

UK Space Agency International Partnership Programme

Three Year Review





The UK Space Agency leads the UK efforts to explore and benefit from space. It works to ensure that our investments in science and technology bring about real benefits to the UK and to our everyday lives. The agency is responsible for all strategic decisions on the UK civil space programme. As part of the Department for Business, Energy and Industrial Strategy, the UK Space Agency helps realise the government's ambition to grow our industry's share of the global space market to 10% by 2030.

The UK Space Agency:

- Supports the work of the UK space sector, raising the profile of space activities at home and abroad
- Helps increase understanding of our place in the universe, through science and exploration and its practical benefits
- Inspires the next generation of UK scientists and engineers
- Regulates and licences the launch and operation of UK spacecraft, launch operators and spaceports
- Promotes co-operation and participation in the European Space Agency and with our international partners



**Caribou
Space**

Caribou Space works with governments, space agencies, development agencies and private sector space companies to bridge the space and development worlds. It is the selected partner for the UK Space Agency International Partnership Programme, providing Official Development Assistance compliance, monitoring & evaluation, knowledge sharing, communications, sustainability and programme strategy support.

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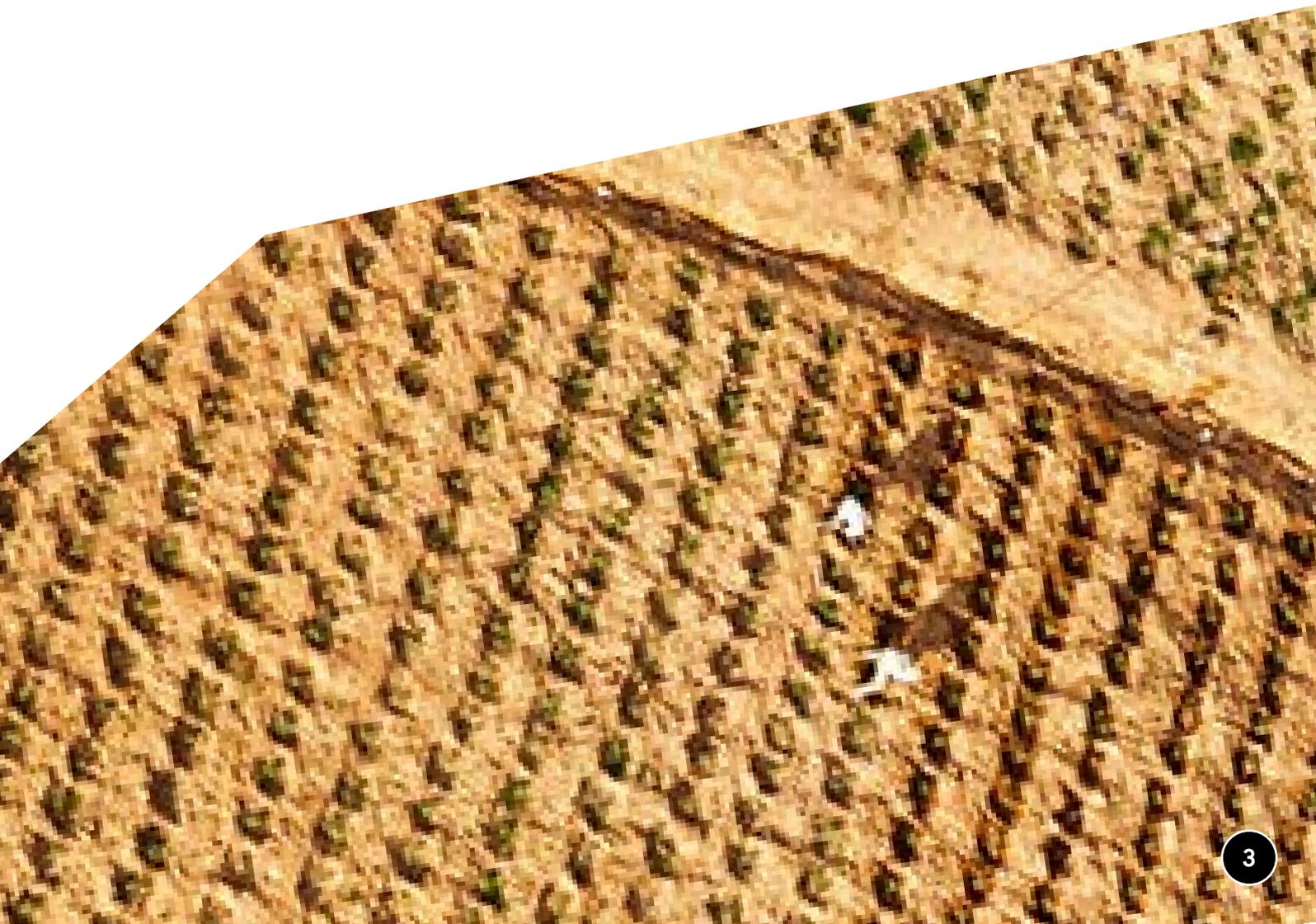
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Caribou Space has also published these additional reports for UK Space Agency:

- Space Solutions for Development
- Space for Forestry in Developing Countries
- Space for Disaster Resilience in Developing Countries
- Space for Agriculture in Developing Countries

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Introduction

The International Partnership Programme (IPP) is a five year, £30 million per year programme run by the UK Space Agency (UKSA). IPP focuses strongly on using the UK space sector's research and innovation strengths to deliver sustainable economic or societal benefits to emerging and developing economies around the world. It is part of and funded from the Department for Business, Energy and Industrial Strategy's Global Challenges Research Fund (GCRF). This is a £1.5 billion fund announced by the UK government to support cutting-edge research and innovation on global issues affecting developing countries.

