



Newton Prize 2019





FOREWORD FROM THE CHIEF SCIENTIFIC ADVISER

Professor John Loughhead
CB OBE FREng FTSE FIMechE FIET
Chief Scientific Adviser, Department for Business,
Energy and Industrial Strategy (BEIS)

Science, research and innovation are playing a major role in delivering the Sustainable Development Goals. In recent decades research breakthroughs and transformative innovations have improved the health of millions of people, helped make the world a better place for women, and delivered real progress in our fight against climate change.

But progress is too slow, and we must push even harder if we are to achieve the 2030 Global Goals. The inspiring and defining feature of the Newton Fund is its internationalism, with partners from different countries bringing their expertise and local knowledge to bear on problems that require collective action.



Department for
Business, Energy
& Industrial Strategy

This year's Prize countries are China, Indonesia and the Philippines. From the outset of the fund in 2014, mutually beneficial relationships have evolved between the UK research and innovation community and their counterparts in all three countries based on shared objectives, meaning that no two partnerships are the same. This diversity is one of our strengths.

The work produced through these shortlisted projects demonstrates how efforts to tackle global development challenges can change lives. The innovative solutions showcased here have already had impact on the ground in averting flooding risk, providing energy to rural communities and protecting cities against future threats. As well as making a valuable contribution to global goals, these partnerships also develop new and fruitful networks between researchers and provide vital career opportunities to researchers and innovators from all three partner countries.

If we are to strive for a better and fairer society, then collaborative research and innovation is not a choice but a necessity. That's why in 2019 the Government published the UK's International Research and Innovation Strategy. The strategy puts forward a strategic vision and a framework, showing how the UK will invest in long term international partnerships and collaborations to help meet its own economic and social goals as well as addressing global challenges. The Newton Fund is a great example of what this means in practice.

I would like to congratulate all the researchers highlighted by the Newton Prize but also recognise that in many cases the names here represent extensive teams, each member of which made an incredible contribution.

These inspiring projects demonstrate what can be achieved when we work together in partnership for the global good.



Professor Alice Gast FREng
Imperial College London President
Newton Prize Committee Chair

FOREWORD FROM THE NEWTON PRIZE COMMITTEE CHAIR

I am delighted to present the awards celebrating the very best of this prestigious international programme that creates partnerships and sustains so much impactful work.

I have visited many research institutions across the globe and am impressed by the way meeting fellow researchers naturally sparks friendships, a sense of common purpose and meaningful collaborations. Working together across borders produces research and innovation making a profound difference to people's lives and bringing lasting and positive change.

The Newton Fund is a brilliant example of this in action, as it provides the support to bring researchers from the UK and countries around the world together to work on a broad range of important topics such as: enhancing staple food crops, eradicating avian diseases, pioneering science for the treatment of asthma and creating infrastructure to cope with natural disasters. The Newton Prize furthers this ambition by providing additional support to the strongest collaborations and best

ideas so that researchers can ensure their work influences society, locally and globally. These prizes not only advance the research and translation agenda, they also provide important capacity building so that after a collaboration, each partner has the team and community to extend the benefits of their work.

Over 150 applications reflecting the full spectrum of Newton Fund work made selecting the winners a challenge. I am grateful for the knowledge, wisdom and expertise of my fellow committee members, from the UK and China, Indonesia and the Philippines. Thank you to all involved for their hard work.

I'm pleased to include a special Chair's Award this year recognising the broader partnerships arising from the Newton Fund. Collaboration across boundaries is so important as the complex, grand challenges facing the world need integrated international teams. Advancing society is a unifying mission for us all.

INTRODUCTION

The Newton Fund builds research and innovation partnerships with 17 active partner countries to support their economic development and social welfare, and to increase research and innovation capacity for long-term sustainable and equitable growth. It tackles global challenges such as malaria, antimicrobial resistance and climate change; addressing areas of critical importance for humanity and the planet.

The total budgeted UK investment for the Newton Fund is £735 million from 2014 to 2021, and partner countries provide matched resources within the fund, making it a truly equitable partnership. It is managed by the UK Department for Business, Energy and Industrial Strategy (BEIS) and delivered in the UK through seven UK delivery partners.

The Newton Prize

The Newton Prize is a £1 million fund which celebrates the exciting research and innovation the Newton Fund has supported since its launch in 2014. It is designed to enable international research partners to continue working together on solutions to some of the world's key challenges.

Each year, from 2017 until 2021, outstanding Newton funded projects, fellowships or other awards will win the Newton Prize to advance or develop existing Newton funded work. The Prize will be awarded for the best research or innovation that promotes economic development and social welfare.

In 2019, the Newton Prize is for projects, fellowships or other awards as part of Newton Fund partnerships with China, Indonesia and the Philippines.

Three prizes of up to £200,000 each will be awarded to a project with each prize country that demonstrates high quality research and impact, and an additional prize (the Chair's Award) of up to £500,000 will be awarded for a project that also demonstrates the best knowledge exchange and partnership development.

Research and innovation is a highly effective way to achieve international development goals and improve quality of life for people in developing countries as well as the UK. The Newton Fund supports the United Nations 2030 Agenda for Sustainable Development and the shortlisted projects each tackle one or more of the Global Goals.

SUSTAINABLE DEVELOPMENT GOALS



CHINA

“The Newton Fund brings together the best UK and Chinese scientists to tackle global challenges and to achieve the UN’s Sustainable Development Goals.”

