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Partner Country Case Study: Brazil

Final Evaluation of The Newton Fund

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TETRA TECH
International Development

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Disclaimer

The views expressed in this report are those of the evaluators. They do not represent those of the Department for Business, Energy and Industrial Strategy, the Newton Fund or of any of the individuals and organisations referred to in the report.

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Abbreviations

AH	Award Holder
AHRC	Arts and Humanities Research Council
AI	Artificial Intelligence
AMS	Academy of Medical Sciences
BAM	Brazil Atmospheric Model
BBSRC	Biotechnology and Biological Sciences Research Council
BEIS	Department for Business, Energy and Industrial Strategy
BNDES	Brazilian Development Bank
CAPES	Coordination for the Improvement of Higher Education Personnel
CEMADEN	National Centre of Natural Disaster Monitoring and Alerts
CONFAP	Brazilian National Council for the State Funding Agencies
COP26	26th UN Climate Change Convention of the Parties
CNPQ	Brazilian National Council for Scientific and Technological Development
CSSP	Climate Science for Service Partnership
CTTD	Desalination Technology Testing Centre
DARA	Development in Africa with Radio Astronomy
DBT	Department for Biotechnology
DRR	Disaster Risk Reduction
DP	Delivery Partner
ECR	Early Career Researcher
EfS	Education for Sustainability
EMBRAPA	Brazilian Agricultural Research Corporation
EMBRAPII	Agency for Industrial Research and Innovation
ENCTI	National Strategy in Science, Technology and Innovation
ENSO	El Niño Southern Oscillation
EPSRC	Engineering and Physical Sciences Research Council

ESRC	Economic and Social Research Council
EU	European Union
FAP	State Research Support Foundations
FAPERJ	Research Support Foundation of the State of Rio de Janeiro
FAPESP	São Paulo Research Foundation
FCO	Foreign and Commonwealth Office
FINEP	Brazilian Studies and Projects Finance Organization
FioCuz	Oswaldo Cruz Institute
FNDCT	National Fund for Scientific and Technological Development
FWI	Fire Weather Index
GCI	Global Competitiveness Index
GCRF	Global Challenges Research Fund
GDP	Gross Domestic Product
HELIX	High-End Climate Impacts and Extremes
IAPP	Industry-Academia Partnerships Programme
IBF	Impact-Based Forecasting
ICAI	Independent Commission for Aid Impact
ICLEI	Local Governments for Sustainability
ICT	Information and Communications Technology
INEW	Indo-UK Centre for Improvement of Nitrogen use Efficiency in Wheat
INPA	National Institute of Amazonian Research
IPCC	Intergovernmental Panel on Climate Change
INPE	National Institute for Space Research
ICT	Information and Communications Technology
ICTs	In-Country Teams
IT	Information Technology
LIF	Leaders in Innovation Fellowships Programme
LQ	Location Quotient

LSHTM	London School of Hygiene and Tropical Medicine
MCTI	Ministry of Science, Technology, Innovation and Communications
MEC	Ministry of Education
MEL	Monitoring, Evaluation, and Learning
MTE	Mid-Term Evaluation
MRC	Medical Research Council
NERC	Natural Environment Research Council
NF	Newton Fund
NTD	Neglected Tropical Disease
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PCE	National Control Program
PI	Principal Investigator
PINTEC	Survey of Innovation
PNSIPCF	National Integral Health Policy for Field and Forest Populations
PPA	Pluriannual Plan
PPB	Basic Productive Process
R&D	Research and Development
RCUK	Research Council United Kingdom
S&I	Science and Innovation
SDG	Sustainable Development Goal
SENAI	National Service for Industrial Training
SECAP	Evaluation of Public Policies, Planning, Energy and Lottery
SIN	Science and Innovation Network
SINAN	Information System for Notifiable Disease
SIS-PCE	System of Schistosomiasis Control Program
SME	Small and Medium-sized Enterprises
SPRINT	São Paulo Researchers in International Collaboration

STEM	Science, Technology, Engineering and Mathematics
STFC	Science and Technology Facilities Council
STI	Science, Technology and Innovation
TOC	Theory of Change
TGR	Thioredoxin Glutathione reductase
UK	United Kingdom
UKRI	United Kingdom Research and Innovation
UNFCCC	United Nations Framework Convention on Climate Change
UNSEEN	Unprecedented Simulated Extremes using Ensembles
UNESP	São Paulo State University
US	United States
VfM	Value for Money
WCSSP	Weather and Climate Science for Service Partnership
WEF	World Economic Forum
WHO	World Health Organisation
WP	Work Package

Executive Summary

Newton Fund in Brazil at a glance

- Operating since 2014, the Newton Fund's priorities in Brazil span nine areas including health, climate change, and the 'food, energy, water and environment nexus'.
- The Fund has focussed on achieving geographical decentralisation of science and innovation partnerships, including areas of the country that have historically been poorer and more isolated.
- Annual UK Newton funding for Brazil has been £9m, making it one of the largest investments alongside India and China.
- It is the UK's 'flagship programme' on science and innovation partnership in Brazil.
- The main Brazilian funding partners for collaboration are government institutions at the federal and state levels.
- UK partners include The Academy of Medical Sciences, Economic and Social Research Council (ESRC), and the Met Office.

The case study

Tetra Tech International Development produced this Brazil Partner Country Case Study to inform the Final Evaluation Report of the Newton Fund. It is one of 11 country case studies that investigates the Fund's implementation and its results. It serves as a deep dive into the development, relevance, additionality, and results of (a) the programme activities; and (b) their success factors and barriers that affected their implementation.

The case study sampled three calls, and from each a project was selected for in-depth analysis:

- **Climate Science for Service Partnership (CSSP)** Brazil is a partnership between the Met Office and three Brazilian institutions working in weather services and research: the Institute for Space Research (INPE), the National Institute for Amazon Research (INPA) and the National Centre for Monitoring and Early Warning of Natural Disasters (CEMADEN). CSSP aims to strengthen the research base on climate change and weather variability, with the ultimate aim of increasing the resilience of vulnerable communities. This includes a disaster risk reduction research package to improve Brazil's response to extreme events.
- **Newton Advanced Fellowship** aims to build the capacity of the Brazilian research team and transfer knowledge to **assist the development of drug discovery for the treatment of schistosomiasis**, a neglected tropical disease (NTD) for which current treatments are limited. The Fellowship involves research collaboration between four institutions. It is a follow-on from a previous collaboration shortlisted for the Newton Prize.
- **(Re)Connect the Nexus** sought to generate knowledge about how young people understand and interact with resources in the 'food-water-energy nexus'. It brought together UK and Brazilian engineers and human geographers in the metropolitan region of the Paraiba do Sul river basin (São Paulo State) through a mobility grant. Its long-term objective was to improve local policies and initiatives and foster research connections across food, energy, water and

the environment. Through outreach work, the team shared its research results with schools and successfully influenced Education for Sustainability (EfS) curricula design.

The case study research was carried out by reviewing documents at project- and fund-level and through interviews. Between October and November 2020, the team interviewed 29 people from UK and Brazilian institutions. Interviewees came from Delivery Partners in both countries, award holders (AHs) and UK Embassy staff, and high-level stakeholders from partner organisations. All the country case studies involved wide-ranging in-country consultations and included as many diverse interview respondents as possible within the short timeframe of our fieldwork activities.

The case study is a self-contained investigation and its findings are not intended to be generalised to the entire Newton Fund in country. Case studies were limited to three projects per case study, which were conducted remotely owing to the Covid pandemic. In some projects, the added logistical challenge of remote research limited the number and range of stakeholders consulted. The case study findings reflect the data provided by each project and available information online. The volume of documentation provided varied by project, thus limiting the possibility of triangulating findings. In terms of total Newton Fund expenditure, the projects selected represent a very small fraction of all expenditure across 5,400 projects. The case study is therefore not representative of all Newton Fund activities. Whereas it provides valuable depth and illustration of Newton Fund activities, the case study alone does not provide generalisable evidence.

Key Findings

Effectiveness

- **The Newton Fund in Brazil has helped build the capacity of UK and Brazilian researchers and institutions.** At the institutional level, Newton was sometimes the first instance of international collaboration. The Fund had an explicit focus on achieving geographical decentralisation of science and innovation partnerships, including areas of the country that have historically been poorer and more isolated.

- **Newton Fund collaborations brought the opportunity for early-career researchers to play a large part in running collaborations, raising their professional profile in so doing.** Partnering with the UK allowed access to high-quality equipment and scientific techniques. In some instances, match funding limitations meant that Brazilian researchers did not always benefit as much from international exchanges and capacity building opportunities. For example, instances where the inability to finance a team which could focus on modelling, led to Brazilian team assuming a ‘data provider’ role.

- **The Newton Fund provided important ‘seed funding’ with a strong added value in knowledge transfer and networking building.** The initiatives paved the way for long-term, sustainable partnerships. The case studies show how Newton can help create networks that Award Holders (AHs) can build on. In all three projects sampled, an initial mobility grant or initial collaboration led to further collaboration.

Emerging impacts

- **The Newton Fund stands out in terms of its strong ambition to link science to impact, including for society’s most marginalised.** All three projects had clear aims to contribute to bringing about tangible change in their respective fields, for example improved climate modelling, curricula changes around Education for Sustainability (EfS), or novel drug therapies

for neglected diseases. More resource and time could still lead to improvements across the portfolio through outreach and dissemination with government, civil society or private sector stakeholders.

- **Timelines for scientific discovery, especially in certain thematic areas, are typically longer than the seven-year Newton Fund cycle**. It might take ten to 15 years before innovations are trialled, tested and brought to market for the benefit of the broader population.

- **There is strong interest on both sides of the partnership to sustain collaborations going forward, exemplified by high-level commitments from the Brazilian government.** Further clarity on the future of the Newton Fund would allow for improved forward-planning and could help cement trust and collaboration between UK and Brazilian counterparts.

- **All collaborations sampled showed strong interest in continuing to work together.** In the case of the (Re)Connect the Nexus, the Brazilian research team invested its own time and resources in sustaining conversations and engagements around knowledge sharing with local authorities.

- **Working with Brazilian partners has brought benefits to UK science and climate researchers.** Brazilian partner institutions shared highly specialised expertise in hydrology and Amazonian studies through the CSSP project. This collaboration provided crucial data to improve UK partners' climate models. Fresh data, models and research findings produces relevant, high-quality research that will help address climate change issues, which are of global relevance.

Complementarity and Coordination

- **The Newton Fund's experience in Brazil has shown that it is possible to foster a diverse portfolio of high-quality science collaborations, including in areas of the country that have traditionally not taken part in international S&I partnerships**. Through its work with numerous state funding agencies (FAPs) across the country, Newton has prepared them for further international collaboration. This serves the Brazilian government's aim to decentralise science and innovation. There has been interest from local authorities in project findings, including the EfS curriculum developed by (Re)Connect the Nexus, and the tools developed by CSSP for Manaus river forecasting. Positive as these signs are, it is too early to observe real evidence of uptake or scaling-up.

Lessons Learned

- **The Newton Fund's match funding model fostered balanced partnerships and a sense of shared ownership between collaborators.** The Newton Fund's move towards match effort was a positive step in allowing for greater flexibility and appropriateness within local context. Partnerships were strengthened by the flexibility and cooperation among different Brazilian State Research Support Foundations (FAPs), which created favourable conditions for cost-sharing and inter-regional knowledge exchange.

- **Brazilian and UK partners reported a challenge around mapping the effects of mobility schemes and collaborations financed under Newton.** An inadequate centralised monitoring, evaluation, and learning (MEL) system and lack of a repository for collating project results and achievements led to a missed opportunity to showcase results from the collaboration.

- **There was demand among Brazilian partners and local researchers for more targeted support specifically for capacity building and knowledge transfer in different types of**

intervention. Research collaborations have not always produced similar levels of engagement from students or early-career researchers from the UK and Brazil – partly due to limited match funding from Brazilian partners.

- **Despite increases in shared ownership, funding priorities are sometimes seen as coming top-down from the UK.** This means that the programme is not as collaborative or responsive as it could be to changes in context. Newton's introduction of more agile, responsive calls, such as those on Zika and the joint Global Challenges Research Fund (GCRF) – Newton COVID-19 call were particularly appreciated by award holders.

Considerations and recommendations for the Newton Fund in Brazil

- **In terms of its longer-term ambition, the Fund could do more to capture socio-economic impacts and to map the pathways from scientific outputs towards policy, dissemination activities and tangible outcomes.** To facilitate systematic data collection and reporting, any potential future phases of the programme should include a monitoring, evaluation and learning plan.
- **There is demand for future phases of the programme, or other S&I initiatives, which would include short-term, agile and responsive funding streams.** In-country teams (ICTs) would have an important role in identifying priorities jointly with counterparts in Brazil's research community.
- **Newton is a strong brand in Brazil, and a Fund-level alumni network could help raise the Fund's profile even further.** For instance, the Leaders in Innovation Fellowships (LIF) Programme was cited as best practice in its work to raise interest and disseminate news throughout the Brazilian research community. Newton Fund alumni could boost the profile of any future phases of the programme in a way the Chevening scholarships, for example, have created a strong alumni identity.
- **Newton's investment in people and its support to early career researchers, ECRs, emerged as a key added value of the programme.** The critical human resources needed to carry forward projects could, in many cases, be supplied by ECRs in support of senior academics and researchers, if the funding rules provide for it.
- **There is strong interest in continuing collaboration and discussing further partnerships.** Newton Fund in Brazil has been significantly affected by COVID-19 and by uncertainty over availability of funding post-2021. Although this is not exclusively a Brazilian concern, the Fund should communicate its likely direction at the earliest opportunity.

1 Introduction

1.1 Aim and purpose of the case study

This report presents our findings for our country case study of Newton Fund activities under in Brazil. While these findings will inform the Newton Fund's final evaluation, they are specific to the country under investigation and not to be generalised to the broader Fund. The strength of evidence (Section 1.5) for this case study should guide the reading of the results set out in Sections 3-6. Remote research on the Newton Fund in Brazil was carried out in **October to November 2020**.

The purpose of the case study is to examine:

- the relevance of the country-level work to Newton Fund's theory of change, including the ways in which funded projects have supported the Newton Fund to achieve its stated outputs and outcomes.
- the effects of Newton funding in terms of the scale and type of results delivered by the sampled projects, and their potential impact on the socio-economic challenges identified in the country and more widely.
- the likely sustainability of the activities and results of the sampled projects and by the Newton Fund.

We also aim to better understand the overarching significance and impact of the Newton Fund in Brazil, such as on the internationalisation of research institutions, the relationship between the partner country and the UK, and in the sharing of best practice between the two countries.

1.2 Research scope

This country case study focussed on the activities under the Newton Fund in Brazil. Specifically, it assessed the following:

- the **development of each activity** – examining its origins, how engagement with the Newton Fund occurred, and an overview of the process of securing Newton funding.
- the **relevance of each activity** to Brazil's development needs and to Newton Fund and Official Development Assistance (ODA) goals.
- the **additionality of each activity.**[1]
- the **results of each activity** in terms of the outputs, outcomes and impacts generated to strengthen the science and knowledge base, innovation capacity and policy influence in Brazil and beyond.
- the **success factors (and barriers) which affected each activity**, as well as the potential benefits from each activity that might be expected to arise in the future.

[1] In the context of the Newton Fund, additionality aims to assess whether a given call or project could have happened in the absence of the Newton Fund (for example, through funding for similar activities provided by other programmes).

The case study included a mix of ongoing and completed activities. When assessing these activities' results, we considered their ambitions as well as early signs of achieving impacts recognising that impacts of research and innovation take time.

To understand how sustainable solutions to economic development and poverty reduction have emerged from Newton Fund activities, our enquiry focussed on the factors that facilitate specific research activities, increase the quality of research outputs, enhance international collaboration for higher-level education and translate research into innovative practices.

1.3 Case study selection

As part of our sampling methodology for the Newton Fund country case studies, we shortlisted case study calls for each country based on three measures: size, pillar, and sector (see Annex 2 for details). Project selection considered thematic areas of focus, aiming to include priority areas for the Newton Fund in each country. We also sought to achieve a spread of Delivery Partners (DPs) and activity types across the countries in our sample. Following consultations with in-country teams (ICTs), DPs and the Newton Fund Central Team, we selected **three calls per country**. This selection allowed us to include a call under each of the Newton Fund's core activity pillars: People, Research, and Translation.

The next step to the case study selection is the sampling of one specific project from each of these three calls to ensure as broad geographical and partner coverage within the country case study's short timeframe. We also considered the relevance of their specific research areas to the Newton Fund's priorities in Brazil when the projects were selected.

In Brazil, the sampled calls and projects analysed in depth in this report are:

Calls	Projects
CSSP Brazil	CSSP Brazil Work Package 3
Social Science of the Nexus and Healthy Cities	(Re)Connect the Nexus: Young Brazilians' experiences of and learning about food-water-energy
Newton Advanced Fellowships 2018-19	Strengthening skills on structure-based drug discovery for novel anti-schistosomal therapeutics

1.4 Methodology

The research for the country case studies included desk-based review documentation and remote key informant interviews (see Annex 1). For the Brazil case study, we consulted 29 UK and Brazil stakeholders such as Delivery Partners in both countries, Award Holders (AHs), senior staff from partner organisations as well as the programme team and UK Embassy staff.

Due to COVID-19-related travel restrictions, we had to switch to a purely remote approach. We assured the quality of our interviews by building rapport with stakeholders by email prior to the

interviews, reviewing documents thoroughly to identify the most important gaps to keep the sessions brief amongst other steps. Details of the limitations of this approach and our mitigation actions are set out further in Annex 1.

1.5 Strength of evidence assessment

Tetra Tech used a traffic light system to assess the case study's strength of evidence '(see figure 1 below).[2] The rating assesses the evidence supporting the conclusions reached given the methodological limitations outlined in Annex 1. Table 1 details the main sources of evidence used for this case study and the rating assigned to it.

Figure 1: Strength of evidence ratings

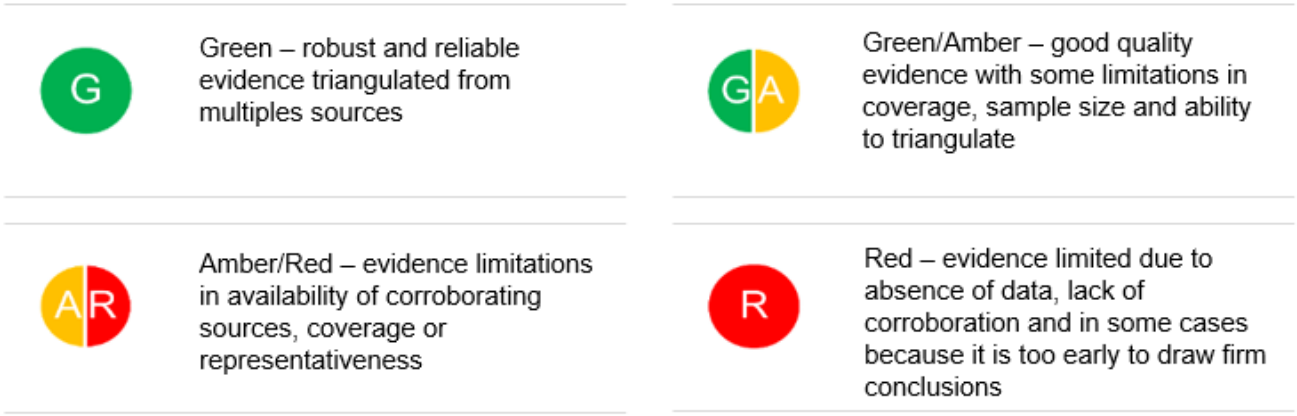


Table 1: Strength of Evidence for the Newton Fund in Brazil

Strength of Evidence	
Green/ Amber GA	There are gaps in the evidence, which limited the assessment of relevance, effectiveness, emerging signs of impact and sustainability. This is due to the relatively small sample of interviews conducted which limits the extent to which it is possible to assess if the Newton Fund in Brazil has produced results and benefited its intended recipients. In addition, the extent, type and structure of monitoring data and documentation varied across DPs, limiting the extent to which outputs and outcomes can be reviewed and triangulated.

