British Geological Survey

Geoscience for Sustainable Futures: partner survey and interview analysis

International Geoscience Programme

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BRITISH GEOLOGICAL SURVEY

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Geoscience for Sustainable Futures: partner survey and interview analysis

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Foreword

Over 30 partners from lower- and middle-income countries took part in BGS's 'Geoscience for Sustainable Futures' (GSF) programme (2017–2021). Towards the end of the programme, BGS undertook an online survey of partners with some follow-up interviews to find out about their experiences of being involved in the programme. This document summarises the views of partners who took part and provides valuable insight into the programme from the partners' perspectives.

Acknowledgements

The GSF programme was founded on the expertise, enthusiasm and energy of our partners. None of it would have been possible without them and we are extremely grateful.

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Summary

Over 30 partners from lower- and middle-income countries took part in BGS's 'Geoscience for Sustainable Futures' (GSF) programme (2017–2021). Towards the end of the programme (2021), BGS undertook an online survey of partners with some follow-up interviews to find out about their experiences of being involved. This document summarises the views of partners who took part in the survey with additional detail from those who were interviewed.

Partners were very positive about working with BGS and the vast majority agreed that BGS added value to the work. The communication skills, attitude, knowledge and experience of BGS staff were particularly valued. Partners were enthusiastic about positive changes that took place because of the work done within the project, citing workshops, training, presentations and publications, as well as datasets and models as key outputs. Similarly, the longer-term impacts of the work were seen as strengthening networks, contributing to knowledge, raising awareness and changing ways of thinking. Good examples of systemic and policy-level influence were given, as well as more numerous examples of benefits internal to the partner organisation.

Obstacles to longer-term change were also shared. Examples include limited financial resources of citizens to enable behaviour change and the need for political support to ensure follow-up action.

1 Introduction

The ODA-NC Geoscience for Sustainable Futures (GSF) programme (2017–2021) involved around 170 staff from BGS and over 30 partners around the world. It used Official Development Assistance (ODA) funding to advance collaborative geoscience research and innovation to address challenges in lower- and middle-income countries.

These activities were organised into projects under three research platforms (RPs) focusing on different UN Sustainable Development Goals (SDGs; see front page of this report) and working in different regions:

- RP1: Integrated resource management in Eastern Africa (SDGs 2, 3, 6 and 12)
- RP2: Resilience of Asian cities (SDGs 6, 11 and 13)
- RP3: Global geological risk (SDGs 1, 9, 11)

The global challenges that the SDGs target can only be tackled in an effective and sustainable way if people and organisations work together (SDG 17: Partnerships for the goals). Working in partnership with others to enhance knowledge sharing, collaboration, co-production and capacity strengthening was the central tenet of the GSF programme.

In June and July 2021, BGS undertook an online survey of GSF partners with some follow-up interviews to find out about their experiences of being involved in the GSF programme. This document summarises the views of partners who took part in the survey and interviews. Information on what the GSF programme achieved can be found in Gill et al. (2022).

2 Methodology

A survey was sent to 23 partners in mid-June 2021 to obtain their views. They were then encouraged to pass on the questionnaire to appropriate colleagues for their feedback in late July. A total of 24 partners responded to the survey. The survey included around 20 questions gathering information about the respondent (e.g. gender; career stage) and then divided into three key topic areas:

- their relationship with BGS around this project (Section 4)
- the outcomes and impact of the work (Section5)
- their reflections on future work with BGS (Section 6)

Each of the survey respondents who indicated willingness was then contacted by an independent Monitoring, Evaluation and Learning (MEL) consultant (author Lyon) and invited to share their views in a follow-up interview. Five accepted and were asked a series of questions in an interview lasting around an hour. A summary of the responses to the questions is appended to this document and relevant quotations are included in *italics* throughout.

3 Respondent information

The 24 respondents to the survey were split evenly between early (one to seven years of experience), mid- and senior level (15 years and over) in their career. Just over half of the respondents work in government, five work in a university environment, three in a geological survey or similar organisation and the final three in a non-governmental organisation (NGO), think tank or other type of organisation. Eighty per cent of the respondents were men, twelve per cent were women, with the remainder preferring not to comment on their gender.

4 Relationship with BGS

In terms of working relationships, most respondents strongly agreed (79 per cent) or agreed (17 per cent) that partnering with BGS delivered value to their research. A single partner was neutral in their response. All respondents agreed — most of them strongly — that it was easy to openly discuss problems and any issues were dealt with respectfully and constructively.

All respondents were positive about the relationship with BGS in interviews. For example:

- '*BGS were very experienced and trained in dealing with partners*'
- '*Friendly and knowledgeable people*'
- '*They value our opinion*'

In terms of a clear plan for the partnership, including vision, objectives and responsibilities of each partner, 22 respondents agreed or strongly agreed (13 and 9 respectively) and two were neutral or left their response blank. Overall, the partners reflected that the plans were clear:

- '*When BGS was proposing the project to us, we could see the objectives*'

And that there was flexibility:

- '*We discuss, and every agency gives their view*'

Regarding the necessary resources (personnel or finance) being available for the partnership to function effectively, 17 respondents agreed or strongly agreed (10 and 7 respectively), with six being neutral or leaving the response blank and one disagreeing with this statement.