Dame Barbara Woodward,
HM Ambassador to the
People’s Republic of China

Over **980** individual partnerships supported by the UK and China since 2014

A NEW GENERATION OF SOLAR PANELS TO REDUCE FOSSIL FUEL CONSUMPTION

Solar energy has huge potential to reduce our reliance on polluting fossil fuels and support sustainable global development. For rural communities even access to a small amount of electricity could lead to life-saving improvements in agricultural productivity, health, education, communications and access to clean water. However solar panel systems can be expensive, inefficient and short-lived, restricting their wider application and hampering progress needed to deliver development goals.

This UK-China research and development project has paved the way for a new generation of efficient, low cost, solar panel

systems that make effective use of solar energy for heating, hot water and electricity.

The team behind the project has made several technological breakthroughs such as a 55 percent higher heat transport capacity, 20 percent higher solar efficiency than in similar systems, improved quality, and a better control system.

These solar panels have been installed in 150 rural houses in China as well as a number of thriving businesses. Over 1,000 students in the UK and China have been taught how to use the technology and their new product will be included in International Energy Agency guides which

make it much more likely to influence new design, practice and policy making. The project team has since secured £2 million to develop a low carbon heating system for UK public buildings and the next exciting phase for the team will be the development of commercial systems to take the product to market.



20kW demonstration system, Guangdong
© Xudong Zhao

A high performance solar heat and power system employing the innovative photovoltaic/thermal technology.

Project leads:

Professor Xudong Zhao, University of Hull, UK and Professor Jie Ji, University of Science and Technology of China

Delivery partners:

Innovate UK and Engineering and Physical Sciences Research Council, part of UK Research and Innovation, and the Ministry of Science and Technology, China



The system can maintain a very comfortable and habitable indoor environment. My chimney no longer emits black smoke and the in-house flowers bloom brightly throughout the winter.

Mr Niu of Guihua Village, Lishi City, Shanxi Province, China

A NATURE-BASED SOLUTION TO THE PROBLEM OF CLIMATE CHANGE

Climate change is causing sea levels to rise. Wetlands and reefs provide a natural buffer from the sea, shielding the coastline and low-lying coastal communities from the impact of waves and rising water. However, rapid urbanisation has dramatically reduced natural defences in some countries, increasing people's exposure to the impacts of extreme weather events.

Scientists in the UK, China and the Netherlands have come up with a novel approach to ensure natural defences can once again protect low-lying urban deltas. Using remote sensing, state-of-the-art

biophysical modelling and fieldwork to study the Pearl River Delta, a particularly vulnerable area in southern China, the team examined the resilience of different ecosystems and how much space they need to be effective.

The team have developed new models to assess the potential for re-establishment of mangrove forest on tidal flats. Using the models and knowledge developed during the project, the team have estimated the space needed for mangrove ecosystems to sufficiently reduce storm impacts and ensure safety. The team is working with the Hailing Island National Mangrove Park

to establish new mangroves and construct oyster reefs which help to stabilise the seabed and support wetland restoration.

It is one of the first projects to actively integrate coastal ecosystems into coastal protection schemes in this area, offering an excellent opportunity to study the effectiveness and management of nature-based solutions. This will benefit coastal engineers in the UK and Netherlands, as well as China and the wider international research and coastal engineering community and the results can be applied to other countries in the region with similar coastlines, such as Indonesia and the Philippines.



ANCODE team on Hailing Island, 2018 © Dr Judith Wolf

Applying nature-based coastal defence to the world's largest urban area – from science to practice (ANCODE).

Project leads:

Dr Judith Wolf, National Oceanography Centre, UK and Dr Zhan Hu, School of Marine Science, Sun Yat-sen University

Delivery partners:

Engineering and Physical Sciences Research Council, part of UK Research and Innovation and National Natural Science Foundation of China



This opportunity has facilitated collaboration between China, the Netherlands and the UK, and led to a very exciting and challenging project. Working with local stakeholders and students, and exchanging knowledge and expertise, increases capacity for future work to address climate challenges.

Dr Zhan Hu, Associate Professor, School of Marine Science, Sun Yat-sen University

DESIGNING SUSTAINABLE SERVICES FOR THE NEW URBAN POPULATION

Cities around the world are struggling to meet the challenge of rapid urban expansion and demographic pressures related to ageing populations. In developing countries economic progress places even greater pressure on vital but under-resourced services such as healthcare and transportation.

One of the most pressing challenges in China and the UK is to provide better services for various urban and rural populations and to allow access to essential resources easily and on a sustainable basis.



© iStock

This project has brought together over 40 young researchers in related fields from the UK and China to investigate how to apply big data and service design principles to the difficulties people face in cities, affecting their wellbeing and ability to contribute to society and the economy.

Research led to new service designs for urban populations ranging from improved transportation services using big data, to better access and suitability of core services for the elderly. These interventions have also improved awareness of the needs of marginalised parts of society, and enabled elderly and often poor and

vulnerable people to remain active in the community.



Big data tech © Sheng-feng Qin

Transforming service design and big data technologies into sustainable urbanisation.

Project leads:

Professor Sheng-feng Qin, Northumbria University, UK and Professor Cuixia Ma, Institute of Software, Chinese Academy of Sciences

Delivery partners:

British Council, UK and National Natural Science Foundation of China

Design thinking is a very important method and a tool for solving complex and big systems' problems. Integrating big data analysis and visualisation techniques into smart service design, delivery and assessment is an excellent roadmap towards solutions.

Professor Zhang Weihua, Chief Scientist, Southwest Jiaotong University



A NEW WAY TO MONITOR CROPS FOR GLOBAL FOOD SECURITY

Food production is under threat from a combination of urban development, shrinking space for arable land, groundwater depletion and other challenges, and climate change is exacerbating these pressures. Accurate monitoring of agricultural productivity is essential for both global food security and the livelihoods of low-income rural regions, but current monitoring methods aren't meeting this challenge.