1.6 Report structure

The report is structured as follows:

- Section 2 introduces the context of Brazil, including political and economic developments and trends in the R&I landscape.

[2] Our aim was to achieve a sufficient degree of confidence about the extent to which outcomes have occurred, Newton Fund's level of contribution to the outcomes and our theory about how the Newton Fund has contributed or failed to contribute. Confidence is affected by the extent of triangulation across sources and the position, knowledge, analytical capacity, and potential biases of primary informants. The ratings are not designed to be a rigid framework, but rather a way to ensure evaluative judgements were made systematically across the Evaluation Questions.

- Section 3 discusses high-level emerging results of the Newton Fund in Brazil based on findings from the three sampled projects and broader consultations undertaken with the programme team.
- Sections 4 to 6 analyse three specific projects more in-depth, providing an assessment of the relevance, effectiveness, emerging impact, and sustainability of the sampled activities.

2 Context

2.1 Political and economic context

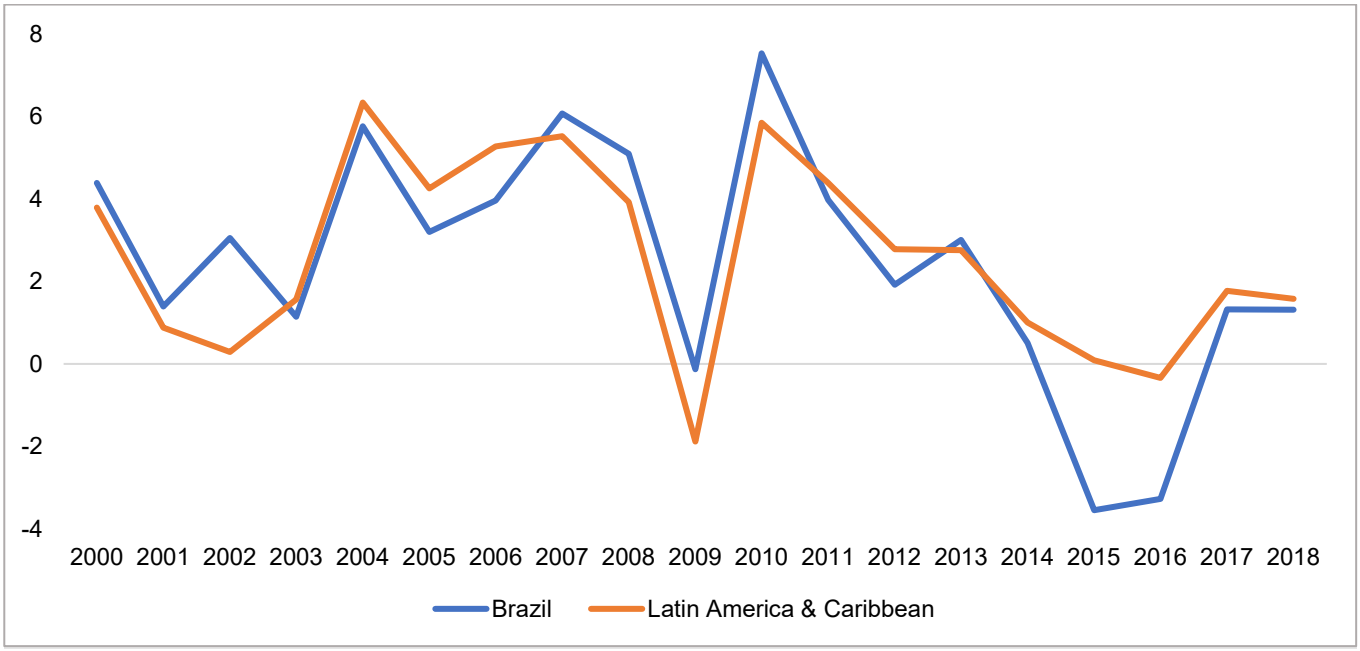
In 2014, Brazil entered into an economic and political crisis which returned more than 29 million people to poverty they had previously escaped. The economy has been slowly recovering since 2017. The government published a new development plan for 2019-2031, which sets out policies to increase incomes and quality of life while reducing social and regional inequalities. During this time, it also published science, technology and innovation-related strategies with detailed indicators.

Brazil is a Presidential Federal Republic[3] composed of 26 states, a Federal District, and more than 5,500 municipalities.[4] Its two-chamber political system has 594 seats, comprising the Federal Senate and the Chamber of Deputies. There are 33 parties registered in Brazil, with the Social Liberal Party currently in government. The current government's priorities are centred around economic growth and employment, aiming to deliver a budget surplus by 2026 (a revision from pre-COVID-19 plans of achieving this by 2020). The current President is Jair Bolsonaro, elected in 2018 on the back of an agenda of free-market liberalisation and privatisation.[5] According to a poll by CNT/MDA, 39.5% of people in Brazil found his government 'bad or terrible' in August 2019, up from 19% in February. The President and his party have fallen under public scrutiny due to their stance on issues such as public health, education and the environment.[6] A more recent survey in January 2020 shows that people's negative perception of the government stood at 31%. According to the latest survey, the government is considered to perform well in fighting corruption, boosting the economy and ensuring public security.[7] Municipal elections took place on 4 October 2020 and on 25 October 2020 – the first elections since Bolsonaro's election as President. Emerging results suggest a return of more traditional centrist and left-wing parties in many areas of the country.[8]

The Organisation for Economic Co-operation and Development (OECD) classifies Brazil as an upper-middle-income country.[9] As of 2014, the country was expected to exceed the per capita income threshold for ODA eligibility in 2019.[10] Due to the economic recession that followed (reaching -3.5% growth in 2015)[11], graduation is now not expected to occur within the next five to ten years. European Union (EU) institutions provide the majority of ODA to Brazil. The United Kingdom (UK) is the 5th largest bilateral donor after Germany, France, Norway and Japan. In 2017, over USD 350m of total ODA went to the economic infrastructure sector, and the second-largest ODA sector in Brazil was social infrastructure.

[3] gov.br (n.d.) 'How the Government Works'.
[4] Forum of Federations (n.d.) 'Brazil'. Available at: http://www.forumfed.org/countries/brazil/
[5] The Economist Intelligence Unit (2021). 'Brazil'. Available at: http://country.eiu.com/Brazil/ArticleList/Analysis/Politics
[6] Reuters (2019). 'Brazil poll shows Bolsonaro government approval sinks. Available at: https://www.reuters.com/article/us-brazil-poll/brazil-poll-shows-bolsonaro-government-approval-sinks-idUSKCN1VG1KR
[7] Reuters (2020). 'Bolsonaro's popularity jumps as Brazil economy improves, crime drops' Available at: https://www.reuters.com/article/us-brazil-politics-poll/bolsonaros-popularity-jumps-as-brazil-economy-improves-crime-drops-idUSKBN1ZL1ZQ
[8] The Guardian (2020). 'Setback for Bolsonaro after poor results in Brazil local elections. Available at: https://www.theguardian.com/world/2020/nov/16/setback-for-bolsonaro-after-poor-results-in-brazil-local-elections
[9] OECD (n.d) 'Financing for sustainable development'. Available at: http://www.oecd.org/dac/stats/historyofdaclistsofaidrecipientcountries.html
[10] OECD (2014). An outlook on ODA graduation in the post-2015 era. p.1.
[11] World Bank (n.d.). Available at: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=BR

Figure 2: GDP growth in Brazil and the Latin America & Caribbean region, 2000-2018



Source: World Bank

From 2000 to 2012, Brazil was one of the world's fastest-growing economies.[12] Its growth rate started to slow in 2013. The country's economic crisis began in 2014 and caused significant setbacks to previous poverty-reduction efforts.[13] According to the OECD economic outlook published in November 2019, the Brazilian economy has been gradually recovering since 2017 thanks to pension reforms lifting confidence and supporting investment. However, the high unemployment rate is falling slowly, and newly created jobs are of low quality, including many in the informal sector.[14]

The Bolsonaro government published a **National Strategy for Economic and Social Development for 2019–2031.** The strategy is organised into 5 axes: economy, institutions, infrastructure, environment and society. Its detailed objectives are summarised in Table 2 below.

Table 2. National Strategy for Economic and Social Development

Overall objective: Raising the income and quality of life of the Brazilian population while reducing social and regional inequalities	
Economy	Achieve sustained economic growth, focusing on productivity gains, ensuring the reduction of social and regional inequalities and environmental sustainability.
Institutions	Improve state governance, focusing on improving the delivery of public services to citizens and the business environment and guaranteeing national sovereignty.

[12] Economy Watch (2010) 'Brazil Economy'. Available at: https://www.economywatch.com/world_economy/brazil/
[13] World Bank (2021) 'The World Bank in Brazil'. Available at: https://www.worldbank.org/en/country/brazil/overview
[14] OECD (2019) Economic Forecast Summary. p.1.

Infrastructure	Promote the integrated development of infrastructure to gain competitiveness and improve the quality of life, ensuring environmental sustainability and promoting national and international integration.
Environment	Promote the sustainable use of natural resources and the transition to a low carbon economy, focusing on the application of environmentally friendly technologies that contribute to economic and social development.
Society	Promote well-being, citizenship and social inclusion, focusing on equal opportunities and access to quality public services, through income generation and reduction of social and regional inequalities.

Source: Ministry of Planning, Development and Management. National Strategy for Economic and Social Development (Estratégia Nacional de Desenvolvimento Econômico e Social)

For medium-term plans, the Secretariat for the Evaluation of Public Policies, Planning, Energy and Lottery (SECAP) of the Ministry of Economy publishes its **Pluriannual Plan (PPA)**. The PPA for 2020-2023 was published in December 2019. Among its main goals, it emphasised increasing efficiency of public sector action by reducing state interference in the economy and fostering scientific and technological research, focusing on health care, including for the prevention and treatment of rare diseases.[15]

2.2 Science and innovation landscape

During the evaluation period, Brazil announced new science, technology and innovation plans. Public expenditure on science and technology research and development (R&D) increased from 2008 to 2015 but has since decreased.

In 2016, the Ministry of Science, Technology, Innovation and Communications (MCTI – formerly MCTIC) announced its National Strategy for Science Technology and Innovation (STI) 2016-2022, which includes 12 R&D priority areas: aerospace and defence, water, food, biomes and bio-economics, sciences and social technologies, climate, economy and digital society, energy, strategic minerals, nuclear, health, and converging and enabling technologies. In the report, reference is made to creating specific action plans for each area and promoting academic-business cooperation.[16]

A new Information Technology (IT) law was created in 2019 to provide tax incentives to IT companies that invest in research, development, and innovation from the sale of goods and services provided that MCTI approves projects.[17]

MCTI published its Strategic Map (2020-2030) in alignment with the National Strategy for Economic and Social Development (2019–2031) and the PPA[18] with a vision "*to be the protagonist of the country's sustainable development through science, technology, innovation and*

[15] gov.br (2019). 'DIÁRIO OFICIAL DA UNIÃO'. Available at: http://www.in.gov.br/web/dou/-/lei-n-13.971-de-27-de-dezembro-de-2019-235937365
[16] Ministry of Science, Technology, Innovation and Communication (2017). Estratégia Nacional de Ciência, Tecnologia e Inovação 2016-2022. p.87-114
[17] Deloitte (2020). 'Global investment and innovation incentives updates: January 2020' Available at: https://www2.deloitte.com/us/en/pages/tax/articles/global-investment-and-innovation-incentives-updates-january-2020.html
[18] gov.br (n.d.). 'Mapa Estratégico'. Available at: https://estrategia2020-2030.mctic.gov.br/info/mapa

communication". This defined 19 strategic objectives, divided into five areas: government, institutions, internal process, people and infrastructure, and budget.

Table 3: Strategic Map – MCTI 2020-2030

Government	• Optimise the country's scientific capacity in response to challenges of the Brazilian reality. • Promote universal access and increase the quality of the country's communication services. • Increase national autonomy in meeting the demands for space products and services. • Promote the development of nuclear technology and its applications. • Promote entrepreneurship, innovation and applied technologies, contributing to sustainable development.
Institutions	• Stimulate research and the transformation of scientific knowledge into wealth for society. • Promote the innovation, transformation and convergence of broadcasting services, and improve the standards that govern the sector. • Promote the application of technologies for sustainable development and the mastery of strategic technologies. • Strengthen the research system and improve STI and communication infrastructure. • Expand the presence of innovation and entrepreneurship in the country. • Stimulate science education, dissemination and popularisation of science. • Promote the digital transformation of Brazil.
Internal process	• Improve corporate governance and management. • Enhance the integrated performance of STI and communication actors. • Strengthen national and international partnerships.
People and infrastructure	• Develop skills, integrate and value people and attract new talent. • Promote innovation in processes, products and services. • Ensure adequate physical infrastructure and information and communication technology.
Budget	• Optimise budget resources. • Expand non-budgetary fundraising.

Source: Ministry of Science, Technology, Innovations and (MCTI). Strategic Map – MCTIC 2020-2030. Available at https://estrategia2020-2030.mctic.gov.br/info/mapa

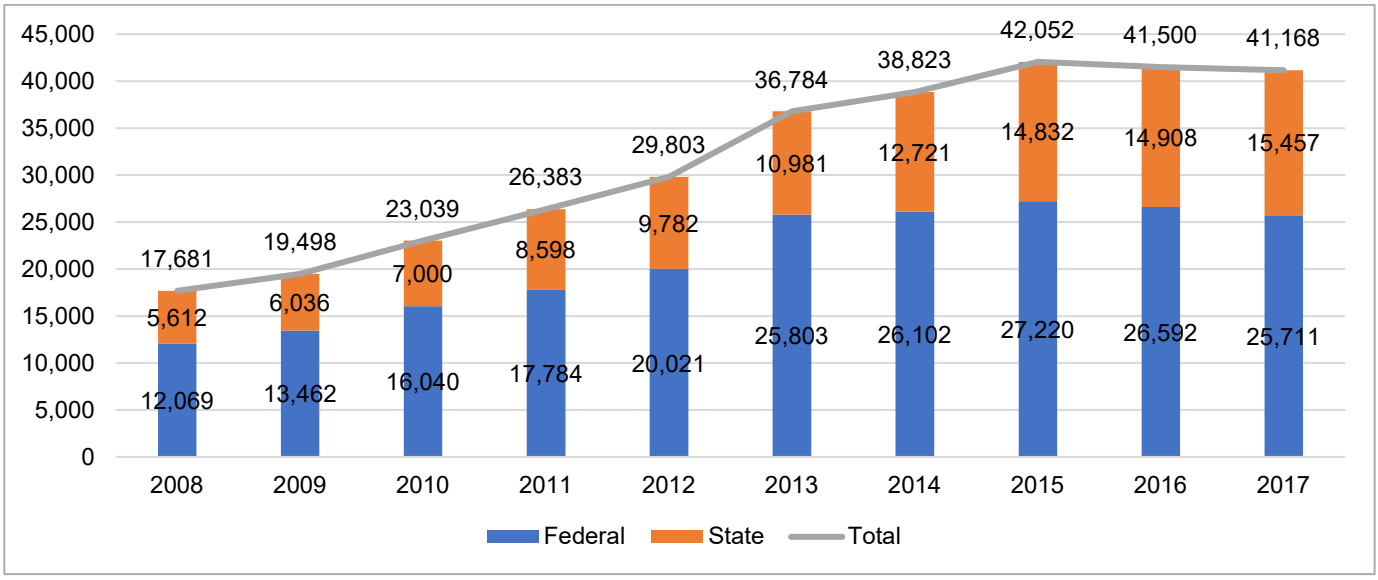
The MCTI set its indicators to achieve the objectives listed in Table 3 above. Detailed indicators used are outlined in the section below on MEL Systems.

There were several changes to science and innovation discourse during the evaluation period. During the 2018 general election campaign, President Jair Bolsonaro expressed pro-business views towards science and innovation. He spoke about incentivising private capital to invest in the R&D sector, moving away from what he described as a centralised, government-dependent strategy. As for innovation, his campaign centred around two concepts: i) providing tax incentives for entrepreneurship; and ii) further opening to international investment and reducing taxes for the purchase of equipment, including import taxes for high-technology tools. Bolsonaro also called for creating stimuli for decentralised hubs, with partnerships between universities and private initiatives.[19]

In January 2019, President Bolsonaro presented 35 goals to be achieved during his first 100 days in power.[20] One of the areas he covered was science and technology. The goals included establishing the Desalination Technology Testing Centre (CTTD) in a semiarid region of the country. In April 2019, the CTTD was inaugurated at the Federal University of Campina Grande (UFCG) Desalination Reference Laboratory.

In March 2020, several Brazilian STI institutions launched calls for research proposals on technological solutions to tackle COVID-19. Among these, MCTI established an advisory committee and strategic plan to provide quick responses on COVID-19, influenza and other diseases.

