Natural Resources Institute

Annual Review 2024/5

Transforming lives through research, innovation and learning

UNIVERSITY OF GREENWICH

Natural Resources Institute

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NRI is a leading research, development and education organisation of the University of Greenwich. We work with partners worldwide to drive research and innovation to address environmental, social and economic challenges for a sustainable future. Our work across sectors and disciplines aims to co-create environmental resilience, sustainable agriculture, gender equality, health and food security towards a just world free from disease, hunger, poverty and violence.

www.nri.org

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Foreword

Professor Jane Harrington
Vice Chancellor, University of Greenwich

The vision for a world free of hunger, poverty and disease is under threat. Persistent challenges remain in building resilience to climate change, safeguarding food systems against geopolitical shocks, and addressing persistent nutrition gaps in the world's most vulnerable regions. In many regions, hard-won gains in these areas are being reversed. As the world grapples with these disruptions and threats, the University of Greenwich remains steadfast in our commitment to act as a positive force for change. This commitment is exemplified by the Natural Resources Institute (NRI).

In 2024/2025, NRI researchers and partners rose to these challenges, through research, innovation and collaboration, striving to solve tomorrow's problems today. This report highlights efforts to address neglected tropical diseases, strengthen sustainable agriculture and food systems, improve public health through One Health approaches, and drive technological innovation in pest and crop management. It also features work supporting sustainable entrepreneurship, advancing gender equality and women's empowerment, and nurturing students and early-career researchers as future leaders in sustainable development.

This work resonates strongly with our Strategy 2030 priorities. NRI epitomises impactful research and knowledge exchange, creating opportunities for our students, beneficiaries and partners across the world. Its international reach builds meaningful partnerships that extend the university's influence far beyond our campuses. And its commitment to sustainability reinforces our goal of shaping a future that is just, resilient and inclusive.

Beyond the highlights of the past year, this report also demonstrates the ambition of NRI's 2024–2030 Strategic Plan. It shows how the institute is helping realise the university's mission: to create opportunities, build partnerships, and deliver impact for the benefit of individuals and society.

I invite you to explore this review and see how, through research, innovation and partnership, NRI is helping to shape a better future for all. Across the university, we will continue to leverage our expertise as educators to curate knowledge, create opportunities and change lives for the better, locally and on the global stage.

Welcome to NRI's Annual Review 2025

Professor Sheryl Hendriks
Director, NRI

"A Year of Impact, Innovation and Inspiration"

I am honoured to reflect on a year that has once again demonstrated the commitment of our team and the power of science to transform lives, uplift communities and shape a more sustainable future. The stories in this report are not only achievements. They are expressions of our values, partnerships and the brilliance of our researchers and students. Across continents and disciplines, NRI has continued to lead with purpose, co-creating solutions that reflect the lived realities of vulnerable populations.

In Benin, Cameroon, Ghana and Mozambique our entomology training programme is helping to eliminate river blindness by equipping local teams with rare and vital surveillance skills. Through our participation in the Regional Scholarship and Innovation Fund (RSIF) and Commonwealth Scholarship programmes, Côte d'Ivoire scholar Arsène Nahangnon Soro conducted the first molecular-based study of cashew anthracnose in Africa, offering new hope for disease-resistant crops and improved farmer livelihoods. In Mongolia, we were part of a multi-disciplinary study of the cashmere value chain, which is guiding efforts to balance economic opportunity with environmental sustainability. This research is helping herders, policymakers and processors envision a future where Mongolian cashmere is both globally competitive and ecologically sound.

In Nigeria, our research is helping communities navigate the devastating impacts of farmer-herder conflicts, safeguarding nutrition and childhood development. In Madagascar, a team of NRI researchers has been involved in designing, testing and validating a simplified approach for measuring women's empowerment in multisectoral agriculture and nutrition interventions. The replicable and adaptable tool provides an accurate, simplified means for programme monitoring and evaluation.

Our work on wild meat value chains, led by Professor Delia Grace Randolf, is shaping global discourse on food safety, biodiversity, and the right to food. The landmark report launched at the 8th World One Health Congress highlights that wild meat provides essential nutrition to over 400 million people, whereas removing it from diets would risk food insecurity.

We are also advancing public health through the RedRoz project, which is developing community-led rodent control strategies to reduce disease risk in Tanzania and Madagascar. Early results show dramatic reductions in rodent populations and improved household wellbeing, underscoring the value of interdisciplinary, One Health approaches.

Closer to home, our pioneering research into pollination is optimising bumblebee behaviour to improve crop yields in UK greenhouses. Through the integration of sensor technology, AI and plant chemistry, this work will help optimise pollination efficiency while reducing reliance on mechanical pollination. A multidisciplinary team, including NRI scientists, has developed an innovative smart trap for improved surveillance and real-time detection of one of the UK's most economically significant pests.

Our commitment to sustainable agriculture is further exemplified by the development of a plant-based pesticide derived from croton seed oil. This innovation not only reduces chemical use but also strengthens local economies and supports smallholder farmers, especially women and youth, in Kenya. Additionally, our researchers are looking into the distribution and spread of Rattail fescue, a grass which is already a serious invasive weed with increasing prevalence in Europe. The researchers hope to unravel the mechanisms through which this grass weed has spread in Europe and the UK, leading to yield loss and contamination of harvests.

Meanwhile, our Food Accelerator has been supporting over 130 early-stage innovators and entrepreneurs in the food and drink industry to overcome some of the biggest obstacles to growth through the development of technical skills and access to affordable open-access research and development facilities. We have shared this experience with African food entrepreneurs in Rwanda, helping them to innovate sustainably and access international markets, with tangible improvements in product quality, safety and waste valorisation.

Our teaching programmes continue to nurture the workforce of the future. Through industrial practice MScs, our students gain hands-on experience with leading food companies, contributing to innovation and quality assurance while building careers that matter. Employers show appreciation for the calibre of our graduates, and many students transition into permanent roles in the placement companies, driving change from within the industry.

These achievements contribute to achieving our strategic vision for the future, namely to be a global leader in collaborative research, knowledge exchange and learning to co-create a just, healthy and sustainable future for all. Our goals are bold, but they are grounded in the same spirit that drives our current successes: collaboration, excellence and a deep commitment to impact. As outlined in our 2024–2030 Strategic Plan, NRI is committed to nine strategic objectives:

1. Impactful collaborative research with partners across sectors and disciplines to co-create environmental resilience, sustainable agriculture, health and food security.
2. Improved international profiles (as individual researchers and as an institute).
3. Impactful innovation and knowledge exchange initiatives.
4. Maintaining excellence in state-of-the-art research and innovation (through people, systems and infrastructure).
5. Successful learning in a portfolio of academic and professional learning programmes.
6. Being an inclusive and equitable community - at work and in our work.
7. Building NRI's future leaders in innovation, learning and research.
8. Resource optimisation and institutional financial sustainability.
9. Embedding sustainability in all we do.

Thank you to the excellent NRI Team, our collaborators, partners and funders who have contributed to this remarkable year. Your work, partnership and support inspire hope, drive progress, and reaffirm our belief that together, we can transform lives for a better future.

Sustainable Agriculture for One Health

Conserving biodiversity and Indigenous knowledge in Guatemala

Jeremy Haggar

The Sierra Yalijux mountain range in central Guatemala is both a Key Biodiversity Area and home to the sacred hills of the Q'eqchi' Indigenous People. However, the area is threatened by forest fragmentation and climate extremes, isolating highland endemic species and increasing environmental degradation.

In 2024–2025, a project led by NRI's Professor Jeremy Haggar helped to demonstrate the rich biodiversity value of the area, while also contributing to the establishment of a new biological corridor and supporting Q'eqchi' communities to document their Indigenous knowledge of nature.

Working in collaboration with the Federation of Cooperatives of the Verapaces (FEDECOVERA) and the Association of Private Nature Reserves of Guatemala, the project monitored animal biodiversity in remnant forest fragments and agroforestry systems. This work confirmed the presence of four endemic frog species and three endemic salamanders listed on the International Union for Conservation of Nature (IUCN) Red List, including the critically endangered frog, Craugastor daryi. Crucially, these findings showed that even small forest fragments and sustainable agroforestry systems can play an important role in biodiversity conservation. Sightings of wild cats (Margay, Ocelot, and Jaguarundi) further underlined the ecological significance of the region.

The project also played a pivotal role in strengthening community-led conservation. When prolonged drought and forest fires struck the region in 2024, four cooperatives united to protect a forested ridge along their boundary. To reinforce this commitment, project partners are working with the communities to define two forest conservation areas under Cooperative Management Agreements with Guatemala's Council for Protected Areas (CONAP). These agreements will safeguard sacred hills, such as Cerro Qwa Siyap and Cerro Don Juan, ensuring cultural and ecological values are simultaneously protected.

Professor Haggar said: "These local agreements and the formation of the broader biological corridor will be critical to communities accessing incentives for forest conservation and restoration and provide a more secure environment both for biodiversity and the Indigenous communities".

Equally important was the development of instruments for protecting traditional knowledge, advancing community rights, and fostering more equitable, respectful engagement between Indigenous Peoples and external actors. With project support, ten Q'eqchi' communities representing 4500 families documented their terms and conditions to regulate access to their knowledge and resources in Biocultural Protocols, approved by their cooperative assemblies. Dr Pamela Katic, Associate Professor in Economics at NRI, who also contributed to the project explained: 'this work demonstrates how Indigenous communities can articulate governance norms rooted in their biocultural values and territorial rights.'

The project is further supporting 10 cooperatives affiliated to FEDECOVERA to reforest 440 hectares of land that had largely been converted into cardamom fields, the main source of income for the communities. This exercise will help convert these fields into agroforestry systems and enhance their conservation value.

To promote wider landscape conservation, the project convened a multi-institutional roundtable that brought together cooperatives, private nature reserves, and government agencies. This collaboration aimed to enable access to reforestation incentive payments, the Guatemalan Institute for Tourism which is providing training to communities interested in tourism, and the National Council for Protected Areas which helps update private nature reserve management plans and conservation agreements.

Importantly, the Ministry of Environment and Natural Resources has now selected the Sierra Yalijux for the development of a Biological Corridor, providing a permanent forum for joint action between FEDECOVERA, the Association of Private Nature Reserves and their members, and government institutions to sustain conservation in the region beyond the life of the project.

"These local agreements and the formation of the broader biological corridor will be critical to communities accessing incentives for forest conservation and restoration."

Through this work, NRI and project partners not only helped support biodiversity conservation but also to embed Indigenous knowledge and community stewardship at the heart of long-term conservation strategies in Guatemala.

Deforestation in Alta Verapaz, Guatemala

So that all may see: NRI builds capacity to eliminate river blindness

Frances Hawkes

A key challenge to eradicating onchocerciasis is a shortage of disease surveillance skills. Onchocerciasis, commonly known as river blindness, is a neglected tropical disease (NTD) caused by the parasitic worm Onchocerca volvulus. The parasites are transmitted by repeated bites of blackflies belonging to the biological group Simulium. Africa carries the bulk of the disease burden with over 99% of infected people living in 31 African countries. To address this skills gap, a team from NRI conducted a blackfly entomology training course in June 2023 at the University of Energy and Natural Resources (UENR) in Sunyani, Ghana.