This UK-China research collaboration has pioneered a new approach which has improved accuracy of crop monitoring by ten percent and produced crop yield estimates over large areas at an unprecedented ten metre resolution –

compared to the previous one kilometre resolution estimates. The result is likely to be the most accurate portrait created to date of changing agricultural production in the North China Plain.

Previously researchers used either field surveys and mathematical models or satellite imagery to monitor crops, but both methods have their limitations. The team combined these previously incompatible data sets using new data assimilation techniques to give significantly improved estimates of agricultural productivity.

The project is among the first to make use of data from the new Sentinel and Chinese GF satellites and has fed directly

into agricultural production planning in China, providing more accurate analytics of crop development and responses to different stresses so that more suitable management practices can be deployed.

Besides providing better predictions of crop yield and crop growth, the team is training academics to use the software developed during the project, and the state-of-the-art techniques are already being applied to other countries including Ghana, Argentina and the UK.



Using chlorophyll meter to take samples © Institute of Agricultural Resources and Regional Planning (IARRP)

Regional crop monitoring and assessment with quantitative remote sensing and data assimilation.

Project leads:

Professor Philip Lewis, University College London, UK and Professor Zhongxin Chen, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences

Delivery partners:

Science and Technology Facilities Council, part of UK Research and Innovation and National Natural Science Foundation of China

This project will lead to critical advances in quantitative remote sensing and data assimilation technology, enabling high resolution, high accuracy crop yield predictions that will benefit people both in and outside of China.

Professor Shunlin Liang, University of Maryland



NEW DRUGS TO BEAT CANCERS ENDEMIC IN DEVELOPING COUNTRIES

According to the World Health Organisation, cancer is the second leading cause of death in the world. Nasopharyngeal and lung cancers in particular are endemic in China, Indonesia, Vietnam and wider Southeast Asian countries. Current cancer treatments include surgery, radiotherapy and chemotherapy, but scientists are searching for more effective treatments with fewer and less unpleasant side effects.

Recent findings from this UK-China research collaboration could signal a new era for treatment of not only nasopharyngeal, but also lung cancer, now the leading cause of cancer deaths

in China. The team discovered novel compounds of the rare precious metal iridium, some of which originally arrived on earth 66 million years ago in an asteroid that wiped out the dinosaurs. Researchers discovered that when iridium is attached to albumin, a protein in our blood, it can penetrate into the nucleus of cancer cells and destroy them when blasted with light, leaving healthy cells unharmed.

The research has the potential to significantly reduce the burden of endemic cancers on developing countries, which often lack the resources and infrastructure to fight cancer, as well as benefiting healthcare systems worldwide.

In recognition of the quality and innovation of this research, Dr Zhang has been appointed Associate Professor at Shenzhen University. During her Newton fellowship, Dr Zhang received advanced training from world-leading experts at the University of Warwick which she can now transfer to young researchers at Shenzhen University to speed up the discovery of new anti-cancer compounds.

Novel approaches to the design of multitargeted drugs to treat endemic cancers.

Project leads:

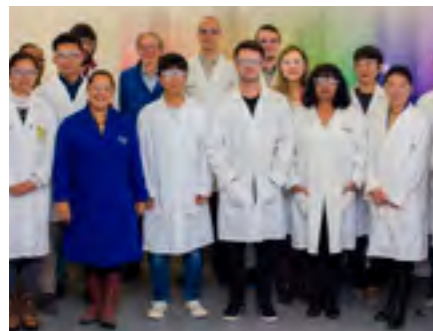
Professor Peter Sadler FRS, University of Warwick, UK and Dr Pingyu Zhang, Shenzhen University, China

Delivery partners:

Royal Society, UK and National Natural Science Foundation of China

Research links established between UK and Chinese academics will lead to lasting collaborations, and also have potential to translate new drugs into the clinic as a UK-China joint development.

Dr Pingyu Zhang, Associate Professor, Shenzhen University



Newton research group
© Professor Peter Sadler



SMART FARMING TO FEED THE WORLD

The world's population is growing and global demand for meat and animal products is set to increase 40 percent over the next decade. China is the second largest poultry producer in the world, but a lack of space for new agricultural land, climate change, disease outbreaks and other challenges all threaten global food supply.

An innovative and user-friendly 'internet of things' platform developed by this team of UK-China researchers could significantly improve and increase productivity of livestock farming for more sustainable food production. Drawing from a wide range of expertise, the team has developed an affordable device that can be worn by farmers to monitor animal welfare and the barn environment.



Poultry farm, China
© Dr Yue Gao



Using artificial intelligence, the device monitors environmental factors such as temperature, noise and pollution so farmers can quickly detect problems and prevent losses. Some farmers involved in the trials have already seen a reduction in feed cost and mortality in their poultry farms as a result of the technology.

The platform is capable of capturing large quantities of data which farmers, industry and governments can use to identify the source of pollution and disease outbreaks, and plan preventative measures in 'at risk' areas. Healthier, happier hens will also lead to better quality meat that is free from disease, protecting public health and improving nutrition.

LIVEQuest: A self-contained wearable internet-of-things system for precision livestock agriculture.

Project leads:

Dr Yue Gao, Queen Mary University of London, UK and Professor Zhixun Xie, Guangxi Veterinary Research Institute, China

Delivery partners:

Innovate UK, Biotechnology and Biological Sciences Research Council and Engineering and Physical Sciences Research Council, all part of UK Research and Innovation, and Ministry of Science and Technology, China

We strongly believe that our solution could have a huge impact on the future of livestock farming, delivering socio-economic and environmental benefits as well as being vital for long term natural resource sustainability.