Figure 3: Public expenditure on science and technology R&D, 2008 – 2017(unit: Brazilian Real)



Source: National Science, technology and innovation indicators (2019). Ministry of science, technology and innovation. Available at: http://www.mctic.gov.br/mctic/export/sites/institucional/indicadores/arquivos/Indicadores_CTI_2019.pdf

Public expenditure on science and technology R&D has seen a positive trend from 2008, reaching R$42,052 million (approximately £7,277 million as of December 2015) in 2015 but

[19]Assespro (2018). 'Veja o que Bolsonaro e Haddad propõem para ciência e tecnologia' Available at: https://agenciabrasil.ebc.com.br/economia/noticia/2018-10/programas-de-bolsonaro-e-haddad-divergem-sobre-politica-de-ciencia-te

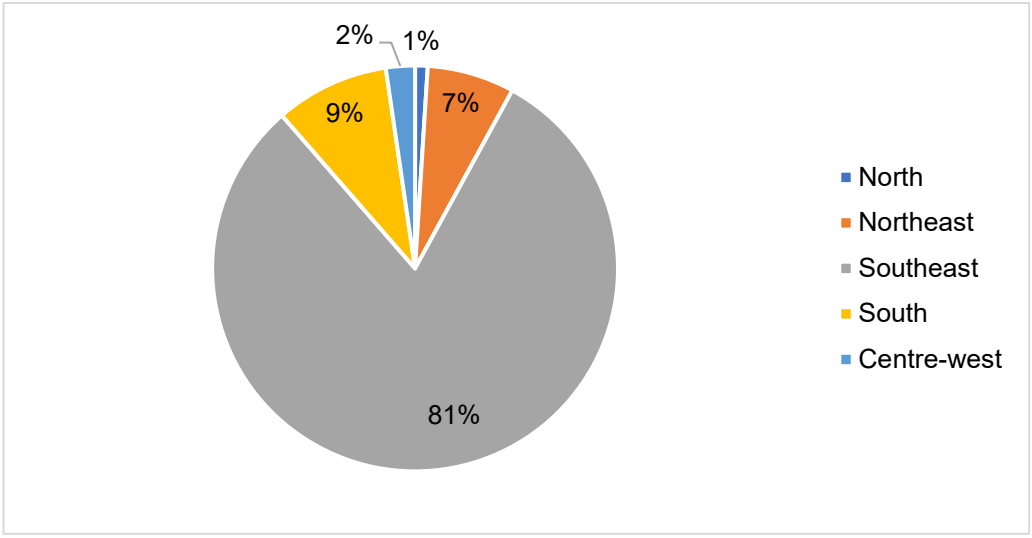
[20]gov.br (n.d.). 'Governo lança plano com 35 metas para os primeiros 100 dias' Available at: https://www.gov.br/planalto/pt-br/acompanhe-o-planalto/noticias/2019/01/governo-lanca-plano-com-35-metas-para-os-primeiros-100-dias

slightly decreasing in 2017 to R$41,168 million (equivalent to approximately £9,205 million as of December 2017).[21][22] In 2017, federal spending on science and technology R&D stood at 59% by the Ministry of Education (MEC), 18% by the MCTI and 13% by the Ministry of Agriculture, Livestock and Supply. [23]

MCTI includes 16 research units. These bodies are responsible for the generation, application and dissemination of knowledge, and the development of technologies and the promotion of innovation in their respective areas of activity. A smaller share of research activity occurs in state-owned enterprises and state research institutes such as the Institute for Technological Research, the Butantan Institute and the Agronomic Institute of Campinas. The industrial sector accounts for a small share of science and technology development.[24] According to the Coordination for the Improvement of Higher Education Personnel (CAPES),[25] areas of research excellence in the country include medicine, physics, astronomy, psychiatry and psychology.

The government also recognises some challenges in terms of R&D development. **One major challenge is the geographical and social concentration of R&D.[26]** According to the National Strategy for Science Technology and Innovation (STI) 2016-2022, the country's innovation efforts need to be more evenly distributed. In this regard, 2017 data show that state-level investments in science and technology R&D level are highly concentrated in the country's southeast, as shown in Figure 4.

Figure 4: State government expenditure on Science and Technology R&D by region in 2017 (unit: British pound sterling[27])



Source: National Science, technology and innovation indicators (MCTI, 2019). Available at http://www.mctic.gov.br/mctic/export/sites/institucional/indicadores/arquivos/Indicadores_CTI_2019.pdf

[21] National Science, technology and innovation indicators (MCTI, 2019).
[22] Please note that when converting the Brazilian Real into British Pound Sterling, the positive trend over the ten years from 2008 (£5,183, R$1= £0.29) to 2017 (£9,206, R$1= £0.22) can be seen, but funding in GBP terms dropped in 2015 due to currency depreciation (R$1= £0.17).
[23] National Science, technology and innovation indicators (MCTI, 2019).
[24] Pesquisa (n.d.) 'Pesquisa brasileira precisa de um novo perfil' Available at: https://revistapesquisa.fapesp.br/2000/10/01/pesquisa-brasileira-precisa-de-um-novo-perfil/
[25] CAPES is a foundation within the Ministry of Higher Education which promotes international scientific cooperation, carries out evaluations of postgraduate courses in Brazil, trains education professionals, and disseminates Brazilian scientific outputs. More information can be found at: http://www.capes.gov.br/.
[26] Ministry of Science, Technology, Innovation and Communication. 2017. Estratégia Nacional de Ciência, Tecnologia e Inovação 2016-2022.
[27] 1 Brazilian Real = 0.14 Pound Sterling

According to the World Economic Forum's (WEF) Global Competitiveness Report, Brazil ranks 71st out of 141 countries in the Global Competitiveness Index (GCI) 2019, one position higher than the previous year (72nd) with a 1.4 increase in its score, to 60.9. According to the GCI report, a significant simplification of regulations to start and close a business, lower inflation and a somewhat better labour market efficiency despite high unemployment and poverty rates drove this change.[28]

Brazil's gross domestic expenditure on R&D as of 2017 (the latest year for which the data is available) was 1.26% of GDP, decreasing from 1.27% in 2014. Of this, 49.7% came from government and 47.5% from business, while only 2.8% came from academia.[29]

As shown in Table 4, Brazil's research output is highly specialised in agricultural sciences, biology and biomed, health services, and natural resources and conservation. As of 2018, Brazil's specialisation rate in agriculture science was the third highest among the 17 Newton countries, after Kenya and Peru. Meanwhile, Brazil's rate of specialisation in engineering, materials and physics is below the global average. Brazil's specialisation score for astronomy, biology and biomed, chemistry, Information and Communications Technology (ICT), engineering, maths, psychology, social sciences and geosciences, atmospheric and ocean sciences all increased during the evaluation period.

Table 4: Extent of specialisation of articles across selected research fields

	2013	2014	2015	2016	2017	2018
Agricultural Science	5.10	5.11	4.71	4.46	4.17	4.03
Astronomy	0.46	0.59	0.53	0.52	0.47	0.61
Biology and Biomed	1.37	1.38	1.42	1.47	1.52	1.55
Chemistry	0.73	0.73	0.69	0.71	0.78	0.77
ICT	0.67	0.73	0.69	0.71	0.74	0.75
Engineering	0.61	0.54	0.59	0.55	0.56	0.56
Health Services	1.22	1.20	1.20	1.18	1.18	1.20
Materials	0.60	0.84	0.75	0.64	0.69	0.48
Maths	0.63	0.67	0.73	0.76	0.77	0.78
Physics	0.60	0.60	0.60	0.63	0.54	0.58

[28] World Economic Forum (2019). Global Competitiveness Report 2019. p.14-16.
[29] UNESCO Institute for Statistics (n.d.). Available at: http://data.uis.unesco.org/

Natural Resources and Conservation	1.57	1.59	1.66	1.62	1.62	1.52
Psychology	0.50	0.49	0.62	0.64	0.64	0.73
Social Sciences	0.76	0.79	0.84	0.91	0.90	0.92
Geosciences, atmospheric, and ocean sciences	0.95	0.88	0.86	0.93	0.94	0.98

Source: Scopus (data sourced from U.S. National Science Foundation).
Note: the figure represents a measure of concentration of a country's publications in a field, by dividing the fraction of publications in a country that are in a certain field by the equivalent global fraction. A score higher than 1 shows that the country is more specialised than the global average, and a score lower than 1 shows that the country is less specialised.

2.3 Overview of research and innovation funding structure

Research funding in Brazil can come from many sources, which can be directly or indirectly linked to Brazilian ministries. Institutional funding typically comes from the National Fund for Scientific and Technological Development (FNDCT), established in 1969 within MCTI and includes numerous science and technology funds.[30]

Many states have their public institutions that fund R&D activity and have constitutional guarantees of states' tax incomes. The most notable and largest institution is the São Paulo Research Foundation (FAPESP), one of the 27 State Research Support Foundations (FAPs). The state of São Paulo is Brazil's hub of scientific research. It is responsible for 52% of Brazil's scientific output in international publications, despite having only 22% of the country's population and 30% of the country's scientists. State institutions such as FAPESP have established co-operation agreements with many other governments' research funding agencies, including Research Councils UK, France's National Research Agency and Germany's Research Foundation.

There are major agencies at a national level which provide funding for research:[31]

- The Brazilian development bank (BNDES): the state-owned development bank is described as the *"most important funding agency for long-term [research] projects in Brazil"*. Its support for innovation funding became a strategic priority in 2003, and it has designed innovation support programmes such as Innovative Capital and the FUNTEC technological fund. [32]Since 2006, it has supported several innovation programmes offering lower interest rates for R&D projects.[33]

[30] DWIH Sao Paulo (n.d.). 'Research and innovation in Brazil: support and funding' Available at: https://www.dwih-saopaulo.org/en/research-innovation/the-research-and-innovation-landscape-in-brazil/research-and-innovation-in-brazil-support-and-funding/
[31] Mazzucato, M., & Penna, C (2016). The Brazilian Innovation System: A Mission-Oriented Policy Proposal. Brasília, DF: Centro de Gestão e Estudos Estratégicos. p. 99–100.
[32] Fundo tecnológico - BNDES FUNTEC (n.d.) Available at: https://stip.oecd.org/stip/policy-initiatives/2019%2Fdata%2FpolicyInitiatives%2F13909
[33] Cassiolato and Lastres (2019). The Brazilian National System of Innovation: its evolution and dynamics at the end of the second decade of the millennium. p. 15.

- The Brazilian National Council for Scientific and Technological Development (CNPQ): affiliated to the MCTI, it provides more direct financing of research projects than the other agencies and focuses on facilitating international collaboration. It gives grants both to individuals (students or researchers) and to specific research projects.
- The Brazilian Studies and Projects Finance Organization (FINEP): affiliated to the MCTI, it typically provides loans and grants for research institutions, although BNDES has more resources. It provides funds primarily through reimbursable loans and non-reimbursable grants.
- Coordination for the Improvement of Higher Education Personnel (CAPES): a federal government agency under the MEC, responsible for quality assurance for undergraduate and postgraduate institutions. It coordinates higher education support activities and funds scholarships for postgraduate students in Brazil and abroad.

Agencies such as the National Service for Industrial Training (SENAI) are also important within the innovation system. They provide training for professionals in the industrial sector (such as vocational training and technological assistance). SENAI offers nearly 2,000 courses and has a student enrolment of over two million per year.[34]

2.4 Monitoring, evaluation and learning (MEL) systems

The Brazilian government publishes a well-established national innovation survey of firms, the Survey of Innovation (PINTEC). It first appeared in 2000, with the national statistics agency, the Brazilian Institute of Geography and Statistics, responsible for its distribution. The survey is carried out every three years and covers sectors that include industry, services, electricity and gas.[35] PINTEC methods have been modelled on the EU's Community Innovation Survey. It includes an analysis of activities by region and other strata of interest. It includes 'main indicators' (for instance, the number of businesses that graduated from incubators) and a set of 'secondary indicators'. The OECD has recently utilised PINTEC data in an STI Scoreboard that compared countries such as Brazil, EU countries and South Africa on innovation metrics, including open innovation indicators.

The MCTI also established a number of 'strategic indicators' within its Strategic Map scope. The matrix consists of 11 objectives and 31 indicators to be achieved by 2030. Each indicator includes baseline data and an annual or biennial goal.[36]

Table 5: Examples of MCTI strategic indicators

Objective	Indicator	Measurement	Baseline	2026	2030
Optimise the country's scientific	Evolution of the proportion of revenue in goods with national	Billing of the enabled industry of goods with national technology / Billing of the enabled	13,77% (2019)	20%	27%

[34] Alliance4Universities. (n.d.). Available at: https://alliance4universities.eu/en/
[35] IBGE (n.d.). 'Survey of Innovation – PINTEC' Available at: https://www.ibge.gov.br/en/statistics/multi-domain/science-technology-and-innovation/17379-survey-of-innovation.html?=&t=o-que-e
[36] A full matrix can be seen at EstrategiAcao, Available at: https://estrategia2020-2030.mctic.gov.br/arquivos/Painel_indicadores_estrategicos_2020-2030.pdf

capacity in the dimension of the challenges of the Brazilian reality.	technology under the ICT Law	industry that complies with the PPB			
	Amount of Technology Transfer Contracts signed between ICT and the private sector	Annual increase over the value of the previous base year.	R$ 1.21 b (2028)	R$ 2.31 b	R$ 3.33 b
	Brazil's Participation in World Scientific Production	Citable documents indexed in the Scopus database according to year of publication: Brazil / World * 100	2.63% (2018)	3.19%	3.47%
	Visibility of national scientific production	Citations received for documents published in the year and indexed in the Scopus database: Brazil / World * 100	1.74% (2018)	2.17%	2.39%
	National scientific production in international collaboration.	Number of articles produced by Brazil in collaboration with foreign authors / Number of articles produced by Brazil * 100	33.87% (2018)	45.41%	51.18%
	Average relative citations.	Standard formula of average citations.	0.71 (2018)	0.76%	0.78%

Source: Available at :https://estrategia2020-2030.mctic.gov.br/info/desempenho

2.5 International collaboration

Brazil has a long history of scientific cooperation with the UK. The Foreign, Commonwealth & Development Office (FCDO) Science and Innovation Network (SIN) has fostered world-class bilateral science partnerships for almost ten years.[37] When the Newton Fund launched

[37] gov.uk (n.d.). 'UK Science & Innovation Network in Brazil'.

in April 2014, the SIN team already had strong, long-standing partnerships and relationships with various Ministries, Directors of Research Foundations and Scientific Institutes, and University Rectors in Brazil. Recent high-level initiatives to further foster bilateral collaboration include the UK-Brazil Year of Science in 2018. This strong partnership allowed the Newton Fund in Brazil to quickly get up and running, as further outlined in Section 3.

Although long-standing, individual agreements already existed between UK and Brazilian institutions, the level of pre-existing collaboration varied strongly by state. FAPESP is the most internationally connected Brazilian FAP, with individual agreements with over 35 UK institutions as of 2020, including Newton Fund DPs.

The evaluation period has seen high levels of research collaboration between Brazil and the UK. More than 13,000 Brazil-UK co-authored publications were produced between 2015 and 2018, with a growth of 31.5% during this period. In terms of research exchanges, the UK was the 8th most popular destination for Brazilian students in 2019, after Argentina, the United States, Portugal, Australia, France, Canada, and Germany. During the same period, British students going to Brazil were much fewer – the UK ranked 28th as the country of origin for international students in Brazil.[38]

As shown in Table 6, other UK initiatives in Brazil include the Prosperity Fund, a £56m fund active between 2017 and 2023. The programme has four focus areas: trade, energy, green finance and future cities. Unlike the Newton Fund, this does not require match funding. The Global Challenges Research Fund (GCRF) is also active in the country, with projects on topic areas similar to Newton and some of the same DPs.[39] Unlike Newton, GCRF does not require partnership with a specific country, nor does it require match funding.

Table 6: Summary of major UK funding initiatives similar to Newton

Funding initiative	Description of activity
Prosperity Fund	A UK initiative to support Brazil's economic growth by providing UK expertise in trade, future cities, energy and green finance areas between 2017 and 2023.
Global Challenges Research Fund (GCRF)	A £1.5 billion fund programme by the UK Government over 2016 to 2021. Its three key areas are: equitable access to sustainable development, sustainable economies and societies, and human rights, good governance and social justice. Some of the UK DPs are also implementing the Newton Fund.
Global Innovation Initiative	An initiative led by the UK and United States (US) governments since 2013 to "*forge university and business linkages that support international mobility in innovation and discovery activities*" in four countries: Brazil, China, India and Indonesia. The activities focus on science, technology, engineering, and mathematics (STEM)

[38] UNESCO (2021). 'Global Flow of Tertiary-Level Students' Available at: http://uis.unesco.org/en/uis-student-flow
[39] The Global Challenges Research Fund, launched in 2017, is a five-year GBP 1.5bn fund led by BEIS. Delivery Partners include UK Research Councils, UK Higher Education Funding bodies, the Academy of Medical Sciences, Royal Society, British Academy, the Royal Academy of Engineering and the UK Space Agency. More information can be found at: Global Challenges Research Fund – UKRI

	issues in particular, with projects funded in Brazil including Smart Grids. The programme ended in 2018.
UK-Brazil Year of Science and Innovation	A joint initiative offering a wide variety of events in both countries throughout 2018, with four focus areas: climate and biodiversity, sustainable agriculture, health and life sciences and energy.

The **Global Innovation Initiative** led by the UK and US governments was launched in October 2013 to strengthen multilateral research collaboration between the two countries and others in the world, particularly on STEM-related issues of global significance. This initiative includes Brazil as one of four designated countries, along with China, India and Indonesia. As part of this programme, 16 research teams, composed of one institution from the UK, US and an institution from either Brazil, China, India, or Indonesia were chosen to receive grants of up to USD 250,000 to fund international research projects.[40] The programme ended in 2018.

The 2018 **UK-Brazil Year of Science and Innovation** marked the importance of the UK-Brazil collaboration in S&I. This initiative was launched in March 2018 by the British Embassy in Brazil and the Brazilian Ministry of Foreign Affairs. Its objective was to "*celebrate the high level of collaboration between the two countries in diverse areas of science, and also to act as an important platform for the creation of new projects".* Activities began in March 2018 and were completed in 2019, and included workshops, exhibitions, and academic and entrepreneurial missions in both countries. Its four priorities were: climate and biodiversity, sustainable agriculture, health and life sciences, and energy. These closely align with Newton Fund priorities in Brazil.[41]

There have been no major changes in the relationship Brazil has with other countries during the evaluation period. A selection of international funding initiatives in science and technology is provided in Table 7 below.

Table 7: Summary of major non-UK funding initiatives similar to Newton

Funding initiative	Description of activity
Horizon 2020	Horizon 2020 is an €80 billion EU funding programme for research and innovation which started in 2014. The thematic pillars of the funding are: excellent science, competitive industries and tackling global societal challenges. Funding is available for entities across the world.
Eureka – GlobalStars project	The GlobalStars initiative aims to facilitate international R&D cooperation between EUREKA and non-EUREKA partner countries.
SPRINT Initiative	FAPESP runs the São Paulo Researchers in International Collaboration (SPRINT) programme, which seeks to link researchers from the state with peers abroad. There have been four rounds of

[40] IIE (2018). 'A Model for Successful Implementation of Multi-Lateral Research Partnerships' Available at: https://www.iie.org/Programs/Global-Innovation-Initiative/Final-Report
[41] Newton Fund priorities in Brazil (n.d.). Available at: https://www.newton-gcrf.org/impact/where-we-work/brazil/

	funding each year since 2014 and projects have led to partnerships with universities in the UK, US, Germany and the Netherlands.
Denmark's Innovation Fund	There are many bilateral partnerships between Brazil and other European countries, such as the Danish government's Innovation Fund on strategic research collaboration on food science with FAPESP. The Fund launched an application round in 2015 with a budget of £1 million for research in eight food science topics.
Science Without Borders	A Brazilian government-funded international scholarship programme, which the World Economic Forum recognised in 2015 as a leading example of a programme to boost student and researcher mobility in Latin America. The programme ended in 2016.
CAPES/ PrInt[42]	The successor programme to Science Without Borders, with an annual budget of £60 million. The project duration is four years, from November 2018.

The EU is an important partner for Brazil. An EU – Brazil Science and Technology Agreement has been in place since 2007 and was extended in 2017 for five more years – until 2022. Current priority areas for EU – Brazil cooperation include marine research, bioeconomy, health, sustainable agriculture, energy (particularly advanced biofuels), nanotechnology, information and communication technologies, and nuclear fusion (Euratom-Fusion[43]).

