

Annex: Role of R&D in supporting ODA objectives

Since the UK Government's Aid Strategy in 2015, investing in Research and Development (R&D) has formed a key element of the UK Government's approach to ODA. This approach has transformed the UK's capability to invest in R&D focused on global development, delivering significant progress towards furthering the Government's targets for ODA and enabled the UK to build reputation and relationships across the globe.

The 2015 Aid Strategy has also enabled the ODA budget to be spent across Government. Since then the Department for International Development (DfID) has spent the majority of the ODA budget, however, other Government Departments and other bodies have delivered between 19% and 27% of the UK ODA spend.¹ In 2019, DfID spent 73% of the UK's £15.2 bn ODA budget, whilst six other Government Departments spent over £100 million, of which the Department for Business Energy and Industrial Strategy (BEIS) was the largest contributor at £950 million.

A significant proportion of these funds were utilised to support R&D activities. For example in the Financial Year 2019/20, the BEIS ODA allocation for R&D was in excess of £400 million.²

This document sets out a range of case studies demonstrating how ODA-funded R&D programmes are contributing to the objectives set out in the Foreign Secretary's statement to the House on 26 November.

Case Studies

Climate change and biodiversity

Developing a framework of catchments classification for hydrological predictions and water resources management in ungauged basin of the Congo River

GCRF administered by the Royal Society

Researchers from Université de Kinshasa, Democratic Republic of Congo are working in fields of climate change, environmental protection and resilient development in the river and among the communities living along the Congo River basin. More than 40% of the African freshwater volume is contained in the Congo basin, which constitutes a key asset for strategies to increase opportunities for improved water security in Africa. It is estimated that the Congo basin has one quarter of the untapped world's hydropower potential. Due to its forest, the basin plays a key role in global moisture recycling, sustaining rainfall for crops and drinking water in many arid regions of Africa and the world. In a region with very poor road infrastructure, the river network offers some 20,000 km of navigable routes, necessary for exchange of goods and services between the riparian countries and the international market. There are massive wetlands that sustain a rich and unique biodiversity of the world. However, beside this potential offered by the basin, a challenge remains undaunted, that of a critical lack of reliable information to enable rational planning and wise decisions on how best to invest funds on post-war reconstruction and ensure climate resilient development in the basin. The team is developing a framework to provide cutting-edge quality information on the structure, processes and functions of water resources as well as impacts of change in physical environment and society.

Building resilience using climate smart agricultural interventions in northern Ghana

GCRF administered by the Royal Society

Climate-Smart Agriculture (CSA) is one method proposed for Ghanaian farmers to adapt in light of increasing temperatures and drought risk, but evidence for its effectiveness remain partial. A team from Kwame Nkrumah University of Science & Technology, Ghana are using mapping tools, soil samples and a community approach to determine how CSA might be best applied to Ghana and

¹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/878395/Statistics-on-International-Development-Provisional-UK-Aid-Spend-2019.pdf

²https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731507/research-innovation-funding-allocation-2017-2021.pdf

West Africa, with a focus on soil viability.

Uncovering plastic's harmful impact on human health

Newton Fund delivered by the British Council

Turkey discards 144 tons of plastic waste into the Mediterranean every day. Over time these plastics leak harmful chemicals into the environment. A UK-Turkey collaboration has revealed how endocrine disrupting chemicals (EDCs) used in everyday plastic food containers and food packaging are damaging the brain development of human embryos, leading to new health-protecting regulations on plastic products.

The researchers studied the effects of exposure to EDCs during embryonic development. They discovered molecular defects, which point to the underlying mechanisms of the detrimental effects of EDC exposure during development, leading to the progression of cancer, endocrine and metabolic diseases later in life.

The results of this project have contributed to regulations on the use of products containing EDCs globally. New laws on the use of plastic bags have reduced their use in Turkey alone by over 77 percent.

