UK Research and Innovation

Tackling climate change:

Adaptation and Resilience Opportunities

Global Events Report 2021

Contents








Executive summary

UKRI, in partnership with a number of COP26 delivery partners and international colleagues, hosted a series of events focused on climate adaptation and resilience in the run-up to COP26. Following the global launch event in June 2021, nine events were co-hosted with partner countries/ regions and a further nine thematically-focussed events were self-organised by the [international] research community, engaging over 1500 participants across the globe. An expert group of international IPCC lead authors developed a set of core questions used to gain international perspectives. The events fostered open dialogues between key stakeholders (including governments and policy-makers, funders, interdisciplinary researchers and research end-users) to support solution-driven discussions. For some countries the event was the first time representatives of different sectors had come together to share perspectives on research around shared challenges. The events identified common research priorities for adaptation and resilience internationally, as well as core principles for research to incorporate and areas for potential future collaboration. As a first step in meeting the need for further research in this space, UKRI have recently invested £1.7M to support 12 new international, collaborative and interdisciplinary project-scoping grants that seek to address key environmental research challenges relevant to the COP26 Adaptation and Resilience theme.

Discussions around the events series core questions raised some pertinent issues for climate adaptation and resilience research which should be considered as part of future climate adaptation actions.

In summary these are:

- There is high demand for interdisciplinary research and innovation to develop a broader, systems-level understanding of complex climate risks and how to address their impacts.
- Equitable research partnerships that enable co-design and collaboration across sectors to combine diverse sources of knowledge are crucial for enabling transformative adaptation.
- Incorporating local knowledge throughout the research process and embedding solutions in local contexts is key for effective adaptation outcomes.
- It is important to develop appropriate metrics and indicators for monitoring and evaluating adaptation options. These success measures need to be determined with input from local stakeholders as well as the research community and policy makers.
- Whilst adaptation interventions should be context-specific and locally-led, there is a need to connect and coordinate adaptation action at the global scale.
- International climate adaptation and resilience-focussed research is extensive however there is a lack of data sharing, learning and best practice across disciplines, sectors and borders which must be enhanced.
- Knowledge synthesis has to be digestible for users. This can be though shared dialogues, or other means that help promote opportunities to scale up or translate findings to other locations.

The COP26 negotiations in Glasgow have concluded. There are a number of outcomes that aim to enhance climate adaptation and resilience efforts internationally which were also identified during the events series. The next step will be to act on the commitments made.

- Events in the series highlighted the importance and urgency of accelerating climate adaptation action – the impacts are here now and there is demand for increased commitments from all actors. Consensus amongst world leaders on urgently accelerating climate action is growing, with nearly 200 countries having agreed the Glasgow Climate Pact and outstanding elements of the Paris Agreement at COP26.
- Within the pact is a commitment to double the level of funding for developing nations to adapt to climate change by 2025 and develop better ways to compensate for the loss and damage that climate change inflicts. The UKRI events series highlighted the need for more innovative and accessible adaptation finance, from both the public and private sectors.

- The importance of biodiversity and the role that biodiverse ecosystems play in supporting human climate adaptation and resilience is critical and was raised in some form across the events series. Leaders from more than 100 countries (comprising 85% of the world's forests) promised to stop deforestation by 2030. These commitments require dedicated effort and further research and innovation to realise. Policies set at the global scale will impact upon the adaptive capacity of different nations/ regions, some of which are more reliant on deforestation as a key part of their economies. Research to maximise opportunities for co-benefits from climate adaptation measures and avoid trade-offs is needed.
- There are opportunities to learn from responses to the COVID-19 outbreak around the scale and speed of global collaboration and coordination achievable, which is now required to address global challenges such as climate change.
- Every event in the series highlighted the importance of strengthening links between research, policy and practice to drive research into action, whilst COP26 discussions also recognised an increased demand for research and innovation to inform evidence-based climate adaptation policy and decision-making.

It will be up to governments worldwide to turn these commitments into effective adaptation action. There is a clear role for UKRI to play in meeting this demand for relevant, accessible climate adaptation information, in terms of generating the underpinning research across all disciplines to tackle adaptation challenges under the 'Net-Zero plus' agenda, but also in supporting research collaboration across stakeholders and maximising translation of research into tangible impacts both in the UK and though collaborative equitable partnerships across the world.

Introduction

Introduction

The UK hosted the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow on 1–12 November 2021, which brought parties together to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change. The COP26 Presidency is committed to working with all countries and joining forces with academia, civil society, companies and people on the frontline of climate change to inspire climate action ahead of COP26 and beyond.

UKRI, in partnership with a number of delivery partners and international co-hosts and colleagues (See Annex 1), hosted a series of events focused on climate adaptation and resilience in the run-up to COP26. The aim of the events has been to showcase research that is collaborative, locally led and globally relevant and aligned to the UK COP26 presidency's adaptation loss and damage (formally resilience) theme.

Collectively, these events have fostered open dialogues between key stakeholders (including governments and policy-makers, funders, interdisciplinary researchers and research end-users), around how climate risks and their impacts are understood and managed, providing a voice to communities which may otherwise have been marginalised. They have showcased the collaborative international efforts we are supporting to enhance adaptation and resilience in a wide range of locations impacted by climate change.

Events were organised around a set of core questions, which were independently formulated by an IPCC expert panel comprising members from Uganda, Trinidad and Tobago, Malaysia, Chile and the UK to produce narrative and cross-cutting themes to bring coherence to Adaptation and Resilience events and enable comparisons to be drawn from across participating countries.

Q1: What research is needed to respond to the adaptation gap?

Where the adaptation gap describes the difference between current adaptation actions and those needed to avoid harm and enable wellbeing.

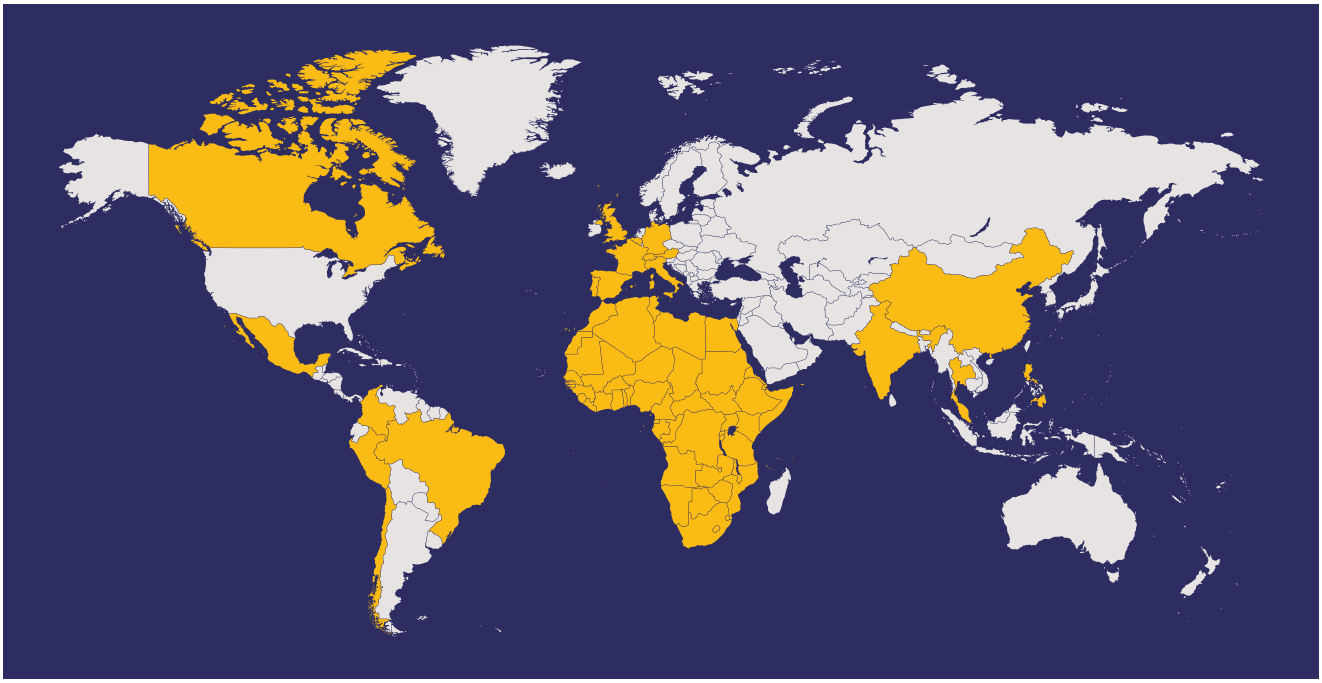


Figure 1: Map illustrating participation from around the globe

Q2. How to evaluate the feasibility of adaptation options and outcomes for resilient and sustainable development?

We know a good deal about what adaptation options are available, but do not routinely assess feasibility and the outcomes of adaptation.

Q3: What examples are there of transformative adaptation research enabling action through addressing issues such as social justice, capacity building and governance?

Research which enables a step change in the ability of people and ecosystems to adapt and become more climate resilient through real-world action.

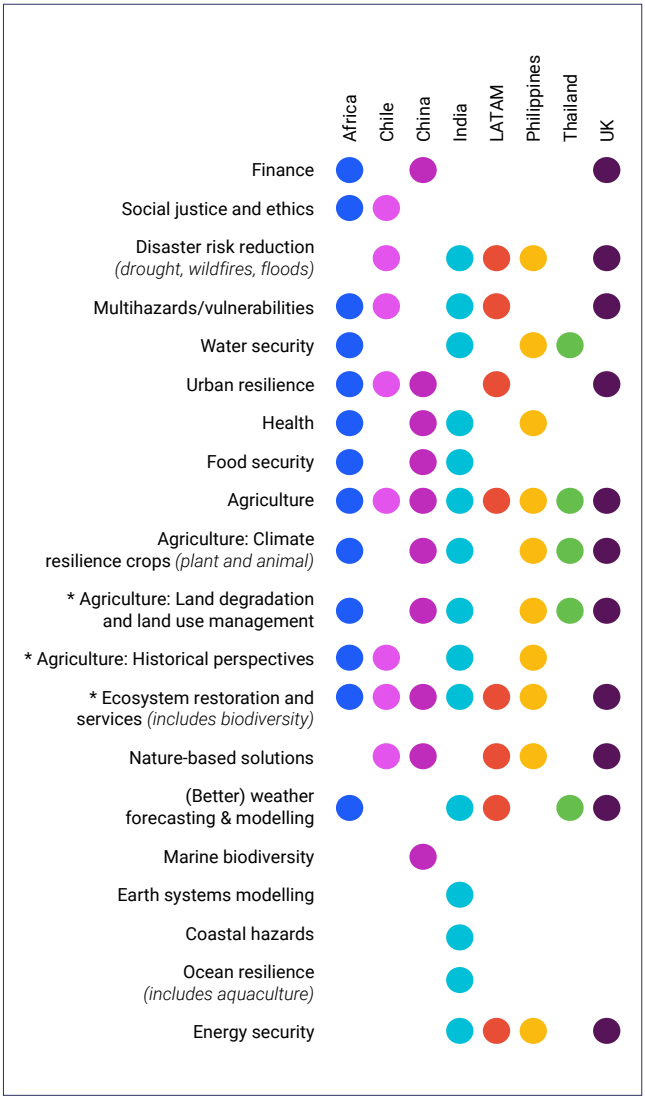


Figure 2: Indicative country priorities# and areas of common research and collaboration interests

\# Priorities are based on those identified by participants on the day and are not necessarily representative of all funders/researchers/policy makers

* Subcomponents of agriculture

Q4. How can research funders, universities and data managers best champion inclusive, urgent and solutions-oriented adaptation research?

Rethinking institutional roles and functions, for example through open data, new research funding mechanisms and new roles for universities as points of capacity and stability in fast changing social and policy contexts.

The events in the series have highlighted the importance of:

- Interdisciplinary research
- Equitable research partnerships, with co-design embedded from the outset
- Cross-stakeholder collaboration, combining diverse sources of knowledge – enabling transformative research partnerships
- Incorporating local knowledge and embedding solutions in local contexts
- Strengthening links between research, policy and practice, including the private sector
- Innovative and accessible adaptation finance (from private and public sectors)
- Adaptation dialogue and learning platforms
- Identifying opportunities to scale up or translate findings to other locations
- Connecting and coordinating adaptation action globally, and
- The need for urgent action

They have also provided the basis for future potential research collaborations as common priorities across countries have been identified (Figure 2), however it should be noted that the priorities identified during the events are reflective of the participants at each event and additional priorities or rankings would be likely with different partners participating.

The following sections of this report are divided into country reports (alphabetical) and self-organised events which consist of a mixture of research themes and organisations involved in adaptation and resilience research.

Africa

Africa

Background

The Africa Research and Impact Network (ARIN) co-hosted three African focused events with UKRI covering pan-Africa as well as specific regions, which brought together a range of different stakeholders to showcase ongoing adaptation and resilience research based in Africa and gain insights on opportunities for upscaling them. A separate event led by the British Institute in Eastern Africa and wider partners, which focussed on building transformational pathways to adaptation in Eastern Africa is captured as a separate segment.

Speakers and attendees at the events included researchers from across Africa and around the globe as well as high-level African government officials who engaged positively with the discussions and are keen to support further cross-stakeholder conversations in future.

Africa summary

Priority research themes for Africa which were highlighted through the presentations and discussions at the events include:

Adaptation and resilience	Pan Africa	East Africa	Southern and Western Africa
Finance for adaptation	■	■	
Social justice and ethics for adaptation		■	
Tackling multihazards	■	■	■
Water security		■	■
Urban resilience (includes housing)		■	■
Health impacts	■	■	
Food Security	■	■	■
Climate resilient crops (including energy crops)	■		
Ecosystem restoration and services (includes biodiversity)	■		■
Land degradation and land use management	■		
Cross-stakeholder co-production of action-oriented research (includes indigenous knowledge)	■		■
Weather forecasting capability			■
Identification of metrics and goals (includes local and global)	■		
Research to inform National Adaptation Plans (NAPs), IPCC special reports and UNFCCC negotiation	■		

Q1: What are the major adaptation research gaps in Africa and what research is needed to respond to the adaptation gap in Africa?

Pan Africa

The Pan-African event raised a range of pertinent high-level issues for climate adaptation and resilience research, whilst regional events explored more context specific challenges.

Common themes identified for research across Africa:

- Understanding adaptation and resilience needs at the local level is critical. Indigenous and local knowledge can provide key insights when developing effective solutions and are often overlooked. Many communities already have the skills and knowledge to adapt, but need greater support to do so.
- Appropriate governance to enhance adaptation at various scales (spatial and institutional) is not well understood. Evidence-based policy making should factor in climate change uncertainties. Currently there is a disconnect between policy makers and researchers across Africa.
- There needs to be capacity building for science-policy literacy among researchers as well as greater interaction with communities to enable citizen-science, and this should go beyond the life-span of any single research programme.
- Climate adaptation should be mainstreamed in the government's financial and budgetary mechanisms, which will require better monitoring and assessment. Metrics should be developed to enable more agile evaluation of policies at the national and local scales.
- Farming practices are currently very vulnerable to the weather. There is a lack of research on cultivation and use of indigenous climate-resilient crops and effective pest control methods. Diverse cropping systems are essential, as is a focus on providing climate-resilient food as well as incomes for smallholder farmers, in partnership with organisations along the whole value chain. The gender productivity gaps should also be addressed.
- More research is required into socio-ecological agricultural resilience including how to restore natural ecosystems, set buffer zones and monitor biodiversity.
- There should be an integrated approach to land use and water resource planning in urban and rural settings and across regional boundaries, to account for the impacts of adaptation interventions up and downstream.
- Interdisciplinary research is vital to enable understanding of how climate, development, economic growth and migration are interlinked in complex ways.

East Africa

The East African event also recognised the need for more transdisciplinary research involving collaboration of local stakeholders from across different sectors and engagement of local communities throughout the process. By strengthening links between research, policy and decision-making, research uptake and impact can be increased.

It was acknowledged that data is unique to local contexts and not necessarily repeatable elsewhere. There is strong disparity between rural and urban communities and their ways of living and how climate change impacts them.

Specific East African points included:

- Climate finance governance should be better understood at different levels. Collaborations with the Green Climate Fund could be explored to allocate financial support for adaptation to the East Africa region.
- Research to understand how climate change exacerbates resource-based conflicts is needed.
- Most of the research is currently led by the global North and there are large gaps in research capacity within the East Africa region, this needs to be enhanced to enable more sustainable research and research outcomes.
- Combined and concurrent climate risks are inherently unpredictable; a systems-wide approach which brings together fragmented data at different resolutions to understand systemic risk is required.
  - There is a need for more accurate climate risk information at the local level, communicated in ways that are relevant for different users.
  - There is a lack of historical climate risk data for the East Africa region which could inform future adaptation measures.
  - Advances in computing and Artificial Intelligence enable rapid predictions across time-scales (hours to decades) – this should be linked to early warning systems.

