Research Capacity Strengthening in LMICs

Executive Summary

Summary of the evidence base

International donors have long supported efforts to strengthen research capacity in LMICs as a means of achieving long-term sustainable development. This document presents the results of a Rapid Evidence Assessment (REA) of the literature on interventions to strengthen research systems and organisations. The REA set out to answer two research questions:

- What are the strategies and interventions available to strengthen research *systems* and support an enabling environment for research in low or middle-income countries?
- What are the strategies and interventions available to strengthen research *organisations* to produce and manage research in low or middle-income countries?

In order to answer the research questions, we reviewed 227 studies from a vast body of literature on research capacity strengthening in low- and middle-income countries (LMICs). Given the large differences between LMICs, we concentrated the analysis on a subset of countries with lower income and lower investment in research (see Appendix B for methods). The geographical focus of the reviewed studies is summarised below.

Fig i. Geographical focus of the literature
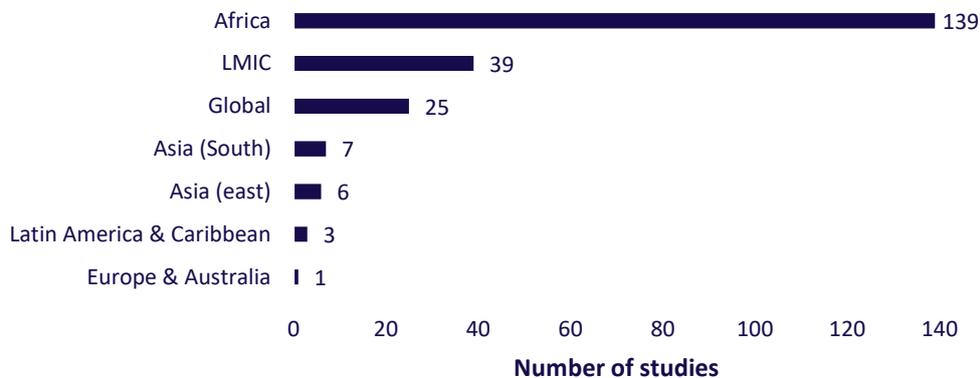
Although the literature reviewed covers both research systems and organisations and spans a number of topics, the strength of evidence on each topic varies greatly (see section 3). Overall, there is much stronger evidence on problems and challenges than on the interventions. Evidence on the effectiveness of the interventions in a specific domain is limited, although broad guiding principles and good practices are identified (see section 7).

Evidence on research systems

The literature has identified several problems affecting research systems in LMICs, and some lessons learnt from past interventions. However, much of the evidence is inferred from experiences with specific institutions or programmes and does not build on systematic baseline data and conceptual frameworks [23] [48] [81] [200]. Three areas are seen as key to strengthening research systems.

Raising awareness of the importance of research

Problems/needs: There is consistent evidence that LMIC governments do not prioritise research and innovation in development. Many have committed themselves to increasing gross domestic expenditure on R&D, but in most cases it still accounts for less than 0.5% of gross domestic product [210] [139] [208] [144] [133] [42]. Competing priorities of food security, health care, education and other basic social services mean that governments have not built a supportive environment for research [144] [159].

Interventions: From the review it emerged that, while donor interventions can influence LMIC research systems, their positive impact is often short-lived unless activities align with national priorities and are defined alongside national stakeholders [189] [206] [146] [208] [118] [223] [42]. The Nigeria Evidence-Based Health Systems Initiative (NEHSI) is a good example of how to engage with all relevant levels of governments and civil society to raise awareness of the importance of research and generate support for interventions [58].

Supporting legal and institutional frameworks for research

Problems/needs: LMICs often have an incomplete and fragmented policy framework for research [210] [208] [5] [46] [42]. Even when policies are in place, their implementation is poor due to lack of adequate financial and human resource support, limited attention to monitoring and evaluation [35] [135], and fragile, disconnected and under-resourced national-level research institutions that are incapable of responding to external changes and demands [122].

Interventions: In order to be sustainable, capacity strengthening must take a systems approach that responds to capacity needs at different levels (individual, organisational, and environment or network) and is tailored to the context where they are being implemented [23] [93] [205] [63] [48] [56]. Whilst interventions to coordinate government activity are in place (such as the Science Granting Councils Initiative and the HERANA project [35] [42]), no proven coordination strategy was identified. Forums promoting coordination and consensus-building led to few agreements which were rarely implemented and monitored while newly created 'super-ministries' were often unstable and failed to promote policy coordination [42].

Promoting research impact

Problems/needs: The literature provides consistent evidence on the importance of research for public health [33] [63], economic development [136] [219] [207] and policy development [222] [50]. However, a number of factors limit the positive effect of research across LMICs: weak linkages between higher education, research, private sector and government [208] [2] [125] [93] [205] [63], poor alignment of research with national needs and priorities [136] [68], and weak demand for research in policymaking [87] [80] [208] [5].

Interventions: Several interventions stressed the importance of long-term donor support to deal with these structural deficiencies [182] [58] [169] [165]. In order to maximise the positive impact of research, interventions should focus on generating long-term commitment to research between relevant stakeholders in government, civil society and the private sector [169] [165] [35] [127] [195]. The use of intermediaries, such as national or international organisations with a permanent foothold in the country, is seen as an effective long-term strategy [107] [182].

Evidence on research organisations

Research organisations in LMICs face a number of challenges. Many of these challenges come from the limited importance given to research in higher education institutions [41] [173] [112] [58] [46] [173] [126] [208] [20] [42], which exacerbates the well-documented funding constraints faced by these organisations [66] [208] [204] [136] [25]. Within this context, three areas are especially problematic.

Research management

Problems/needs: Research management capacity across LMIC universities is very limited. This, in turn, affects researchers' ability to effectively obtain research funding and manage research projects [13] [58] [46]. Common areas in need of improvement are financial management, grants management, and monitoring and evaluation [112] [91]. Multiple reporting and grant management requirements put a strain on research organisations' resource-scarce systems [208] [110]. Moreover, procurement processes for research projects are reported to be bureaucratic and unscrupulous, and research support structures are often insufficient and ineffective [199] [41].

Interventions: Two relevant intervention strategies emerge from the literature. First, donors can provide unearmarked pooled funding and a single monitoring and evaluation framework to allow a more efficient use of the funding by the recipient organisation while reducing demands on overstretched support services [208] [110]. Second, capacity can be built through dedicated initiatives (such as the Good Financial Grant Practice) and researcher support programmes that use of cost-effective tools such as Massive Open Online Courses (MOOCs) and engaging senior or retired alumni to share insights with junior researchers [222] [76].

Career incentives

Problems/needs: A key barrier to research production is the lack of incentives to produce research. Academic staff often carry large teaching, administrative and consultancy workloads which means that the time available for research is minimal [208] [195] [151] [20]. This contrast with attractive career opportunities in higher income countries, which causes the 'brain drain' of the most talented researchers [122] [146] [204] [154]. These two problems severely affect research system development in LMICs, as well as the performance of individual research organisations.

Interventions: The HERANA project showed that monetary rewards provided by universities effectively promote the advancement of research but that competing incentives (to teach, offer consultancy services etc.) are often stronger [41] [42]. A well-designed national system of incentives can be effective in changing researcher practice. For instance, South Africa's innovation system awards output subsidies to universities, which then choose how to reward the academic(s) responsible for research activities [41] [42]. Appropriate training and career development opportunities linked to research are also powerful tools to promote a shift in culture [226] [222] [20].

Research information systems

Problems/needs: The third barrier affecting research production and research management in LMICs is the lack of adequate ICT infrastructure underpinning an organisation's research information system. Many LMICs have gaps in ICT infrastructure and system deployment, which hampers the production, management and dissemination of research, and particularly are weak in regard to research production, management and communication. Higher level research enquiry, for example using supercomputers, modelling and simulation equipment, large astronomical telescopes or grid computing, or 'big data' research continues to be limited [41] [79] [131] [138] [175].

Interventions: There is a positive correlation between accessibility and utilization of electronic resources (i.e. e-journals, e-books, online databases, electronic conference proceedings etc) and productivity of academic staff [13]. However, the SCAP initiative showed that when e-infrastructure for scholarly communication is developed with external funds, universities may not commit to ownership and long-term maintenance of the infrastructure. Donors should therefore institutionalise and harmonise infrastructure development and grow capacity, developing an internal policy framework in support of scholarly communication [195].

Evidence on donor interventions

On top of discussing specific projects or programmes, the literature provides some evidence on general strategies and good practices for RCS interventions. The review has identified the following typology of donor RCS interventions [52] [64] [81] [88] [179] [63] [48]:

- **Vertical research projects**: Interventions that strengthen research capacity incidentally and instrumentally, in order to produce research results for a specific project or programme;
- **North–South or South-North-South partnerships**: Interventions that deliberately strengthen research capacity through collaboration between Northern and LMIC researchers;
- **Centres of excellence**: RCS interventions aimed at high-potential research-intensive organisations, often with the ambition of making them the hub of research activity within a country;
- **Networks and consortia**: Long-term RCS interventions aimed at building sustainable organisational capacity for RCS, often with a strong South-South component.
- **Training**: RCS interventions that are focused on the delivery of *ad hoc* training to researchers, research managers, government officials and other stakeholders.

Best practices emerging from the reviewed literature include:

- **Prioritise national commitment**: Determining a research agenda based on country needs involves input from key national and local stakeholders, such as funders, national authorities and researchers [127] [53] [198] [158] [50].
- **Solicit match funding:** Interventions should strive to address the dearth of local funding or in-kind investment matching international funding, which is often an indicator that there is insufficient local buy-in, and the programme's sustainability is at risk [14] [120] [39] [23] [58].
- **Engage local partners**: Donors should work together with LMIC partners to: set the agenda and the goal of the intervention; engage with stakeholders; clarify responsibilities and be accountable to beneficiaries; promote mutual learning; enhance local capacities; share data and networks; disseminate the results; pool profits and merits; help raise the profile of research with policy makers, the media, and local populations [19] [117] [166] [186] [39] [182].
- **Coordinate funding**: Donors may often be funding the same organisation through different projects, awards and grants. Concentration, coordination and consistency among funding agencies is key to ensure value for money and to prevent haphazard contributions to the sector's development in LMICs [110] [146] [81] [208] [42].
- **Promote accountability**: Promoting accountability to local partners and stakeholders can be an effective evaluation strategy, so long as project goals are clearly articulated to all partners at their inception and direct lines of communication are established. Strong accountability mechanisms can enhance impact, in particular when this is met by internal support for change within the organisation [166] [198] [166].
- **Work horizontally**: Networks and consortia are useful for working cooperatively on shared problems at regional or global levels, can help focus on common research priorities, increase

knowledge exchange and speed diffusion of innovations and help forge long-term relationships and sustainability [210] [38] [34] [128] [160] [39]. However, there is a need to translate the research capacity effects of networks and collaborations from organisations to the research system as a whole. Long-term donor support is necessary to achieve sustainable change [22] [63] [23] [106] [208] [182].

- **Work flexibly**: The literature suggests that donors should look at RCS interventions as experiments to ensure that plans have sufficient flexibility and allow room for trial and error, failure, learning and innovation. Interventions should incorporate emerging learning with explicit review points, since the 'theory of change' may change alongside the conditions of implementation. Finally, donors should allow for plans to be adapted rather than trying to massage new understandings into the original plan [165] [208] [76].

Evidence gaps

The REA has highlighted a number of gaps in the evidence on RCS activities in LMICs. The three most important gaps are summarised below:

- **Lack of system-level data**: There is a lack of up-to-date baseline data on research systems, which makes it difficult to pinpoint specific needs at system level and plan interventions. Higher education information systems in many LMICs lack incentives for universities to provide performance data to a central administrator, and for the central data administrator to report to government and/or to the higher education councils. The lack of baseline data at the level of research systems (as well as in many research organisations) makes it difficult to prioritise interventions in the context of multiple gaps and competing needs.
- **Lack of evidence about interventions**: Although the evidence on RCS interventions varies for each topic, the level of evidence on interventions is overall much weaker than the evidence on the problem the intervention is trying to solve. In particular, there is a lack of evidence about the effectiveness of specific interventions and intervention strategies. Whilst the literature proposes a number of good practices for RCS interventions, these seem to emerge from observation and deduction and not on rigorous assessments of the available evidence. By contrast, when interventions are routed in evidence, authors are careful not to infer that the lessons learnt would be applicable in different circumstances.
- **Lack of evidence on research diffusion and take up**: While the literature concentrates on research production capacity, little attention is paid on the policies, practices and institutions needed to support the diffusion and take up of research in society. In particular, there seems to be a limited understanding of strategies that support the use of research in policymaking and the economy. Country-level analyses of the barriers to research diffusion and take up, the role of intermediaries and the capacity gaps affecting the research community and non-research actors (i.e. businesses, government and civil society) would be highly beneficial.

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List of acronyms

AAS	African Academy of Sciences
AAU	Association of African Universities
AHSS	Arts Humanities and Social Sciences
CREP	Centro Rosarino de Estudios Perinatales
DFID	Department for International Development
DHET	Department of Higher Education and Training
HAQAA	African Higher Education Quality Assurance and Accreditation
HEI	Higher Education Institute
HR	Human Resources
ICT	Information and Communications Technology
IDRC	International Development Research Centre
IT	Information Technology
LMIC	Low and Middle-Income Countries
M & E	Monitoring and Evaluation
MOOCs	Massive Open Online Courses
NARS	National Agricultural Research Systems
NEHSI	Nigeria Evidence-Based Health Systems Initiative
NGO	Non-Governmental Organisation
NHRS	National Health Research System
OA	Open Access
ODA	Overseas Development Assistance
ORID	University of Ghana's Office of Research Innovation and Development
PI	Principal Investigator
RCS	Research Capacity Strengthening

REA	Rapid Evidence Assessment
R&D?	Research and Development?
SCAP	Scholarly Communication in Africa Programme
SCGI	Science Granting Councils Initiative
SIDA	Swedish International Development Agency
SRKS	Strengthening Research and Knowledge Systems
STEM	Science, Technology, Engineering and Mathematics
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WHO	World Health Organisation

1. Introduction

1.1 Background

There is abundant evidence that research can play an important role in a country's development by informing and supporting decision-making, identifying emerging socio-economic or environmental problems, and (to an extent) supporting economic growth through innovation [33] [50] [63] [136] [207] [219]. When one looks at the production of science and technology in low and middle-income countries (LMICs), the first observation is that there is a growing gap between a handful of "emerging economies" (mostly in East Asia), mid-income countries (e.g. most of South America) and the bulk of countries whose research productivity remains minute or very small (most of Sub-Saharan Africa) [122].

Underinvestment in research, coupled with the explosive public demand for university education, has hampered the development of research infrastructure in LMICs. This is especially evident in Sub-Saharan Africa, where research capacity has grown less than other LMIC regions thus limiting the region's ability to innovate and compete on the global stage [148] [90].

Over the past four decades, international donors have supported efforts to strengthen research capacity in LMICs as a means of achieving long-term sustainable development. This document presents the results of a Rapid Evidence Assessment (REA) of the literature on interventions to strengthen research systems and organisations. The study focuses primarily on the barriers faced by low and lower-middle income countries whose research systems are at an early stage of development. It also summarises the evidence on interventions undertaken to date, as they emerge from the accessed literature, with a view to identify effective ways for DFID to invest in research capacity strengthening (RCS).

1.2 Conceptual framework

The REA set out to answer two core research questions:

- What are the strategies and interventions available to strengthen research systems and support an enabling environment for research in low or middle-income countries?
- What are the strategies and interventions available to strengthen research organisations to produce and manage research in low or middle-income countries?

In order to answer the research questions, we searched and analysed literature specific to research systems and research organisations. Research systems can be defined as the national or regional environment that defines, enables and promotes research. This includes (at least) the set of institutions from the public and private sectors, strategy and policy frameworks, practices, and structures that either facilitate or hinder the production, diffusion and uptake of research. By contrast, a research organisation can be defined as a public or private institution (such as universities, research institutes or company research departments) whose primary goal is to conduct fundamental research, industrial research or experimental development, irrespective of their legal status or way of financing. Research organisations are key components of a research system, alongside individual researchers and research support staff, research funders, and policymaking or rule-setting organisations.

The literature does not neatly distinguish between research organisations and research systems. In order to differentiate between the two categories, we used the following anchor concepts:

- **Purpose**: Studies that are mostly concerned with actors whose primary purpose is to fund, regulate or facilitate research (i.e. research funders, policy-making organisations or networks of organisations with national or international reach) were generally included in the literature on research systems. By contrast, studies focusing on challenges or interventions related to actors directly undertaking research, local networks or research groups were generally included in the literature on research organisations.
- **Scope**: Studies that are mostly concerned with political and cultural barriers, national and international funding streams, and legal or policy issues were included in the literature on research systems. By contrast, studies that concern issues related to institutional governance, research practice, research management or research dissemination were included in the literature on research organisations.
- **Topic**: Even using the above concepts, the distinction was not always clear since, for instance, several studies presented evidence gathered at organisational level to illustrate issues that have a system-level impact, whilst others dealt with both sets of challenges. For that reason, the REA looked at the various topics raised within each study and considered whether they belonged to the discourse on organisations or systems. As such, some studies contribute evidence to both the section on research systems and on research organisations.