Through one of the largest EU initiatives **Horizon 2020**[44], Brazilian researchers, enterprises and institutions can team up with European partners to carry out joint research programmes.[45] Horizon 2020 was extended in May 2018 to cover the whole country, beyond the eight states covered initially.[46] This initiative also involves match funding. However, case study research found that Horizon 2020, unlike Newton, does not ask international partners for their contribution in design or thematic preference. Another important initiative of cooperation with the EU is the **EUREKA** intergovernmental network[47], which launched its first GlobalStars call in 2016, promoting collaboration between several European countries and Argentina and Chile. The GlobalStars Brazil call was launched in July 2018 and supports R&D collaboration between Brazilian businesses and research institutions and the governments of Germany, Austria, Spain, the Netherlands, Belgium and Switzerland. The Brazilian agencies involved are FINEP, FAPESP and EMBRAPII (the Agency for Industrial Research and Innovation).[48]

[42] EAESP (n.d). Available at; https://eaesp.fgv.br/en/capes-print
[43] ITER (2008). 'Brazil & Europe in fusion agreement'. Available at: https://www.iter.org/newsline/49/632
[44] Horizon 2020 has an emphasis on fostering scientific excellence, industrial leadership and tackling social challenges. European researchers can include partners from any other country.
[45] European Commission (2018). 'Brazil – country page'. Available at: https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020_localsupp_brazil_en.pdf
[46] European Commission (n.d)., Research and Innovation, 'Brazil'. Available at: http://ec.europa.eu/research/iscp/index.cfm?pg=brazil
[47] Government of the Netherlands (2018). ' The Netherlands and Brazil to intensify cooperation in innovation'. Available at: https://www.government.nl/latest/news/2018/08/20/the-netherlands-and-brazil-to-intensify-cooperation-in-innovation
[48] FAPESP (2018). 'Chamadas de Propostas' Available at: http://www.fapesp.br/11843

Several other national governments have established similar research partnerships with Brazil in areas that align with Newton Fund priorities. In 2015, **Denmark's Innovation Fund** launched a strategic research collaboration in food science with FAPESP. The overall budget is DKK ten million (approx. £1 million) with research calls for eight food science topics such as nutrigenomics' impact on human health and new sources of bioactive compounds.

FAPESP's ongoing **SPRINT initiative** aims to partner researchers in the state of São Paulo with researchers abroad. There have been four rounds of funding per year since 2014, and partnerships have so far been established with researchers from universities in the UK, US, Australia, Canada, Germany, France and the Netherlands. The projects are in several science fields and are expected to generate capacities that can leverage further research funding in the future. Projects that have received funding include research on the characterisation of Potyviruses infecting vegetable crops in Brazil and on building metabolomics capacity in livestock research.

Science Without Borders is a scholarship programme run by the Brazilian Government. In its first phase, with a budget of $1.36 billion (approximately £900 million), it successfully enrolled 101,000 Brazilian students on sandwich courses (from undergraduate to PhD level) on STEM and creative industries at the world's best universities. The programme received support from the UK Government, which aimed to take up to 10,000 Brazilian students for four years from 2012. **CAPES/ PrInt** is the successor programme to Science Without Borders, launched in 2018, to foster the internationalisation of academic programmes and financed by CAPES. The annual programme budget is £60 million.[49] The University of São Paulo and the University of Brasilia are its key partners.

[49] Times Higher Education World University Rankings (n.d.). 'New funding aims to reboot internationalisation in Brazil'.

3 Emerging results of the Newton Fund in Brazil

This section sets out the emerging results of the Newton Fund in Brazil. The findings are based on the three calls included as part of the case study as well as the broader consultations undertaken with the programme team (see Section 1.4 for details of the methodology).

3.1 Key findings

The Newton Fund in Brazil is a high-profile collaboration, characterised by a strong commitment from both the UK and Brazilian sides. It builds on a long history of partnership and is described as the UK's 'flagship programme' for science and innovation partnerships in Brazil. Newton has raised the profile of UK science widely across Brazil. It has established high-quality, in-depth research partnerships and started to deliver important science impacts in areas of high relevance to ODA priorities in Brazil and to global challenges.

There are signs of government buy-in at a high level: a recent example of a 'win' was the Science Minister's agreement to organise an online event to review the Memorandum of Understanding (MoU) between the Met Office and INPE (as further outlined in Section 4).

Newton was set up in Brazil at a favourable time characterised by high spending in S&I between 2014 and 2020, which allowed it to generate results, despite political challenges during this period. Brazil invested in FAPs in states that often had historically low S&I links. Many FAPs, particularly smaller ones, had the UK as their predominant international partner.

The Newton Fund programme in Brazil had a challenging inception period. The programme was initiated quickly, with partners 'learning by doing', before operating in a more structured way through large-scale collaboration. The effectiveness of collaboration improved over time as trust level built up.

The Newton Fund partnership in Brazil is egalitarian with shared ownership, joint priority identification and co-development of policy between partners. Earlier stages of the programme were typified by Brazil being mostly responsive to priority areas, and ideas coming from the UK. This changes to a situation where Newton's present design allows Brazilian partners to include context-specific content and priorities; and, that the UK Embassy is making a specific effort to support DPs to identify joint areas for priority setting and call development.

Newton's thematic areas are viewed as being high priority by both sides of the partnership. The level of engagement in designing, drafting and managing funding calls sets Newton apart from other UK and non-UK programmes. Newton brings diverse UK partners, allowing for the inclusion of broad thematic areas. Mutual trust has been established, which increases the likelihood of partnerships being sustained into the future.

Newton's diversity of partners aligns with Brazilian priorities to decentralise S&I investment away from centres of research excellence, particularly those in São Paulo State. The Newton Fund has given several FAPs in smaller, poorer and less internationally connected states the first opportunity to work internationally.

Efforts to support the internationalisation of FAPs have already brought important results in institutional capacity-building. In states where international collaboration was previously limited or non-existent, Newton has brought extensive lessons learned from UK best practice. For example, the north-eastern state of Tocantins began a new collaboration with Switzerland, following its first experience under Newton. Several FAPs and CONFAP have set up new teams to

manage international partnerships. An initiative between Brazilian states to launch joint calls emerged from the Newton Fund, allowing smaller FAPs to participate in international calls.

The Newton Fund is seen as having boosted UK partners' level of collaboration and encouraged strategies to become global institutions. Feedback from UK partners also suggests that Newton's unique delivery of ODA funding through non-traditional channels has led DPs to consider MEL systems to capture impact and apply new tools such as Theories of Change (ToCs) to inform their work.

The Newton Fund 'brand' in Brazil is seen as unique in the Brazilian landscape. Newton stands out in its unique ambition to deliver ODA through S&I, which is closely aligned with Brazilian partner institutions' priorities. The Newton Fund name has become synonymous with a strong engagement mechanism with the UK.

The Fund's match fund mechanism brings a sense of co-responsibility and shared ownership. Local partners particularly appreciate the match funding element, as it gives the programme a more balanced structure, with the two partners treated as equals. For some UK DPs, the partnership's strength and the ease of collaboration is leading them to regard Brazil as a partner of choice in Latin America.

3.2 Challenges and lessons learned

As would be expected for a programme of its size and scope, the Newton Fund has not been without challenges, and there is potential to learn lessons from its experience in Brazil. It is important to note that the programme has already learned from and responded to initial difficulties in setting up the Fund and its partnerships.

Research respondents highlighted that Newton is different from other funding available for S&I collaboration in that its funding levels are quite small, especially compared to other funds working on, for example, medical research. Short timeframes for collaborations can be challenging to align with the ambition to lead to practical change, particularly in areas requiring substantial and long-term testing, such as clinical trials. Despite its relatively small size, it was argued that Newton funding is particularly valuable in terms of bringing collaborators together for the first time, helping to build research partnerships that have the potential to leverage larger amounts of funding from other sources. Newton provided 'seed funding' or 'start-up capital', with a strong added value in knowledge transfer and networking building. However, it was more limited in terms of providing routes for follow-up funding.

Match funding continues to be a challenge. Meeting match funding requirements has proven difficult due to budget cuts, the economy and currency fluctuations. Some partnerships set up in the early days of the programme had a pound for pound requirement, which was eventually phased out and replaced by match effort. Moving from match funding to match effort has made collaboration with Brazil (and with other partner countries) much more feasible and, in this way, collaborations were largely able to progress despite funding challenges.

The Fund's structure has at times been unclear to local partners and continues to present some practical challenges. This complexity is partly due to the Fund's size and ambition. The diversity of the partners involved, while a strength in terms of quality and diversity of research produced, also adds management complexity. There are at least 26 Delivery Partner institutions within Brazil plus UK DPs and Newton's governance structure, this can result in Newton's perception as "*not the easiest beast to understand".*

Although there have been improvements and lessons learned in the management and running of the programme, there were teething problems. These included uncertainty on ODA finance requirements and different ways of working of Brazilian and UK partners. Typically, UK DPs cover costs on the UK side of the partnership. In cases where they also finance the Brazilian side, there were practical challenges among Brazilian partners in receiving those funds. On occasion this led to project delays.

There remain challenges around ensuring links fostered by Newton become long-term partnerships. In Brazil, as across Latin America, the UK has not historically been the partner of choice in S&I, and researchers may naturally continue to gravitate towards the US. Although Newton has strengthened with the UK, it will take time to achieve its ambitious goals – longer than a seven-year programme. Owing to Newton's promising results so far, there is a strong appetite for continued engagement among Brazilian partners. This will require fresh effort and funding. In future, Newton could do more in terms of clearly communicating its vision for the S&I partnership between the UK and Brazil – including any availability for further funding.

4 Project: Work Package 3 (WP3) – Impacts and Disaster Risk Reduction

Summary

Project title	Work Package 3 (WP3) – Impacts and Disaster Risk Reduction
Call title	Climate Science for Service Partnership (CSSP) Brazil
Short description	Work under WP3 contributes to the aims of the CSSP Brazil programme by developing new knowledge and research findings. It furthers the modelling of processes related to key impacts of climate change, specifically related to the water cycle, water stress and crop yields, and by implementing new techniques to refine projections of impacts using existing models. It is expected that WP3 activities will lead to research outputs in the form of scientific papers, and will provide opportunities for applying outcomes from Brazilian research through the use of in-country observations to test models. The project aims to provide new and improved services by developing tools to assess risks and impacts of climate change and natural disasters.
Objective(s)	WP3 aims to produce knowledge on the impacts of climate variability and climate change in Brazil to improve capability in disaster risk reduction through a better understanding of weather and climate risks. It aims to increase the number and quality of peer-reviewed publications on climate change impacts and disaster, enhance Brazilian partners' profile in international research, and support the application of new scientific findings to disaster risk reduction and response. WP3 contributes to the overall aims and objectives of CSSP Brazil. CSSP Brazil is a highly inter-connected project, with work cutting across its three WPs. WPs 1 and 3 both rely on land-surface modelling, and so draw on, and benefit from, each other. WP1 has provided improved hydrology modelling and understanding, which can benefit hydrological impact assessment, including river flow

	and crop modelling in WP3. In return, the soil-moisture stress improvements from WP3 benefit vegetation modelling in WP1.
Pillar	Research
Action value (total budget allocated in country, in GBP)	UK: GBP 2,225,498 (estimate for WP3 of GBP 6,991,544 CSSP total) BR: GBP 1,886,755.69 (estimate for WP3)
Start/end date (Status: on-going or complete)	2016 – ongoing
DP UK and overseas	Met Office; Ministry of Science, Technology and Innovation (MCTI)
Award holders/grantees	UK: University of Leeds; UK Centre for Ecology and Hydrology; University of Oxford; University of Exeter; University of Reading; University of Edinburgh BR: CEMADEN, INPE, INPA

Description of the project

CSSP Brazil is part of a developing global network of Weather and Climate Science for Services Partnerships (WCSSP) between the Met Office and various partner country agencies working on weather and climate science. These partnerships aim to harness international scientific expertise to strengthen vulnerable communities' resilience to weather and climate variability.

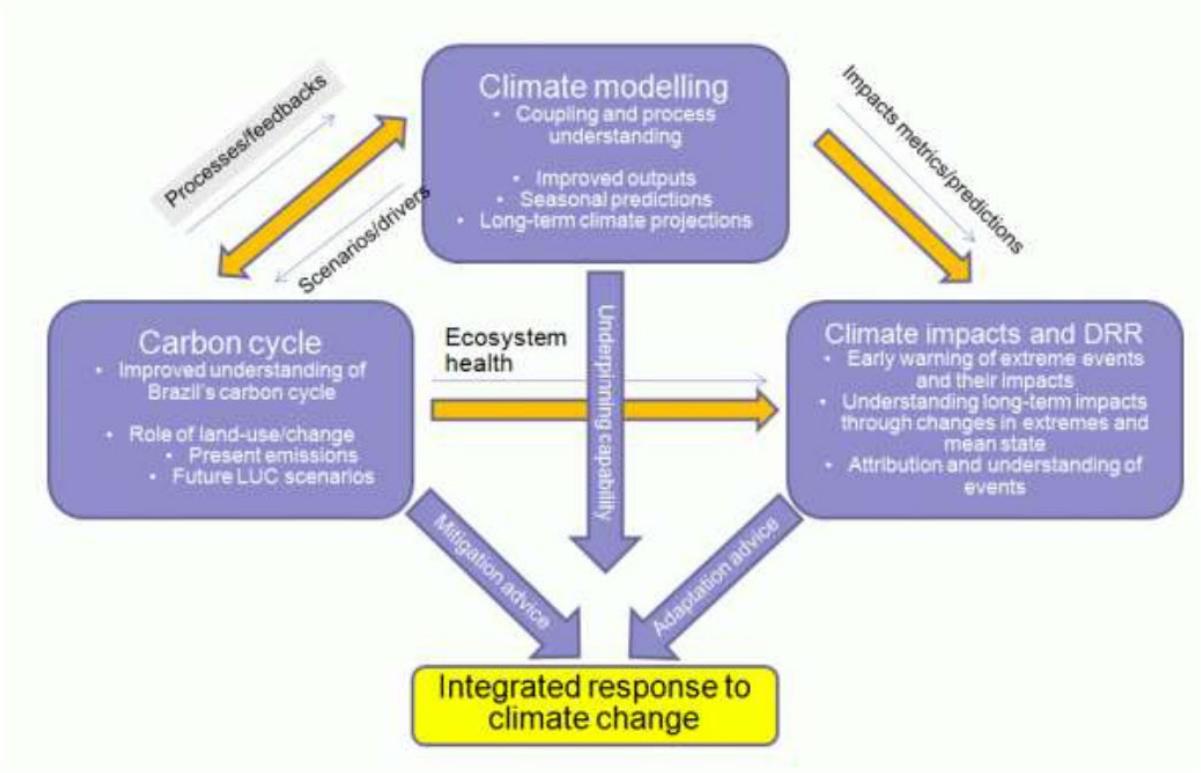
In Brazil, CSSP is a scientific research programme led by the Met Office and the Brazilian National Institute for Space Research (INPE), the National Institute for Amazon Research (INPA) and the National Centre for Monitoring and Early Warning of Natural Disasters (CEMADEN). The different Brazilian partners bring distinct but complementary areas of expertise. INPE's goal is to produce knowledge in science and technology in space and terrestrial environments by offering unique products and services. INPE specialises in developing satellites and space technologies and hopes to expand its competencies in weather, climate forecasting, and global environmental changes.[50] INPA focuses on carrying out scientific studies of the physical environment and living conditions in the Amazon region to promote regional socio-economic development and human welfare.[51] CEMADEN's work centres around monitoring natural threats in risk areas in Brazilian municipalities vulnerable to natural disasters and providing research and technological

[50] Additional information available from INPE (2021). 'Missão, Visão e Valores'. Available at: http://www.inpe.br/institucional/sobre_inpe/missao.php
[51] Additional information available from gov.br (n.d.). 'Sobre o INPA'. Available at: http://portal.inpa.gov.br/index.php/institucional

innovations to improve early warning systems and ultimately reduce the number of fatalities and material damage across the country due to weather events.[52]

The CSSP programme aims to produce research which can be used by decision-makers to better understand climate issues and inform policy and responses to these risks. As further outlined in the sections below, CSSP Brazil builds a strong UK-Brazil bilateral partnership and strengthens long-standing individual collaborations. By focusing on research and innovation in climate science, the partnership aims to support the publication of cutting-edge science that can form a basis upon which to build or strengthen climate services. This aims to support social welfare and climate-resilient economic development in Brazil while enabling UK researchers to develop strong and sustainable relationships with Brazilian partners.[53]

Figure 5: CSSP Work Packages. Source: CSSP Brazil 2019-20 Summary Report



As shown in Figure 5, CSSP Brazil comprises three interlinked Work Packages. **Work Package 1** aims to improve the understanding of Brazil's ecosystems, focusing on their carbon cycle – helping to understand the country's role in the global carbon budget to support reporting of global greenhouse gas emissions. This looks at the effects of land-use in present and future emissions.

Work Package 2 focuses on climate modelling to understand present climate processes and potential future scenarios, focusing on rainfall (using seasonal and sub-seasonal timescales).

Work Package 3 focuses on climate impacts and disaster risk reduction and aims to improve understanding of present extreme events and how their likelihood might change in the future. The Work Package focuses on how hydrological extremes (floods and droughts) affect river flow, agricultural production and wildfires. This includes the testing and refining of the Met Office's

[52] Additional information available from Cemaden (2016). 'Missão'. Available at: http://www.cemaden.gov.br/missao-do-cemaden/
[53] Met Office (2019) CSSP Brazil Work Package Summary Report – for Science Review Panel Meeting (3-5 July 2019).

JULES model, which simulates the impacts of climate change on crops, irrigation, river flows, wildfires and land use. Together, the three work packages aim to help inform mitigation policy (by quantifying carbon and greenhouse gas budgets) and adaptation policy (by better understanding risks of extremes and impacts, and how these might change in a future climate).

The CSSP programme has two strands. The first consists of research and capacity building led by an internal Met Office team. The second is a succession of two-year research grants awarded to collaborations between UK academic institutions and the three Brazilian partner institutions. Academic partners in the UK include the University of Leeds, the Centre for Ecology and Hydrology, the University of Oxford, the University of Reading, the University of Exeter, and the University of Edinburgh. This case study focuses on the work carried out by the internal Met Office team and research carried out by the University of Oxford and the University of Leeds.[54]

Pathway to impact

As shown in Annex 4, Figure 6, this collaboration fits well into the Theory of Change for Newton Fund Research and People Pillar activities. As shown in the figure, the partnership consists of:

- **Activities**: CSSP Brazil WP3 aims to enhance UK-Brazil science partnerships at the institutional and individual level, through collaborations between UK and Brazilian institutions working in complementary research areas. The supported activities include joint workshops and visits, joint data collection activities in-country, research exchanges and mobility grants for early career researchers (ECRs), and joint production of papers and research dissemination activities.
- **Expected Outputs**: The collaboration aims to result in research publications and research findings that can help understand the likely effect of climate variability and extreme weather events in Brazil, and the country's role in mitigation activities and setting carbon budgets to inform international negotiations. It is expected that the partnership will lead to improved capacities in climate modelling in Brazil, through improvements and adaptations to the local context in the JULES model. This can be applied to simulate key processes relating to climate change impacts and adaptation (including in the study of river flows, wildfires and irrigation), to be shared and disseminated among Brazilian partner agencies working in disaster risk reduction (DRR).
- **Expected Outcomes:** Scientific findings and improved capacity are expected to result in improved land surface modelling and more precise climate projections of future extreme weather and its likely impact, in timescales that go from the seasonal to the centennial.