Building a nation-by-nation encyclopaedia of global Climate laws

The Governance and Implementation of Sustainable Development Goal 13 on Climate Change GCRF delivered by the British Academy

Following the Paris Agreement in 2016, international efforts to tackle climate change now largely depend on national execution and enforcement. This research expanded on existing dataset to develop a single, searchable resource covering 196 countries, regions and territories around the world, and over 1,800 laws and executive policies - the most comprehensive open-access global database on climate laws and policies.

In the process of developing the database, the research team's analysis identified the core elements and success factors of an effective climate change law, for example clear long-term targets, rolling short-term targets, agreed duties and statutory timelines, and close scrutiny through an independent body.

The outcomes of this project are informing international climate change negotiators about the credibility of individual national pledges in the context of the Paris Agreement and are providing parliamentarians internationally with justification for more ambitious domestic action, which is needed to adequately tackle climate change at the supra-national level. The success of international efforts largely depends on how aligned and effective the implementation and enforcement of climate action is domestically, as well as on the ability of countries to step up their ambition over time.

The project team has presented their work in the national assemblies of Morocco, Peru, Spain, Portugal and the UK, and to policymakers from Chile, Colombia, Indonesia, Ireland, New Zealand and Russia. The research findings have fed into the work of the Executive Secretary of the UN Framework Convention on Climate Change (UNFCCC), and are informing national debates on climate laws in Argentina, Canada, Belgium, Germany and the Netherlands.

Leaders in Innovation Fellowships

Newton Fund administered by RAEng

The RAEng Leaders in Innovation Fellowship has provided training and mentoring to entrepreneurs from across Latin America, Africa and Asia, including Suzana Yusup from Malaysia who has developed a thermal conversion process which produces bio-based materials for soil enrichment. The process uses carbon dioxide in the absence of a chemical-based solvent, helping to reduce greenhouse gas emissions while enhancing crop productivity for farmers.

Improving access to sustainable energy in Mozambique

Sustainable Energy Access in Mozambique: Socio-Political Factors in Conflict-Laden Urban Areas GCRF delivered by the British Academy

Over one billion people around the world still lack reliable access to electricity. Three times more people depend on highly polluting fuels. And, despite its rich energy resources, Mozambique has one of the worst energy access rates in the world. Only one in five people has reliable access to electricity and most households depend on firewood and charcoal for their energy needs. This research explored the politics and economic development of Mozambique as well as the impact of sparse energy infrastructure. The project revealed the need for civic education and the value of designing policies that increase citizens' involvement in the planning and innovation of their urban environments. This will help guarantee affordable energy access for all and greater local control over energy decisions.

COVID and global health security

Containing the West African Ebola outbreak

Contributions of Public Health England and Ebola Response Anthropology Platform

The 2014-2016 West African Ebola outbreak was the largest in history. In 2014, when the outbreak was declared a public health emergency of international concern (PHEIC), there was real concern that Ebola would spiral out of control. Yet, by March 2016, the crisis was declared over.

The UK played a leading role in the international coordination that was crucial to turning it around. Anthropologists were key to this response, significantly improving and shaping the global response. The initial response of the global community that focused on technical discussions of 'weak' health systems and expertise from anthropology and other social sciences was essential to moving past this analysis to incorporating structural violence, political economy, history and the context of the region.

Public Health England was involved in this response:

- The UK has a long history of outbreak response, applied by sending researchers to labs such as the Public Health England (PHE) lab, Sierra Leone. Diagnostic research led to the publication of revised patient management guidelines.
- Fast-tracking an Ebola vaccine – vaccines were under development long before 2014, the Porton Down facility (now run by PHE) has undertaken Ebola virus studies since 1977.
- Efforts were redoubled by UK and US pharmaceutical companies during the outbreak
- These efforts enabled have further supported the response to the subsequent outbreak in Eastern Congo in July 2019.

Improving Malaria control strategies

MRC funded project

The World Health Organisation (WHO) estimated that in 2017 there were 219 million cases of malaria worldwide and approximately 435,000 deaths from malaria.

One way in which the UK research provides leading contributions to malaria control and eradication efforts, is through improving control strategies. The Malaria Atlas Project (MAP) – which receives MRC funding – is one example of such an approach. MAP brings together a global network of researchers to assemble global databases and develop innovative methods to better understand the global landscape of malaria risk. MAP has informed global policy design and implementation, including the WHO World Malaria Report and Global Technical Strategy (2016-2030).