> *"The exercise was timely and key to increasing capacity in what have become rare entomological skills, but for which demand is rapidly increasing."*

Twenty-one participants from six countries—Mozambique, Cameroon, the USA, Ghana, Benin, and the UK — received training in various practical skills, including field sampling and the proper handling and storage of adult, larval, and pupal blackflies. They also learned how to rear blackflies in the laboratory and identify their different life stages. A key part of the training was sex identification, as only female blackflies bite humans and transmit the parasite. Participants practised dissecting adults and larvae to develop this skill. Additionally, they were trained in preparing larval chromosomes and using cytotaxonomy, a method of classifying organisms based on chromosomal information. The training also covered the background of onchocerciasis elimination, vector control practices, and sampling techniques. A visit to Fuller Falls, a blackfly breeding site, helped trainees learn how to sample larval and pupal blackflies from the vegetation and rocks in fast-flowing rapids where blackflies typically lay their eggs.

The exercise was timely and key to increasing capacity in what have become rare entomological skills, but for which demand is rapidly increasing. This is because entomological surveillance is a core component of elimination surveillance in all

Trainees and instructors looking for blackfly larvae in the shallows of Fuller Falls on the River Oyoko, Ghana

countries where the disease is prevalent. The World Health Organization (WHO) Road Map for NTDs 2021-2030 lists the need for entomological capacity as a critical gap for onchocerciasis elimination.

Trainees will be able to incorporate knowledge and skills from the course into their research and other activities that support onchocerciasis elimination surveillance. Without entomological surveillance, it is difficult for countries to know whether they should stop mass drug administration with ivermectin. It is also problematic to know if they are approaching the threshold to confirm that they have interrupted transmission enough to qualify for elimination status. Mass drug administration with ivermectin is currently the core strategy to eradicate onchocerciasis, with a minimum requirement of 80% therapeutic coverage. The WHO estimates that at least 12-15 years of annual treatment are required in high and moderate endemic areas to eliminate transmission, corresponding to the lifespan of the adult Onchocerca volvulus.

'Many countries have had sustained ivermectin campaigns, so now it is important that local teams have the entomological skills needed to test whether the campaigns have interrupted transmission through sampling and analysis of the blackfly vector population', said Dr Frances Hawkes, Associate Professor in Medical Entomology at NRI. Reflecting on the practicality of the approach, she noted: 'This is much less invasive and costly than testing for infection in humans, which involves taking blood samples or small "skin snip" samples to check for parasites in patients, which can be a painful procedure.'

The course enhanced entomological skills for experienced trainees and provided a foundation in critical entomological skills for new onchocerciasis researchers and practitioners. These skills will be needed in onchocerciasis-endemic countries nearing disease elimination. Trainers included NRI's Prof. Robert Cheke, Dr. Rory Post from Liverpool John Moores University, and Pelagie Boko-Collins from Sightsavers Benin.

Partners and funders

The exercise was part of a project funded by the Gates Foundation, Improved Simulium capture for onchocerciasis elimination surveillance.

Blackfly larvae

Bee ‘Superfood’ breakthrough could boost colony health and protect pollinators

Phil Stevenson

With honeybees struggling as climate change and agricultural intensification strip away the flowers they rely on, NRI researchers and partners have developed an engineered bee feed supplement that could help tackle their global decline.

Published in Nature in 2025, their research reveals that a precision-engineered yeast supplement, designed to provide essential compounds found in plant pollen, significantly improves honeybee colony reproduction. NRI’s expertise was central to this work, providing the chemical analysis that identified which sterols are essential for bee health.

Honeybees depend on sterols – specialised lipids found in pollen – for growth and reproduction. However, as floral diversity declines, beekeepers are forced to rely on commercial pollen substitutes. Yet, these lack the right sterol compounds, making them nutritionally incomplete.

Through delicate work including dissecting individual nurse bees to separate the guts, and advanced chemical analysis, the team identified six sterols, 24-methylenecholesterol, campesterol, isofucosterol, β-sitosterol, cholesterol, and desmosterol, that dominate in bee tissues.

Before this work, it was unclear which of the diverse sterols in pollen were critical for bee health. ‘Our analysis identified exactly which sterols bees use, giving us a precise nutritional target for the modified yeast,’ said Phil Stevenson, Professor of Plant Chemistry at NRI and co-author of the Nature paper.

The researchers used CRISPR-Cas9 gene editing to engineer the yeast *Yarrowia lipolytica* to produce the exact mixture of these sterols sustainably. *Y. lipolytica* was selected since this yeast has a high lipid content, has been demonstrated as food-safe, and is already used to supplement

A beekeeper checking on a hive

aquaculture feeds. The yeast biomass was then cultivated, harvested, and dried into a powder that could be mixed into artificial pollen diets.

In controlled three-month feeding trials, colonies given the sterol-enriched supplement reared up to 15 times more larvae to the viable pupal stage than colonies on sterol-deficient diets. These enriched colonies also sustained brood rearing for longer, and the sterol profile of their larvae matched that of naturally foraged bees.

Pollinators like honeybees contribute to the production of over 70% of leading global crops and declines in bee populations threaten food security and biodiversity alike. ‘Honeybees are critically important pollinators for the production of crops such as almonds, apples and cherries, and so are present in some crop locations in very large numbers, which can put pressure on limited wildflowers. Our engineered supplement could therefore benefit wild bee species by reducing competition for limited pollen supplies,’ Professor Stevenson explained.

The yeast-based supplement could be commercially available within two years, offering beekeepers a sustainable way to improve colony resilience without depleting natural pollen sources. Beyond honeybees, the same technology could be adapted to support other pollinators and even farmed insects, opening new avenues for sustainable agriculture.

While the results are promising, large-scale field trials will be essential to confirm long-term benefits and pollination outcomes in real-world agricultural settings. The researchers are optimistic about scaling the approach and integrating it into bee management strategies.

Professor Stevenson said, ‘Research to prevent the sudden loss of bee colonies has focused primarily on pesticides and parasites like Varroa mites. But our work shows that good nutrition is crucial too, and just like with people, good diets for bees can lead to healthy outcomes. Thus, this research could be the beginning of the end of colony collapse disorder.’

Partners and funders

This study was led by the University of Oxford. It also involved key contributions from the Royal Botanic Gardens Kew and the Technical University of Denmark.

It was funded in part by BBSRC and the Novo Nordisk Foundation.

Optimising bumble bee behaviour to improve pollination services and crop yields

Phil Stevenson

Pollinators are critical ecosystem service providers supporting plant reproduction in natural ecosystems and contributing to food production. For example, 90% of flowering plants and 75% of food crops benefit from pollination services. Some crops, including strawberries and tomatoes, are highly dependent on pollinators but are typically grown under protected and controlled environments (PACE) so typically require pollination services from managed or commercial bees.

Understanding how natural processes such as diseases and nutrition influence the health of pollinators is critical to maintaining these pollination services – especially for global food security and in light of global changes. NRI scientists led by Prof Phil Stevenson have been studying the interactions between pollinators and flowers for many years and are using some of these findings to optimise the pollination service of commercial bumble bees in fruit and vegetables in the UK.

In 2013, along with scientists at Newcastle University – notably Prof Geraldine Wright – NRI researchers discovered that the nectar of Citrus and Coffee contained caffeine at concentrations that enhanced honeybee memory for floral odours associated with good food. Further studies showed that this influenced the behaviour of foraging bees and colonies towards a caffeinated food store, suggesting that honeybees were being 'drugged' by the plants to better recall and return to them and so improve pollination.

In PACE crops, bumble bees are the preferred pollinators for strawberries although honeybees may also be used. Tomatoes rely heavily on bumble bees because they require a specific type of pollination called buzz pollination, which only bumble bees can provide. Our research thus focuses on bumble bees due to their importance in pollination. However, their services are notoriously unreliable. We are therefore exploring how to optimise their behaviour to boost pollination and crop yields.

Working with NIAB and Berry Gardens (a fruit growing company) in 2017, NRI scientists investigated whether they could prime or train commercial bumble bees with caffeine to improve their ability to locate and target strawberry crop flowers and improve yields. In the lab, they showed for the first time that bees could be 'trained' to locate a food source more effectively if it had been primed using caffeine and the target odour. Under greenhouse conditions, the effect was more nuanced. However, earlier studies suggested that fruit quality could be improved with bees primed with caffeine.

Building on this, the researchers are working with Oxford University to improve pollination by bumble bees in tomatoes. Greenhouse-grown tomatoes require active pollen transfer, either through mechanical means or by foraging bees such as the domesticated bumblebee, *Bombus terrestris*. In greenhouses, tomatoes pollinated by bumblebees have larger fruit and greater yield per hectare than those pollinated mechanically but using bumblebees has some drawbacks. Growers are limited to using UK native subspecies of the buff-tailed bumblebee, *B. terrestris audax*, to prevent the spread of disease to wild bumblebees. However, these colonies generally decline within 2-4 weeks of placement and exhibit relatively poor pollination rates on soft fruit and vegetable crops including commercially

Bumblebee covered in pollen

valuable tomato varieties. The reasons for their poor performance are unknown. Currently, growers place colonies in glasshouses without any direct monitoring. Except for counting bitemarks left by visiting bees on flowers, they also have no way to relate bee behaviour to actual pollination rate and yield of tomatoes. The researchers have proposed developing methods to monitor and improve the management of *B. terrestris audax* on UK-grown tomatoes in collaboration with Thanet Earth (Kent), the UK's biggest glasshouse tomato grower, and sensor-based bee technology company, Bee-Ops.

"Understanding how natural processes such as diseases and nutrition influence the health of pollinators is critical to maintaining these pollination services."

This project will employ the latest sensor technology to monitor the activity and efficiency of *B. terrestris audax* colonies in commercial glasshouses at Thanet Earth. Sensor technology will enable the project team to provide growers with important data about the current state of pollination. This will include a rating of the quality of the colonies received from their preferred suppliers and high-resolution information about floral visitation and foraging rate of colonies for specific varieties and its influence on yields under particular conditions (e.g. time of year, temperature).

They will also comprehensively test how the developmental phase of colonies introduced to glasshouses influence foraging rate. Using an optimised pollen substitute for bumblebees developed by Oxford and NRI, they aim to improve colony longevity by studying how nutritional intervention early in colony development affects the colony's population size and foraging rate.

Further, they will measure the volatile compounds emitted by tomato floral odours. Using methods developed at NRI, they will train bees to orient towards tomato floral scents by exposing bees in colonies to tomato floral scent in association with caffeinated nectar. These data will form the basis of a strategy for improved colony management by showing how specific interventions improve the pollination efficiency of bumblebees on specific tomato varietals. The researchers predict that the combination of methods develop through this project will generalise to bumblebee pollination of other fruit and vegetable crops grown in greenhouses or polytunnels.

Partners and funders

This work was funded through a BBSRC industrial partnership award (2017) and a BBSRC-PACE (2024) grant.

