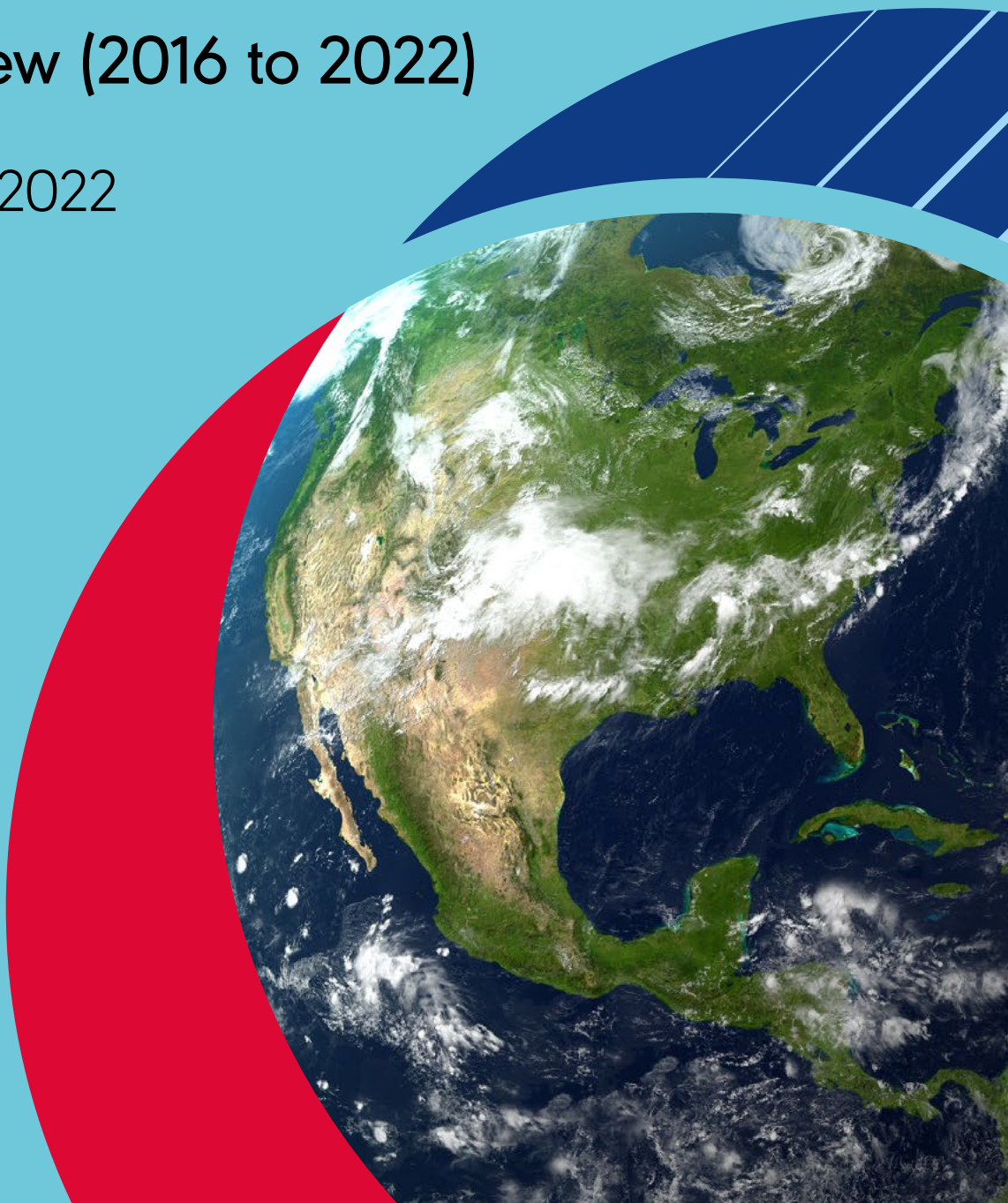
UK SPACE AGENCY

International Partnership Programme (IPP)

Using space to deliver sustainable development

IPP in review (2016 to 2022)

September 2022



The UK Space Agency plays a major role in delivering the government's National Space Strategy.[1] We support a thriving space sector in the UK, which generates an annual income of £16.5 billion and employs 47,000 people across the country. Our professional staff include scientists, engineers, commercial experts, project managers and policy officials who help to:

- catalyse investment, using our funding and resources to increase the value of non-government contracts and private capital secured by UK space organisations, and to maximise the space sector's long-term growth
- deliver missions and capabilities, independently and with others, that use space science, technology and applications to meet national needs and help humanity to understand our universe
- champion space, encouraging other sectors to use space to deliver better services, tackle the climate emergency, inspire STEM education and lifelong learning, and advocate for sustainable space activities

The International Partnership Programme (IPP) was the UK Space Agency's sustainable development initiative.[2] It was designed to utilise UK expertise in satellite technology and data services to deliver innovative solutions which help tackle specific global challenges in partnership with developing countries, while facilitating new trade opportunities for the UK space sector.

Funded from the Department for Business, Energy and Industrial Strategy's (BEIS) Global Challenges Research Fund since 2016, IPP was compliant with official development assistance (ODA) and delivered in line with the UK's Aid Strategy and United Nations' (UN) Sustainable Development Goals (SDGs).[3, 4, 5]

1 https://www.gov.uk/government/publications/national-space-strategy
2 https://www.gov.uk/government/collections/international-partnership-programme
3 https://www.newton-gcrf.org/gcrf/
4 https://www.gov.uk/government/publications/uk-governments-strategy-for-international-development
5 https://sdgs.un.org/goals

The Global Challenges Research Fund (GCRF) supports cutting-edge research and innovation that addresses the global issues faced by developing countries. It is a £1.5 billion fund from BEIS and part of the UK government's ODA commitment. The GCRF is delivered by the Academy of Medical Sciences, the British Academy, the Department for Education Northern Ireland, the Higher Education Funding Council for Wales, the Royal Academy of Engineering, the Royal Society, the Scottish Funding Council, UK Research and Innovation, and the UK Space Agency.

Acknowledgements

The UK Space Agency would like to thank:

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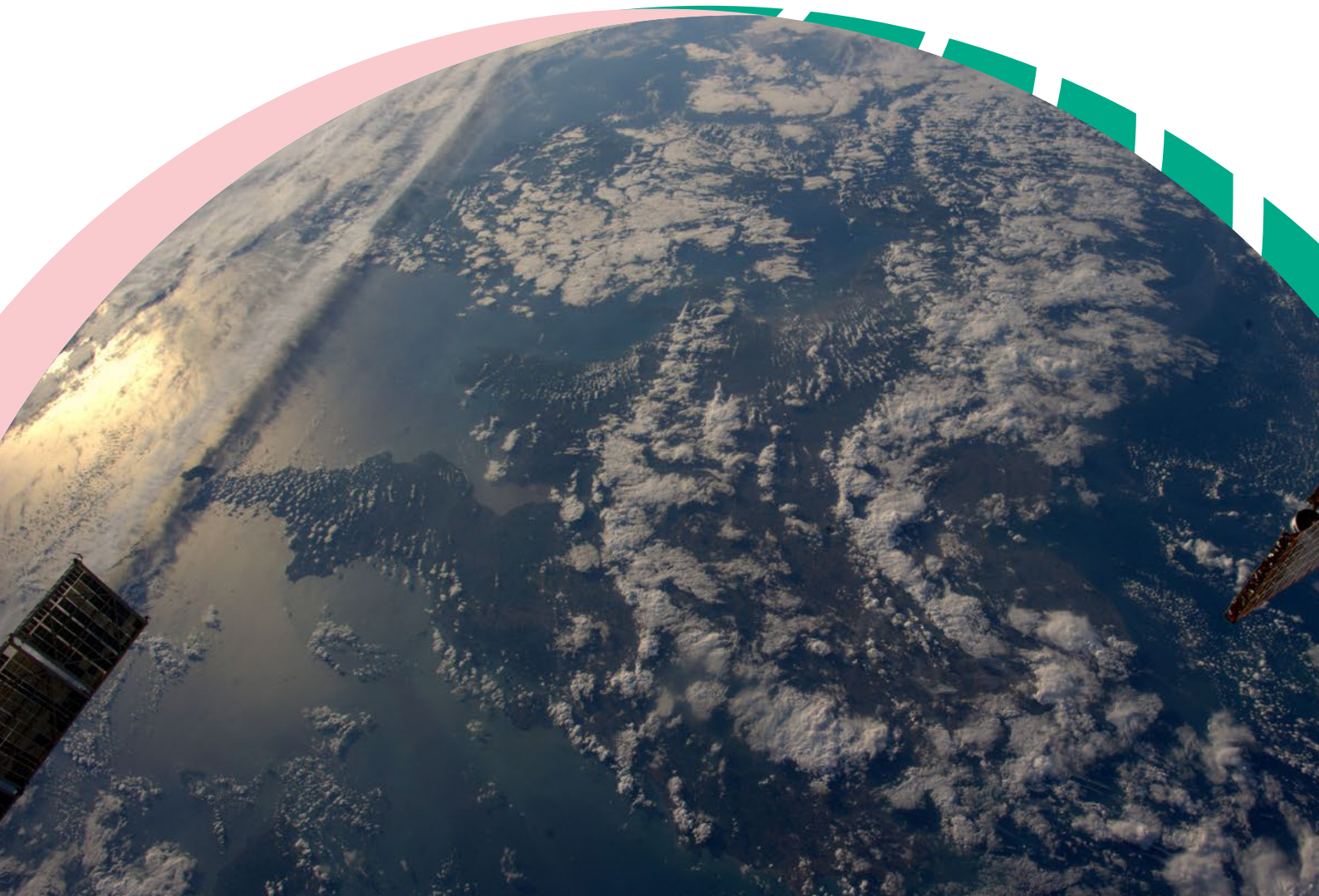
- Caribou Space for their valued monitoring and evaluation and sustainability support since 2016, and for contributing to this report through their endline evaluation of IPP
- GCRF evaluation partners – Itad, RAND Europe, AFIDEP, Athena Infonomics, Digital Science and LTS International – for contributing to this report through their process evaluation of IPP



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Introduction

The UK Space Agency's sustainable development initiative – the International Partnership Programme (IPP) – has concluded. From inception in 2016 to conclusion in 2022, IPP had an impact on and outreach to over two million people and invested almost £150 million of public funding.

This document provides a summary of IPP, including background, objectives, results and challenges faced in delivering this type of programme. Unless otherwise referenced, figures and statements below are taken from two independent assessments of IPP led by Caribou Space and the GCRF in 2021-22. The full results of the programme can be found in the IPP endline evaluation report, which is an independent assessment of IPP output, outcomes and impacts.

IPP inception

In 2016, the GCRF awarded the UK Space Agency a total sum of £152 million over five years to establish a space-based initiative, funding research and innovation which delivers economic and societal benefits to countries on the Development Assistance Committee list that are eligible to receive ODA.[6]

Although space-based tools and techniques were already used in other UK and global initiatives to deliver similar objectives, they were not being used as a systematic or large-scale resource to help deliver the UK Aid Strategy. IPP therefore became the largest programme of its type in the UK and set out to deliver tangible benefits while proving that case for investment in space to help address the UN SDGs.

IPP objectives

IPP's overarching objective was to achieve a measurable and sustainable economic, societal and/or environmental impact on applicable SDGs using space-based tools and techniques. Where possible, this would avoid development of space hardware, such as building new satellites or infrastructure. Instead, the UK Space Agency designed IPP using existing satellite data and developing new, innovative applications to ensure value for money and delivery within programme timelines, while maximising the return on investment and prospect of sustainability.

Another objective was for projects to be highly collaborative and develop new, non-traditional, global space partnerships which support capacity building, thereby increasing outreach of the UK space community.

6 www.oecd.org/dac/financing-sustainable-development/development-finance-standards/daclist.htm

IPP structure

Run entirely by the UK Space Agency with assistance from Caribou Space – commissioned to provide monitoring and evaluation (M&E) and sustainability support – IPP was delivered through a series of medium-to-large international projects.[7] Collaboration was fundamental and mandated by the need for a defined end user in the partner country who supported the project proposal and confirmed that the proposed space solution would have a positive impact on their specific developmental challenge(s).

Projects were led by groups of industry, academia, inter-governmental organisations and non-governmental organisations, with each partner contributing to the overall cost at varying levels (match funding was dependent on the size and type of organisation). The UK Space Agency provided the bulk of funding for all projects.

M&E was incorporated from the outset – both at programme and project level – and followed theory of change and logical framework models. A pathway to sustainability also had to be considered from the outset to ensure impact realisation once IPP funding ended.

Project spotlight: EO4cultivar

EO4cultivar, led by Environment Systems, uses satellite imagery and data services to support sustainable food production and resilient agricultural practices in Latin America. Through EO4cultivar, 41,000 hectares of agro-export-oriented land in Peru and Paraguay are under more sustainable land management practices, while eight agro-export organisations have made changes in their decision-making processes and are consistently using the satellite data in their routines. The project also funded three Latin American students to study their PhDs in the UK.

Partner countries: Peru, Colombia, Paraguay

7 www.caribou.space/

IPP was delivered through a series of open and thematic calls for proposals. Several of these collaborated with overseas governments to address specific developmental challenges, such as illegal logging and disaster response in partnership with the Malaysian government, and a strategic call for disaster relief in collaboration with the UK's Department for International Development (now part of the Foreign, Commonwealth and Development Office), focused on how space could facilitate a swifter response to humanitarian disasters.

In total, IPP launched three calls, with successful proposals identified through independent assessment by experts in space technology and applications, UK government officials working in partner countries, and experts in aid impact and delivery.

IPP operated on an International Organisation for Standardisation 9001 continuous improvement model, with lessons-learned exercises and consequent adjustments between each funding call. This included a 'discovery phase' trialled in Call Two, which allowed for project requirements to be defined, agreed and signed off by end users before starting the bulk of technical work. This model was rolled out in Call Three and reflects IPP's focus on developing sustainable solutions, as opposed to traditional space innovation programmes which often end once the technical solution has been developed.

IPP programme delivery

IPP grant-funded 43 projects in 47 countries across Africa, Asia Pacific, and Latin America and the Caribbean (including Small Island Developing States) through three calls for proposals since 2016. These spanned a variety of sectors, including climate and disaster resilience, agriculture, health, education, deforestation, maritime and urban planning.