Dr Yue Gao, Farm AI project lead, Queen Mary's University of London's School of Electronic Engineering and Computer Science

Through the project, thirty new jobs have already been created and ten young researchers and more than thirty farmers have been trained in smart farming technologies. Training allows Chinese smallholders to compete against larger operations, improving their livelihoods. Having built strong partnerships, the team is now planning to develop the technology and extend its impact to neighbouring developing countries and other meat markets.

PROTECTING CITIES AGAINST THE CHALLENGES OF CLIMATE CHANGE AND EXTREME WEATHER

Megacities cover less than 0.2% of the Earth's land area but are home to one person in every ten on the planet (World Meteorological Organisation). Most urban dwellers live in developing countries, often in informal settlements vulnerable to hazards, such as air pollution, heatwaves and flooding. As climate change increases the frequency of environmental hazards, cities must find new ways to adapt to protect the lives of urban populations.

Focusing on Shanghai and Hangzhou in the Yangtze River Delta region in China, this UK-China science collaboration has produced new tools to help urban planners and decision makers assess and mitigate the risks, providing a foundation for



Focus group with experts and decision makers in critical urban areas
© Laixiang Sun

services to support climate and weather resilient economic development and social welfare.

Strong relationships between the project partners and departmental authorities enabled the team to deliver influential policy briefings and work closely with local authorities directly involved in the municipal governments' climate policy making process. The Shanghai Municipal Government has included the team's policy recommendations in its 2017-2035 Master Plan and the implementation planning of the 13th Five Year Plan.

This work enabled Chinese partners to better understand and adopt suitable

UK experiences in climate service and risk assessment related to community, economy, health, large infrastructure and the environment. The project has mobilised academia, research institutes and governmental organisations, providing a successful example of collaboration, information and knowledge sharing across governmental departments in Shanghai and Hangzhou. It has also improved understanding of the changes in the frequency and intensity of extreme events in the future – outputs which can be directly used by other countries in Southeast Asia.

Development of an integrated urban framework for climate services in the Yangtze River Delta region.

Project leads:

Professor Laixiang Sun, SOAS University of London, UK and Professor Peiqun Zhang, National Climate Centre of China Meteorological Administration

Delivery partners:

Met Office, UK, the Chinese Meteorological Administration and the Chinese Academy of Sciences Institute of Atmospheric Physics

International collaboration in climate change research and learning experiences in climate risk mitigation from London and other exemplary cities help us to design effective policies and technical guides to protect our city from the effects of climate change.

Policy Brief of Shanghai Meteorological Service to the Mayor of Shanghai, Nov 2017



THE MISSION TO ERADICATE AVIAN DISEASES

Poultry production improves the lives of many by improving nutrition and providing an effective source of income that can lift people, particularly those living in rural communities, out of poverty. However, diseases such as avian flu can be financially devastating for farmers and can spread to humans globally as pandemics through migratory birds.

The mission of the UK-China Centre of Excellence for Research on Avian Diseases (CERAD) is to serve as a research network to tackle avian diseases in the two countries. Set up in 2015, CERAD began to investigate avian tumour diseases and develop innovative vaccines.

Avian leukosis was a major problem crippling many Chinese poultry farms, particularly in the native breeds of chickens. Drawing from previous experience of eradicating avian leukosis from the UK, the CERAD team provided critical assistance to eradication programmes in China so that direct losses from the disease reduced by £35 million.

Joint research also led to the application of innovative gene editing technologies to develop recombinant vaccines that could simultaneously protect against multiple avian diseases, and the team is currently in talks with commercial companies in China to translate this innovation into vaccines.

Collaborative research between UK and Chinese partners have also resulted in exchange visits of young scientists and doctorate students. CERAD also serves as the route and catalyst for further participation of UK scientists in China on different research projects.



Demonstrating experimental data to students, China
© Professor Venugopal Nair

Sino-British Centre for Research on avian diseases.

Project leads:

Professor Venugopal Nair OBE, Pirbright Institute, UK and Dr Zhiqiang Shen, Shandong Binzhou Animal Science and Veterinary Medicine Academy, China

Delivery partners:

Biotechnology and Biological Sciences Research Council, part of UK Research and Innovation and Shandong Binzhou Animal Science and Veterinary Medicine Academy

A few years ago, my Langshan chicken farm suffered major losses due to avian leukosis. Using the advanced diagnostic tools and eradication protocols...we managed to reduce the losses significantly.

Poultry farm owner in Shandong, China



INDONESIA

“The quality of Newton Prize proposals reflects the...strengthening collaboration between academics and institutions in the UK and Indonesia.”

Yanuar Nugroho, Deputy Chief of Staff, Executive Office of the President 2015-2019

Over **100** projects supported through the Newton Fund between 2016 and 2019

BUILDING RESILIENT COASTAL COMMUNITIES

Coastal urban areas are particularly exposed to the impacts of climate change and natural hazards, which tend to hit the poorest and most marginalised people the hardest. The recent flooding and tsunamis in Indonesia highlight the devastation caused by coastal hazards, and the urgent need to build the resilience of coastal communities.

By combining two different approaches to reduce vulnerability and exposure to hazards – disaster risk reduction (DRR) and climate change adaptation (CCA) – UK and Indonesian researchers have developed new integrated DRR and CCA strategies that can protect centres of economic growth and protect homes,

businesses and infrastructure in coastal urban areas.