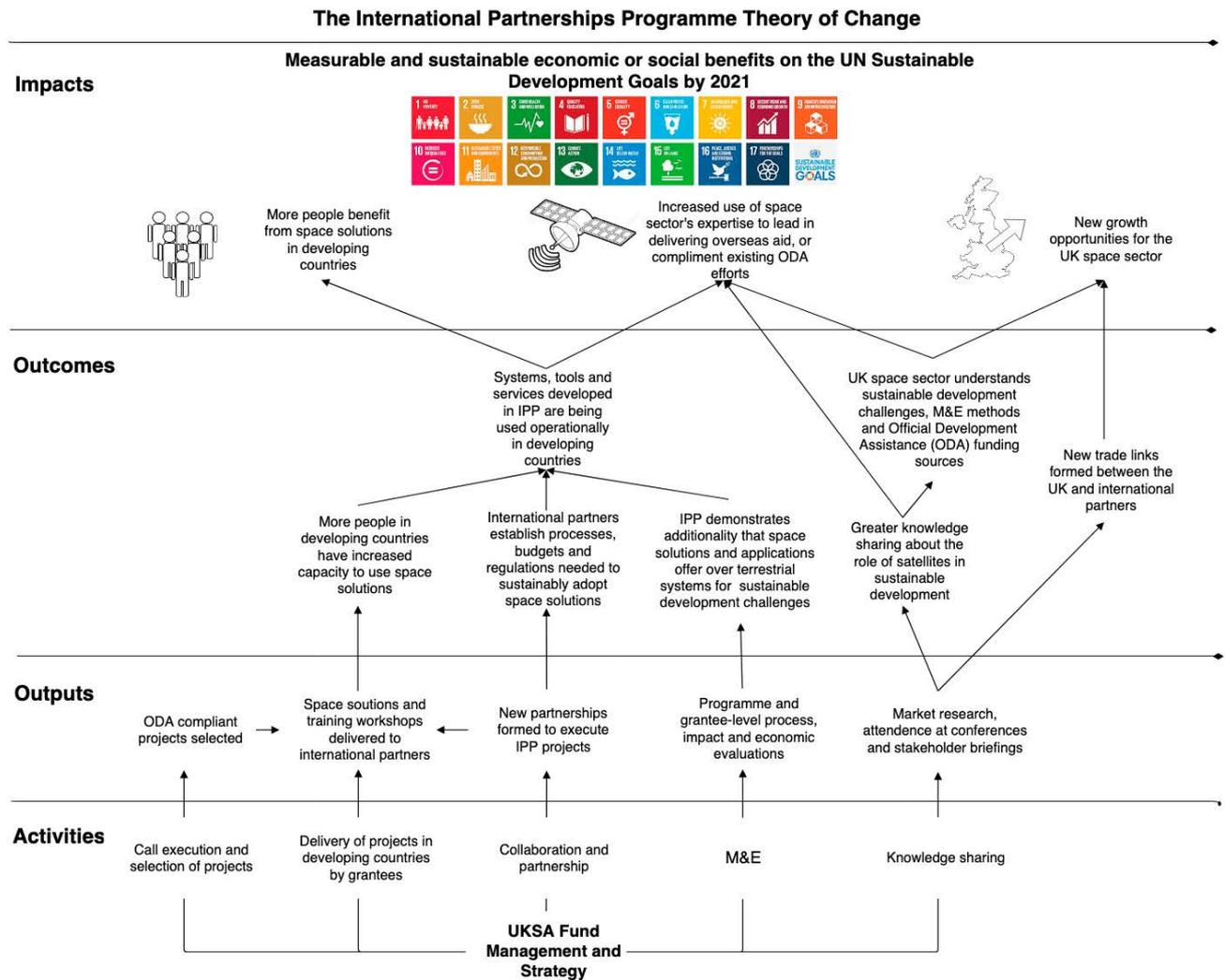
IPP has now completed three years of implementation. During this time, it has funded 33 projects in 44 countries and built new partnerships between over 120 space-sector organisations and 147 organisations in developing countries. The purpose of this report is to provide a snapshot of the results achieved between 2016 and now, in terms of both the outputs of individual projects and the emerging outcomes and impacts that projects are having with respect to the United Nations Sustainable Development Goals (UN SDGs).^{1,2}

Through its monitoring and evaluation (M&E) framework, IPP has developed a Theory of Change that helps to explain how the programme expects to have an impact on UN SDGs and on developing economies (see Figure 1).

¹ <https://sustainabledevelopment.un.org/sdgs>. The SDGs are a set of 17 global goals established by the UN General Assembly to be achieved by 2030. All UN member states have agreed to work towards achieving these goals. They recognise that ending poverty and other deprivations must go hand in hand with strategies that improve health and education, reduce inequality and spur economic growth while tackling climate change and working to preserve the world's oceans and forests.

² The results reported here can be communicated back to government, the public and other stakeholders interested in IPP.