There was consensus that information and knowledge sharing between BGS and the partner organisations was effective, with 92 per cent agreeing or strongly agreeing (12 and 10 respondents respectively) and the other two being neutral or leaving their response blank.

The experience of BGS staff was appreciated, as well as their technical knowledge and communication.

- '*Their insight is different to our local knowledge*'
- '*I learned a lot, with every interaction*'

In terms of sensitive and effective handling of any cultural differences between BGS and partner organisations, 23 respondents agreed or strongly agreed (12 and 11 respondents respectively), with one neutral response.

5 Outputs and impact

When asked if anything had changed as a result of the work the respondents had been involved in, the majority (88 per cent) answered positively and 8 per cent in the negative.

Respondents were asked to select the types of outputs their work produced from a list of eight alternatives. The results are shown in Table 1.

Table 1 Partners' views on the types of outputs from the work.

Type of output	Number of mentions
Workshops, outreach or training/educational activities	19
Conference presentations	14
Datasets, databases and models	13
Publications (e.g. peer-reviewed papers; workshop reports, etc.)	11
Influence on policy and/or practice	9
Further funding applications	8
Software products	3
Artistic products	1

Looking at the ownership/authorship of the deliverable(s), most respondents felt that their effort was fairly reflected, with a third in strong agreement, a quarter neutral and the rest in agreement.

Moving on to the main, longer-term impact of the work, respondents were given a list of eight categories and asked to select as many as applied. On average, 4.3 categories were selected, with a range of only one to the full eight. The selected impacts are given in Table 2.

Table 2 Partners' views on some of the longer-term impacts of the work.

Type of impact	Number of mentions
Building and strengthening networks	20
Contributions to knowledge	20
Raising awareness	16
Changing ways of thinking	14
Training researchers/intermediaries to strengthen research uptake approaches	11
Change in policy and practice	9
A change in direction attributable to research	8
Connecting up the supply of evidence with the demand for it	6

Expanding on the descriptions of those impacts, several survey respondents commented on personal benefits they had gained:

- skills improvement
- improved methods
- confidence in their findings
- better knowledge
- good working relationships

Other impacts mentioned included:

- awareness being raised within the broader community
- changing regulations
- contributing to evidence-based policy decisions

In interviews, partners were asked about substantive changes they had seen so far. The changes cited varied between projects, with examples given of changes in processes (e.g. geological surveys submitted as part of the planning process) and raising awareness to promote behaviour change and policy:

- '*Developers now submit geological reports specific to the site*'
- '*There was a lot of resistance at first but now they are complying*'
- '*Regular readings are taken, and data sent to government. There is a new regulatory authority in place that receives it.*'
- '*We are collaborating well e.g. the data is being used in campaigns to save water — and the energy used to pump it*'
- '*The project has raised awareness with workers on wastage and contamination caused by current practices. There has been some improvement: the workers' groups are trying to take precautions. Elimination of the hazard in total would need finance to buy equipment and tools. They are aware of the problems, but they have no option (but to continue without the tools due to financial constraints).*'
- '*A policy brief has been submitted to government and they are using it to educate traders and consumers. Links between their institute and local agriculturalists have been strengthened — there have been targeted workshops and information has been shared.*'

In terms of how these changes happened, a range of responses was given in the survey. This started with field investigation activities, through the production of outputs to communication actions including dissemination, community engagement, training, workshops and knowledge-sharing sessions.

The survey then asked respondents about the level of significance of the changes seen as a result. Eight respondents saw the changes as very significant and eleven as somewhat significant. Three respondents stated that they did not know and two left the response box blank. When asked to explain why they gave this assessment, the respondents focused on two areas: internal and external.

On the changes internal to their organisation, respondents commented on:

- learning new techniques and skills in:
    - investigation
    - research
    - data management and analysis
    - writing and presentation
- better tools for decision making
- an expanded job scope

Looking beyond their organisations, respondents commented on the research being used in decision making, policy and realising the importance of academic research in development and economic growth.

In interviews, partners were asked a further question about the major obstacles to positive change. Their responses are summarised below.

Several respondents mentioned the financial constraints to changing behaviours:

- '*The research identifies the problems, identifies the solutions but you leave the people the way they are. You have taught them something, but they don't change.*' (In this case, change in behaviour needed new equipment, which the users could not afford.) The respondent suggested looking for other donors or support and/or more demonstrations to promote change
- '*People want to do the right thing but they need income to get food, shelter, send the children to school. So they don't follow science because they want to have a living.*'

Several respondents commented on the importance of political support both within the institution and more broadly:

- '*it is about the political priorities*'
- '*there may be political and managerial issues in taking action*'

The need to bring — and keep — 'top management' on board was emphasised:

- '*Political goodwill is a challenge. The majority are concerned with tangible outputs — such as a road — but ecological aspects are not given priority.*'

The final question in this section of the survey asked how the work's impact was monitored. There was a variety of responses, with most addressing the nature of the impact rather than the systems used to monitor. However, some partners mentioned:

- using monitoring and evaluation (M&E) tools
- participatory M&E
- references to publications/articles and follow-up with network members, stakeholders, policymakers and the community

One partner specifically mentioned the Balanced Scorecard (BSC) of their institution. This is a strategic planning and management system used by organisations.

6 Future opportunities

The last section looked at what respondents would do differently if there were future opportunities for collaboration with BGS.