Finally, we have looked at strategies through the lens of a framework that draws heavily on the literature [52] [64] [81] [88] [179] [63] [48]. Some notable, recent interventions have been classified using this framework in Appendix C. However, it is worth noting that at programme level, interventions often use more than one strategy and therefore cannot be neatly classified. The framework below is still useful to help their conceptualisation:

(1) **Vertical research projects**: Interventions that strengthen research capacity incidentally and instrumentally, in order to produce research results for a specific project or programme;
(2) **North–South or South-North-South partnerships**: Interventions that deliberately strengthen research capacity through collaboration between Northern and LMIC researchers;
(3) **Centres of excellence**: RCS interventions aimed at high-potential research-intensive organisations, often with the ambition of making them the hub of research activity within a country;
(4) **Networks and consortia**: Long-term RCS interventions aimed at building sustainable organisational capacity for RCS, often with a strong South-South component.
(5) **Training**: RCS interventions that are focused on the delivery of *ad hoc* training to researchers, research managers, government officials and other stakeholders.

2. Methodology

This methodology is based on DFID's 'How to Note' [218] and it involves a series of clear sequential steps:

Table 1. Stepwise methodology

Step	Activities
Selection	• Determine criteria for the inclusion / exclusion of studies in the literature • Refine criteria for the categorisation of study types and design methods
Search	• Draw up a list of search words, based on research questions' topics • Design research strings • Determine criteria for the inclusion / exclusion of databases • Review and refine a list of accepted sources of literature
Filing	• Pre-screen literature against the inclusion criteria • File documents using Zotero and complete missing metadata
Review	• Determine quality criteria for the literature review • Review the literature using the stated criteria • Record and annotate quality assessment on Excel
Synthesis	• Quantitative analysis of the literature using Excel (study classified by type, design, source and quality) • Qualitative analysis of the evidence to draw out key findings and trends • Expert input and review of the synthesis and conclusions • Validate findings summarised in the REA document with external experts

2.1 Selection of databases

In addition to using search engines, we reviewed a large number of online databases, academic journals and organisational or project websites and selected those that were likely to produce relevant search results. Below is a list of databases consulted for this study.

Table 2. List of databases consulted

Databases and repositories	Academic journals	Organisational or Project websites
• 3iE (International Initiative for Impact Evaluation) • Development Experience Clearinghouse (DEC) • Gates Open Research • IDRC Digital Library	• African Journal of Science, Technology, Innovation and Development • British Medical Journal • Journal of African Research in Business & Technology	• African Academy of Sciences • African Universities' Research Approaches (AURA) programme • Association of Commonwealth Universities • Cambridge-Africa Programme • Canadian International Development Agency

• WHO Institutional Repository for Information Sharing (IRIS) • Open Knowledge Repository (World Bank) • Research for Development (R4D) • Social Science Research Network (SSRN) • PubMed Central • The World Bank Open Data • University of Nottingham library catalogue Scholarly publishers' databases (e.g. Wiley, Science Direct, SpringerLink) • Web of Science	• Journal of Higher Education in Africa • Nature: International Journal of Science • Research Policy • Science and Public Policy • Science Technology and Society • Scientific African	• Carnegie UK • Developing Excellence in Leadership Training and Science Africa (DELTAS) initiative • Development Research Uptake in Sub Saharan Africa (DRUSSA) • French Development Agency • INASP • Liverpool School of Tropical Medicine • New Partnership for Africa's Development (NEPAD) • Norwegian Agency for Development Cooperation • Organisation for Economic Co-operation and Development (OECD) • Royal Society • Overseas Development Institute • Science Granting Councils Initiative • Southern African Research and Innovation Management Association • Strengthening Research and Knowledge Systems (SKRS) programme • Swedish International Development Cooperation Agency (SIDA) • Relevant ministries of the home countries

2.2 Search strategy

2.2.1 Research questions and keyword selection

We used the research questions as a starting point to identify the various topics that should be covered by the REA. Appendix A contains a list of topics and keywords that were considered in this investigation. We developed search strings using a combination of keywords reflecting the concepts explored in Appendix A.[a] The search strategy used various combinations of over 120 keywords (see table 3 below). Each keyword has been searched for across the list of databases included in section Table 2. Searches with different combinations of these keywords and additions of keywords narrowing the scope (e.g. "academic", "research organisation") have been executed.

Table 3. Indicative list of keywords (excluding common variations)

> Research strategy; research system; research policy; science policy; research principle; research culture; research integrity; research ethics; structural incentives; recruitment policies; recruitment practices; research governance; research collaborations; research proposals; organisational strategy; organisational policy; organisational system

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[a] On designing search strings see, for instance: http://libguides.oulu.fi/c.php?g=110917&p=861470

Financial management; research funding; financial transparency; financial efficiency; research management processes / procedures; research training; research data; data protection and privacy; monitoring and enforcement of organisational policies; doctoral training, research information / research management information; research development / research business development; research support; access to equipment; access to travel, conferences and networking; researcher workload; administrative burden; teaching buyout

Access to research; open access; research publications; subscriptions to research publications; scholarly journals; intellectual property; publication incentives

Development; developing country; Low- and medium-income country; low income country; Africa; West Africa; East Africa; South Africa; India; Bangladesh; Pakistan; Indonesia; Vietnam; South East Asia; Latin America; Ethiopia; Ghana; Kenya; Nigeria; Rwanda; Tanzania; Uganda.

Search strings were formed using Boolean words (OR and AND) and common search techniques (such as the use of " " for exact sentences, * to denote truncated words, ( ) to indicate search priority and ~ to search for synonyms). Each search string was first tested on Google Search and Google Scholar, and then used in other databases.

Table 4. Examples of search strings used in the search

("~research system" OR "~research policy" AND "scientific") AND (~development) AND (Africa OR "~developing country*" OR Ethiopia OR Ghana OR Kenya OR Nigeria OR Rwanda OR Tanzania OR Uganda)

("~academic research*" OR universities OR academia) AND (Africa OR "~developing country*" OR Ethiopia OR Ghana OR Kenya OR Nigeria OR Rwanda OR Tanzania OR Uganda)

("research commercialisation" OR "technology transfer" OR "innovation") AND (universities OR academia OR "research organisations") AND (Africa* OR "~developing country*" OR Ethiopia OR Ghana OR Kenya OR Nigeria OR Rwanda OR Tanzania OR Uganda)

2.2.2   *Snowballing*

Search strings were continuously revised and updated, as new search words emerged from our own analysis of the literature. In addition, we complemented searches with snowballing research, which included:

- **Automated suggestions**: Literature suggested by online databases (such as those managed by academic publishers) based on the document under review; the suggested literature generally covered similar subjects (keywords), was published in similar outlets (e.g. journals) or was authored by the same individuals.
- **References from reviewed papers**: Relevant references contained in those documents that contain particularly relevant and recent evidence.
- **References from experts**: Documents shared or suggested by thematic experts (i.e. project associates and other stakeholders).
- **Google Scholar citations:** Analysis of subsequent citations from relevant papers.

2.3 Selection of studies

Studies were reviewed and assessed in two phases: we included 381 relevant studies for quick review using the eligibility criteria listed in Table 5 (all literature – initial). Using those criteria, we then filtered the initial sample down to 227 studies which were reviewed using the quality criteria set out in Table 7, below. Only the evidence from high and medium-quality studies was used in the preparation of this document.

2.3.1 *Eligibility criteria*

Our selection of studies to be included in the REA review was based on five eligibility criteria: relevance, practical focus, recency, quality and language.

Table 5. Eligibility criteria for inclusion in the review

Criteria	Description	Underlying questions
Relevance	The REA focuses on studies that address the research questions in the context of LMICs, with priority being given to low and lower-middle income and low-GERD countries (see Appendix B)	Does the study relate to the research questions, at least in part? Specifically, does it present evidence that is relevant to LMICs?
Practical focus	The REA prioritises studies that bring evidence of interventions to strengthen research systems and research organisations in LMICs.	Does the study focus on practical interventions? Does it at least consider the practical challenges/issues and unique circumstances affecting research systems and organisations in LMIC?
Recency	The REA covers primarily studies published from 2008 onwards. A 15-year recency threshold (i.e. studies published since 2003) will be used for studies of especially high relevance and/or quality.	Is the study published after the cut-off date of 2008? For older studies, i.e. 2003 onwards: does the study contain lessons and evidence that are likely to be relevant today?
Quality	The REA only contains studies that have a clear methodological framework, propose a novel theoretical approach and/or bring new empirical evidence, thereby excluding studies that can contribute little or no credible evidence to this investigation.	Does the study appear to have reasonable length, depth and credibility? E.g. does it contain evidence, is it independently authored, does the author/institution appear credible etc.?
Language	The REA only explores English-language literature.	Is the study (full text) written in English?

2.3.2 *Selection biases and mitigation actions*

The REA is likely to be affected by a number of small biases:

- **Practical focus:** Practical interventions were explored more frequently in grey literature reports than in academic journals; however, we sought to ensure that all studies demonstrated sufficient methodological rigour.
- **Language**: The focus on anglophone literature excludes relevant studies covering LMIC that are written in local and other international languages (such as French and Spanish); this, in turn, is likely to bring an Anglo-centric perspective to the assessment of research systems and organisations that may not always be culturally appropriate.
- **Discoverability**: The REA is likely to disproportionately represent studies published in international scholarly journals or on well-indexed websites as opposed to local studies; we have considered the extent to which these studies have been done through a North-South or South-South lens and have endeavoured to give sufficient space to the South-South perspective by searching specifically for studies conducted by LMIC researchers.
- **Location bias**: Search results on Google Scholar and other search engines will also be affected by our location and we therefore changed search settings to discover results surfaced from searches performed in LMIC.

2.4 Assessment of studies

2.4.1 Study type and design

Studies have been classified based on their type, design and method. The pilot review highlighted the need to adapt and slightly simplify the typology offered by DFID in its 'How To' note [218] (for instance, the literature available in this field is unlikely to contain experimental studies). We also found it useful to distinguish between descriptive and observational studies, and between systematic reviews and meta-analysis. The below classification was therefore adopted.

Table 6. Study types and design types

Study Type	Study Design	Study Methods
Primary	Descriptive	Case study
	Observational	Case-control study, cohort/panel study, cross-sectional study, longitudinal study, survey
	Experimental/Quasi-experimental	Randomised experiments, controlled experiments, repeated measures
Secondary	Systematic review	-
	Meta-analysis	Bibliometric analysis, other quantitative analysis
	Literature review	-
Theoretical/conceptual	-	Theoretical/conceptual
Mixed methods	-	Mixed Methods

2.4.2 Assessment criteria

The quality of the literature was then assessed using criteria based on DFID guidance, which have been appropriately reviewed to befit the types of studies. Studies were then assigned a score based on whether they met the criteria in Table 7: Adequately (2), In part (1) or Not at all (0).

Table 7. Quality assessment criteria

Quality criteria	Associated questions	Score
Conceptual framing	Does the study acknowledge existing research?	0-2
	Does the study construct a conceptual framework?	
	Does the study pose a research question or outline a hypothesis?	
Transparency	Does the study present or link to the raw data it analyses?	0-2
	What is the geography/context in which the study was conducted?	
	Does the study declare sources of support/funding?	
Appropriateness	Does the study identify a research design?	0-2
	Does the study identify a research method?	
	Does the study demonstrate why the chosen design and method are well suited to the research question?	
Validity	To what extent does the study demonstrate measurement validity?	0-2
	To what extent is the study internally valid?	
	To what extent is the study externally valid?	
Cogency	Does the author 'signpost' the reader throughout?	0-2
	To what extent does the author consider the study's limitations and/or alternative interpretations of the analysis?	
	Are the conclusions clearly based on the study's results?	
Relevance	Does the study explicitly consider any context-specific cultural factors that may affect the analysis/findings?	0-2
	Does the study address issues that are specific to LMIC?	
	Is it part of a wider initiative or is it self-contained?	
Total		0-12

Each study was then graded as High, Medium or Low quality based on its total score, as shown in the table below.

Table 8. Scores and quality standard

Study quality	Abbreviation	Score	Definition
High	↑	10-12	Comprehensively addresses multiple principles of quality
Medium	→	6-9	Some deficiencies in attention to principles of quality
Low	↓	0-5	Major deficiencies in attention to principles of quality.

2.5 Peer review

3. Evidence base

The Rapid Evidence Assessment showed that there is a large body of literature on research systems and research organisations in LMICs, but that evidence is concentrated around a limited number of key topics. A total of 381 studies were identified for initial review through a 'first screening assessment', which aimed at quickly determining whether a document was suitable for inclusion in the first research. From this initial group, 227 studies met the minimum threshold for inclusion in the REA. These studies form the evidence base of the document.

Fig 1. PRISMA diagram
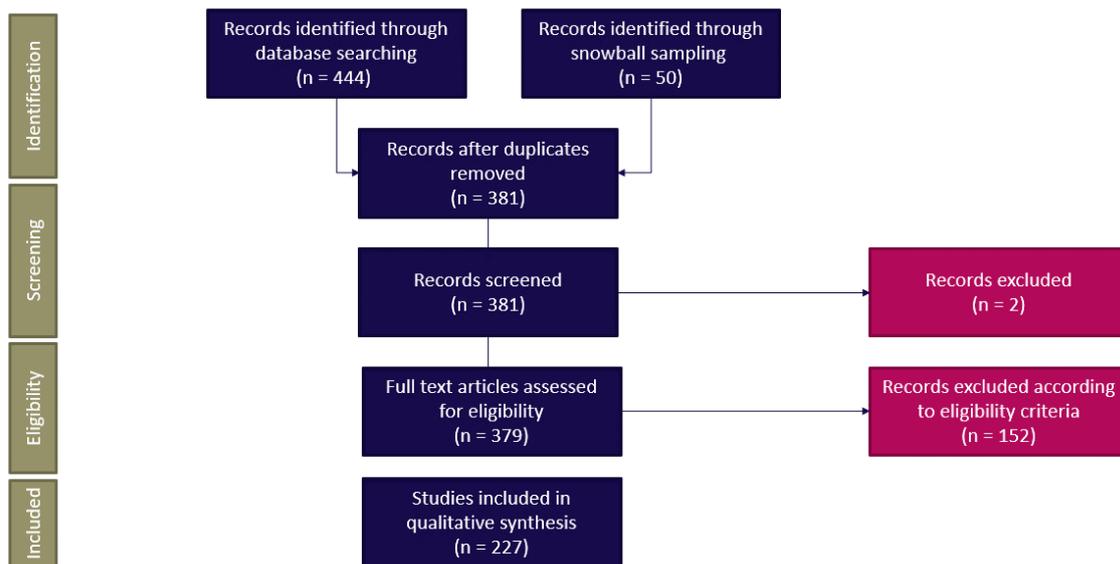
The analyses looked at various traits of the selected studies.

Sponsor: What organisation has commissioned the study or what is the author(s)' affiliation? For academic papers, we considered the affiliation of the first author only. For reports and other grey literature, we considered the main commissioning organisation (so, for instance a study sponsored by DFID and carried out by an academic would be classified as source: 'Government').

Fig 2. Type of sponsor organisation (n = 227)
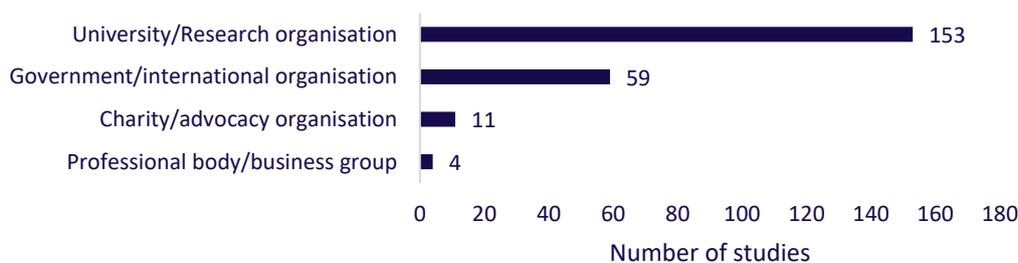
Geographical focus: What region and country does the study focus on? National studies were grouped under a regional label (e.g. India = Asia (South)). The geographical distribution of the studies included in the REA reflects the socio-economic status and research system development stage of each country (see Appendix B).

Fig 3. Geographical focus (n = 227)

Region	Number of studies
Africa	137
LMIC	44
Global	29
Asia (South)	7
Asia (east)	6
Latin America & Caribbean	3
Europe & Australia	1

Number of studies
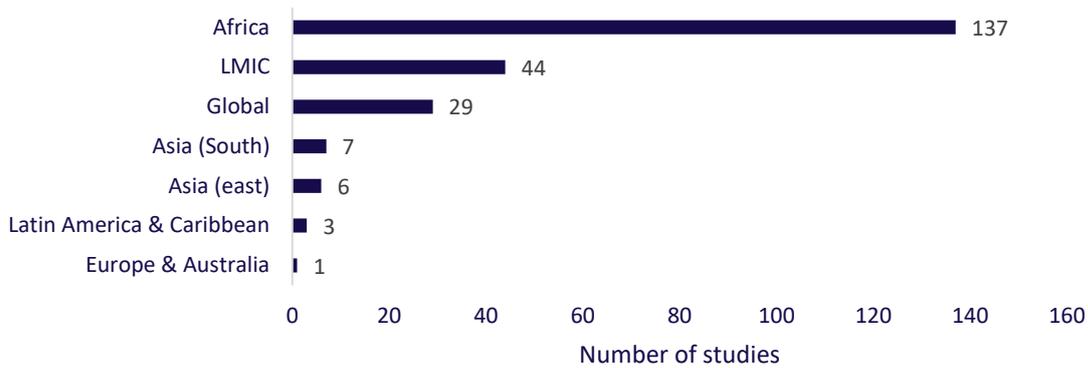
Methodology: What methodology is used to provide the evidence?