- Nature-based and highly participatory, action-oriented research, using approaches such as those taken in agroecology will make East Africa more resilient.
  - Food security requires responsible governance (e.g. GM crops) and greater incentives for private sector participation.
  - Research into livestock resilience to climate change is missing.
- There is a lack of research around health and climate, specifically vulnerability and risk assessment, capacity to adapt, financing for resilient health systems, measuring the impact of climate change on health and modelling future scenarios and impacts.
- Data for understanding hydrological systems and water use in East Africa is sparse, better water system models that capture complex interactions with climate change are needed. Regulations can be used to control water demand (e.g. limiting water-intensive agricultural and industrial activities in water-deficit areas), if data is available.
- Ecosystem services provided by wetlands, forest areas and savannahs (such as water and air quality and biodiversity) can benefit community resilience, providing the appropriate policies are in place.
- More research is needed into gender and the role of social networks in climate adaptation, as well as understanding whether interventions made in one location may have unintended impacts elsewhere.

Southern and Western Africa

The Southern and Western African priorities focused on greater coordination between researchers and practitioners in order to translate their work into practical solutions and strengthening links to policy makers. Building equity into solutions and deriving co-benefits to enable sustainable development were also considered critical as was the need for greater international collaboration and access to funding.

For research-specific adaptation gaps, the following interconnected issues were raised by both regions:

- Nature Based Solutions offer potential co-benefits (enhanced long-term delivery of ecosystem services, environmental justice, environmental stewardship, increased productivity of landscapes and increased resilience).
- There is a coordinated drive in Southern Africa towards developing various agroforestry systems to mitigate climate risk for agriculture.
- Food security and "hidden hunger" is an issue. While many staple crops provide adequate calories, many provide inadequate micronutrients, in particular mineral micronutrients.
- Further research to understand which indigenous crops in Southern Africa are most resilient to drought; the food system is dominated by rain-fed agriculture and there is need to develop and strengthen water systems and land management.
- Indigenous knowledge could also benefit early warning systems.
- Western African also highlighted the requirements for expanding current knowledge around climate science. There are substantial gaps in our understanding of the climate system in West Africa, and potentially greater gaps in the translation and application of research and in meeting the information needs of users.

Q2: What examples are there of transformative adaptation research enabling action through addressing social justice, capacity building and governance? And why are these considered transformative in an African context?

Common principles which are important for transformative adaptation, were identified as:

- Multidisciplinary research
- Community-centered approaches which build community knowledge
- Integrating indigenous and local knowledge with scientific knowledge
- Engendering adaptation research and actions
- The ability to scale up from pilots or drive research through to innovation
- Understanding the consequences of adaptation actions including on other linked systems
- Linking policy implementation and decision-making process with evidence and
- Financial commitment

Multidisciplinary research is crucial as it enables the effective translation of research through to implementation. For example, there is a lot of research into sustainable cropping in Africa, but training and education is needed to encourage farmers on the ground to use the new advances and build community knowledge. Inclusive research allows for the co-production of bottom-up research ideas with local stakeholders (including women and other under-represented groups), with greater potential to benefit community livelihoods. There is a need to build the capacity of researchers (through university support) and local communities for action-oriented research and knowledge brokering, to help drive research uptake.

Case study 1: Future Climate For Africa (FCFA)

The FRACTAL project led by the University of Cape Town, have embedded researchers in a selection of southern African cities to co-produce with other stakeholders relevant knowledge that will support resilient development pathways and enable decision-makers to better integrate pertinent climate knowledge into their resource management decisions and urban development planning.

Transformative research outcomes have the potential to offer co-benefits, for example promotion of e-cooking as an option for local communities will enhance both climate mitigation and adaptation efforts and nature based solutions, such as species-site matching to restore degraded grasslands and forests can enhance biodiversity whilst enabling communities to preserve and benefit from natural resources, resulting in a greater long-term resilience.

Another opportunity for transformative research is in the agricultural sector through breeding crop varieties that would withstand changes in temperatures, resulting in greater food security. The African continent has a diverse and unique agricultural history and we need to identify communities that have already successfully adapted to environmental change in the past.

Adaptation interventions don't exist in closed systems and can have cascading impacts, they also need to be able to be scaled up. Data that informs these sort of issues should be shared across the continent and this poses challenges around how data collection is designed, who collects and owns data and the knowledge generated. Social inequalities are highly aligned with data inequalities; we need to consider the transformative nature of data generation and circulation, which can transform perceptions, how people communicate and interact, help to connect data at different scales and inform governance.

There is potential to learn from approaches taken to reduce the risk of non-climate-related hazards. The Eastern and Southern Africa Regional Seismological Working Group (ESARSWG) network spans nine countries along the East Africa Rift. The data are analysed collectively within the network to produce seismological bulletins for the region and compile a regional earthquake catalogue for use in periodic regional seismic hazard analysis update. This allows an agile approach and a rapid response.

The Sustainable Energy Access and Climate Action Plan (SEACAP) is an example of linking policy implementation and research. SEACAP provides a handbook on how to translate political commitment into practical measures. It provides step-by-step guidance and examples of measures relevant for local authorities in a Sub Saharan context which can be flexed to adapt to the local context.

Transformative research requires longer term (5-10 year) financial support. It is critical to sustain impact beyond the lifetime of a project and create the right policy landscape and sustainable business models for the long term. This will require funding and structural support from government to community levels. Projects should try to partner with local actors (government/business/NGO/Universities) to support longer term follow-up, e.g. locally led data collection and ongoing reflection.

Case Study 2: Transformative agriculture

Harnessing the benefits of African leafy vegetables for smallholder farmers and their households:

- The Universities of York, Newcastle, North West (South Africa) and ARC South Africa are promoting smallholder farmer cultivation of climate-resilient indigenous crops.
- They have secured market access and are developing new value-added products for new markets, working with women and youth farmers - the enterprise aspect is attracting youth back into agriculture.
- This is transformative to the livelihoods of farmers and can be scaled up. The project is linked to the national breeding programme for input of new improved varieties and is building capacity in local universities too.

Climate-smart agricultural practices, such as agroforestry, conservation agriculture, drought tolerant crops, push-pull techniques and integrated pest management studied by Consortium of International Agricultural Research Centers (CGIAR), donors, national governments and civil society organizations has resulted in farmers being actively involved in research pilots and scaling solutions up locally. Large-scale farming can also share best practice with small scale subsistence farmers.

Participatory Integrated Climate Services for Agriculture (PICSA) has been used in several countries in Southern and Western Africa including Mozambique, Malawi, Lesotho, Zimbabwe, Ghana, Burkina Faso, Senegal and Mali. The project worked closely with:

- National and regional meteorological services to build their capacity in rescuing, cleaning and analysing historical data so that they are able to communicate useful and useable products to farmers.
- Extension services and other intermediaries to support them in empowering farmers with a combination of climate and weather information (historical, seasonal and short-term forecasts) and participatory decision-making tools.

This has been successful in encouraging farmers to make adaptation changes in different crops, livestock and other livelihood enterprises.

Case study 3: Approaches to water security management

The REACH Programme has worked with partners in the Awash Basin Development Authority (Ethiopia) to understand climate change risk in East Africa and has helped strengthen future water resource planning under climate change. The work has also helped to ensure that water and WASH facilities are available for the most vulnerable.

The NIMFRU project has been ongoing in Uganda to understand the Water Crowding Index (WCI) needs of communities and how to enhance their capacity to undertake preparedness actions for flood risk and reduce the impact on their livelihoods.

Ecosystem restoration and sustainable hydropower production could enable transformative adaptation. For instance, the crisis of hydropower production at Ntaruka station in Rwanda in 2003 was due to poor management of the upstream wetlands and reduced rainfall in previous years. Different ecosystem adaptation actions that benefited poor rural households saw the station returned to full operational capacity.

In Sakai, Kenya, community based adaptation to drought provided agricultural extension services, conservation training, local forecasts and water supply through sand dams, which enabled farmers to produce food over successive seasonal droughts with harvests up to five times greater than for those who were not involved in the pilot programme.

Credit: Asalu Amos, Co-Investigator, NIMFRU Project

Q3: What forms of partnerships are required to achieve these transformations? How best should the UK engage African researchers and policy makers in the in pursuing these transformative opportunities?

The types of partnerships that have enabled climate adaptation transformations have found to be longer-term, multi-sector partnerships which bring local stakeholders into decision-making, including non-state actors and experts from local communities. This approach enables evidence-based decision making now and for the future, but relies upon access to timely data which is openly shared.

Transformational partnerships should be balanced and equitable, with equal opportunities for everyone to share views from global north and global south perspectives. From a climate justice angle, affluent communities (past colonial powers) should support African communities to adapt as they have caused many of the current local issues. Research capacity building is still required in many African regions and the role of UK research partnerships needs to shift to supporting and enabling action-oriented research with shared and equitable leadership between African and UK researchers. The African research agenda is often driven by research funding agencies which sit outside of Africa and it is crucial for context specific research priorities to be co-designed. Additionally, research should be more agile to enable it to respond to dynamic and evolving adaptation challenges.

Communities are the main end-users of adaptation interventions and need to be educated and empowered to do so. Creating space for the most vulnerable to influence local planning for climate adaptation can enhance uptake and avoid exacerbating poverty. Appropriate tools and participatory approaches that allow us to capture these different voices are needed E.g. developing scenarios of future land use and land cover change in East Africa, under the KESHO framework.

Long-term partnerships with sustainable funding allow for greater transdisciplinary research that brings different stakeholders together. Partnerships between researchers and local governments, and data collection for adaptation need to be longer term than most projects allow for. We need to develop adaptation indicators and understand better how to track progress in adaptation, which also requires long term support.

Case study 4: The Ada consortium

The Ada consortium brought together government and non-state actors to design, pilot and implement the County Climate Change Fund (CCCF) mechanism in Kenya. This is now being scaled out nationally after 10 years, and this long period allowed necessary learning and tweaking to take place.

Partnerships that allow for open and bottom-up networking could persist longer than academic projects might and create opportunities to partner with interest groups aiming to support communities of practice. Knowledge brokering is also important, learning from the past to inform the future.

Partnerships which link research institutions, government, practitioners and funding agencies around specific domains (e.g. urban water security) involving key stakeholders (local government, utilities, private sector, NGOs) may be more successful in addressing specific shared problems than individual organisations. These can then be scaled as appropriate e.g. from in-country to across countries at the regional scale.

Case study 5: Coordinating Policy

The EAC Partner States have signed and ratified several International Conventions and Treaties These include:

- The Convention on Biological Diversity (CBD)
- The United Nations Framework Convention on Climate Change (UNFCCC)
- The Cartagena Protocol on Biosafety (CPB)
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora
- The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, and
- The United Nations Convention on Combating Desertification (UNCCD)

The East Africa Commission could help to address common issues across the region by developing coordinated policies that will guide member states in addressing the adaptation gaps that are common to all. Connections with national/international policy and donor organisations will enable transformations to become possible.

Government support for adaptation is essential, but there are political sensitivities that adaptation research and action touch upon, including finance. Public-Private Partnerships (PPP) are needed with a commitment from Governments and the Private Sector. We need to recognise the differences between private sector investment in trade, development and adaptation, where barriers to investment lie and to document investments being made now, and those needed in future.

A specific example of private sector engagement is with the insurance sector. They quantify climate-related risks and losses for clients and can communicate the impact on insurance premiums and business models. By working with insurers to make climate adaptation considerations a prerequisite for insurance of long-term investments, greater investment in adaptation finance by the private sector as well as the state can be encouraged.

Q4: Evidence shows that Africa is registering relatively low presence at the global UNFCCC climate action platforms such as the Global Climate Action Portal (see here: https://climateaction.unfccc.int/). How can we best profile adaptation research and actions taking place in various African countries to the global scale? And what support is required to achieve this?

There is a lot of work on adaptation that has been undertaken by African researchers and we need to better understand adaptation actions that are already taking place. Africa have long-held experience and expertise in certain fields of adaptation such as nature-based solutions, this should be recognised and better evidenced on global action platforms. Creating opportunities to profile African researchers from different regions and showcase their work on adaptation has the potential to benefit us all globally e.g. What can the Cerrado learn from climate adaptation in the Sahel? What areas in East Africa are representative right now of conditions that large parts of the region or the world will face in 2040-50?

A review of research undertaken to date would contribute to greater understanding of what has been and still needs to be achieved, including where industrial partners can add value through commercialisation of research innovations. It is crucial to integrate current climate adaptation research activities in as many platforms as possible and enhance the profile of African research through more publications, with sufficient recognition given to the role of African researchers.

Sharing data between researchers but more importantly between research sectors will be an important part of enabling coordinated adaptation action. Evidence-based adaptation learning platforms are required to enhance awareness, resource access and mentorship by sharing ongoing actions and best practice at local, regional and national levels and providing better access to disaggregated data and information.

There is a growing awareness on the value of narratives of change and adaptation. Research to identify regions and communities that are currently facing specific environmental stress conditions, to study how they cope, tell their stories and promote their successes for scaling up, or translating to other locations e.g. through the use of a wide range of traditional crops and animal breeds will be critical.

African partners are very good at dissemination of research amongst their own networks within African countries, however this has to become global. Co-creation of knowledge with other international partners through equitable partnerships will help to raise the profile of joint action at the global scale. Greater international collaboration is required particularly in West Africa and francophone countries can help to resource new partnerships.

There may be opportunities to better align existing research achievements with current demand for research, a change of language in how outcomes are communicated may be required to meet policy and strategic needs. Improved advocacy skills will ensure relevant messages reach target audiences, including local people. Support for women negotiators in participating in the UNFCC climate actions negotiations will also build capacity and engender tailored decisions and actions for adaptation.

Adaptation and development are interlinked. Monitoring and evaluation metrics are needed to understand when adaptation and development must be considered alongside each other. Many institutions use 'adaptation metrics' to mean inward monitoring of research outputs and less of adaptation outcomes and need to understand better how to translate research outputs and into tangible solutions.

Improved levels of stakeholder engagement has strengthened collective action approaches. For example, the CGIAR (CCAFS) Two Degree initiative is a coalition of hundreds of like-minded partner organizations from around the world, brought together with a single unifying vision for scaling climate smart agriculture. In East Africa, enhanced information and data sharing among key stakeholders will encourage political uptake of climate actions by linking government with technical adaptation experts.

By understanding why there is a low presence on the global action portal and identifying the barriers to overcome this, Africa can have greater presence. It could be helpful to make contact with various organisations such as CR4D (Climate Research for Development in Africa), engage more with UNFCCC National Communications, the regional consultations/points of contact for WCRP and African authors of the IPCC WG2 report for AR6. There are other platforms and forums that should be further explored such as the Next Einstein Forum and weAdapt.org.

Chile

Chile

Background

On 26th August 2021 the UK's Science and Innovation Network, in collaboration with the British Embassy Santiago and UKRI, hosted a workshop with a range of UK and Chilean academics to consider the role of research and innovation in assessing the regional impact and risks of climate change from a local perspective.

Welcoming remarks were given by the British Ambassador to Chile, Louise De Sousa who highlighted the importance of international, collaborative efforts in addressing climate adaptation and resilience challenges and the strength of UK-Chile partnerships for science and innovation, building on the legacy of the Newton-Picarte Fund.

Chile summary

Priority research themes highlighted by speakers and workshop participants included:

- Disaster risk reduction – drought, wildfires
- Biodiversity loss
- Integrated climate risk assessment models
- Multi-dimensional vulnerability
- Resilient housing
- Historical perspectives of resilience
- Impact of climate on agri-ecosystems
- Nature based solutions
- Inequity and social justice

Discussion focused on the question:

What examples are there of transformative adaptation research enabling action through addressing social justice, capacity building and governance?

- What research has improved capabilities and adaptive capacity to reduce vulnerability and climate risk for the poor?
- How can research help communities, businesses and governments grapple with trade-offs when choosing between different adaptation options?
- How is research helping address structural and governance challenges facing countries in adapting to systemic and emergent risks?

For Chile, transformative adaptation could be seen as high-speed, high-impact, fundamental change, for example Chile are rapidly transforming the national energy grid to incorporate more renewable approaches and local communities are turning to tourism to support their livelihoods instead of livestock farming, due to poor conditions brought about by climate change.

Integrated risk assessment models will be important for informing adaptation options, these should include policy relevant indicators of risk, with interactive interfaces to enable engagement of different stakeholders with model outputs. Multi-dimensional vulnerability, which takes into account gender, class, ethnicity, age, race, disability etc. must be better understood in order to enhance the resilience of marginalised groups.