Several respondents commented on the success of the current approach. One respondent was particularly positive about the current approach:

- '*The information is packaged to be understood by end-users and the risks made clear. We normally go big, to various platforms, the media, local radio, the papers to share the information to gain a big following.*'

However, others suggested changes in the process of collaboration:

- '*Giving room for more physical inception meetings and dissemination workshops*'
- '*Research data sharing policies should also be looked at again to enable my institution to have custody and unlimited use of the datasets.*'
- '*Planning for the local bureaucratic processes to limit delays in undertaking activities*'
- '*How to outreach the knowledge to public*'
- '*Overall, the previous project works very well. Probably the involvement of more local junior researchers for knowledge transfer would be good.*'
- '*I'd like to have more opportunities accorded to members of my institution to contribute as co-authors in publications.*'
- '*Discuss research offline*'
- '*Engage with many other researchers*'
- '*Produce indexed papers from joint research with agencies and academia, co-develop projects that benefit the local research.*'
- '*More long-term workshops*'

A further group of responses focused on expanding the activities within the collaboration, for example:

- '*BGS to offer training sponsorship for short courses such as project management and financing to enhance capacity of the team/institution.*'
- '*Maintain the same level of engagement but cover more sectors*'
- '*Student and faculty exchange*'
- '*BGS to involve partners in laboratory sample analysis (which were done in UK labs)*'
- '*The opportunity to share the roadmap of BGS and the potentials for collaboration will be interesting.*'
- '*Further cooperation in various other specific geological/applied geological-related subject matter that has the importance to be considered that have the impact from the very bottom to the regional level.*'

The feedback in interviews was that more partners want more.

- '*The project should be enlarged — for other cities*'
- '*I am hoping for more opportunities'*

In terms of the areas of focus of potential future work, respondents produced a long list of work areas, split in Table 3 by process- and content-related areas.

Table 3 Potential areas for future work identified by partners.

Process-related areas	Content-related areas
○ Building long-term databases and better understanding the concepts ○ Exchange programs (mentioned twice) ○ Mapping and modelling training ○ Supervision exchanges of postgraduate students ○ Predictive models and how to apply them ○ Training and capacity building on all aspects, including managing projects ○ Using the research data for peer-reviewed publications as a way of enhanced dissemination ○ Funding opportunities ○ How to popularise and communicate geoscience activities to audiences that include pre-university ○ Scholarship and sponsorship opportunities for further studies to early research careers ○ Data management and technical expert knowledge sharing ○ Adapt methodologies that are applicable to the local scene, fostering awareness of the importance of geological knowledge to aid in engineering works in planning and development ○ Databasing, information technology aspects and environment-related subject matter	○ Focus more on synergy between land and lake ○ Heavy metals in fish ○ Food loss and waste across Lake Victoria ○ Mitigation on environmental conservation and resource management ○ Topics that are related to disaster risk reduction or urban resilience ○ Geoscience hazards ○ Continue to work on other parts of the city or other cities ○ Application of resistivity in geotechnical site investigations ○ Marine geology; sedimentology ○ Urban geology and subsurface geology ○ Engineering; urban geology

7 Final thoughts

It should be noted that this information was gathered from a one-off exercise and is based on the perception of a self-selected group of interviewees. The sample size is limited.

The data does show, however, that the people who responded were very positive about working with BGS and the vast majority agreed that BGS added value to the work. BGS staff's communication skills, attitude, knowledge and experience were particularly valued. Partners were enthusiastic about positive changes that took place as a result of the work done within the project, citing workshops and training, presentations and publications.

Similarly, the longer-term impacts of the work were seen as:

- strengthening networks
- contributing to knowledge
- raising awareness
- changing ways of thinking

Good examples of systemic and policy-level influence were given, as well as more numerous examples of benefits internal to the partner organisation.

Obstacles to longer-term change were also shared. Examples include limited financial resources of citizens to enable behaviour change and the need for political support to ensure follow-up action. Interview responses also highlighted that further consideration must be given to developing systems with partners for gathering evidence of project impact, both positive and unintended negative change. Without investing in this, there is a risk that the long-term impacts of these types of development-focused projects will not be known.

References

GILL, J, SARGEANT, S, DOBBS, M, MILLS, K, and WHITE, D. 2022. Geoscience for Sustainable Futures: our journey towards impact. *British Geological Survey Open Report* OR/22/017.

