



Frontiers
seed funding:
Understanding
zero-waste
protein
systems

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Project

Multi-scale zero-waste smart protein

Awardee:

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Project collaborators:

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Overview

This 12-month project led by Miao Guo, in partnership with collaborators from the UK, Indonesia, Peru and Madagascar, created a consortium to address global protein deficiency challenges. As a result, the project improves the experts' understanding of zero-waste protein systems and the global distribution of food and waste-to-protein technology.



Challenge

A person is undernourished when they do not have access to enough food or nutrients needed for growth and health. Undernutrition is a global issue, with 768 million people undernourished worldwide in 2021. More than half of undernourished people live in Asia and one-third in Africa. This need for adequate nutrition has put pressure on food supply chains to increase production of protein. While plant-sourced protein presently dominates the market, there is an estimated increase in demand for animal-sourced protein of up to 90% by 2050, resulting in grave implications for land and water use.

With a background in academia, Miao worked at Imperial College London for over a decade in engineering. Her work on bio-proteins connected her with the Frontiers symposium via a colleague, alongside 20 other academics from the UK. At the symposium, she collaborated with participants from across the world in discussions on nutrition and food.

“Although we work in different fields, we found core main interests in zero waste proteins and low carbon sustainable proteins for the future.”

Miao Guo, Kings College London

Project solution

Against this backdrop, Miao brought together a team from the UK, Madagascar, Indonesia, and Peru to create a consortium for next-stage transformative research. The programme was made up of four stages.



During the first stage, the team conducted stakeholder mapping across three protein value chains to analyse local perceptions of novel protein (protein that comes from less-mainstream food animals) and waste-derived feed protein (protein that comes from animal by-products.). Then, they set up a platform to engage community groups involved in the protein value chains and scope out and refine existing research on region-specific multi-scale protein systems.

Next, the consortium mapped out potential waste resources which could be used for ‘multi-scale zero-waste protein systems’, meaning, systems where protein supply does not go to waste, given the increasing demand on the protein market. Through this analysis, the consortium developed a fundamental understanding of the protein supply and demand challenges in Africa and Southeast Asia. In particular, the resource distribution was mapped out and the protein supply-demand capacity was explored at the regional and national level.

Subsequently then, the team evaluated existing multi-scale protein technology to identify potential zero-waste protein systems. During this stage of the project, three protein systems

were examined: insect protein, microbial protein – typically produced by bacteria, or algae – and waste-derived feed protein. The team also screened existing technologies, developed a database, and analysed existing zero-waste solutions.

These project components concluded with the formation of the planned consortium. During the final stage, consisting of Miao Guo and four other project collaborators from the UK, Indonesia, Peru, and Madagascar. The network gained 30 members in Latin America, plus more than 20 from Southeast Asia. The consortium was also helpful in facilitating their application for the Frontiers Follow-On Grant application. Workshops and discussion groups were facilitated to build up the network.



“Do something to break out of the boundaries of countries. Our work should benefit human beings and wider communities and across borders in multiple countries.”

Miao Guo, Kings College London

Impacts

Establishing the consortium led to a new conceptual understanding of multi-scale zero-waste protein systems. It also helped researchers to better understand the global distribution of food or feed-grade waste resources and waste-to-protein technology. The team's research was compiled into a manuscript 'Zero-Waste Protein: A sustainable solution for hunger pandemics' and was submitted to a high-profile journal.

Other impacts included rescoping a cross-country learning platform and building scientific evidence on global resource potential for sustainable new protein solutions. In addition, new insights and analyses were brought to light on sustainable solutions to global protein security.



Lessons learnt

The team identified a number of project-related lessons learned, considering the COVID-19 pandemic as well as navigating the complexities of a consortium. Challenges in the project included travel restrictions, remote working – which resulted in reduced laboratory capacity – and lockdown measures. Engaging with stakeholders virtually and project delays also proved challenging. As a consortium, the team needed to be adaptive to new working patterns and new ways of engaging with stakeholders. They also had to consider how specific COVID-19 regulations in each team member's country may have impacted their ability to work. This was difficult not just due to the pandemic, however. Due to the global nature of the project, different regulations across different countries had to be kept in mind.

Another learning involved the hurdles faced when submitting papers to prestigious academic journals – part of the process and an important lesson. However, Miao and her team found that hard work and persistency helped them achieve their aims. While their submission to the Nature Journal was rejected, however was ultimately accepted to The Lancet.

The future

Looking forward, the team intends to take the consortium forward and continue to address global challenges to secure and resilient food systems. To continue their collaborative research efforts, the team aims to secure a research grant. Though undernutrition is a widespread problem, projects such as these aim to bridge the gaps.

Protein has always been a topical subject, but even more so in light of the Food and Agriculture Organization's latest [State of Food Security and Nutrition in the World 2022 report](#). Miao and her team hope to ride this wave of interest and continue to research how to move away from a meat-based diet for a more sustainable future.

“Never let an opportunity go, step out of your comfort zone and share your research and proactively develop collaboration with others.”

Miao Guo, Kings College London



Miao Guo

For more information, including eligibility:
www.raeng.org.uk/frontiers and follow  @RAEngGlobal

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