Transformative research processes coupled with greater urgency are required to enable transformative research outcomes. Research and action at the local level must consider adaptation from various viewpoints – what needs to adapt (people, economy or nature?). For example, resilient housing is a particular problem in Chile, which the government are researching. Mobile phone-based monitoring networks are in place to collect data for housing risk during disaster events and emergency response, preparedness and planning. There need to be official assessments of climate risk and use of these mobile phone networks could be expanded to incorporate climate-related risks as well.

Co-production of adaptation options and social learning will enhance the traditional research pipeline, incorporating tacit knowledge as well as explicit knowledge into adaptation solutions. When scientific evidence is trusted, people are more willing to change their habits, so research outcomes must be communicated clearly and in local languages to enable real action.

Case study 6: Agri-Ecosystems

Researchers in Chile are working directly with poor rural communities to gain local knowledge of agri-eco systems and how to respond to climate risks. There is a rich reservoir of knowledge and culture amongst the 66 different agri-ecosystems that exist across Chile, with broad networks of stakeholders. NGO's, academics, local communities and government are working together to protect traditional agriculture, over more technologically driven approaches.

There is a need to capitalise on unique strengths for Chile such as opportunities for nature-based solutions to climate risks, for example the trapping of fog in the highlands to provide greater water security for local communities. It is also important to acknowledge and learn from past strengths in resilience to climate risks that existed historically for Chile. Disaster response in terms of emergency medicine and vaccines used to be a strength, but various drivers have led to greater vulnerability currently.

The impacts of climate change and the net zero agenda will not be felt equally by different stakeholders and social justice must be considered as part of adaptation solutions. There are participatory approaches used in Africa that have successfully been applied to local communities in Chile, which can help to address social justice issues in the face of climate risks.

Adaptation and resilience research is fragmented, with prototypes in different areas that should be better joined up to enable more transformative action. A deeper understanding of key enablers and barriers for uptake of climate services would help to develop a roadmap for climate services that provide benefit to society.

Chile are supporting positive trends in other areas, such as greening financial systems. It is crucial to translate climate impact into financial risk as a route to engaging economic policy makers in taking transformative action. Adaptation finance requires both public and private investment, but cost-benefit analysis is often ineffective and too long term to capture the attention of economic sectors. Scenario planning is an important tool for providing economic perspectives and demonstrating how risk exposure leads to higher capital costs.

Long term transformations cannot be achieved without proper planning and climate science has to better inform decision making and policy development e.g. land use management, or how drought effects electricity production. Research needs to set the targets for change to policy makers, with targets embedded in local contexts.

China

China

As part of the COP26 Adaptation and Resilience events series, the Administrative Centre for China's Agenda 21 (ACCA21) and UKRI jointly hosted a workshop on 15th September 2021.

The event engaged decision makers, local researchers, and practitioners in interactive conversations and helped to showcase existing research strengths and inform future adaptation and resilience research priorities.

The research showcase highlighted priority climate adaptation and resilience research themes for ACCA21, including but not limited to:

- Urban adaptation and resilience
- Agriculture and food security
- Marine biodiversity
- Human health and wellbeing
- Nature based solutions for resilient cities
- Land use management at national and sub-national scales
- Adaptation finance

Discussions focussed around five questions that were prioritised by ACCA21 (derived from the events series core question set), aiming to identify key priorities and gaps for regional adaptation and resilience research.

Q1: What are the existing climate adaptation gaps and what research is needed to respond to them?

There is a need for an integrated system for adaptation in cities, with big data approaches taken to link diverse sources of information together. A better understanding of the health impacts and socioeconomic costs of extreme heat and ambient air pollution in cities and how to respond in emergencies is required, particularly for vulnerable groups such as the elderly. Clean air actions and climate mitigation measures must be more aligned to benefit each other.

The impacts of extreme weather should be better understood not just for people in cities, but also for the agricultural sector and the spread of pests and diseases. Where adaptation options are developed for the agricultural sector, further research around their implications is required, in terms of cost and the impact on farmers' incomes, prospects for broader food security and how to motivate key economic entities to coordinate actions in the agricultural sector.

Case study 7: Adaptation in agriculture

Key adaptation measures being undertaken by farmers and governments in China include:

- Changes in sowing seasons
- Growing new species of crops
- Improved irrigation techniques and water storage
- Adapting use of fertilisers
- Soil improvement and enhanced fire risk management and emergency response

Enhancing carbon sequestration for oceans is fundamental, it is the largest body on earth and the future of survival and climate solutions. Different pathways to trap CO2 should be properly evaluated and bio/geoengineering could be one approach.

Research is crucial to gaining a better understanding of the impact of climate change on evolution of phytoplankton diversity and simulating the effects on marine biological pump function and carbon storage. Research to understand single, short term stressors exist, but further research into multiple, long term stressors needs greater attention.

For management of the built environment, there is a need for research into Nature Based Solutions (NBS) for tackling multiple adaptation and resilience challenges, such as flood risk and water security. A multi-domain framework should be developed to assess NBS placement options, with trade-offs at different scales considered.

It is important to embed climate adaptation and mitigation approaches within broader development pathways. Supporting the health and wellbeing of vulnerable communities are key foundations in reducing disaster risk by enhancing their capacity to prepare, respond and recover from extreme weather events and climate-induced natural hazards. Socioeconomic costs and consequences should be quantified. Research should support long term gathering and integration of epidemiology and climate data, to improve characterisation of relationships between these risk factors.

Another issue is the gap between the natural and social sciences, as the two need to interact more. There is a lack of joint research design between scientists and policy makers and researchers need to better understand and engage with policymaking processes to enable research uptake.

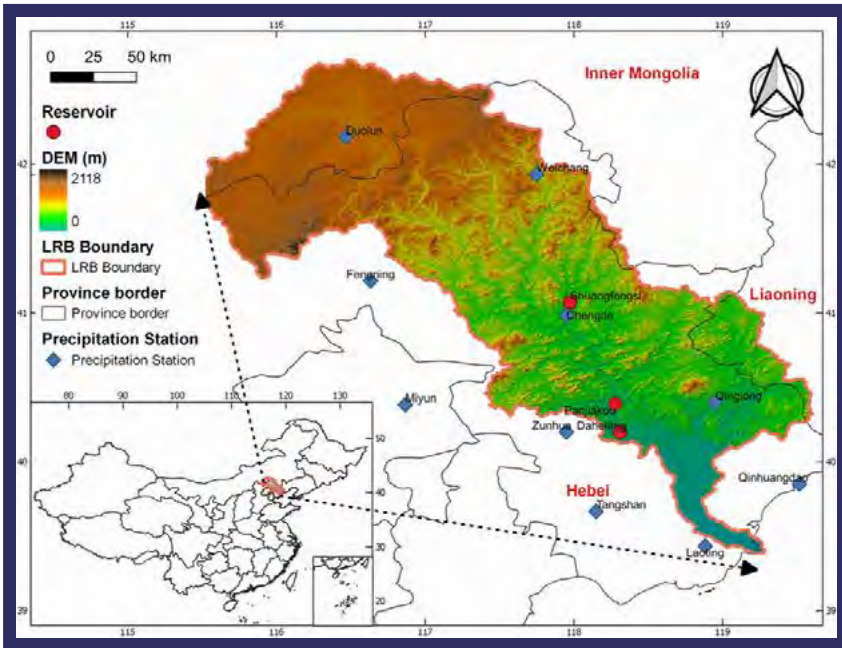
Development of new methodologies including long term observation and critical simulation technologies for predicting past and future climate will be important. As access to and use of technology is increasing around the world as part of adaptation solutions, there is a need to better understand the potential impact these new technologies may have on future climate as well.

Q2: What planning and implementation regimes are appropriate at national, sub-national and local level to make sure accelerated adaptation is also increasing the general well-being of local community?

Accelerated adaptation is in some instances more urgent than mitigation, as China are experiencing the impacts of climate change now. In China, climate adaptation strategies for urban settings actually arose before mitigation strategies were developed. The first national adaptation strategy was developed in 2013, with demonstration projects informing future implementation of adaptation solutions to bring about both incremental and transformational change.

Research must consider how different adaptation measures might interact across spatial scales. National planning processes sit above local level processes and these need to complement each other. Developing a national adaptation strategy requires a lot of resource over long timescales, as part of this there should be greater financial support for local community-level demonstration projects.

There is potential for national and subnational agendas to be contradictory, those setting the agendas must understand the trade-offs between climate targets and their impact on society, such as changes in demand for land use. Different adaptation options should be considered in parallel, including both engineering-based solutions and nature-based solutions, as a hybrid approach is required.



Case study 8: Trade-offs

Trade-offs at different scales should be considered when implementing nature-based solutions. For example, afforestation of river basins has upstream and downstream implications for land use and sustainable water systems management. Policies to protect water resources for downstream areas (outside the basin) can impact livelihoods locally (e.g. potential for aquaculture) and trans-boundary eco compensation schemes will be important to support local communities.

Credit: Zhao, J., Chen, H., Liang, Q. et al. Large-scale flood risk assessment under different development strategies: the Luanhe River Basin in China. Sustain Sci (2021). https://doi.org/10.1007/s11625-021-01034-6

City-level adaption plans are under development in China, framed around an 'ecological civilisation strategy', as a result China are considered top performers in climate adaptive cities, where traditional development practices are becoming greener and this trend must continue across more cities. City-level adaptation plans should consider both rapid urbanisation process in interior China as well as retrofitting in coastal regions.

Adaptation is a local process with multiple dimensions; whilst decision making varies with different governable systems, it is ultimately the local communities who will experience the impacts of adaptation solutions and have the knowledge to help inform their successful deployment. It is important that we use research to facilitate the abilities of locals to act, but this requires institutional and financial resources to be made available as well.

Q3: What lessons can we learn from current research on the evaluation of adaptation feasibility and outcomes from multiple viewpoints? How can evaluation research feed into the immediate needs of adjusting current climate adaptation policy, finance and programming?

There is a need to protect the people at most risk of climate impacts from a health perspective, including the elderly, the young and the poorest, as well as outdoor workers, through adaptation policies.

When it comes to city-level planning, developers must look beyond the development of large urban cities and consider other approaches that offer greater climate resilience.

Research can help to understand how climate change will alter the resilience of the highly engineered systems we rely on. There should be space for innovation, private enterprise and corporate responsibility to be integrated as part of these systems.

Social equity is linked to exposure to climate impacts; the affordability of adaptation solutions and access to resources/capital is not equitable across different stakeholders or locations. It is important to ensure adaptation measures are accessible and locals co-design these with research and policy makers.

Enabling multi-stakeholder participation in research and interaction between different sectors will help to understand how climate adaptation options impact local lives and to 'learn by doing'. It will be important to embed adaptive climate risk governance within interventions to account for changing climate scenarios, with involvement of stakeholders in decision-making at local and municipal levels.

Q4: How can adaptation finance meet adaptation needs and what modalities can be used to get finance flow to where it is needed in building resilience urgently and at scale?

There is plenty of green finance, investment and technology innovation within the climate mitigation sector, but this is not as well addressed for climate adaptation currently.

Greener growth of the industrial sector is critical, there should be greater financial incentives and reward for lower emission/lower polluting companies.

There are opportunities to increase revenue from green industries through carbon tax and carbon trading mechanisms, such as low-interest loans, public stock offerings, and green bonds and it should be made easier to sell green bonds/IPO (Initial Public Offering) on the market. Economists and the finance sector should work together to agree on benchmarks of carbon pricing, but the market should influence price changes.

There are lots of challenges for climate adaptation finance, for example how to avoid trade-offs with green finance standards. It is important to evaluate the effects of financial products and assistance for adaptation and whether they enhance climate resilience for the most vulnerable.

Q5: What key messages around adaptation and resilience would you like to see given at COP26?

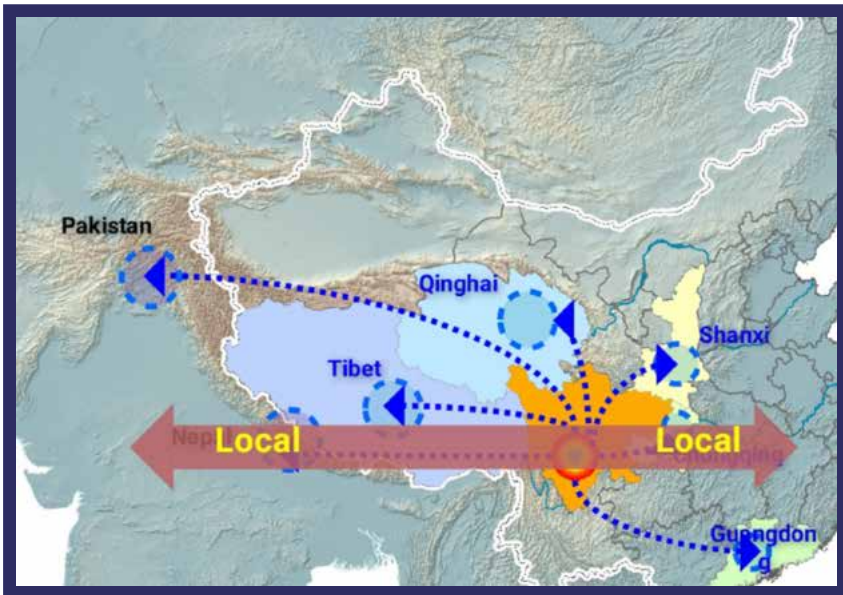
At COP26 it is critical to enhance understanding of the climate emergency to encourage accelerated adaptation; disaster risk reduction is particularly urgent.

A greater focus on cultural change that reverses processes of impoverishment and marginalisation is needed, with more attention on 'one health' and social inclusion. A cultural shift is required to build an economic culture of logical investment to build resilience early.

We should promote the idea that adaptation is critical to the climate change mitigation strategy.

From a research perspective there is a need for:

- A systems approach to adaptation with all actors and stakeholders working together to identify solutions that will work in practice. This is particularly important in the agricultural sector, where adaptation and mitigation strategies are focussed on alternative agricultural practices with the wider impacts/trade-offs not well understood.
- More research into marine science, to better understand the impact of climate change on marine ecosystems and the communities that depend on them, to develop a sustainable human-ocean wellbeing system.
- To increase multi and inter-disciplinary research; we must improve the ability of researchers to work together across disciplines and for academics to understand how to provide/ communicate more convincing solutions to society where there is still high uncertainty.
- More emphasis on the importance of cities in climate adaptation and consideration of the resilience of people and their health and wellbeing in cities. Urbanisation is set to increase further over the next few decades.
- Greater understanding of climate-health-socioeconomic interactions and what adaptive measures are needed.
- New alliances and cooperation, for people, technology, science and education.
  - Regional cooperation is needed for successful adaptation; rich and poorer regions, developed and developing countries working together to coordinate adaptation action.
  - Learning from each other; sharing lessons learned at the regional, local and city levels (e.g. eco-civilisation strategy), identifying benefits of incremental adaptation and diversifying pathways to adaptation.



Credit: Professor Al Likun, Chinese Academy of Sciences (Invited expert of APN)

Case study 9: Alliances for adaptation

The Asia-Pacific Network for Global Change Research (APN) promotes shared advances towards the Sustainable Development Goals (SDGs) and takes a problem driven approach to climate adaptation at global to local levels. For example, the APN is helping the WCRP (World Climate Research Programme) to implement the CORDEX (Coordinated Regional Downscaling Experiment) as part of a national initiative to plan future adaptation policies, and mountain hazard modelling approaches applied in West China are being translated to other locations facing similar risks in South Asia, Vietnam, Pakistan, Nepal and Italy via APN partners.

India

India

Background

A joint COP26 partnership event was organised by the Ministry of Earth Science (MoES), Government of India and UK Research and Innovation (UKRI) on Wednesday, 29th September 2021. The event brought together leading academics, innovators and businesses in the UK and India with government representatives to discuss the role of research and innovation in climate change adaptation and resilience.

Some of the priority research themes for India highlighted by the event speakers and co-hosts include:

- Earth systems modelling and climate change projections
- Adaptation of agricultural systems
- Food and water security
- Coastal hazards, vulnerability and risk
- Early warning systems and multi-hazards
- Ocean resilience
- Energy security
- Health and wellbeing

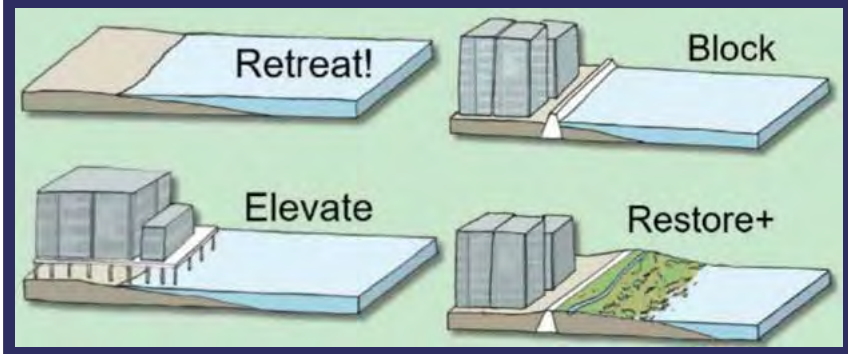
India summary

Prof K VijayRaghavan, Principal Scientific Advisor (PSA) to Government of India, gave the keynote address where he highlighted serious climate change concerns for India, the importance of UK-India partnerships in research and innovation and potential areas for future cooperation. This was followed by a panel discussion between senior representatives from key Indian government departments working on climate change research and innovation.
The panellists explored the gaps, feasibility and opportunities for adaptation and resilience research, focussed on the series core question set.