Appendix A: overview of tasks and partners

Code	Task title	Task aim	Partners
RP1: integrated resource management in Eastern Africa			
A	Support to African groundwater community	Groundwater management is at an early stage in many parts of Africa, partly due to the low levels of development. However, management of groundwater is critical to the implementation of SDG6 and there are several initiatives to help promote management and share good practice. Despite the persistence of integrated water resources management, groundwater is often forgotten about and not properly integrated into thinking and planning of water resources. In this project, BGS is providing support to a number of pathways for good groundwater governance: • support to policy development • consensus building • knowledge synthesis and exchange • supporting networks These include developing a new pan-African groundwater programme through the African Ministers Council for water, synthesising existing data to provide policy-friendly summaries of groundwater.	• African Ministers Council for Water (AMCOW) • United Nations Educational, Scientific and Cultural Organization (UNESCO) • International Water Management Institute • International Association of Hydrogeologists
B	Mining practice and recovery of gold in Migori County, Kenya	This project aimed to promote good practice for artisanal and small-scale gold mining (ASGM) in Migori in south-west Kenya through collaboration with local mining cooperative Migori County Artisanal Miners Co-operative (MICA) and the University of Nairobi. ASGM is a major employer in Kenya (estimated 40 000 people) and produces five metric tonnes of gold per year. Improvement to ASGM practices has the potential to provide a significant boost to local economies, securing livelihoods and enhancing the quality of life for many communities. However, ASGM can also have significant negative environmental consequences. This can be through the release of harmful chemicals used in processing (including mercury and cyanide) into soil and water, poor water management practices and the incorrect storage and management of waste left over from the mineral extraction process.	• University of Nairobi (Department of Geology) • Migori County Artisanal Miners Co-operative, Kenya
C	Critical raw materials in Eastern Africa	Global net zero ambitions are dependent upon resources of the raw materials that are required for the energy transition. The World Bank has recognised that this represents a significant opportunity for developing countries that are rich in these resources, but that there is a need for mining to be done in the most sustainable way possible. This project aimed to investigate resources and value chains of some critical raw materials (chiefly lithium and graphite) in eastern Africa, in order to provide meaningful overview information for investors and policymakers. This information can then be used to make informed decision about management of mining and mineral resources.	• University of Witwatersrand, South Africa

Code	Task title	Task aim	Partners
D	Using EO data for mining sites and their evolution in time along the Migori river catchment area	This task aimed to improve understanding of the monitoring of mineral resource exploration and mining, from concept to closure, using earth observation tools.	• University of Nairobi • Ministry of Petroleum and Mining, Kenya
E	Environmental geochemistry and health	The programme of work addresses RP1: resource security in East Africa, specifically work package 1: agriculture and nutrition. Key advances in environmental geoscience lie at the nexus of geochemistry (soil, water, sediment), health (nutrition, toxicology, epidemiology) and agriculture (crops, livestock, fisheries). BGS and research partners are developing an integrated approach to risk assessment and public policy, including: • capturing and integrating soil geochemical processes across multiple scales • develop a predictive model of soil-to-plant micronutrient and environmental pathways of contaminant exposure to assess health consequences (e.g. oesophageal cancer incidence, soil erosion and input to lake environment) • support policies in agriculture (e.g. agri-strategies, fisheries-aquaculture) and public health surveillance (e.g. geochemical maps, location of aquaculture cages) • determining land/lake transfers via soil erosion and implications for loss of agricultural opportunity and sustainability of lake fisheries	• University Eldoret (School of Environmental Sciences) • Moi University (School of Public Health) • Kenya Marine & Fisheries Research Institute • Kenyan Agricultural Laboratory Research Organisation • International Agency for Research on Cancer
F	Effective and innovative ways of managing and delivering geodata	This project focused on effective and innovative ways of managing and delivering geodata that contributes to social and economic structural transformation, wealth creation and poverty reduction. The project facilitated ODA partners in realising the value of their data assets through the development and population of effective digital data workflows. We leveraged our networks, such as OneGeology, to enable ODA partners to utilise geospatial technology and computing systems to accelerate the dissemination of essential geoscience data for the benefit of society. Using modern data translation techniques (e.g. scanning and digitisation) and new information delivery methods appropriate to ODA partner infrastructure (e.g. mobile apps, interoperable web services), new and innovative digital access solutions have been developed that enable geoscience data to be embedded in policy development and wider ODA-related research.	Including: • African Union Commission • Ugandan Chamber of Mines and Petroleum • Uganda Directorate of Geological Survey and Mine • Geosoft (now Seequent) International Geoscience Services Ltd • Onegeology Consortium
G	Rural water supplies during drought in Ethiopia	This work examined the performance of rural water supplies during one of the worst droughts in Ethiopia since the 1980s to see which performed best. The work was joint with UNICEF in Ethiopia and the results used to help learn lessons to plan future more resilient rural water supply interventions.	• UNICEF • Addis Ababa University, Ethiopia • Overseas Development Institute

Code	Task title	Task aim	Partners
H	Real-time monitoring of faecally contaminated drinking water	Globally, two billion people consume water contaminated with faeces. This exposure increases the incidence of infectious disease such as diarrhoea, which alone results in more than half a million deaths per year in low- and middle-income countries. Recent BGS sensor research has focused on on-site testing using portable tryptophan-like fluorescence (TLF) sensors that require no reagents and provide instantaneous readings. TLF sensors have the potential to be used for real-time microbial risk screening of drinking water supplies.	Many partners including: • University of Makerere, Uganda • University of Malawi, Malawi • University of Dakar, Senegal • University of Nairobi, Kenya • UCL, UK
RP2: resilience of Asian cities			
I	3D Kuala Lumpur pilot study	Cities and human settlements can be made more inclusive, safe, resilient and sustainable through better integration of geoscience into the urban development process. A key step in this process is to enhance awareness of urban geology among non-geoscience decision makers, so that inherent subsurface risks and benefits are understood and accounted for during planning, design and construction. Three-dimensional geological models are an effective tool for geologists to communicate with geoscience stakeholders in government and industry during this process. They can also provide a framework to enable geological data and information to be integrated into building and city information models, thus facilitating more sustainable infrastructure and utility asset management.	• Department of Minerals and Geosciences Malaysia - Jabatan Mineral dan Geosains Malaysia • Public Works Department - Jabatan Kerja Raya • Kuala Lumpur City Hall - Dewan Bandaraya Kuala Lumpur • Mass Rapid Transport Corporation • Universiti Tenaga Nasional • University of Malaya
J	Kuala Lumpur geology	Cities and human settlements can be made more inclusive, safe, resilient, and sustainable through better integration of geoscience in urban development. A key step in this process is to develop a robust understanding of the geology within an urban environment and share this knowledge with geoscience stakeholders.	See I