The team assessed the existing capacity in Indonesia to tackle environmental threats and developed a clear policy statement on embedding the DRR and CCA strategies in Indonesia’s development plan.

The team also assessed tsunami preparedness in Indonesia and other countries in the Indian Ocean. This research influenced the Intergovernmental Oceanographic Commission of UNESCO and the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning on their approaches to assessing tsunami preparedness and priorities for capacity development of member states.

The work has resulted in procedural changes to help workers carry out complex routine operations involved in receiving warning information and communications about impending natural hazards.

The research can be adapted for use in other coastal areas at risk, such as the UK, which is particularly vulnerable to sea level rise. The UK and Indonesian researchers have benefited from the opportunity to exchange knowledge and expertise, and the project has led to further funding to continue work on mitigating and adapting to the risk of environmental hazards.



Fieldwork in Jakarta
© Professor Richard Haigh

Mainstreaming integrated disaster risk reduction and climate change adaptation strategies into coastal urban agglomeration policy.

Project leads:

Professor Richard Haigh and Professor Dilanthi Amaratunga, University of Huddersfield, UK and Dr Harkunti Rahayu, Institute of Technology Bandung, Indonesia

Delivery partners:

British Council, UK and Ministry of Research and Technology/ National Research and Innovation Agency (Kemenristek/BRIN)

The research has helped us to carry out a comprehensive assessment of tsunami preparedness in Indonesia and other countries in the Indian Ocean, allowing us to improve our standard operating procedures.

Professor Dwikorita Karnawati, Chair of UNESCO IOC ICG/Indian Ocean Tsunami Warning and Mitigation System and Director General of National Agency of Meteorology, Climatology and Geophysics



IMPROVING THE LIVES OF WOMEN THROUGH BETTER URBAN PLANNING

Large areas of Jakarta are classified as 'kampungs' – consisting of self-built dwellings that house the city's urban poor population. Many kampung residents have lived there for generations and pay land and property taxes. However, regular land disputes mean that residents are extremely vulnerable to eviction, as land is cleared to make way for new urban developments.

This UK-Indonesia collaboration has conducted the first in-depth study on the impact of resettlement and rehousing schemes on urban poor women in Jakarta. The work has informed policy making and produced a new toolkit to ensure the views and needs of women are accounted for by urban planners and decision makers.



Kampung Luar Batang, Jakarta
© Lisa Tilley

Through testimonies from kampung women, evictees, and social housing residents, the project identified how poor women's voices and experiences need to be better represented within policy initiatives aimed at building sustainable future cities.

The research demonstrated how the assumptions that urban planners often make about women's roles and responsibilities within households can have detrimental consequences. For example, the assumption that women are economically inactive 'housewives' fails to recognise the work that women do within the informal urban economy, how this work is vital to livelihoods, and how re-location

to public high-rise accommodation can cut women off from these essential economic networks and infrastructures.

Another goal of the collaboration was to develop research capacity. The team ran specialist workshops to improve access to publishing in international peer-reviewed journals and bring research by Indonesian scholars to a wider academic audience. The partnership forged between researchers in Jakarta and Warwick will lay the foundations for many years of joint work around issues of economic development and social welfare.

The gendered everyday political economy of kampung eviction and resettlement in Jakarta.

Project leads:

Professor Juanita Elias, University of Warwick, UK and Dr Chusnul Maryah, Universitas Indonesia

Delivery partners:

British Council, UK and Ministry of Research and Technology/ National Research and Innovation Agency (Kemenristek/BRIN)

The high-quality outputs that came out of the project were the direct result of collaborations with Indonesian scholars and activists. Many intangible benefits also flow from these kinds of research links which serve as a springboard for further research and educational collaborations.

Dr Juanita Elias, University of Warwick



LEADING THE WAY FOR IMPROVED TUBERCULOSIS DIAGNOSTICS

In 2018 the World Health Organisation reported 10 million cases of tuberculosis globally, causing 1.3 million deaths every year. Indonesia ranks third in the number of tuberculosis cases and every year 842,000 new cases are diagnosed.

This project is developing knowledge about tuberculosis, and its associated fungal diseases called chronic pulmonary aspergillosis (CPA) and chronic pulmonary histoplasmosis (CPH). The ambition is to create the means (a chest X-ray and simple antibody test) to identify susceptible groups and outbreaks much faster and therefore curb the number of people dying from these diseases or being misdiagnosed.



Workshop
© Professor Retno Wahyuningsih



As well as pioneering studies of the population, this project is collecting blood samples and H. capsulatum isolates – a form of fungi – which are essential to develop new diagnostic tools for CPA and CPH, and to determine histoplasmosis endemic regions.

The work in Indonesia is leading the world, and will change management approaches to tuberculosis in the long term, especially in cases that are not cured or resistant to treatment by shedding light on associated fungal infections so that people can be treated properly. This work stimulated the Foundation for Innovative Diagnostics in Geneva to initiate a major programme

Development of serology diagnosis of chronic aspergillosis and histoplasmosis in Indonesia.

Project leads:

Professor David W. Denning, University of Manchester, UK and Professor Retno Wahyuningsih, Universitas Indonesia

Delivery partners:

Medical Research Council, part of UK Research and Innovation, Indonesia Science Fund (DIP) and Indonesia Endowment Fund for Education (LPDP)

These results have global implications for tuberculosis programs – simple antibody testing and chest X-rays can diagnose chronic fungal infection after tuberculosis.