Q1: What are the major adaptation research gaps in India?

The mean summer monsoon precipitation over India and its variability are projected to increase as global warming continues during the 21st century. Climate change is altering the water cycle leading to significant decrease of moderate rainfall events, while heavy and very heavy rainfall events and associated flooding have increased in frequency as is evident in the 2013 Uttarakhand flash floods, 2015 Chennai floods and 2018 Kerala floods.

Rapid warming is accompanied with a rapid rise in sea level; India's coastline has experienced an average increase of 3.2 - 5 millimetres per year since 1993. Further research is needed to understand the impact of climate change on the lives and lifestyles of coastal and ocean communities. Supporting the fisheries sector is a priority, where operational practices are already having to change in response to climate impacts.



Credit: Dr M. V. Ramana Murthy, Director, NCCR, Chennai

Case study 10: Chellanam fishing village

Chellanam fishing village in Ernakulam District has more than 13,000 people and 1000 houses situated very close to the sea, it is a narrow landform 150m–1800m wide and has been suffering from sea level rise and coastal erosion. The image opposite illustrates some coastal erosion management options.

Coastal cities are highly vulnerable to hydrometeorological hazards such as cyclones, tsunamis, coastal erosion, and flooding. India through its Ministry of Earth Sciences has developed two operational integrated flood warning systems (iflows) for two urban cities namely Chennai and Mumbai, wherein flood inundation information is given in advance using forecasted precipitation data. However, there is currently a lack of data in urban and coastal areas and further research can help to safeguard livelihoods and sustainable development in highly densely populated areas and megacities located along the coastlines.

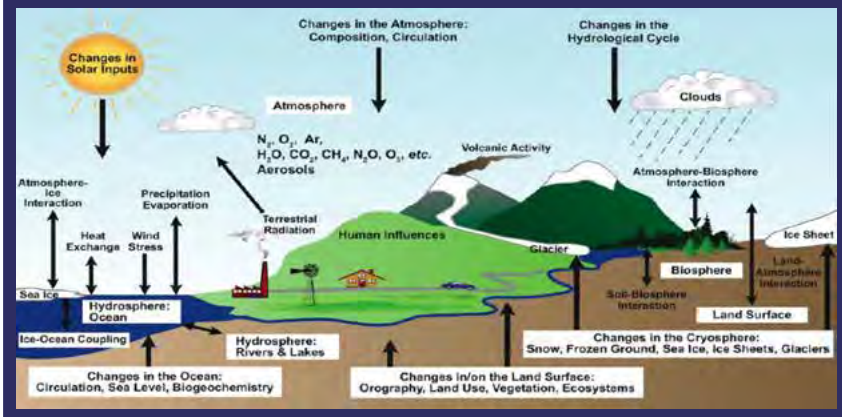
Urbanisation is increasing in India and the battle for adaptation will be won or lost in cities (it's projected that 68% of the world's population will live in urban areas by 2050). City systems need early warning systems in place to reduce potential threats. Research around how to reinforce and design existing/future urban infrastructure (water, power, roads etc) to be resilient to current and future climate risks is critical, as is understanding sustainable resource management through blue/green infrastructures to help build climate resilience. A deeper understanding of ecosystem functions and processes and ways in which India can harness sustainable solutions to protect against climate threats such as sea level rise, cyclones, saline intrusion and water quality changes are required e.g. mangrove restoration.

Location-specific climate vulnerability assessments are needed (ecosystem, or state-level) in India, over long time periods. Development of tools for downscaling climate model outputs and climate projections at local levels (for coastal, urban, rural areas) will be a key component. A common framework for coastal vulnerability and risk assessment is required which could be replicated for all coastal areas of the country.

Vulnerability at the farm systems-level should be assessed with models and decision support tools developed for farmers around irrigation practices, soil moisture and land resource use. E.g. encouragement of drip irrigation, sowing less rainfed dependent crops and more monsoon/winter crops to lower impacts on water resources. A better understanding of feedback cycles within agri-systems for improved water resource planning will be key.

Water is to adaptation what energy is to mitigation. Monitoring of hydrological processes and data collection are key to managing water resources. Often key tools for managing water lie outside the water sector, so taking a nexus view interlinked with the food and energy sectors is important. For example, it is possible to decarbonize irrigation through solar-powered irrigation pumps and farmers can sell excess electricity if this is connected to the grid. Re-examination of the water allocation policies and operating rules should also be taken up to see how these need to be updated to handle extremes that are likely to arise. Hydrologic design criteria, standards and guidelines need to be revisited and revised.

A system to monitor the multifactorial impacts of climate change on human health is needed for India and beyond, with more complex models to capture sources of stress. Rising temperatures, changing water levels and extreme weather conditions affect viruses and bacteria, potentially making them more invasive. In-depth research on the interrelationships between climatic variations and life forms is important. A 'one-health' approach will be essential for addressing the health impacts of climate



Credit: Dr R. Krishnan, Centre for Climate Change Research, IITM Pune

Case study 11: Earth System Models (ESMs)

Earth System Models (ESMs) provide information about physical, chemical and biological elements governing earth systems and are fundamental for understanding climate change and dealing with its impacts.

change, preserving biodiversity as well as assessing the effectiveness of adaptation responses.

Proper planning and development is integral in the transition towards renewable energy in India. One of the key challenges is the variability in wind and solar power potential across India's highly variable terrain. There is a need to develop better models to forecast these elements accurately.

Q2: How to evaluate the feasibility of adaptation options and outcomes for resilient and sustainable development?

Climate adaptation action is typically in response to stressors (climate and non-climate). We have to better understand vulnerabilities, how people respond to stressors and the interplay between them, through a social protection lens. One of the missing links in evaluation of adaptation actions is a good method for establishing the true costs of adaptation, as adaptation actions are often bundled together.

We should evaluate how adaptation interventions can bring about co-benefits, for example in enhancing the resilience of the health sector. Adaptation for improved resilience to climate change could offer an opportunity to address these basic issues for sustainable development as well.

We must have clear aims for evaluating adaptation options, developed with local stakeholders to ensure positive development outcomes. Optimum use of satellite data and techniques like remote sensing, GIS, DSS, etc., need to be further explored to develop, test, implement and monitor innovative adaptation options. This will help bridge the gap between data and information/service delivery. Methodology to better understand stakeholder behaviour towards adaptation options are also integral.

We need a step-change in data availability that can support locally-relevant and socially acceptable climate change adaptation, which could include low-cost technologies, pervasive sensing, participatory monitoring, and citizen science.

Q3: What examples are there of transformative adaptation research enabling action through addressing social justice, capacity building and governance?

Capacity building is key for transformative adaptation research outcomes in India, this is needed most for organisations that implement adaptation actions at grassroot levels. For local communities to utilise modern technologies, proper training opportunities to support uptake are required.

Studying adaptation and proposing relevant solutions/policies require transdisciplinary and cross-sector research, to fully consider all aspects of the system and understand complex issues like displacement in a transformative manner. Scientific input to adaptation planning is vital and there is a need to inter-link the agencies involved in developing strategies for adaptation-mitigation co-benefits.

Enhanced communication of research outputs between different stakeholders across the country and improved strategies for communicating climate information to public and policy makers is critical. It is imperative for key institutions to come together

Case study 12: Systems level transformation

The Andhra Pradesh Community Managed Natural Farming (APCNF) initiative aims to bring about 'Systemwide Agro-Ecology Transformation' by providing an integrated institutional mechanism for all programmes, schemes and activities intended for farmer's empowerment; encompassing welfare, development, capacity enhancement, credit flow and financial support.

Credit: The Andhra Pradesh Community Managed Natural Farming (APCNF) – https://apcnf.in/wp-content/uploads/2020/05/Can-Zero-Budget-Natural-Farming-Save-Input-Costs-and-Fertiliser-Subsidies.pdf

to understand their respective roles in climate risk reduction and enhancing preparedness. Within India, different states are developing adaptation plans, with data centres established across India. There is a need to create a shared information database to assess climate risk and map vulnerability across the country.

Q4: How can research funders, universities and data managers best champion inclusive, urgent and solutions-oriented adaptation research?

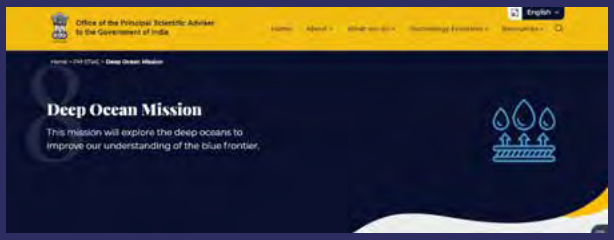
It is important to identify shared priority areas for future research in India in relation to climate change impacts, such as:

- Water security
- Food production
- Agricultural water usage
- Risk reduction for children and elderly
- Increasing energy demand
- Sea level rise and its impacts on coastal areas
- Development of user friendly tools for mitigation of coastal hazards

Funders can ensure that programmes of research and innovation they support are designed to be usable and demand driven as well as tailored to the specific context.

Research outcomes for adaptation should be scalable, affordable and more importantly adjustable, to account for future climate scenarios. Framing adaptation at the local level is important, but this needs to be embedded in a matrixed approach to managing adaptation action at the national and global scales as well. Research funders can help to link different research stakeholders together at local, national and international levels through funding opportunities and universities can support a drive for more interdisciplinary research at a range of scales.

There is a need to build capacity at the state level for developing adaptation action plans and influencing adaptation strategies. Sub-national units and state governments should be involved in the implementation of adaptation actions, together with local stakeholders to engage in joint decision making and monitoring and evaluation of the approaches taken. Research can enhance capacity of key stakeholders to support co-production of local adaptation action.



Case study 13: Deep Ocean Mission

India has announced the Deep Ocean Mission which aims to develop an ocean climate change advisory service to understand and provide future projections of important climate variables on seasonal to decadal time scales. As part of this, India has established the International Training Centre for Operational Oceanography to provide ship-board experience and advanced training in now-casting and forecasting to build capacity and become a centre of excellence in this field.

Latin America

Latin America

Background

The British Embassies in Brazil, Colombia, Mexico and Peru hosted a joint workshop with UKRI on 15th October 2021.

The event gathered a broad view of Latin America's biodiversity landscape in the context of climate change from researchers and local biodiversity-focused organisations to understand how natural ecosystems and the communities that depend on them can adapt to become more resilient and avoid biodiversity loss, in current and future climate scenarios.

The event was opened by Cindy Parker, Regional Director for Science and Innovation at the British Embassy in Brasilia, who talked about the importance of capturing scientific voices from around the globe and highlighted that Latin America represents a region that is really rich in biodiversity but also very vulnerable as a result of climate change.

Case study 14: Marine adaptation

The Peruvian Marine Research Institute (IMARPE) promotes several adaptation interventions which include selective fishing gears, bio-conversion of fishery and aquaculture wastes into fertilizers for organic agriculture, and combining ecotourism with marine Peruvian gastronomy offering traditional dishes.

Images credit: Roger Flores, Red de Acción en Agricultura Alternativa and Edwin Pinto, IMARPE

Latin America summary

Presentations and subsequent discussions at the event highlighted some common priority research themes for climate adaptation and biodiversity in Latin America:

- Biodiversity monitoring
- Interaction of multiple climate change stressors
- Ecosystem services and productivity
- Ecosystem management and governance
- Drought and wildfire risk
- Marine pollution
- Green infrastructure for cities

Discussions focussed around the four events series core questions, aiming to identify key priorities and gaps for regional adaptation and resilience research within the biodiversity context.

Q1: Is there a climate adaptation research gap in your region? If so, what research do you think is needed to respond to it?

Effective ecosystem management that protects local biodiversity can enhance the ability of communities and ecosystems to adapt to climate change. There is demand for more research to better understand the inter-relationship between different species and the impact of climate change on the ecosystem services they provide.

We know very little about species genetic erosion and extinction debt as a result of climate change. Extinctions are complex and delayed, so today's climate impacts will have longer term consequences. We need to combine socio-demographic data, climate data and biogeophysical data to better understand and monitor biodiversity changes caused by climate change.

Further research on the interaction of multiple stressors due to climate change is required. For example, how species respond to habitat transformation is dependent on how these populations are affected by climate.

There is a general lack of information on how communities are already adapting to climate change, for example through changes in their livelihoods. Bioprospection which looks at the molecular structure of organisms and their potential for use by industry (such as drugs, cosmetics, agrochemicals) is an important area of research for adaptation.

We know little about how governance of ecosystems affects ecosystems services that are impacted by climate change. Research should aim to highlight successful local management interventions and explore how to incorporate local measures into national adaptation policies.

Specific research is required into droughts and wildfires in Amazonia, which are increasing in frequency due to climate change and likely to degrade carbon storage and biodiversity. Poor management of flammable ecosystems increases the fragility of nearby non-flammable ecosystems; the way this fragility is experienced (migration, adaptation, loss) needs further research. It is important to further understand how farming practices interact with the long-term effects of climate change, for example how changes in precipitation due to deforestation and resultant feedbacks impact the forest and agriculture sector.

It is also necessary to develop marine forecasting models, particularly along the South American Pacific coast, for short-term, medium-term and long-term observations and species vulnerability assessments, in order to take preventative actions for fishery and aquaculture activities. Pollution sources and how they are affecting marine biodiversity is a particularly important area of research needed.

Further research is required around adaptation solutions to enhance biodiversity in cities, such as green infrastructure and urban greening. Research needs to be combined with new architectural and urban design concepts.

Q2: In the context of biodiversity, how to evaluate the feasibility of adaptation options and outcomes for resilient and sustainable development?

To evaluate the feasibility of adaptation options, it is important to develop a baseline that measurements can be made against. There are large scale data networks across the Latin America region, some going back for many years, and we need to ensure open access of information and make use of long-term baseline data from regional networks, (such as Rainfor, and PPBio) and pair with new networks in altered and managed systems.

A key challenge is tracking adaptation interventions and how well they are working, as well understanding the impacts of climate on biodiversity in the absence of any interventions. Monitoring systems that enable researchers to follow trends in ecosystem changes and the species living within them are essential. Technologies that allow research and interventions to be scaled up are also required.

We need to capture local interventions that enhance the resilience of biodiversity whilst protecting local livelihoods. For example, adaptation towards fire-safe agricultural practices that maintain food security and are less damaging to the environment, but also affordable for farmers.

Land tenure and related policies and governance need to be fully considered as part of adaptation solutions. Management models can cause conflicts if felt to ignore the owner requirements (e.g. carbon market models).

It is important to quantify the benefits of ecosystem services to the local communities to ensure ownership and "buy in" from communities.

Case study 15: The gathering firestorm in Southern Amazonia

Brando et al, 2020: This paper shows, how increasing risk of drought and fire will degrade carbon storage and biodiversity In Amazonia. This is a foreseeable future disaster that could be prevented.

Case study 16: Community governance for conservation case study

Around 80% of Mexico's forest is owned by communities under a model of communal property. Studies have found that when a community's governance dynamics are strong, the forest is well conserved and better managed, whereas weaker governance structures lead to greater vulnerability. Community-led conservation and management of the forest tends to be more effective than carbon-market-based models which can create tensions over public lands.

Case study 17: Local community participation

The Sinchi Institute has several areas of research that involve the participation of local communities and the sustainable use of non-timber products, which offers the possibility of new businesses for people in the Amazon.

Case study 18: Commercialisation case study

In Colombia, the Useful Plants and Fungi project (https://in-colombia.org/) is developing a platform for a Value Chain Network (http://redin-colombia.org/), which will allow the commercialisation of bioproducts from the country's biodiversity, enabling interaction among all the actors across the value chain, and helping to alleviate poverty, inequality and gender balance. Examples like this could be replicated in other countries.

Q3: What examples are there of transformative research enabling action through addressing social justice, capacity building and governance?

There is incredible power in indigenous people, and this can be utilised to improve conservation action. It is important to improve the legal status of their land. There is evidence that market-based policies fail as they can create increased inequality and social injustice.

It is essential to involve local communities in research and interventions. A successful approach used is presenting new ideas for small businesses, such as in eco-tourism, as well as new ways to address climate change challenges and build capacities in isolated regions.