Beehive in a greenhouse

Smart traps offer new line of defence against major horticultural pest

Gonçalo Silva

Scientists at NRI, in collaboration with the University of Bristol and Spanish technology company IRIDEON S.L., have developed an innovative smart trap to tackle one of the UK's most economically significant pests, the whitefly (*Bemisia tabaci*). This regulated quarantine pest is frequently found on imported ornamental plants such as poinsettias and poses a serious risk to the wider horticultural sector due to its ability to transmit over 300 plant viruses, affecting high-value crops such as tomatoes and cucumbers.

Currently, plant health inspections rely heavily on visual checks and in-field yellow sticky traps. These methods often require laboratory confirmation to distinguish *B. tabaci* from morphologically similar, non-quarantine species such as the common glasshouse whitefly (*Trialeurodes vaporariorum*). This process is time-consuming, costly, and prone to delays, limiting the ability of inspectors to respond quickly to potential outbreaks.

The smart trap, on the other hand, enables passive, automated and real-time detection and identification of *B. tabaci*, offering a transformative alternative to traditional surveillance methods. Developed under the 'Smart traps for improved surveillance and early detection of plant pests' project, the smart trap combines a suction trap with an optical sensor powered by machine learning.

NRI coordinated the project, bringing together a multidisciplinary team of entomologists, plant virologists, engineers, and data scientists. It also led the biological testing and stakeholder engagement, while the University of Bristol developed the machine learning algorithms. IRIDEON contributed its optoelectronic sensor expertise, previously applied in mosquito surveillance.

The development process involved optimising the trap design to trap whiteflies, integrating the sensor hardware, and training the machine learning model using flight pattern data from *B. tabaci*, and other insects. The resulting system achieved over 99% accuracy in distinguishing the target pest under controlled conditions. A stakeholder workshop held at NRI in early 2025 brought together representatives from Defra, the Animal and Plant Health Agency (APHA), and the British Ornamental Association, who provided valuable feedback on the trap's usability and deployment potential.

Dr Gonçalo Silva, who led the project, said: 'The benefits of the smart trap are its real-

Scientists demonstrating how the smart trap works

The smart trap enables passive, automated and real-time detection and identification of *B. tabaci*

"The smart trap, on the other hand, enables passive, automated and real-time detection and identification of B. tabaci, offering a transformative alternative to traditional surveillance methods."

time and passive surveillance capabilities. Our initial results showed great promise that the technology can be used to enhance the efficiency of inspections and help maintain pest numbers and the scale of outbreaks at low levels.'

The next phase of the project will focus on scaling up the technology for commercial production, including field validation in commercial nurseries and integration with digital platforms for remote monitoring. The team is also exploring opportunities to adapt the system for other regulated pests, expanding its utility across the plant health sector.

The project's outcomes align closely with the UK's Plant Biosecurity Strategy (2023–2028), which emphasises the need for innovative technologies to enhance early warning systems and reduce reliance on chemical controls. By automating pest detection and enabling rapid response, smart traps offer a sustainable, scalable solution to one of the most pressing challenges in plant health.

Partners and funders

The Smart traps for improved surveillance and early detection of plant pests project was funded by Innovate UK's Small Business Research and Innovation (SBRI) scheme from April 2024 to March 2025.

Rodent control strategies to reduce disease risk in ecologically and culturally diverse rural landscapes

Steve Belmain

Rodents are a known public health threat, emblematic of poverty, hardship and epidemics. The WHO estimates that 400 million human cases of rodent-borne infections occur every year. At least 60 zoonotic infections involve rodents at some stage of their cycle, and some, such as plague, can develop into human-to-human disease outbreaks. Leptospirosis alone is one of the world's most common but neglected zoonoses with an estimated 1 million cases and 60,000 fatalities each year, and chronic impacts that can lead to food insecurity and long-term indebtedness.

Disease risk from rodents depends on the abundance of infected animals and the individual, household and community practices that influence exposure. The different transmission routes of rodent-borne infections, including via ectoparasite (fleas, ticks, lice, mites) vectors and environmental contamination, have important implications for epidemiology and human exposure. Thus, mitigating risk requires an understanding of both disease ecology at landscape scales and the nature of human-animal interactions within social contexts.

Tackling such complex problems requires a multi-disciplinary, One Health approach, bringing together fields of social anthropology, microbiology, ecology and wildlife management. The interdisciplinary RedRoz project is developing rodent control strategies that effectively reduce the threat from rodents and are sustainable for local communities in heterogeneous landscapes.

"Our research has shown the opposite, demonstrating that removing rats through intensive trapping also reduced flea abundance inside houses, particularly the key flea species known to have a higher incidence of plague infection"

NRI's Professor Steven Belmain, an international expert on rodent management, has been leading project efforts to understand seasonal population dynamics of rodents. His work focuses on how these dynamics relate to local agricultural and household practices, especially the ecology of rodent dispersal and reproduction.

A rat in one of the traps used on the project

A key activity of this research has been to trap rodents within households and other areas around rural communities. The work was empirically designed in two regions of Tanzania and Madagascar where intensive trapping was conducted in six communities in each country. The impact of this continuous trapping by every household, every day of the year, was compared to activities in six other communities where households' use of rodenticides was typically infrequent and ad hoc.

During the period that intervention communities were being assisted in daily trapping, Prof Belmain and the wider team collected samples from rodents for laboratory tests for diseases, particularly plague, leptospirosis and typhus. The researchers used marked baits to track how rodents moved around, particularly between houses and cropping areas, to understand how rodents and the diseases they carry can spread to humans and other animals.

Preliminary data analysis from the project shows that intensive trapping by communities can dramatically reduce rodent numbers and keep numbers low, as long as the community keeps trapping. In contrast, communities that did not coordinate their actions and only occasionally used rodenticides, saw high rodent numbers year-round. Families in intervention communities noticed immediate benefits. They had very few rats in their houses, which meant less disturbance during sleep and fewer bites at night. Fewer children had nightmares about rats biting them and food stores inside houses were not being

another positive result from the research is that intensive rat trapping did not cause potential problems with fleas spreading plague. The ecology of flea species dynamics is complex in the context of plague transmission, and knowledge is lacking at the global scale. Some experts have previously argued that rat trapping could increase human plague cases. Professor Belmain explained: ‘Our research has shown the opposite, demonstrating that removing rats through intensive trapping also reduced flea abundance inside houses, particularly the key flea species known to have a higher incidence of plague infection. Although these findings are promising, more analysis is needed to understand whether the intensive rat trapping actually reduces the incidence of diseases in the rodent population, thereby reducing the risk of diseases spilling over to humans.’

Partners and funders

The RedRoz project was funded by the UKRI Medical Research Council from January 2021 to December 2024. It was implemented in collaboration with researchers from the UK (NRI, University of Aberdeen, St. Andrews University), Tanzania (Sokoine University of Agriculture and Muhimbili University of Health and Allied Sciences) and Madagascar (Vahatra Association and the Pasteur Institute).

Prof Steve Belmain examining a rat trap in Tanzania

Looking ahead: NRI leading research to combat emergent grass weed

Lucie Büchi

Rattail fescue (*Vulpia myuros*) is an annual grass (i.e. growing from seeds every year) usually emerging in autumn and producing numerous small seeds during the next summer. It originates from the Mediterranean area and has been present in most of Europe, including the UK, for hundreds of years now. NRI is conducting research into the distribution, spread and ecology of this grass weed, which has increased in prevalence in Europe in the past twenty years.

This grass weed has spread in the UK over the past century but the reasons for this recent spread are not well known. It is increasingly widespread in urban spaces such as car parks, pavement cracks and tops of walls. Importantly, rattail fescue has also emerged as a weed in arable fields in the past 20 years in Europe and the UK, causing considerable damage when allowed to spread.

Interestingly, a similar sequence of events happened in Australia. Rattail fescue was accidentally introduced in the country with European settlers in the late 1700s but became a weed of economic importance from the 1960s in Australian pastures and arable fields, causing significant economic losses. At that time, rattail fescue was not known as a weed in other arable settings around the world.

New weeds constantly emerge in arable fields and understanding how and why a species already present in an area can suddenly also thrive in agricultural fields is paramount to designing better control methods. Weeds induce high economic damage through yield loss and contamination of harvests. Therefore, weed management is a big part of farm and field management. For example, blackgrass (*Alopecurus myosuroides*), one of the main grass weeds in the UK, currently costs the UK economy around £400 million per year. It is thus of vital importance to study emerging weeds, such as rattail fescue, before they become major problems.

The NRI team first encountered rattail fescue in Switzerland, where the weed had invaded

"Ultimately, we hope that understanding this species better will allow us to tackle the problem before it creates damage similar to blackgrass"

a long-term field experiment. Research lead Dr Lucie Büchi, Associate Professor in Crop Ecology at NRI said, 'We then realised that there was some confusion around the identification of this species, even among extension agents and farmers.' The team, in collaboration with scientists from Rothamsted Research, has since published a literature review on the species, an identification leaflet and launched an online survey to collect information about rattail fescue's presence and associated cropping practices. Since then, the team has been conducting field work and pot experiments to better understand the ecology of this species and a closely related one. A PhD project (funded through a Vice Chancellor's scholarship) on this species is also ongoing.

Through these experiments, the researchers hope to unravel the mechanisms through which this grass weed has spread in Europe and the UK and thrives in arable fields. 'Ultimately, we hope that understanding this species better will allow us to tackle the problem before it creates damage similar to blackgrass' Dr Büchi said.

Partners and funders

This work has been supported by a research grant from the Royal Society (RGS\R1\231310).

Rattail fescue in an urban area, North East England

NRI-led project paves way for eco-friendly pest control in Kenya

Mandela Fernandez-Grandon

Modern agriculture has become increasingly reliant on pesticides in the quest to feed a growing global population. While pesticide use has soared worldwide, rising concerns about the safety and sustainability of synthetic pesticides are driving a shift toward seeking viable alternatives.

The NRI-led "Designing and Developing Plant-Based Natural Product Innovations Using Croton Seed Oil" project is a prime example of collaboration for innovation and impact as sustainability gains global attention. Through this project, NRI partnered with organisations in Kenya to improve capacity to develop eco-friendly pest control products from the croton seed oil. The oil is extracted from the local croton nut sourced from the Croton megalocarpus tree, a fast growing indigenous tree found in ten Sub-Saharan African countries including Kenya.

The project developed and determined the viability of a sustainable, pyrethrum-based, environmentally benign pest control product incorporating croton oil. The project also helped create a knowledge base for croton oil processing, a database of its compounds, and conduct a market analysis to identify potential competitors and opportunities. Dr Mandela Fernandez-Grandon, one of the scientists on the project, said: 'Pyrethrum is one of the oldest natural insecticides and has stood the test of time for a reason – it works. However, modern formulations often include by-products of the petroleum industry to enhance its efficacy. We hope that the incorporation of croton oil could provide a more sustainable way to increase its efficacy while providing reliable income for local communities.'

"The project developed and determined the viability of a sustainable, pyrethrum-based, environmentally benign pest control product incorporating croton oil."