Project spotlight: D-MOSS

Led by HR Wallingford, the multiple award-winning D-MOSS platform uses Earth observation data to give early warning for dengue fever outbreaks. This helps public health officials plan cost-effective action and move away from a reactive system, where disease control interventions occur after a dengue outbreak or use historical incidence rates rather than science-based solutions to make informed decisions. Using D-MOSS, officials can take preventative action on the dengue virus up to six months earlier than with traditional, manual risk assessments.

Partner countries: Vietnam, Cambodia, Laos, Malaysia, Philippines, Sri Lanka, Thailand

Figure 1: IPP portfolio by sector

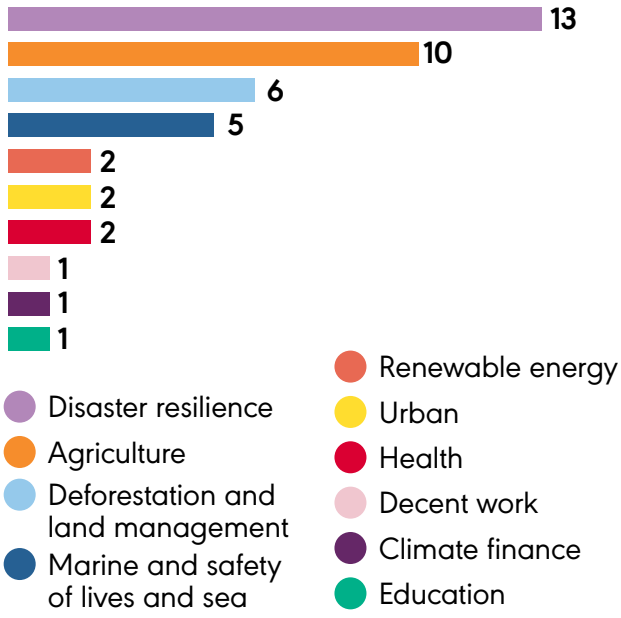
IPP projects funded 43

Partner countries 47

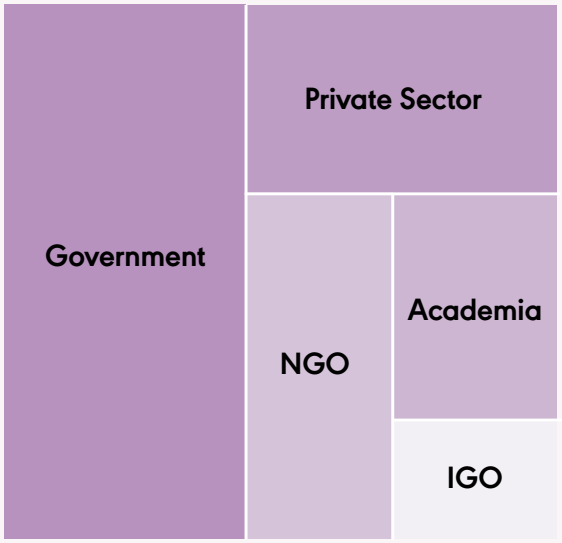
UK consortium members 180

Partnering in emerging markets 189

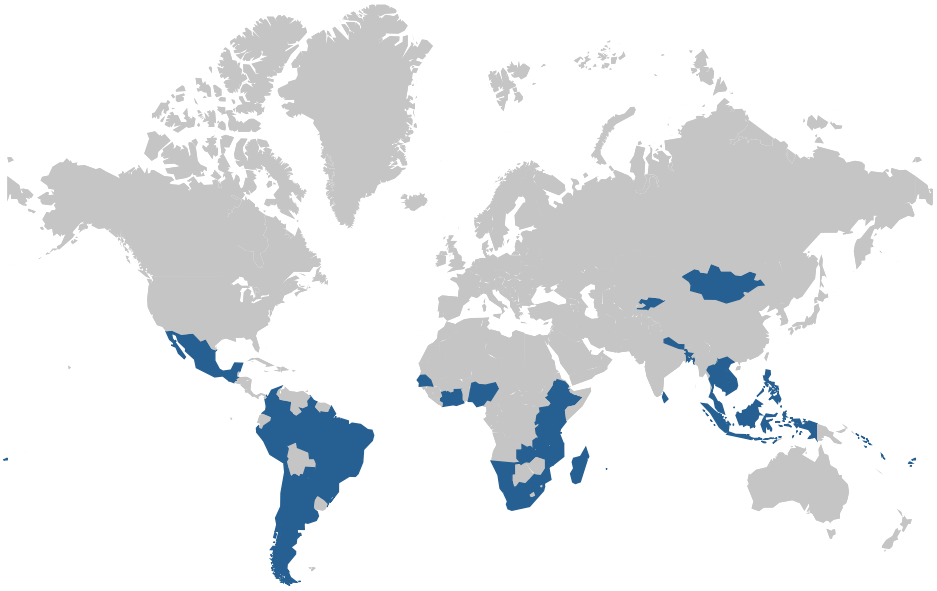
Projects by sector



Partner types



Project locations



What did IPP achieve?

To measure IPP achievements, individual project results were examined through two independent assessments led by Caribou Space and the GCRF. Collated results were then compared against the programme-level theory of change.

Aside from 10 Call Three projects unable to progress beyond discovery phase due to funding restrictions caused by the COVID-19 pandemic, nearly all remaining 33 projects were able to technically deliver intended outputs. However, the success of IPP projects was measured in terms of outcome and impact, meaning occurrent change as a result of project completion and achievement of economic or societal benefit.

At the programme level, IPP has proven to be "**a unique and effective programme that has successfully tested space-based approaches for development**, delivering a novel portfolio of development-focused space research and innovation, taking development considerations into account and showing the ability to adapt and learn over the lifetime of the programme to support greater impact".[8]

Project spotlight: RE-SAT

RE-SAT, led by the Institute for Environmental Analytics, is a cloud-based renewable energy analytics platform that supports governments, utilities, investors and other stakeholders to reach their renewable energy targets. In the Seychelles, Mauritius, and Montserrat, RE-SAT supports decision-making and modelling to reach renewable energy targets ranging from 15% to 100%. In Palau, St Lucia, Vanuatu, Tonga and Mauritius, RE-SAT validates proposals from energy producers to assess value for money and feasibility.

Partner countries: the Seychelles, Mauritius, Montserrat, Palau, St Lucia, Tonga, Vanuatu

Outcomes and impacts

IPP projects have successfully delivered numerous outcomes and impacts, such as saving an estimated 100 million tonnes of CO2 emissions through deforestation avoidance and identifying three oil slicks which saved millions of pounds in clean-up costs.

Below is a summary of a selection of outcomes and impacts achieved at programme and project level. Complete results to date can be found in the full endline evaluation reports.

IPP successfully demonstrated the utility of space-based approaches to development.

The space solutions developed and deployed through IPP are so useful to end users that nearly all were still being used after IPP project funding had ended. A survey, led by Caribou Space, confirmed that 91% of international partners believe that some or all benefits from the grantee-run projects they were involved in have been sustained to some degree.

8 GCRF process evaluation of IPP (July 2022)

These benefits include continued use of the datasets, products and solutions created with IPP funding, but also extend further to the methodologies and techniques created, broader knowledge and capacity, and benefits associated with raising the demand for satellite data.