Figure 1: IPP Theory of Change³



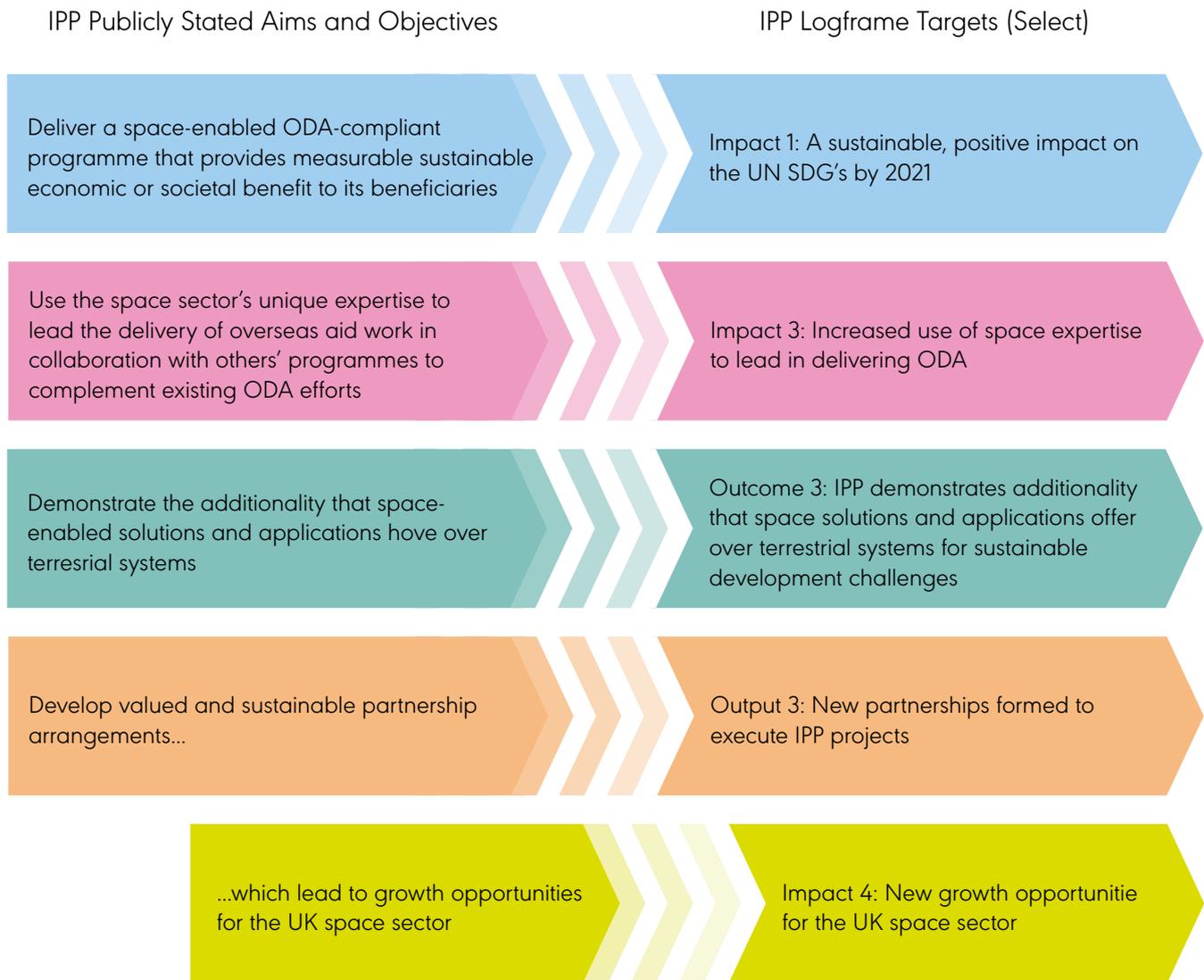
Building on this Theory of Change, Caribou Space has developed a Logical Framework⁴ to assess IPP's performance. Known as the IPP Logframe, this is regularly monitored.

This report uses IPP's publicly stated aims and objectives and links them to measurable metrics from the IPP Logframe (see Figure 2) to present a selection of notable programme results.

³ Caribou Space. 2018.

⁴ A Logical Framework is a tool for planning and M&E of a development project. It describes the anticipated chain of cause and effect in a simple grid format, with clear, measurable targets and indicators that can be regularly reported on to track progress.

Figure 2: IPP Publicly Stated Aims and Selected IPP Logframe Targets⁵



Progress towards each of these aims, along with additional IPP Logframe output (and where possible outcome and impact) targets, are briefly assessed below to give quantified results in terms of what the IPP projects and the programme as a whole have achieved. Where relevant, the assessment also provides anecdotal examples from individual projects to illustrate how IPP is delivering on these targets; this is ahead of a complete midline evaluation in 2020 that will assess these targets more comprehensively.⁶

⁵ Caribou Space. 2019.

⁶ This report only looks at a subset of the complete list of IPP targets. In total the IPP Logframe has 25 targets and 57 indicators, which are detailed in the IPP Logframe. The midline evaluation in 2020 will look at the complete suite of targets and indicators, but this report focuses on those that were deemed most relevant at this interim stage, based on their alignment to IPP's publicly stated aims and objectives.

Figure 3: Summary of IPP Results to Date

Actionable Intelligence Delivered

- IPP tools used in >12 disaster situations
- Volcanoes, typhoons, floods and armed conflict
- Facilitating evacuation planning, return home plans, victim identification and family tracing



- 976 boats equipped with vessels monitoring
- 6,635 fishers and 25,000 households benefitting
- 45 fishermen rescued in five rescue events

45 Lives Saved

25,000 Farmers Engaged

- 25,000 farmers directly engaged
- Further 1,350 receiving indirect information
- Decision support for planting, fertiliser application, irrigation timing and pest management



- Over 25km² of oil slicks detected and intercepted before making landfall, saving at least £1.5 million in clean-up operations
- Supporting clean-up activities, and prosecution of potential culprits

50,000+ Barrels Intercepted

300+ Health Workers Trained

- 341 health workers trained in remote areas
- 75% attained passing grades
- Empowerment to provide life-saving care to pregnant woman and newborn infants



- 40 million hectares of forest under observation
- 383,000 hectares of deforestation avoided
- 14 land titles issued to smallholders in Peru

40 Million Hectares Monitored

30,000+ Students Benefitting

- Satellite internet access for 312 schools
- Trained 574 teachers, benefitting 34,000 students
- 96% of students increased use of ICT in classroom



- 90,000 parcels of land digitised in Dakar City
- Only £9-13 million of property tax is collected
- Accurate space-enabled database could increase this to £66 million
- Could further grow 5-10% per year

£66 Million Property Tax Boost

Scenario Planning Improved

- Modelling scenarios to reach 15% renewable energy by 2030 in Seychelles
- Exploring wind farms in addition to solar photovoltaics (PV)



Other results:

- ↑ 120 UK organisations partnered with >130 international organisations
- ↑ Over 2,000 people in developing countries trained
- ↑ Consortiums beginning to find commercial success
- ↑ IPP represented at over 150 industry conferences and workshops
- ↑ 8,500 unique views of IPP websites and selected reports
- ↑ Positive impact on UK plc product/service offer



Space Solutions Delivering a Sustainable, Positive Impact on UN SDGs by 2021

Through IPP, by the end of April 2019, UKSA had funded 33 projects⁷ in 44 countries with direct economic, social and environmental impacts on 10 UN SDGs. A map detailing the projects is available on the Space for Development website.

Figure 4: IPP Project Locations⁸



Since the start of the programme, 25 IPP-funded space-based solutions/tools have been delivered to international partners to use for solving important development challenges.⁹ These include, for example, applications to support precision agriculture, early warning systems for disaster prediction and disease detection. While most (19) of these were only delivered in 2018 or early 2019, some are starting to deliver early impacts in line with the UN SDGs, as the following examples underline:

⁷ Each project is delivered by a consortium of partners, with one UK organisation as the prime. This report refers to the prime in the names of projects listed, but for a full overview of all consortium partners and their capabilities see: UK Space Agency. 'International Partnership Programme: Space Solutions for Development.' April 2019. Accessed in August 2019 at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/803629/PRODUCT_CATALOGUE_V3_May2019.pdf

⁸ UKSA IPP programme documentation. 2019.