By enhancing the capacity of EcoFix – a croton nut processing company based in Kenya – to develop sustainable agricultural technologies, the project's benefits go beyond just environmentally benign pest control. It also positively impacts the entire croton seed value chain. The project opened new revenue streams and increased demand for croton seed oil, particularly benefiting smallholders who collect the nuts. These smallholders – predominantly women and youths – now have a critical source of income, thus improving their livelihoods. In addition, using locally sourced raw materials reduces supply chain risks and lowers the environmental footprint of the croton value chain enhancing both economic and ecological sustainability. EcoFix was the commercial partner on the project while Egerton University was the in-country academic research partner.

Dr Fernandez-Grandon (R) and Eric Ngutu looking at insect pests on field beans in Kenya

The discovery of bioactive principles in Croton oil led to the commercial development of environmentally benign pesticides by Kapi Chemicals, EcoFix's primary customer in Kenya. This product not only reduces farmers' reliance on synthetic chemical pesticides but also represents a significant step forward in sustainable agriculture.

Beyond these outcomes, one of the key milestones of the project was the mentoring and support of Research Associate Eric Ngutu. Eric's work was central to the development of plant-based natural products using croton seed oil. Through the project's support, he has developed into an independent scientist with robust research skills. Following the project, he won grant funding to present the work at an international conference and went on to find employment. By building local capacity in this way, the project laid a foundation for its impacts to live on after it was completed.

Professor Phil Stevenson who was the overall project lead, said: 'It takes a great deal of teamwork and persistence to co-develop a multi-partner international project like this, but what matters most is that this project leaves behind real, lasting impact – empowering local communities, strengthening agri-businesses, and setting the stage for future innovation. Dr Stevenson is Professor of Plant Chemistry and Head of the Chemical Ecology and Plant Biochemistry Group at NRI.

New organic formulations and processing techniques developed during the project will provide new products that will attract more customers. This will support the growth of the pyrethrum and croton industries and, more importantly, promote sustainable food production. Moreover, Kenya was formerly the global leader in pyrethrum production contributing 90% of global supply in 1983 with nearly 30,000MT. This indicates the potential of the products of this project and the scope for income generation for smallholders.

The project is expected to have a lasting positive impact on local communities and the agricultural sector in Africa. It has not only created a sustainable model for agricultural practices but also empowered smallholders and businesses alike, setting a precedent for future innovations in the field. It also typifies how NRI is working collaboratively to embed world-leading knowledge and expertise in business to address key challenges.

Partners and funders

The Designing and Developing Plant-Based Natural Product Innovations Using Croton Seed Oil project was funded by Innovate UK through its African Agriculture Knowledge Transfer Partnerships (AAKTP) scheme.

The Dalmatian chrysanthemum is widely used as a source of pyrethrum, a natural pesticide

Global partnerships for impact: Building capacity to tackle fungal diseases

Andrew Armitage

Fungal diseases pose significant global risks to horticulture, resulting in losses from farm-to-fork. These diseases cause direct losses before harvest, spoil food after harvest and contamination by mycotoxins poses health risks to both humans and livestock when consumed. The threat of fungal diseases is exacerbated through range expansion due to climate change, continued emergence of fungicide resistance and through propagation of susceptible plant varieties. Despite advances in molecular biology and DNA sequencing, there remains a significant gap in the accurate understanding of the fungi responsible for many horticultural diseases and crop losses.

Through initiatives like the Regional Scholarship and Innovation Fund (Rsif). the Partnership for skills in Applied Sciences, Engineering and Technology (PASET) and Commonwealth Scholarship programmes, NRI hosted a range of visiting PhD students between 2021 and 2025. With access to modern/state-of-the-art facilities and training in molecular techniques, students were able to precisely identify fungal pathogens and undertake subsequent study of pathogen diversity. NRI has also established partnerships with African universities and built research capacity to tackle local challenges in various African countries through such programmes.

For six months in 2024, NRI hosted PhD student Arsène Nahangnon Soro, a RSIF PASET scholar from Université Félix Houphouët-Boigny, Côte d'Ivoire. He aimed to characterise fungal diseases of Cashew in Côte d'Ivoire, the world's leading cashew producer. Despite its top status, farmers in Côte d'Ivoire face continued threats from pests and disease. Arsène's work aimed to determine the causes of these diseases and support efforts to manage them and to breed more resistant cashew varieties.

Anthracnose is considered the most damaging fungal disease of cashews affecting leaves, flowers, fruits and even cashew nuts and causing significant yield losses. This and the wide distribution of the disease throughout cashew growing areas in Côte d'Ivoire motivated Arsène to work on identifying solutions. 'Despite our (Côte d'Ivoire) position as the world's leading producer of raw cashew nuts, with production projected to reach approximately 1.15 million tonnes in 2025, our country has a low yield per hectare (547 kg/ha in 2018, compared with 1 to 2 tonnes/ha in countries such as India and Vietnam). My country wants to maintain our position as the world leading producer and increase our yield per hectare. One way of achieving this is to control disease, which requires precise knowledge of the agents responsible for the disease', Arsène said.

Through the study of DNA from fungal strains collected from cashew nurseries and orchards across Côte d'Ivoire, Arsène precisely identified the causal agents of Cashew anthracnose. This groundbreaking work represents the first molecular-based study of this disease, not only in Côte d'Ivoire, but in Africa. With DNA-based analyses providing deeper insight than previously available, this study identified that a diverse set of Colletorrichum species is responsible for the disease.

"This groundbreaking work represents the first molecular-based study of this disease, not only in Côte d'Ivoire, but in Africa."

This has implications for cashew breeding as crop resistance will need to be durable against multiple fungi, rather than a single pathogen. Also, findings indicated that Colletotrichum species previously reported on mango may also be responsible for infecting cashew. This opens opportunity to study whether there is co-infection between cashew and mango orchards when grown in close proximity across the Côte d'Ivoire.

The initial results of this work were published as a new disease report of Anthracnose diseases on cashew, with further manuscripts covering the full disease survey soon to follow. These publications build upon the outputs from similar visiting scholars published in 2024. They include a publication of a study of fungal diseases of African yam bean led by visiting scholar Olaide Ogunsanya from the Federal University of Agriculture, Nigeria and the International Institute of Tropical Agriculture, Nigeria. They also include a publication of a study of post-harvest diseases of Yam, led by Adjata Kamara from Université Félix Houphouët-Boigny. NRI is committed to supporting future scholarships, and in 2025, facilitated research focused on fungal diseases of Fonio.

Dr Andrew Armitage, Associate Professor in Bioinformatics and Plant Pathology, NRI said: ‘Plant pathogens are constantly evolving, with new variants frequently emerging that can overcome crop resistance, pesticides and management strategies. Scholars working with NRI have been characterising which fungi are responsible for disease across a range of important African subsistence and cash crops. These run parallel to our study of horticultural diseases in UK crops, including Botrytis diseases of strawberry. Understanding what drives these crop losses is the first step to adapting how we develop more resistant crops and how we respond to these constantly evolving threats to food security.’

NRI’s commitment to capacity building and knowledge exchange is evident through its ongoing support for such programmes which create impact. The institute is currently supporting scholarships focusing on fungal diseases of Fonio which have run throughout 2025. Through such initiatives, NRI continues to build a robust network of expertise, driving innovation and resilience in global agriculture

Ripe cashew apple

Partners and funders

Arsène, and Adjata’s work was supported through RSIF PASET scholarships. PASET, the Partnership for skills in Applied Sciences, Engineering and Technology is a World Bank-funded programme aiming to strengthen science and technology capability for the socio-economic development of Sub-Saharan Africa.

Olaide’s work was supported through the Commonwealth Split Site Scholarship.

Gender and Social difference

A simplified approach for measuring women's empowerment in agriculture and nutrition programmes

Ravinder Kumar

Empowerment is a complex, multidimensional concept that cannot be observed directly. Given the interlinkages between gender, nutrition and agriculture, it is important to assess both the effects of nutrition and agroecology interventions for women's empowerment, and the effects of women's empowerment on nutritional and agroecological outcomes. While many programmes promote gender-responsive actions, and research has been conducted on women's empowerment, there is a lack of appropriate frameworks and tools to integrate gender empowerment measurement into monitoring and evaluation (M&E) systems.

Existing approaches such as the Women's Empowerment in Agriculture Index (WEAI), its adaptations for projects (Pro-WEAI), for nutrition (WENI), and the abbreviated versions (A-WEAI and A-WENI), all require high level research and statistical skills. They are resource-intensive in terms of survey time and cost. It is difficult to integrate them into project baseline and endline surveys or to adapt them for routine collection of multiple types of information, or for use in programme/project monitoring and evaluation systems to inform technical support.

This was the rationale for developing a simplified approach to measure women's empowerment in a nutrition and agriculture context. Since 2022, a team of NRI researchers has been involved in designing, testing and validating a simplified approach for measuring women's empowerment in multisectoral programmes focused on agriculture and nutrition interventions. Drawing on existing approaches to measurement, NRI's Associate Professor Ravinder Kumar, Professor Vegard Iversen and gender expert Vero Ramananjohany from Madagascar, developed an adaptable and replicable simplified methodology. Following piloting and data analysis, an initial set of 42 questions, were reduced to 25 questions by eliminating less impactful questions.

The simplified approach was piloted in the baseline (2022) and endline (2024) surveys of the EU's regional programme in Support of Food and Nutritional Security in the Indian Ocean (SANOI). The endline research (2024) provided an opportunity to test its effectiveness in detecting differences in women's empowerment status due to a programme intervention. The method involved both qualitative and quantitative measurements and was tested through a survey of women of reproductive age (15-49) from households (1609 baseline and 1507 endline) in Madagascar, and 24 focus group discussions with women and men.

" This approach provides programme teams with actionable, real-time data to understand, track and adjust their efforts to support women's empowerment."

Statistical tests were used to evaluate the influence of each question, ensuring the simplified approach preserved assessment quality while reducing complexity. The tests indicated good reliability and consistency between the two methods, with the simplified methodology achieving 92.4% consistency compared to the original. This approach maintained the reliability of the results while allowing for quicker and more cost-effective survey administration. It made it possible to assess the complex phenomenon of women's empowerment without losing rigour and robustness in measurement.

The simplified approach was equal to existing methods in providing a reliable and robust understanding of women's empowerment across four domains – decision-making, access and control of resources, participation, leadership and mobility. Decision-making and mobility scored relatively highly, while participation and leadership and access to resources and control scored lower. The survey also revealed that the four domains of women's empowerment were not systematically correlated with each other and therefore each was an important dimension of measurement to include. The average empowerment score from tests of the methodology in Madagascar was 0.57, which is below the 'acceptable' threshold of 0.6. Only 44% of the women achieved an 'acceptable to desirable' women's empowerment score (on a 3-point scale - desirable, acceptable, unsustainable). The application of this approach in the SANOI programme indicated that women's empowerment scores above the acceptability threshold were associated with less likelihood of being in poverty, greater access to dietary diversity at home and higher agroecological performance.