The same survey noted that over 80% of IPP projects have expanded, adapted or changed scope in some way during or since grant funding. This included funding to ingest new datasets, expand to new regions or countries, or to explore new sectors. Most of these projects were easily transferable because the core data is scalable. Data cubes bring additional value for long-term expansion or adaptation because they capture data over a long timescale and large area which can be applied to many different concepts outside the boundaries of a single project.

Although some projects did not fulfil objectives, independent assessment concluded that **IPP was successful in demonstrating the value of space-based approaches for delivering development outcome and impact**.

IPP's portfolio of 43 projects created 60 bespoke solutions in collaboration with international partners. Many of these developed new and innovative processes and algorithms which had not previously been applied to the specific development challenges being addressed. Beyond these technical outputs, IPP's most tangible achievements to date can be grouped into three main areas:

- information for decision-making – bespoke solutions (data and products) enabling improved decision-making for international partners
- capacity development – enabling partners to make use of data and solutions
- partnerships, collaboration and diplomacy – forging new partnerships for project delivery

IPP demonstrated that when combined with appropriate capacity development and policy change, satellite data provides essential information and evidence for decision-making.

IPP enabled this through more timely and near real-time data which supports faster and more relevant interventions. Often this facilitates forward planning and preventative action rather than just reactive action, such as early intervention of anticipated deforestation activity, or provision of targeted public health before a forecasted disease outbreak. International partners confirmed that having access to data that is timely and relevant facilitates their decision-making processes and decreases the time and costs spent on decision-making.

IPP also enabled this through more accurate, better decisions grounded in independent data, rather than estimates based on previous experience, allowing decision-makers to be more confident in their judgements and to use resources more effectively.

Together, these conditions can help resource managers be more accountable. Farmers, forest managers and energy providers can be held to account for what happens to the resources they manage as a result of real-time, accurate information provided through space-based solutions.

IPP demonstrated that space-enabled solutions are more cost-effective than non-space alternatives in forestry, agriculture and disaster resilience.

Forestry: Space-enabled solutions for forestry are on average six times more cost-effective than non-space alternatives (aerial photography, drones, patrols) in the short term. In the longer term they are nearly 10 times more cost-effective.

Agriculture: Space-enabled solutions for agriculture are on average five times more cost-effective than the non-space alternatives (drones, patrols, extension workers) in the short term. In the longer term they are up to 5.8 times more cost-effective.

Disaster resilience: Space-enabled solutions for disaster resilience are on average 1.8 times more cost-effective than the non-space alternatives in the short term. In the longer term they are up to 1.9 times more cost-effective.

For example, the Forests 2020 project helped improve governance of over 100 million hectares of forests and contributed to avoided forest loss of over one million hectares. For multiple IPP projects, analysis demonstrated that the approaches used were significantly more cost-effective than traditional approaches. It is estimated that IPP's impacts will benefit over seven million people in developing countries, with impacts across 10 SDGs.

Building trusted partnerships

Building strong and trusted partnerships to maximise investments and sustainability prospects was fundamental to IPP, particularly in the crowded development sector. Therefore, through regular engagement with key stakeholders, the UK Space Agency's IPP team tried to ensure cohesion with the wider development landscape through engagement, analysis and collaboration with other actors – from the UK Met Office to developmental organisations and in-country leads in the UK's Foreign, Commonwealth and Development Office.

Individual grantees also tried to align with wider development strategies. For the expansion of the Earth and Sea Observation System tool, synergies were explored with groups of existing programmes and aligned with the strategies of BEIS, the Department for International Trade and the UK Space Agency where appropriate.

UK government engagement. IPP established a large global network of UK government officials. Engagement was particularly important with UK officials in IPP's 47 partner countries who were regularly updated on relevant programme activity, both for wider awareness and to provide local support as necessary. This was strengthened in Call Two by inviting their intelligence on project proposals (need for the solution, partners, prospect of sustainability, etc.) and considered a crucial element of the IPP assessment process.

The IPP team forged relationships between project leads (primes) and local UK officials, which was considered key to effective in-country stakeholder engagement. Site visits were also considered important to understand the context in which the space solution was being developed. IPP required all projects to have a baseline evaluation which included stakeholder consultation to support engagement with end users, and stakeholder mapping, facilitating understanding of the in-country landscape.

The IPP team also encouraged coherence between projects and grantees through seminars, networking events and knowledge exchange, facilitating new relationships and shared learning. This included efforts to coordinate grantees internally within the programme to maximise outputs.

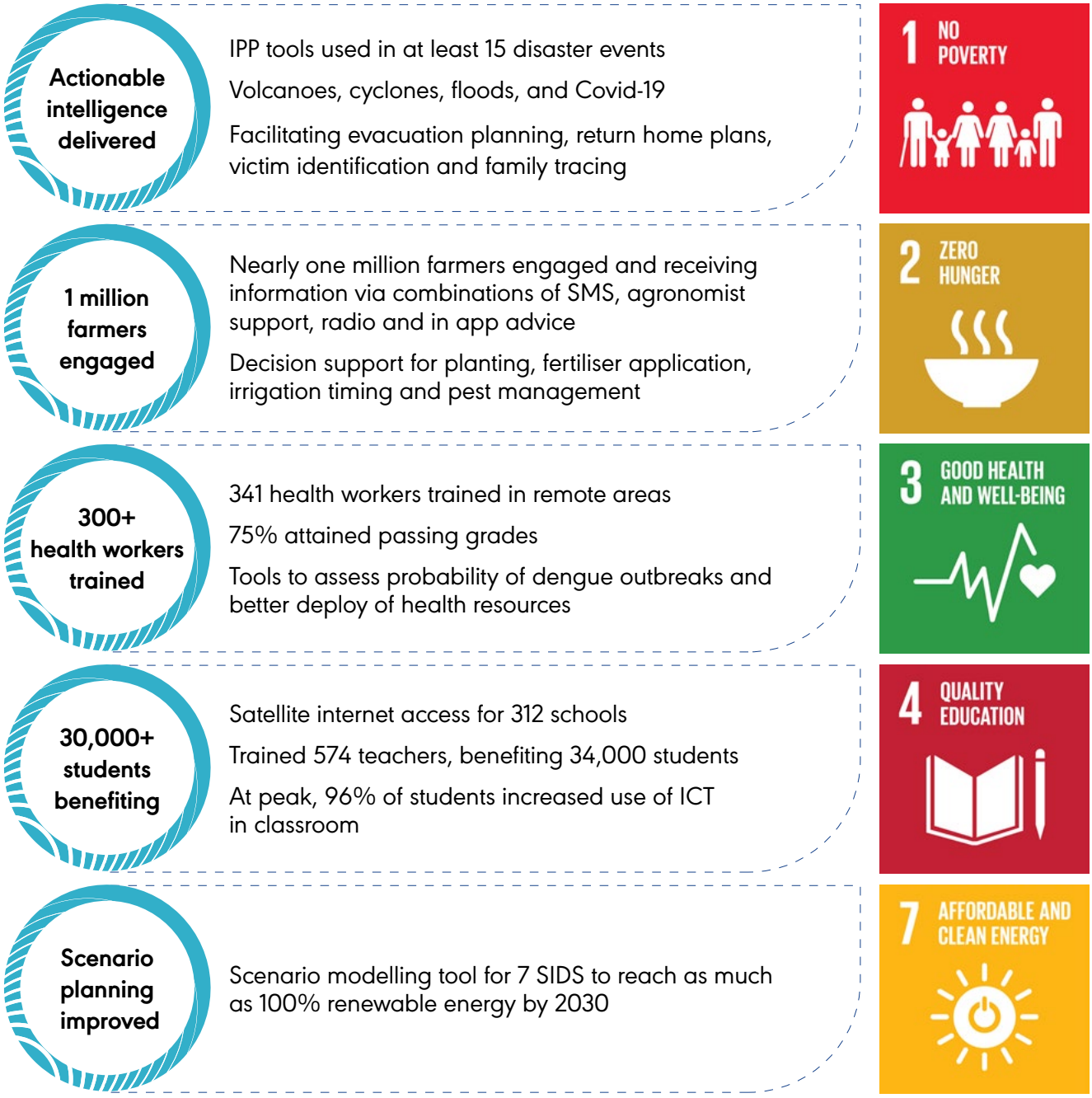
Alignment with UK government policy. The combination of efforts to build relationships across UK government departments was found to be highly beneficial in demonstrating IPP's alignment with wider UK government objectives. The programme attracted a wide variety of support for its projects across the UK government network, greatly enhancing project sustainability and in-country credibility.