Code	Task title	Task aim	Partners
K	South-east Asia urban geology partnerships	Cities and human settlements can be made more inclusive, safe, resilient and sustainable through better integration of geoscience into the urban development process. A key step in this process is to enhance awareness among geoscientists of the role that geology can have in the urban environment and increase the number of geoscientists engaged in urban geology.	• Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP) • Department of Minerals and Geosciences Malaysia - Jabatan Mineral dan Geosains Malaysia • General Department of Geology and Minerals of Vietnam • Public Works Department - Jabatan Kerja Raya • Kuala Lumpur City Hall - Dewan Bandaraya Kuala Lumpur • Mass Rapid Transport Corporation • Universiti Tenaga Nasional (Uniten) • University of Malaya • Universiti Kebangsaan Malaysia • Ministry of Natural Resources and Environment of Vietnam • workshop participants from Thailand and Myanmar
L	South-east Asia materials flow analysis	This task used satellite data to assess geohazards (e.g. subsidence) in Hanoi (Vietnam) and construction material demands associated with urban growth.	• General Department of Geology and Minerals of Vietnam • Hanoi People's Committee • Ministry of Construction

Code	Task title	Task aim	Partners
M	Earth observation for assessment and monitoring of the urban environment and hazards	This work investigates supply and demand of raw materials used in construction and infrastructure in Vietnam. Rapid urban expansion has caused an increasing strain on raw materials that are required for construction and for the manufacture of everyday items that are now considered essential for maintaining quality of life. If flows of raw materials are constrained then growth can be adversely affected, costs of building essential infrastructure can increase and feedstocks for manufacturing and industry may be restricted. This can also lead to illegal mining operations to fulfil demand, which can, in turn, cause great harm to the environment. To mitigate this and to ensure that raw materials are sourced sustainably in adequate quantities and are effectively used and recycled, it is important to understand how they flow through society, from source to end use and waste management. Mapping material flows and stocks at city level provides essential background information on raw material availability and use, and identifies risks and supply disruption issues that can be mitigated by tailored interventions. The outcomes of material flow analysis can assist effective decision making and planning of urban development projects. This research improves the understanding of materials flows associated with rapid urban expansion in Asian cities.	• General Department of Geology and Minerals of Vietnam • Vietnam National Space Center Hanoi People's Committee • Ministry of Construction
RP3: global geological risk			
N	National landslide susceptibility modelling, Ethiopia	Building on work carried out for the World Bank by BGS producing hazard and risk maps for a series of countries in sub-Saharan Africa. The aim of this project was to strengthen the collaboration with IGSSA in order to produce a national scale map of landslide susceptibility that was more tailored to the specific processes taking place in Ethiopia than the World Bank one. The initial focus was to increase the current inventory of landslides using literature and online imagery (GoogleEarth) to validate the current World Bank susceptibility model and assess what the areas of improvement were. Using additional data, the final aim was to create a more detailed map of landslide susceptibility in collaboration with Getnet Malwa at IGSSA.	• Institute of Geophysics, Space Sciences and Astronomy, Addis Ababa University, Ethiopia

Code	Task title	Task aim	Partners
O	METEOR	Multiple hazards cause an increased impact on populations. Mainstreaming DRMi into planning systems of governments and large organisations can reverse the trend of rising cost from disasters in terms of death, damage and destruction. Many developing countries lack the tools, expertise and data to factor the potential risk of disasters into their investment decisions. METEOR provided openly available, national-scale exposure data for all ODA countries, produced through a rigorous methodology tested and validate in Nepal and Tanzania. The project combined satellite imagery and detailed structural engineering data to understand delineated building construction type and to model the vulnerability of the exposure to flood and seismic hazards, with landslide and volcanic hazards identified as of greatest importance to Nepal and Tanzania respectively. New, national-scale hazard data were generated and the impact of the multi-hazards on exposure was assessed with the aim to assist in DRM to lessening the impact of these hazards on the populations.	• Fathom • The Global Earthquake Model Foundation • ImageCat • Humanitarian OpenStreetMap Team • Oxford Policy Management Ltd • Disaster Management Department of Prime Minister's Office of Tanzania • National Society for Earthquake Technology, Nepal
P	myHAZ – a multi-hazard, citizen science app for St Vincent and the Grenadines (SVG)	This project aimed to develop a citizen science smartphone tool for residents of St Vincent and the Grenadines to share their observations of multiple natural hazards and environmental phenomena and their impacts. Citizen science facilitates resilience building by enhancing citizens' understanding of hazards and risk, whilst also building trust and communication links between citizens, scientists and authorities. The near-real time reporting of hazards within the app enables scientists and emergency managers to gain a rapid understanding of an evolving hazard event and its impacts, in particular for scientists who may not be based on island (e.g. the UWI Seismic Research Centre, which are based in Trinidad and Tobago). Use of myHAZ is also encouraged during periods of quiescence to help citizens become more aware of more subtle changes in their surroundings, which may provide early warning to more significant events.	• NEMO: National Emergency Management Organisation, St Vincent and the Grenadines • UWI-SRC: University of the West Indies Seismic Research Centre, Trinidad and Tobago
Q	Pathways to Action	This project aims to identify hazard and risk communication pathways during active and latent periods. By characterising both formal (e.g. from NEMO to local communities) and informal (e.g. between friends/neighbours/via social media) flows of communication within and between communities, we hope to develop understanding of what components of the communication and the landscape it moves through affect sense making, promote learning and prompt risk-reducing action.	See P