Women selling food on a streetside in Madagascar

A woman selling street food in Madagascar

Piloting and validation of the methodology demonstrated that integrating it into existing M&E systems of agriculture and nutrition programmes is both feasible and effective. The approach allows for adaptation to project-specific questions, and can be easily administered for baseline, endline, and periodic monitoring. While the approach requires further testing and validation in diverse nutrition-sensitive and multi-sectoral contexts, it represents a major first step in developing a replicable and adaptable tool for programme monitoring and evaluation

Ravinder Kumar said: 'This approach provides programme teams with actionable, real-time data to understand, track and adjust their efforts to support women's empowerment. It provides evidence on a continuous basis for improving activities that can support agroecological adoption, nutrition and women's empowerment'.

'Some EU-funded organisations have already adopted the method in their projects on nutrition and women's empowerment. Other donors, such as the German Agency for International Cooperation (GiZ) have also shown interest in using it,' he added.

Partners and funders

This work was conducted as part of the Nutrition Research Facility (NRF)'s technical support on M&E to the EU's SANOI programme working towards improving food and nutrition security in selected areas of four countries (Madagascar, Mauritius, Seychelles and Comoros). NRI is the core partner of the NRF. The NRF was established and is funded by the European Commission as part of the Knowledge and Research for Nutrition (K&R4Nut) project.

Women at the heart of Africa's agrifood systems

Lora Forsythe

Women are deeply engaged in agrifood systems, providing labour, essential knowledge and care that sustain households, communities and markets. Yet their vital roles often remain undervalued, and persistent gender inequalities continue to limit their opportunities, challenges made even more urgent by the impacts of climate and environmental change.

A new report by the Food and Agriculture Organization of the United Nations (FAO), NRI, and African Women in Agricultural Research and Development (AWARD) provides a comprehensive analysis of the status of women in agrifood systems in sub-Saharan Africa (SSA). Launched at the Africa Food Systems Summit in September 2025, the regional report builds on FAO's 2023 Status of Women in Agrifood Systems global report, exploring how gender inequality intersects with climate change, environmental degradation, and socio-economic and institutional factors to shape women's livelihoods, food security and access to resources.

Drawing on African-led research and consultation, the report identifies both persistent barriers and transformative opportunities for gender equality. It calls for better data, gender-transformative policies, and inclusive governance to build more resilient, equitable, and sustainable agrifood systems.

The report shows that 76 percent of employed women in SSA work within agrifood systems, representing nearly half (49%) of the total workforce in the sector. Women's participation in off-farm activities such as processing, packaging and distribution has risen steadily, from 21 percent in 2005 to 29 percent in 2022. However, over 90 percent of employed women in the region remain in the informal sector, where their contributions often go unrecognised and undervalued. Dr Fiorella Picchioni, Research Fellow at the University of Bristol and a co- author of the report noted that 'their productive work is often informal, precarious, and poorly paid, while reproductive labour remains invisible.'

"While there is still a long way to go, encouraging developments across sub-Saharan Africa are helping to address the inequalities faced by women in the region."

Women selling fresh fruit in a market. 76% of employed women in SSA work in agrifood systems

A woman selling okra on the street

‘While there is still a long way to go, encouraging developments across sub-Saharan Africa are helping to address the inequalities faced by women in the region,’ said Dr Lora Forsythe, Associate Professor in Gender, Inequalities and Food Systems at NRI, who led the report’s core writing team. Collective action towards women’s land rights, addressing gender-based violence, and leadership in agroecological movements and natural resource governance are signs of progress towards improving women’s livelihoods and wellbeing, and ensuring women’s priorities are more meaningfully represented in decision-making.’

Inequalities extend to access and ownership of land and natural resources. In most countries across the region, men are more likely than women to own agricultural land or hold secure tenure. Women also face barriers in accessing water, forests, agricultural inputs and information essential for production and livelihoods. These disparities compound broader challenges, including limited access to finance, higher vulnerability to climate shocks, and widespread food insecurity, that affect women disproportionately.

The report emphasises that women in the region play diverse and vital roles in the culture, knowledge, innovation and social bonds associated with food within African agrifood systems.

FAO’s Assistant Director-General and Regional Representative for Africa, Abebe Haile-Gabriel, echoed these findings, adding that ‘agrifood systems across sub-Saharan Africa are powered by women’s informal, domestic, and subsistence work. Investments and enabling policies are needed to create more formal wage-paying jobs for women, and social protection programmes must be expanded to safeguard women’s livelihoods.

The report argues that empowering women by creating environments where they can make and act on choices, individually and collectively, enhances social equity, food security and climate resilience. It also emphasises that supportive policies, targeted interventions, and robust international accountability across public and private sectors are vital to recognising and sustaining women’s contributions, positioning agrifood as a key driver of equity, fairness and dignified livelihoods.

Partners and funders

The report was led by Dr Lora Forsythe, and lead chapter authors include Professor Akosua Darkwah (University of Ghana), Dr Losira Sanya (Makerere University), Dr Fiorella Picchioni (University of Bristol), and Dr Lora Forsythe and Dr June Po (Natural Resources Institute), with additional support and guidance from Professor Adrienne Martin. This work was carried out with funding from the International Development Research Centre, Ottawa, Canada.

Food safety, nutrition and value addition

SAFOODS: Improving nutrition and climate resilience in West Africa

Christopher Turner

In the bustling markets of Ziguinchor, Senegal, daily life unfolds in colour and complexity. Crowded alleyways, vibrant produce stands and the constant rhythm of commerce set the scene. Yet, beneath the bustling energy lies a deeper challenge: how do vulnerable urban consumers navigate their food environment to acquire and consume nutritious, healthy diets in the face of climate-related pressures?

To better understand these challenges, the SAFOODS project invited residents of low-income neighbourhoods in Ziguinchor to participate in a study to investigate their lived experiences of fruit and vegetable acquisition practices in the urban food environment. Using a combination of focus group discussions, participatory mapping and photography methods, residents shared their fruit and vegetable acquisition and consumption practices and conveyed how these fitted into their daily lives and activities. Fieldwork was coordinated by Dr Chris Turner, Senior Lecturer in Food Systems and Public Health Nutrition at NRI, along with Dr Ninon Sirdey from CIRAD (France), and colleagues from ISRA-BAME (Senegal).

Data analysis was undertaken by Julia Ligori from the Institute of Research for Development (France), supported by Dr Turner. Findings highlighted the factors that either facilitate or hinder the consumption of fruits and vegetables in disadvantaged neighbourhoods, drawing on testimonies and images from the daily lives of these communities. The analysis revealed four key themes related to the food environment of vulnerable urban populations: limited basic services, such as water and streetlighting; the central role of women in food provision; market access and mobility challenges; and the effect of high and volatile prices.

"Our work led to the development of a user-friendly tool based on past and present data to predict the future nutritional impact of crop production, using mango in Côte d'Ivoire as an example."

Dr Turner said: 'The findings from this project highlight the diverse drivers of food acquisition and consumption practices in urban settings. One of the most interesting and novel findings from this study was

Fish drying on racks in Ziguinchor Region, Senegal

importance that participants placed on urban infrastructure and service challenges, particularly in relation to mobility challenges, which were exacerbated during the rainy season. These findings reinforce the reality that food environments are an integral part of the wider built environment, and that improving access to fruits and vegetables in urban settings such as Ziguinchor requires holistic multi-sectoral systems-orientated governance and interventions at the city level, beyond what might typically be considered within the realm of public health nutrition.'

Meanwhile, in Korhogo, Côte d'Ivoire, another part of the SAFOODS story was taking shape, this time with mangoes, a popular seasonal fruit rich in essential micronutrients, widely produced in the north of the country (Korhogo area). However, nutritional flows across value chains and their resulting nutritional impact are poorly understood. During her time at NRI, researcher Dr Aurélie Bechoff applied the NUTRI-P-LOSS methodology to assess nutritional flows in the mango value chain. NUTRI-P-LOSS is an innovative approach co-developed by Dr Bechoff, that predicts nutritional postharvest losses across crop value chains.

Her findings showed that the domestic nutritional contribution of mango is likely to increase in future, helping to address vitamin A and C deficiencies and anaemia-related issues. These issues remain prevalent, particularly among vulnerable groups such as children under five and women of reproductive age. Dr Bechoff noted, 'Our work led to the development of a user-friendly tool based on past and present data to predict the future nutritional impact of crop production, using mango in Côte d'Ivoire as an example.'

Strengthening African FOOD Systems in the face of climate change and food insecurity (SAFOODS) is a multi-country project that aims to tackle the dual challenges of food and nutrition security and climate change adaptation in West Africa. It focuses on fruit and vegetable food systems of tomatoes, mangoes, green beans and spinach, which are crucial for nutrition in several cities across Senegal and Côte d'Ivoire but vulnerable to the impacts of climate change. The project aims to enhance the resilience of these food systems by developing effective adaptation strategies. SAFOODS is coordinated by CIRAD (France) and co-implemented with ISRA-BAME (Senegal), Université Nangui Abrogoua (Côte d'Ivoire), and NRI.

Partners and funders

SAFOODS is funded by national donors from the participating countries through the European Commission's Food Systems and Climate (FOSC) programme.

Mango tree branch with ripe fruit

Wild meat, food safety and the right to food

Delia Grace Randolph

Wild meat is vital to diets and livelihoods, providing essential nutrition and economic sustenance for many communities, particularly in Africa and Asia. However, the COVID-19 pandemic brought the fragile balance between humans and nature into sharp focus, sparking calls to halt wild meat trade and consumption to protect public health and biodiversity.

A landmark report, 'Eating Wild Animals: Rewards, Risks and Recommendations' led by Delia Grace, Professor of Food Safety Systems at NRI, delves into the complex world of wild meat hunting, consumption and trade, revealing the risks and opportunities of this intricate issue.

Launched at the 8th World One Health Congress in September 2024, the report explores wild meat consumption and its associated value chains from hunting to harvesting, marketing and consumption. It also examines the implications of eating wild meat for human nutrition and the risk of zoonotic disease emergence and spread from this practice.

The authors acknowledge the intrinsic risks of wild meat consumption and recommend ways to reshape the wild meat trade to maintain its benefits to millions of mostly poor communities while preserving biodiversity and minimising inherent risks.

A vital source of nutrition

Roughly 400 million people depend on wild meat across sub-Saharan Africa and East and Southeast Asia. It is vital for their nutritional needs and an essential source of calories, protein, fat and micronutrients for which there is no readily available substitute.

The authors argue that a ban on wild meat hunting, trade and consumption would be impossible, even immoral, to enforce considering the benefits wild meat provides to millions of mostly poor populations.

The report reveals that wildlife and wild fish provide at least 20% of animal protein in rural household diets in at least 62 countries and at least 15 countries, mostly in Africa, would risk food insecurity if wild meat were excluded from diets.

The ugly side of wild meat

Wild meat consumption is a significant and direct contributor to the spread of neglected endemic zoonotic diseases and the emergence of new illnesses from animals. The report notes that over 91 disease spillover events, resulting in 25 different zoonotic disease outbreaks, have been documented in connection with eating wild meat.