⁹ Caribou Space. 'IPP Logframe 2019'. April 2019.

SDG1: No Poverty (includes Disaster Resilience)

IPP tools have been applied to over a dozen natural disaster situations, including volcanic eruptions and typhoons, and have even been used in evacuation centres set up to cope with population displacement resulting from armed conflicts.

The Earth and Sea Observation System (EASOS), led by the **Satellite Applications Catapult** working with UK flood specialist Ambiental, developed EASOS Flood Watch.

This was used in Malaysia during the 2017-2018 disaster season to predict and model floods by providing actionable intelligence for operational management of flood events. Guided by information provided via EASOS Flood Watch Lite, a street by street plan was developed for clean-up, inspection and repair of key infrastructure, return to home and security against looting. In one instance, following flooding, EASOS supported a clean-up and safe return home plan for 7,000 displaced people by providing street by street risk information.¹⁰

The IPP-funded **Inmarsat Philippines project's satellite communications (SatComms)** tools have contributed in a diverse range of situations, from family tracing in disaster aftermath scenarios to facilitating identification of recovered bodies of landslide victims and even the rescue of a human trafficking victim (who was found in Palawan and connected to her parents in Vietnam through satellite phone).¹¹



SDG2: Zero Hunger (Agriculture)

Across seven agriculture-related projects, tools are being developed that either directly engage farmers or provide information to intermediaries such as agronomists, non-governmental organisations (NGOs) and meteorology departments. While many of the decision support tools are only just starting to be rolled out, over 25,000 farmers have already been directly engaged in IPP to map field boundaries, test decision support tools and begin implementing agronomic advice.^{12,13} This is almost as many farmers as there are in the whole of Northern Ireland.

Through the **Centre for Agriculture and Bioscience International (CABI) Pest Risk Information Service (PRISE)** project, at least 1,350 farmers have indirectly received information from plant doctors about pests and diseases through plant clinics, cooperatives and other informal and formal village meetings.^{14,15} One extension officer/plant doctor in Zambia's Kafue district stated that "generally, the alerts were useful to farmers and, [for those] who followed the right management options available for the pests and used proper inputs (e.g. top dressing fertilisers), *their crops were not highly affected [by the pest outbreak]*".¹⁶

By early 2020 the first projects should begin to show concrete evidence of how they lead to substantial yield increases for producers when the project advice and products are applied.



10 Satellite Applications Catapult. 'EASOS Early Impact (Quick Wins) Report'. May 2018.

11 Inmarsat. 'Endline Evaluation Report Philippines DRR Project'. April 2019.

12 Earth-i. 'ACCORD Monthly Update Project Report'. March 2019.

13 Rezatec. 'IPP Mexican COMPASS: Midline Evaluation Report'. 13 February 2019.

14 CABI. 'PRISE Pest Alerts Providing Early Warning to Farmers on Pests' Outbreaks: A Snapshot Case Study for Zambia'. August 2018.

15 CABI. 'PRISE: Logframe'. February 2019.

16 CABI. 'PRISE Zambia Case Study'. December 2018.

SDG3: Good Health and Well-being (Health)

Utilising e-health solutions through SatComms technology, the **Inmarsat Nigeria** project has managed to provide video training for 341 health workers in remote areas. As a result, 246 (or 75%) of these have attained at least a 60% pass rate. When interviewed, there was consensus among policymakers, facility heads and frontline health workers that watching instructional videos has significantly empowered the health workers to provide life-saving care to pregnant women and their infants, including the resuscitation of newborn babies, prevention of bleeding after birth, educating women on breastfeeding techniques and immunisation dates, calibrating infant injections to weight and the safe removal of the placenta. An estimated 30 lives have been saved across three states where health workers regularly view videos supplied by the project.

According to one health worker in Ondo State: *“watching the videos...I have been able to identify different conditions that can affect infants like sepsis...and concerning pregnant women, I also learned about [how to manage] post-birth haemorrhage [sic] i.e. bleeding after birth.”*



SDG4: Quality Education (Education)

Within the **Avanti iKnowledge** project in Tanzania which focused on education (led by Avanti Communications), 312 schools were provided with satellite internet access, reaching an estimated 34,000 students. 574 teachers were trained in the use of ICT for educational objectives and 96% of their students reported at endline that they saw an increased use of ICT in their classrooms.¹⁷



SDG7: Affordable and Clean Energy (Renewable Energy)

Phase 1 of **Renewable Energy Space Analytics Tool (RE-SAT)**, IPP's only renewable energy project (led by the **Institute for Environmental Analytics**), saw successful development and launch of a renewable energy analytics platform prototype for the Seychelles. The government of the Seychelles is now actively using the platform to model scenarios for how the country will reach its target of 15% renewable energy by 2030. The platform has helped to illustrate how solar photovoltaic (PV) alone will not achieve this target as was previously hoped because there is simply not enough land and roof space. As a result, the government has begun to explore the potential for offshore wind farms, in addition to PV solutions, to meet its goals.

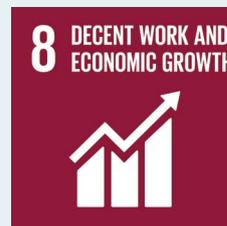
To date, a further six Small Island Developing State (SIDS) governments have been engaged in RE-SAT and began to use customised versions of the platform in early 2019, with official launches in 2020.



¹⁷ Ace Africa & Avanti Communications Ltd. 'iKnowledge (Tanzania): Endline Monitoring and Evaluation Report for Phase 1 and Phase 2 Schools'. October 2018.