Professor David Denning, University of Manchester

MAINTAINING BRIDGES FOR CONNECTED AND PROSPEROUS COMMUNITIES

Bridges are immensely important infrastructure, allowing people to go to school, hospital and the workplace and to transport supplies and materials between places, without having to negotiate busy roads or fast flowing rivers.

In Indonesia, an archipelago with many rivers crossing the land, bridges are essential for the country's social and economic prosperity. However, frequent earthquakes combined with sometimes low quality infrastructure and inadequate bridge monitoring and management, often result in fatal bridge collapses.

Off-the-shelf bridge monitoring systems are very costly and usually designed for large, long-span bridges, which often

makes them unaffordable. Researchers in the UK and Indonesia have successfully developed a bridge monitoring system prototype using wireless sensor networks that can process bridge measurement data locally and generate information more quickly which is particularly useful in an emergency.

The team, comprising researchers from Coventry University, ITB, Universitas Telkom and PUSJATAN, has built a bridge simulator at Civil Engineering ITB, providing better training and learning facilities. They are also developing capability in 'civionics' - combining civil, electronics and software engineering - in Indonesia as well as in the UK.

Affordable bridge monitoring solutions will reduce the possibility of potentially life-threatening accidents and improve the economic development and resilience of the region. Safer, more reliable and sustainable traffic and transport infrastructure will improve access to education, health services and economic activities.

While the project is currently being delivered in Indonesia, the need for bridge monitoring systems is global. The technology and knowledge being generated within the project are transferable to other countries including the UK.



Testing bridge monitoring system in the lab
© Pratama Budi Wijayanto

Developing affordable energy efficient bridge health monitoring and early warning system with wireless sensor networks and multi-agent system.

Project leads:

Dr Dina Shona Laila, Coventry University, UK and Professor Bambang Riyanto Trilaksono, Institute of Technology Bandung, Indonesia

Delivery partners:

Royal Academy of Engineering, UK and Ministry of Research and Technology/ National Research and Innovation Agency (Kemenristek/BRIN)

This collaboration has provided opportunities for Indonesian researchers to communicate their research outputs to a wider international audience which will inspire other researchers in Indonesia to contribute to global research and development.

Dr Dina Shona Laila, Coventry University



PREVENTING THE SPREAD OF INFECTIOUS DISEASES

Tracking and identifying new outbreaks of arboviruses – insect-spread infectious diseases – is an increasingly important global task. There is growing evidence that climate change is contributing new infectious disease strains and the expansion of tropical diseases into mainland Europe.

A team of researchers from the UK and Indonesia have used a new test called MinION, developed by Oxford Nanopore Technologies (ONT), to identify and sequence the genomes of 90 isolates of dengue virus and 30 isolates of the chikungunya virus in Indonesia.

Compared to conventional tests which are time consuming, require well preserved samples and expensive equipment, MinION is simple, quick and inexpensive. The test is accessible to those working in low-to-middle income countries and suitable for use in rapid, on-site testing in the event of a major outbreak.

The data collected by the team will be essential to monitor the spread of disease and provide guidance on the choice of potential vaccines. The research is relevant to other countries in the region, as well as to the UK so it can prepare for the possibility of these pathogens reaching the UK in the future.

The platform has been set up at the Eijkman Institute in Jakarta and staff members have been trained in how to prepare samples and analyse the data, enabling the institute to perform sequencing studies in the future. It will also support the Eijkman Institute's capacity to do genome research, to advance our understanding of the biology of humans and pathogens to improve human health.



Explaining the use of MinION sequencing to staff at remote laboratory
© Dr Tedjo Sasmono

Transmission dynamics and molecular epidemiology of arboviruses in Indonesia.

Project leads:

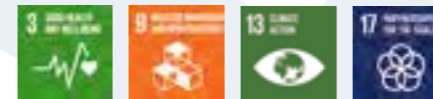
Professor Simon Frost, University of Cambridge, UK and Dr Tedjo Sasmono, Eijkman Institute for Molecular Biology, Indonesia

Delivery partners:

Medical Research Council, part of UK Research and Innovation, Indonesia Science Fund (DIP) and Indonesia Endowment Fund for Education (LPDP)

With the limited arbovirus surveillance research in Indonesia, funding from Newton Fund for UK-Indonesia collaborative research has really helped us in understanding the arboviral disease dynamics in Indonesia.

Dr Tedjo Sasmono, Eijkman Institute for Molecular Biology



SOYA FLOUR CAN REDUCE THE RISK OF DEMENTIA

Dementia deteriorates a person's memory, thinking, behaviour and ability to perform everyday tasks. In 2018 the global societal cost of dementia was estimated to be \$1 trillion US dollars and the number of people with dementia is expected to triple in the next few decades, placing a huge burden on health systems worldwide. Women have a higher risk of dementia than men.

There is currently no cure for dementia but a UK-Indonesia research collaboration has found that the consumption of tempe, a fermented soybean product, could reduce the risk of dementia and improve memory.

In many East Asian countries people very frequently eat tofu, which has been shown

to increase the risk of dementia in older East Asian people. Observational studies showed that a simple dietary change to tempe reduced that risk by 20 percent and improved memory.

Oestrogen deficiency in women can increase the risk of dementia. Tempe flour contains plant-based hormones which could provide a safe alternative to synthetic oestrogen treatment (linked to an increased risk of breast cancer and thrombosis) to prevent long term oestrogen deficiency in women – which could prove a major breakthrough in the oestrogenic treatment of early menopause. Studies of rodents showed that tempe was highly effective in promoting memory and reducing early hallmarks of dementia.