New knowledge to combat non-communicable disease in South Africa

Newton Fund delivered by the Academy of Medical Sciences

The World Health Organisation estimates that 85% of global deaths from non-communicable disease (NCD) occur in low and middle-income countries.

Epigenetic mechanisms – a cell's ability to activate and silence genes – have been exciting new targets for NCD intervention. However, most epigenetic data is currently from European populations and it is unclear whether findings from this data can be extrapolated to other populations. The Newton Fund has supported a UK-South Africa study comparing epigenetic data from the Batswana South African ethnic group with existing data in other populations. It found that current blood-based epigenome-wide association study findings can largely be extrapolated to under-represented ethnicities for whom epigenetic data is not yet available.

Collaboration with world leaders in epigenetic epidemiology research in the UK has developed the skills and expertise of South African researchers and will lead to more research on health questions relevant to populations of developing countries.

RAEng Engineering X Pandemic Preparedness Programme

GCRF administered by RAEng

Through the Engineering X Pandemic Preparedness Programme, a team of engineers based at the Universidad Peruana Cayetano Heredia in Peru are developing an Internet of Things (IoT) inkjet-printed sensor that monitors respiratory rate, heart rate and oxygen saturation of COVID-19 outpatients and feeds data to a cloud-hosted patient diary. A neural network trained on sensor data with access to the patient diaries alerts clinicians to any risk of respiratory complications, easing pressure on ICUs and smoothing patient management workflow.

Safeguarding drinking water in developing world cities

Safeguarding Potable Water Provisioning to Urban Informal Settlements in Africa and Asia
GCRF delivered by the British Academy

This research has helped to safeguard potable water provision in urban informal communities in Dar es Salaam (Tanzania) and Dhaka (Bangladesh), where it had been identified that improved water supplies were nevertheless severely compromised by sewage contamination at a critical zone around the point of use where water is taken from the standpipe to the home. The research has catalysed local partners to build new WASH (Water, Sanitation and Hygiene) programmes that did not exist previously to support communities affected by unsanitary water provision.

Tackling household air pollution in rural Kenya

GCRF administered by the Royal Society

A research group at the African Population and Health Research Centre, Kenya is targeting the reduction of household air pollution by transforming cooking facilities within homes in rural and slum communities. The majority of households in Africa are dependent on wood or charcoal for their cooking, and the cultural roles that assign household chores, including cooking, to women and girls and children under their care, means that mothers and daughters continue to breathe harmful air and many lose their lives while working towards sustaining their families. The group will provide an alternative cleaner burning and affordable fuel, ethanol, to rural households to reduce the burden of household air pollution. This has the potential to transform the cooking practices, and livelihoods, across the continent, and the associated health benefits of clean cooking options. In 2016, estimates for Kenya indicate that 14,000 deaths were attributable to poor household air quality.

Making prosthetic limbs from plastic bottles

GCRF networking grant delivered by the Academy of Medical Sciences

Recipients of a GCRF networking grant have developed prosthetic limbs made out of plastic bottles. These prosthetics are 40% lighter and, at £10 a unit, is 500 times cheaper than current alternatives.

Two patients in Jaipur have been fitted with the limbs, describing them as 'lightweight' and 'easy to walk with'. Furthermore, the recycled plastic bottles are able to offer a porous socket which helps to keep the wearer cool. This is a feature that neither carbon nor glass fibre sockets – which are currently the best designs available can boast.

Testing the effect of an integrated intervention to promote access to sexual/reproductive health and rights among disabled women/girls

GCRF administered by the Royal Society

Over 63% of disabled adults in Ghana are women, the group that has the most difficulty accessing sexual and reproductive healthcare. Researchers at the University of Ghana are implementing interventions to connect women with these services and assess the benefits, in order to strengthen local health system capacity and satisfy 'universal access to healthcare as envisaged [by the UN]'.