Code	Task title	Task aim	Partners
R	Geophysical technologies for landslide monitoring and early warning (India)	This project aimed to develop a novel geophysical monitoring approach in monsoonal, mountainous regions, helping to identify subsurface precursor processes to slope failure, hence improving early warning of moisture-induced landslide events. A new geophysical monitoring system (PRIME), developed by BGS, was deployed at the Munnar Landslide Observatory (Kerala, India). The system is designed as a low-cost and low-power remote monitoring system using the mobile phone network for telemetric control and is therefore ideally suited for deployment in developing countries with significant landslide hazards. During the project, daily geophysical measurements were used to image moisture build-up in the slope during the monsoon season, which indicated an increased chance of failure and highlighted the benefit of subsurface monitoring for improving landslide early-warning systems.	• ACWNA: Amrita Centre For Wireless Networks and Applications, Amrita University, Kerala, India
S	Seismic hazard in Bandung, Indonesia	This project aimed to aimed to resolve a scientific dispute on the activity of the Lembang Fault, which lies along the northern margins of Bandung city in Indonesia. This matters because the Lembang Fault is the principal source of local seismic hazard to the city. Additionally, we sought to engage the local art community in a creative discussion on the topic of 'seismic hazard, people and topography'.	• Resilience Development Institute, Bandung Institute of Technology, Indonesia
T	Groundwater depletion (South Asia)	Intensively cultivated areas in South Asia are crucial for regional food security and have a long history of major surface and, more recently, groundwater development. Managing groundwater exploitation is critical to agricultural viability.	• National Institute of Hydrology India • International Waterlogging and Salinity Research Institute, Pakistan • Pakistan Water and Power Development Authority
U	Science into decision making in Ethiopia	In 2012, at the closure of the Afar Rift Consortium project, there was no mechanism for sharing of data or lessons learnt about the volcanic unrest and five volcanic eruptions in Ethiopia that were monitored by the research project. Despite the adverse impacts of those eruptions, the knowledge of volcanic hazards and impacts in Ethiopia at a national level remained low. Since that time, a series of workshops have been held in Ethiopia, designed to bring together scientific institutions and researchers in Ethiopia with local and national disaster risk managers, responsible government ministries, non-governmental organisations and other stakeholders impacted by natural hazards. The project aimed to encourage scientific institutions and disaster risk governance and support institutions to work effectively together through influencing these organisations and creating space for dialogue.	• National Disaster Risk Management Commission • Ministry of Mines • Ministry of Water • Geological Survey of Ethiopia • Addis Ababa University • Ethiopian Red Cross • Ethiopian Roads Authority • Ethiopian Civil Aviation • other non-governmental organisations

Code	Task title	Task aim	Partners
V	Multi-hazards in the East African Rift	Natural hazards and their impacts do not respect country boundaries. The East African Rift presents similar opportunities and challenges along its length. We have collaborated with partners in Ethiopia, Tanzania, Malawi, DRC and Rwanda.	Tanzania: • Geological Survey of Tanzania • Tanzania Meteorological Agency • Tanzanian Office of the Prime Minister • Dodoma University, University of Dar Es Salaam DRC • Goma Volcano Observatory Ethiopia • Ethiopia Geological Survey • Addis Ababa University Malawi • Polytechnic Blantyre - University of Malawi UK: • Heriot-Watt University • University College London

Code	Task title	Task aim	Partners
W	Volcanic event response	BGS responds to volcanic events (unrest and/or eruption) across the world in a variety of different ways. We provide authoritative scientific evidence and advice to UK Government departments, embassies and overseas territories' administrations to ensure UK citizens and interests, including humanitarian and diplomatic needs, are supported and mitigation measures are well-managed. We also contribute to COMET, the International Disaster Charter and other requirements. Events are inherently multi-hazard and lead to complex and cascading impacts. This task is underpinned by our international science networks (volcano observatory and volcanic ash advisory centres; COMET; IAVCEI; GVM network) and our experience of volcanic events and their impacts. We will also support long-term scientific partners during events, especially in East Africa and the Caribbean region, when requested. There are many requirements during emergencies and we aim to ensure that consistent, authoritative and timely scientific evidence supports decision making at all scales and in different nations and jurisdictions. Since October 2020, we have also been providing a 24/7 emergency response service (commissioned) for the European Response and Coordination Centre (ARISTOTLE European Natural Hazards Scientific Partnership), which also focuses on humanitarian needs.	• Seismic Research Centre, University of West Indies, Trinidad • National Emergency Management Organisation, St Vincent and the Grenadines • INSIVUMEH: National Institute for Seismology, Volcanology, Meteorology and Hydrology, Guatemala • CONRED: National Coordinator for Disaster Risk Management, Guatemala • Institut Teknologi Bandung, Indonesia • Resilience Development Initiative, Indonesia • International Committee of the Red Cross • UK FCDO • UK Cabinet Office • Other UK Government departments (e.g. MoD, Department for Transport, Defra, Government Office for Science) • European Emergency Response and Coordination Centre (ERCC) • ARISTOTLE • European Natural Hazards Scientific Partnership (ENHSP) • Washington, Toulouse, and Darwin Volcanic Ash Advisory Centres • many other UK and international research partners