However, wild meat consumption may not be as significant a pathway for disease spillover as exposure to animal fluids and excrement during the handling of wild animals. This makes

Wildmeat on sale at a market in the Democratic Republic of Congo

A woman preparing bush meat for a meal in the Democratic Republic of Congo

strategies to address the safety of wild meat during handling and consumption particularly vital. Interventions at this point could also ensure that wild animals are handled in ways that minimise suffering and distress.

Another risk is from the biodiversity loss due to changes to ecosystems that make them less able to support life. Sustainable harvesting of wild animals must be ecologically sound. The report outlines strategies and research priorities to minimise the risks associated with wild meat production and consumption and promote a safer, more sustainable future.

A new approach to wild meat value chain management

The authors recommend a novel approach dubbed 'Eco-Epi-Well-Wel'. This approach integrates four key pillars: enhancing ecological health, mitigating epidemiological risks for humans and animals, fostering human wellbeing, and promoting the welfare of wild and domestic animals.

Professor Delia Grace said: 'Eating meat from wild animals has many complicated aspects but is too often addressed by groups with one point of view. A more holistic management allows better and fairer solutions. For example, awareness campaigns in local hunting communities should follow such an integrated approach; emphasising the importance of limiting hunting to certain robust species, encouraging alternative or supplementary sources of protein whenever possible, and, crucially, raising awareness of the zoonotic risks associated with the wild meat trade and how they can be mitigated.'

However, given the substantial lack of awareness of zoonotic hazards associated with wild meat and of best practices for mitigating risks in many hunting communities, the report calls for research to understand the sources of zoonotic risk knowledge and drivers of behaviour. This should be followed by piloting and evaluating the effectiveness of targeted social marketing campaigns.

"Roughly 400 million people depend on wild meat across sub-Saharan Africa and East and Southeast Asia."

The report's recommendations will require the consideration of social, economic, and environmental factors, making a collaborative One Health approach essential. The One Health approach highlights the interconnectedness of human, animal, and environmental health.

Additionally, the report stresses the importance of a community-based approach to the sustainable management of wild meat resources. This is because most zoonotic risks occur at community level where most wildlife hunting and butchering occurs. In this approach, local communities need to be part of decision-making and be responsible for managing wildlife practices, given their proximity to wildlife populations, their intimate knowledge of local wildlife, and their wildlife use practices.

This report not only reinforces the universal right to safe and healthy food for all but also lays a practical roadmap for safeguarding human health, promoting the welfare of wild animals, and preserving the delicate balance of the ecosystems they call home. It will be a valuable resource for policymakers, researchers, and development practitioners in the health, veterinary, environment and wildlife sectors.

Food accelerator roadshow: driving international food innovation and entrepreneurship

Valerie Pondaven

Some of the biggest obstacles to growth for early-stage innovators and entrepreneurs in the food and drink industry are the lack of support for business and technical skills development, and affordable, open-access research and development facilities. The Food Accelerator Programme, a pioneering initiative led by NRI is helping address this challenge to facilitate food innovation and entrepreneurship locally and internationally.

In 2024, the Food Accelerator launched the Food Accelerator Roadshow – an initiative to broaden access to NRI's R&D facilities to a wider network of stakeholders and discover new prospects to apply our research in food formulation, chemistry, nutrition and food science. In partnership with the Tony Blair Institute for Global Change (TBI), five Rwandan food businesses were selected from TBI's food business accelerator pipeline of over 100 small and medium food enterprises from across Africa. This project aimed to enhance their products' sustainability, quality, and safety while helping them explore opportunities in the UK food and drink sector.

The businesses were awarded business innovation vouchers to address their specific innovation challenges by drawing on the expertise and technical capacity at NRI and the cutting-edge Medway Food Innovation Centre (MFIC). Through this initiative, they received dedicated business and technical support, training, tools, mentoring and networking opportunities, and access to the MFIC. All costs were covered by their innovation vouchers.

As part of the Roadshow, owners of the selected businesses visited MFIC to identify opportunities for support and interact with NRI food scientists. These interactions helped lay the foundation for tailored support from NRI experts by providing a platform to discuss the challenges the businesses were facing. Discussions centred on food standards, cost-effective product development, ingredient and product storage, and shelf life, as well as product value addition and fortification, and waste valorisation, among other topics.

Professor Nazanin Zand, head of the Food and Markets Department at NRI, said:

'Supporting these entrepreneurs is about much more than refining individual products, it's about strengthening food systems. Many of them are already producing high-quality products, but face challenges such as meeting safety standards, reducing waste, or scaling up sustainably. We work with them understand their products, optimise processes, and explore new value-addition opportunities. This empowers them to innovate and compete confidently in regional and global markets.'

The businesses were assisted to develop action plans for process and product improvement in line with the project goal. One of the enterprises, Zatoms Ltd, is implementing a plan to valorise waste from their avocado oil business to make cosmetic products while Ballistic Burgers developed a new plant-based burger recipe. Ishyo Foods is exploring ways to use waste from their yoghurt business to make cheese. Incuti Foods is working on improving the flavours, safety and quality of their chilli sauces, whereas ZEAN Ltd is exploring waste valorisation in their banana chips business.

Some of the products developed by one of the food businesses that participated in the roadshow

"NRI's support has significantly improved our production method for banana chips. We reduced energy consumption and improved the quality of our chips by optimising our processing temperature, and minimised waste by reducing their oxidation potential."

During their visit, the entrepreneurs were introduced to UK food and drink companies, public bodies and various service providers, creating vital connections that could enhance their prospects in the competitive UK market. They also attended the International Food Expo and several networking events, gaining critical exposure to potential collaborators and opportunities to market their products. This exposure provided business and market insights into new technologies and consumer demands which have since led some of the businesses to adapt their production processes to gain a competitive edge in local and international markets. Additionally, the businesses received Hazard Analysis and Critical Control Point (HACCP) training, which is vital for food safety standards, enabling the businesses meet international regulations.

Sharon Akanyana, Managing Director, Ishyo Foods said: 'Participating in the visit to the UK and University of Greenwich has been great. We not only explored innovative ways to extend the shelf life of our milk drinks but also discovered how to turn dairy by-products into value-added products. The exposure to UK industry practices and food safety training has positioned us to be more confident about selling in international markets.'

One of the business owners interacting with NRI staff during the programme

'NRI's support has significantly improved our production method for banana chips. We reduced energy consumption and improved the quality of our chips by optimising our processing temperature, and minimised waste by reducing their oxidation potential. Seeing other innovative products using bananas at the International Food Expo opened exciting new possibilities,' noted Enode Nduwayezu, Managing Director of Zone des Entreprises Agricole (ZEAN LTD).

This initiative helped foster transnational partnerships, promoting collaborative growth and innovation. Through such projects, NRI is catalysing industry-leading innovation to transform the food and drink sector in the UK and abroad.

Partners and funders

The Food Accelerator Roadshow was funded through the International Science Partnerships Fund.

The food entrepreneurs on a tour of the Medway Food Innovation Centre

Climate and conflict

Livestock diversification mitigates the impact of farmer-herder conflicts on animal-source food consumption in Nigeria

Olusegun Fadare

In the heart of West and Central Africa, a persistent struggle over water and land resources is reshaping rural life and intensifying social and economic pressures. The resultant widespread tensions between farmers and herders have escalated in recent decades, fuelled in part by environmental changes. Nowhere is this crisis more acute than in Nigeria's Middle Belt region. The region, characterised by rich arable lands and vibrant livestock farming, has become a flashpoint of violent clashes between nomadic Fulani herders and sedentary farming communities. Statistics show farmer-herder conflict incidents surged from approximately 25 events in 2010, to 425 in 2018, resulting in over 2,700 fatalities.

As these conflicts persist, leading to loss of life, property destruction, and significant disruption to rural livelihoods, research has revealed a more insidious cost: the impact on household nutrition and child development.

In a study published in the Food Policy Journal, researchers from NRI and the University of Reading investigated how these conflicts are affecting the diets of farming households. The study found that farmer-herder conflicts significantly reduce household consumption of animal-source foods such as milk, meat, and eggs. However, households that diversified their livestock holdings – including cows, sheep, goats, chickens, and other small animals – experienced a sustained level of consumption compared to households relying on only a single type of livestock. The study also highlighted the critical role seasonality in farming and herding activities plays in escalating the conflicts. Farmer-herder conflict follows seasonal patterns, peaking during the height of the dry season when competition for resources is most acute, and declining with the onset of the dry season.

'Livestock diversity is emerging as not just a resilience strategy, but a lifeline,' said Dr. Olusegun Fadare, who led the research. "When violence disrupts access to food and markets, having multiple livestock types provides both a nutritional and economic buffer.'

Animal-source foods are among the richest sources of micronutrients critical for women of childbearing age and for optimal child development. Reduced intake of these nutrients could have long-term negative consequences on early childhood growth and development.

Several important policy insights and recommendations emerge from this research. Firstly, keeping diverse livestock types enables households to maintain diets rich in animal protein, even in conflict situations, providing evidence for policies that support livestock diversification as a strategy to mitigate the impact of conflict. Secondly, cattle may not be ideal as relief material in conflict settings, given their vulnerability to emaciation and theft. Lastly, households may respond to conflict by either ceasing investments in large livestock or selling them in exchange for smaller livestock, which are less vulnerable to conflict-related risks.

Cattle herding in a water-scarce environment

Yet, for many families, this transition may reduce household income, as large livestock like cattle are perceived as valuable assets. Reduced income can hinder households' capacity to meet non-food but critical needs for early childhood development such as education, healthcare, and water and sanitation. Dr Fadare said: 'To address this economic trade-off, it is recommended that social protection and safety net programmes be extended to households enduring protracted conflicts. This would enable them to meet essential non-food needs.'

"When violence disrupts access to food and markets, having multiple livestock types provides both a nutritional and economic buffer."

Insights from this research thus illustrate a crucial pathway through which conflict can lead to poor child health outcomes. The study's findings and evidence on livestock diversification as a conflict risk mitigation strategy have been presented to key academic and policy stakeholders, reinforcing the link between peacebuilding and nutrition security.

This study complements a broader NRI-led initiative led by Dr Uche Okpara in Northern Nigeria and the Sahel region aimed at developing lasting community-based conflict resolution mechanisms to address farmer-herder conflicts in Nigeria.

As the region grapples with the twin crises of climate change and persistent conflict, this research offers a hopeful path forward. Supporting livestock diversification and rethinking traditional aid models, offers an opportunity not just to mitigate the impacts of conflict, but to build healthier, more resilient futures for millions across the Sahel.

Partners and funders

This study was conducted with support from the University of Reading.

Small livestock such as goats and sheep are less vulnerable to conflict-related risks

Sustainable value chains

Exploring sustainability challenges in Mongolia's cashmere value chain

John Morton

Mongolia is one of the world's largest producers of cashmere. The country's cashmere industry supports approximately 190,000 herding families, who not only represent the majority of the rural population but are also considered custodians of Mongolia's cultural identity. Cashmere is Mongolia's third-largest export and its most significant non-mineral export. Yet, despite its national importance, little is known about the cashmere value chain in the country.