SDG8: Decent Work and Economic Growth (Maritime)

IPP has funded **two projects that support the safety of lives at sea** and over 976 small fishing boats have already been equipped with vehicle tracking devices.^{18,19} Based on average crew sizes in South Africa and Indonesia where these projects are being implemented, it is estimated that IPP is directly benefitting around 6,635 fishermen and indirectly benefitting almost 25,000 people in fishing households.^{20,21}

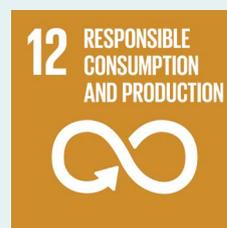


Both projects have been used to significantly help small-scale fishermen, both directly in real-life search and rescue operations²² and indirectly by enabling them to avoid accidents at sea (for example, by providing their location to larger vessels which then can avoid them).

As of April 2019, IPP-funded equipment had been used in five rescue missions which saved a total of 45 fishermen.²³ These rescues included: a boat lost in fog that used the emergency SOS function of an AIS transceiver to send an alert and safety message that allowed the crew to be rescued by a larger vessel; two vessels disabled by mechanical failure and subsequently taken under tow by other fishing vessels; a crew whose vessel sank shortly after being rescued; and one instance where a crew member suffered a major, undiagnosed medical problem (later discovered to be a minor stroke) and onboard SatComms equipment was used to transmit medical and safety instructions.²⁴

SDG 12: Responsible Consumption and Production (Responsible Mining)

The one project under this SDG, **HR Wallingford's Dam Monitoring from SATellites (DAMSAT)**, was launched in early 2019 and focuses on reducing the risk of tailings dam failures. As the technology is still being developed, there are no outcome or impact-related targets to report yet.



SDG14: Life Below Water (Maritime)

This SDG focuses on both the conservation and the sustainable use of marine resources and on both illegal, unreported and unregulated (IUU) fishing and marine pollution – all of which are a concern to IPP.

To date, in the **Indonesia Inmarsat project**, there has been only a single incidence of a boat from the pilot fleet reporting an IUU event. This is likely to reflect the high compliance levels of these relatively small vessels in territorial waters or it may be due to the anticipated difficulties in detecting and reporting on IUU behaviour. However, project monitoring is revealing other benefits: in the last quarter, the Lombok Sentinel fleet made 35% more gross margin than the control fleet (£65.92 or IDR 1.32 million) per trip. These vessels also used 32% less fuel than the control boats, indicating some advantage from the use of vessel monitoring to find fish.



18 exactEarth Europe. 'South Africa Safety Initiative for Small Vessels Operational Take-Up (OASIS -TU) Final Report'. 29 March 2019.

19 Inmarsat. 'Indonesia Project Performance Review Report 5'. March 2019.

20 exactEarth Europe. 'Final Report: Annex D Logframe.' 22 March 2019. Inmarsat. 'Indonesia Project Performance Review Report 5'. March 2019.

21 Calculations of indirect beneficiaries are based on average household sizes provided by <https://population.un.org/Household/index.html#>. Accessed April 2019.

22 exactEarth Europe. 'Midline Project Evaluation'. November 2018.

24 Same as above.

With regards to marine pollution, in June 2017, following a maritime accident in the Putri Sea off the coast of Malaysia and Singapore, **EASOS Marine Watch** helped prevent a 19km² oil slick from reaching the coastline by predicting to 90% accuracy “the likely trajectory and dispersion of the oil slick along the [Malacca] Straits”. Because of the modelling that EASOS provided, the authorities could successfully contain the oil with no reports of landfall either in Singapore or in Malaysia. The clean-up cost savings resulting from this assistance are an estimated £1.5 million.

In April 2019, approximately 27m³ of marine oil made landfall in Malaysia. EASOS was used to model the historic movement of the slick and to identify vessels in the area of the slick when it originally appeared; this will support the prosecution of a potential culprit. In addition, in May 2019, EASOS Marine Watch detected a 4.9km² oil slick and informed the Malaysian authorities, who scrambled two vessels, located the oil and enacted containment and clean-up procedures including use of absorptive booms and dispersants to avoid the oil hitting an estimated 13km of coastline. Due to this early intervention, the clean-up cost savings for the incident are an estimated £1.6 million.

SDG15: Life on Land (Deforestation and Land Management)

IPP has funded **five projects on forestry management** which have provided tools to support improved forest governance. When applied, these are expected to ultimately slow deforestation rates in project regions by providing local forest authorities with actionable intelligence. As of late 2018, many of the IPP deforestation projects had only just begun to hand over tools for forestry management to the relevant governments and given the slow nature of how these changes occur, observed deforestation rates have yet to show significant change.²⁵ However, an estimated 40 million hectares of forests are already being monitored using IPP-funded Earth observation (EO) solutions (roughly equating to the area of Sweden) and an estimated 383,000 hectares (roughly 27 times the size of London’s Hyde Park) of deforestation has been avoided.^{26, 27, 28}

In addition, in Peru a large driver of deforestation is landlessness and small agro-forestry producers who cut down areas of forest illegally to farm. Using **tools developed by Vivid Economics** under the auspices of IPP, the regional government of San Martin has now issued 14 land titles to smallholders to provide them with their own land to farm and it intends to use the tool to issue thousands more in the future.



SDG17: Partnerships for the Goals (Urban, Infrastructure and Industry)

The one IPP project contributing to this SDG, **Airbus’ Property Database for Dakar**, was completed in early 2019 as a successful demonstration of the potential of satellite technology to map building change for the purposes of land administration and taxation.

Research by Airbus has shown that only an estimated 19% of property owners currently pay property tax in Dakar, the capital of Senegal, and that these rates are not based on



25 Literature suggests there is a long lag between investment and impact. Vivid Economics. ‘Midline Report for Deforestation Prevention from Land Use Monitoring and Valuation in Côte d’Ivoire’. November 2018.

26 Vivid Economics. ‘Midline Report for Deforestation Prevention from Land Use Monitoring and Valuation in Côte d’Ivoire’. November 2018.

27 Vivid Economics. ‘Midline Report for Remote Mapping and Socio-economic Valuation Tools to Support Planning and Implementation in Land Use Interventions in Peru’. March 2019.

28 Ecometrica. ‘IPP Forests 2020: Annex 1 – Updated Logframe Version 59’. March 2019.

29 €10-15 million and €76 million according to Airbus’ calculations.

30 Airbus Defence & Space. ‘Satellite Image Analysis for Operational Maintenance of a Property Database for Dakar City, Senegal: M&E Endline Evaluation Report Version 1.0.’ January 2019.