[54] External awardees for CSSP Brazil include:
1. University of Leeds: Developing impacts modelling capability and understanding – agricultural crop modelling and application, GBP 332,761, Dr Marcelo Galdos (ongoing 2019-2021)
2. Centre for Ecology and Hydrology (Lancaster): Developing impacts modelling capability and understanding hydrological modelling, GBP 225,440, Dr. Doug Clark (ongoing 2019-2021)
3. University of Oxford: Current extremes: attribution and unprecedented events, GBP 199,780.6, Dr. Sarah Sparrow (ongoing 2019-2021)
4. University of Exeter: Ecosystem response to extremes, GBP 260,000, Dr Lucy Rowland (ongoing: 2019-2021)
5. University of Reading: Seasonal forecasting of Manaus river maximum, GBP 149,984, Dr Nicholas Klingaman (ongoing: 2020-2021)
6. University of Exeter: Meteorological driving data for offline land surface and impacts simulations, GBP 180,000, Prof Stephen Sitch and Prof Pierre Friedlingstein (completed: 2018-2020)
7. University of Edinburgh, University of Reading: Attribution of impacts and extremes for disaster risk reduction, GBP 201,169, Prof Simon Tett (completed: 2017-2019)

- **Expected Impact**: In the longer-term, the project aims to lead to better-informed decision-making, thus contributing to improved DRR in Brazil and mitigating the effects of climate change on a global scale.

4.1 Emerging project results

Relevance of Newton Fund activities

ODA relevance

CSSP has clear relevance to ODA goals. It directly contributes to achieving the Sustainable Development Goals (SDGs), particularly SDG 13 and 17.[55] WP1 aims to improve Brazil's understanding of its ecosystems, particularly their carbon balance. WP2 focuses on climate modelling to understand present and future emissions. WP3 focuses on climate impacts and disaster risk reduction. **All these objectives align with SDG 13 targets.** These include improving human and institutional capacity on climate change mitigation, adaptation, impact reduction, early warning systems, and integrating climate change measures into national policies. They also align with SDG 17 targets such as promoting the development and dissemination of environmentally sound technologies and enhancing global partnerships for sustainable development, including multi-stakeholder partnerships that share knowledge, technology and expertise.[56] CSSP directly contributes to Newton Priority seven in Brazil: climate change. It also indirectly feeds into Priority two on sustainable agriculture and Priority five on biodiversity and ecosystem.

Relevance of the collaboration to Brazil's priorities

The research collaboration is highly relevant to the challenges faced in Brazil. Data published by INPE shows that Brazil's Cerrado region, a vast tropical savannah, is now experiencing even more fires than the Amazon region. In the first ten days of September 2019, 8,012 fires were reported in the Cerrado region. Across Brazil, there have been approximately 45% more wildfires in 2019 than in the previous year. [57] In addition, river flooding in the Amazon has also increased due to changing weather patterns and warmer temperatures over the Atlantic Ocean and cooler temperatures over the Pacific. This effect influences tropical weather patterns and can be due to shifts in wind belts caused by global warming. Flooding can impact the health and incomes of people living near rivers and disrupt cattle ranching and agriculture.[58]

Agricultural productivity plays a major role in Brazil's national economy. The agricultural industry is highly dependent on climatic variables such as temperature and rainfall. Rising temperatures caused by climate change are expected to bring evapotranspiration[59] levels up, leading to decreased soil moisture. Climate variability, therefore, can lead to increased levels of drought and floods, in both arid and humid regions, ultimately affecting agricultural yields. In addition, varying regional climate types across Brazil bring different challenges to agriculture. For example, yields for crops in tropical climates are projected to decline more due to warming

[55] SDG 13 is based on taking urgent action to combat climate change and its impacts, while SDG 17 focuses on strengthening the means of implementation and revitalising the global partnership for sustainable development.
[56] United Nations. (2020). 'The 17 Goals'.
[57] The Associated Press. (2019). 'Fires more numerous in Brazil's Cerrado region than Amazon'. The Seattle Times. Available at: https://www.seattletimes.com/nation-world/nation/fires-still-erupting-in-brazils-amazon-and-cerrado-regions/#:~:text=The%20government's%20monitoring%20agency%20reported,first%2010%20days%20of%20September.&text=In%20recent%20weeks%2C%20fires%20across,2010%2C%20stirring%20an%20international%20outcry
[58] Hares, S. (2018). ''Catastrophic' floods rising on Amazon River, say scientists'. Reuters. Available at: https://www.reuters.com/article/us-brazil-environment-floods/catastrophic-floods-rising-on-amazon-river-say-scientists-idUSKCN1LZ2IV
[59] the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants (Oxford Dictionary).

temperatures. As climate change can significantly impact food security and agricultural production, it is important to understand its effect on specific crops and geographic areas to introduce more sustainable farming practices. [60]

Relevance to Brazilian priorities was ensured by running workshops to identify shared priority areas. Brazilian states and municipalities are developing interventions to mitigate climate change impacts. Regional networks, such as Local Governments for Sustainability (ICLEI), and global coalitions of voluntary commitments, such as the Global Compact of Mayors for Climate and Energy, as well as the Brazilian Conference on Climate Change, all aid in supporting the role of local governments in climate change mitigation (CDKN, 2019).[61] In this context, research undertaken in this project can help feed into evidence-based policy and mitigation strategies.

Origins and quality of the collaboration

The idea for the Brazil CSSP collaboration came from the UK and built on the Met Office's similar work in other countries. Following on its promising work on CSSP China, the Met Office looked to apply lessons learned and expand to other countries that were seen as a potential good fit and interested in working in this area.

In Brazil, the CSSP collaboration builds on previous collaboration and contacts between the Met Office and the three Brazilian institutions involved. CEMADEN, INPE and INPA were deemed by the Met Office to be a good fit. Brazil was seen as an environment where research findings could be taken up by relevant institutions and applied to their work.

Although all three partners in Brazil had long-standing collaborations with academic research partners in the UK and with the Met Office, CSSP is the first collaboration of size and scope between the two countries. The UK has a long history of research programmes and initiatives that focus on measuring meteorology in the Amazon. The three Brazilian institutions also have prior experience working together and some important areas of overlap and complementarity, including climate issues applied to the specific challenges and opportunities in the Amazon region. The CSSP partnership was an important opportunity to expand joint research in areas not explored in previous collaboration, such as applying the UK's JULES model to Brazil Atmospheric Model (BAM).[62]

To design the call and its specific research windows, CSSP held workshops to identify topic areas and potential avenues for research. The workshops reportedly included discussions on the research areas themselves, as well as possible dissemination activities. While defining the focus area joint, the evaluation and selection process was carried out solely by the Met Office. Results from the panel assessments were then discussed with Brazilian partners.

The CSSP partnership became more balanced over time, and more reflective of the areas of focus deemed important by partners. While workshops and meetings between partners were organised at the outset of the collaboration, the joint areas identified were not always reflected in the specific calls. At the outset of the collaboration, there was some misalignment of preferences between partners over the timescale of weather events to be studied.

[60] Follador et al. (2016). Potential impacts of climate change on Brazilian agriculture and economy. Available at: https://www.researchgate.net/publication/312086404_Potential_impacts_of_climate_change_on_Brazilian_agriculture_and_economy

[61] Climate and Development Knowledge Network (n.d.). Available at: https://cdkn.org/regions/brazil/?loclang=en_gb

[62] The Brazilian Global Atmospheric Model (BAM) is the Centre for Weather Forecasting and Climate Research's new global atmospheric model. It includes a new dynamical core and state-of the-art parameterisation schemes in the hopes of developing a seamless framework for weather and climate prediction (Figueroa, et al., 2016).

The design and focus of calls became more collaborative over time, with ideas proposed by partners on both the UK and Brazil side; and, increasingly 'bottom-up' with the specific Brazilian partner institutions (rather than MCTI) able to propose areas for research. A decision to work on shorter weather timescales made the collaboration more immediately relevant to practitioners and politically more feasible to focus on. The programme's initial design has meant that, although a lot of research and climate data has been generated, it has not yet led to strong observable results among the community of practice or among communities affected by changing weather patterns.

The high quality of the UK-Brazil partnership was a key strength of CSSP Brazil. Both sides of the collaboration viewed CSSP as the beginning of a much longer-term partnership. The programme has created and strengthened connections that they hope to continue to grow for the rest of their career. CSSP also helped increase joint work between institutions in Brazil which do not typically collaborate, and there appears to be further scope to increase this.

All partners on both sides brought specific and high-value expertise in particular areas of focus. It helped ensure that the programme produced research relevant to policymakers and had the potential to lead to on the ground change. Brazilian partners were appreciated for bringing an understanding of the demands of service providers, as well as strong technical expertise.

Previous UK-Brazil collaborations in this field focused on the science, while CSSP aimed to link science to services. CSSP is the first collaboration between the Met Office and the participating Brazilian partners which has clear translation objectives and fits into science plans, guided by a signed MoU. Compared to other ODA initiatives, CSSP was seen as much more egalitarian and described as a two-way partnership – although both the UK and Brazil recognised that most of the funding and research ideas continue to come from the UK. Newton's match effort model helped make CSSP a partnership defined by joint ownership and joint responsibility.

Additionality

The collaboration in its current form would not have been possible without the Newton Fund. CSSP helps build networks and strengthen relationships in a way that smaller, shorter-term projects cannot. A combination of the Met Office's work and commissioned work from UK academic partners makes CSSP diverse and multi-disciplinary. Although the different institutions could probably carry out similar research on an individual basis, or with the partners they already worked with, this would have brought a more restricted programme with lower quality scientific findings.

According to Brazilian partners, CSSP is different from other collaborations in this field, in that it brings together a wider community of practice, and it focuses specifically on Brazilian priorities. Joint design of calls increased the engagement of both sides of the partnership, ultimately leading to a strong collaboration and promising scientific findings. The support of ICTs was cited as a catalyst to collaboration and forming connections between partners.

4.2 Effectiveness of Newton Fund activities

Research outputs

Through a series of short, rolling projects, the collaboration has resulted in several important research outputs. One of the CSSP programme's main objectives was to strengthen research collaborations between participating institutions and produce high-quality and potentially high-

impact science. Progress reported so far from both sides of the partnership highlight that this has already been the case, and that the planned scientific results have largely been delivered. CSSP programmes have resulted in over 50 published journal papers with 20 more expected to be published before the end of the programme.[63]

Capacity building for individuals

Through the partnership with the UK, Brazilian partners could obtain funding for researchers at different stages of their career, including young researchers, to develop their capacities in climate sciences. This was achieved through workshops, specialised training, and exchanges in UK institutions. The focus on capacity building increased over time, including access to technical modelling and extreme weather attribution methods. Participants suggested a greater focus on international mobility could have been introduced through exchanges and fellowships.

Capacity building for institutions

The CSSP collaboration led to the sharing of models and practices which could be applied to Brazilian institutions' work. For example, the HadGEM3 atmosphere model, developed for the EU-funded project HELIX (High-End Climate Impacts and Extremes) programme, was provided to INPE to support its work inputting into Brazil's next national communication to the United Nations Framework Convention on Climate Change (UNFCCC). The model helped INPE carry out projections for different levels of global warming on extreme weather, river flooding, drought and human heat stress.

For CEMADEN, which was only founded in 2011, CSSP reportedly helped build institutional capacity, with the organisation developing and growing in parallel to the programme. **CSSP raised the profile of CEMADEN's work through its association with an international partner of the calibre and reputation of the Met Office**.

Partners on both sides of the collaboration described the relationship as still slightly unbalanced – for example a perception that the Brazilian partners' role was to provide data for input to UK partner models. This means that the project resulted in less institutional capacity building than it potentially could have if the collaboration had been structured in a way which favoured knowledge transfer in these specific technical areas. This was mostly due to match funding issues on the Brazilian side of the partnership, and the inability to finance a team which could focus on modelling. Potential future phases of the programme could consider strategies to further support knowledge transfer in specialised technical areas.

Translating research into improved service delivery

CSSP aims to support the translation of climate science into improved services. The programme's three components were designed to feed into each other, resulting in improved practice on the ground. Our research indicates that translation into improved services has not yet been achieved. This could be partly due to design issues with research timescales and limited engagement with stakeholders who could take up research tools and findings in their work – although this has improved over time.

[63] Though impossible to list out all publications in this report, WP3 has resulted in some publications highlighted as particularly high-profile, such as one paper titled: 'Attribution of detected temperature trends in Southeast Brazil' in Geophysical Research Letters' by De Abreu (at al.). The team has also submitted two more papers that are awaiting publication: Abatan et al. (upcoming) 'Mechanisms of meteorological drought over the state of São Paulo, Brazil' in *Atmospheric Research*; and Franke et al. (upcoming) 'The GGCMI Phase II experiment: global gridded crop model simulations under uniform changes in carbon dioxide, temperature, water, and nitrogen levels' in *Geoscientific Model Development*.

Case study research identified two main reasons why research has (not yet) translated into improved practice. First, there were limited capacities to absorb the knowledge generated by the programme. For findings to be fully absorbed and translated into improved practice, Brazilian partner institutions would need similar modelling capabilities to the UK partners. For this to occur, **further investment in capacity building and infrastructure development is needed.** Establishing modelling capabilities within Brazilian partner institutions would help ensure that forecasting services are operational and long-lasting.

Second, there are important challenges in communicating scientific findings to policymakers and stakeholders working in DRR and the general public. The collaboration has not, to date, included systematic efforts to communicate findings in a simple and easily accessible way. For this to occur, **an explicit engagement strategy with key stakeholders and potential users of these tools could be devised.**

Positive examples and potential areas for further exploration

Despite overall challenges in translating science into services, some examples were highlighted as best practice due to their strong link to reality and potential for on the ground change.

For example, WP3 has been producing research on **extreme drought** in Brazil and investigating how the models developed through CSSP Brazil could be applied to predict future events. CSSP supported joint research that explores the potential impact of the fire season and produced a report which highlighted regions at particular risk. This research began in April 2020, supported by the MCIT. Due to its high relevance and collaboration with the Brazilian Ministry, it is seen as holding the potential to **increase rapid response ability.** Similarly, INPA carries out a **yearly forecast of the peak river height in the Amazon region** and is leveraging the CSSP collaboration to work with the UK research community to assess how they can improve the scientific research behind these services and improve forecasting on the ground.

Despite these promising examples, overall, the collaboration has not yet resulted in the mainstreaming of research findings into improved practice. For this to take place, it was argued that **CSSP would need to include technical and operational teams, such as IT and modelling implementation teams, rather than focus solely on working with scientists.** Investments in infrastructure, such as supercomputers, would also be needed at the institutional level to take-up scientific findings.

Potential improvements in future phases

Although all partners agree that more needs to be done to increase climate prediction capability, the collaboration does have the potential to lead to improved services, with additional efforts in the short-run and changes in its structure in potential future phases. It was agreed that partners could focus on convincing managers to start using developed model for sub-seasonal predictions in the short term**.**

To translate climate science into services, future collaboration should be more multidisciplinary, for example by including researchers from the economic and social sciences for their insights and experience in communicating findings to stakeholders at the state and municipality level. There is scope to link modelling science to the health or agriculture fields, thus making research findings more immediately policy relevant. Similarly, issues related to flooding and rainfall could be linked to work carried out in the hydrology field, rather than focusing on pure meteorology.

Benefits for the UK

Both sides of the collaboration agreed that working with Brazilian partners through CSSP brings benefits to the UK science landscape and climate researchers. Benefits to the UK were observed through several channels.

Each institution brings a specialised, but complementary, area of focus, which UK partners saw as highly valuable. For example, Brazilian partner institutions and the scientists working therein brought highly specialised expertise in hydrology and Amazonian studies. UK partners have much to learn from applying Brazilian partners' models to their work. **Investing in setting up strong partnerships with local organisations helped increase sustainability and applicability of the research**, resulting in potentially greater impact in the long-run (although this will require buy-in from local decision-makers).

Collaborating with Brazil provides crucial data to improve UK partners' climate models. For example, the collaboration between Brazilian partners and the University of Leeds has improved the JULES model, which is used by the Met Office for land surface modelling. Fresh data, models and research findings resulting from this partnership benefit the UK by producing relevant, high-quality science that help address the SDGs. This is especially the case when working on climate change issues, which do not affect just Brazil or the UK but are a global challenge.

The UK will host the 26th UN Climate Change Convention of the Parties (COP26). **CSSP Brazil is an opportunity for the UK to increase its influence and credibility in an area of high relevance to the UK government.**

Additional benefits

The COVID-19 pandemic made international travel impossible and affecting the UK and Brazil severely, resulting in research teams devising different ways of carrying out research and continuing the collaboration. This has had unexpected benefits on local communities: due to the inability to travel internationally, the project trained communities in the Amazon region to collect data for the project, leading to capacity building at the local level that the project did not initially foresee.

Challenges in the collaboration

- With its high number of partners, diverse regions of focus, and diversity of thematic areas, it took some time to define and understand each partner's specific role in the research. This led to some initial delays and setting up the call was characterised by extensive 'learning by doing'.
- There was some delay in reaching a common understanding around priorities for take-up and application of research findings, particularly in areas which were not core to some of the partners. Over time, there was more focus on the shorter-time horizon utilised by Brazilian partners to plan for short-term disaster risk reduction.
- The project was affected by a vulnerability in funding on the Brazil side. These challenges were partly overcome by switching to a match effort model. This allowed the project to advance but resulted in more UK than Brazilian scientists working on the programme, which negatively affected the perception of shared ownership of the project.
- There were some initial issues related to the partnership's management. This included challenges due to turnover within partner organisations, which sometimes slowed down the signing of collaboration agreements.

- An additional challenge was posed by data sharing, particularly in terms of UK institutions providing access to climate data for Brazilian partners to run their models.
- The timing and length of the collaborations were also seen as posing a challenge. Research grants are of two years in duration, but three would have been preferred.
- The project faced some challenges around disseminating and communicating its findings. These have limited the ability to translate findings into improved services.

4.3 Emerging signs of impact

Potential impact on poverty reduction and economic development

CSSP has resulted in high-quality science and strong research collaborations.

The programme is generating practical research and evidence. For example, the link with EU-funded Project Helix has generated climate data which has already contributed to national climate communication in Brazil. Another example is the Manaus river level forecasting collaboration between CEMADEN, INPE, INPA and the University of Reading which used climate indices and statistical analyses to develop a model for improved flood risk forecasting.

INPA and its UK partners have been working with the state government in Amazonas to improve forest management of floodplains. Some results from this research have already been included in local polices. Working with local government in this way was described as a "***rare opportunity for scientists to have an impact on public policy***".

The continued gap between scientific results and the intended audience, which requires a greater focus on the communication of scientific findings, poses the second challenge. While partner institutions have the organisational mandate to issue weather warnings, there are challenges related to climate literacy and communication of scientific findings in impactful and easy to understand ways. The science of early warning systems could consider these 'softer' aspects further in future partnerships.

The UK Embassy team has an influential role in creating a bridge between research institutions and the relevant Ministries. Broader communication efforts and targeted engagements with key decision-makers will assist in bringing the science generated through CSSP to mitigate the impact of severe weather events and climate change and help inform climate-sensitive policies.

There are research outputs which are relevant regionally, beyond Brazil. A fire forecasting tool was shared widely with stakeholders in Brazil and other countries in the region, including Bolivia, Colombia, Peru and Venezuela.