Strong links with local business and government have sped up the results of this research and increased awareness about dementia among policy makers and service providers, resulting in a new focus on promoting better care and more research into this area. The project has led to several spin off projects and collaborations beyond the partner countries.

Tempe to improve memory in elderly people with dementia (TIME).

Project leads:

Professor Eef Hogervorst, Loughborough University, UK and Professor Tri Budi Rahardjo, URINDO and Universitas Indonesia

Delivery partners:

British Council, UK and Ministry of Research and Technology/ National Research and Innovation Agency (Kemenristek/BRIN)



Rumah Tempe, Indonesia
© Atik Irsan



We have shown tempe flour has beneficial effects on memory in UK middle-aged women. If we can show benefit for early-oestrogen deficient women it could be a major breakthrough.

Professor Eef Hogervorst, Loughborough University

PHILIPPINES

“Our collaboration with the United Kingdom is one that we consider as best practice for international cooperation and we are more than committed to continue and further strengthen our partnership.”

Fortunato de la Peña, Secretary for Philippines' Department of Science and Technology (DOST)

Over **130** British and Philippine institutions have been supported through the Newton Agham Programme

A NEW APPROACH TO ELIMINATING MALARIA IN THE PHILIPPINES

After a decade of steady advances in fighting malaria, global progress has significantly slowed down. The Philippines is committed to eliminating the disease by 2030, but this is challenged by residual malaria transmission – where infection rates fall but the proportion of individuals missed by the surveillance system and conventional diagnostic methods increases.

This UK-Philippines research collaboration has led to a new integrated diagnostic approach, nearly doubling the number of people detected and treated for malaria in southern Palawan, where more than 90 percent of national malaria cases are reported. The team combined novel and

simple-to-use approaches to disease surveillance to expand the coverage of malaria diagnostic services in rural clinics to reach high-risk indigenous groups.

The project aimed to identify individuals with low level infections and locate them in the community. It greatly improved the accuracy with which cases could be geographically identified by using tablet-based mapping – an approach which has huge potential and can be applied beyond malaria to a range of infections.

Researchers developed the capacity of rural health facilities to effectively monitor malaria transmission through government health systems, and demonstrated how

community health workers, if well trained and supported, can be at the frontline of detection and surveillance not only of malaria but also of other diseases.

The research has built awareness, secured commitment and fostered knowledge exchange among local health and field workers, scientists, funders and policy makers including the Asia Pacific Malaria Elimination Network and the World Health Organisation. The project's outcomes will be relevant to other malaria endemic countries.

ENSURE: Enhanced surveillance for control and elimination of malaria in the Philippines.

Project leads:

Professor Chris Drakeley, London School of Hygiene and Tropical Medicine, UK and Dr Fe Espino, Research Institute for Tropical Medicine, Philippines

Delivery partners:

Medical Research Council, part of UK Research and Innovation and the Department of Science and Technology Philippine Council for Health Research and Development

We think the simple addition of screening all facility attendees not just those who are sick, even if only periodically, has the potential to speed up malaria elimination in the Philippines.

Dr Fe Espino and Professor Chris Drakeley



Evaluating the use of tablet-based mapping to refine malaria maps in Rizal, Palawan
© Joshua Paul, LSHTM



BOOSTING PROSPERITY AND HEALTH BY CONVERTING SEWAGE INTO FERTILISER

In the Metropolitan Manila region in the Philippines, 75 percent of sewage directly flows into natural water bodies untreated, causing severe water pollution which adversely impacts people's health and the local economy.

Newton funded researchers in the UK and the Philippines have now come up with an innovative solution based on rigorous research to effectively convert wastewater into nutrient-rich fertiliser. This has the potential to improve local economies by creating jobs, enhancing agricultural practises, increasing food security and improving sanitation and the provision of clean water.

Data obtained in collaboration with the local industry partner, Maynilad Water Services Inc., for a zone in Metro Manila with a population of 80,000, shows the annual recovery of 4,986kg of phosphate for fertiliser. This could potentially grow

to 623,250kg if extended to the whole of Metro Manila. Furthermore, due to the benefits that the project brings to the agriculture sector this approach could be replicated in other Southeast Asian countries. Agri-businesses have taken a keen interest in the project due to the global demand for phosphorous fertiliser.

The project provides a foundation for further research to address the problem of water pollution and poor sanitation coverage. It is expected that the project's success will incentivise other cities in the Philippines to invest in sanitation for all.



Project team at sewage treatment plant, Manila, Philippines
© Dr Devendra Saroj

Water-energy-nutrient nexus in the cities of the future.

Project leads:

Dr Devendra Saroj, University of Surrey, UK and Professor Michèle Clarke, University of Nottingham, UK and Professor Michael Angelo Promentilla, De La Salle University, Philippines

Delivery partners:

Engineering and Physical Sciences Research Council, part of UK Research and Innovation, Department of Science and Technology Philippine Council for Industry, Energy, and Emerging Technology Research and Development

I hope that the private sector will make use of this pioneering technology, which will particularly benefit farmers.

Ms Laarni Piloton, Department of Science and Technology Philippine Council for Industry, Energy, and Emerging Technology Research and Development



A NEW FARM-SIDE DIAGNOSTIC PLATFORM TO DETECT POULTRY DISEASES

The poultry industry in the Philippines accounts for 17 percent of the agricultural output, equating to 60 billion Pesos per annum. One major factor affecting the growth of the industry is the inability to rapidly and accurately detect bacterial and viral infections within flocks.

Currently, diagnostic methodology often relies on clinical observations. This is time consuming and can affect the ability to implement control measures to limit the spread of the disease to adjacent farms and into the human food chain.