Project spotlight: DAMSAT

DAMSAT uses satellite Earth observation techniques combined with real-time, in-situ monitoring devices to monitor dams. Led by HR Wallingford, its measurement of tailings dam displacements in monitored areas of Peru has reduced the risk of failures and pollution incidents – modelled to be a 34% reduction in annual loss of life and injuries. DAMSAT was adopted by Bristol Water in July 2021 to monitor its 15 dams, allowing for more effective monitoring, allocation of maintenance resources and driving down of costs.

Partner country: Peru

Figure 2: Snapshot of IPP impacts on SDGs



986 boats equipped with vessel monitoring

6,635 fishers benefited

46 fisherfolk rescued in six rescue events

46 lives saved

Network of experts in place in three SIDS to build capacity and support

600 trainees, 1000 civil servants reached to build capacity for climate finance applications

Capacity for climate finance

3 large oil slicks detected and intercepted, saving at least £3 million in clean-up operations

Identified 5 vessels of interest for IUU fishing

Supporting clean-up activities, and prosecution of potential culprits

£3.1 M in clean up costs avoided

110 million hectares of forests under observation

One million hectares of deforestation avoided in project windows

53 land titles issued to smallholders in Peru

Monitoring tools used in cocoa, oil palm and soy supply chains of 40+ companies

110 million hectares monitored

90,000 parcels of land digitised in Dakar City

System calculations show potential to grow city property tax base from £9-13 million to £66 million/year

Potential for £66 million property tax boost

Effective programme management

As a novel initiative for the UK Space Agency in 2016, the IPP team introduced new delivery processes which were improved as the programme developed. The programme was also run on an exceptionally low overhead (less than 4%), which enabled more funds to be channelled into the development projects.

Good communication and adaptability. The endline evaluation concluded that the UK Space Agency's programme management of IPP had been adaptive and generally well received, although greater 'hands-on' involvement at individual project level would have enhanced project delivery. The IPP team maintained good relationships and communication with primes, responding quickly to their enquiries.

IPP's flexibility to suggestions and changes – particularly on M&E and project extensions – was evidently helpful in supporting project implementation and ensured efficiency. Caribou Space provided consistent, specialist M&E and sustainability support, which many grantees considered valuable.

Comprehensive application and assessment process. IPP applications required bidders to demonstrate relevance to local needs, intended benefits to the partner countries, value for money (return on investment, financial plans and resourcing, reasonable expenses, etc.), and proof that the space-based technology was more cost-effective than its terrestrial alternative. The applying team also needed to demonstrate that they had integrated relevant expertise and existing data available on the subject matter, along with information from local partners where relevant.

IPP's assessment of applications was robust and independent. The process included critical assessment by a broad panel of experts of the relevance of the technical solution to user needs, including whether the space solution would be more effective than a terrestrial alternative and most appropriate to answering the developmental challenge under consideration.[9] Successful applications demonstrated relevance to local needs in varying ways – through linkage to policy priorities and targets as well as through the positive impact on helping countries to face environmental or development challenges. This was bolstered by input from UK government officials working in proposed partner countries.

Continuous improvement process. IPP learned from earlier calls and evolved the programme accordingly to enhance project delivery and sustainability. For example, the legacy evaluation of one of the Call One projects (Earth and Sea Observation System) described the need for a 'discovery' or 'inception' phase. This resulted in introduction of a 'pilot' phase for some Call Two projects, followed by a formal 'discovery' phase in Call Three. The discovery phase was designed to offer more time for end user engagement, co-design and agreement on partner contributions and responsibilities, and to enable greater analysis of the political economy and end users – thereby reducing risk and enhancing sustainability prospects.

Successful discovery phase projects were expected to proceed to 'implementation phase', but funding cuts meant the full impact of introducing a discovery phase could not be measured in the two evaluations. However, interviewees from Call Two projects with a pilot phase were complimentary of this model.

9 IPP assessment sheets for independent assessors

Comprehensive risk assessment. Risks – such as failure to deliver, in-country engagement, misuse or misunderstanding of information – were identified at inception and monitored closely throughout. This led to the unusual step of curtailing several IPP projects early when there was unacceptable risk to delivering successful outcome and impact. According to the GCRF evaluation survey, 72.6% of IPP grantees agreed or strongly agreed that potential negative consequences of their projects were identified and mitigated as a result.

Extensive and thorough M&E processes. M&E was considered an essential and unique aspect of IPP (as a development initiative), with extensive processes at both programme and project levels. Every project had a dedicated M&E work package and budget. Every project also had to produce an M&E plan with a detailed, project-level theory of change at inception.

Baseline, midline, endline and cost-effectiveness analysis evaluations were undertaken as projects progressed. Some, such as the Earth and Sea Observation System, also conducted legacy evaluations to explore potential impacts of the project after IPP funding had ended. At the individual project level, evaluations could be conducted by the project group or independent evaluators.

The focus on M&E extended to programme level, whereby the UK Space Agency undertook baseline, midline and endline evaluations of IPP, evaluating processes and outcome/impact indicators. Learning from the evaluation processes was implemented as the programme evolved.

IPP's recognition of the importance of M&E has facilitated a body of evidence which shows the value of projects to stakeholders and end users. This has greatly assisted project uptake and sustainability.

Project spotlight: SIBELIUs

The SIBELIUs project, led by eOsphere, developed a platform to provide improved pasture monitoring capabilities to support large and economically significant herding communities. Its use uncovered a significant difference in the pasture quality of land between West and East Mongolia, helping local authorities facilitate improved pasture management decisions to help prevent the degradation of pasture regions in the hills and mountains – an increasing problem in both Mongolia and Kyrgyzstan. Data cubes created through SIBELIUs have been installed at local partner facilities which the World Food Programme has access to.