Code	Task title	Task aim	Partners
X	Global data and networks (volcanic hazards and risk)	Global data and networks include several activities related to improved understanding of volcanic hazards and risk. Building on the GVM GAR2015 indices, we aimed to develop new methods for gathering global data on volcanic activity and build networks on volcano reporting. Understanding risk is a priority for the Sendai Framework for Action. Assessing risk at the global scale is critical to informing understanding of progress towards disaster risk reduction and sustainable development. Several stakeholders, including UK Government, are increasingly monitoring multi-hazard activity across the globe to ensure they can make anticipatory and timely decisions about potential humanitarian crises, systemic risks and the health and wellbeing of their residents overseas. Currently, FCDO funds BGS to provide input to one such monitoring activity (the International Natural Hazards Forward Look), which is designed to increase situational awareness amongst Government partners to potential humanitarian crises. BGS currently is the only provider of a summary of global volcanic activity and impact.	See W
Y	Opportunities and threats on small islands, examples from the UK Overseas Territories	The UK Overseas Territory of St Helena, Ascension and Tristan da Cunha in the South Atlantic consists of two isolated islands and a third archipelago. Two of the three islands are volcanoes with potential to erupt, so pose a risk to the highly exposed populations that inhabit them. Taking a multi-disciplinary approach is essential for sustainability and resilience in these locations where resources (including access to portable water) are limited, transport is essential for supplies and emergency transport off-island cannot be immediately provided. This task has built on previous work on Ascension and Tristan da Cunha to explore how earth science research can be integrated with conservation and ecological research to inform and enhance existing natural hazard planning and risk management initiatives. There is an objective to develop a ‘virtual observatory’ for Ascension and Tristan da Cunha but, despite submission of proposals, funding has not yet been made available.	• Tristan da Cunha Government • Ascension Island Government (AIG) and the Conservation Department of AIG • FCDO • Ministry of Defence • RAF • US Air Force • BBC Babcock • local communities

Code	Task title	Task aim	Partners
Z	Hazard and risk data and evidence in Ethiopia	Since 1900, an estimated 405 000 fatalities have been caused by natural hazards in Ethiopia, with 80 million people affected and total damages more than US$1500 million (EM-DAT, 2019). An absence of accessible and reliable data about several frequent hazards in Ethiopia, including ground fissuring, rifting and volcanic hazards (e.g., gas emissions; ground deformation; volcanic earthquakes; volcanic ash; lava flows, etc.) has led to a lack of awareness of the risks they pose. Records of the impacts and consequences of these hazards are also not easily available and, in many cases, have not been recorded at all. We are developing understanding, knowledge and data related to multi-hazards in this volcanic environment, including: • earthquakes • volcanic ash • ground fissuring • lava flows • landslides • flooding • groundwater • past hazardous events and their impacts With our Ethiopian partners, we are designing and populating new databases and resources to enhance and share knowledge widely and give new insight into rapid and long-term changes and consequences in a rift environment.	• Addis Ababa University • Geological Survey of Ethiopia • Geospatial Information Institute • National Disaster Risk Management Commission • Ministry for Water • Metehara Sugar Plantation

Appendix B: interview questions and summary of responses

Project impact
1. What did you understand the purpose of the project to be? Link to SDGs?
There was a variety of descriptions of the project purpose. Respondents were clear on the subjects being addressed and two were able to directly link them to the relevant SDGs. Two respondents said the project built on previous projects and talked about the aggregated outputs and outcomes.
2. What substantive changes have you seen so far?
The changes cited varied between projects with examples of changes in processes (e.g. geological surveys submitted as part of planning process), raising awareness to promote behaviour change and policy. ○ '*Developers now submit geological reports specific to the site. There was a lot of resistance at first, but now they are complying. A group of around 20 agencies come together (including the department of geological science, dept of environment, town planning, police and fire and land) to review, discuss, and recommend actions on proposals. In one case there was a high-rise building proposed in a limestone area, and the developers submitted a detailed report. We investigated the geohazard and concluded it is a dangerous development. We proposed action the developer can take to mitigate the problems. They would not have submitted the report to us (even if they had done it) previously*.' ○ '*Regular geological readings are taken, and data sent to government. There is a new regulatory authority in place that receives it. We are collaborating well e.g. the data is being used in campaigns to save water – and the energy used to pump it.*' ○ '*The project has raised awareness with workers on wastage and contamination caused by current practices. There has been some improvement: the worker groups are trying to take precautions. Elimination in total would need finance to buy equipment and tools. The workers are aware of the problems, but they have no option (but to continue without the tools due to financial constraints)*.' ○ '*A policy brief has been submitted to the government and they are using it to educate traders and fish consumers. Links between the project partner and lake users have been strengthened – there have been targeted workshops and information has been shared (e.g. advice on the location of fish cages). Now that consumers have been reassured about the safety of fish grown in cages, demand has grown*.'
3. What evidence is there for that?
Most of the project partners talked of what they knew from their own observations: there was no reference to systems for monitoring change from four respondents. One cited an endline evaluation (funded from another source) that showed impact at the national level (updated guidelines and regulations) that will then be customised to the county level.