To address this, the multidisciplinary team behind this project has developed a simple farm-side molecular diagnostic platform and complementary surveillance software



Functional prototype device being used in early field trials in the Philippines
© Professor Wamadeva Balachandran

that can be used at the site of infection and test for viral and bacterial pathogens.

Within eight months, the team successfully produced a portable, battery powered, stand-alone diagnostic platform. It abides by World Health Organisation guidelines for resource-poor settings, which means the device can be operated anywhere in the farm, eliminating the need for laboratory infrastructure, trained personnel, and additional equipment.

The total cost of the device is 95 percent lower than comparable commercially available devices, is validated against gold standard devices and is shown to perform to an equivalent standard. The team has also developed and demonstrated tests

for the detection of Salmonella, E. coli. and Newcastle disease virus which can achieve detection within 30 minutes. Additionally, commercially available tests developed by a third party for the detection of Porcine epidemic diarrhoea has also been demonstrated.

The successful implementation of these technologies will restrict the spread of poultry infectious diseases, antimicrobial resistance (AMR) and zoonotic pathogens through early detection and containment.

Low-cost portable molecular diagnostic platform for rapid detection of poultry infectious pathogens.

Project leads:

Professor Wamadeva Balachandran, Brunel University London, UK and Dr Dennis Umali, University of Philippines Los Banos

Delivery partners:

Biotechnology and Biosciences Research Council, part of UK Research and Innovation and the Department of Agriculture – Biotechnology Programme, Philippines

A low-cost, simple system like the device demonstrated will be of great use to farm veterinarians and farm managers in monitoring and controlling poultry diseases with ease.

Dr Antonio Augustus Laranas - The Chicken Doctors, Philippines



INITIATING A SALMONELLA SURVEILLANCE PROGRAMME FOR BETTER PUBLIC HEALTH

Salmonella enterica is one of the most significant foodborne pathogens. It has been known to have the ability to mutate, resist drugs and find new ways to transmit to other humans and animals. While numerous potential methods of transmission exist, commercial chicken and pig meat have been recognised as crucial food vehicles for the pathogen, posing a significant risk to health and wealth of countries such as the Philippines, which produce and consume large amounts of these foods.

This pioneering research aims to be the first to use whole genome sequencing to understand the genetic diversity of

Salmonella enterica across the swine and poultry food chains in Metropolitan Manila, Philippines. Studies using whole genome sequencing in the Philippines are extremely rare and are at the early stages but significant work has begun to track the source of the pathogen – a key measure to control its spread.

Over 1,800 *Salmonella enterica* strains from the swine food chain have been collected from 270 newly slaughtered hogs, and 600 samples obtained from fresh meat markets. Of these 270 hogs, 77 percent tested positive for Salmonella, allowing researchers to start investigating where and how the hogs became infected.

Long term, research focusing on *Salmonella enterica* incidence, virulence, drug resistance, and transmission, are needed to give the Philippines the capacity to put in place an effective surveillance programme.



Screening of antimicrobial resistance in *Salmonella enterica* isolates from meat
© Alyzza Marie Calayag, University of the Philippines Diliman

Using genomics to trace Salmonella transmission and antimicrobial resistance in the poultry and swine food chains in Metropolitan Manila, Philippines.

Project leads:

Professor Taane Clark, London School of Hygiene and Tropical Medicine, UK and Professor Windell Rivera, Natural Sciences Research Institute, University of the Philippines Diliman

Delivery partners:

Biotechnology and Biological Sciences Research Council, part of UK Research and Innovation and the Department of Agriculture – Biotechnology Programme, Philippines

Ultimately, this collaboration enables far-reaching impacts not only on animal and human health systems, but also in the food industry and trade in the Philippines.

Professor Taane Clark, London School of Hygiene and Tropical Medicine



PIONEERING SCIENCE TOWARDS TREATMENT FOR ASTHMA

Asthma affects one in ten Filipinos, and 98% of those who have asthma lack proper treatment. Poverty, and the current condition of the healthcare system are major factors. Inhalers are prohibitively expensive and health centres are often inaccessible.

This project represents pioneering work into asthma biology and long-term management by pharmaceutical intervention schemes. The original goal of this Newton funded PhD project was to engineer human trachea tissue in the laboratory, with a view to using this as transplantable tissue to repair tracheal damage caused by trauma and disease.

As the project progressed the team discovered that the stiffened gel scaffold of the airway-smooth muscle model created the marked changes resembling those seen in asthma, where stiffening of the bronchus is a marker of the condition.

Based on these developments the focus of the project shifted towards engineering bronchiolar tissue and developing this as a highly adaptable 3D model to study airway pathologies and the role of mechanical forces in disease development, allowing much more accurate models on the progression of diseases like asthma.

Long term it is hoped that the impact of this work will be a clinically relevant human tissue model of airway physiology, and a platform for testing new drugs to treat asthma.



Assessing the airway bioreactor performance
© Jopeth Ramis

Tissue engineering of bronchi in health and sickness: assessing the effect of matrix stiffening on cellular changes in the airways.

Project leads:

Professor Felicity Rose, University of Nottingham, UK Professor Ian Adcock, Imperial College London, UK and Mr Jopeth Ramis, Technological Institute of the Philippines

Delivery partners:

British Council, UK and the Department of Science and Technology – Science Education Institute, Philippines

My team of co-investigators/collaborators bring extensive international experience in basic science and experimental medicine, including airway biology. Together with the research environment, facilities, and government support, this will enable challenges to be met and resolved.

Mr Jopeth Ramis, Technological Institute of the Philippines



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DELIVERY PARTNERS

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