Partner countries: Mongolia, Kyrgyzstan

Benefits to the UK

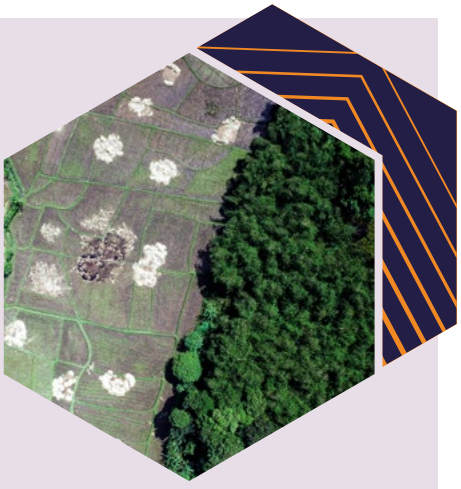
IPP demonstrated a positive economic return to the UK. IPP has a proven return on investment of two-to-one (additional £0.97 for every £1 of public money invested).[10] More broadly, IPP has generated approximately £200 million in gross value added, and supported 3,300 full-time jobs. IPP projects also saw direct benefits. For example, the legacy evaluation of the Earth and Sea Observation System project noted new lines of business, expansion of products and expansion into new geographies.

IPP helped UK organisations enter new markets. A secondary objective of IPP was to develop valued and sustainable partnership arrangements which lead to growth opportunities for the UK space sector. IPP achieved this by brokering new partnerships between over 350 UK and international organisations across the portfolio of 43 projects in 47 developing countries, consequently helping grantees to enter new markets at home and overseas.

For example, the DAMSAT tool – originally designed to monitor Peru's tailings dams and still doing so – was adopted by Bristol Water in 2021 to improve the safety of its 15 dams. IPP also attracted many non-space organisations (such as Vivid Economics, now part of McKinsey) to join the UK space community, supporting growth of the sector in breadth and depth.

IPP was a good use of resources. A BEIS-funded evaluation of the GCRF confirmed that: "GCRF faces challenges in assessing value for money, reflecting common issues in both development and research and innovation portfolios, and these can seem overwhelming; a suitable response is to focus on cost control and efficiently producing outputs."[11] However, from the nature of satellite projects to their design and implementation, IPP projects took steps to ensure they delivered value for money.

Project spotlight: Forests 2020



The Ecometrica-led Forests 2020 project monitored over 110 million hectares of forest across seven countries using Earth observation data. In Indonesia, Colombia, Belize and Kenya, improved data and alerts are used by law enforcement and forest ranger teams to help tackle illegal logging and other illegal activities. Recently, the Ghana Forest Compliance Service was officially adopted, allowing companies to access a free, publicly available application to view land use results. Forests 2020 extends to food supply chains, where over 250,000 farms across cocoa, oil-palm and soy supply chains were monitored for compliance with zero-deforestation commodity regulations.

Partner countries: Ghana, Kenya, Belize, Brazil, Colombia, Mexico, Indonesia

10 London Economics evaluation of IPP, March 2022

11 GCRF evaluation: stage 1a management review report, February 2022

Challenges of delivering complex projects in developing countries

With 47 countries engaged in IPP, it was impossible to have a 'one size fits all' approach to stakeholder engagement, project delivery and results on the ground. Therefore, in order to achieve intended outcomes and impacts, IPP projects had to ensure the uptake and use of their space-enabled tools and technologies in partner countries. Local stakeholder buy-in and high-level support embedded throughout the lifespan of projects proved essential.

In some instances, political challenges and changes to governance structures occurred midway through projects, which impeded engagement with in-country stakeholders. However, as noted in the GCRF evaluation, these were mitigated when projects had a good understanding of the partner country context and had successfully engaged their stakeholders since inception.

Projects with high levels of local support – particularly those which employed an in-country representative to act on their behalf – invariably enjoyed successful delivery and sustainability. However, differing approaches to engagement and local delivery across the IPP portfolio resulted in varying levels of success.

Political challenges resulted in project delays and the need for additional resources. The GCRF evaluation found that 38.8% of IPP grantees stated that political, governance and security challenges posed a moderate or significant barrier (see figure 3). The political landscape in partner countries created challenges for project implementation, primarily due to high turnover of in-country government staff. Many countries have civil services directly linked and appointed by the government of the day. Therefore, invariably local political support changed when a government changed during the typical four-to-five-year lifespan of an IPP project.

This impacted the stability of in-country commitments to projects and resulted in significant additional effort to engage and onboard new stakeholders following political changes.

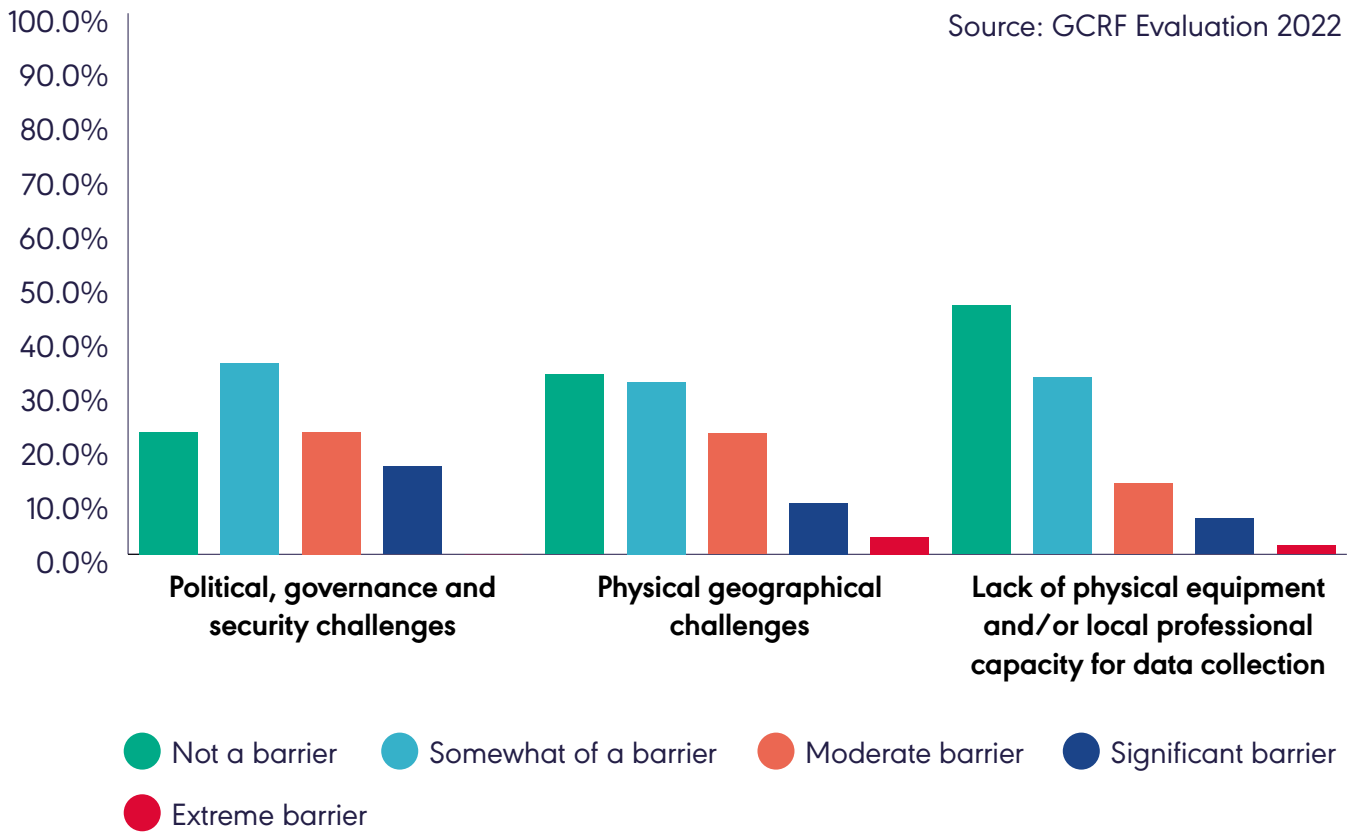
One example of the resulting impact is sustainability funding agreed at project inception but later not materialising. Some projects also experienced bureaucratic delays in securing data-sharing agreements across partner organisations, which meant they had to be rescoped and extended, while others were unable to achieve significant outcomes within the IPP funding window.