Fig 4. Methodologies used (n = 227)

Methodology	Number of sources
Descriptive/case study	40
Meta-analysis	38
Literature review	35
Descriptive/survey	33
Theoretical/conceptual	25
Mixed methods	21
Observational/cross-sectional	18
Observational/longitudinal	8
Experimental	5
Systematic review	4

Number of sources
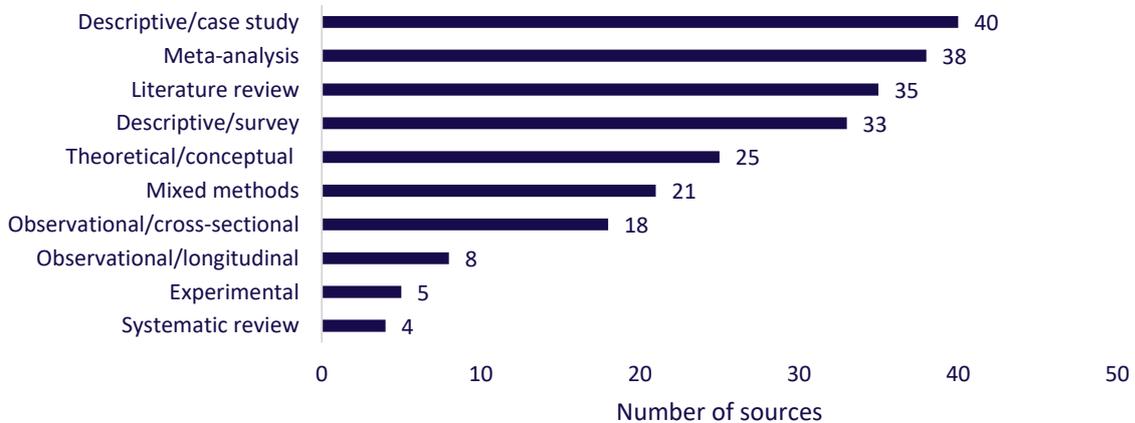
Interventions: Does the study present evidence of an intervention? If so, has the intervention been funded and/or executed by a donor organisation? Donor interventions include programmes and projects funded or otherwise supported by public and private development organisations, research funders and so on, generally in the field of research capacity strengthening. Other interventions include national, South-South interventions or academic collaborations purely focused on research.

Fig 5. Evidence of interventions (n = 227)

	Number of studies
Evidence of intervention	93
No evidence of intervention	134

Number of studies

UKaid
from the British people

Quality: What is the quality of the study (high, medium or low)? This is based on the methodology set out in section 2.4.

Fig 6. Quality of evidence (n = 227)
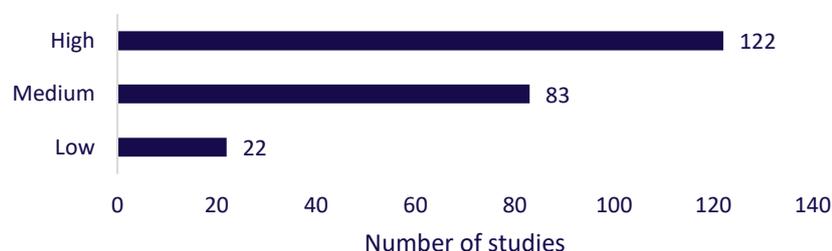
Strength of evidence: What is the strength of evidence on a given topic? Evidence is assessed using a three-point scale (Weak, Moderate, Strong) and it is based on a combination of the number of studies and the strength of the evidence on that specific topic provided by each study. The strength of evidence on a specific topic may be different from the overall quality of evidence of the study, which can cover several topics. The assessment considers two aspects: (a) the strength of evidence on the problems or needs in a specific domain and how these affect research systems or organisations (e.g. is there strong evidence that weak governance and transparency affect research production?); (b) the strength of evidence on the interventions put in place to address the identified needs and problems, and the effectiveness of such interventions.

Table 9. Strength of evidence by topic

Topic	Topic description	Strength of evidence	
		Problem/need	Intervention
Research systems			
Political economy barriers			
Governance and political context	The extent to which weak governments, low access to education and limits to freedom affect research production	Weak	Weak
Recognition of research in LMICs	The extent to which research production is considered important by the authorities	Moderate	Weak
National research environment			
Legal framework	The extent to which LMICs have adequate strategies, policies and norms for research	Moderate	Weak
National institutional framework	The extent to which LMICs have effective national institutions	Moderate	Weak
Research funding	The extent to which LMICs have adequate funding for research production	Strong	Moderate
Research impact			
Impact on health	The factors limiting the positive impact of research on public health	Moderate	Moderate
Impact on development	The factors limiting the positive impact of research on economic development	Moderate	Weak
Impact on public policy	The factors limiting the positive impact of research on public policy	Moderate	Weak
Research organisations			
Research governance			
Policies and culture in research organisations	The extent to which RPOs have appropriate policies and research culture	Moderate	Moderate

Integrity and ethics	The extent to which research integrity and ethics are promoted and respected	Weak	Weak
Human resources			
Recruitment and retention of research staff	The extent to which LMIC RPOs struggle to recruit and retain researchers	Moderate	Weak
Gender issues in research	The extent to which female researchers are represented in LMIC RPOs	Weak	Weak
Career incentives for research staff	The extent to which academic staff are incentivised to undertake research	Strong	Moderate
Training and mentoring	The extent to which researchers have access to adequate training & mentoring	Moderate	Moderate
Research management			
Financial management	The extent to which LMIC RPOs have adequate financial management practices	Moderate	Weak
Research support	The extent to which LMIC RPOs provide adequate support to their researchers	Moderate	Weak
Research information systems	The extent to which LMIC RPOs have adequate research information systems	Moderate	Weak
Research dissemination			
Research publications	The problems affecting scholarly communication in LMICs	Strong	Moderate
Libraries	The barriers faced by libraries in providing access to scientific information	Weak	Weak
RCS interventions			
Lessons learnt in RCS interventions			
Scope of RCS interventions	The past and current areas of focus of RCS interventions	Weak	
Planning an RCS intervention	Good practices to be followed in planning RCS interventions	Moderate	
Engaging stakeholders	Principles and approaches for engaging stakeholders in RCS interventions	Strong	
Managing RCS interventions	Good practices to be followed in managing RCS interventions	Moderate	
Evaluating RCS interventions	Good practices to be followed in evaluating RCS interventions	Moderate	

4. Synthesis of evidence related to research systems

4.1 Understanding of research systems in LMICs

The literature highlights a lack of empirical data on research systems in LMICs. Whilst the literature on research capacity strengthening is abundant, studies tend to rely on direct data collection (e.g. from project evaluations or stakeholder interviews). Such data is limited, piecemeal and ad hoc, affecting our ability to benchmark needs and understand opportunities for interventions.

Evidence on problems, challenges and needs: WEAK

- There are few conceptual frameworks and little up-to-date baseline data on research systems in LMICs, which makes it difficult to pinpoint specific needs at system level and plan interventions [23] [48] [81] [200].
- Higher education information systems in many LMICs lack incentives for universities to provide performance data to a central administrator, and for the central data administrator to report to government and/or to the higher education councils. In countries where legal provisions require the collection and distribution of university performance data, data are still predominantly compiled and submitted in paper format [42].

Evidence on interventions: WEAK

- Building research information systems in LMIC can be very difficult, so efforts should initially focus on the most research-intensive countries and organisations [65]. Several donor interventions are already focusing on centres of research excellence and flagship universities (see Appendix B).

4.2 Political economy barriers

A total of 41 studies mention political economy barriers affecting research systems in LMIC. Yet, in most cases, such studies do not provide substantial analysis of such barriers, their root cases, dynamics or practical consequences. Moreover, discourses focus largely on the limited role attributed to research by key actors at system and institutional level. Very few initiatives attempted to deal with these problems, and no best practice emerged.

4.2.1 Governance and political context

The literature presents limited evidence on the link between research and the political economic context of LMICs. Studies discuss access to and participation in research, largely in the context of access to higher education. Fewer studies analyse the correlation between 'good governance' and research systems. Similarly, the discussion of limits to academic freedom as a major barrier to research is limited.

Evidence of problems, challenges and needs: WEAK

- Stability and rule of law: problems related to voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption have limited the development of research systems in LMIC and negatively affect the ability of universities to develop research [216] [214] [20]. They also affect the effectiveness of research capacity strengthening (RCS) as substantial amounts of aid are diverted from their ultimate goals by bureaucratic barriers and corruption [45].
- Academic freedom: research values of independence, transparency, peer review and open academic publication of research results can still be problematic in contexts where a culture of open public debate is less established, as is often the case in LMICs [188] [208]. A survey of academics shows that limits to academic freedom and political instability negatively affect researchers' careers, but are seen as less important than lack of research funding, equipment, access to research, training or mentoring support and other direct barriers [20].
- Access to education: public universities are often established to satisfy ethnic interests, yet higher education in LMICs is an "elite system" with low participation rates [177] [41].

Evidence on interventions: WEAK

- Many different types of actors are involved in health systems research, including universities, think tanks, ministries of health, and health service delivery organisations. Strengthening networks between these different actors, in the same country, is critical [23].
- Adverse socio-political and economic factors and low national and international priority given to research are the background against which interventions operate [184] [165]. Interventions must therefore be based on the analysis of key players, politics and practicalities [208] [182] [76]. Similarly, when working at organisation level, interventions must consider the internal dynamics and processes of partner institutions to promote organisational change [39].

4.2.2   Recognition of research role

Consistent evidence is available on the recognition given to research by governments. While studies mention this issue, none of them make this the main focus of analysis. There is moderate evidence on the effect of donor interventions on the national research agenda, but weaker evidence on their ability to change national attitudes towards research.

Evidence on problems, challenges and needs: MODERATE

- There is consistent evidence that LMIC governments are yet to fully recognise the role of research and innovation in development. Many have committed themselves to increasing gross domestic expenditure on R&D, but in most cases, it still accounts for less than 0.5% of gross domestic product [210] [139] [208] [144] [133] [42]. Competing priorities of food security, health care, education and other basic social services mean that governments have not built a supportive environment for research, with chronic underinvestment in libraries and information services [144] [159].
- The "insatiable social demand" for higher education has created a system where universities' prioritise education at the expense of research [177] [42]. The shortage of university funds for research purposes reflects the fact that many private HEIs depend largely on students' tuition fees [173]. However, there is evidence that where the education sector is growing the benefits eventually carry over to research [136].
- Lack of South-South collaborations, combined with low levels of investment, contributes to gaps in LMICs research agenda, a lack of local ownership of research undertaken locally, and suboptimal utilization of available research capability [149] [147]. Moreover, research agendas are set more by international funders than by LMIC institutions, thus having a negative effect on capacity development [45] [101] [63].

Evidence on interventions: WEAK

- A general lesson from past interventions is that donors can and do have influence on LMIC research systems, but for interventions to have lasting effects they must align with national priorities and be defined alongside national stakeholders [189] [206] [146] [208] [118] [223] [42].
- Priority-setting exercises in LMICs are increasingly recognised as essential for directing finite resources to support research and to ensure that research is responsive to local needs and preferences [118] [223].
- A national research capacity forum, tasked with identifying gaps in research capacity from a strategic perspective that takes account of national priorities, is seen as an effective strategy for local priority setting in RCS. The Nigeria Evidence-Based Health Systems Initiative (NEHSI) brokered a partnership between the Government of Nigeria, the Department of Foreign Affairs, Trade and Development Canada and IDRC. It benefitted from a detailed, 2-year

planning stage during which the project's planners engaged in consultations with different levels of government and stakeholders. State and local government authorities set the research priorities and were involved throughout the project, while a social audit ensured that communities' voices were heard [58].

4.3 National research environment

A total of 112 studies contribute evidence relating to the national research environment. This includes those organisations, networks and systems that regulate, hinder or support research practice within a national system. The strength of evidence is moderate. Three dominant topics are identified:

- The legal and policy framework for research n LMICs
- The institutional frameworks for research in LMICs
- Studies discussing the lack of funding in LMIC research and its effects

4.3.1   Policies and institutions

19 studies are concerned with the broader policy framework for research, the evidence concerning country-level policies and institutions is moderate. Evidence is commonly extrapolated from external initiatives (e.g. networks or consortia of research organisations) to propose framework improvement in LMICs, with emphasis on common regional challenges. Policies tend to receive more attention than national institutions. We have found far fewer studies contributing evidence to interventions on this topic, and the strength evidence on interventions is weak.

4.3.1.1   Legal framework

We have identified several studies discussing the legal framework for research in LMICs (including strategies, policies, regulations and other norms). The level of evidence on needs is moderate while the evidence on interventions is weak in so far as it discusses how interventions *ought to be* as opposed to what interventions have worked in practice.

Evidence on problems, challenges and needs: MODERATE

- In many LMICs there is a non-conducive environment for research because the policy and legislative framework is incomplete and fragmented [210] [208] [5] [46] [42].
- There is evidence of a renewed commitment to research by LMIC governments to prioritising science in recent years. This is illustrated by the development of new high-level policy and strategy documents since 2010 [133] and systemic improvements in some disciplines [100]. However, the implementation of research strategies and policies remains poor due to lack of adequate financial and human resource support; limited attention to monitoring and evaluation; information overload and asymmetries; and the lack of a common understanding of what constitutes research excellence [35] [135].

Evidence on interventions: WEAK

- In order to be sustainable, capacity strengthening must take a systems approach that responds to capacity needs at different levels (individual, organisational, and environment or network) and is tailored to the context where they are being implemented [23] [93] [205] [63] [48] [56].
- Relatively few actions support improvements to the broad research system or environment compared to initiatives to support individual skills [26] [146] [81] [39] [115] [50] [48].

- The literature highlights initiatives dedicated to that focus on coordinating research and innovation policies and activities between government bodies, such as the Science Granting Councils Initiative and the HERANA project [35] [42]. No proven strategy to promote coordination was identified. In fact, forums promoting coordination and consensus-building lead to few agreements which were rarely implemented and monitored, while newly created 'super-ministries' were often unstable and failed to promote policy coordination [42].

4.3.1.2   National institutional framework

Few studies consider the national institutional framework for research in LMIC, as distinct from the policy framework discussed above. The national institutional framework includes organisations, networks and institutional collaborations performing four functions: governance, creating and sustaining resources, producing and using research, and financing.

Evidence on problems, challenges and needs: MODERATE

- LMICs have national-level research institutions more frequently than they have adequate research policy or legislation [100]. However, such institutions are fragile, disconnected and constantly under-resourced, and incapable of responding to external changes and demands [122].
- Research councils perform a wide range of institutional functions: disbursement of research grants, scholarships and loans; funding for infrastructure development; dissemination and uptake of research reports and findings; supporting scientific publishing/scientific journals; advocacy; collection of data and statistics; training of researchers; policy advice; setting research agendas/priorities; management of scientific collaborations and agreements; and coordination of the national innovation system [133].
- In LMICs, national research institutions face common challenges: lack of funding; lack of capacity and expertise; lack of comprehensive and up-to-date data; lack of leverage or sanctions to compel institutions to meet targets; incomplete institutionalisation, function drift, role confusion and contested political autonomy. The absence or ineffectiveness of national research institutions causes duplication, fragmentation and missed opportunities in national and international RCS initiatives [208] [41].

Evidence on interventions: WEAK

- The HERANA project has shown the importance of strengthening capacity in education ministries, and suggests that the creation of quasi-independent government agencies opens up space for developing and concentrating specialised capacity and expertise at the level of national governance [42].
- There is an unmet need for research councils to share information and learning on a regular basis. The Science Granting Councils Initiative (SCGI) has shown interest in supporting programmes that shift ownership to Africa and shows potential for national level SGCs to leverage funding from international funders without undermining local ownership activities [35] [41].
- A project implemented by the West Africa Health Organisation successfully delivered research policies, plans and agendas, the implementation of a national research ethics committee, and the adoption of a research information management system across four countries. It did so through a systematic and participatory approach to national research governance based on local priorities, building on sustained and long-term donor commitment [182].

4.3.2   Research funding

There is strong evidence on the lack of national funding for research and how this acts as a key constraint on research development at both system and organisation level; the effect it has on the number, type and scale of research projects conducted; and the contextual dependency on external funding sources (e.g. donors and Northern research partners) to conduct research. However, far fewer studies discuss the role and practice of national research funders in LMICs. Fewer studies look at interventions, their effectiveness and possible side-effects such as donor dependency.

