp/article/jdsa/3/2/3_2_149/_pdf/-char/en

About the One Planet Fellowship

The One Planet Fellowship seeks to build a vibrant, highly connected, and intergenerational network of African and European scientist leaders to lead next-generation research aimed at helping Africa's smallholder farmers adapt to climate change. The Fellowship equips African researchers to deploy a gender lens to analyze the potential of their research to bridge the gender gap in African agriculture.

Inspired by the AWARD Fellowship Model, the One Planet Fellowship brings together an intergenerational network of scientists from across Africa and Europe, builds the leadership skills of emerging scientists from both continents, strengthens their scientific research skills, and catalyzes research partnerships and networks.

High potential African agricultural researchers, referred to as One Planet Laureate Candidates, are competitively selected and paired with more established African researchers, One Planet Fellowship Mentors, carefully chosen to match their area of expertise and career goals. The pairs commence a year-long mentorship relationship and are supported to build a successful partnership to enhance the Fellows' career growth. The pairs also receive support to attend various leadership and science research skills courses.

In the course of the Fellowship, the Laureate Candidates select emerging African scientists and emerging European scientists to whom they serve as mentors, creating a three-generational mentorship pod.

Laureate Candidates are further supported to enhance their research skills through research placement at leading European research institutions with a strong emphasis and reputation for climate change science. Here, the Laureate Candidates are paired with outstanding European researchers who serve as supervisors to strengthen specific skills for Laureate Candidates

The first cohort of One Planet Laureate Candidates was launched in September 2019. To date, the One Planet Fellowship has admitted 130 Laureate Candidates from 14 African countries.

The One Planet Fellowship is funded by the Bill & Melinda Gates Foundation, the BNP Paribas Foundation, the European Union, and Canada's International Development Research Centre (IDRC). African Women in Agricultural Research and Development (AWARD) and Agropolis Fondation jointly implement the Fellowship.



Meet the featured Laureate Candidates

Kenya



Rebecca Jerop
Lecturer, Laikipia University
2020 One Planet Laureate Candidate



Miriam Karwitha
Lecturer / Researcher, Egerton University
2019 One Planet Laureate Candidate



Elizabeth Wangeci Njuguna
Postdoctoral Research Fellow, ICGEB
2020 One Planet Laureate Candidate



Elias Kibiwot Mibei
Lecturer-Researcher JKUAT
2020 One Planet Laureate Candidate



Esther Mwendu
Lecturer, Pwani University
2021 One Planet Laureate Candidate

Côte d'Ivoire



Akoua Tamia Kouakou
Researcher, Jean Lorougnon Guédé University
2019 One Planet Laureate Candidate



Howélé Michaëlle
Postdoctoral Researcher, Université Félix Houphouët-Boigny
2019 One Planet Laureate Candidate



Kouadio Christelle Marina
Postdoctoral Researcher, Nangui Abrogoua University
2020 One Planet Laureate Candidate



Tajudin Aliyi Mohammed
Plant Pathologist, EIAR
2021 One Planet Laureate Candidate



Wuletawu Abera Worku
Postdoctoral Scientist, CIAT
2019 One Planet Laureate Candidate

Burkina Faso



Miriam Coulibaly Diakité
Food Research Engineer, IRSAT
2020 One Planet Laureate Candidate



Inès Fabienne Rouamba
Research Engineer, 2iE
2019 One Planet Laureate Candidate



Alimata Bandaogo
Agri-pedologist INERA
2019 One Planet Laureate Candidate



Toundji Olivier Amoussou
Post-Doctorate Researcher, CIRDES
2019 One Planet Laureate Candidate

Ethiopia



Terfa Meseret Tesema
Associate Professor, Hawassa University
2021 One Planet Laureate Candidate



Offoro Kimambo
Lecturer, SUA
2019 One Planet Laureate Candidate



Edith Kadege
Agriculture Research Officer, TARI
2021 One Planet Laureate Candidate



Raheli Nazayoeli
Research Officer TIRDO
2020 One Planet Laureate Candidate

Tanzania

Malawi



Trust Kasambala
Senior Lecturer, LUANAR
2019 One Planet Laureate Candidate



Austin Phiri
Chief Agricultural Research Scientist, Ministry of Agriculture
2019 One Planet Laureate Candidate



James John Banda
Research Officer, Ministry of Natural Resources
2021 One Planet Laureate Candidate



Rodrigue Pèlèbè Orobiyi
Research Assistant, University of Parakou
2021 One Planet Laureate Candidate



Laura Estelle Loko
Senior Lecturer, UNSTIM
2020 One Planet Laureate Candidate



Bolarinwa Islamiyat Folashade
Senior Lecturer, LAUTECH
2020 One Planet Laureate Candidate



Toyosi Fadekemi Igejongbo
Lecturer, FUTA
2021 One Planet Laureate Candidate



Eva Nambeye
Lecturer, UNZA
2020 One Planet Laureate Candidate



Miriam Makungwe
Research Officer, IWMI
2020 One Planet Laureate Candidate

Nigeria

Zambia

Senegal



Marie-Therese Daba
Ph.D. Student, Gaston Berger University
2019 One Planet Laureate Candidate



Mame Sokhna Sarr
Researcher, ISRA
2019 One Planet Laureate Candidate



Moussa Kante
Teacher-Researcher, University of Segou
2020 One Planet Laureate Candidate



Dahan Kueshi Sémanou
Ph.D. Student, University for Development Studies
2019 One Planet Laureate Candidate

Benin

Togo



AgSpirations

African Women in Agricultural Research and Development (AWARD) is working toward inclusive, agriculture-driven prosperity for the African continent by strengthening the production and dissemination of more gender-responsive agricultural research and innovation. We invest in African scientists, research institutions, and agribusinesses so that they can deliver agricultural innovations that better respond to the needs and priorities of a diversity of women and men across Africa's agricultural value chains.

For more information, visit www.awardfellowships.org

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