From June 2023 to September 2024, a team led by NRI's Professor John Morton conducted a multi-disciplinary study of the cashmere value chain in Mongolia. The team confirmed interlocking threats to the cashmere value chain at many levels.

A high-end cashmere product shop in London

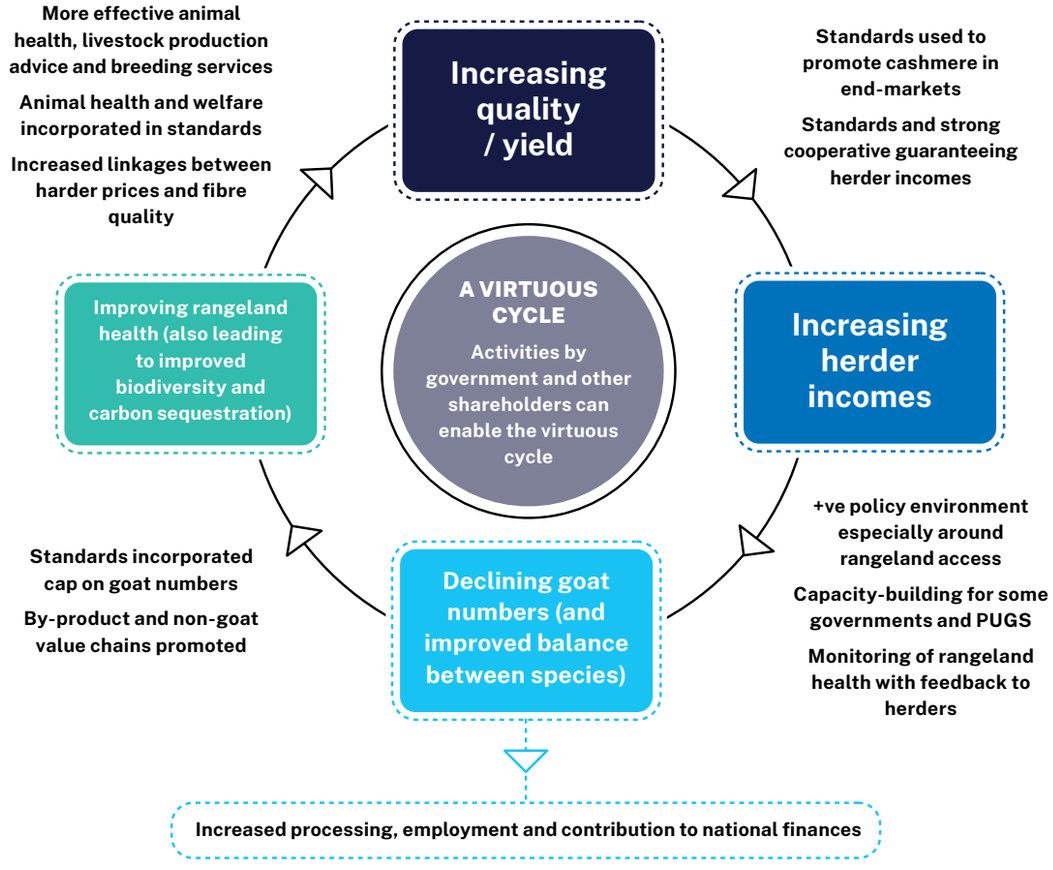
Herders have greatly increased goat numbers in the last two decades, contributing to overgrazing, declining rangeland biodiversity, and a reduction in fibre quality. The study found that herders often need credit to manage their expenses due to the highly seasonal income from cashmere. This financial pressure forces many of them to sell raw cashmere cheaply to middlemen linked to factories in China, resulting in lost opportunities for value addition in Mongolia.

"Currently, a vicious cycle exists: decreasing herder incomes drive increasing goat numbers, which in turn cause declining rangeland health, and a drop in the quality and quantity of fibre, further threatening incomes."

Cashmere, the extremely fine wool obtained from the undercoat of certain goat breeds in environments that experience cold winters, is a fascinating example of a unique commodity. Produced by traditional transhumant herders, who are vulnerable to weather shocks and adverse environmental trends, this wool is traded globally, reaching top-end fashion houses in London, Milan and New York.

Several options have been or could be explored to address the sustainability challenges in Mongolia's cashmere value chain. The government is working to ban the export of raw or semi-processed cashmere to China. Herder cooperatives are another option to try and address these challenges. Although currently the cooperatives serve a minority of herders, they generally have good relations with Mongolian private processing factories, which is helping realise this policy.

Professor John Morton explained: 'Initiatives to certify Mongolian cashmere for export markets, not only on the quality of its fibre but also as the product of sustainable rangeland use, are promising but need harmonisation. The environmental impacts of processing, particularly through water pollution, need both voluntary and regulatory action', he added.



The team's analysis and recommendations emphasise the need to transform Mongolian cashmere production and marketing. These were validated by a multi-stakeholder workshop that brought together herders, government, civil society and the private sector in the capital, Ulaanbaatar. Currently, a vicious cycle exists: decreasing herder incomes drive increasing goat numbers, which in turn cause declining rangeland health, and a drop in the quality and quantity of fibre, further threatening incomes. The goal is to shift to a virtuous cycle of environmentally sustainable and internationally competitive production. This move would require concerted action at multiple levels – livestock services, rangeland monitoring, legislation on rangeland use and capacity building for herders and their representatives – a difficult task but one for which many of the foundations exist.

The team working with Professor Morton comprised Pavel Kotyza of the Czech University of Life Sciences as economist, CIRAD's Mathieu Vigne as environmental specialist and Burmaa Dashbaal as national consultant. For this study, the team visited herders, cooperatives and district-level officials in five provinces in Mongolia. They also visited multiple processing factories and held interviews with a range of stakeholders from government, the private sector, donors, researchers, NGOs and the trade union movement, as well as engaging intensively with existing databases and secondary literature. The study raised awareness of the importance and complexity of the cashmere value chain in Mongolia. Its findings and recommendations were the subject of a lively multi-stakeholder workshop in September 2004, and some have been incorporated in the European Union's cooperation programme for 2024 to 2028.

Partners and funders

This was funded by the European Union through its Value Chain Analysis for Development (VCA4D) programme. VCA4D is managed by Agrinatura (the European Alliance on Agricultural Knowledge for Development) .

A goat and sheep herd in Mongolia

Analysing Value Chains for Development: New Directions

John Morton

Value Chain Analysis for Development (VCA4D) is a programme funded by the EU Directorate for International Partnerships (DG-INTPA), and implemented by Agrinatura, the European Alliance for Agricultural Knowledge for Development. At the request of European Union Delegations in different countries of the Global South, VCA4D conducts studies of selected agricultural commodities, examining the entire value chain from production through transport and processing to final sale or export. For each value chain, studies of the economic, social and environmental aspects (known as "domains") ask:

- Does the value chain contribute to economic growth?
- Is that growth inclusive?
- Is the value chain socially sustainable (in terms of working conditions, gender equality, food security of producers, etc.)?
- Is the value chain environmentally sustainable (in terms of carbon emissions, other environmental impacts, impacts on biodiversity)?

As well as providing a 5-person Project Management Unit in Brussels, NRI provides individual staff to participate in VCA4D studies, as economists, social sector specialists, and environmentalists. Since the 2020 NRI Annual Report, VCA4D has moved to a second phase, during which four NRI staff members have contributed to nine new value chain studies listed below.

Since the 2020 NRI Annual Report, VCA4D has entered its second phase, during which NRI staff have contributed to nine new value chain studies. These include social analyses of fish (Tanzania), milk (Burundi), cashmere and pine nut (Mongolia), and poultry (French Pacific territories). They also include economic analyses of coffee and cocoa in Tanzania and Sierra Leone, and an environmental analysis of the cocoa value chain in Sierra Leone.

Phase II has seen VCA4D evolve in several new directions. NRI staff were involved in each of the examples described below.

Geographical reach: the new studies have included for the first time EU accession candidates (e.g. Moldova wheat, maize and sunflower), and another post-socialist country, Mongolia, where VCA4D studies of cashmere and pinenuts were conducted. It has also included one of the EU's Overseas Countries and Territories, the French Pacific Territories, for a study on poultry. There has also been an increased emphasis on Francophone Africa, including studies on the milk value chain in Burundi and groundnuts in Madagascar.

A farmer harvesting a cocoa pod

New models for VCA4D studies: phase I studies were implemented by a team of three international specialists, covering respectively the economic, social and environmental domains, assisted by a national consultant working across all three domains. Some Phase II studies have expanded this model. In Burundi, additional bilateral EU funds were leveraged to mobilise a national consultant for each domain, and allow for large-scale primary data collection. Two of those national consultants have gone on to work as international team members in other countries. In Moldova, national consultants were also mobilised for each domain, working with three international specialists and additional resource people to study the wheat value chain. The national consultants then went on independently to produce further studies of maize and sunflower.

Enhanced dissemination: VCA4D has organised five workshops in Phase II, (Nigeria - maize, Tanzania – fish, coffee, Burundi – milk, Mongolia – cashmere) to encourage discussion of the findings, engaging not only EU representatives and government agencies but also farmers, herders, the private sector, civil society and NGOs, banks, and other donors.

A fisherman carrying fish in Tanzania

Synthesis studies: in 2022, VCA4D commissioned a number of synthesis studies, comparing VCA4D findings on specific issues across value chains and across countries. Seven NRI staff co-authored six papers covering land tenure, livestock, private investment, productivity improvements for staple food crops, food processing, and agroecology. These studies were then presented at a specially organised workshop in Brussels in January 2023, and some are being adapted for publication in academic journals. For example, the study on context, governance and risk in beef value chains in Eswatini and Zimbabwe was published in Review of Agricultural, Food and Environmental Studies, 2025.

Training materials: VCA4D has prioritised the drafting of materials for training prospective international and national consultants in methods for studying the three domains. In March 2025, four social sector specialists, including an NRI's Professor John Morton, participated in a week-long workshop to generate training materials for the three domains. NRI staff have also received training in AFA, the software used in VCA4D economic analyses. The VCA4D management team has commissioned animated videos to introduce the programme, its objectives and methodologies, and a "serious game" to demonstrate the usefulness of VCA4D studies to policy makers.

At the time of writing, Agrinatura is waiting for approval of its proposals for VCA4D Phase III. Phase III is designed to further strengthen a pool of expertise on the three domains, pilot the use of different combinations of national and international consultants, and increase the dissemination and impact of VCA4D findings.

Unequal exchanges: The hidden environmental cost of global trade agreements

Truly Santika Rintanen

International trade has long been recognised as a cornerstone of global prosperity, a catalyst for innovation, and a pathway to sustainable development. But a groundbreaking global study by NRI researchers reveals a more complex and troubling story, that beneath 'the promise of growth lies a vast, hidden system of ecological inequality.

The study offers the most comprehensive global analysis to date of how Regional Trade Agreements (RTAs), the bilateral and multilateral deals designed to reduce trade barriers, are reshaping the planet's use of natural resources.