Evidence on problems, challenges and needs: STRONG

- The funding gap across the LMICs research sector results from many years of public spending cuts under structural adjustment programmes. This has produced low wages for researchers, weak concentrations of expertise in departments and few physical facilities for conducting research including libraries, information technologies and laboratories [66] [208] [204] [136] [25].
- Research funding bodies in Sub-Saharan Africa are at different stages of development: some councils (e.g. in South Africa, Tanzania, Kenya and Zimbabwe) are well established, whereas others (as in Namibia, Botswana and Mozambique) are in their early stages of establishment. A dedicated science funding council is largely a feature of the research systems of countries in the Anglophone tradition, such as Kenya, South Africa, Uganda, Zambia and Zimbabwe [133].
- In many Sub-Saharan countries, the national landscape is characterised by a multitude of funding agencies, programmes and instruments often organised around sectoral interests, such as health and agriculture that are influenced by international research/ODA funding. Most LMICs use block grants (i.e. direct institutional allocations), although there are indications that this is changing [41] [85].

Evidence on interventions: MODERATE

- Donor interventions can create over-dependence on external funding for research [146]. The Scholarly Communication in Africa Programme (SCAP) recommended that national governments establish national research foundations so that scholars can seek local funding from more sources than just the university research budget [195].
- At a policy level, decisions need to be made about whether scarce research funding is concentrated in fewer research-intensive institutions or distributed more widely [222]. Centres of research excellence in LMICs — either independent institutes, or university-based ones - often depend on money from abroad. For instance, 47% of Kenya's research budget, 57% of Uganda's, and a staggering 78% of Mozambique's comes from foreign grants [76].
- The SCGI project has shown that national research agendas in LMICs are evolving and that the traditional dominance of research in health and agriculture is not set to continue. It suggests that ICT and energy are growing in significance, while future trends will include more investment in climate change and a greater presence of Japanese and Chinese supported activity. It will be important to build capacity to fund science over a wider variety of areas and look for ways in which to build capacity across sectors [35].

4.4   Research impact

There is moderate evidence on the impact of research in low and middle-income countries, suggesting that impact is not often measured. Specifically, there does not seem to be any ongoing effort in LMICs

to measure research quality and research uptake, and only few examples of system-wide assessment of research publications. While impact is mentioned in 41 of the reviewed studies, the evidence for the impact of research is higher for health and development than it is for public policy.

Several studies imply or briefly mention the contribution of research to societal goals, yet most do not examine the issue of research impact in sufficient depth and impact is this is almost never the main subject of the study. In most cases, the positive impact of research is assumed, and the discussion only mentions measures that can be put in place to increase the impact of research.

4.4.1 Impact on health

22 studies discuss the importance of research for public health in LMICs. Studies often focus on the factors that influence that effectiveness of a National Health Research System (NHRS).

Evidence on problems, challenges and needs: MODERATE

- Locally-led health research in LMICs is critical for overcoming global health challenges [63]. Yet decision makers in LMICs seldom make effective use of social determinants of health research findings to formulate and implement public policies; as a consequence, public health-related decisions tend to be insufficiently evidence-based [33].
- The capacity to work with research and define research priorities on the policy-side is often weak, with few or no scientific advisory bodies linked to governmental institutions [208]. Linkages between higher education, research, private sector and government are often not developed into innovation systems [208] [2] [125] [93] [205] [63].
- The absence of prioritised national health research agendas, integrated within the national health research system, that respond to local needs leads to failure in adequately translating research into actions at the level of both policy and practice [33].

Evidence on interventions: MODERATE

- A review of interventions to strengthen NHRS in West Africa revealed that system-level capacity strengthening was not achieved due to structural deficiencies and suggests that long-term donor support is needed and that the international organisations with a permanent in-country presence (such as the UN and WHO) are better placed to strengthen health capacity at system level, especially when working at regional or sub-regional level [182].
- A review of the impact of individual and institutional capacity strengthening programmes conducted by the UNICEF/UNDP/World Bank/WHO highlighted the need for a more equitable RCS process. It suggests that: support is tailored to the existing research capacity in disease endemic countries, it is focused on strengthening NHRS, and is done through local stakeholder engagement from the intervention design stage [127].
- The Centro Rosarino de Estudios Perinatales (CREP) in Rosario, Argentina, is a good example of how a long-term, flexible plan can lead to sustainable increases in research capacity [58]. Lessons learnt from the ESSENCE programme on RCS in the health sector led to the development of seven RCS principles: 1) Network, collaborate, communicate and share experiences 2) Understand the local context and accurately evaluate existing research capacity 3) Ensure local ownership and secure active support 4) Build in monitoring, evaluation and learning from the start 5) Establish robust research governance and support structures, and promote effective leadership 6) Embed strong support, supervision and mentorship structures 7) Think long-term, be flexible and plan for continuity [58].

4.4.2 Impact on economic development

The impact of research for economic development in LMICs, especially in the context of innovation and the 'knowledge economy', is discussed in 17 studies.

Evidence on problems, challenges and needs: `MODERATE`

- There is evidence that investments in research have a positive impact on economic development and this link is especially strong in LMICs [136] [219] [207]. However, the function of higher education institutions is still primarily linked to poverty reduction and community support, rather than economic competitiveness, entrepreneurship and innovation [41] [42].
- University-industry collaborations are not supported at system level. There is a need to align research to national development goals, develop a human resource that is relevant to the needs of industry and produce research which supports business competitiveness [136] [68].
- Collaborations with non-HE actors have become important for top-tier LMIC universities and academics are incentivised to work with non-HE actors. However, the most highly-prioritised stakeholders are government bodies, research funders and donors; collaboration enterprises and industry are less important [220]. Moreover, if policy aims to successfully increase the impact of academic research through fostering engagement, not only academics but firms too need to be skilled in initiating and maintaining such collaborations [184] [163].

Evidence on interventions: `WEAK`

- The Scholarly Communication in Africa Programme (SCAP) demonstrated that LMIC universities would benefit from the presence of innovation-focused intermediaries that extend the value, utility and reach of academic research [195].
- National Agricultural Research Systems (NARS) effect technological change through a linear model of research, development, and extension (where research originates from the scientific researcher and flows to the farmer [48]).
- Given the general reticence to make use of formal R&D activities, the private sector should be encouraged to engage in university collaborations. This can be done by involving the private sector directly, and through industry associations and civil society organisations, in setting agendas [35].

4.4.3 Impact on public policy

Only a handful of studies explore the impact of research on public policy, including influence on policymaking and influence on social issues.

Evidence on problems, challenges and needs: `WEAK`

- The literature shows that the adoption of scientific research outputs by governments is very limited, and that government demand for research policy and regulatory environment is weak or inexistent [87] [80] [208] [5].
- The problem cuts both ways, however, as there is a need to support local capacities in linking research topics to national and regional policy and development priorities, as much research produced in LMICs is of limited or no value to decision makers. Major barriers to evidence-based policy-making include poor communication and dissemination, lack of technical capacity in policy processes, as well as the influence of the political context [87] [80].

- Overall, poorly-developed research capacity and linkages with policy are limiting the societal impact of research and, by extension, LMICs abilities to respond to social and health challenges [222] [50].

Evidence on interventions: WEAK

- Constraining factors can be addressed by more holistic capacity strengthening approaches that are demand-driven and supported by a long-term commitment of the donor as well as the beneficiaries [169] [165].
- The evaluation of the ASADI initiative showed that local intermediary organisations can have an important role in promoting the use of research to influence public policy. Because LMICs have a sparsely populated policy landscape by international standards, the programme focused on growing the capacity of the academies to supply evidence-based insights to enhance national thinking about health and sustainable development. These strengthened academies have become an effective route for scientific and medical evidence to affect policy thinking. However, the evaluation also showed that policy advice has to be given at the right point in the policy process which makes it difficult to work to an external timescale, and that securing the long-term sustainability of intermediaries is key [107].

5. Synthesis of evidence related to research organisations

5.1 Research governance

Research governance defines the broad range of regulations, principles and standards of good practice that ensure high quality research. Research governance takes place on three levels: on a macro level (policy), meso level (funding) and micro level (organisation) [68]. Research governance at organisational level comprises a range of issues affecting stakeholder behaviour. The most important of these issues are:

- Organisational strategies and policies related to research, and in particular the cultural issues affecting the perceived importance of research within the organisation
- Career incentives to perform and publish research
- Policies and practices concerning research integrity and ethics

36 studies cover research governance in LMIC. Overall, the REA has revealed moderately strong evidence on research governance at organisational level. Most studies of research governance focus on the interaction between funding agencies and researchers in the selection, monitoring, and evaluation of publicly funded research. Micro-level studies on the governance of research at organisational level are not numerous, but they tend to be methodologically robust as they rely on empirical data collected through surveys, interviews and direct observations. This is, by and large, true for organisational level-studies as a whole.

5.1.1 Policies and culture in research organisations

Research strategies and policies within organisations are frequently mentioned in the literature. In particular, studies concentrate on the importance attached to research by organisational leaders and on the perceived function of universities as teaching institutions in LMIC.

Evidence on problems, challenges and needs: MODERATE

- Universities often have research governance structures and policies in place, but their status and effectiveness is limited. Most institutions do not have a formal and/or accessible research strategy and generally lack policies and/or guidelines to inform implementation. Even when strategic plans for research are in place, these may not be reflected in the reality of the academics' work environment [41] [173] [112] [58] [46].
- In line with the incentives put in place by governments and funders, university leaders also prioritise teaching over research. This can mean that university management may consider research to be marginal to the business model. Management commitment is vital to achieve the changes in policies, rules and systems that will support research [173] [126] [208] [20] [42].
- Research cultures of enquiry and critical thinking are hard to maintain in the face of competing incentives and performance targets. This also affects teaching, limiting the extent to which students are encouraged in independent exploration and enquiry [224].

Evidence on interventions: MODERATE

- The HERANA project showed the importance of, and the difficulty in, creating a shared understanding of the role for the HE sector in national development among government officials, university managers and academics, and donors. It also showed that despite strong institutional commitments to strengthening knowledge production at university level, without national support to curtail the pressure for income generation through increased undergraduate enrolments, the universities could not manage the contradictory demands of undergraduate training and knowledge production [41] [42].
- The HAQAA initiative has recently adopted an assessment tool for African universities (AQRM) that measures institutional performance (including governance and management, infrastructure, finance, research, publication, innovation and community engagement) and ranks institutions accordingly. The initiative is still recent but it has already developed awareness of institutional policies for research and helped identified critical gaps [77].

5.1.2   Integrity and ethics

Only eight studies discuss problems related to research integrity and research ethics and related interventions. The issue of research misconduct was well-explored, but overall the number and depth of studies on this topic is low compared to the perceived scale of the problem.

Evidence on problems, challenges and needs: WEAK

- 91% of African countries have a national ethical review committee for health research [100]. However, outside the health sector, there appears to be little or no discussion of research misconduct and many LMICs have no national body for dealing with misconduct [12].
- Various studies showed that concerns about research misconduct within an institution are widespread among LMIC researchers, coupled with a low chance of getting caught for scientific misconduct and a low severity of penalties [152] [102].
- Typical challenges are the failure to accept and adhere to recognized standards for research ethics, which can cause problems in international collaborations; and practical challenges in applying ethical standards when recruiting participants and collecting empirical data (especially from vulnerable groups) [102] [11].

Evidence on interventions: WEAK

- Research misconduct can only be dealt with simultaneously at the micro and macro-levels: by promoting individual integrity of all individual research staff and institutions through training, mentoring and supportive supervision; and by establishing transparent and accountable national and institutional frameworks that take potential instances of research misconduct seriously [102].
- An intervention in three Mozambique universities demonstrated that not only did these institutions lack a robust research governance framework, including an ethics policy, but that they were resistant to developing one in the first place. Research governance is perceived to impede research due to extensive or bureaucratic approval processes and lack of knowledge of governance requirements, especially ethical requirements, by investigators [115].

5.2 Human resources

A total of 32 studies contributed evidence on issues related to human resources in LMIC universities, especially in the face of the rapid change in the higher education sector. Four interconnected topics are explored by the literature:

- Challenges related to recruitment and retention of researchers and research support staff, and the connected problem of the 'brain drain';
- Gender issues in research;
- Issues related to career incentives for academics, and their ability to drive research; and
- Training and mentoring of researchers.

5.2.1   Recruitment and retention

13 studies explore the challenges connected to recruitment and retention of researchers and research support staff in LMICs, with a focus on worker exploitation, slow recruitment, undertraining and lack of mentoring.

Evidence on problems, challenges and needs: MODERATE

- Despite decades of investment to strengthen research capacity, there is a shortage of senior scientists available to lead or manage research in many LMICs. The rapid growth in student and staff numbers known as massification has led to more intense workload for academics, pressure to hire young under-professionalised staff and more emphasis on teaching [191] [177] [41] [202] [217] [213] [42].
- The pressure to recruit is compounded by slow and inefficient recruitment processes, and by a culture that seems more preoccupied with employing strong students than with producing high-quality impactful research [176].
- The development of attractive career pathways is key to bringing research in LMICs to international standards of excellence: however, poor salary structures and non-transparent promotion systems lower motivation to do research and publication [188] [210] [36] [41] [151].
- Career paths for research management and administration staff are poorly defined: the lack of opportunities for career progression, training and professional development acts as a significant barrier to recruiting and retaining specialist research support [46].

Evidence on interventions: WEAK

- Improving recruitment processes will require an update of HR policies, an increase in the number of HR officers and better training. However, the more successful cases suggest that institution building and enhancement of the research environment are often required [188][146].
- Concrete actions to promote the retention of skilled and experienced researchers in LMICs include: improving conditions of service, job security, career pathways, opportunities for engagement with peers [66].

5.2.2   Gender issues in research

We found only a handful of studies discussing gender issues in research in LMICs, but their findings around under-representation of female researchers in LMICs are very consistent. We found no evidence on the impact of gender issues on research production.

Evidence on problems, challenges and needs: WEAK

- Studies of scientific occupations have shown that, compared to men, women tend to drop out of the career pipeline at the point they should be moving upward. Accordingly, female scientists are increasingly under-represented at each stage of the scientific career ladder but there is little comparative evidence from LMICs as to the causes [192] [168].

Evidence on interventions: WEAK

- Supporting locally led initiatives and piloting new work on gender mainstreaming has achieved local change and enabled learning by involving men and women and securing the support of senior leadership. Stakeholders have sometimes found it advantageous to hold women-only events to enable experiences to be shared [76].

5.2.3   Career incentives for research

19 studies mention career incentives and disincentives for academic staff to perform and publish research. Problems of low salary, low time, low funding and practical difficulties in carrying out research affect a system's capacity to retain talent and grow its research capacity. There is strong evidence on both the problem and its impact on research production, and moderate evidence on past interventions.

Evidence on problems, challenges and needs: STRONG

- Across LMICs there is a divide between academic and "mission-oriented research", largely run through consultancies [132]. Low salaries have fuelled the dramatic growth of consultancy research, which can rapidly provide policy-relevant research but may undermine academic research, and can focus on research topics that are useful to the contractor but not necessarily to the researcher and national interests [132] [212] [213].
- Although research may be a stipulated requirement for promotion, the teaching function remains the clear priority for many institutions. Therefore, academic staff often carry large teaching, administrative and consultancy workloads which means that the time available for research is minimal [208] [195] [151] [20].
- North-South research collaborations often work as a vehicle for LMIC researchers to find employment opportunities in high income countries. This has historically created a problem known as 'brain drain', which severely affects research system development in LMICs and shows a need to invest in science to attract and retain researchers [122] [146] [204] [154]. LMICs have tried to lure researchers employed abroad into returning in their home country. But this has been hampered by difficulties in matching the salaries, infrastructure, training and career progression available in higher income countries [124] [149] [65].
- In the African context, brain drain is especially acute among public universities and staff retention is also affected by the pull from other sectors of the national economy, known as internal brain drain [154].

Evidence on interventions: MODERATE

- The HERANA project showed that monetary incentives are effective. Case studies have shown that monetary rewards provided by universities have implications for the advancement of core academic activities (teaching, supervision of postgraduate students and research). However, academics are subjected to competing incentives from the university itself, research funders, NGOs and entities that offer consultancy opportunities which support the production of different outputs [41] [42].
- A well-designed national system of incentives can be effective in changing researcher practice. For instance, South Africa adopted an innovation systems approach with direct and indirect incentives for research. A knowledge output subsidy is awarded to the university, which then chooses how to reward the academic(s) responsible for research activities. However, incentives linked to research publications and the supervision of PhD and masters students must be coupled with adequate research funding and lighter teaching workloads in order to be effective [41] [42]. Moreover, when designing system-level incentives, one-size-fits-all government policies may lead to universities becoming less diverse and differentiated [204].

5.2.4   Training and mentoring

There is moderate evidence on the lack of appropriate research training and peer mentoring and related RCS interventions. However, the studies largely rely on researcher surveys and interviews and do not adequately explore the root causes of these problems, nor the impact that they have on research production at system level.