Distribution of arsenic on agricultural soils and its influence on exposure risks through maize ingestion and agricultural activities in Matehuala, San Luis Potosi, Mexico

Newton Fund administered by the Royal Society

A team at Instituto Potosino de Investigacion Cientifica y Tecnologica, Mexico are working with researchers at Heriot-Watt University to study arsenic in the environment and particularly, the significantly high concentrations of arsenic reported to be found in the surface and groundwater of a particular semi desert area in Mexico. The team are investigating the origin of that contamination, how it varied over space and time, and the extent and the impact of its pollution. Arsenic has contaminated water, soil, crops and, as well as people, as measured by arsenic concentration in their hair. The lack of awareness and poverty in Cerrito Blanco, Matehuala, in the San Luis Potosi state in Mexico seem to combine to exacerbate the arsenic exposure problem.

Improving care and diagnosis for children with pneumonia

NIHR

The NIHR Global Health Research Unit on Respiratory Health (RESPIRE) is trialling a bubble continuous positive airway pressure (bCPAP) device developed by a Bangladeshi partner to deliver oxygen to children with severe pneumonia. They are also developing a computational model to diagnose pneumonia directly from clinical grade paediatric chest X-rays. Using recent machine learning advances in the field of computer vision, it is hoped to achieve a diagnostic performance comparable to that of a trained radiologist. There are further plans to develop this diagnostic computational model into a software package, thereby enabling individuals unfamiliar with programming to interact with the model.

Girls' education

Parenting programme benefits disadvantaged children nationwide in Bangladesh

Scaling up an early childhood development intervention by integrating into health services in Bangladesh

GCRF delivered by the British Academy

This programme delivering parent-training sessions through local health clinics led to significant benefits to the development of disadvantaged young children. An implementation strategy was designed in collaboration with the Bangladesh Ministry of Health, with \$1.5 million committed to train 2,000 government staff across 550 clinics, reaching 22,000 families by 2020. By 2024, national scale up will result in 40,000 trained staff across 13,000 clinics, reaching an estimated 520,000 families per year.

Ensuring quality pre-school teaching and care in Ghana

Assessing Sustained Impacts of the Quality Preschool for Ghana Teacher Training Intervention on Children's Early Primary Grade Outcomes

GCRF delivered by the British Academy

In 2007, Ghana added two years of kindergarten to its universal basic education system. Despite its success in increasing access to pre-primary education, the Ghanaian government now faces the challenge of improving quality and ensuring that young children effectively develop the skills needed to succeed in primary school.

This research assessed the impacts of the Quality Preschool for Ghana programme, which aimed to enhance the quality of kindergarten education. It offered in-service training and coaching for teachers, coupled with parental-awareness meetings. The research set out to uncover if enhancing kindergarten education quality also led to improved learning outcomes in primary school.

The research found that the Quality Preschool for Ghana programme did indeed improve kindergarten children's academic and social development outcomes. It also led to sustained gains in the children's attention and behaviour skills, all-important for classroom engagement and learning, which persisted in children who had transitioned to primary school. When combined with parental-awareness meetings, however, the in-service training and coaching for teachers was found to reduce the rate of growth in children's school readiness skills, specifically academic outcomes in literacy and numeracy skills.

The outcomes of the research suggest that even a relatively brief kindergarten teacher training, built into existing educational systems and implemented over a short period of time (i.e. one school year), can have a significant and long-term impact on the development and academic attainment of children in primary school. Such interventions are affordable and can easily be implemented at scale.

The research team are currently working with Innovations for Poverty Action Ghana, the Ghanaian Ministry of Education and the Ghana Education Service to adapt the Quality Preschool for Ghana programme to rural communities, which generally have lower rates of school enrolment and curricula relying heavily on local languages. It is hoped that once adapted, the programme will be scaled up nationally.

Three female masters students win top spots in civil engineering projects and national recognition

GCRF administered by the Royal Society

Three female masters students supervised and co-supervised by two GCRF funded researchers were awarded top spots in the final-year civil engineering class at the University of Cape Town (UCT). One student also went on to win second place for her research thesis in the South African Institution of Civil Engineering (SAICE) National Investigative Project (IP) Showdown.