Covering nearly three decades (1990–2018) and 195 countries, the research provides a rare, multidimensional analysis of the environmental footprints associated with trade across multiple dimensions simultaneously, including energy, raw materials, water and land use. The study was unique not only because of its scope but also its innovative methodology. Using data from the cutting-edge GLORIA resource-tracking database and a counterfactual analysis framework rarely applied to trade research, the researchers isolated the true environmental impact of trade agreements and tested whether the environmental provisions included in these deals actually work.

'The findings are striking,' said Truly Santika, Associate Professor in Environmental Geography at NRI and lead author of the study published in Global Environmental Change. 'The study exposes a systemic imbalance in global trade, where wealthier nations effectively outsource the environmental costs of their consumption to poorer countries.' Put differently, rich economies import resource-intensive goods produced abroad, such as metals, textiles and agricultural products, allowing them to preserve their own environments while shifting pollution, habitat destruction and resource depletion onto their less affluent partners.

This dynamic, known as "ecologically unequal exchange," underscores how global trade reinforces patterns of inequality, not only economically but also ecologically. Earlier research shows that over 10 billion tons of raw materials, worth roughly $10 trillion, are extracted each year from poorer nations to satisfy the consumption demands

Oil palm plantation workers unloading a truck

in wealthy countries, an amount that dwarfs global foreign aid. This study adds unprecedented empirical depth to that picture, showing that RTAs accelerate these unequal resource flows, enabling affluent countries to maintain high levels of consumption while projecting an illusion of sustainability at home.

Crucially, the research also evaluates the real-world effectiveness of environmental clauses embedded in trade deals. The results show that while such provisions can temporarily reduce some resource imports, their impact fades within two years and often proves negligible, or even counterproductive, for key resources like energy, water and land. Weak enforcement, vague obligations and strong market pressures to sidestep rules, all contribute to this shortfall.

‘These findings challenge the dominant narrative that trade liberalisation can deliver green growth,’ said Valerie Nelson, Professor of Sustainability and Political Ecology at NRI, and co-author of the study. ‘If we are serious about sustainability, we must confront the material limits of our planet and design trade systems that reflect ecological reality and fairness.’

The researchers call for a fundamental rethink of global trade governance, not toward protectionism, but toward ecological justice. They advocate embedding resource accountability and equity mechanisms directly into trade and financial systems, ensuring that economic integration aligns with planetary boundaries and social equity. As nations race to meet climate and biodiversity goals, this study offers timely and transformative insights whereby true sustainability in trade requires more than “greener” policies; it demands a rebalancing of who bears the environmental cost of prosperity.

Partners and funders

This research was part of the TC4BE (Transformative Change for Biodiversity and Equity) project supported by the EU’s Horizon Europe Programme. Some funding was also received from UK Research Councils ESRC, NERC, and BBSRC, the British Academy, and the UKRI Expanding Excellence in England (E3) program through NRI’s Food and Nutrition Security Initiative (FaNSI). Environmental Policy Analyst Duncan Brack also contributed to this work.

A cargo ship. An NRI-led study found that global trade reinforces ecological inequality.

Research-led teaching

Hands-on learning programmes at NRI: nurturing the workforce of the future

Claire Coote and Richard Fuchs

Student success is the first of four strategic priorities at the University of Greenwich and NRI, and achieving the best graduate outcomes is a key aim of our teaching programmes.

Recognising the importance of hands-on industry skills, NRI has launched three programmes with industrial practice. This highlights our commitment to equip our students with essential skills for the future. They receive both academic knowledge, relevant skills and practical experience equipping them for their future careers.

The MSc Applied Food Safety and Quality Management with Industrial Practice, and MSc Food Innovation with Industrial Practice both started in 2020 with the students starting their placements in November 2021. The MSc Global Environmental Change with Industrial Practice launched in January 2025, expanded our range of hands-on teaching programmes. Students complete the taught MSc requirements then spend up to one year working with an appropriate company. Students on NRI's food and IP programmes have attracted significant interest from a growing portfolio of employers who recognise the quality of our postgraduate students.

We have partnered with Step Recruitment, a leading provider of paid student internships and placements. Step provide our food programme students with coaching on how to secure placements before the students start their industrial practice. More recently we have started working with the Twin Group who support our environmental students with similar skills and help to identify and secure placements.

"These examples highlight the range of opportunities available to NRI students and the versatility of our teaching programmes in providing them with the necessary grounding for success after graduation."

Through these programmes, we provide our students with practical work experience and guide them towards potential career paths. This arrangement also supports businesses and strengthens connections between NRI and the local and national economy.

Since our first placements in 2021 we have had a growing number of students going on industrial placements at food companies across the country. Between November 2023 and May 2024, 37 students were placed at 25 different companies in England and Northern Ireland. Below, we briefly profile some of

Students conducting experiments in a greenhouse at NRI

NRI's Conor Walsh (L) conducting a field study with students

these companies and the roles our students have performed there.

Oddbox, a food delivery company, based in Birmingham, have offered full-time permanent roles to the two students they have hosted so far. Students work in quality assurance and are part of a small, supportive team that puts customer satisfaction, efficiency and sustainability at the centre of what they do.

Bennett Opie Ltd, a Sittingbourne-based food manufacturer and distributor specialising in pickles, preserves and cocktail garnishes currently employs two placement students. Additionally, a former NRI placement student now works there as a Quality Assurance Technologist.

Dartford-based PrepWorld provides high quality fresh cut fruit packs to many of the UK's largest supermarket chains. They have hosted several students to fill quality assurance and new product development positions.

Biscuiteers, an award-winning, luxury gifting brand, based in Colliers Wood, South London, produces and designs bespoke biscuits. They have frequently employed January entrance students in spring and summer. Biscuiteers have so far taken nine students from two January cohorts.

Northampton-based TMI Foods focus on pre-cooked bacon production but have expanded into a diverse range of innovative on-trend plant-based and vegetarian options. They have given our students opportunities to work in several interesting roles for their placements, including as a quality assurance supervisor, science and innovation co-ordinator, and as a technical compliance technologist.

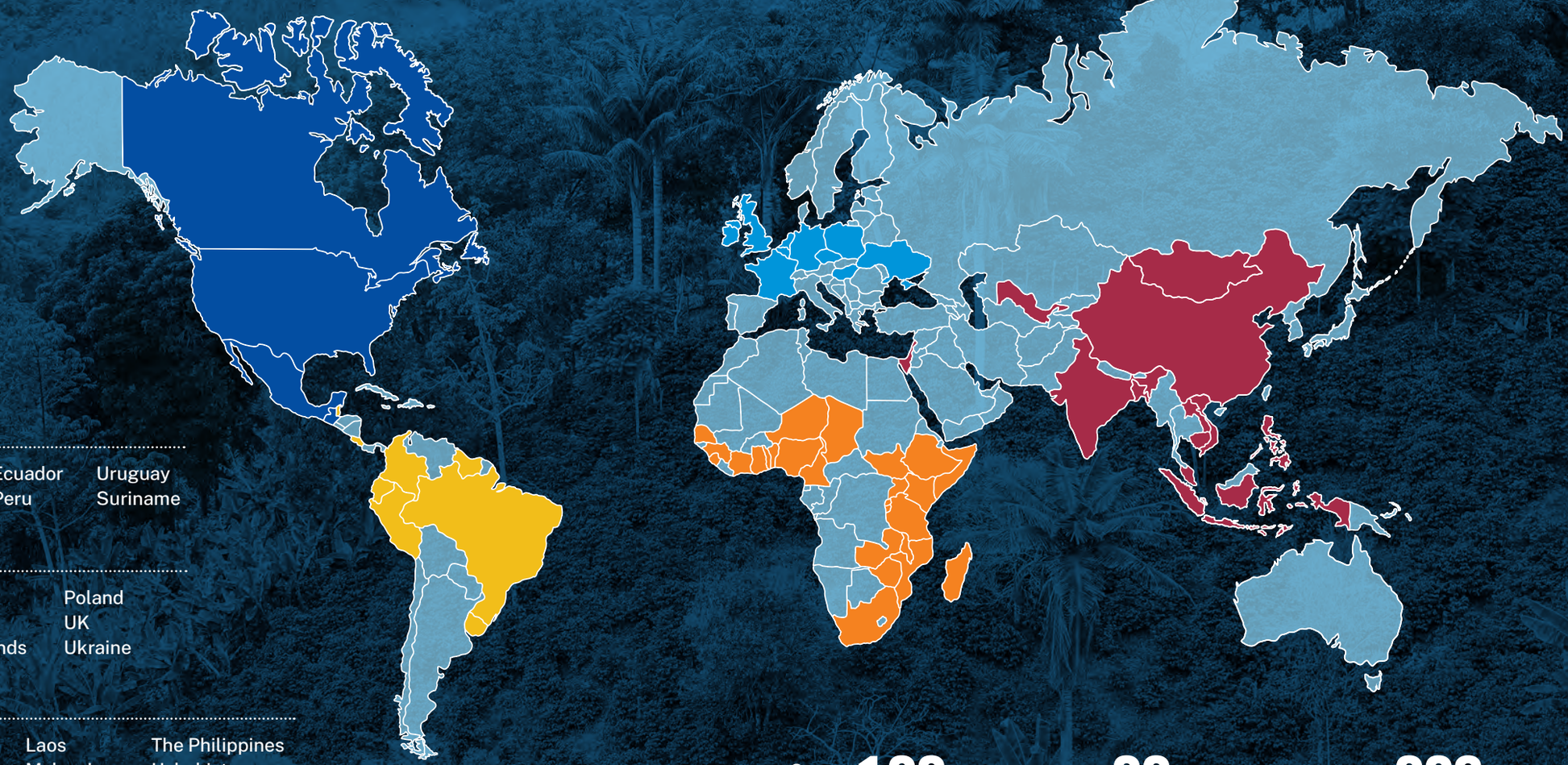
Harjot Nagpal, who studied on the MSc Food Innovation programme, joined The Bread Factory, an artisanal bread company in Hendon as a product developer and was later promoted to a Product and Process Technologist. 'My Placement at The Bread Factory was above and beyond my expectations. The company has an excellent work culture and a team of people that were always willing to support me', she said.

Rounak Manoj, a Food Innovation graduate, secured his placement at Pieminister in Bristol – a B Corp-certified company renowned for its award-winning pies – through an opportunity identified by Step Recruitment. This success demonstrates the strong collaboration between Step and NRI. Starting as a Quality Assistant, Rounak was promoted to Junior Stock Controller within six months. Reflecting on his experience, he said: 'I was happy to secure a placement like this. Pieminister was the perfect place to work.' A member of the Pieminister team added: 'It has been great having our placement student. He has definitely added value to the team and business through his experience and learned knowledge.'

Across other leading food companies, the story is similar. At Mondelez International, one of the world's largest snack producers, a team member noted that their NRI placement student 'has allowed the quality control team to keep up with demand of business with two increases in production seen while she has been part of the team.' At GU Indulgent Foods, another colleague remarked: 'Our placement student quickly exceeded the capability of the previous role holder and has made the role her own... she is a valued member of our team.'

These examples highlight the range of opportunities available to NRI students and the versatility of our teaching programmes in providing them with the necessary grounding for success after graduation.

NRI at a glance
(2025)



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