Evidence on problems, challenges and needs: MODERATE

- Mentoring and support play an important role in the majority of young scientists' careers, especially in professional and interdisciplinary fields. At an institutional level, if early career researcher support is not given priority, then resources will not be invested, restricting the opportunities for development [226] [222] [20]
- There is a need for better and more systematic training opportunities for LMIC researchers. This can be done by supporting the development of open access training curricula [23].
- Monitoring and evaluation of researcher development can be effective in demonstrating the value of researcher support. It can also be an important strategy in guiding researchers in their career development and attracting other researchers to develop their skills, as they see the benefits of participating [222].
- The inclusion of new technologies into a scholarly communication ecosystem often requires extensive and continued retraining of support staff [195].

Evidence on interventions: MODERATE

- The SORT-IT training model is an example of successful training programmes on health research. The training programme has had a positive impact on health policy and practice, e.g. establishing good medical practices and highlighting gender gaps, but its impact was greater at individual and institutional level [123].
- South Africa uses government funding to encourage mentoring and supervision of postgraduate students and early career researchers. This was effective in creating system-level change, but its quantitative approach provides perverse incentives to prioritise quantity of trained research students over the quality of training [190] [222].
- Supporting individual skills development and capacity at the organisational level has enabled LMIC partners to take over the running of key services. It also showed that a learner-centred methodology is more effective than a general participatory approach to training. MOOCs and

online courses have allowed greater engagement by disadvantaged groups and higher completion rates [76].

- Efforts to promote the professional development of research support staff are often unsustainable, as they tend to be nested within funding for specific projects and programmes of limited duration. Some of the better-established institutions have offered research management training courses, but these are often not widely accessible to outside organisations. It is important to couple research management training with the improvement of professional practices and infrastructure supporting research activity [210] [73] [112].

5.3 Research management

36 studies discuss research management issues. The most commonly discussed issues are:

- Issues related to research infrastructures such as software and research information systems;
- Issues related to financial management; and
- Issues related to research support services.

5.3.1 Financial management

7 studies provide evidence on financial management practices and challenges in LMIC research organisations. Studies discuss financial management, grant management and monitoring and evaluation but tend to lament the lack of baseline data to work with (which, in itself, is an indicator).

Evidence on problems, challenges and needs: <mark>MODERATE</mark>

- The African Institutions Initiative has shown that financial management, grants management, and monitoring and evaluation remain common areas in need of improvement as well as formalisation. The degree to which guidelines exist on specific administrative processes varies across regions, and many aspects of research administration are improvised or implemented inconsistently. Data management and storage systems and practices are generally weak, younger and less established organisations rarely keep records of research outputs, funding applications and grant applications [112] [91].
- Previous needs assessments for sound financial management in LMICs identified the following areas for improvement: grantsmanship skills (grants writing, peer review, pre/post awards management, mentorship, communicating research findings, responsible conduct of research), regulatory frameworks, research funding infrastructure and data collection and reporting [91] [65]. There is a general lack of awareness amongst PIs and their institutions as to what constitutes research management and so inevitably they fail to include some or any research management costs in their budgets [46].
- Multiple reporting and grant management requirements put a strain on research organisations' resource-scarce systems [208] [110].

Evidence on interventions: <mark>WEAK</mark>

- Donor initiatives that agreed to provide unearmarked pooled funding and accepted a single monitoring and evaluation framework allowed a more efficient use of the funding by the recipient organisation while achieving progress against strategic objectives and better aligning research against strategic priorities. It also led to changes in the sense of ownership and collaboration between management and donors [208] [110].
- The African Academy of Sciences is developing a pan-African standard in Good Financial Grant Practice (GFGP) for research and academic institutions and not for profit organisations, which

seeks to reduce the burden of multiple audits for grant recipients who often have a number of funders and also provide real assurance that funds are well managed. The initiative seems relevant and likely to produce considerable evidence on this issue, but no evaluation has been published so far on the progress of the initiative. The level of evidence on interventions remains low.

5.3.2   Research support

Although relatively few studies discuss research support services, these are quite comprehensive and their findings consistent. Whilst there is moderate evidence on the lack of support services and their negative impact on research productivity, there is weak evidence as the interventions in place to address this problem.

Evidence on problems, challenges and needs: MODERATE

- Research administration is often viewed by senior management teams and researchers as an expensive luxury rather than a prerequisite for supporting research quality and realising project potential and efficiencies. Some institutions choose not to invest in centrally contracted research management positions, and using project-based funding for research management capacity building does not foster the creation of or nurture the development of sustainable research offices [13] [58] [46].
- Research organisations in LMICs execute too many projects at the same time with little or no link to the organisational mandate and no standard processes or framework for projects execution, the majority of which either fail or are abandoned. Procurement processes for research projects are reported to be bureaucratic and unscrupulous, and research support structures are often insufficient and ineffective [199] [41].

Evidence on interventions: WEAK

- There are beacons of good practice in research management, such as the University of Ghana's Office of Research Innovation and Development (ORID) and the Research Support Centre at the University of Malawi's College of Medicine, but whilst some initiatives have produced models of excellence, none are widely replicated [46].
- The following areas have been identified as priorities to improve research support services in LMIC institutions: research management, grants management and research project impact assessment. Similarly, the demand for capacity strengthening among LMIC research councils is clustered around general organisational improvement as opposed, for example, to greater understanding of science and technology systems [133] [226] [199].
- Opportunities for maximising and pooling resources for researcher support within institutions include integrating Massive Open Online Courses (MOOCs) to supplement researcher support programmes, and engaging senior or retired alumni to share insights with junior researchers [222] [76].

5.3.3   Research information systems

Many studies discuss issues related to research information systems at institutional level. Evidence on the impact (manifest or potential) of internet communication technology on access to research, dissemination of research and research collaborations in LMICs is moderately strong, albeit much of it is outdated. By contrast, evidence on research information services in LMIC research organisations

is less strong, but it clearly shows that research information systems across LMIC universities are still inadequate. This reinforces the findings that insufficient data is available on research at system level (section 5.1).

Evidence on problems, challenges and needs: MODERATE

- Very few institutions have an effective electronic management system in place, making it difficult to know exactly how many projects are active and to track their progress. It also means that figures for research income across an institution are not readily available. Common problems include ineffectiveness in record management practices, incompetent personnel, inadequate infrastructural facilities, and constant power failure [196] [197] [46].
- There is a need for better research monitoring and evaluation systems at institutional level, which should track progress and change in individuals, programmes, school/faculty/colleges and central support functions. In particular, thorough institutional evaluations need key indicators to assess the effects of 'system' changes and the effect on external stakeholders [71].
- Information and Communication Technologies (ICTs) are critical to LMIC's long-term growth. However, many LMICs have gaps in ICT infrastructure and system deployment, which hampers the production, management and dissemination of research. While academics in the region increasingly use the Internet for research, this is generally restricted to browsing for online information or accessing online journals. Higher level research enquiry such as accessing distant scientific infrastructure, for example, supercomputers, modelling and simulation equipment, large astronomical telescopes or grid computing, or 'big data' research continues to be limited [41] [79] [138] [131] [175].

Evidence on interventions: WEAK

- Investment in ICT infrastructure can be effective. Past interventions showed a positive correlation between accessibility and utilisation of electronic resources (i.e. e-journals, e-books, online databases, electronic conference proceedings etc) and productivity of academic staff [13].
- The SCAP initiative showed that e-infrastructure for scholarly communication is often developed as a result of externally funded programmes but that universities did not commit to ownership and long-term maintenance of the infrastructure. It also meant that e-infrastructure had often been developed in a piecemeal, "cottage-industry" fashion without cognisance being given to interoperability and cohesive enterprise management of systems across the institution. It concludes that donors should institutionalise and harmonise infrastructure development and grow capacity, developing an internal policy framework in support of scholarly communication [195].

5.4 Research dissemination

For the purpose of this review, research dissemination embraces issues related to the production of and access to scholarly communication, including published outputs, data and non-written forms of communication, such as participation at conferences. We found 50 studies discussing issues related to research dissemination.

Over half of the studies within this category focused on the production-side of scholarly communication, several studies also covered issues related to access to scholarly research, including library services.

5.4.1 Research publications

There is strong evidence on the problems affecting scholarly communication in LMICs, such as researchers' attitudes to publishing, challenges to publishing, costs of publishing, publishing venues (e.g. local vs. international journals) and the spread of open access. Evidence on interventions is moderate.

Evidence on problems, challenges and needs: STRONG

- Africa produces only 2% of the global publication output. Despite progressive improvements over time, Sub-Saharan Africa still lags behind other regions in terms of research productivity across all disciplines and its research remains comparatively marginal in the global context of academic research production. Moreover, a handful of countries account for the majority of peer-reviewed publications (South Africa, Ghana, Kenya, Nigeria) [195] [51] [162].
- LMIC researchers still struggle to publish in international journals [33]. Editorial ignorance of the local context is suggested as a reason that LMIC publications do not receive due regard and consequently academics are becoming discouraged [20]. Some have argued that the imperatives of global competitiveness have created a hierarchy determined by values from the global North over the developing world [69].
- At the same time, LMIC publishers remain underdeveloped as government support specifically for scholarly publishing is lacking [195] [54]. Faced with limited research grant funding and constrained by a lack of international publishing opportunities, research organisations must choose whether they want to support local research by making outputs from that effort freely and openly available [9].
- Because so much LMIC scholarship remains outside of the main abstracting and indexing databases (particularly the Web of Science index), and because institutions and scholars have not applied a cohesive or strategic approach to disseminating outputs, there is a preponderance of unpublished research which is not easily accessible because it is generally not held in university libraries or available online [195].

Evidence on interventions: MODERATE

- University ranking systems have led to a strong emphasis on quantifiable research outputs, which is out of touch with the daily realities with which lecturers and senior lecturers are faced. Scholarly publishing in South Africa is strongly influenced by the Department of Higher Education and Training (DHET) system of paying subsidies to universities for research publications. The 'publish or perish' culture is the major driver behind the huge increase in publication output since 2005 and has led to negative consequences such as a focus on quantity over quality, and the problem of predatory publishing [134] [20].
- Altmetric tools may be an effective alternative to measuring the effectiveness of scholarly communication in Africa, but in order to be relevant in the developing world, altmetric tools must also be compatible with the less sophisticated publishing technologies employed by small publishers [9] [72].
- The 15-year 'Strengthening Research and Knowledge Systems' (SRKS) programme showed that few interventions support neglected parts of the research system, such as libraries consortia and local publishing mechanisms. The programme showed the importance of intervening at different levels, giving authors new platforms to publish (Journals Online), appropriate quality standards (Journal Publishing Practices and Standards), training for scientific writing (AuthorAID) and an improved IT infrastructure within their institutions (Campus IT framework) [76].

5.4.2   Libraries

Several studies discuss access to and management of scholarly research, but the evidence is less strong than that on scientific publications. Studies discuss the practices of, and challenges faced by, research libraries; and the impact of open access on access to research in LMIC. Evidence on both the challenges and interventions is weak.

Evidence on problems, challenges and needs: WEAK

- The librarianship profession in Africa has been lacking in the knowledge of the right steps to take in facilitating access of information for development [159], but flagship African universities have made key strides when it comes to library journal subscriptions, which academics reported had improved factors considerably over the last five years [41].
- Poor access to information is caused, among others, by lack of awareness of open access and of OA institutional repositories, inadequate ICT infrastructure, lack of a clear open science policy, low level of researchers' information search and publishing skills, inappropriate training opportunities for library and information professionals and a lack of authors' desire to deposit their works in institutional repositories [138] [151] [225] [180] [76].

Evidence on interventions: WEAK

- In Kenya, university libraries are required to engage in collaborations and resource sharing activities to enhance their services, but the effectiveness of Inter Library Loans has been plagued by inadequate policies, limited budgets for collection development, inadequate ICT and lack of skilled staff [92].
- The creation and use of institutional repositories is an important step in making LMIC research accessible, but academic and research institutions in many LMICs are still battling to overcome many challenging issues in attempting to make their research outputs openly accessible by means of internet technologies like institutional repositories [225] [180].
- The SRKS supported library resources by strengthening university IT networks (Campus IT) and strengthening digital library-management skills through the delivery of postgraduate degree programmes. It showed that while individual capacity building can be effective, larger investments of time and resources are needed to achieve deeper change [76].

6. Synthesis of evidence about donor interventions

6.1 Lessons learnt in RCS interventions

A vast body of literature has developed around the role of donors in supporting and promoting the development of research projects, infrastructure and capacity in LMIC. A total of 104 studies discuss interventions, most of which refer to interventions funded by international donors. On top of that, the literature looked at the science of donor interventions as a research subject in its own right. In a sense, almost all the studies discussing donor interventions discuss the successes and failures of such interventions and proposed alternative approaches. However, subsets of such studies do so in more depth by using comparative, cross-sectional or longitudinal methodologies, or by relying on systematic evaluations. The overall strength of evidence is strong.

6.1.1   Scope of RCS interventions

The literature shows that donor interventions historically focused on health and agriculture, but that more recent interventions support 'forgotten' disciplines in the STEM but also AHSS fields. The overall strength of evidence is moderate.

- The bulk of scientific research, initiatives and capacity strengthening support is focused on health and agriculture [56]. However, from the 2000s there has been an increase in support for 'neglected' disciplines such as mathematics, physics and also the social sciences and humanities, as well as emerging applied innovation-related disciplines [20].
- Funding for higher education has historically had three important gaps: lack of funding for the establishment or further development of any types of higher education institution other than the traditional university; a lack of support for institutional capacity building in the area of research; little support for strengthening the central government departments tasked with steering the higher education sector [87] [116].
- RCS donors see their role as being to support the production of research, rather than supporting the communication and uptake of research. Many donors see strengthening research brokering and use as a secondary focus, and make provision for "soft skills" to improve recipients' communication and policy [56].

6.1.2   Planning an intervention

Although several studies talk about the importance of networks of collaboration for research, the evidence on this subject is of mixed quality. Most studies discuss evidence from national and international networks established in the context of a programme. Other papers talk about networks indirectly, with passing references to collaboration and coordination among research organisations.

- Four main RCS strategies have been identified from the literature. First, investing in vertical research projects that support national capacity by valuing research capacity outcomes equally as research outputs [63]. Second, investing in centres of excellence in a way that generates Southern leadership and integration with the broader research systems [88] [63] [48]. Third, investing in project-specific North–South partnerships that prioritise LMIC needs and researchers [52] [63] [48]. Fourth, investing in networks and consortia with less

hierarchical leadership, strong information exchange and consideration for system-level impact [64] [81] [88] [179] [63] [48].

- Networks and consortia can be a cost-effective intervention strategy that can encourage less-hierarchical leadership and competitive and individualistic attitudes. They are useful for working cooperatively on shared problems at regional or global levels, can help focus on common research priorities, increase knowledge exchange and speed diffusion of innovations and help forge long-term relationships and sustainability [210] [38] [34] [128] [160] [39].
- Networks and consortia can develop around donor programmes and/or through South-South collaborations. Institutions and initiatives like the AAS, AAU, CODERSRIA, CAMES, DRUSSA, HERANA and OSSREA work across nearly all disciplines found in universities in Africa (see Appendix C). These have been generally successful in building research capacity among participating organisations, some of which went on to become national hubs of research [189] [44] [220] [42]. However, there is a need to translate the research capacity effects of networks and collaborations from organisations to the research system as a whole. Long-term donor support is necessary to achieve sustainable change [22] [63] [23] [106] [208] [182].

6.1.3   Engaging stakeholders

The literature consistently stresses the importance of engaging national and subnational stakeholders from planning and throughout all phases of an RCS intervention. The evidence is strong.

- Traditional scientific hubs in high-income countries tend to dominate in most scientific areas whereas collaboration between LMICs is still limited. In Sub-Saharan Africa, collaboration is driven partly by geography but also by shared culture and language [172] [86] [3].
- Determining a research agenda based on country needs involves input from key national and local stakeholders, such as funders, national authorities and researchers [127] [53] [198] [158] [50]. The evaluation of a SIDA-funded RCS programme showed that government buy-in and clarity in national priority setting are key to prevent misalignment of donor interventions and bolster their long-term impact [14].
- Interventions should strive to address the dearth of local funding or in-kind investment matching international funding, which is often an indicator that there is insufficient local buy-in, and the programme's sustainability is at risk [14] [120] [39] [23] [58].
- Donors should work together with LMIC partners to: set the agenda and the goal of the intervention; engage with stakeholders; clarify responsibilities and be accountable to beneficiaries; promote mutual learning; enhance local capacities; share data and networks; disseminate the results; pool profits and merits; help raise the profile of research with policy makers, the media, and local populations [19] [117] [166] [186] [39] [182].

6.1.4   Managing interventions

The literature also suggests good practice in managing RCS interventions. There is strong evidence on the need for more coordination among donors, and moderate evidence for the need for more flexibility (especially around budgets).

- Donors may often be funding the same organisation through different projects, awards and grants. Concentration, coordination and consistency among funding agencies is key to ensure value for money and to prevent haphazard contributions to the sector's development in LMICs [110] [146] [81] [208] [42].