Cultural and bureaucratic misunderstanding. The GCRF evaluation found that the conventional western style of business communication (emails and conference calls) was found to be insufficient for maintaining regular engagement and building trust with stakeholders in some partner countries. There were also local procedural challenges which were not well understood or factored in (such as exporting hardware, which required licences for customs clearance), and lengthy processes to obtain partner approval, data access or continued engagement by local staff into a project.

For projects in IPP Calls One and Two, this often resulted in substantial delays due to inadequate forecasts at project inception. The issue was later rectified by adding the discovery phase into Call Three projects but overall, several IPP projects would have significantly benefited from:

- more frequent in-person visits to engage with partner country stakeholders, or embedding project representatives in the partner country
- greatly extended project duration to account for delays without impacting overall delivery

Figure 3: Barriers to implementation



Underestimation of local capacity and capabilities. Some IPP projects underestimated the level of capacity and capability locally available. Capacity in terms of knowledge and infrastructure on the ground was essential for projects to achieve sustainability. While some projects specifically factored in capacity building from inception – providing knowledge transfer and infrastructure installation – others did not and incorrectly assumed that a certain level of infrastructure was already in place.

For example, one IPP project visited a remote forestry enforcement station to install a real-time forest monitoring system, only to find that the station had no electricity or running water and the station officers had no vehicles to act on the information. Addressing capability gaps in local capacity invariably accrued extra cost and time delays.

Physical and geographical challenges. 31.8% of IPP grantees stated that physical and geographical challenges posed a moderate or significant barrier to successful project delivery (see figure 3). Some projects worked in disaster areas which severely impacted the ability to work in-country. For example, CommonSensing partnered with three Pacific Island countries, each of which experienced an unusual number of tropical depressions (cyclones/flooding) during the project. These resulted in the cancellation of activities and limitations on travel and staff availability.

Furthermore, many IPP projects focused on developing space-enabled solutions to physical challenges. For example, the COMPASS application was developed for seasonal crops which meant data could only be collected at certain times of the year. Therefore, any type of project delay could mean the loss of an entire data-gathering season, severely impacting project timelines. This issue was magnified for all projects during the COVID-19 pandemic.

Lack of mandated operational phase. Projects able to demonstrate the value of their space-enabled tools in a real-world setting (an operational scenario for multiple events or over a significant period of time) received more in-country interest and support than projects without a built-in operational phase. The increased support was seen to greatly enhance project sustainability. There was no central guidance from the UK Space Agency on an operational phase for IPP projects, and some projects used the majority of time on technical development which, despite being standard for a technology project, is not optimal in obtaining required data to win local stakeholder support. Therefore, implementing a significant operational phase into all future projects of this type to demonstrate the value of the tool is recommended in order to build local stakeholder trust and long-term support.

Lack of technical support. The IPP midline evaluation found that IPP could further support its projects by providing greater technical and sectoral expertise and more 'hands-on' management. This was supported by the GCRF evaluation survey findings: only 13.5% of grantees stated they had received technical research advice from the UK Space Agency, and only 17.9% confirmed receipt of support on research design.

Although this was earlier recognised by the IPP team, who took steps to provide technical support and independent oversight, they were unable to take further action for reasons outside their control.

The findings may also be indicative of the fact that project primes led all interactions with the IPP team, and no specific requests for technical support or assistance were received.

Furthermore, grantees commented that while the IPP team tried to participate in project visits to partner countries, increased effort in this area could have greatly enhanced credibility and potentially smoothened some of the procedural challenges faced by project teams in partner countries.

Conclusions and recommendations

We have put forward the following conclusions and recommendations drawing from findings presented in both the Caribou Endline Evaluation and GCRF Evaluation.

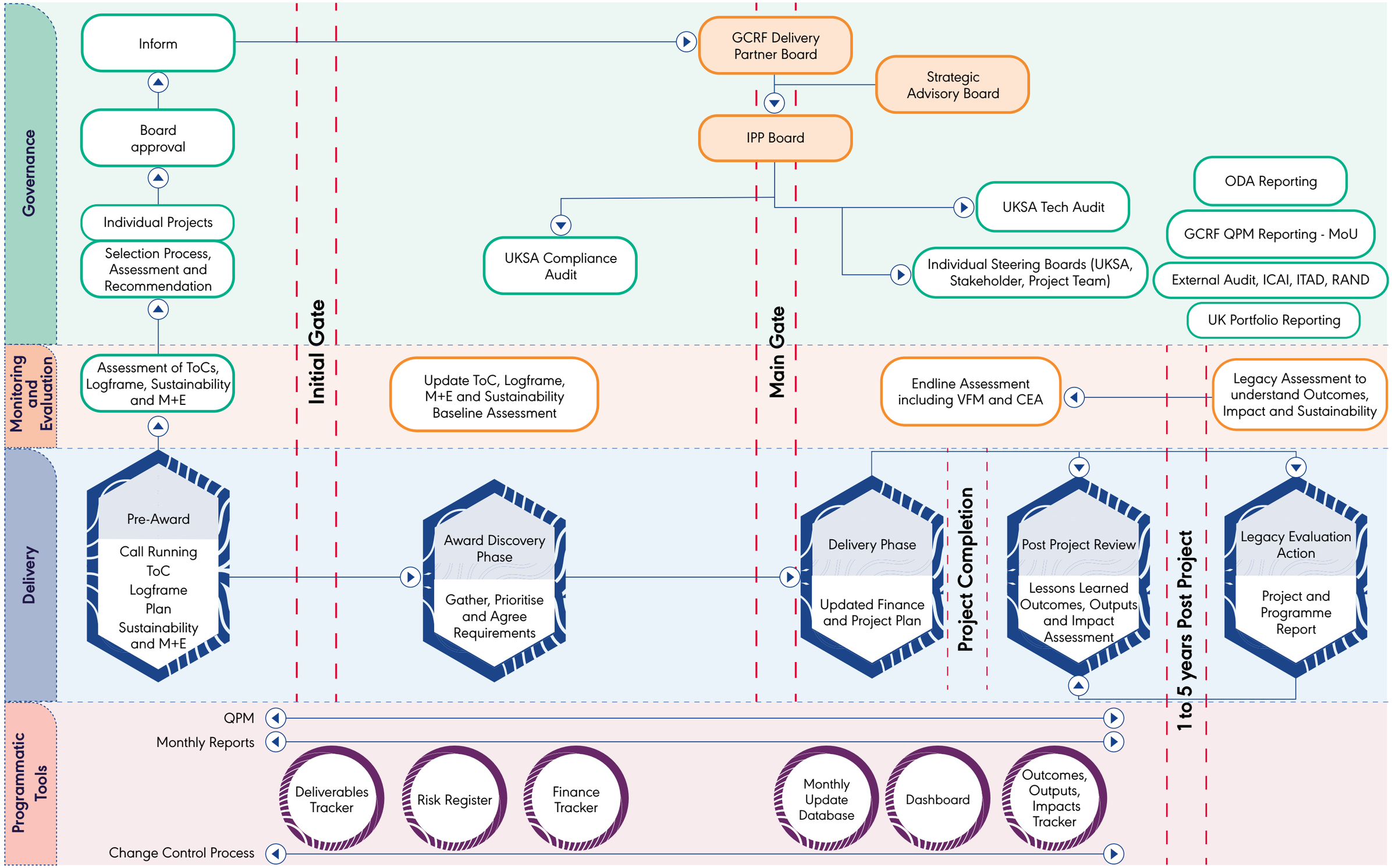
- Through its successful partnership model, **IPP proved the case for investment in space** in the development and delivery of space capabilities to meet partner country needs, while supporting growth of the UK space sector. The innovative products and services developed through IPP are being repurposed to meet the UK's national needs and are also being used by the project leads to develop new partnerships across the world.
- IPP was unique in developing innovative technologies while building use cases with real-world data from extensive field trials in the hands of actual end users. With IPP projects able to field-trial and de-risk technology, they provided assurance of working and cost-effective products and services which could deliver real benefit to potential customers.
- IPP investment stimulated innovation, resulting in technology development of new and novel industry-led products and services with commercial application, directly linked to user needs. This facilitated the growth of many UK organisations, including small-medium enterprises, through national and international contracts.
- IPP enhanced participants' organisational and operational capabilities, shifting emphasis to delivering benefit and effect where previously focus was lost after product development.
- IPP enabled the sector to identify and access new and emerging market opportunities which they would otherwise be unable to (80% of projects would not have occurred without IPP).
- IPP supported significant employment (3,300 full-time jobs) in the sector in high-value, high-paying roles, benefiting the UK economy.
- IPP supported the UK government's Levelling Up agenda, with 42% of grant funding invested into areas outside the South East (compared to 33% for other funds reported by the UK space sector).