31 Caribou Space. ‘International Partnerships Programme: Baseline Evaluation Version 2.5’. January 2019.

up to date information about the size and condition of dwellings in the city. During the project's trial period, Airbus digitised over 90,000 parcels of land and found that, if implemented, property tax collection could grow from the approximately £10 million actually collected to £66 million.^{29,30} Furthermore, it showed that maintaining the database would identify changes in 5-10% of properties annually. Property tax collection in Africa represents less than 0.5% of GDP compared with around 1.8% across the OECD and 4% in the UK.³¹ Because of this, it is widely believed that tools to support improved property tax systems such as that developed by Airbus could be a significant resource for governments to enable investments in transportation, sewage infrastructure, health, education and other areas.

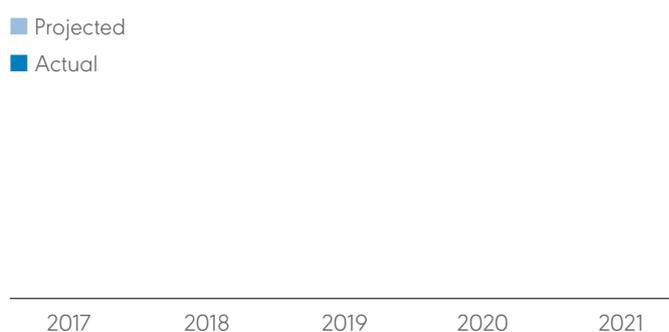
The city of Dakar has not yet procured the system, largely because of changes in the national system for taxation and land management. Nevertheless the team is actively pursuing opportunities in other countries as well as engaging with the national Senegalese government.

Capacity Building in Developing Countries

Capacity building to use space-based solutions in developing countries is an important societal benefit that IPP is delivering. Over 2,000 people and 186 organisations have been trained on IPP-funded solutions. Based on current trends, over 4,000 individuals in developing countries are expected to receive training via IPP projects by the end of the programme.

In addition, IPP has so far funded three PhD student places for international students in the UK (two female, one male)³³ and engaged 11 undergraduate students³⁴ in research projects within international partner institutions.

Figure 5: Actual and Projected Number of Individuals with Increased Capacity to Use Satellite-enabled Solutions³²



Sustainability of Solutions

While many consortiums are still optimistic about their ability to obtain continuation funding for their projects in the future, mainly from private sector or government procurements to ensure the sustainability of their impact, few have reached that point yet. This is because many are still in the development and testing phases of their work and it is too early to secure a commitment from key stakeholders to adopt their services or technology into the future. Examples of initial success in terms of sustainability and commercialisation include:

32 Caribou Space analysis of IPP project Logframe data. 2021 will cover results only for Q1, as IPP is set to end in March 2021, and so has a lower projected result than other years.

33 EO4cultivar. 'WP9: Agricultural Innovation: Milestone Progress Report for UKSA.' August 2018.

34 Satellite Oceanographic Consultants. 'IPP Logframe for C-RISE'. April 2019.



- OASIS-TU, where the South African Maritime Safety Authority has confirmed that it has put the necessary budget in place from 2019 to continue the project, including the cost of ongoing data supply from exactEarth. The project demonstration in Tristan da Cunha has also delivered commercial success for exactEarth, with local partners subsequently procuring the data supply to monitor locations for the lobster boat systems already deployed. In other countries where the technology is being demonstrated, there are already positive indications that many local partners are interested in acquiring hardware and the data service from exactEarth³⁵ and its equipment partners.
- Ecometrica's Mexican academic consortium partner ECOSUR has confirmed a three year renewal of the Forests 2020 EO Labs.
- EASOS, which is still endeavouring to secure an ongoing procurement arrangement from the Malaysian government and is also expanding the EASOS system to other relevant sectors and geographies. To this end the Satellite Applications Catapult has committed additional funding past the end of the IPP programme for Malaysia to improve the viability of the system.

³⁵ exactEarth Europe. 'Midline Project Evaluation'. November 2018.



Increased Use of Space Expertise in ODA

To better enable the UK space sector to deliver satellite solutions that have development benefits overseas, IPP has led a substantial upskilling of companies on official development assistance (ODA) and M&E requirements. This in turn is expected to help these companies secure further funding for their solutions and to support other ODA projects in the future.

This has included support and capacity building around M&E methodologies, planning for sustainability and commercialisation of tools developed and development of public communications and knowledge sharing plans. Across all projects, under the guidance of Caribou Space, IPP has to date delivered 60 workshops, training 37 organisations on various topics related to M&E and ODA. On the back of this training, these organisations have produced 31 M&E plans and 89 project evaluations.

Project consortiums have also been actively promoting their expertise and capability in addressing development challenges at over 150 conferences and workshops (see Figure 6). Two-thirds (around 100) of these conferences have been held internationally and one-third (around 50) were in the UK.³⁶

While many projects are waiting until implementation is further forward before publishing case studies and other research, 31 academic papers and case studies have already been produced and have catalogued some of the individual project results.³⁸

IPP shares knowledge via both the UKSA website³⁹ and the SpaceforDevelopment.org knowledge portal. This enables IPP to reach a global audience and provide valuable information about the ability of the space sector to deliver overseas aid work. The two websites receive a combined 5,000 unique views per month.⁴⁰

The sector-focused reports on the opportunity for space in agriculture⁴¹, disaster resilience⁴² and forestry⁴³ have been read 1,200, 900 and 700 times respectively.^{44, 45} A directory called Space Solutions for Development, which showcases the range of UK expertise in satellite technology and how it can help tackle problems such as illegal deforestation, disaster response and food production, has a readership of 3,000.⁴⁶

Figure 7 shows how many views each report has had over the last year.

37 Caribou Space records and analysis of IPP Logframe data.

38 Caribou Space. 'IPP Logframe Output Monitoring'. April 2019.

39 GOV.UK. 'International Partnership Programme'. <https://www.gov.uk/government/collections/international-partnership-programme>. Accessed August 2019.