- The literature suggests that donors should look at RCS interventions as experiments. This would help ensure that plans have sufficient flexibility and allow room for trial and error, failure, learning and innovation. Interventions should incorporate emerging learning with explicit review points, since the 'theory of change' may change alongside the conditions of implementation. Finally, donors should allow for plans to be adapted rather than trying to massage new understandings into the original plan [165] [208].
- Experimental programmes therefore need flexible budgets. A DFID-programme review showed that budget constraints limit programme adaptability and effectiveness. Fixed annual budgets set at the beginning of the programme limited the ability to adapt to emerging learning and rethink approaches with local partners: any delays in implementing activities and spending budgets led to a greater likelihood of underspending within the year, which was treated as an aspect of programme performance [76].

6.1.5 Evaluating interventions

The literature provides evidence from independent evaluations of internationally backed research initiatives. These studies have been published as 'real-time' evaluations (i.e. while the programme was still ongoing) or ex-post evaluations and were of consistently high quality. The strength of evidence is moderate due to the low number of studies.

- Historically, evaluations of RCS programmes have been limited because outcomes can only be assessed over the longer term, and because some initiatives have lacked a clear theory of change [120]. Interventions are more effective when based on a comprehensive needs assessment so capacity strengthening can be targeted to specific needs. Programmes with a clear impact pathway and good monitoring and evaluation (M&E) system are thought to be more effective [165].
- Promoting accountability to local partners and stakeholders can be an effective evaluation strategy, so long as project goals are clearly articulated to all partners at their inception and direct lines of communication are established. Strong accountability mechanisms can enhance impact, in particular when this is met by internal support for change within the organisation [166] [198] [166].
- A key insight from the African Institution Initiatives is that real time evaluation – i.e. during a programme's life as opposed to at the end of it – is particularly suitable for the kinds of complex interventions and uncertain contexts the initiative faced [44]. Evaluations of past interventions need to understand and address the social and political dynamics within which partners work or projects are embedded, and to focus more on people and inter-relationships within national systems and within large organisations [76].

7. Conclusions

7.1 Key needs emerging from the REA

The REA identified a range of challenges and potential interventions to strengthen research capacity in LMICs. It also showed that the issues affecting research systems in LMICs are interconnected, and that progress on one issue is limited if taken in isolation from the broader context. The idea that lack of funding is the main problem affecting research in LMICs is outdated and inaccurate. Instead, the literature showed that the problems are much more systemic – involving bureaucratic inefficiency, lack of adequate incentive structures for researchers and universities and a lack of commitment to research among both public and private actors.

7.1.1   Key problems affecting research systems

- **Research is not regarded as important**: There is a clear need to make the case for LMIC governments to invest in research as a vehicle for development. This has been reflected in government policy, such as strategic documents produced by the African Union, but the commitments have not yet translated into financial and political investments [210] [139] [208] [144] [133] [42]. In turn, high-level commitment to research can translate into downward pressure on institutional management to recognise the important role of research and provide adequate support and appropriate career structures [41] [173] [112] [58] [46].
- **The policy framework is deficient:** In many LMICs there is a non-conducive environment for research because the policy and institutional frameworks are deficient, fragmented and inadequate to support an expansion of research capacity [210] [208] [5] [46] [42]. Even when the right policies are in place, implementation remains poor [135] [35] [122].
- **The link between research and society is weak:** Much of LMIC's indigenous research (i.e. research not directly funded by a donor) happens in a bubble. It has high potential impact but relatively little real impact on LMIC policy, economic development due to weak linkages between higher education, research, private sector and government [208] [2] [125] [93] [205] [63], poor alignment of research with national needs and priorities [136] [68], and weak demand for research in policymaking [87] [80] [208] [5].

7.1.2   Key problems affecting research organisations

- **Research management is highly deficient**: Research management capacity across LMIC universities is very limited and has been neglected by donors. This, in turn, affects researchers' ability to effectively obtain research funding and manage research projects [13] [58] [46]. Common areas in need of improvement are financial management, grants management, and monitoring and evaluation [112] [91]. Multiple reporting and grant management requirements put a strain on research organisations' resource-scarce systems [208] [110]. Moreover, procurement processes for research projects are reported to be bureaucratic and unscrupulous, and research support structures are often insufficient and ineffective [199] [41].
- **Scholars lack incentives to conduct research**: A key barrier to research production is the lack of incentives to produce research. Academic staff often carry large teaching, administrative and consultancy workloads which means that the time available for research is minimal [208] [195] [151] [20]. This contrast with attractive career opportunities in higher income countries,

which causes the 'brain drain' of the most talented researchers [122] [146] [204] [154]. These two problems severely affect research system development in LMICs, as well as the performance of individual research organisations.

- **Research organisations still have a significant digital gap**: Research production and research management in LMICs are also affected by the lack of adequate ICT infrastructure underpinning an organisation's research information system. Many LMICs have gaps in ICT infrastructure and system deployment, which hampers the production, management and dissemination of research, and are particularly weak in regard to research production, management and communication. Higher level research enquiry such as accessing distant scientific infrastructure, for example, supercomputers, modelling and simulation equipment, large astronomical telescopes or grid computing, or 'big data' research continues to be limited [41] [79] [138] [131] [175].

7.2   Good practice in RCS intervention

Most of the needs and problems identified in the literature have been matched by lessons learnt from past RCS interventions. These lessons have also been crystallised in a number of good practices that should be considered by donors planning an intervention at system level or organisation level.

7.2.1   Good practices for system-level RCS interventions

- **Prioritise national commitment**: Determining a research agenda based on country needs involves input from key national and local stakeholders, such as funders, national authorities and researchers [127] [53] [198] [158] [50].
- **Solicit match funding:** Interventions should strive to address the dearth of local funding or in-kind investment matching international funding, which is often an indicator that there is insufficient local buy-in, and the programme's sustainability is at risk [14] [120] [39] [23] [58].
- **Engage local partners**: Donors should work together with LMIC partners to: set the agenda and the goal of the intervention; engage with stakeholders; clarify responsibilities and be accountable to beneficiaries; promote mutual learning; enhance local capacities; share data and networks; disseminate the results; pool profits and merits; help raise the profile of research with policy makers, the media, and local populations [19] [117] [166] [186] [39] [182].
- **Work horizontally**: Networks and consortia are useful for working cooperatively on shared problems at regional or global levels, can help focus on common research priorities, increase knowledge exchange and speed diffusion of innovations and help forge long-term relationships and sustainability [210] [38] [34] [128] [160] [39]. However, there is a need to translate the research capacity effects of networks and collaborations from organisations to the research system as a whole. Long-term donor support is necessary to achieve sustainable change [22] [63] [23] [106] [208] [182].

7.2.2   Good practices for organisation-level RCS interventions

- **Coordinate funding**: Donors may often be funding the same organisation through different projects, awards and grants. Concentration, coordination and consistency among funding agencies is key to ensure value for money and to prevent haphazard contributions to the sector's development in LMICs [110] [146] [81] [208] [42].
- **Promote accountability**: Promoting accountability to local partners and stakeholders can be an effective evaluation strategy, so long as project goals are clearly articulated to all partners at their inception and direct lines of communication are established. Strong accountability

mechanisms can enhance impact, in particular when this is met by internal support for change within the organisation [166] [198] [166].

- **Work flexibly**: The literature suggests that donors should look at RCS interventions as experiments to ensure that plans have sufficient flexibility and allow room for trial and error, failure, learning and innovation. Interventions should incorporate emerging learning with explicit review points, since the 'theory of change' may change alongside the conditions of implementation. Finally, donors should allow for plans to be adapted rather than trying to massage new understandings into the original plan [165] [208] [76].

7.3   Evidence gaps

The REA has highlighted a number of gaps in the evidence on RCS activities in LMICs. The three most important gaps are summarised below:

- **Lack of system-level data**: There is a lack of up-to-date baseline data on research systems, which makes it difficult to pinpoint specific needs at system level and plan interventions. Higher education information systems in many LMICs lack incentives for universities to provide performance data to a central administrator, and for the central data administrator to report to government and/or to the higher education councils. The lack of baseline data at the level of research systems (as well as in many research organisations) makes it difficult to prioritise interventions in the context of multiple gaps and competing needs.
- **Lack of evidence about interventions**: Although the evidence on RCS interventions varies for each topic, the level of evidence on interventions is overall much weaker than the evidence on the problem the intervention is trying to solve. In particular, there is a lack of evidence about the effectiveness of specific interventions and intervention strategies. Whilst the literature proposes a number of good practices for RCS interventions, these seem to emerge from observation and deduction and not on rigorous assessments of the available evidence. By contrast, when interventions are routed in evidence, authors are careful not to infer that the lessons learnt would be applicable in different circumstances.
- **Lack of evidence on research diffusion and take up**: While the literature concentrates on research production capacity, little attention is paid to the policies, practices and institutions needed to support the diffusion and take up of research in society. In particular, there seems to be a limited understanding of strategies that support the use of research in policymaking and the economy. A systematic analysis of the barriers to research diffusion and take up, the role of intermediaries and the capacity gaps affecting the research community and non-research actors (i.e. businesses, government and civil society) would be highly beneficial.

Bibliography

[1] Abrahams, L. Burke, M. and Mouton, J. (2009/2010). Research productivity-visibility-accessibility and scholarly communication in Southern African universities. *The African Journal of Information and Communication*. 10: 20-36. Available at: doi.org/10.23962/10539/19768

[2] Adam, T., Ahmad, S., Bigdeli, M., Ghaffar, A. and Rottingen, J. (2011). Trends in Health Policy and Systems Research over the Past Decade: Still Too Little Capacity in Low-Income Countries. *PLOS One.* 6/11: 1-10.

[3] Adams, J. Gurney, K. Hook, D. and Leydesdorff, L. (2014). International collaboration clusters in Africa. *Scientometrics*. 98/1: 547–556.

[4] Adebayo, O. (2013). Science Research and Publication in Africa: The Nigeria Perspective. *The African Journal of Plant Science and Biotechnology.* 7/1: 106-109.

[5] ABC. (2016). Scoping study: Africa-Britain-China (ABC) Agricultural Technology Research Collaborations for International Development. Amsterdam: Elsevier/ DFI/ CABI

[6] Aina, A. (2010). Beyond Reforms: The Politics of Higher Education Transformation in Africa. *African Studies Review*. 53/1: 21–40.

[7] Alabi, G. & Alabi, J. (2014). Understanding the Factors that Influence Leadership Effectiveness of Deans in Ghana. *Journal of Higher Education in Africa / Revue de l'enseignement supérieur en Afrique* 12/1, 111–132.

[8] Ali, F. Shet, A. Yan, W. Al-Maniri, A. Atkiins, S. and Luca, H. (2017). Doctoral level research and training capacity in the social determinants of health at universities and higher education institutions in India, China, Oman and Vietnam: a survey of needs. *Health Research Policy and Systems.* 15/76: 1-11.

[9] Alperin, J. (2013). Ask not what altmetrics can do for you, but what altmetrics can do for developing countries. *Bulletin of the American Society for Information Science and Technology.* 39/4: 18–21.

[10] Altbach, P. (2009). Peripheries and Centers: Research Universities in Developing Countries. Asia Pacific Education Review. 10/1: 15–27.

[11] Amerson, R. and Strang, C. (2015). Addressing the Challenges of Conducting Research in Developing Countries: Addressing the Challenges of Research. Journal of Nursing Scholarship. 47/6: 584–591.

[12] Ana, J. Koehlmoos, T. Smith, R. and Yan, L. (2013). Research Misconduct in Low- and Middle-Income Countries. PLOS Medicine. 10/3: 1-6.

[13] Ani, O. (2014). Effect of Accessibility and Utilization of Electronic Information Resources on Productivity of Academic Staff in Selected Nigerian Universities. Science Research. 2/6: 166-171.

[14] Annerstedt, J., Liyanage, S. and SIDA (2008). Challenges when shaping capabilities for research Swedish support to bilateral research cooperation with Sri Lanka and Vietnam, 1976-2006, and a look ahead. Stockholm: Edita Communication.

[15] Apiola, M., Suhonen, J., Nangawe, A. and Sutinen, E. (2015). Building CS Research Capacity in sub-Saharan Africa by Implementing a Doctoral Training Program. Proceedings of the 46th ACM Technical Symposium on Computer Science Education – SIGCSE. 15: 633–638 (ACM Press, 2015).

[16] Arencibia-Jorge, R. (2013). Scientific development in African countries. Oxford: INASP.

[17] Arocena, R. Göransson, B. and Sutz, J. (2015). Knowledge policies and universities in developing countries: Inclusive development and the "developmental university". *Technology and Society.* 41: 10–20.

[18] Asamoah-Hassan, H. (2007). *Embracing electronic scholarly publishing in Africa.* Vancouver: PKP Conference.

[19] Bates, I. Boyd, A. Smith, H. and Cole, D. (2014). A practical and systematic approach to organisational capacity strengthening for research in the health sector in Africa. *Health Research and Policy Systems.* 12/11: 1-10.

[20] Beaudry, C. Mouton, J. and Prozesky, H. (2018). *The Next Generation of Scientists in Africa.* Cape Town: African Minds.

[21] Beoku-Betts J. (2005). 'A lot of them thought I wouldn't last there': African women and career advancement in academic scientific careers. *Journal of Technology Transfer.* 30/4: 397-407.

[22] Bennett, S., Agyepong, I., Sheikh, K., Hanson, K., Ssengooba, F. and Gilson, L. (2011). Building the Field of Healthy Policy and Systems Research An Agenda for Action. *PLOS Medicine.* 8/8: 1-5.

[23] Bennett, S., Paina, L. Kim, C., Agyepong, I., Chunharas, S., McIntyre, D. and Nachuk, S. (2010). *What must be done to enhance capacity for Health Systems Research.* Montreux: Background paper for the global symposium on health systems research.

[24] Bertin, P. Fry, J. and Ragsdell, G. (2015). On the recent transformation of the research system: in search of a conceptual framework for developing countries. *International Journal of Science in Society.* 7/1: 1-16.

[25] Bezuidenhout, L. and Chakauya, E. (2018). Hidden concerns of sharing research data by low/middle-income country scientists. *Global Bioethics.* 29/1: 39–54.

[26] Boshoff, N. (2008). Neo-colonialism and research collaboration in Central Africa. *Scientometrics.* 81/2: 413-434.

[27] Bosire Onyancha, O. (2008). Growth, productivity, and scientific impact of sources of HIV/AIDS research information, with a focus on eastern and southern Africa. *African Journal of AIDS Research.* 7/1: 55–70.

[28] Botha, J. Webber, K. Muller, N. (2016). 'Institutional research in South African Higher Edu cation: Framing the Contexts and Practices.' in *Institutional Research in South African Higher Education. Intersecting Contexts and Practices.* Stellenbosch: SUN PRESS. 1-22.

[29] Boyce, R. Rosch, R. Finlayson, A. Handuleh, D. Walhad, S. Whitwell, S. and Leather, A. (2015). Use of a bibliometric literature review to assess medical research capacity in post-conflict and developing countries: Somaliland 1991-2013. *Tropical Medicine and International Health.* 20/11: 1507–1515.

[30] British Council, The. (2018). *Building PhD Capacity in Sub-Saharan Africa.* London: British Council/DAAD

[31] Bunting, I., Cloete, N. & Van Schalkwyk, F. (2017). *An Empirical Overview of Emerging Research Universities in Africa: 2001–2015,* Cape Town, Centre for Higher Education Trust

[32] Campion, P. and Shrum, W. (2004). Gender and science in development: Women scientists in Ghana, Kenya and India. *Science, Technology and Human Values.* 29/4: 459-85.

[33] Cash-Gibson, L. Guerra, G. and Salgado-de-Snyder, N. (2015). SDH-NET: A South–North-South collaboration to build sustainable research capacities on social determinants of health in low- and middle-income countries. *Health Research Policy and Systems.* 13/45: 1-9.

[34] Chanda-Kapata, P. Campbell, S. and Zarowsky, C. (2012). Developing a national health research system: participatory approaches to legislative, institutional and networking dimensions in Zambia. *Health Research Policy and Systems.* 10/17: 1-7.

[35] Chataway, J. and Ochieng, C. (2017). Case Studies of the Political Economy of Science Granting Councils in Sub-Saharan Africa. Brighton and Johannesburg: University of Sussex / NRF.

[36] Chiemeke, S. Longe, O. Longe, F. and Shaib, I.O. (2009). Research Outputs from Nigerian Tertiary Institutions: An Empirical Appraisal. *Library Philosophy and Practice.* 23: 1-10.

[37] Christian, G. (2008). Issues and Challenges to the Development of Open Access Institutional Repositories in Academic and Research Institutions in Nigeria. Ottawa: International Development Research Centre.

[38] Choi, H. and Ko, J. (2010). Facilitating large-scale clinical trials in Asia. *Urologic Oncology: Seminars and Original Investigations.* 28/6: 691–692.

[39] Christoplos, I. Zwi, A. and Lindegaard, L. (2015). Evaluation of the Consortium for Advanced Research Training in Africa (CARTA). Sweden: Citat.

[40] Cimini, G. Zaccaria, A. and Gabrielli, A. (2015). Investigating the interplay between fundamentals of national research systems: Performance, investments and international collaborations. *Journal of Infometrics.* 10/1: 200-211.

[41] Cloete, N., Maassen, P. and Bailey, T. (2015). Knowledge Production and Contradictory Functions in African Higher Education. Cape Town: African Minds

[42] Cloete, N. Bunting, I. and van Schalkwyk, F. (2018). *Research Universities in Africa*. Cape Town: African Minds.