Commercialisation of bioproducts from the local biodiversity can address inequalities of the local communities and support climate adaptation.

Applying the different methodologies available to start addressing green infrastructure and urban forest research such as the iTree Methodology, the ecosystem classification approach, the Neighbourwoods methodology, or the urban biotope approach, will enable action for these adaptation opportunities in cities.

Q4: How can research funders, universities and data managers best champion inclusive, urgent and solutions-oriented adaptation research? Do you believe this approach is enough and if not, what can be changed?

There are research centres with access to extensive data sets within Latin American countries, which should be shared across the continent. Cross-border collaborative centres for Latin America will be important and require international support to build capacity to address shared climate adaptation research gaps.

There is a need to change paradigms about what a solution is. We need to think beyond solutions that have failed in the past or have already been well studied. Funding for high risk solutions that might not work is needed.

Funders need to better recognise and promote the true value of traditional knowledge within scientific research. The Global Challenges Research Fund does this to some extent and was praised as an approach to addressing major global challenges.

Research is still siloed and critically underfunded. Implementation is often happening without research or an appropriate evidence base to evaluate change. Stronger links between research and implementers (businesses, NGOs, etc.) are required.

Long-term large projects (4+ years) and interdisciplinary and transdisciplinary (going beyond pure science) research will be key to success. Funding calls focussed solely on research for adaptation would be an important step forward. Current funding processes are not inclusive in that timeframes for call submissions do not allow for strong, equitable project teams to be established. Short call timeframes can only be met by well-established groups.

Philippines

Philippines

Background

As part of the COP26 Adaptation and Resilience events series, The Department of Science and Technology (DOST-Philippines) and UKRI-NERC co-hosted a webinar on 19th October 2021, with the theme "Building Science-Based Climate Change Adaptive and Disaster Resilient Nation". The webinar, attended by over 300 participants, engaged high-level officials from both the Philippines and the UK, foreign partners, researchers, scientists, and key players in the field of climate change and disaster resilience, for a series of presentations followed by a discussion session around the event series core question set.

The research showcase highlighted some priority research themes for DOST, including but not limited to the impact of climate change and disaster risk reduction on:

- Industry and infrastructure
- Health
- Agriculture
- Aquaculture
- Natural resources

Points raised through questions and answers sessions with the speakers as well as the discussion session are summarised below.

Q1: What research is needed to respond to the adaptation gap?

There is a need to better understand future water security scenarios in the Philippines, given the compounding risks of flooding, drought and rising sea levels. The maintenance of a potable water supply is important to consider given the potential for disaster events to increase pollution and reduce accessibility to water supplies, particularly for displaced communities.

Expansion of research on the water-food-energy nexus was identified as a priority, given increasing demand for all three of these resources, and the impact that climate change can have in limiting the availability of each.

This was particularly highlighted for the agricultural sector where declining reliability in water supplies, as well as increasing occurrence of drought periods in a warming climate, means further investigation into crops with lower water requirements is required. There are some promising results coming from projects which are using biotechnology to develop drought tolerant rice varieties already, but several gaps exist in scaling this work up more broadly.

This includes:

- Research to understand whether the nutritional content of geo-engineered rice varieties remains the same as traditional varieties.
- Social science research to understand the cultural barriers to making geo-engineered crops an acceptable food product.
- Expanding this type of research to other food crops.
- Further research into how modification of plant hormones may be able to stimulate plants to respond faster to environmental stresses.
- Exploring whether similar approaches could be used for different environmental conditions e.g. flooding.

Adapting to changes in the water-food-energy nexus is also particularly important in relation to extreme weather events, which have the potential to displace Filipinos into evacuation centres where inadequate clean water and food can then make them vulnerable to the spread of diseases and other health risks. Employing GIS methods and vulnerability analyses to better select the locations of evacuation centres when weather related disasters do occur, could help mitigate against cascading risks such as land sliding, as well as health risks related to contaminated water supplies and poor sanitation. Further research is also required into behavioural interventions that could help reduce the increases in pregnancy rates which were observed in evacuation centres after Typhoon Haiyan, as well as support the mental health of displaced communities.

In relation to developing climate resilient infrastructure, there are opportunities to build upon current and previous studies on the morphology

of rivers to ensure that future structures are designed and built in sustainable ways that don't require frequent rebuilding as the climate changes. Given the different geological and topological setting of every river along with variations in sediment supply as well as the characteristics of the storms and typhoons that lead to river overflows, computer modelling provides valuable opportunities to understand different scenarios, and propose appropriate management interventions. Application of social science approaches is also required to better understand the feasibility of proposed adaptation measures such as relocating communities or the construction of new structures, which may not be culturally acceptable or feasible.

Finally, there is a need to make the scientific data that is already available on climate change and disasters, accessible to all – this could potentially be achieved in part through digitisation of existing data.

Q2: How to evaluate the feasibility of adaptation options and outcomes for resilient and sustainable development?

Disaster risk reduction and climate adaptation are interdependent and require interconnected efforts with science at the core, to effectively reduce risks. Research and innovation solutions for adaptation must therefore embody a systems thinking approach in order to develop sustainable and appropriate solutions for current and future climate scenarios.

It is important to ensure that research to address the adaptation gap seeks to concurrently resolve other gaps in equity and equality, and that tackling the adaptation gap does not distract from these other long-standing gaps.

In terms of the uptake of potential evidence based adaptation solutions, a lack of ownership in science, technology and innovation (STI) technologies among local communities is perceived to be a barrier. Whilst in some cases STI tools and platforms are available, for their potential to be fully harnessed combined efforts and collaborations from the government, private sector, academia and the public are required. For research into the impacts of climate related disasters on infrastructure, it is important for researchers to work in conjunction with engineers, planning offices and local government units in order to fully utilise the results and ensure future infrastructure development is planned in a sustainable manner.

Case study 19: Open Access river catchment data from the Philippines

Researchers based in the UK and the Philippines have created an open access database to assist with water resource and flood risk management and disaster risk reduction in the Philippines. A nationwide digital elevation model (DEM) has been used to systematically calculate river catchment and stream network properties for 128 medium- to large-sized catchments (drainage area > 250 km^2). Results are presented in a national-scale geodatabase to summarise key catchment characteristics (e.g., shape, relief, average slope) and provide detailed information on the stream network (e.g., elevation, upstream area, stream slope). The data are hosted in an online ArcGIS web-application so that users can freely access, explore and download the data.

Credit: School of Geographical and Earth Sciences, University of Glasgow; Department of Civil and Environmental Engineering, Brunel University London; National Institute of Geological Sciences, University of the Philippines Diliman

There remains a gap in communicating the risks related to climate change and potential solutions (both adaptation and mitigation) to affected communities, as well as policy makers.

Q3: What examples are there of transformative adaptation research enabling action through addressing social justice, capacity building and governance?

Project Sarai: The Smarter Approaches to Reinvigorate Agriculture as an Industry (SARAI) project is working towards reducing climate risks by providing agricultural stakeholders with site-specific

crop advisories for nine priority crops (rice, corn, banana, coconut, coffee, cacao, sugarcane, soybean and tomato). These targeted crop advisories focus on integrating local weather data and drought forecasts with farm management activities, specifically nutrient and water management, and proactive pest and disease monitoring, in order to maximise crop yield. A computer-based information system monitors, on a near real-time and site-specific basis the actual area planted to crop, and its condition based on free and daily updated satellite images. The project has developed several mobile applications, accessible on smartphones, which farmers can use to obtain the information they need to be able to make proactive choices on decisions such as when to plant their crops, when and how much to irrigate these crops, and how to identify and limit pest damage. Making these key decisions allows farmers to avoid or reduce crop losses. An online knowledge portal houses the various programme components in a form easily accessible by farmers, and capacity building is embedded within programme to ensure the products reach the intended users.

Development of Health Index: Vulnerability to Extreme Environmental Events for Marinduge island (D-HIVE) project: This is a multidisciplinary, community-based research and development project which is aiming to produce health vulnerability indices (HVI) at household level. These can then be mapped and integrated into the emergency response system (ERS) with the aim of improving household resiliency across the island province. It is hoped that the HVI ERS tool can eventually be used throughout the Philippines to help society improve its resiliency, reduce vulnerabilities and achieve sustainable development.

Weather and Climate Science for Service Partnership Programme (WCSSP): This joint project implemented by climate scientists from the UK Met Office and the Filipino scientists from Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) has led to the generation of multi-model climate change projections for the Philippines. This research and knowledge exchange is resulting in improved weather forecasting models and systems that can help communities better anticipate and prepare for extreme weather conditions which helps protect against property and crop damage and loss of life.

Q4: How can research funders, universities and data managers best champion inclusive, urgent and solutions-oriented adaptation research?

Collaborative projects are crucial and should involve buy in and co-ownership by a country or region's stakeholders including but not limited to researchers, local communities, practitioners including farmers and engineers, as well as the government sector. Harnessing and leveraging joint efforts among these different stakeholders will allow adaptation research to benefit from local expertise, research knowledge and technological experience.

International partnerships and collaborations are important in bringing together technical skills and expertise with first-hand experiences of climate related disasters and local knowledge and understanding of where science needs to focus next.

There are opportunities for a greater focus on science communication in relation to adaptation research, in order to support driving science-based adaptation solutions into action. This is particularly important in achieving buy in and ownership of solutions from affected communities where terms like 'resilience' and 'transformation' may be less well known. Utilising graphics and visuals in explaining hazards and risks, as well as making provision for translators and knowledge brokers would support this.

Furthermore, the elevation of science-based adaptation solutions as practical and feasible adaptation approaches could be achieved by supporting greater connection between basic research funding and follow on/innovation/translation funding. This could help get experimental approaches out into the field and drive technological innovations further along the development pipeline.

Monitoring must be included in research programmes to ensure they remain on track to meet their objectives; challenges can then be addressed accordingly and the impacts of research appropriately shared and amplified.

More broadly, solutions-oriented adaptation research needs to be complemented by a policy and funding landscape that addresses the bottlenecks in transitioning to a low-carbon economy through technical assistance, policy support, market development, and accelerating access to available financing instruments.

Thailand

Thailand

Background

Thailand Science Research and Innovation (TSRI), the Thailand Ministry of Agriculture and Cooperatives (MoAC) and UK Research and Innovation (UKRI) jointly hosted a workshop on the 20th October 2021 focused on the impact of climate change on agriculture and food security.

The event engaged a variety of stakeholders, including academics, decision makers, and government actors from both the UK and Thailand, allowing for interactive conversations around key adaptation and resilience research challenges

Priority research themes highlighted within the research showcase presentations and discussions included:

- Livestock farming
- Rice farming
- Climate Smart Agriculture
- Weather forecasting and climate modelling
- Water management

Breakout discussions focused on 3 of the core question set developed for the event series:

Q1: What research is needed to respond to the adaptation gap?

More research should be undertaken around preventative action to mitigate climate risks, rather than simply responding to climate risks as they arise. A particular priority for Thailand in this regard is addressing the need to develop more advanced weather forecasting and finer scale climate models.

From an agricultural perspective there is a need for broader understanding of water management approaches, in order to support farmers in coping with current and increasing variability in rainfall between different years and seasons. Further research into drought resistant crops is required to support food security in Thailand, as well as focussed research which explores the co-benefits of adaptation options for agriculture, environment, and livelihoods. Eco-tourism could be considered as a potential adaptation approach, and provide a route to diversifying both cropping systems and livelihoods.

Production of biogas from livestock waste represents a valuable opportunity for reducing greenhouse gas emissions from the agricultural industry, however further research is required into how to increase the efficiency of this process.

Research to support the health and well-being of vulnerable groups and agricultural workers should be prioritised as it would strengthen the capability of these communities to adapt and engage with further research into the adaptation gap.

There are opportunities to benefit from combining technological methods with experimental approaches e.g. using modelling and remote sensing techniques to identify field experiments that are needed. Alongside this, capacity building is required to bridge the gap between the technical know-how required to operate technologies (often funded and provided by the public sector) and knowledge of where or how these would best be deployed, which tends to sit within local communities.

Q2: How to evaluate the feasibility of adaptation options and outcomes for resilient and sustainable development?

Any climate adaptation policies that are implemented must be responsive to local needs and should be driven from the bottom up by those most affected by climate issues.

When undertaking evaluation of adaptation options, it is important to take into account the geographical context and sector in which any interventions are made, as adaptation processes do not exist in isolation but as part of complex socio-economic systems.

There is a need to develop standards and metrics for monitoring and validating government policies for climate adaptation, with input from a variety of stakeholders.

Case study 20: Sustainable Rice Platform (SRP) 'Implementation for climate smart practices for rice farmers'

This initiative is a multi-stakeholder alliance of over 100 institutional members from public, private, research, civil society and finance sectors. With the aim of supporting farmers to adopt climate smart and sustainable best practices by 2023, they have developed a toolbox containing:

- A scoring criterion for sustainable rice farming techniques
- An assurance scheme to verify compliance with the SRP standard of 41 requirements, 8 contributing to climate resilience
- Performance indicators to ensure farmers are on the right track
- A training programme to ensure consistency and quality in training and auditors

So far the SRP has been implemented in the irrigated Central Plains and the rainfed northeast of Thailand, totalling roughly 120,000 farmers. In 2020, an audit of Roi-Et farmers showed 91.5% were now producing sustainably cultivated rice. This has led to increased income, a drop in fertilizer cost and less burned stubble.

Q3: How can research funders, universities and data managers best champion inclusive, urgent and solutions-oriented adaptation research?

Research translation should be prioritised by all actors in the research pipeline (funders to users) to enable inclusive, urgent and solutions-oriented adaptation research outcomes. This requires the sharing of research results in an accessible manner to those outside of academia so that the knowledge can be turned into action. Language barriers can act as an obstacle to wider dissemination of scientific results – in Thailand this translation needs to be not just to Thai but also to local languages.

Universities and funders could act as knowledge brokers between different groups, from academics, to local organisations, to governments. There is a particular need to build closer links between adaptation research and policy, to strengthen the evidence-base for adaptation decision making.

There is a need to better utilise data and information arising from research that has already been conducted, to share learning between researchers and understand which future priority research areas will generate the greatest impacts. For example, there is similar research taking place in Thailand, the UK and other countries into how to ensure swine production is sustainable and resilient in a changing climate, but currently there is no platform to combine datasets at an international level.

Co-funding of collaborative international research projects by a range of countries can encourage greater buy in from in-country stakeholders and ensure impact through better uptake of research outcomes.

Future research should be interdisciplinary and transdisciplinary – food systems are complex and sit at the cross section of agriculture, biodiversity, nutrition and the socio-economic settings they exist within, so an integrated approach to climate adaptation is needed.

UK Launch Event

UK Launch Event

Sustainable and Inclusive Climate Adaptation and Resilience: local leadership for a global goal

On 3rd June 2021, we held an initial event to launch the overall series. While we are all now familiar with the concept of climate change, we are not so familiar with what can be done or should be done to address it. Climate change mitigation has been around for a while – we've all heard about the move from coal to wind power and the transition from petrol and diesel to electric vehicles, but that is just one aspect of dealing with climate change and helping to prevent it getting worse; we also need to accept that the climate is changing and adapt to that change, for example through changes in approaches to farming and land management, construction, flood defences, water storage and city planning to name just a few. In order to enhance the resilience of communities around the world who are at risk of the impacts of climate change, we need to understand where we are now in terms of our ability to adapt to these impacts, using a range of information sources to better understand the global climate and the associated systems which are interlinked. We also need to consider the social and economic impacts of climate change and whether our policies are currently enhancing our resilience to those impacts or further exacerbating them.

Q1: What research is needed to respond to the adaptation gap?

The connection between climate change, land-based ecosystems and biodiversity loss, has featured in academic works and made media headlines around the world for many years. Maintaining healthy oceans and understanding their role in supporting global climate resilience still requires large scale international collaboration and long-term investment. This is hard to achieve when many countries experience short-term funding cycles and political instability.

Academic solutions alone won't make us globally more resilient; combining these with end-user driven approaches to climate change adaptation and Disaster Risk Reduction will. There is a need for research to develop more innovative finance-based approaches to mitigate physical climate risk for the most vulnerable, for example through insurance initiatives that are accessible to local communities. We also need to take into consideration the ethical dimensions which can be overlooked. Adaptation methods can easily fail if local knowledge and dominant cultural norms and values and existing power relations are not fully understood.

Research into the barriers to becoming more resilient to climate change and implementing adaptation solution is needed. Part of the gap is in communicating the systemic and cascading nature of climate-associated risks to policy and decision makers. In climate change adaptation research - more than in many other fields - a close collaboration between the scientists and the policy/decision makers is the key. In most developing countries such linkages don't exist. This is now being recognized as a major gap and local people, researchers and governments are starting to look at better ways to work together, but we need to accelerate this awareness, using more defined examples as best practice.