From the supervisors: *"In their fourth year they decided to do their research topics with me as a supervisor. It's been an absolute pleasure supervising them and watching them grow from strength to strength. Not only are they helping break down barriers when it comes to our view of 'waste' water, but they are also breaking down social norms. I'm thankful every day that our paths crossed and I'm excited to see what these amazing young women will continue to accomplish as we strive for a more just and better future."*

From one of the students: *"For me there is no male civil engineer or a female civil engineer, we are all civil engineers. However, having more women in civil engineering helps to inspire others to know that they too can do it. A lesson I [learnt] was that it's important to acknowledge that women think and reason differently to men. The problem comes when people assume that the treatment given to men and women must be different. It should be a matter of understanding one another and finding common ground, even if it means compromise from either side. The journey is not easy, especially if you feel like you are walking it alone. Having someone alongside with the same goals, vision and mindset will certainly help."*

Strengthening African capacity in soil geochemistry to inform agricultural and health policies

DFID administered by the Royal Society

A female PhD student at the University of Zimbabwe is exploring factors governing micronutrients supply in smallholder farming and food systems. The study responds to critical concerns about prevalence of low dietary zinc and iron intake among human populations in Southern Africa, largely due to consumption of nutritionally poor staple grains produced on nutrient-poor soils. The student's work throughout her PhD has been recognised through several regional and international awards including the International Fertiliser Society's Brian Chambers Award (2015), the International Plant Nutrition Institute Scholar Award (2016) and the Marschner Young Scientist Award (2017).

"Being a PhD student funded under the Royal Society-DFID Africa Capacity Building Initiative has brought countless opportunities which include technical capacity building skills gained through exchange visits to the University of Nottingham and the British Geological Survey and other collaborating institutions within my research program. The multi-disciplinary nature of my supervisory team from both my local institution and UK institutions is amazing. This has significantly improved my scientific writing and analytical skills since embarking on my studies."

Leaders in Innovation Fellowships

Newton Fund administered by RAEng

The RAEng Leaders in Innovation Fellowships, supported by the Newton Fund has provided training and mentoring to entrepreneurs from across Latin America, Africa and Asia, including Thando

Gumede from South Africa and her business M-Teto which is a mobile gaming application and school based intervention software to respond to and prevent gender-based violence in schools.

Partnerships in Science, research, technology

Global Challenges Research Fund policy workshops

GCRF administered by the Academy of Medical Sciences

The Academy of Medical Sciences have delivered a policy workshop project that has enabled over 40 national academies in ODA eligible countries to consider how scientific evidence can help address key global health challenges. In addition, they have built capacity in ODA countries for the provision of scientific advice to national Governments that have resulted in policy change. Workshop topics have covered multimorbidity, rapid diagnostics tests, clinical research capacity, obesity, neurodevelopment disorders, mental health, universal health coverage, non-communicable diseases, urban health, anaemia at altitude and COVID-19.

Future Leaders – African Independent Research (FLAIR)

GCRF delivered in partnership between the African Academy of Sciences (AAS) and the Royal Society

The Royal Society and African Academy of Sciences have established a bilateral partnership to create the premier postdoctoral programme in Africa producing Africa's next generation of independent research leaders undertaking cutting-edge research that will address global challenges facing Africa. Future Leaders – African Independent Research (FLAIR) provides fellowships for talented African early career researchers supporting them to build an independent research career in sub-Saharan African institutions. The programme partnership brings together leading UK and pan-African expertise to strengthen research career pathways and institutions across Africa, championing African solutions to African problems.

Open societies and conflict resolution

Busting myths about the impact of refugees on jobs in Jordan

*Syrian Refugees in Jordan: the Challenge of Sustainable Development
GCRF delivered by the British Academy*

There are more than 15.6 million refugees across the world, with four out of five settled in developing countries. Around 1.3 million Syrians live in Jordan alone, which has a total population of just 6.6 million. This has given rise to widespread concerns among the Jordanian population who fear that the large influx of Syrian refugees is placing severe pressure on the local labour market. There have been polarised debates on the issue in media outlets in Jordan and elsewhere, which have only been compounded by the limited available evidence on the impact of refugees in developing countries.