Signs of sustainability

Sustainability is at the core of CSSP Brazil. Partners describe the creation of the network and the strengthening of partnerships as the most important achievement of CSSP Brazil. **Partners view it as a first step in a much longer collaboration lasting beyond the five years.** The first programme was seen as essential to bring partners together, define complementarity and joint working areas, and identify areas for exploration in a second phase. There is strong interest among all parties in continuing to collaborate, and partners are working under the assumption that CSSP Brazil will have further phases and additional funding. There has already been agreement

between MCTI and the Met Office to continue working together, including a high-level commitment from the Minister of Science in recognition of the importance of this programme.[64]

Research teams have identified several areas they would be interested in exploring further with Brazilian partners. These include fire risk and wildfires; hydropower generation and river catchment areas; flood risks and rainfall, and multidisciplinary collaborations such as impact of weather changes on disease outbreaks like dengue, and the link between air quality and health.

There are reports that CSSP has already unlocked some more funding for Brazilian partners. One CSSP-funded project, a collaboration between the University of Leeds and CEMADEN, has received a mobility grant from a Brazilian funding agency, Brazilian Agricultural Research Corporation (EMBRAPA)[65], to continue its work developing a Brazilian model for tropical agricultural and livestock production. It is possible that, as research findings continue to be disseminated, further interest could be generated among other Brazilian funders.

There is a recognition on both sides of the partnership that research should focus on outreach and applicability to users, for example, there is an interest in investing in producing easy-to-understand bulletins and newsletters. Such dissemination activities could help raise the profile of research partners and help obtain funding from other sources.

Complementarity and coordination

There is evidence of high-level engagement in continuing the partnership, although the collaboration has not yet resulted in observable catalytic or leadership effects among other organisations working in this space. **The signing ceremony on the 10th of October 2020 for the continuation of the programme was designed to be a public event, responding to the preferences of MCTI.** The event's public nature is a clear signal of the high profile of the CSSP partnership and the high levels of commitment to continue the collaboration.

4.4 Conclusions

- CSSP faced some initial challenges in its design and launch phase but is **an ambitious collaboration bringing together a wide range of institutions in Brazil and the UK**, working in different regions, and with different capacity levels and areas of expertise. These challenges included identifying and prioritising research areas relevant to each institution, as well as to policymakers and DRR agencies. Securing match funding was a challenge, particularly given the shrinking funding available for climate research in Brazil. Despite this, the collaboration strengthened over time and has achieved important scientific results. The research has the potential to feed into policymaking and DRR efforts. Additional efforts will be needed to ensure that scientific findings are communicated to the right audience so that on the ground change can occur.
- **Newton was seen as being more flexible than funding alternatives, in terms of what it was possible to finance and the mechanisms to do so, making it more responsive and contextually appropriate.** The flexibility of the funding on the UK side was appreciated, particularly in light of match funding constraints. Activities such as workshops and mobility exchanges (partly financed by the UK) improved researchers' capacities, increased their

[64] Further information can be found at gov.br (2020). 'Brasil e Reino Unido renovam acordo para pesquisas sobre clima'.Available at: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/noticias/2020/10/acordo-entre-brasil-e-reino-unido-vai-compartilhar-dados-climaticos

[65] EMBRAPA is a state-owned research corporation affiliated with the Brazilian Ministry of Agriculture.

international profile, and offered access to new networks and opportunities and made high-quality scientific results possible by financing the work of those working on them full-time.

- Despite the strength of the partnerships and the science generated, **more could be done to ensure the translation of scientific results into improved services.** Although important progress has been made, and there are positive signs of local-level change, there remain challenges around interest in and capacity for take-up of scientific results. There is scope for further co-production of knowledge and the involvement of scientists and decision makers and providers of climate services in the design and development of research collaborations. This would help to ensure buy-in, and applicability of the science and tools generated.

Lessons learned and points to consider going forward

- **The matched effort model has been a strength as well as a drawback.** Match effort dynamics were compared positively to the largely one-sided commitments usually seen in international development collaborations. However, they also meant that Brazilian partners had much less funding available, for instance, to support young researchers and to dedicate resources to focus on the project. This somewhat hindered the capacity building and knowledge transfer potential of this collaboration.

- The collaboration has been able to produce highly relevant research, despite changes in context. This was made possible by a strong focus on producing high-quality science. Focusing on short-run dynamics has supported CSSP Brazil to successfully continue working in an area which has seen shrinking government support. The mediating and coordinating role of the ICT and the British Embassy was particularly important in gaining buy-in with Brazilian institutions. **There is scope for the UK Embassy to continue engaging with Brazilian ministries to bring research teams and policymakers together to disseminate scientific findings.**

- The switch from match funding to match effort, and the flexibility of Newton that has allowed this to take place, has meant that the project was able to proceed despite a shrinking budget, and produce important scientific results. **Future programmes could extend their flexibility around what may be covered by UK funding, taking full account of each partner's ability to provide finance, and better responding to ODA priorities**. For example, investing further funds in training younger researchers in the development and use of the models produced by this programme would help increase the sustainability and potential long-term impact of this type of collaboration among participating institutions.

- To have a greater focus on translating science into services**, the programme could further engage with government to ensure that the gap between research and practice can be bridged**. Engaging with local governments and those working directly on DRR could be a pragmatic way to increase relevance and application of research findings. Being more inclusive and responsive to policymakers' demands could make any future phases of the programme, or similar collaborations, more bottom-up, and more likely to improve practice and policies. Similarly, working with more multidisciplinary groups, including social scientists, could help make climate science more quantifiable in a way that policymakers and the general public would immediately understand.

- As climate change is a global problem, and many of the implementation challenges are similar in other contexts, **there is further scope for cross-country lesson learning.** The programme could consider how to involve other countries in the region that face similar challenges (such as other Amazonian countries) and foster cross-regional learning with CSSP programmes in Asia and Africa. Some of the areas on which WCSSP is working in south-east Asia could be of particular relevance to Brazilian partners, for example, the work carried out on Impact-Based

Forecasting (IBF) capacity building and application.[66] This would fit well with the sub-seasonal timescale which Brazilian partners mostly work on, and could help increase direct relevance and short-term impact of the collaboration.

[66] Please note that the WCSSP Southeast Asia collaboration, and specifically Work Package 3, which focuses on capacity building on IBF, was included as part of Tetra Tech's Final Evaluation Case Study on the Philippines (October 2020).

5 Project: (Re)connect the Nexus

Summary

Project title	(Re)Connect the Nexus: Young Brazilians' experiences of and learning about food-water-energy
Call title	Joint Research Call - Social Science of the Nexus and Healthy Cities
Short description	This project sought to examine young people's (aged ten to 24) understanding, experience and participation in the food-water-energy nexus in the metropolitan region of Paraiba do Sul river basin (São Paulo State). The project also sought to understand how different education curricula – particularly Education for Sustainability (EfS) – can address inequalities, social tensions and social mobility shaping young people's understanding and access to nexus resources.
Objective(s)	The project had several inter-linked objectives: i) to carry out a large-scale baseline survey of young people's understandings, experiences and participation in the 'food-water-energy' nexus in Brazil. ii) to examine material, embodied connections between people and the nexus through qualitative research with diverse groups of young people. iii) to critically evaluate the landscape of formal, informal and alternative education through the lens of the food-water-energy nexus. iv) to situate the Brazilian context within a critical evaluation of education for sustainability at the global level. v) to develop a set of evidence-based resources for diverse educational settings to help address issues related to the food-water-energy nexus in Brazil.
Pillar	Research

Action value (total budget allocated in country, in GBP)	UK: GBP 299,617 BR: BRL 620,527.33 (GBP 90,929.7)
Start/end date (Status: on-going or complete)	September 2016 – September 2018 (complete)
DP UK and overseas	UK Economic and Social Research Council (ESRC), Brazilian National Council for the State Funding Agencies (CONFAP), the São Paulo Research Foundation (FAPESP).
Award holders/ grantees	Prof Jose Antonio Perrella Balestrieri (São Paulo State University), Prof Peter Kraftl (University of Birmingham). The research group also includes the University of Leicester and the University of Northampton.

Description of the project

This project consists of a joint research programme investigating the relationship between young people (defined as ten to 24 years old) and the food-water-energy nexus in the metropolitan region of the Paraiba do Sul river basin (São Paulo State). The research entailed quantitative and qualitative data collection and analysis. It sought to generate insights applicable in the Education for Sustainability (EfS) field. The project was part of the ESRC – CONFAP Social Science of Nexus call, which sought to foster research connections across food, energy, water and the environment.

With its highly **multidisciplinary approach**, (Re)Connect the Nexus brought together engineers from São Paulo State University (UNESP) and geographers from the University of Birmingham. The research also involved professors from the University of Northampton and the University of Leicester, who participated in different aspects of the data collection and analysis process – namely, stakeholder interviews for the former, and quantitative and qualitative data collection with young people for the latter.

The collaboration was included in the Newton Fund Mid-Term Evaluation (MTE) case study report for Brazil, so this chapter focuses on project results since November 2017, when mid-term case study research took place.

Pathway to Impact

The project's Theory of Change can be found in Annex 4, Figure 7. As shown in the figure, the collaboration fits closely with the Newton Fund Research Pillar, including some elements of People and Translation.

- **Activities:** there were several planned components to this research collaboration, including:
    - a quantitative survey with 5,000 young people – both in-school and out-of-school. The survey was carried out in 2018 and included over 3,700 young people. Although this was smaller than the project's initial ambitious aims, it was contended that this is "*one of the largest pieces of youth research ever undertaken*" (Project Key Findings report, 2019).

  - in-depth interviews with students and out-of-school youth. The target for this was **overachieved**, with 48 interviewed instead of the planned-for 40 interviews.
  - in-depth interviews with private and public sector stakeholders working in food, water, energy and education. The research team completed 65 interviews, overachieving their target of 50 interviews.
  - development of a mobile application for data collection with young people **(completed as planned).**
  - a video competition for young people in Brazil, India, Pakistan and the UK **(completed as planned).**

- **Expected outputs:** this collaboration reportedly generated new knowledge on young people's understandings, experiences and participation in the food-water-energy nexus in Brazil, using a multidisciplinary approach. As highlighted in the project proposal, this is a historically under-explored field in Brazil. In this setting, the research collaboration sought to gain a baseline understanding of young people's experiences by collecting, analysing, and disseminating data from young people themselves and other stakeholders.
- **Expected outcomes:** the project has the long-term objective of generating knowledge that can influence policy. This collaboration seeks to strengthen the knowledge base on the relationship between young people and nexus resources in Brazil, to address development challenges and increase resilience in this field. It also aims to raise awareness of and interest in EfS within the school system and private and public sector stakeholders. By generating an understanding of young people and their relationship with nexus resources, the collaboration aims to inform new and innovative EfS teaching materials in the future.
- **Expected impact:** the project will help address development challenges linked to access to and sustainability of the food-water-energy nexus – particularly those posed by rapid urbanisation and resource constraints in Brazil.

5.1 Emerging project results

Relevance of Newton Fund activities

Relevance to ODA and Brazil's socio-economic priorities

The project is closely aligned with Newton Fund country priorities for Brazil, and particularly with Priority 8: the food, energy, water, environment nexus. The project's focus on working with young people from different socio-economic groups (public and private school; out-of-school; rural and peri-urban) fits well with Newton's sustainable urbanisation focus, as well as its economic development and social welfare theme – both priority areas for Brazil. The project's research area is also aligned with the SDGs, particularly SDG 11 on Sustainable Cities and Communities.

Nexus research focusses to socio-economic inequality, particularly as relates to young people, who are disproportionately affected by poverty and inequality of access to education and resources. In this context, (Re)Connect the Nexus aimed to generate new evidence of young people's interaction with the food-energy-nexus, utilising a bottom-up approach and potentially informing policymaking and education initiatives.

This call responds to the Brazilian government's interest in energy and the environment, as defined in the ENCTI and ESRC's priority area of urban transformation. To define the call's area of focus, ESRC organised a workshop with participation from potential partners. Approximately 15

Brazilian academics and representatives from funding institutions participated in the discussions, which resulted in the identification of areas of high relevance.

Origins and quality of the collaboration

The origins of the Re-Connect the Nexus partnership lie in a prior research collaboration between the University of Birmingham, the University of Leicester, the University of Northampton and UNESP, the 'Sharing Futures' project[67], which ESRC also supported under the Newton Fund. Sharing Futures was a bilateral partnership funded as part of the RCUK-CONFAP Research Partnerships Call 2014. It sought to address challenges in planning for sustainable urban environments and evolved from the University of Birmingham's geography department's interest in collaborating with a team of technical specialists in water and energy (Engineering Department of UNESP).

UNESP and Birmingham are now 'partners of choice' and are exploring various other potential collaborations. One of the outputs of the multi-disciplinary Sharing Futures collaboration was a budding partnership between the UK and Brazilian institutions. The initial mobility grant provided by ESRC was instrumental in fostering this collaboration. Sharing Futures' early successes encouraged the two teams to continue working together, applying for the Nexus call in 2016. The combination of the counterparts' technical skills led the project to focus on how young people understand and interact with energy, water, and food resources.

Additionality

There is evidence that the Newton Fund has had additionality i.e. its activities and outputs would not otherwise have happened. The Principal Investigators (PIs) were drawn to the call's thematic focus, which related to their prior, successful collaboration under ESRC funding. The idea for this collaboration emerged through a previous Newton Fund activity that had brought the two AHs together for the first time.

Newton offered funding for activities such as travel, equipment, workshop which many other funds did not. According to Brazilian partners, having a UK counterpart helped achieve important results. The Fund allowed the partners to spend valuable time together in person, which boosted the quality of the partnership. The collaboration mixed science and social science disciplines, which improved the relevance and potential impact of scientific innovation.

5.2 Effectiveness of Newton Fund activities

Capacity building effects

The project generated a large, high-quality dataset and supported researchers to gain practical experience and improve their international profile. It involved several students and ECRs at different stages of their career – from undergraduate to PhD level. Several students went on to apply the research to their dissertations.

The focus on using qualitative research and bringing out the voices and experiences of young people was highlighted as being particularly formative. The insights generated from the research on the inequality of access to resources and education brought one member of the research team back into teaching. This choice resulted from both the end of funding for the project and the interest generated by the project.

[67] Sharing Futures, 'About'. Available at: http://www.sharing-futures.com/

Translation from research into practice: dissemination and behavioural change

The Nexus project is applying collected data and participatory research to inform a new Education for Sustainability, EfS, curriculum, promote scientific literacy, and make it more relevant to young people's interests and problems. The research team applied evidence generated through the Nexus project to inform practice, specifically as related to EfS. The Nexus collaboration generated youth-informed content for scientific education, instead of a more traditional top-down, curriculum approach.

The project could lead to changed practices within schools more broadly and could help disseminate sustainability messaging in Brazilian society. It is applying research findings in two ways: i) internally, within UNESP, informing the institution's training curriculum for primary and secondary school teachers, and ii) with external partners, including local government and other initiatives in the region (such as sustainable farming). The University provides training for primary and secondary school teachers focusing on scientific subjects.

In Guaratinguetá, the team is collaborating with the municipality and schools have begun to include EfS considerations in their curricula. This is a direct follow-up from the Nexus project (self-financed by UNESP), which was brought forward by the schools which took part in the research.

The findings are the focus of engagements with policymakers, local authorities, civil society representatives and teachers. This will foster co-creation of future initiatives, curricula, and policies. During COVID-19, the team and local partners in Potim continued to engage using virtual platforms.

Benefits for UK researchers and institutions

The UK side also provided positive feedback on the partnership's added value, describing it as "*a fantastic experience working with Brazilian collaborators*". This initiative led to a new multidisciplinary research agenda for the University of Birmingham's geography department. The collaboration helped increase familiarity with and awareness of work being carried out in the UK, bringing UK institutions closer to being 'partners of choice' for Brazilian researchers.

Additional benefits

Broader benefits to UNESP include an elevated interest in environmental sustainability themes among university staff, leading to what is seen as a joint effort and community of practice. UNESP has committed to creating a Department of Sustainability in UNESP Guaratinguetá, focusing on water, energy and waste management.

The partnership also helped UNESP staff members understand the **benefit of working with the social sciences** more generally, especially in terms of how an understanding of human behaviour can complement engineering. For instance, members of the research team are now interested in studying behavioural responses and the likelihood of uptake of different technological innovations.

Challenges in the collaboration

Despite its overall positive results, there were some challenges in managing the collaboration, particularly in comparison to the prior Sharing Futures project. There were four institutions involved, and there were some **delays in signing the collaboration agreements due to coordination challenges.**

There was an appetite for more and longer-term interaction. Bringing people together in person was seen as key to fostering partnership-building and increasing mutual understanding. **Visits were described as being too short and slightly rushed due to ambitious targets.**

The collaboration's ambitions were viewed as overly ambitious and research could have generated valid findings from a smaller, yet still statistically significant, sample. **Having more realistic targets could have meant spending more of their budget on analysis and dissemination.**

Limited funding on the Brazilian side for follow-up activities has meant that some researchers are continuing to contribute without financial support. Although their willingness to continue even without funding shows commitment to continuing the research, it may not be viable or sustainable.

5.3 Emerging signs of impact

The project aims to use new evidence to inform policymaking, especially in education and is seen as holding potential for important impact at the local level. Suppose project results continue to be disseminated and taken up by local authorities and mainstreamed in the education system. In that case, they could improve the quality of sustainability education, teacher training, and young people's engagement with scientific subjects. The project also aims to raise awareness of the importance of sustainability at the local level and support community initiatives. The pilot project in Potim shows that the project holds the potential to do so, where there is sufficient appetite from local stakeholders and municipal authorities.

There are other ways in which the project team is applying research findings to their work. **The research has resulted in a new EfS curriculum that is being used to train new teachers.** If this is mainstreamed in the school curriculum in the state and beyond, it can increase awareness of environmental issues among young people and promote more sustainable behaviours.

Ultimately, the impact on broader society will depend on the priority placed by the authorities on work surrounding Nexus resources, and on the ability and interest of institutions to take-up findings and invest in EfS. Although Potim offers a positive case study of local engagement, most other localities reached by the project did not show the same level of interest.

Through dialogue with local authorities, the project continues to bring the **experiences and opinions of young people**, including socio-economically marginalised groups, to the fore. This has the potential to create more inclusive policymaking, which takes into account the views and needs of diverse groups. Going forward, continued engagement with the authorities will be necessary to ensure that findings are implemented in at least some localities. The likelihood of this, and potential barriers to sustainability, are highlighted below.

Signs of sustainability

The research collaboration has resulted in several follow-on initiatives and partners are actively pursuing funding for a future phase:

- Nexus research has led to several PhD theses at UNESP.
- The university has a new partnership with the University of Sterling, where the Brazilian award holder (AH) is providing mentoring and coaching to a young researcher who had previously worked with the UK partners on this collaboration.

- Engagement is continuing informally with UK partners with a view to continuing multidisciplinary research.
- UNESP is relying on internal funding and voluntary or self-funded effort. This is indicative of the goodwill towards the project although funding challenges will limit the scale at which it can continue.