[43] Cloete, N. Goedegebuure, L. Gornitzka, A. Jungblut, J. and Stensaker, B. (2016). *Pathways through Higher Education Research – A Fesrschrift in Honour of Peter Maassen.* Oslo: Department of Education, The University of Oslo.

[44] Cochrane, G. Robin, E. Marjanovic, S. Dipeveen, S. Hanlin, R. Kryl, D. Muchova, L. Yaqub, O. and Chataway, J. (2014). The African Institutions Initiative: Insights from the First Four Years. Cambridge: RAND Europe.

[45] Coloma, J. and Harris, E. (2009). From Construction Workers to Architects: Developing Scientific Research Capacity in Low-Income Countries. *PLOS Biology*. 7/7: 1-4.

[46] Consort. (2017a). *Scoping Work on Research Management in LMICs: Sub-Saharan Africa.* Wellcome Trust Project Report. Cambridge: Consort.

[47] Consort. (2017b). *Current state of research management in Africa*. Wellcome Trust Project Report. Cambridge: Consort.

[48] Datta, A. (2018). *Strengthening research systems: concepts, actions and actors*. K4D Helpdesk Report. Brighton: Institute of Development Studies.

[49] Davis, K. Ekboir, J. Spielman, D. and Zerfu, E. (2007). Strengthening Agricultural Education and Training in sub-Saharan Africa from an Innovation Systems Perspective: A Case Study of Mozambique. *International Food Policy Research Institute.* 14: 35–51.

[50] Dean, L. Gregorius, S. Bates, I. and Pulford, J. (2017). Advancing the science of health research capacity strengthening in low-income and middle-income countries: a scoping review of the published literature. *BMJ.* 7: 2000–2016.

[51] Defor, S. Kwamie, A. and Agyepong, I. (2017). Understanding the state of health policy and systems research in West Africa and capacity strengthening needs: scoping of peer-reviewed publications trends and patterns 1990–2015. *Health Research Policy and Systems.* 15/55: 101-138.

[52] De-Graft, A., Arhinful, D., Pitchforth, E., Ogedegbe, G., Allotey, P. and Agyemang, C. (2012). Establishing and sustaining research partnerships in Africa: a case study of the UK-Africa Academic Partnership on Chronic Disease. *Globalization and Health.* 8/29: 1-13.

[53] Dijkman, J. (2010). *Africa Matters: Emerging Lessons from the RIU Country Programmes.* Research into Use. Discussion paper 09. London: DFID.

[54] Duine, M. (2017). Needs Assessment: Strengthening Indigenous Academic and Digital Publishing in Tanzania. Oxford: INASP.

[55] Egbetokun, A. Oluwadare, A. Ajao, B. and Jegede, O. (2017). Innovation systems research: an agenda for developing countries. Journal of Open Innovation: Technology, Market, and Complexity. 3/25: 1-16.

[56] Enoch, J. (2015). Rapid mapping of international funders' research capacity strengthening priorities. London: UKCDR

[57] Esseh, S. and Willinsky, J. (2011). Strengthening Scholarly Publishing in Africa: Assessing the Potential of Online Systems. (Doctoral dissertation, University of British Columbia).

[58] ESSENCE (2014). Seven principles for strengthening research capacity in low- and middle-income countries: simple ideas in a complex world. ESSENCE for Health Research.

[59] European and Developing Countries Clinical Trials Partnership and World Health Organisation. (2018). Development and strengthening of the national health research systems in sub-Saharan Africa. The Hague: EDCTP.

[60] Ezeh, A. Izugbara, C. Kabiru, C. Fonn, S. Kahn, K. Manderson, L. Undieh, A. Omigbodun, A. Thorogood, M. (2010). Building capacity for public and population health research in Africa. Global Health Action, 3/10: 1-7.

[61] Ford, M. (2012). Mechanisms for Building Research Capacity in Indonesia's Knowledge Sector through Australian Universities. Canberra: AusAID.

[62] Forde, M. Morrison, K. Dewailly, E. Badrie, N. and Robertson, L. (2011). Strengthening integrated research and capacity development within the Caribbean region. BMC International Health and Human Rights. 11: 1-11.

[63] Franzen, S., Chandler, C. and Lang, T. (2016). Health research capacity development in low and middle income countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature. BMJ. 7:1-15.

[64] Gadsby, E. W. (2011). Research capacity strengthening: donor approaches to improving and assessing its impact in low- and middle-income countries. International Journal of Health Planning and Management. 26: 89–106.

[65] Gaillard, J. (2010). Measuring Research and Development in Developing Countries: Main Characteristics and Implications for the Frascati Manual. Science, Technology and Society. 15/1: 77–111.

[66] Ghaffar, A., IJsselmuiden, C. and Zicker, F. (2008). Changing Mindsets: Research capacity strengthening in low- and middle-income countries. Geneva: Council on Health Research for Development (COHRED).

[67] Gomo, E. Kalilani, L. Mwapasa, V. Trigu, C. Phiri, K. Schmidt, J. and van Hensbroek, M. (2011). Towards Sustainable Research Capacity Development and Research Ownership for Academic Institutes in Developing Countries: The Malawian Research Support Centre Model. Journal of Research Administration. 42/1: 38-45.

[68] Göransson, B. and Brundenius, C. (2011). Universities in Transition: The Changing Role and Challenges for Academic Institutions. New York: Springer-Verlag.

[69] Gray, E. (2010). Access to Africa's Research: Publishing Development Research and Measuring Value. The African Journal of Information and Communication. 10/1: 4-19.

[70] Gray, E., Trotter, H. and Willmers, M. (2012). Scholarly communication in Africa: Aligning strategy and technology for increased visibility of Southern African research. Proceedings of the 2012 International Association for Media and Communications Research Conference.

[71] Grobbelaar, S. (2013). Building institutional capacity for Research Uptake. DRUSSA Handbook Series. Stellenbosch: DRUSSA.

[72] Gwynn, S. (2019). Access to research in the Global South: Reviewing the evidence. Oxford: INASP.

[73] Gyapong JO, Ofori-Adjei D. (2011). Capacity building for relevant health research in developing counties. The Hague: Netherlands Organisation for International Cooperation in Higher Education.

[74] Harle, J. (2009). The Nairobi Report: Frameworks for Africa-UK Research Collaboration in the Social Sciences and Humanities. London: British Academy/The Association of Commonwealth Universities.

[75] Harle, J. (2016). 'Who drives research in developing countries?' INASP Blog. Available at: http://blog.inasp.info/drives-research-developing-countries/.

[76] Harle, J. (2018). How can we strengthen research and knowledge systems in the Global South? Oxford: INASP.

[77] Harmonisation of African Higher Education Quality Assurance and Accreditation (HAQAA). (2018). African Quality Rating Mechanism (AQRM) Consolidated Evaluation Report (Fifteen Higher Education Institutions).

[78] Hazelkorn, E. (2016). Global Rankings and the Geopolitics of Higher Education: Understanding the influence and impact of rankings on higher education, policy and society. London: Routledge.

[79] Holmner, M. (2008). A critical analysis of information and knowledge societies with specific reference to the interaction between local and global knowledge systems. (D Phil: University of Pretoria).

[80] Hyder, A. Corluka, A. Winch, P. El-Shinnawy, A. Ghassany, H. Malekafzali, H. Lim, M. Mfutso-Bengo, J. Segura, E. and Ghaffar, A. (2011). National policy-makers speak out: are researchers giving them what they need? Health Policy and Planning Advance Access. 26: 73–82.

[81] Ijsselmuiden, C. Marais, D. L., Becerra-Posada, F. and Ghannem, H. (2012). Africa's neglected area of human resources for health research – the way forward. South African Medical Journal. 102: 228-233.

[82] Inglesi-Lotz, R. and Pouris, A. (2011). Scientometric impact assessment of a research policy instrument: the case of rating researchers on scientific outputs in South Africa. Scientometrics. 88/3: 747–760.

[83] Inglesi-Lotz, R. and Pouris, A. (2013). The influence of scientific research output of academics on economic growth in South Africa: an autoregressive distributed lag (ARDL) application. Scientometrics. 95/1: 129–139.

[84] International Development Consultants (2018). Supporting the Delivery of High-Quality Research in Somalia: External Evaluation Report. Nairobi: IDC.

[85] Jacob, M. (2010). Research funding instruments and modalities: Implication for developing countries. Lund: OECD.

[86] Jacob, M. and Meek, V. (2013). Scientific mobility and international research networks: trends and policy tools for promoting research excellence and capacity building. Studies in Higher Education. 38/3: 331-344.

[87] Jones, N., Bailey, M. and Lyytikäinen, M. (2007). Research capacity strengthening in Africa: Trends, gaps and opportunities. London: Overseas Development Institute.

[88] Jones, A. and Geneau, R. (2012). Assessing research activity on priority interventions for non-communicable disease prevention in low- and middle-income countries: a bibliometric analysis. Global Health Action. 5/1: 1-13.

[89] Jowi, J. and Obamba, M. (2013). Research and Innovation Management: Comparative Analysis of Ghana, Kenya, Uganda. Paris: OECD.

[90] Jowi, J. Obamba, M. Sehoole, C. Barifaijo, M. Oanda, O. Alabi, G. (2013). Governance of higher education research and innovation in Ghana Kenya and Uganda. OECD. Paris: OECD.

[91] Kakande, N. Namirembe, R. Kaye, D. and Mugyenyi, P. (2012). Strengthening Institutional Research Administration in Uganda: A Case Study on Developing Collaborations among Academic and Research Institutions. Journal of Research Administration. 43/1: 39-59.

[92] Kasalu, J. S. & Ojiambo, J. B. (2015). Enhancing Access to Electronic Resources through Collaborations and E- Document Delivery: Experiences of University Libraries in Kenya. Paper presented at: IFLA WLIC 2015: Cape Town.

[93] Kasonde, J. and Campbell, S. (2012). Creating a knowledge translation platform: nine lessons from the Zambia Forum for Health Research. Health Research Policy and Systems. 10/31: 1-8.

[94] Kasozi, A. (2010). The State of Higher Education and Training in Uganda 2010: A Report on higher education delivery and institutions. Kampala: National Council for Higher Education.

[95] Kasozi, A. (2014). Trends in Higher Education Regulation in sub-Saharan Africa. International Higher Education. 75: 21-22.

[96] Kebbede, S. (2012). A methodology for the Adoption of Information Systems in Least Developed Countries (LDCS): Case Study Ethiopia. (Bachelor's Thesis: Lahti University of Applied Sciences).

[97] Kebede, D. Zielinski, C. Mbondji, P. Sanou, I. Kouvividila, W. and Lusamba-Dikassa, P. (2014). Research and its governance in health research institutions in sub-Saharan African countries: results of a questionnaire-based survey. Journal of the Royal Society of Medicine. 107/1: 55–69.

[98] Kiamba, C. (2016). Mapping and Assessment of Innovative Initiatives in Higher Education in Africa. Nairobi: MasterCard Foundation.

[99] King, T. Hodgkinson-Williams, C. Willmers, M. and Walji, S. (2016). Dimensions of open research: critical reflections on openness in the ROER4D project. Open Praxis. 8/2: 81–91.

[100] Kirigia, J. Ota, M. Motari, M. Bataringaya, J. and Mouhouelo, P. (2015). National health research systems in the WHO African Region: current status and the way forward. Health Research Policy and Systems. 13/61: 1-14.

[101] Kok M. Rodrigues A. Silva A. and de Haan, S. (2012). The emergence and current performance of a health research system: lessons from Guinea Bissau. Health Research and Policy Systems. 10/5: 1-11.

[102] Kombe, F., Anoubi, E., Tshufugula, N., Wassenaar, D., Njadingwe, D., Mwalukore, S., Chinyama, J., Randrianasolo, B., Akindeh, P., Dlamini, P., Ramiandrisoa, F. and Ranaivo, N. (2014). Promoting Research Integrity in Africa: An African Voice of Concern on Research Misconduct and the Way Forward: Promoting Research Integrity in Africa. Developing World Bioethics. 14/3: 158–166.

[103] Kotecha, P. Walwyn, D. and Pinto, C. (2010). Deepening Research Capacity and Collaboration across Universities in SADC: a Southern African Universities Regional Research and Development Fund. Johannesburg: South African Regional Universities Association (SARUA).

[104] Kruss, G. Adeoti, J. and Nabudere, D. (2012). Universities and Knowledge-based Development in sub-Saharan Africa: Comparing University–Firm Interaction in Nigeria, Uganda and South Africa. Journal of Development Studies. 48: 516–530.

[105] Kurdi, O. Ghoneim, A. and Al Roubaie, A. (2014). Knowledge Sharing Culture in Higher Education Institutions: Critical Literature Review 1 Knowledge Sharing Culture in Higher Education Institutions: Critical Literature Review. Paper submitted to European, Mediterranean & Middle Eastern Conference on Information System. Doha, 27-28 October 2014.

[106] Kwon, K. Park, H. So, M. and Leydesdorff, L. (2012). Has Globalization Strengthened South Korea's National Research System? National and International Dynamics of the Triple Helix of Scientific Co-authorship Relationships in South Korea. Scientometrics. 64/11: 163–175.

[107] InterAcademy Council (2015). Enhancing the Capacity of African Science Academies The Final Evaluation of ASADI. InterAcademy Council.

[108]   Langer, L. Tripney, J. and Gough, D. (2016). The science of using science: researching the use of research evidence in decision-making. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

[109]   Luo, A. & Olson, J. S. (2008). 'How collaboratories affect scientists from developing countries', in G. M. Olson, A. Zimmerman, and N. Bos (eds.) Scientific Collaboration on the Internet. Cambridge, MA: MIT Press. 365-376.

[110]   Mahmood, S. Hort, K. Ahmed, S. Salam, M. and Cravioto, A. (2011). Strategies for capacity building for health research in Bangladesh: Role of core funding and a common monitoring and evaluation framework. Health Research Policy and Systems. 9/31: 1-9.

[111]   Marjanovic, S. Cochrane, G. Robin, E. Sewanchkambo, N. Ezeh, A. Nyirenda, M. Bassirou, B. Rweyemamu, M. Chataway, J. (2017). Evaluating a complex research capacity-building intervention: Reflections on an evaluation of the African Institutions Initiative. Evaluation. 23/1: 80–101.

[112]   Marjanovic, S. Hanlin, R. Diepeveen, S. and Chataway, J. (2013). Research capacity building in Africa: Networks, Institutions and Local Ownership. Journal of International Development. 25/1: 936-946.

[113]   Marshall-Lucette, S. Corbett, K. Lartey, N. Opio, D. and Bikaitwoha, M. (2007). Developing locally based research capacity in Uganda. International Nursing Review. 54/1: 227–233.

[114]   Martins, N. and Hawkins, Z. (2012). Striving for better health through health research in post-conflict Timor-Leste. Health Research Policy and Systems. 10/1: 1-4.

[115]   Mashaah, T. Hakim, J. Chidzonga, M. Kangwende, R. Yogeshkumar, N. Federspiel, N. Fiorillo, S. Scott, J. and Gomo, E. (2014). Strengthening Research Governance for Sustainable Research: Experiences from Three Zimbabwean Universities. Journal of the Association of American Medical Colleges. 89/8: 69–72.

[116]   Maassen, P. and Cloete, N. (2009). Higher education, donor organisations, nation states, and development: The public donor dimension in Africa. International organisations and higher education policy: Thinking globally, acting locally. 251-278.

[117]   McCarthy, J. (2010). Review of Social Science Capacity Building Support to Indonesia's Knowledge Sector. Canberra: AusAID.

[118]   McGregor, S. Henderson, K. and Kaldor, J. (2014). How Are Health Research Priorities Set in Low and Middle Income Countries? A Systematic Review of Published Reports. PLOS One. 9/10: 1-9.

[119]   McKay, M. (2011). Improving access to scholarly research in Africa: open access initiatives. Serials. 24: 251–254.

[120]   Mcloughlin, C. (2011). Helpdesk Research Report: Research Capacity Strengthening. Birmingham: Governance and Social Development Resource Centre.

[121]   Meek, V. Teichler, U. and Kearney, M. (2009). Higher Education, Research and Innovation: Changing Dynamics Report on the UNESCO Forum on Higher Education, Research and Knowledge 2001-2009. Kassel: INCHER.

[122]   Meek, V. (2013). Scientific mobility and international research networks: trends and policy tools for promoting research excellence and capacity building. Studies in Higher Education. 38/1: 331–344.

[123]   Melin, G., Allinson R., Grudin M, Mostert B., Ploeg M., Sadeski F., Varnai P., Warbis M., Zegel, S. (2015) Evaluation of the Developing Operational Research Capacity in the Health Sector Project – A Technopolis Group evaluation carried out for the UK Department for International Development (DFID). London: Technolpolis

[124]   Metcalfe, A. Esseh, S. and Willinsky, J. (2009). International Development and Research Capacities: Increasing Access to African Scholarly Publishing. Canadian Journal of Higher Education Revue canadienne d'enseignement supérieur. 39/3: 89–109.