Should a similar 'space for sustainable development' initiative be taken forward in future, the UK Space Agency's IPP team would recommend:

- prioritising and maintaining stakeholder and end user communication throughout the project to build a lasting partnership beneficial for everyone involved
- ensuring a significant operational phase is built in at programme start to demonstrate the value of space-enabled solutions and build local stakeholder trust and long-term support.

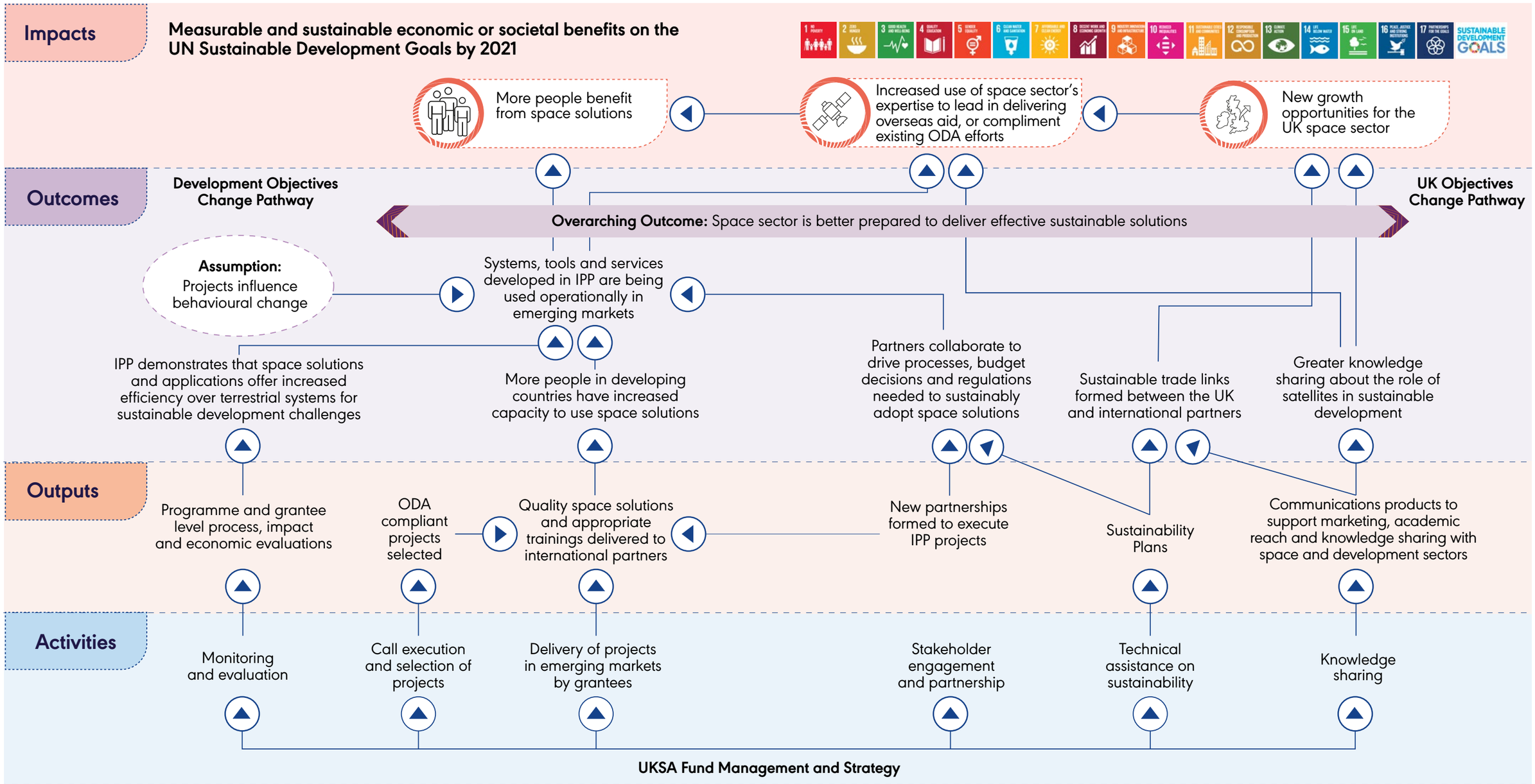
Annex A

Figure 4: IPP flow diagram



Annex B

Figure 5: IPP theory of change



Around the world, decision-makers in governments, NGOs, and private sector require better access to high quality information for addressing global sustainable development challenges. However, data scarcity remains a barrier; the lack of timely, accurate, large-scale data, and reliable communications infrastructure - especially in developing countries - results in inaction, or investments that do not deliver value for money where limited financial resources are available.

Satellite-enabled data services are uniquely poised to provide this type of information and communications infrastructure to improve decision making and connect remote, hard to reach areas. In this way, they can support more cost-effective planning and deployment of resources in developing countries.