We need greater certainty in climate-forecasting models and easy to understand solutions coming from the research community through open access to data. We also need to incentivize interdisciplinary working – the UK is funding interdisciplinary, solutions-oriented research aimed at benefitting developing countries through programmes such as the Global Challenges Research Fund (GCRF), however universities need to ensure that researchers are enabled and rewarded for participation in this type of research. Researchers also need to have an awareness of the other disciplines that complement their efforts to enable effective collaborations and drive uptake of research outputs – again this is relatively new and not adopted globally - yet. Finally, we need greater financial security to enable us to research the adaptation and resilience gaps over long and short-term timescales.

Q2: How to evaluate the feasibility of adaptation options and outcomes for resilient and sustainable development?

There is no "one size fits all" to climate adaptation; it will depend on what is being done by whom and where. A very recent example of this has been the global pandemic; the approaches to combat the pandemic have varied at the national and local scale with differing degrees of success. We must tailor the approach to the situation. The pandemic has taught us that vulnerability and resilience changes, it's not static, similarly the rate of adaptation isn't constant – it can be fast-paced and 'transformative' or incremental, both can be effective in different scenarios.

Evaluation needs to be built in from the start of any research and co-designed into the programme alongside the participants who hold the knowledge and experiences of local communities, including those that are often marginalised. These key stakeholders must be listened to and considered to ensure that the metrics/approaches used to measure success are worthwhile and appropriate. Communicating the success or failure of adaption options also needs to be done in a way that will appeal to policy makers, or translated in a way that offers a solution-driven approach (UK policy makers often take an evidenced-based approach to decision making). Perhaps most importantly, we need baselines for climate adaptation and resilience that enable long term comparisons to be made. This means that data needs to be obtained and shared, urgently and in a consistent manner. Of course, this is idealised and it's important to recognise that there can be a scarcity of data, it's therefore important to build in proxy indicators which can be used where there are evidence gaps.

Feasibility studies are useful, however they also need to be scalable from the outset, so a key question is how to ensure we have locally meaningful measures that resonate globally. This will enable us to develop knowledge and best practice that can be more easily transferred to multiple locations facing similar climate-related risks around the world.

Q3: What examples are there of transformative adaptation research enabling action through addressing social justice, capacity building and governance?

There are a various examples of transformative adaptation research taking place internationally which produce a step change in approach and result in real-world action. In the UK, the Global Challenges Research Fund (GCRF) supports cutting-edge research to address challenges faced by developing countries and provide socio-economic benefits. The programme aims to promote challenge-led disciplinary and interdisciplinary research, strengthen capacity for research, innovation and knowledge exchange in the UK and developing countries through equitable partnerships, while providing an agile response to emergencies where there is an urgent research need.

Case study 21: The GCRF One Ocean Hub

The GCRF One Ocean Hub (https://oneoceanhub.org/) has deployed innovative (including arts-based) methods and an integrated research design to capacity build, share knowledge and connect dialogue across a broad spectrum of stakeholders at different levels of governance. The Coastal Justice Network enables small-scale fisheries leaders to work together with researchers, local civil society organisations and legal professionals. They have enabled an opening dialogue across scales to bring together stakeholders from the local to the international level to co-define challenges and co-develop potential solutions e.g. work with UN Division for Ocean Affairs to deliver a training session on 'Climate Change: Impact and Adaptation' for the UN Nippon Fellows and Alumni, the majority of whom are government officials from low and middle income countries. A key aim is to improve education on climate change for youth and wider citizens, so they have worked with primary school teachers in West Province to develop a challenge-led ocean education programme, which integrates Pacific culture, indigenous knowledge and science.

Other examples include the UKRI and Met Office funded "Community Climate Resilience through Folk Pageantry", which is an arts and social action led project using embedded and situated research working across resident communities, policy makers, local government managers and activists in Manchester as part of the UK Climate Resilience Programme. The GCRF' Tomorrow's Cities Hub aims to embed sustainability of learning beyond the project period; they have founded the African Research and Impact Network (www.arin-africa.org) to link the Hub with cities across Africa and support the mentorship of young policymakers and researchers.

The GCRF GRIPP Project (https://www.grripp.net/) – is another good example, being a network of networks to promote Gender-Responsive Resilience & Intersectionality in Policy and Practice. GRIPP is trying to address issues from a feminist and decolonial perspective. This type of network helps to avoid the creation of unintended ethical issues if included in the research planning. The Escazu Agreement in Latin America and the Caribbean is another example of working with communities to understand rights to nature/ environmental rights.

We need to support equitable research partnerships, share learning and promote best practice for climate adaptation research and interventions. We must avoid poor research practice too, for example Shack Dwellers International (SDI), which is made up of 33 counties and 500+ cities with community networks (https://sdinet.org/) collect data to aggregate their own challenges. They have found that researchers from the global north tend to come with ready planned solutions and often treat them as data collectors rather than as genuine partners. We need to change our thinking and perceptions, as well as our research methods.

What makes the earlier examples effective is in part down to their clear communication which makes the research accessible to a wide audience. They have engaged with a wide range of stakeholders from different sectors, particularly local stakeholders and bring together a range of different research disciplines to fully understand climate challenges from multiple perspectives at the outset. Equally important is that funders such as UKRI have funding frameworks in place that enable interdisciplinary and cross-sector working. Any new networks or collaborations in this area need to ensure they are supporting cross-disciplinary partnerships and that we can translate the research into clear messages for policy makers through to the local populations.

Q4: How can research funders, universities and data managers best champion inclusive, urgent and solutions-oriented adaptation research?

There are several immediate answers that are obvious, such as increase the proportion of funding going to least developed/low-income countries that are most vulnerable and strengthen global and regional cooperation to enable a more joined up approach. However, there is a lot more to these answers than initially meets the eye. In order to increase the proportion of funding the recipients need to have the infrastructure in place to be able to effectively utilise the funding; this can require capacity building as well as better understanding of existing capability. Research funders and universities can play an effective role in enhancing global adaptation research capability through supporting equitable international research partnerships.

UKRI and our COP26 delivery partners such as the British Academy have been working to enhance strategic alignment and collaboration with funders in both the global south and the global north. The inclusion of research excellence as a criteria has helped to ensure that researchers in receipt of funding are the most competitive rather than the most well-known. However, one problem that research funders still need to address is when researchers are too heavily influenced by the funding source and are unable to choose their own partnerships.

The research pipeline from idea through to implementation needs to have transdisciplinarity built in from the start; we need to go beyond academic research to innovation and provide career opportunities through the translation of research into real world solutions. This needs the integration of social sciences, to understand the social, political and economic context that research is being conducted in and where solutions are applied. Various international funders around the world are starting to invest in interdisciplinary and cross-sector calls for research, but not all of them.

Funders need to partner with charities and other organisations who can help to build capacity and ensure strategic coordination while avoiding duplication. The Adaptation Research Alliance (ARA) concept being developed in association with COP26 will, providing the principles and governance model is correct, help to ensure that there is a diversification of funders (both public and private sector), researchers and research institutions,

working together to build capacity, support and provide a greater proportion of funding to southern organisations and partners so that they can engage and lead. We need to work together to ensure that we have the right enabling systems which allow for people to build relationships and trust which is vital for cross-stakeholder collaboration.

In addition, we need to look at ways of overcoming budget and funding timescale constraints, as three to five-year funding cycles (typically seen in European countries) don't allow for continuity of partnerships. This needs engagement at the government level to put in place long-term budget allocations that will enable funders to support more sustainable research programmes and partnerships.

Finally, research needs to be demand-driven. This does not preclude funders or governments from initiating top-down strategic research programmes, however it does mean we need to fully consider the range of actors (individual, local, regional, national) operating at each level during their development. This will enable us to develop bespoke research-based solutions that can be tailored to address the needs of different actors through inclusive and equitable partnerships.

Building transformational pathways to adaptation in Eastern Africa

BIEA-Cambridge University-York-IGP

Building transformational pathways to adaptation in Eastern Africa

BIEA-Cambridge University-York-IGP

Background

A workshop hosted by the British Institute in Eastern Africa (BIEA), Universities of Cambridge and York and UCL's Institute for Global Prosperity was held on 16th September 2021 and brought together a diverse range of scholars and stakeholders involved in cross-disciplinary projects based in eastern Africa spanning the environmental, social sciences and the humanities to explore examples of successful adaptation strategies, the role of research in enabling transformation and building resilience and identifying key knowledge and training gaps.

Workshop findings

Research on adaptation needs to be inclusive and informed by a range of local actors and processes, as perception of climate change risks differ across stakeholders. To do this, there is a need to build local capacity to lead research and understand which participatory processes and platforms are effective in enabling more inclusive adaptation planning.

There is a need for more rigorous and up to date vulnerability assessments in relation to complex climate change risks and to understand how they interact with social, economic and political drivers, including power relations between groups at different levels. This should also focus on uncovering historical injustices and their roles in shaping or constricting adaptation choices to inform adaptation planning processes.

Governance structures are critical in driving or hindering the success of climate change adaptation measures and there is a need for cooperation between non-state actors and local governments of different communities.

Research can be used to stimulate learning around successful adaptation measures and how to scale these up to accelerate climate adaptation in other locations facing similar climate risks. We also need to understand issues that prevent people from adopting adaptive strategies e.g. financial barriers, lack of or limited education etc.

More systematized methods for managing knowledge on adaptation are required. Different African countries have databases of information on climate change risks and adaptation strategies and these need to be easily accessible to researchers who can build on existing knowledge.

Data needs to be deposited in both national and regional repositories where it can remain open access and easy for people to use and interpret, including for ordinary citizens who are not experts in the field. The use of FAIR principles in data management (https://www.go-fair.org/fair-principles/) are highly recommended and there remains much work to build capacity for in country data management facilities. Research data and results need to be disseminated clearly and simply back to communities in order to allow for empowered decision making.

A more granular understanding of how diverse types of adaptation finance are allocated and spent is required. We need to know how different financial models or tools perform in different contexts. For this, there needs to be a more balanced allocation of research funding across regions and places.

There is a need to develop a common understanding of 'feasibility' of adaptation options and what this means to different stakeholders in the community. NGOs, research groups, local governments etc. All have different approaches, metrics and tools for defining adaptation strategies and their effectiveness.

Some metrics that are used in East Africa to measure the effectiveness of climate change adaptation include household income e.g. measuring agricultural yields and income received

in periods of droughts, floods or normal weather and when climate change measures are in place. Funding agencies should fund research that allows communities to determine the success of adaptation measures rather than researchers.

Climate justice processes and transformative actions must be led by local communities and should not be designed by people from the outside. Social justice, capacity building and good governance in research are especially well delivered when the research is co-designed with partners and communities and there is a considerable wealth of innovative good practices already in existence across the continent that research can learn from.

A recent report on Regenerative Agriculture for Africa provides examples of African-led agricultural adaptation, including push-pull integrated pest management systems, the work of Pesticide Action Network, UK on organic pesticides in Ethiopia, the work of the Centre for no-till agriculture in Ghana and the Savory institute for regenerative agriculture in Zimbabwe.

The concept of circular bio-economies and their application to ecological systems, including forestry and agriculture should be considered as part of adaptation processes. Any schemes designed to foster environmental/ecological protection and carbon sequestration need to be designed to improve wider livelihoods without overly commercialising the process - for instance, Costa Rica's Payments for Ecosystem Services (PES) scheme has incentivised landholders to protect their land in ways that are ecologically sustainable primarily because these are effective livelihood strategies, with secondary benefits through additional government payments.

Funding calls need to move away from a model where questions and themes for investigation are created by external funding bodies removed from the lived realities of everyday people, and instead be bolder in allowing for the funding of research that emerges from criteria set by the local communities that such calls often seek to assist. This may, for example involve supporting experimental 'emergent' projects where the co-creation of research questions and methods IS the focus of research.

Funding opportunities need to enable researchers based in African institutes to lead projects, to address imbalances in research decision making processes, curation, analysis and dissemination of results which are all too often led by institutes in the global north. Researchers should view their role not as the experts to be parachuted in to extract data, but rather as facilitators, enablers, curators and disseminators of community led knowledge creation.

The European Science and Technology Advisory group (E-STAG)

E-STAG

The European Science and Technology Advisory group (E-STAG) is convened by the United Nations Office for Disaster Risk Reduction (UNDRR). The E-STAG is a group of science and technology experts, nominated by Member States, to support Sendai Framework Implementation in the region and to advise UNDRR in Europe and Central Asia. The E-STAG members came together on 14th October 2021 to consider the core question set:

Q1. What research is needed to respond to the adaptation gap?

- **Research must be available and relationships in place to make use of any unfortunate post-disaster "windows of opportunity":** DRR researchers have long recognised a post-disaster window of opportunity. For example, in Croatia over six years universities communicated with government promoting a prevention park of DRR. It took an earthquake to motivate politicians to do something.
- **Prevention is cheaper than response:** Acting now can include using modelled future demographic and economic futures alongside climate related hazards. The more co-produced any future scenario visioning can be the better impact can be expected. The Austrian based IIASA has done some of this. Databases and mechanisms to collect disasters-related data must be in place BEFORE a disaster occurs.
- **Ensure a long-term financing mechanism across all sectors and promote both private and public sector involvement in implementation mechanisms:** This is needed to act urgently but sustainably. Research is needed on these funding mechanisms, including national and local comparisons on investment. Research can engage the finance industry so that climate finance can fully recognise and impact on adaptation.

Q2. How to evaluate the feasibility of adaptation options and outcomes for resilient and sustainable development?

- **Systematic reviews of the literature:** This will help to understand which adaptation mechanisms produce what benefits and damages under specific circumstances. There is already a large literature to be drawn from, though very little using a formal evaluation method. European Project results (in particular H2020-SEC and DGECHO) and wider work of the scientific community is a fundamental key source.
- **Research to develop consensus around definitions for and approaches to assessing the adequacy and effectiveness of adaptation planning at the national and sub-national levels:** Climate adaptation is now widely embedded in policy and planning across the world, especially at the national level. However, levels of engagement and the quality of adaptation instruments vary from country to country. Assessing the adequacy and effectiveness of adaptation planning at the national and sub-national levels is extremely difficult as there is no consensus around definitions for and approaches to assessing these aspects. This lack of consensus on appropriate assessment methodologies also constrains scrutiny of whether there is adequate progress towards each country's adaptation objectives. Similarly, despite growing implementation of adaptation actions, there is minimal evidence for successful, attributable risk reduction and therefore it is difficult to ascertain progress.
- **Assessing feasibility needs to be built on lived experience:** Climate adaptation requires variable timeframes and interventions which will have different consequences for diverse individuals, businesses and government agencies. Existing evaluation methods need to incorporate this.

Q3. What examples are there of transformative adaptation research enabling action through addressing social justice, capacity building and governance?

- Systematic reviews: These will share examples of good or inspirational practices and their transferability to other contexts - building upon them encourages convergence on shared principles and eventually bottom up community standards. The Stockholm Environment Institute/ University of Oxford WeAdapt has attempted this.
- New research on governance: This can build evidence on the appropriateness of the traditional DRM cycle (prevention...recovery) to guide adaptation for social change, or if a new model of disaster risk management is required. It has long been accepted that even in individual events multiple phases of the cycle unfold simultaneously; rather than being event-based, adaptation is continuous but drawing from the cycle may help break down and open up opportunities for transformation.
- There are many examples of transformative adaptation at various levels: For example, the Task Force on Climate-Related Financial Disclosures (TFCD) and Taskforce on Nature-related Financial Disclosure (TNFD); the climate assemblies in FR, UK, IE and elsewhere; access to a healthy environment is declared as a human right for many local initiatives, but for many of them it is too early to distil lessons learned.

Q4. How can research funders, universities, and data managers best champion inclusive, urgent and solutions-oriented adaptation research?

- Spaces for bottom-up and side-to-side experimentation need to be kept open: Clear descriptions of the problems to be solved are vital but there should be less prescription related to the solutions.
- Mobilising public and citizen engagement is essential for inclusive practices for social change: This fosters a sense of empowerment and creating conditions of full transparency, accountability and trust. Fostering engagement of (all) societal partners is a vital part of co-production of actionable and place-based knowledge and knowledge (e.g. adaptation) services, monitoring and progress evaluation and building momentum for action.
- Improving the ability of national universities to provide and host updated national-level data: This will enable the provision of good indications of future trends in adaptation (planning, financing, implementation) and associated levels of risk reduction.