40 Space for Development. www.spacefordevelopment.org. Accessed August 2019.

41 Caribou Space and UKSA. 'Space for Agriculture in Developing Countries'. <https://www.spacefordevelopment.org/library/space-for-agriculture-in-developing-countries/>. Accessed August 2019.

42 Caribou Space and UKSA. 'Space for Disaster Resilience in Developing Countries'. <https://www.spacefordevelopment.org/library/space-for-disaster-resilience/>. Accessed August 2019.

43 Caribou Space and UKSA. 'Space for Forestry in Developing Countries'. <https://www.spacefordevelopment.org/library/space-for-forestry-in-developing-countries>. Accessed August 2019.

44 Combination of unique views on the two websites and physical prints.

45 Caribou Space. Monitoring of communications outputs. May 2019.

46 Caribou Space and UKSA. 'Space Solutions for Development'. <https://www.spacefordevelopment.org/library/space-solutions-for-development>. Accessed August 2019.

Figure 7: Total Views of Publications⁴⁷

⁴⁷ Caribou Space analysis of usage of www.gov.uk/government/collections/international-partnership-programme and www.spacefordevelopment.org

IPP Demonstrating Additionality of Space Solutions over Terrestrial Systems

IPP has conducted a cost-effectiveness analysis (CEA), which is a form of value for money (VFM) analysis that compares a consortium's space solutions to non-space alternatives, for example those using human teams, drones and planes. The CEA is based on UK government guidelines set out in HM Treasury's 'Green Book'. Over 20 individual analyses were conducted and all forecast IPP projects to be more cost-effective at achieving their SDG impacts than alternative non-space solutions.

Space-enabled solutions for forestry are forecast to be on average eight times more cost-effective at reducing deforestation than the non-space alternatives in the short term and up to 12 times more cost-effective in the longer term. In the longer term, this corresponds to an average cost of around £13 per hectare of deforestation avoided. This is believed to be because EO offers consistent, accurate, large-scale and analysis-ready optical and radar data at a range of spatial and temporal resolutions supporting the monitoring, tracking and protection of forest resources.

Space-enabled solutions for agriculture are forecast to be on average six times more cost-effective than non-space alternatives at improving crop yield in the short term and up to seven times more cost-effective in the longer term. In the longer term, this corresponds to a cost of £0.05 per £1 of additional crop yield gained. Again, the large scale that space solutions cover, with frequent in-season data, provides unprecedented intelligence on plant health, crop performance and land use which can then support decision-making to improve productivity and protect against losses.⁴⁸

⁴⁸ London Economics. 'Economic Evaluation of the International Partnership Programme (IPP): Cost-Effectiveness Analysis.' September 2019.





Space-enabled solutions for disaster resilience are on average twice as cost-effective as the non-space alternatives in the long term, corresponding to a cost of around £20,000 per avoided killed, missing or injured (KMI) person. Satellite EO is, for example, a more feasible means to map disaster risk areas at a sufficient frequency to make them useful inputs in disaster forecasting or post-disaster mapping tools than, for example, drone or ground-based alternatives. Likewise, SatComms is the only technology that can be deployed quickly enough to support communications in disaster-hit areas that lack connectivity, sometimes as a result of the disaster.

In other sectors where IPP has fewer examples (including tax collection, renewable energy and maritime intelligence), satellite solutions remain the most cost-effective solution and offer significant advantages over terrestrial systems.

See also 'Economic Evaluation of the International Partnership Programme (IPP): Cost-Effectiveness Analysis', prepared by London Economics on behalf of Caribou Space and UKSA.

New Partnerships Formed to Execute IPP Projects

An important aspect of IPP (and one implicit in the name International Partnership Programme) is the forming of partnerships with organisations in developing countries and helping them to build their capacity. To date, IPP has formed partnerships with 147 international organisations, including government ministries, private sector companies, NGOs and academia.

Working in partnership allows beneficiaries to play a key role in defining the challenges they face and identifying the solutions they need. It also helps to secure the necessary buy-in that consortiums need in order to ensure their tools are co-developed and ultimately are adopted, as well as in building in-country capacity to use those tools. As governments are generally tasked with responsibility for the sectors that many IPP projects work in (forestry, disaster risk reduction, infrastructure and so on), they are often essential partners for any projects in these areas.

In addition, six IPP consortiums have formed partnerships with at least 14 academic research institutions and universities in 11 partner countries.

These partnerships have varied purposes and outputs but they include the publication of new (original) research, the development of use cases where satellite data can help, the training of undergraduate students to use satellite-derived data and the verification and validation of data generated by research conducted in the UK.

New Growth Opportunities for the UK Space Sector

Through IPP consortiums, over 120 private sector, academic and NGO organisations are developing new products and trading relationships with developing countries.

Based on a survey by London Economics, many organisations are reporting having developed “credibility, strong relationships, a physical presence [in their partner country] and an understanding of how to operate in their IPP market”.⁵⁰ The relationship building that IPP facilitates between UK organisations and end users in developing countries is a new experience for many of the UK suppliers and has built a significant amount of experience for the UK space sector in working in developing countries. Furthermore, over 80% of survey respondents agreed that IPP has already had a positive impact on their product/service offer and almost 90% expect to observe further positive impacts on product/service offers in the future.⁵¹ Examples include the following:

- The Coastal Risk Information Service (C-RISe) project consortium led by Satellite Oceanographic Consultants has secured over £100,000 of NERC Innovation follow-on funding to work with existing project partners in Madagascar to carry out new research on storm surge forecasting. They have also been granted over £1.5 million from the European Space Agency’s Earth Observation for Sustainable Development (EO4SD) programme to do further work on satellite applications and capacity building for marine and coastal environments, leveraging the relationships formed in IPP and building on work completed and experience gained through C-RISe. C-RISe has also accessed an additional £10,000 of ODA research seed funding to explore widening the range of applications with partners in the project expansion to Mauritius. National funding of just over £7,000 was secured to support the University of Mauritius to develop applications of the C-RISe products.⁵²
- As a result of their two IPP-funded projects in Peru and Côte d’Ivoire, Vivid Economics has reported that “[IPP] has given us greater capacity and depth to take on large data projects...[and] it has given us business development opportunities through new contacts with potential new clients in agricultural commodities and large international NGOs, as well as new suppliers and partners in the EO sector”.⁵³
- In the Philippines, a procurement process for the tools developed as part of Inmarsat’s disaster response project is in motion through the in-country partner. The Department of Social Welfare and Development (DSWD) has applied for a multi-year allocation to procure SatComms equipment for the remaining non-project regional field offices. Outside of the DSWD, engagement with the Office of Civil Defence, the armed forces and the Department of Health has generated strong interest. These stakeholders are all important players in the government of the Philippines’ disaster response and relief framework and are all part of the Philippines’ National Disaster Risk Reduction and Management Council.⁵⁴

⁵⁰ London Economics. ‘Economic Evaluation of the International Partnership Programme (IPP): Economic Return to the UK – Issue 1.’ September 2019.