Complementarity and coordination

The project is working with a local municipality in the state of São Paulo, Potim municipality. Potim is a low-income, historically disadvantaged community in an industrial area of the state with poor access to quality water. **The interest expressed by local authorities and schools in the EfS curriculum underlines the need and potential gains from localised coordination and outreach.**

Research has not yet been mainstreamed into the school curriculum or policymaking. However, there is a **strong indication of interest and continued dialogue**, which could lead to further catalytic and leadership effects in the future. Although additional outreach, funding may be needed for larger-scale change to take place.

5.4 Conclusions

- **The (Re)Connect the Nexus collaboration was an ambitious multidisciplinary and multi-partner research collaboration**, which aimed to generate large-scale quantitative and in-depth qualitative data of young people's experiences interacting with the food-water-energy nexus. From the outset, the project had the ambition to apply research findings to the Education for Sustainability (EfS) curriculum in a bottom-up way.
- **The partnership was valuable in bringing social sciences and 'hard sciences' together and building the Brazilian team's capacity in qualitative research methods.** It further strengthened the partnership between UNESP and the University of Birmingham – which had originated with a previous research collaboration – and has raised interest among Brazilian researchers in further collaborating with the UK.
- **Findings from the research were disseminated in participating schools and with local authorities.** The collaboration has produced a rich dataset on the experiences of a diverse sample of young people, comprising of urban, peri-urban, rural, in-school and out-of-school and different socio-economic groups.
- Ongoing engagements in participating municipalities have led to an interest in **take-up of research findings** from the Mayor's Office in Potim, where the UNESP team is currently carrying out a self-funded pilot programme.
- **Overall, there are strong signs pointing to this research initiative's sustainability beyond the project's end.** UNESP has integrated research findings within the university and through external activities.
- Collaboration with the UK partners has continued in an informal way, as further funding applications have been unsuccessful. Though this indicates **strong interest in investing time and resources in follow-up work** – clearly showcasing the perceived value of the research – the potential local-level impacts of the project are limited by funding constraints and the resulting inability to dedicate more focused efforts to these activities.

Lessons learned and points to consider going forward

- **The Nexus project offers a clear example of how an initial, smaller-scale mobility grant can foster further rounds of engagement.** The possibility of meeting in person, carrying out several visits to the respective countries, and sharing different ways of working in complementary areas were all seen as leading to a stronger, more sustainable and potentially more impactful collaboration.
- **The Nexus project has seen promising levels of community engagement and interest from local authorities in one of its localities**. Carrying out targeted outreach and dissemination was central to the project from the outset, which has fostered continued collaboration even in the face of limited funding. Sharing findings from the research with the school who took part helped make the research process more participatory and less extractive and increases the potential for application of the EfS curriculum in school.
- **Despite strong interest in continuing with further research and dissemination activities to feed into policymaking, the team has so far not been able to obtain further funding – either as a joint UK-Brazil venture or working solely with Brazilian partners.** This area not regarded as a priority for local funders. Integrating more dissemination activities at a higher level could have helped raise awareness of the research and increase the likelihood of further funding.

6 Project: Strengthening Skills on Structure-based Drug Discovery for Novel Anti-schistosomal therapeutics

Summary

Project title	Strengthening Skills on Structure-based Drug Discovery for Novel Anti-schistosomal therapeutics
Call title	Newton Advanced Fellowship
Short description	This Newton Fellowship supports collaborative research in drug discovery related to schistosomiasis, a parasitic neglected tropical disease (NTD) that affects Brazil and numerous tropical countries in Latin America, Africa and Asia.
Objective(s)	The collaboration aims to build the capacity of researchers working on schistosomiasis research in Brazil through partnership with UK institutions and research visits and exchange, including training in the use of specialised equipment available in UK laboratories. Through the application of protein purification methods, it seeks to support testing of different chemical substances and their potential to result in innovative treatment for schistosomiasis.
Pillar	People
Acton value (total budget allocated in country, in GBP)	UK: GBP 74,000
Start/end date (Status: on-going or complete)	11/01/2018 – 10/31/2020 (Ongoing: has received a one-year extension)
DP UK and overseas	Academy of Medical Sciences, Brazilian National Council for the State Funding Agencies (CONFAP), Brazilian National Council for Scientific and Technological Development (CNPQ)

Award holders/ grantees	Professor Floriano Silva, Oswaldo Cruz Institute; Professor Nicholas Furnham, London School of Hygiene and Tropical Medicine (LSHTM)

Description of the project

The project is part of the Newton Advanced Fellowships programme. In the case of the Academy of Medical Sciences, Newton Advanced Fellowships aim to build researchers' capacity in partner countries working specifically in the area of clinical research. The Newton Advanced Fellowship (NAF) scheme provides funding to group leaders at a mid-career stage, in Newton Partner Countries, to establish long-term collaborative links with the UK. Under the terms of the matched funding agreement with Brazil, there is a reciprocal scheme, financed by the overseas funding agencies, that enables UK researchers to visit Brazil.

The Advanced Fellowship sampled for this case study brought together a research team led by Professor Floriano Silva at Oswaldo Cruz Institute (FioCuz) in Rio de Janeiro, Brazil, with a team led by Professor Nicholas Furnham at the London School of Hygiene and Tropical Medicine (LSHTM). The joint research team formed a network that included the Federal University of Goiás in the centre-west region of Brazil and the Diamond Light Source at the University of Oxford.[68]

The primary objective of this Newton Advanced Fellowship was to build the capacity of the Brazilian research team and transfer knowledge to assist the development of drug discovery for the treatment of schistosomiasis, with potential impact on health outcomes in Brazil and beyond.

Pathway to impact

Annex 4, Figure 8 shows how the collaboration has extended to include a prolific research collaboration between four institutions with dual objectives: i) capacity building and knowledge transfer, and ii) supporting joint research.

- **Activities:** The Fellowship comprises visits of varying lengths to each institution, training and capacity building in specialised techniques, and attending conferences in the UK. The team is also working together to apply the Diamond Light Source at the University of Oxford to study protein to support structure-based drug discovery.
- **Outputs:** It is expected that the Fellowship will lead to improved capacity among the Brazilian research team in specialist technical areas and crystallography studies on protein and joint research publications on the findings together with the UK team. It is expected that the research will result in protein expression and purification. This process is useful for disclosing this protein's structural features and increasing understanding of how potential drugs interact with it. This will help identify the target molecules that could help treat schistosomiasis.
- **Outcome:** Improve capacities among the participating Brazilian research team to carry out research on drug development using protein expression and purification. This can potentially be applied to drug development to tackle schistosomiasis in future research.
- **Impact:** It is expected that research findings from the collaboration will feed into the development of new treatment for schistosomiasis, which if successful and launched to market, could improve health outcomes in Brazil and in other countries across Latin America,

[68] The Diamond Light Source is the UK's synchrotron machine, located at Harwell Science and Innovation Campus in Oxfordshire. This highly advanced technological equipment accelerates electrons to near light speeds. The light generated by the machine is used to study a vast range of subject matter, from medical treatments to engineering. Additional information is available from https://www.diamond.ac.uk/Home/About.html

Asia and Africa which are affected by the disease. The disease is endemic in many low-income countries and affects the poorest who live with poor sanitation and poor access to clean water.

6.1 Emerging project results

Relevance of Newton Fund activities

Activity targeting and ODA relevance

This Fellowship and research collaboration focuses on generating new evidence for drug development to tackle schistosomiasis. Schistosomiasis is considered one of the most neglected among NTDs. It has a high global prevalence, with at least 229 million people worldwide requiring preventative treatment in 2018.

The collaboration is closely aligned with the Newton Fund's first priority area in Brazil: health, with a focus on neglected diseases. Schistosomiasis is caused by parasitic worms transmitted to humans via snails living close to contaminated water sources. Despite its prevalence, treatment for schistosomiasis has been neglected. The project fits well with the Newton Fund's capacity building mandate, particularly supporting ECRs from FioCruz to gain experience, technical skills and exposure to international networks.

In terms of ODA relevance, this project is closely aligned with SDG 3, Good Health and Well-Being, and directly contributes to Target 3.3: Research supported by the project ties into the 2012 London Declaration on Neglected Tropical Diseases, NTDs, signed by pharmaceutical companies, donors, endemic countries and NGOs. The Declaration was a commitment to control and eradicate ten diseases by 2020, including schistosomiasis.

Targeting Brazil's priorities

The disease affects approximately six million people in the country[69], while almost 25 million Brazilians live in high-risk areas. Disease prevalence and morbidity have decreased in some states due to government policies. For over 20 years, schistosomiasis has been the prime focus of a National Control Program (PCE) to detect and treat those infected with the disease. More recently, Brazil created the National Integral Health Policy for Field and Forest Populations (PNSIPCF) in 2011, representing the Brazilian government's commitment to improve the health of those suffering from NTDs. Of the 17 listed NTDs by the WHO, 14 are found in Brazil, making the study of NTDs of high relevance to the country's health policy.

Origins and quality of the collaboration

This Newton Advanced Fellowship emerged from a prior collaboration between the UK and Brazilian research teams, funded by MRC, FAPERJ and CONFAP: '*Building Research Capacity for schistosomiasis drug discovery and development through high-content imaging and structural molecular biology studies'.*

[69] Martins et al. (2015). ' Schistosomiasis in Southern Brazil 17 years after the confi rmation of the fi rst autochthonous case'. Revista da Sociedade Brasileira de Medicina Tropical. 48:3.

It was considered highly successful by both sides, and the team applied and was shortlisted for the Newton Prize.[70] As part of their submission, the team proposed further research building on the initial collaboration.

Both sides described the research collaboration high quality, building upon complementary areas of research: the AH from FioCruz brings expertise in schistosomiasis (on which he has been working since 2010) and drug discovery; the AH from LHSTM is an expert in computational structural bioinformatics and neglected tropical diseases. Partners at the University of Oxford bring expertise in the production of protein for structure experiments, while the partnership with the Diamond Light Source brings access to the technology that allows for protein analysis.

The team has a strong interest in continuing their solid partnership through additional work in drug development for schistosomiasis and beyond, and they are exploring new funding opportunities beyond the current collaboration.

Additionality

Both the UK and Brazilian partners believe it would have been difficult to carry out this and the preceding collaboration in the absence of the Newton Fund. This is because of the Fund's specific focus on meeting ODA priorities, including working on NTDs. Without a partner in a country affected by NTDs, it would have been difficult to find a source of funding in the UK.

There was no knowledge of other funding with the same scope as Newton that would provide funds for capacity building and mutual exchange opportunities. The Fellowship brought together researchers at similar stages of their career, who could benefit from each other's area of expertise. The Newton Fund was described as providing good Value for Money (VfM). The partners were highly complementary, and the collaboration increased the value of the research generated.

6.2 Effectiveness of Newton Fund activities

Capacity building for the Brazilian team

The collaboration's main objective was to improve the capacity of the FioCruz team through time spent in the UK, training, and access to laboratory equipment and specialised machinery at Oxford's Diamond Light Source.

The Fellowship allowed the award holder and his team to participate in activities abroad, raising their profile as researchers and providing access to specialised equipment. Brazilian team members were then able to present their work in international fora.

The training received in the use of the Diamond Light Source will be applicable to the team's work in Brazil. It is hoped that the research team will be able to apply the methods learned in the UK to continued work in Brazil and the development of Brazil's research platform in this area. The collaboration was affected by the COVID-19 pandemic, which caused delays. The project received a one-year extension.

[70] Each year, the Newton Prize is awarded to projects that demonstrate the best science or innovation; promoting the economic development and social welfare of Newton partner countries. Newton Fund, 'The race to find new drugs for a neglected tropical disease'. Available at: https://www.newton-gcrf.org/newton-fund/newton-prize/2018-newton-prize/

Research collaboration

The collaboration expanded much further than training and exchanges and was widely regarded as a strong research partnership and even as a "*scientific friendship*". Access to machinery, expertise, and knowledge sharing between the two country teams improved their capacity to produce some of the parasite's protein artificially in a laboratory setting.

The researchers had previously co-authored papers as part of their earlier MRC collaboration.[71] Building on this, a number of joint research publications have already resulted from this collaboration.[72] It was recognised by both UK and Brazilian researchers that the high-quality research partnership fostered by the Newton Fund led to promising scientific results.

The research is ongoing and has been affected by COVID-19, leading to an extension in the project. The research team is hopeful that with additional data resulting from the partnership, more publications will result and could translate research findings into practical change. If successful, the Fellowship will enable the research team to carry out a different type of drug screening, which is the starting point for developing a new treatment for schistosomiasis in the future.

Benefits for UK researchers and institutions

There is evidence that the collaboration has brought benefits to the UK institutions and individual researchers. Taking part in a Fellowship and being associated with the Newton name were seen as raising the profile of the researchers involved, as well as of the Academy of Medical Sciences.

The UK participants benefited from access to strong networks in areas of research excellence in Brazil. The possibility of in-country visits enabled UK researchers to take part in workshops, conferences and events where they could meet potential other collaborators and potential funders such as the Gates Foundation. The Fellowship was described as 'energising' for the UK side, as Brazil is a leader in drug discovery and development in Latin America.

In terms of wider benefits to the UK, a large number of Brazilian scientists are working on diamond synchrotron technology, and the machine in São Paulo is the only one in Latin America. A strong science partnership with Brazil in this area benefits the UK as this collaboration (and others of its kind) can bring innovations in how the technology is applied to other areas of relevance within the UK.

Additional or unexpected benefits

The collaboration went well beyond connecting two individuals or two institutions: it led to the development of a strong research network with several institutions working in different but complementary research areas in the UK and Brazil.

[71] In 2016, the researchers jointly published two papers: 'Discovery of New Anti-Schistosomal Hits by Integration of QSAR-Based Virtual Screening and High Content Screening' and 'QSAR-Driven Discovery of Novel Chemical Scaffolds Active Against Schistosoma Manson'.

[72] The two main AHs co-authored a paper titled: 'In Silico Strategies to Support Fragment-to-Lead Optimisation in Drug Discovery', published in Frontiers in Chemistry journal. This was submitted in October 2019 and published in February 2020. Another important paper to note is: Araujo-Montoya, B.O., Senger, M.R., Gomes, B.F., Harris, G., Owens, R.J., Silva-Jr, F.P. (2020). *Schistosoma mansoni* cathepsin D1: Biochemical and biophysical characterization of the recombinant enzyme expressed in HEK293T cells. *Protein Expression and Purification.* 167.
Other papers have been published with other members of the broader research network.

Challenges in the collaboration

The Fellowship's start was delayed and was further affected by COVID-19, as the FioCruz institution was directly involved in COVID response. For this reason, the project was awarded a one-year extension. Despite the pause in activities, both sides express a strong commitment to continuing their work where it stopped due to the pandemic.

There were some administrative challenges in distributing funds and ways of working. This resulted in a high workload on the AHs responsible for administering the grant, which also took time away from working on the research itself.

Aside from the delays, researchers would have generally benefited from more time and resources for the collaboration. More time in the UK would have allowed the research team to carry out more experiments in a laboratory setting.

Owing to the structure of the funding, researchers were not permitted to work full-time on the research, which hindered progress.

6.3 Emerging signs of impact

Translating scientific discovery into new treatments that can reach and help patients was central to the project. Its ambition was to develop chemical compounds for clinical and pre-clinical studies and that this would have an impact on the development of new treatments for schistosomiasis in Brazil and elsewhere. **When it has its research findings, the team would consider applying for IP registration. With further funding, this could lead to a potential new drug on the commercial market.** Drug research and development has a longer cycle than the current project. It is therefore too early to observe any such impact as the project is ongoing.

The transition between knowledge generation and clinical implementation would require further risk-taking and long-term vision on funders' part. In terms of supporting translation into a clinical product, the industry's involvement would also become necessary. **If initial findings from this collaboration are positive, it is likely that the research team will require more extensive funding to develop a potential new treatment.**

Signs of sustainability

The Fellowship has strengthened the partnership between the award holder institutions and other institutions in Brazil and the UK. In the short term, the research team will continue working together on planned activities for the collaboration's remaining year. In the longer-term, there are strong signs that the project has supported the creation of a strong and sustainable research network. The team has already applied for further joint activities, even though this project is still ongoing.

At FioCruz there are already research programmes in place focusing on schistosomiasis. Once more advanced results are available, the research team believes it will be straightforward to get approval to move forward with animal testing and pre-clinical trials.

More broadly, findings from the study could also be applied to other areas of investigation. For instance, **the research team jointly applied for GCRF funding to use techniques developed in this collaboration in COVID-19 research.** However, their application was unsuccessful as the call focused primarily on short-term response.

In terms of future collaborations, the team are looking at Wellcome Trust funding. However, this process has slowed due to the ongoing COVID-19 pandemic, and additional data will be needed to take those discussions forward.

Other collaborations currently in discussion include potential collaboration between LHSTM and the University of Goias in the field of schistosomiasis and other tropical diseases such as leishmaniosis. **There are also ongoing conversations between UK partners and the Gates Foundation, facilitated by this project and the networking opportunities it created in Brazil.**

Complementarity and coordination

It is too early in the collaboration to observe signs of catalytic or leadership effects. However, **the project has potential for learning to be applied to other studies, particularly in terms of research carried out by using the Sirius synchrotron light source machinery in São Paulo State.** This would support wider drug development efforts in the country. Through capacity building in synchrotron machinery, the project could support further development of this research area in Brazil.

6.4 Conclusions

- As a project focusing on strengthening capacity and supporting knowledge transfer, the **collaboration has gone beyond its capacity building aims** to further strengthen a prolific research collaboration that originated with earlier Newton funding on the same theme.
- **The project is highly relevant to ODA priorities and to the Newton Fund's priorities in Brazil**, as it focuses on a neglected tropical disease that is a poverty-related parasitic infection endemic in several areas of Brazil and beyond. Schistosomiasis is widespread in tropical and subtropical areas of Africa, Asia and Latin America, particularly among low-income communities lacking access to safe drinking water and adequate sanitation.
- **The collaboration has strengthened an existing scientific relationship.** Partners on the Brazilian and UK side collaborated for the first time under a previous Newton Fund call run by MRC and CONFAP. Their work had been shortlisted for the Newton Prize, and this first experience encouraged them to continue working together. The research team from the four participating institutions plans to continue working together and has applied for fresh funding for research related to schistosomiasis and other diseases.
- **The project is ongoing and has been affected by initial administrative delays and further delayed by COVID-19.** This has resulted in a one-year extension of the collaboration. Progress in the collaboration has been promising and the project has generated emerging research results and joint publications.
- **Collaboration between Brazil and the UK has been complementary and effective.** While the UK holds strong expertise and advanced technology in applying synchrotron machinery, Brazil has also been investing in this machinery to support drug discovery and drug development. Building its capacity in this area is therefore important for Brazil, and also for the UK in strengthening its ability to work on drug development for neglected tropical diseases (although the methods can also be applied to other diseases).

Lessons learned and points to consider going forward

- **Newton provided important start-up capital that brought together a team with diverse but complementary areas of focus**. With relatively small amounts of funding, the

collaboration is generating important results in its field and sustaining a network which has real potential for future collaboration.

- **Newton provides important funding in areas which are traditionally 'neglected'.** Due to its ODA funding, it can support medical research even in fields that may not be as high a priority as others in the UK, and for which there is limited potential in terms of marketability. As an ODA programme, Newton can help support research in NTDs, diseases of the poor and for which market value is traditionally seen as limited.