GADRI and UKADR

GADRI and UKADR

The Global Alliance of Disaster Research Institutes (GADRI)[1] and United Kingdom Alliance of Disaster Research (UKADR)[2] have provided partnership support to United Kingdom Research and Innovation (UKRI)[3] in the context of the COP26 Adaptation and Resilience Event Series. The following are priority research themes that have been proposed through this process:

Priority research themes arising from GADRI Summit, September 2021:

- An integrated approach for Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) that is timely in the contexts of speeded up climate emergency.
- Data and knowledge sharing both at national and international levels, including transboundary collaboration and evidence from observations spanning in-situ and remotely sensed observations of weather and climate and associated levels of exposure.
- Impact-based forecasting, early warning and rapid information dissemination in the interests of achieving more resilient infrastructure and societal preparedness.
- Multidisciplinary research that develops comprehensive models of physical, social, and economic infrastructure at local levels, with local engagement from the very beginning for grounded understanding of strengths and vulnerabilities.
- Science in action for residents, governments, practitioners, and researchers. National and local DRR policy links can be boosted by dealing with multi-hazards and new risk landscapes that engage multi-stakeholder and inter-sector corporations in win-win relationships.
- Enhanced international collaboration through funding mechanisms rooted in research into action. Bridge risk reduction and adaptation gaps through shared understanding and improved communication of science for populations, researchers policy makers and economic actors.
- Greater understanding and proactive engagement with the criticality of eco-systems-based disaster risk reduction and nature-based solutions in climate change adaptation and resilience. Understanding of the role of heterogeneity and biodiversity within mixed narratives providing context for evidence.
- Intergenerational equity and justice in confronting climate induced disaster risk by making sure young people have a seat at the table. Enroot a "culture of protection" and engagement through ongoing practice guidelines for Disaster Risk Management education, as normal to education systems for all age groups, and those beyond formal education – include the UN in endorsements.

1 GADRI is an alliance of 209 disaster research institutions, centres and groups from 53 economies that also works alongside five world regional alliances and engages with global, national and local level policy and practice. The 5th Global Summit of GADRI in Sept 2021 was supported by regional alliances, including UK Alliance for Disaster Research (UKADR) in a collaboration with UK Research and Innovation (UKRI) to bring Adaptation and Resilience related research to bare on the outcomes of UN COP26.

2 UKADR is an alliance to facilitate partnership for disasters research across the UK research community and those with whom it works. The UKADR was founded around the time of the Sendai Framework for Disaster Risk Reduction, to provide a national point of contact and a collaborative environment for UK disaster research.

3 UKRI is a non-departmental public body of the Government of the United Kingdom that directs research and innovation funding, funded through the science budget of the Department for Business, Energy and Industrial Strategy.

Future research perspectives for UKADR include the following priority themes

Research themes:

- Emphasis on understanding and addressing the social, economic and environmental conditions that generate and perpetuate disaster risk across all societies.
- The connections between development processes, practices and policy and disaster risk.
- Extensive and intensive disaster risk and loss and damage, including critical perspectives from DRR thinking on how 'loss and damage' is articulated, and tools that enable its assessment and monitoring through science and local knowledge.
- Inclusion of all forms of data acquisition and management that contribute to understanding action and in-action in prevention and response policies and practices at all levels.
- The role of health in climate adaptation and resilience.
- Cascading disasters and climate change.
- Recurrent hazards and their cumulative impacts on recovery and adaptive capacity.
- Gender and intersectionality approaches to disaster risk and its reduction.
- Addressing the gap in relation to people in conflict zones, migrants and displaced people vulnerable to hazards that will intensify with climate change.
- New, long-term, innovative and multi-sectoral financing mechanisms for disaster risk management and adaptation solutions.
- Effectiveness in evidence-based governance.

GCRF Resilience Portfolio workshop

GCRF Resilience Portfolio workshop

On 5th October 2021, UKRI brought GCRF-funded researchers from across the Resilience Portfolio together with colleagues from the UK Alliance for Disaster Research (UKADR) network to contribute their expert insights into the core question set.

The group identified a range of requirements for future climate adaptation and resilience research:

- The right people must be involved in adaptation research – public, policymakers, communities, people with diverse backgrounds and perspectives.
- Research should be context specific and listen to local needs.
- Evaluation over long timeframes, that looks at a range of scales, and is responsive to non-climate change and climate change related adaptation.
- Appreciation that outcomes are not binary e.g. successful/unsuccessful, and recognise different perspectives on what success looks like, particularly beyond economic metrics.
- Locally grounded and inclusive models of evaluation are important, recognising the impact of power and oppression.
- Synthesise learning of transformative adaptation research and facilitate exchange across projects and sectors.
- Enable active participation from diverse, vulnerable and oppressed groups and identify processes, methods and mechanisms which enable inclusive impact, engagement and governance.
- New ways to share data and information among researchers, policymakers and practitioners and in local languages.
- Co-develop research with affected communities and ensure this is appropriately compensated.
- Long term research which offers new opportunities to understand and learn for and from communities than short term projects.

Insect biodiversity

Insect biodiversity

Background

Responses to climate change are likely to vary among groups of insects and it is vital to expand the scope of our understanding beyond well-studied temperate regions to the species rich tropics. Researchers from the ForestGEO arthropod initiative delivered a workshop on 20th September 2021 focussed on the impact of climate change on insect biodiversity in the tropics, their role in supporting climate adaptation and resilience for local ecosystems and communities, and priority areas for future research.

Herbivorous insects along with their host plants and predators account for ~ 75% of terrestrial biodiversity and play crucial roles in ecosystem functioning which can enhance our ability to adapt to climate impacts. Insect biodiversity has implications for food security (35% of the food we eat is directly dependent on insects) and in regulation of pests and diseases, which are predicted to rise with increased average global temperatures. Around 2 billion people consume insects worldwide which has a much lower environmental impact compared to conventional livestock farming, there is a need to promote insect consumption more widely, including as animal feed. Insects provide key ecosystem services including decomposition of organic matter (including waste), nutrient recycling, soil bioturbation and seed dispersal and can help to enhance soil quality and carbon sequestration. Insect populations can therefore act as early warning systems for understanding the impacts of climate change on natural ecosystems, in terms of changes in habitat or loss of ecosystem services.

We are currently experiencing an 'Insect Armageddon', with declines in populations due to habitat loss, climate change, pesticides and invasive species, but further research is required to fully understand the drivers and impacts. Insect diversity is highest in the tropics and tropical insects may be more susceptible to climate change, yet only a fraction of species studied are tropical and long term trends tend to by driven by data sets in the temperate zone (Europe and North America). Large scale funding for local insect surveys focussed on habitats across the tropics is required, alongside support for taxonomy and access to museum collections. There is a need for better long-term monitoring of insect populations across space and time to understand responses to habitat loss and climate change, including for non-pest species. Further research needs to look beyond assessing biomass only to understand differential responses among insect groups, their taxonomic diversity and ecological functions, using tools such as DNA barcoding and eDNA.

It is crucial to act urgently and engage the public and policy makers in preserving insect biodiversity, for example by demonstrating the economic value of insect species, or through education in schools about conservation of forest ecosystems – insects are a great way for children to reconnect with nature. There is role for citizen science in scaling up monitoring of insect biodiversity and in implementing urgent strategies to mitigate further loss, including conservation of habitats and reduction of pesticide use. Further funding is required to intensify monitoring studies that can help to understand how effective mitigation strategies are in preventing further biodiversity loss.

Oceans and Climate

Oceans and Climate

We live on 'planet ocean'. Oceans make up 75% of the earth's surface and play a huge role in influencing global climate change. The GCRF One Ocean Hub hosted the 'Ocean and climate change: building adaptation, mitigation, and resilience' event on 27th September 2021. The Hub brings together coastal people, researchers, decision makers, civil society, and international organisations to collaboratively influence decisions and practices shaping the future of the ocean for justice and sustainability.

Key messages include:

- Innovative research on ecosystems models and integration of socio-economic and cultural data can support decision-making on climate change and the ocean, to enhance adaptation and resilience for vulnerable ocean communities and ecosystems. This will help to remove barriers between biodiversity and climate change policy development.
  - E.g. Models to predict the impact of climate change on different species – biomass and spatial distribution, simulation of management actions, cumulative impacts and outcomes of management.
- The integration of different knowledge systems in System Dynamic Models (including indigenous and local knowledge) can help to develop scenarios and discuss different possible outcomes of adaptation policy interventions.
- Community-based climate adaptation (e.g. oyster farming) in Ghana can support sustainable fisheries, as well as address socio-economic and cultural issues in the small-scale fisheries sector in particular.
- Collaboration must be strengthened at the local, regional and global scales, across countries and conventions, to inform adaptation solutions for ocean communities and ecosystems as these are all interlinked by the ocean.
- Human rights to life, health, food, water and culture depend on a healthy ocean. Guidance adopted under the Convention on Biological Diversity around the nexus between biodiversity, climate change and the ocean can support the protection of human rights and help to consider trade-offs and co-benefits of potential solutions.

Climate and Health

Climate and Health

Climate change has major adverse consequences for human health. These include the hazards of extreme heat, infectious diseases, air pollution, food security, water scarcity and the consequences of floods and other extreme events. The Health and Climate Event, organized by the GCRF Challenge Leader for Health, took place on 21st October 2021 as an opportunity to bring together scientists and other key stakeholders working at the climate/health nexus to discuss key challenges for adaptation and resilience:

Q1: In what ways can health research enable a response to the adaptation gap?

- Health research can help direct greater attention towards climate adaptation as discussions often focus around mitigating climate change.
- Health (specifically environmental health) research considers the whole impact pathway and enables policy makers to identify pressures, actions and outcomes for more resilient health systems.
- A current issue is that evidence is not getting to national and local health decision makers – health research can build evidence of existing adaptations, support knowledge translation and learning from countries which already experience high temperatures.
- Integrated health research can provide estimates of costs and benefits to help inform adaptation decision making.
- Capturing neglected voices and partnering with marginalized communities is important, multiple creative methods are required to facilitate this.
- It is important to identify and embed climate impacts into all health research to better understand vulnerability.

Q2: How to evaluate the feasibility of adaptation options and outcomes in ways that take health consequences into account?

- Adaptation options have to be guided by context-specific risks and impacts, including health consequences.
- Health is a poorly quantified area and there is a need for more common indicators, metrics and language to engage wider stakeholders in climate-health research.
- There is a need to recognise barriers and build connections between disciplines through a central theory of change that unifies different fields around common goals for adaptation.
- Enhanced scenario modelling of different health and environmental policies will help to assess feasibility of adaptation options.
- Currently there is a mismatch between supply and demand of climate information, there is a need to assess where information is required by policy makers to inform health system adaptations.
- Evaluation of adaptation interventions for health outcomes needs to take into account both quantitative and qualitative factors, not all can be measured accurately.

Q3: How can research funders, universities, and data managers best champion inclusive, urgent and solutions-oriented climate/health adaptation research?

- Interdisciplinary, collaborative and applied research around global challenges such as climate adaptation is encouraged by many funders, this needs to be better reflected in success rates for funding applications.
- There is a need for more basic research on environmental health to help understand the climate-health nexus e.g. impact of droughts/ flood on health.
- Funding for the collection of data across decades as well as 3-5 year project timescales is required, involving centers/institutions of global health research with complementary perspectives.
- Funders need to support multisectoral, agile research and invest in equitable partnerships that enable co-design of solutions amongst diverse stakeholders of climate-health research, including different perspectives from local communities.
- Research priorities should be set/informed by stakeholders in the global south, researchers should be prepared to translate between disciplines/sectors to aid team science and avoid judgements of research quality based on publication records alone.
- Research funders should be less prescriptive in setting priorities and allow the research and evidence gaps to inform investments.
- There should be a transparent tracker for climate change research projects and programmes around the world (for health and beyond) to avoid duplication and identify gaps.

Plastics and Climate Change

Plastics and Climate Change

On 22nd October 2021, the University of Portsmouth brought together researchers and international collaborators from a wide range of countries to showcase research around the impacts of plastic waste on climate adaptation and resilience. The Portsmouth-led project know as 'STEPP' (Sustainable Transitions to End Plastic Pollution) was highlighted to show how creative methods are being used to tackle the impact of plastic waste in the Global South.

Mis-management of plastic waste is increasing and this compromises the health of natural ecosystems and their ability to respond to climate pressures. There are impacts on human health from breathing and ingesting microplastics in food and water supplies, and economic costs due to increased risk of flooding for example, as a result of blocked drains. Tackling of plastic waste should be placed at the centre of climate adaptation planning, to help address biodiversity loss, better human health and pollution reduction.

Plastic waste is a symptom of a larger profit driven economy and disproportionately effects poor and vulnerable communities in the Global South. An economic shift towards justice and sustainability is needed; Zero Waste Europe is a global alliance of over 90 countries which strives for a zero waste economy with respect given to ecosystem and community rights. Identifying the origins of plastic waste is an important step.

Waste policies need to be embedded in National Adaptation Plans (NAPs) and polluters should be held accountable, with investment in waste policies that address injustice, poverty and inequality. A convention on plastic pollution should be designed without delay, with an international response categorized by pillars of action to bring about systems-level change, with clearer responsibility around plastic waste disposal and provision of alternative choices to plastic for consumers.

The known and unknown effects of microplastics need considering alongside the impacts of climate change to understand how these intersecting risks are impacting ecosystem and community resilience.

Waste management is a relatively new concept for indigenous communities to deal with and education to change mindsets around pollution is required, the NAAM festival uses arts-based methods to shift attitudes toward environmental issues.

The STEPP project highlighted how participatory methods that incorporate local knowledge and lived experiences in adaptation research can lead to greater uptake of outcomes by local communities. The project team have carried out community-based mapping of pollution hot spots, undertaken questionnaires and held music sessions to understand attitudes towards plastic waste and pathways to reduce waste production. Local communities have come together to co-create murals, songs, film digital stories, street theatre and fashions shows all highlighting issues of plastic pollution they experience. These arts-based methods help to breakdown silos and knowledge hierarchies, reveal hidden and unexpected truths and enable greater climate justice.

Plastic waste can form part of a circular economy where the re-use and recycling of plastic can bring about both economic and environmental benefits to local communities. E.g. climate-smart architecture - floating houses in Bangladesh, supported by plastic drums discarded by industry are being piloted to enhance resilience of local communities to flooding and sea level rise. The Flip Flopi Dhow boat is a public engagement tool made of discarded single-use plastics, which is used to promote the value in re-using and recycling plastics for things like building or arts and craft materials or household tools.

Companies are starting to produce new policies for plastic pollution, but in reality plastic pollution or use is increasing. Genuine action and an overall reduction in the use and production of plastic by companies and communities is crucial to limit the amount of plastic entering ecosystems in the first place.

Towards a Sustainable Earth

Towards a Sustainable Earth

Towards a Sustainable Earth (TaSE) is a research programme funded by UKRI and global partners which aims to significantly improve our understanding of the complex interactions between people and the environment in order to make progress in achieving the Sustainable Development Goals (SDGs).

The eight TaSE projects came together on 7th July 2021 to consider shared priorities in addressing key climate adaptation and resilience challenges:

- Understanding adaptation for a range of different territories, including bio-regions, river basins, deltas and forests – there are often multiple layers of social, cultural and governance issues within and between territories.
- Importance of exploring urban adaptation at a range of scales, recognising that urban-rural boundaries are difficult to define.
- Improved modelling of the water-energy-food-land nexus to enhance water, energy and food security and reduce hydrological hazard risks, including mitigation of vector-borne diseases.
- The need for enhanced projections of climate change and associated impacts at local or territorial scales to reduce uncertainties for vulnerable communities.
- Identification of trans-boundary synergies and opportunities for adaptation-mitigation co-benefits – this can be challenging and requires consideration of social, technical, economic, political, cultural issues and more.
- Multi-level governance, from local to trans-national deserves much greater exploration, with both case studies and analytic insights into how adaptation solutions interact across scales.
- New forms of participative / adaptive governance that incorporate vulnerable communities and account for changing climate scenarios require close attention. There is a need to distinguish aspiration from reality and understand ethical challenges.
- Governance around conflict, inequality and informality in relation to climate impacts and adaptation interventions is complex. Explicit connections to the UN Habitat Urban-Rural Linkages and parallel UNDP and UNEP programs could be useful.
- There is a need for new tools and methods for exploring systems-level transformation, to enable new cross-cutting insights around the feasibility and management of adaptation interventions.
- Integrating multiple forms of knowledge and epistemologies, including academic, policy, business, citizen and indigenous to inform adaptation solutions and understand potential interconnections between stakeholders.
- Scenario development is one of the best ways to remove silos and enable inter-connections. Shared Socieconomic Pathways (SSP) can help to explore future climate scenarios, using known techniques of foresight, horizon scanning and pathway development.

COP26 Adaptation and Resilience series finale event

COP26 Adaptation and Resilience series finale event

Following the conclusion of COP26, UKRI convened a finale event with our co-host partners and wider stakeholders on 15th December 2021 to bring together international views on key climate adaptation and resilience challenges faced globally, gather reflections around the research landscape highlighted by the events series, share future ambitions with each other and identify potential opportunities for research collaboration. Discussions focussed around next steps and priorities for future climate adaptation and resilience research, in light of intelligence gained through the events series and commitments arising from negotiations at the COP26 conference.