⁵¹ Same as above.

⁵² Satellite Oceanographic Consultants. ‘IPP Logframe for C-RISe’. April 2019.

⁵³ Vivid Economics. Personal communication. July 2019.

⁵⁴ Inmarsat. Personal communication. July 2019.

Opportunities for Academia

Importantly, IPP receives its funding from the GCRF which has a strong focus on academia. Thirteen UK-based universities are formal consortium partners in IPP but many are involved in several projects, bringing the total number of UK academic partnerships to 22.⁵⁵ For instance, different researchers and institutes at the University of Leicester are involved in five different IPP projects.

These partnerships have allowed academics at each university to develop new methods of analysis, publish scientific articles and share their research at numerous academic congresses. For example: the Universities of Edinburgh and Leicester have been producing new deforestation and fire risk maps for Forests 2020; PhD students from the EO4cultivar project are conducting research into innovative applications of EO for developing and maintaining a competitive edge in agriculture (including crop modelling and remote sensing for yield prediction, and different techniques for monitoring crop conditions); King's College London, a partner in the PRISE project, is carrying out land temperature work that feeds into the project's crop pest risk modelling; and the Inmarsat Nigeria project has collaborated with the University of Leeds as a partner for reporting on the project's M&E.



⁵⁵ Caribou Space analysis of IPP consortium data. April 2019.

⁵⁶ Caribou Space analysis of scale of funding for the known space/satellite programmes using ODA funding.

Conclusion

Three years after the announcement of IPP and the kick-off of Call 1, IPP has the largest amount of funding for a space-for-development programme.⁵⁶ The programme portfolio spans a large number of countries, sectors and partners and is beginning to show some early promising results in terms of how it is helping to contribute to the UN SDGs. Of the 33 projects, seven are now complete with all projects scheduled to complete by March 2021.

Given the significant inception and development periods needed for space technology projects to allow for research, development and capacity building, many projects from Call 1 are only now rolling out full solutions for testing and evaluation. Most Call 2 projects are still in the development phase and thus have even less to report in terms of outcomes and impacts achieved. Many outcomes (and certainly many project impacts) take a long time to materialise; in some cases it can take as long as a decade. The fact that project outputs and some early outcomes are starting to be achieved is exactly in line with what IPP was expected to deliver in its first two to four years of operation.

As noted above, 25 tools developed in IPP have been handed over to the relevant international partners and over 2,000 people have been trained in the use of EO data and SatComms-based systems. IPP projects have been presented at over 150 conferences and IPP consortiums have gained substantial experience working with ODA funding and in new developing country markets. These are important progress markers on the way to contributing to the SDGs and provide clear signs that IPP is making progress towards its expected endline results.



Figure 9: Endline SDG Targets for IPP Countries and Regions⁵⁷



Build resilience to disasters in IPP target countries by:

- Reducing the number of deaths, missing persons and persons affected by disasters
- Reducing direct economic loss in relation to GDP
- Using knowledge derived from IPP projects to create or strengthen at least 12 national and local disaster risk reduction strategies



Promote safe and secure working environments in small boat communities targeted by IPP projects by:

- Reducing the annual number of small boat deaths by 10%
- Increasing the number of people working in safe employment



Reduce hunger and achieve food security in IPP Project areas by:

- Contributing to a 3-5% increase in agricultural productivity
- Improving agricultural return on investment, crop yields and reduce crop losses
- Improving incomes for 30,000 smallholders
- Bringing 1 million hectares of agricultural land under sustainable management (EO based) practices



Improve the management of hazardous material and chemical waste in regions targeted by IPP projects by:

- Reducing the risk of mine tailings contaminating water and soil



Ensure healthy lives and well-being in IPP target areas by:

- Increasing the number of live births assisted by a trained professional by 20%
- Reducing the incidence of (potentially) deadly diseases



Conserve marine environments and promote legal, sustainable fisheries by deterring overfishing and IUU fishing in IPP focus areas by:

- Increasing by at least 2,000 the number of households benefiting from enhanced fisheries practices (e.g. VMS)
- Increasing the average income of small and medium-sized fishing boats



Ensure that all girls and boys have a quality education in Tanzania by:

- Increasing by 1,500 the number of youths with ICT skills
- Increasing to 20% the number of students reporting the use of ICT for their learning
- Ensuring that 60% of students report the integration of ICT in the classroom



Protect terrestrial ecosystems in forests targeted by IPP by:

- Reducing average deforestation rates by 5%
- Contributing to 100,000 hectares of avoided forest loss and improved forest governance by 2021
- Bring over 375 million hectares of forests under regular EO and monitoring for better governance



Ensure access to energy for all in IPP targeted SIDS by:

- Increasing by 3% the amount and proportion of renewable energy generated in SIDS.



Strengthen domestic tax collection in the city of Dakar by:

- Improving potential for domestic tax collection by £32 million per year in relevant IPP countries

⁵⁷ Caribou Space analysis of IPP project data.

Next Steps

2019 will be a pivotal year for IPP. More and more tools will be handed over and tested and are expected to be acquired for long-term use by international partners. To better assess this, Caribou Space will be conducting a comprehensive midline evaluation in early 2020. That report will contain initial answers to questions of:

- Process: how has IPP been delivered to date?
- Impact: what difference did IPP make?
- Economic efficiency: did the outcomes and impacts justify the costs?

The purpose of the midline evaluation will be to document the results and learnings to date and make recommendations for the remaining programme implementation, subsequently making space-for-development programmes more efficient, effective, relevant, sustainable and impactful.