4. How do you anticipate long term change happening? Do you anticipate changes in policy, changes in practice, and/or changes in process?

Respondents referred to further proposals for funding, expanding the scope of the project (e.g. geographically).

Other references were made to bringing agencies together, i.e. more collaboration, increasing understanding of the importance of geoscience, including with students and researchers using the research in a positive way.

One respondent commented that this project '*seems to be more about publication than influence*'. They noted the importance of influencing the political agenda and suggested that, while local government officials attended workshops, there is scope to further influence action. For example, if BGS could talk to the UK Government who could then talk to the national government — and involve them earlier — that would contribute to recommendations from the research being implemented. Another noted that '*once the management/mayor are happy, things run more smoothly*.'

Another respondent was more confident in the current approach, stating:

- '*the information is packaged to be understood by end-users and the risks made clear. We normally go big, to various platforms, the media, local radio, the papers, to share the information to gain a big following*.'

5. What are the major obstacles to positive change happening for your project?

On implementation:

- '*Limited manpower*' (to review the number of reports submitted)
- '*The research is shared with policymakers, intellectuals, academics, but many institutes are involved in dissemination — and so it is difficult to understand what we have achieved*' (given the number of people involved and the length of time taken for change)
- Several respondents mentioned the financial constraints to changing behaviours:
  - '*The research identifies the problems, identifies the solutions but you leave the people the way they are. You have taught them something, but they don't change.*' In this case, change in behaviour needed new equipment that the users could not afford. The respondent suggested looking for other donors or support and/or more demonstrations to promote change.
  - '*People want to do the right thing, but they need income to get food, shelter, send the children to school. So they don't follow science because they want to have a living.*'
- Several respondents commented on the importance of political support, both within the institution and more broadly:
  - '*it is about the political priorities*' and '*there may be political and managerial issues in taking action*'.
- The need to bring — and keep — 'top management' on board was emphasised:
  - '*Political goodwill is a challenge. The majority of them are concerned with tangible outputs – such as a road – but ecological aspects are not given priority*.'
- One respondent mentioned '*rigidity to change*' and the importance of taking the research to the end-users:
  - '*the farmers do not check the internet*'.

On collaboration:

There was a time constraint that limited the numbers of people involved and the level of involvement (limited opportunities to meet).

- '*Financial support was limited*.'

6. Have you seen or do you anticipate any unexpected outputs or outcomes, either positive or negative?

Most respondents were in the situation summarised by a colleague:

- '*Nothing negative to report – though it might have happened "behind me".*'

In one case, the subject of the research became a 'hot topic' in a positive article published by a local newspaper:

- '*the facts we could provide changed the discussion*'

On the relationship with BGS

1. Was the vision and plan for collaborating clear? Did the plan happen in reality?

Overall, the partners reflected that plans were clear, communication was good:

- '*when the (lead) partner was proposing the project to us, we could see the objectives*.'
- '*We had research objectives which have been achieved* [...] *and now the findings will be shared. We are on the right course*.'

When plans change, there is flexibility:

- '*we discuss, and every agency gives their view*'
- '*Initially the project was focused on the scientific output. We didn't anticipate a longer-term relationship – building one into another. That is better than we could have expected. We are still communicating*.'

2. How did the partnership and project align with your organisation and your country's needs?

All respondents were positive about the alignment. Several reported that the work was within their purview, the responsibility of their department or organisation:

- '*it was within the scope, aims and objectives*'
- One mentioned alignment with the national plan: '*these are real needs and BGS support was* [...] *helping us to make good policy, we developed the project together.*'
- Others mentioned the formal processes of approval that had been met: '*it was approved by the Ministry. And it was then sent to External Affairs, and they approved.*'

3. Do you have any suggestions of how BGS can improve their relationships with partners in the future?

All respondents were positive about the relationships and so no suggestions were made on how to improve that specifically. Responses to this question were therefore focused on how BGS can do more.

On BGS

- '*BGS were very experienced and trained in dealing with partners. They know how to deal with partners. very good coordination*.'
- '*They value our opinion – whatever they do, they ask, get consent and then they go for it. They don't do anything without that. They do collaborate, explain rationale, benefits, share suggestions*.'

The experience of BGS staff was appreciated, as was their technical knowledge and their communication:

- '*their insight is different to our local knowledge*'
- '*Friendly and knowledgeable people.*'
- One respondent commented on how they learned a lot, with every interaction.

On future work

- '*Projects should be enlarged – for other cities*.'
- '*Hoping for more opportunities*', e.g. fund for further education, see the work on analysing the samples (which was done outside the project country and so the respondent did not see the process), staff exchanges, proposal-writing workshops.
- One respondent also suggested an MoU as part of building a longer-term relationship.