This research investigated the extent to which Syrian refugees are having a negative effect on their host society in Jordan, with a particular focus on employment. It revealed that existing perceptions are largely misplaced, with Jordanians living in areas with a high concentration of refugees having no worse labour market outcomes than Jordanians with less exposure to the refugee influx. This holds across various labour market outcomes, including unemployment levels, hours, wages, sectors or occupation. The little adverse impact of Syrian refugees on the Jordanian labour market is due to several factors, with demographics playing an important role. Almost half of Syrians living in Jordan are under the age of 15 and only 23% (mostly men) are part of the local labour force. In addition, in areas with high concentrations of Syrian refugees, the demand for goods and services has increased, which in turn has served to stimulate the local labour market for Jordanians and Syrians alike. The inflow of foreign aid has furthermore created additional jobs for the native population, particularly in public services such as education and health, which are expanding in response to the refugee crisis.

These research findings have important implications for policy and public awareness. They illustrate the importance of rigorous evidence in making well-informed policy decisions and have the potential to contribute to a significant shift in existing concerns about the adverse effects of refugees on the local economy and employment, in Jordan and elsewhere. The results also suggest that providing a legal framework for refugees' formal employment does not need to be detrimental to the native job market as it does not necessarily increase competition. The provision of foreign

aid is furthermore crucial in that it not only serves to support improved public services for both the refugee and the native population but also helps create job opportunities potentially offsetting any negative effects of refugees' presence on the Jordanian labour market.

Humanitarian preparedness and response

Minimising flood impact on roads in the Mekong Delta

Optimal Investment Strategies to Minimise Flood Impact on Road Infrastructure in Vietnam
GCRF delivered by the British Academy

Authorities in Ho Chi Minh City have applied for a loan from the World Bank to make use of a new modelling tool – developed by this research – to maximise the benefit of flood prevention investments in the Mekong Delta, which is under imminent threat from rising sea levels. The tool determines the effectiveness of vital flood prevention measures such as enhanced draining ditches and reservoirs to store excess water.

Trade and economic development

Africa Prize for Engineering Innovation

GCRF awarded by RAEng

The Africa Prize for Engineering Innovation has supported entrepreneurs from more than 12 countries across the continent with training, mentoring and access to funding and expertise. Up until 2019 72 businesses have been supported, who have between them raised more than USD \$14 million in grants and equity, and these businesses are now projected to positively impact more than 3 million lives in the next 5 years.

Reducing Disaster Risk to Life and Livelihoods by Evaluating the Seismic Safety of Kathmandu's Historic Urban Infrastructure

GCRF delivered by the British Academy

Kathmandu's medieval cities are exceptional architectural and artistic achievements but also form part of the fabric of everyday urban life. The 2015 Gorkha Earthquake was a humanitarian disaster that caused 9000 fatalities and changed Kathmandu's iconic skyline in seconds, with 403 monuments damaged across its UNESCO World Heritage Site. Representing a key component of tourism in Nepal, and generating 7.6% of the country's GDP, their safe rehabilitation is key to reducing risk to lives and livelihoods.

With no definitive evidence of whether modern materials are more resilient, local communities and craftspeople are frequently excluded from decision-making while the risk to them, and their livelihoods, remains. So, rather than reverting to modern materials, researchers studied why the monuments had collapsed, taking a new approach to reduce future risks, using the resilience of traditional seismic adaptation in the Kathmandu Valley. This research integrated archaeology and architecture with 3D visualisation and other pioneering technologies with architectural methods and community engagement to enhance the seismic safety of Kathmandu's historic monuments and preserve their intangible value.

This research has had multiple and far-reaching positive effects, most notably to the everyday lives of Kathmandu's residents whose livelihoods depend on local tourism. The inaugural exhibition, opened by the President of Nepal in April 2018 at the earthquake museum in Kathmandu, showcased the project findings and was visited by over 100,000 international visitors and 40,000 local people in its first few months.