- **Future science and innovation partnership programmes could consider setting out paths for follow-on funding which could support research teams after initial collaborations**. This would help foster the translation of scientific discoveries into products that have the potential for drug testing and market testing in future phases. Clinical research requires extensive funding over long timeframes in order to bring forward scientific discovery. Newton often focuses on smaller, shorter collaborations than those available from other funding streams. To translate research findings into improved treatments, additional funding will be needed on a different scale and timeframe than what was made available to the research team through Newton.

Annex 1 – Methodology

Research methods and data collection approach

The country case studies are central to our Final Evaluation approach and involved an intensive period of remote research by the evaluation team members.

Preparation for the research included a document review of country-specific documents on Brazil's research and development context. Documents reviewed include the evaluation's Brazil Endline Report and the updated Country Situation Note. We also conducted a literature review of additional documentation on Brazil's science and innovation landscape, and existing UK-Brazil collaboration activities. Project-specific documentation, such as application forms, progress and final reports, were reviewed for each action included in the study, where provided by the Delivery Partner, local partners, or researchers.

The document review was accompanied by remote research with respondents in Brazil and the UK in October to November 2020. Three main categories of stakeholders were interviewed: i) in-country UK representatives and Newton Fund in-country team; ii) UK and local funders; and iii) participating researchers. In some cases, additional university staff, such as university leadership or other research teams, were also interviewed.

Our data collection was complemented by an analysis of the pathway to impact for each action, which can be found in Annex 4. Here, we analysed each project's trajectory to impact by placing it within the Newton Fund Theory of Change. This allowed us to visually represent the pathway to outputs, outcomes and impact of each activity, and highlight its (potential) contribution to broader Newton Fund goals.

Limitations of the research approach

Case studies were limited to three projects per case study, which were conducted remotely owing to the Covid pandemic. In some projects, the added logistical challenge of remote research limited the number and range of stakeholders consulted. The volume of documentation provided varied by project, thus limiting the possibility of triangulating findings. The case study findings reflect the data provided by each project and what is available online. The case study is not representative of all Newton Fund activities. Whereas it provides valuable depth and illustration of Newton Fund activities, the case study alone does not provide generalisable evidence.

Research findings have been triangulated across different stakeholder groups and various sources of documentation (project documents and online resources such as the Research Council UK (RCUK) Gateway to Research portal). However, the research team could not independently verify statements by all the different contributing stakeholders or verify what was reported in the documentation.

Specifically, to the Brazil case study, for the ESRC-FAPESP (Re)connect the Nexus collaboration, it was unfortunately not possible to interview the UK PI, which limited our ability to discuss results for the other 2 counterparts of the research partnership.

Additionally, the COVID-19 pandemic has resulted in the need to revisit our data collection approach, particularly in terms of our 11 country case studies. The case study research was originally scheduled to take place in three waves of partner country visits between March and August 2020. The inability to travel internationally and the closure of offices, embassies,

universities and research centres required switching to a **remote-based approach**, as agreed with BEIS in March 2020.

In revising our case study approach, we recognised that switching to a remote-based approach would have likely implications on the quality of data collected, as outlined in our April 2020 Concept Note. The quality of interviews could have been affected for several reasons, including:

- problems with connectivity, technical issues and limited telephone or internet coverage, which posed the risk of lowering the quality of calls and cause loss of rapport, creating abrupt feelings in interviews, and affecting the depth and quality of our findings.
- the absence of visual or nonverbal cues, inability to observe behaviour and body language, with the risk of telephone interviews becoming mechanical and cold.
- having little opportunity to establish rapport with respondents and having potentially shorter times for interviews as respondents may more easily become fatigued by telephone compared to face-to-face interaction.
- limited engagement, low response rates and little interest in participating in our research, which might limit the breadth and depth of our findings.
- the inability to visit laboratories or facilities, and limited scope for unplanned interviews with additional staff members, researchers, or others in the same institution.
- fewer opportunities for check-ins and informal conversations with in-country teams (ICTs), who are a rich source of data.

We mitigated these issues in several ways, where:

- we included additional time for document review prior to interviews so that conversations moved on to speaking about results, emerging impact, and challenges (to consider for shorter interview times and potentially lower quality interviews). However, it is important to consider that availability and quality of project data and information varied considerably across sampled interventions.
- we favoured video interviews wherever possible to limit the lack of nonverbal cues and to help establish rapport with respondents.
- we had several email exchanges prior to interviews to create an initial connection and rapport with participants, and to set out the objectives and areas covered in the interviews by sharing topic guides prior to our calls.
- we organised follow-up interviews wherever possible to fill any remaining information gaps brought about by having shorter interview times. We also gathered interviewee insights on additional respondents and carried out additional interviews which emerged from email exchanges and interviews.
- we organised regular check-ins with ICTs via email or telephone and delivered online presentations and validation sessions with each ICT to share emerging findings after having carried out all interviews. This allowed us to ensure we had accurately reflected the Newton Fund's experience in each country.

Annex 2 – Case Studies Sampling Overview

This Annex summarises the sampling approach used for the partner country case studies which inform the Final Evaluation of the Newton Fund. Detail on the approach and criteria used to develop the sample for the case studies is annexed to Tetra Tech's Newton Fund Final Evaluation Report.

Final evaluation country sample

A total sample of 11 countries with three calls per country (totalling 33 calls) was agreed with the Department of Business, Energy, Innovation and Science (BEIS).

The countries selected for the country sample were China, Malaysia, Chile, Turkey, South Africa, Brazil, India, Philippines, Jordan, Peru, and Kenya. The sample includes three additional countries (Jordan, Kenya, and Peru)[73] due to the Newton Fund's expanded scope. Six of these countries were included in the Mid-Term Evaluation (MTE)[74] of the Newton Fund case study research.[75]

The criteria used for the country selection were:

- coverage of all regions covered by the Newton Fund.
- coverage of different levels of existing innovation and capacity of partner countries (as defined by the 2015 Global Innovation Index rankings and BEIS' initial assessment of capacity).
- learning opportunities from new ways of working regionally in countries that either graduated from the DAC list or have ODA sensitivities; or operating in/ recovering from crises.
- the inclusion of Peru, Jordan, Kenya (countries that have not been explicitly included in the evaluation scope until now).

Non-selection of countries (or calls) does not reflect significance, quality, or importance.

Proposed sample of calls and projects

Data from BEIS' Newton Fund Activity Tracker (January 2020)[76] enabled the evaluation to determine 'call' activity and identify three 'calls' per country, giving a total of 33 calls in the sample. The following criteria were used to develop the call sample:

- ensuring coverage of all DPs.
- ensuring coverage of the three different pillars.
- reflecting emphasis on spending/thematic priorities in each country.
- allowing for longitudinal analysis by including six projects analysed as part of the MTE.

[73] Jordan, Kenya, and Peru were not included in the MTE data collection, as they had just joined the Newton Fund. BEIS agreed to carry out in-depth case studies in the three new countries to ensure coverage of activities there.
[74] Mid-Term Evaluation of Newton Fund (December 2018). Available at: https://www.newton-gcrf.org/resources/
[75] These were: China, Malaysia, South Africa, Brazil, India, and the Philippines. Mexico and Egypt, which were part of our MTE sample, have been replaced with Turkey and Chile respectively to increase opportunity for learning.
[76] The BEIS 'Activity Tracker' is an Excel-based internal monitoring tool by BEIS and updated quarterly by the UK Delivery Partners.

The outcome of the call sampling approach allowed for the identification of specific projects under each selected call. This was achieved in consultation with DPs, BEIS ODA Research and Innovation and ICTs.

The project sample allows for coverage of all DPs and pillars within the Newton Fund portfolio. Six projects were analysed as part of the MTE and again at Final Evaluation to allow for longitudinal analysis. The sample list of 33 calls and projects is annexed to Tetra Tech's Newton Fund Final Evaluation Report.

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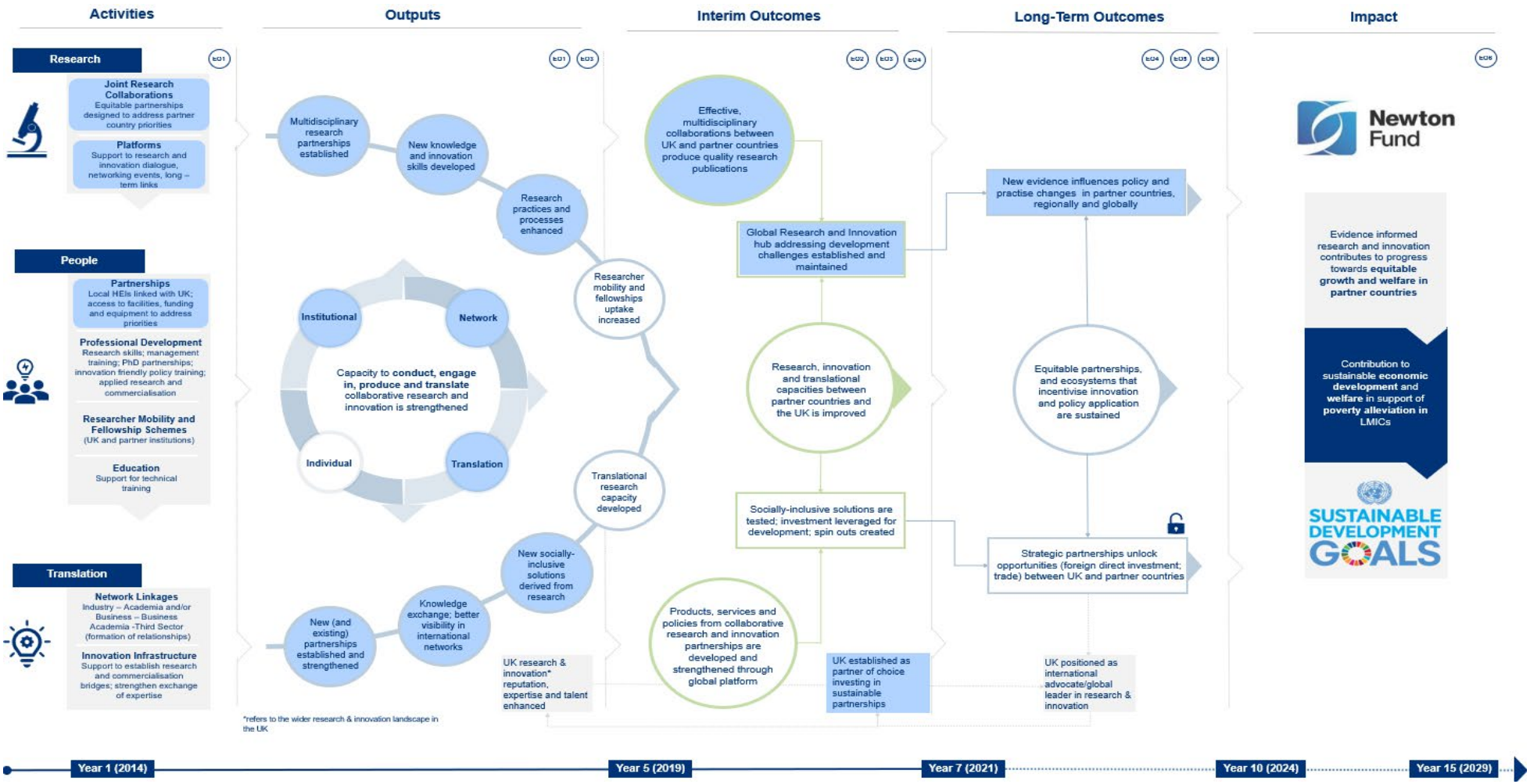
Annex 4 – Theories of Change per Action[77]

Figure 6: CSSP Brazil – WP3



[77] The figures present the pathways to impact for the three projects reviewed in this case study, set within the overall Newton Fund theory of change. Specific pathways to impact for each project are indicated by the blue shaded shapes in each figure.

Figure 7: (Re)Connect the Nexus

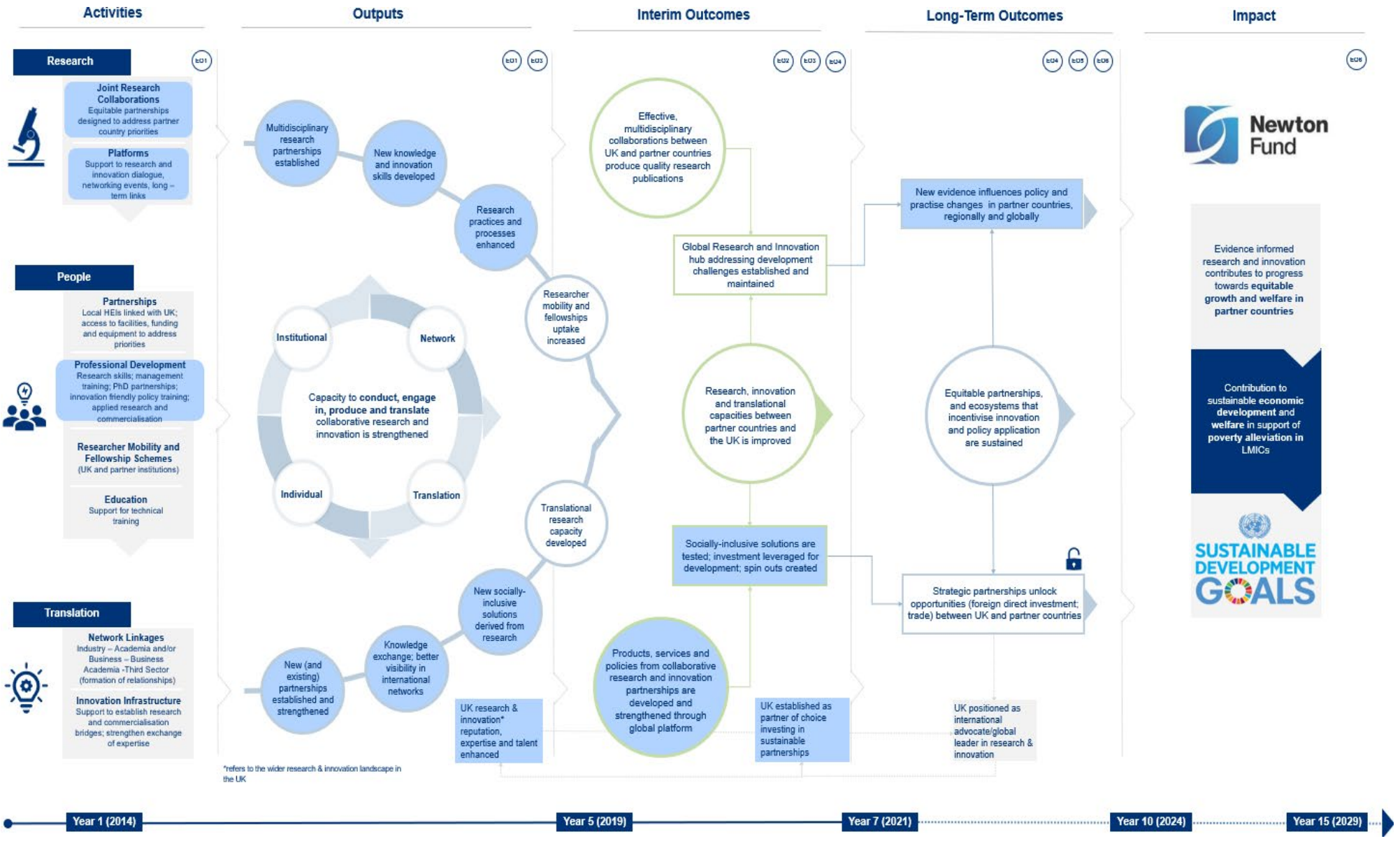
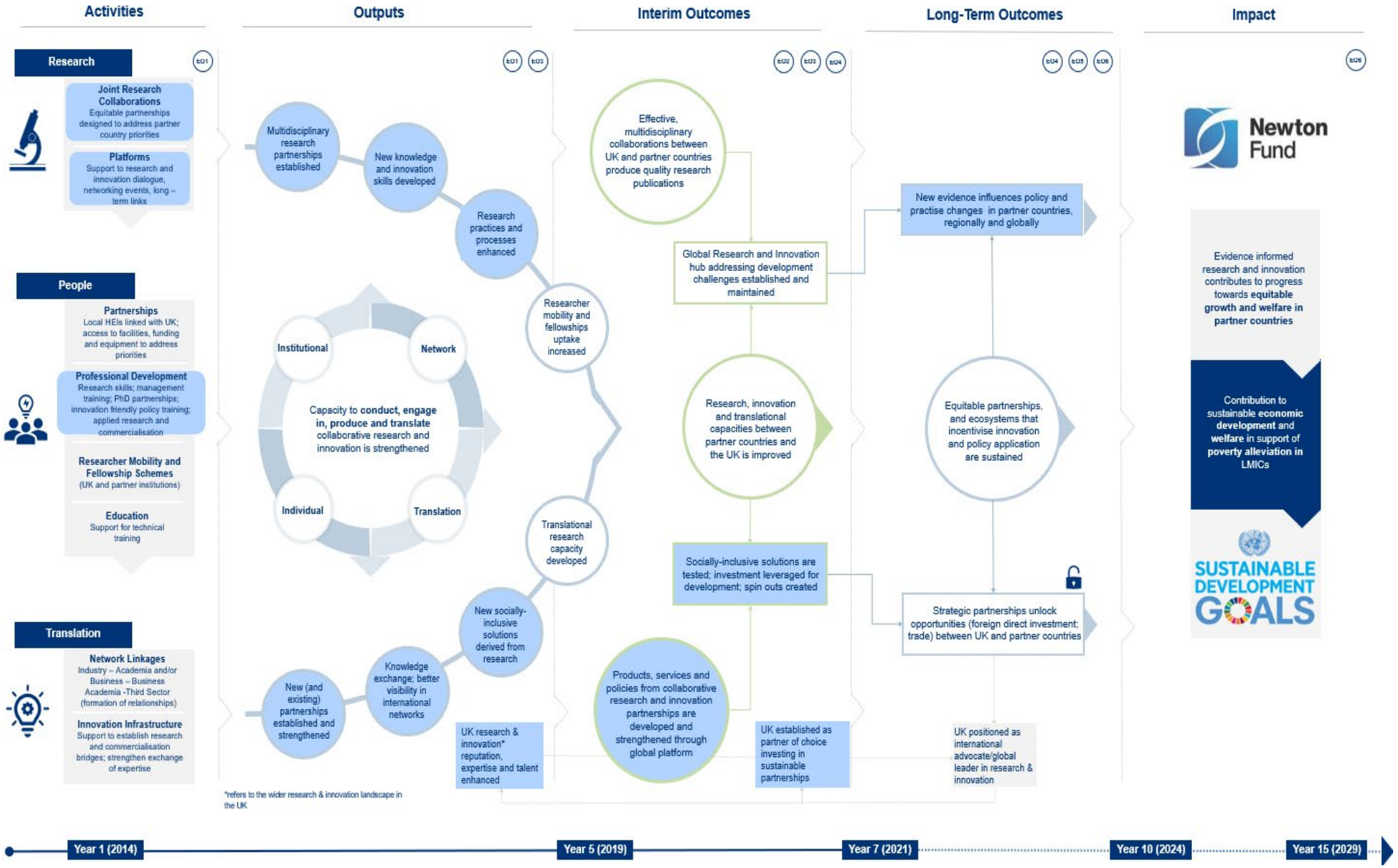


Figure 8: Newton Advanced Fellowship



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