Across the countries and organisations represented, there are overarching ambitions to:

- Scale up action and build capacity to deliver against national adaptation plans and strategies.

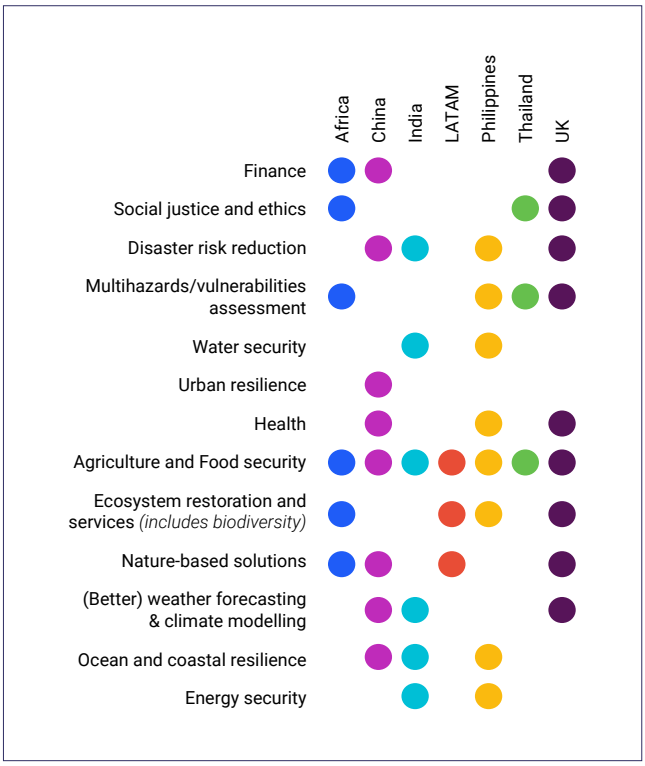


Figure 3: Priority research themes highlighted at the finale event by co-hosts and steering group members

- Drive greater international and cross-stakeholder collaboration.
- Enhance systems-level approaches to mitigate intersecting climate risks.

Key points raised by international co-host partners and UK steering group members:

- Multiple perspectives are required to inform successful adaptation interventions and a shift in power relations between adaptation actors is needed.
- The value of indigenous and traditional knowledge must be recognised as integral to adaptation research programmes.
- Research-policy-practice links (including private sector) need to be strengthened to drive uptake of research outcomes.
- There is an urgent need to share contextualised knowledge and data to inform locally-relevant solutions.
- Appropriate financial support must be mobilised from both the public and private sector for adaptation at a range of scales.
- Collaboration with the private sector is helping to identify the business opportunities associated with climate adaptation and resilience to drive development and economic growth e.g. bioeconomy-based approaches.
- It is crucial to integrate climate adaptation and resilience measures into local, national and regional planning processes and foster greater collaboration between government departments within and across borders to develop more joined-up adaptation policy.
- Greater coordination of adaptation research and action is becoming possible through alliances that enable cooperation amongst stakeholders rather than competition and could prove a

powerful tool for change, particularly by bringing alliances with similar goals together e.g. the UK Alliance for Disasters Research (UKADR) and the Global Alliance of Disaster Risk Institutes (GADRI).

The recently launched Adaptation Research Alliance aims to help realise these ambitions by not just supporting articulation of demand and identification of needs and opportunities across a range of stakeholders, but also by mobilizing and catalyzing the resources that are needed to meet those needs and accelerate the scale of investment and action-oriented research for adaptation in the developing world.

The demand for urgent action is clearly recognised here in the UK:

- The Royal Society has produced a series of briefings for policymakers on key science and technology areas for accelerating global progress towards 'net zero' and increased resilience to climate change.
- UKRI is working with other UK and international government bodies to drive forwards interdisciplinary, international and cross-stakeholder collaborative research through a wide variety of programmes, such as the UKRI-FCDO Future Climate for Africa programme and UKRI-Met Office UK Climate Resilience Programme.
- The UK Collaborative for Development Research (UKCDR) recent review of UK-funded research on climate change and international development highlighted the crucial role of funders in enabling impact and recommended improvements in aligning research to local contexts and the sustainability of the funding cycle. UKCDR have also developed the Equitable Partnerships Resource Hub which brings together relevant tools, guidance and resources from global partners focused on ensuring equity in international research partnerships.

Case study 22: Informing preparatory action

Researchers based at the University of Reading are developing state-of-the-art global flood forecasting models to allow governments and humanitarian organisations to take preparatory actions to prevent loss of life and livelihoods. The group have recently been awarded one of the 2021 GEO-SDG Prizes in recognition of the impact their research has had in providing longer-range forecasts to the Government of Bangladesh to inform the early distribution of aid to people ahead of flood events. In 2020, over $5 million of humanitarian aid reached 200,000 people in advance of the highest water level ever recorded.

Next steps and priorities for future climate adaptation and resilience research, post COP26

A significant advance of COP26 was in adaptation and resilience gaining high-level political traction, support and recognition, with many countries announcing allocations to the Adaptation Fund and the Least Developed Countries Fund. There is a need to create simple, acceptable adaptation goals that seek to remove unnecessary loss and damage and generate the political commitment required to implement affective action. It is crucial to make the link between climate resilience and future prosperity more visible, building in perspectives from business, policy, and civil society around how effective adaptation can enable desired futures.

Areas of research which require greater attention internationally post COP26 include:

- Human migration must be incorporated into future climate adaption planning within and across borders.
- The impacts of climate-induced hazards on communities and infrastructure in urban and peri urban areas.
- The role of social policy in fostering urban resilience.
- The differential societal impacts of adaptation measures, particularly for marginalized communities or states experiencing or recovering from violence.
- The potential for adaptation processes to be gender and equity transformative and address social inequalities.

- Research to understand implications of climate change on livelihoods for the poor and those directly dependent on land.
- The application of intersectionality to these analyses to understand how to mitigate climate risk across diverse communities and enable truly inclusive adaptation solutions.

Taking a holistic, systems approach to climate adaptation is fundamental to success:

- Complex systemic pressures such as health and wellbeing, livelihoods, biodiversity loss and poverty must be considered as part of future adaptation research in order to address structural issues of vulnerability, equity and social justice. Systemic climate risk must be embedded in to early action and sustainable development.
- There is a need to go beyond interdisciplinary science and encourage cross-departmental government decision making for climate adaptation, with greater coordination across policy sectors impacted by climate change.
- Our understanding of how climate adaptation needs evolve over time and space is lacking. Research to understand how risk flows across landscapes/boundaries and between communities (mountain-lowland, urban-rural) need to be strengthened.
- Communicating risk effectively, providing timely information at the right scale to the right people is key. Climate risks need to be mainstreamed into company and personal risk management.
- There is a need to build the adaptive capacity of vulnerable communities and provide training to underpin cross-stakeholder conversations around appropriate strategies.

It is important to make knowledge and data for adaptation more accessible at national to local levels and to improve the culture for equitable data sharing.

An implicit challenge is in how we cascade projects outputs from one to the other:

- There are rich local narratives that need to be better documented alongside quantitative data.
- Investment in data infrastructures and research alliances that provide access to well curated, useable data for a range of stakeholders can add value to existing research.

Case study 23: Community participation

A tool that has been developed and applied across multiple projects, such as the Development Corridors partnership (https://developmentcorridors.org/) has been a participatory scenarios tool - KESHO. This generates co-designed potential land uses into the near and mid-term future at a variety of scales (national, regional to local). As well as being a useful research tool it can be used as a planning and educational tool.

Engaging in a KESHO workshop at Voi, Kenya. Participants, representing a diverse range of sectors, identify the different drivers behind land use change. Using this information, potential land use is reconstructed to 2030 and 2063 to resonate with the Sustainable Development Goals and development agenda of the African Union respectively. Credit: Prof Rob Marchant, University of York

Participants from a PhD training network on 'Resilient Ecologies of East African Landscapes' explore the history of land use, access, beneficiaries and land rights around Mt Suswa, Kenya with Maasai communities. Credit: Prof Rob Marchant, University of York

- New routes for brokering knowledge between the producers and users of research are required but must be co-designed and rooted in trust and respect.
- Longer-term projects are required to facilitate dialogue and communication across both formal and informal social networks who are influencing decision making at the local level.
- There are opportunities for science to be a facilitator in bridging the gap between bottom-up local actor priorities and top-down policy priorities, for example by enabling community actors to gather data of use to policy makers.
- Co-generation of adaptation data between stakeholders through research projects has the potential to underpin periods or processes of social change, shift power relations and reduce knowledge hierarchies.

More research focussed on monitoring and evaluation of interventions made and costs vs benefits (and co-benefits) will be important.

There is a need to:

- Draw lessons from examples of maladaptation so that we don't repeat the same mistakes.
- Learn by doing, with real-time feedback around whether new technologies, infrastructure or methods are working.
- Take advantage of digital tools in monitoring adaptation interventions, for example through citizen science approaches using social media. Storytelling is also a powerful tool.
- Mainstream project-based learning often subsumed by 'science' into transformative action research.
- Learn from long term global environmental change and how communities and ecosystems have adapted in the past 100 years.
- Establish criteria and common metrics around feasibility of adaptation options informed by a range of stakeholders and suitable for different scenarios or locations, as success may look different across a range of contexts.
- Improve our ability to assess the economic value of various adaptation research outputs.

There is a lot of enthusiasm for Nature Based Solutions (NBS) for climate adaptation which are proliferating especially in global north, but there are a lot of desires placed on them:

- We need to be more critical to understand the limits of NBS interventions, what constitutes good practice and how they address risk, equity and co-benefits, including their impact on local biodiversity.
- Strong monitoring systems are required to build evidence around efficacy of NBS for adaptation and resilience longer-term.
- There is a need to demonstrate impacts of NBS in developed countries from economic perspectives and opportunities for adaptation and mitigation co-benefits, including where hybrid solutions can be applied.

Knowledge exchange between the Global North and Global South must go both ways:

- There is much to learn from experiences already gained from counterparts in the Global South around tackling climate risks, where communities are already taking steps to adapt often without government support. The Global North needs to better understand how community action can help to minimise risk.
- There is a need to develop greater understanding in the Global North of how to really influence behavioural change for adaptation.
- It is important to facilitate discussions amongst communities of practice to help shape learning internationally with a more sustainable legacy.

In recent years billions have been mobilised in climate finance to invest in adaptation and resilience for 2030 and beyond, but there is a need for funders to:

- Better articulate the different funding pathways that already exist and drive efficiency/efficacy of those.
- Provide greater financial support to facilitate two-way knowledge exchange.
- Support the phasing of research with beneficiaries engaged at all stages of co design, research and communication. It is important for funders to understand how these phases of research and the stakeholders/funders involved overlap and reinforce each other.
- Acknowledge that shortcomings in inclusivity of existing research processes may mean that current research-based knowledge does not necessarily promote equity and sustainability.
- Create opportunities for long term programmes of work required to develop equitable relationships, properly co-design the research and communicate the outputs – it is often harder to secure funding if those outputs are further away.
- Acknowledge that the data generated through long-term programmes may be used for decades to come and needs to remain accessible and interpretable to be of value.
- Explore opportunities for smaller scale, longitudinal studies of five years or more.
- Invest in scientist communicators so that research findings can be fed back to decision makers in real-time.
- Consider that what constitutes 'value' varies between funders and non-funder stakeholders and both need to be engaged at the beginning of the research process.
- Ensure speed and inclusivity in moving forwards adaptation research, but without compromising good governance.
- Consider how current funding programmes are contributing to the longer-term career paths for future climate research leaders and ensure the next generation are well supported.

Case study 24: Cross-sector co-creation

Under the GCRF One Ocean Hub, in the Algoa Bay, South Africa, researchers from social sciences and marine science are working in partnership with local managers and relevant governance structures to co-create climate services. The research is new and novel as it seeks to develop tools for Algoa Bay that integrates all social, ecological, and economic data into models for decision support in marine spatial planning through scenario modelling. The insights and methods to develop the model could potentially be transferable in other countries.

The burden of action is often shifted to those most vulnerable to climate risks, who have limited power to make change in their own lives. Vulnerable communities need to be able to prioritise their own needs and co-designed research is very important in achieving this. Funders and researchers need to listen to all voices, including the poor and marginalised and there is a need to drive structural change to empower local actors but also place the burden of action on those in a position of power.

The IPCC takes communications seriously and spent time explaining results of recent reports to policy makers at COP26, where the WG1 report was recognised in a significant manner, marking a real improvement in science-policy communications. It will be paramount for the research community to be aware of the Glasgow-Sharm El Sheik Global Goal on Adaptation and develop ideas to take to COP27 and COP28 for discussion. There are likely to be multiple goals that are location, ecosystem or country-specific but it will be key to gain consensus for more urgent, ambitious and coordinated action for climate adaptation and resilience from policy makers worldwide.

Annex 1:

List of Co-Hosts as they appear in the report

The Africa Research and Impact Network (ARIN)

The Science and Innovation Network, in collaboration with the British Embassy Santiago

The Administrative Centre for China's Agenda 21 (ACCA21), affiliated to China Ministry of Science and Technology (MOST)

Government of India's Ministry of Earth Science (MoES)

The British Embassies in Brazil, Colombia, Mexico and Peru

The Department of Science and Technology (DOST-Philippines)

Thailand Science Research and Innovation (TSRI), the Thailand Ministry of Agriculture and Cooperatives (MoAC)

UK Research and Innovation (UKRI)

Self-organised: British Institute in East Africa -Cambridge University-York University and UCL's Institute for Global Prosperity

Self-organised: The European Science and Technology Advisory group (E-STAG), convened by the United Nations Office for Disaster Risk Reduction (UNDRR).

Self-organised: The fifth Global Summit of the Global Alliance of Disaster Research Institutes (GADRI)

Self-organised: GCRF-funded researchers from across the Resilience Portfolio together with colleagues from the UK Alliance for Disaster Research (UKADR) network

Self-organised: ForestGEO arthropod initiative

Self-organised: The GCRF One Ocean Hub

Self-organised: GCRF Challenge Leader for Global Health

Self-organised: University of Portsmouth

Self-organised: Towards a Sustainable Earth (TaSE) led by Manchester University

UK Steering Group Members

Foreign, Commonwealth and Development Office (FCDO)

UK Collaborative for Development Research (UKCDR)

British Academy

Royal Society

UK Alliance for Disaster Research (UKADR)

Kings College London


Department for
Business, Energy
& Industrial Strategy


British Embassy


British Institute
in Eastern Africa


ipcc
INTERGOVERNMENTAL PANEL ON
climate change


สกสว
TSRI


E-STAG
SENDAI FRAMEWORK


ForestGEO


GCRF


Newton
Fund


UNDP


CYMDEITHAS DDYSGEDIG CYMRU
THE LEARNED SOCIETY OF WALES


UKCDR


COP26 UNIVERSITIES NETWORK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1824
The University of Manchester


UNIVERSITY OF
CAMBRIDGE

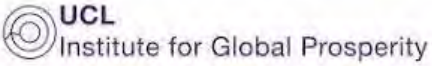

UNIVERSITY OF
PORTSMOUTH


UNIVERSITY
of York


KING'S
College
LONDON


THE
ROYAL
SOCIETY


Foreign,
Commonwealth
& Development
Office


UCL
Institute for Global Prosperity


UNDRR
UN Office for Disaster Risk Reduction


Adaptation Research Alliance


GADRI
Global Alliance of
Disaster Research Institutes


British Embassy
Santiago


Ministry of Earth Sciences
Government of India


ORIN
AFRICA RESEARCH & IMPACT NETWORK


Department
for Environment
Food & Rural Affairs


MOST 科技部
Ministry of Science and Technology


The
British
Academy


UKADR
United Kingdom Alliance
for Disaster Research


ONE
OCEAN
HUB

Annex 2:

List of countries represented across events series

Africa

- Benin
- Botswana
- Burkina Faso
- Cameroon
- Egypt
- Gambia
- Ghana
- Guinea
- Kenya
- Liberia
- Malawi
- Mali
- Morocco
- Mozambique
- Namibia
- Nigeria
- Rwanda
- Senegal
- Somalia
- South Africa
- Tanzania
- Tchad
- Tunisia
- Uganda

- Bangladesh
- **Brazil**
- **Canada**
- **Chile**
- **China**
- **Colombia**
- **EU**
- France
- Germany
- Netherlands
- **India**
- Japan
- **Mexico**
- **Peru**
- **Philippines**
- **Thailand**
- Trinidad and Tobago
- **United Kingdom**
- United States

Bold = co-host