[125]   Mgone, C., Volmink, J., Coles, D., Makanga, M., Jaffar, S., and Sewankambo, N. (2010). Linking research and development to strengthen health systems in Africa. Tropical Medicine and International Health. 15/12: 1404–1406.

[126]   Migosi, J. A., Migiro, S. O. & Ogula, P. (2011). Factors that motivate business faculty in Kenya to conduct research. International Journal of Education Administration and Policy Studies. 4/10: 198-204.

[127]   Minja, H. Nsanzabana, C. Maure, C. Hoffmann, A. Rumisha, S. Ogundahunsi, O. Zickerm F. Tanner, M and Launois, P. (2011). Impact of Health Research Capacity Strengthening in Low- and Middle-Income Countries: The Case of WHO/TDR Programmes. PLOS Neglected Tropical Diseases. 5/10: 1-7.

[128]   Miiro, G. Oukem-Boyer, O., Sarr, O., Rahmani, M., Ntoumi, F., Dheda, K., Pym, A., Mboup, S. and Kaleebu, P. (2013). EDCTP regional networks of excellence: initial merits for planned clinical trials in Africa. BMC Public Health. 13/258: 1-12.

[129]   Mirzoev, T. Omar, M. Green, A. Bird, P. Lund, C. Ofori-Atta, A. and Doku, V. (2012). Research-policy partnerships - experiences of the Mental Health and Poverty Project in Ghana, South Africa, Uganda and Zambia. Health Research Policy and Systems. 10/30: 1-14.

[130]   Morales, C. (1998). National agricultural research systems in Latin America and the Caribbean: Changes and Challenges. Santiago: ECLAC

[131]   Motala, S. (2013). Access to Research and Scholarship: A View from South Africa's University of Johannesburg. Johannesburg: University of Johannesburg.

[132]   Mouton, J. and Waast, R. (2009). Mapping Research Systems in Developing Countries: Synthesis Report. Paris: UNESCO.

[133]   Mouton, J. and Coates, D. (2016). Objective 1: Building Sustainable Research Management in Science Granting Councils in Sub-Saharan Africa. Stellenbosch: Centre for Research on Evaluation, Science and Technology (CREST).

[134]   Mouton, J. and Valentine, A. (2017). The extent of South African authored articles in predatory journals. South African Journal of Science. 113: 1–9.

[135]   Mugwagwa, J. Edwards, D. and de Haan, S. (2015). Assessing the implementation and influence of policies that support research and innovation systems for health: the cases of Mozambique, Senegal, and Tanzania. Health Research Policy and Systems. 13/21: 1-7.

[136]   Mukhwana, E. Kande A., Too, J. (2017). Transforming University Education in Africa: Lessons from Kenya. African Journal of Rural Development. 2/3: 341-352.

[137]   Muriithi, P. Horner, D. and Pemberton, L. (2013). Understanding factors influencing the effect of scientific collaboration on productivity in a developing country: Kenya. Proceeding of the American Society for Information Science and Technology. 50: 1–10.

[138]   Mutula, S. (2009). Challenges of doing research in sub-Saharan African universities: digital scholarship opportunities. International Journal of Humanities and Social Science. 1: 1-10–10.

[139]   Mutula, S. (2011). Challenges of postgraduate research: case of developing countries. South African Journal of Libraries and Information Science. 77: 184–190.

[140]   Nabegu, A. and Naibbi, A. (2017). Research Management in the University. Paper presented at a sensitization meeting organized by the directorate of academic planning, northwest university, kano, at city campus auditorium. Kano: Maitama Sule University.

[141]   Ngongalah, L., Niba, R., Wepngong, E., Musisi, J., Ngwayu, C. and Mumah, S. (2019). Tackling the research capacity challenge in Africa: An overview of African-led approaches to strengthen research capacity. [Preprint] Available: http://dx.doi.org/10.1101/518498.

[142]   Ngongalah, L. Niba, R. Wepngong, E. and Musisi, J. (2018). Research challenges in Africa – an exploratory study on the experiences and opinions of African researchers. [Preprint] Available: http://dx.doi.org/10.1101/446328.

[143]   Nico, C. and Peter, M. (2015). Knowledge Production and Contradictory Functions in African Higher Education. Cape Town: African Minds.

[144]   Njuguna, F. and Itegi, F. (2014). Research in Institutions of Higher Education in Africa: Challenges and Prospects. European Scientific Journal. 3/1: 352-361.

[145]   Nurse, K. and Wight, D. (2011). Development assistance and research capacity strengthening: the commissioning of health research in East Africa. Journal of Eastern African Studies. 5/2: 233-251.

[146]   Nurse, K. and Wight, D. (2011). Development assistance and research capacity strengthening: the commissioning of health research in East Africa. Journal of East African Studies. 5/2: 233-251.

[147]   Nwaka, S. Ilunga, T. Da Silva, J. Verde, E. Hackley, D. De Vré, R and Ridley, R. (2010). Developing ANDI: a novel approach to health product R&D in Africa. PLoS Medicine. 7/6: 1-6.

[148]   Obamba, M. (2012). Uncommon Knowledge: World Bank Policy and the Unmaking of the Knowledge Economy in Africa. Higher Education Policy. 26/1: 83-108.

[149]   Ochola, L. and Gitau, E. (2009). Challenges in retaining research scientists beyond the doctoral level in Kenya. PLOS Neglected Tropical Diseases. 3/3: 1-3.

[150]   Ocholla, D. (2011). An Overview of Issues, Challenges and Opportunities of Scholarly Publishing in Information Studies in Africa. African Journal of Library, Archives and Information Science. 21/1: 1-16.

[151]   Ogundahunsi, O. Vahedi, M. Kamau, E. Aslanyan, G. Terry, R. Zicker, F. Launpos. P. (2015). Strengthening Research Capacity - TDR's Evolving Experience in Low- and Middle-Income Countries. PLOS Neglected Tropical Diseases. 9/1: 1-6.

[152]   Okonta, P. and Rossouw, T. (2014). Misconduct in research: a descriptive survey of attitudes, perceptions and associated factors in a developing country. BMC Medical Ethics. 15/25: 1-8.

[153]   Olsson, Å. And Cooke, N. (2013). The evolving path for strengthening research and innovation policy for development. Paris: OECD.

[154]   Onah, F. and Anikwe, O. (2016). The Task of Attraction and Retention of Academic Staff in Nigeria Universities. Journal of Management and Strategy. 7/2: 9-20.

[155]   Oni, G. Fatusi, A. Tsui, A. Engulelassie, F. Ojengbede, O. Agebnyega, T. Ojofeitimi, E. Taulo, F. and Quakyi, I. (2011). Strengthening public health education in population and reproductive health through an innovative academic partnership in Africa: The Gates partners experience. Global Public Health. 6/2: 193–209.

[156]   Onyancha, O. (2008). Growth, productivity, and scientific impact of sources of HIV/AIDs research information, with focus on eastern and southern Africa. African Journal of AIDS Research 7/1: 55-70.

[157]   Onyeka, I. (2014). Health research in Africa: are we communicating our findings to relevant stakeholders? African Health Sciences. 14/3: 779–781.

[158]   Orchard, J. (2011). SCARDA Change Management Approaches Used in the Project 'Strengthening Capacity for Agricultural Research and Development in Africa' and the Lessons Learned from their Application. London: DFID.

[159]   Ossai-Ugbah, N. (2013). The Role of Professional Library Associations and Institutions in Facilitating Access to Information in Africa. Academic Journal of Interdisciplinary Studies. 2/2: 263-270.

[160]   Paina, L., Ssengooba, F., Waswa, D., M'Imunya, J. and Bennett, S. (2013). How does investment in research training affect the development of research networks and collaborations? Health Research Policy and Systems. 11/1: 1-13.

[161]   Pandey, S. and Pattnaik, P. (2015). University Research Ecosystem: A Conceptual Understanding. Review of Economic and Business Studies. 8/1: 169–181.

[162]   Patra, S. and Muchie, M. (2017). Engineering research profile of countries in the African Union. African Journal of Science, Technology, Innovation and Development. 9/4: 449-465.

[163]   Perkmann, M. Tartari, V. McKelvey, M. Autio, E. Brostrom, A, D'Este, P. Fini, R. Geuna, A. Grimaldi, R. Hughes, A. Krabel, S. Kitson, M. Llerena, P. Lissoni, F. Salter, A. and Sobrero, M. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. Research Policy. 42/2: 423–442.

[164]   Pho, P. and Tran, T. (2016). Obstacles to Scholarly Publishing in the Social Sciences and Humanities: A Case Study of Vietnamese Scholars. Publications. 4/19: 1-23.

[165]   Posthumus, H. Martin, A. and Chancellor, T. (2013). A systematic review on the impacts of capacity strengthening of agricultural research systems for development and the conditions of success. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

[166]   Pound, B., Macala, J. & Mokhothu, N. (2011). Case study on institutional change of the national agricultural research system in Lesotho. London: Department for International Development (DFID).

[167]   Pouris, A. and Ho, Y. (2014). Research emphasis and collaboration in Africa. Scientometrics. 98/3: 2169-2184.

[168]   Pulford, J. Gregorius, S. and Bates, I. (2017). DELTAS Africa Learning Research Programme: Learning Report No.1 Liverpool: Liverpool School of Tropical Medicine.

[169]   Rajalahti, R., Woelcke, J. and Pehu, E. (2005). Developing Research Systems to Support the Changing Agricultural Sector. Discussion Paper 14. Washington: World Bank.

[170]   Ramos, Y. (2014). Science and technology for development in Sub-Saharan Africa: key topics, challenges and opportunities. London: SciDev.Net.

[171]   Redman-MacLaren, M. MacLaren, D. Harrington, H. Asugeni, R. Timothy-Harrington, R. Kekeubata, E. and Speare, R. (2012). Mutual research capacity strengthening: a qualitative study of two-way partnerships in public health research. International Journal for Equity in Health. 11/79: 1-12.

[172]   Royal Society. (2011). Knowledge, networks and nations: Global scientific collaboration in the 21st century. Royal Society. London: Elsevier.

[173]   Salazar-Clemeña, R. and Almonte-Acosta, S. (2007). Developing Research Culture in Philippine Higher Education Institutions: Perspectives of University Faculty. Hangzhou: UNESCO.

[174]   Salvo, I., Mwoka, M., Kwaga, T., Rukundo, P., Ernest, D., Osaheni, L., John, K., Shafik, K. and de Sousa, A. (2015). Open access, open education resources and open data in Uganda. Pan African Medical Journal. 21/1.

[175]   Semali, L. Baker, R. and Freer, R. (2013). Multi-Institutional Partnerships for Higher Education in Africa: A Case Study of Assumptions of International Academic Collaboration. International Journal of Higher Education. 2/2: 53-66.

[176]   Shapayah, Y. and Mwanzu, A. (2015). Slow Staffing Processes in Universities in Kenya: A Case of USIU-Africa Faculty. Paper presented at EAMARC 2 Conference at USIU-Africa.

[177]   Sifuna, D. (2010). Some reflections on the expansion and quality of higher education in public universities in Kenya. Research in Post-Compulsory Education. 15/4: 415–425.

[178]   Singh, M. (2010). Higher education research: global topics and local settings. London: Centre for Higher Education Research and Information.

[179]   Siriwardhana, C., Sumathipala, A., Siribaddana, S., Samaraweera, S., Abeysinghe, N., Prince, M. and Hotopf, M. (2011). Reducing the scarcity in mental health research from low and middle income countries: a success story from Sri Lanka. International Review of Psychiatry. 23/1: 77–83.

[180]   Siyao, O. Whong, F. Martin-Yeboah, E. and Namamonde, A. (2017). Academic libraries in four Sub-Saharan Africa countries and their role in propagating open science. International Federation of Library Associations and Institutions. 43/3: 242–255.

[181]   Sombié, I. Aidam, J. Konaté, B. Somé, D. Kambou, S. (2013). The state of the research for health environment in the ministries of health of the Economic Community of the West African States (ECOWAS). Health Research Policy and Systems. 11/35: 1-11.

[182]   Sombié, I. Aidam, J. and Montorzi, G. (2017). Evaluation of regional project to strengthen national health research systems in four countries in West Africa: lessons learned. Health Research Policy and Systems. 15/46: 89-99.

[183]   Souvairan, E. de Haan, S. Montorzi, G. Edwards, D. and IJsselmuiden, C. (2014). Monitoring and Evaluation for National Research Systems for Health. A Resource for Strategic Planning, Learning and Generating Evidence for Research Management. Council on Health Research for Development (COHRED).

[184]   Spielman, D. Ekboir, J., Davis, K. and Ochieng, C. (2008). An innovation systems perspective on strengthening agricultural education and training in sub-Saharan Africa. Agricultural Systems. 98/1: 1–9.

[185]   Spielman, D. Davis, K. Nehash, M. Ayele, G. (2010). Rural innovation systems and networks: findings from a study of Ethiopian smallholders. Agriculture and Human Values. 28:2, 195-212.

[186]   Stöckli, B., Wiesmann, U., and Lys, J. (2018). A Guide for Transboundary Research Partnerships: 11 Principles, 3rd edition (1st edition 2012). Bern: Swiss Commission for Research Partnerships with Developing Countries (KFPE).

[187]   Streete, T., Henry, M., Ivey, P. and Oliver, G. (2013). Critical case study on the state of research management in the Caribbean. Regional and Thematic Papers on Research Management 2009–2013.

[188]   Teferra, D. and Altbach, A. (2003). African Higher Education: An International Reference Handbook. Bloomington: Indiana University Press.

[189]   Teferra, D. and Knight, J. (2008). Higher Education in Africa: The International Dimension. Ghana: African Books Collective.

[190]   Teferra, D. (2015). Manufacturing - and exporting - excellence and 'mediocrity': doctoral education in South Africa. South African Journal of Higher Education. 29/5: 8–19.

[191]   Tessema, K. (2009). The Unfolding Trends and Consequences of Expanding Higher Education in Ethiopia: Massive Universities, Massive Challenges. Higher Education Quarterly. 63/1: 29–45.

[192]   Thege, B. Popescu-Willingmann, S. Pioch, R. and Badri-Hoher, S. (2014). Paths to career and success for women in science: Findings from international research. Kiel: Springer.

[193]   Thornicroft, G., Cooper, S., Bortel, T. V., Kakuma, R. and Lund, C. (2012). Capacity Building in Global Mental Health Research. Harvard Review of Psychiatry. 20/1: 13–24.

[194]   Tierney, W., Nyandiko, W., Siika, A., Wools-Kaloustian, K., Sidle, J., Kiplagat, J., Bell, A. and Inui, T. (2013). "These are Good Problems to Have…": Establishing a Collaborative Research Partnership in East Africa. Journal of International Medicine. 28/3: 625–638.

[195]   Trotter, H., Kell, C., Willmers, M., Gray, E. and King, T. (2014). Seeking Impact and Visibility: Scholarly Communication in Southern Africa. Cape Town: African Minds.

[196]   Ubogu, F. and Heever, M. (2017). Collaboration on Academic Research Support among Five African Universities. Qualitative and Quantitative Methods in Libraries. 2/2: 207–219.

[197]   Udensi, J. and Akor, P. (2014). An Assessment of Record Management System in Establishment Division of Two Universities in Nigeria. International Letters of Social and Humanistic Sciences. 13: 97–109.

[198]   Ugbe, U. (2010). It may take a little while…: Insights on agricultural research for innovation and development in Nigeria. Discussion paper 05. Research into Use.

[199]   Ugonna, C., Ochieng, E., Matipa, W. and Shah, R. (2015). Strategies for Enhancing the Application of Strategic Project Management (SPM) in Research Organisations: Case Nigeria. Conference paper presented at International Conference on Organisation and Management (ICOM): Abu Dhabi.

[200]   Uneke, C., Ezeoha, A., Ndukwe, C. and Onwe, P. (2010). Development of Health Policy and Systems Research in Nigeria: Lessons for Developing Countries' Evidence-Based Health Policy Making Process and Practice. Healthcare Policy. 6/1: 109-126.

[201]   University of Stellenbosch, Centre for Research on Science and Technology and Institut de rechereche pour le développement. (2009). Mapping Research Systems in developing countries. Paris: UNESCO.

[202]   UNESCO. (2010). Higher education in sub-Saharan Africa – A Statistical Portrait. UNESCO: UIS Workshop on education statistics. Windhoek, 17-21 October, 2010.

[203]   UNESCO. (2015). 'Mapping Research and Innovation in the Republic of Rwanda' in Lemarch, G. and Tash, A. (eds.) GO-SPIN Country Profiles in Science, Technology and Innovation Policy, vol. 4. United Nations Educational, Scientific and Cultural Organisation: Paris.

[204]   Van Vught, F. (2008). Mission Diversity and Reputation in Higher Education. Higher Education Policy. 21/2: 151 -174.

[205]   Vasquez, E., Hirsch, J., Giang, L. and Parker, R. (2013). Rethinking health research capacity strengthening. Global Public Health. 8/1: 104 - 124.

[206]   Vernooy, R., Nelles, W., Campilan, D. and Li, Z. (2009). Learning to evaluate capacity development and collaborative learning about community-based natural resource management: lessons from Asia. Working paper 2009-4. Lima: International Potato Center.

[207]   Vinkler, P. (2008). Correlation between the structure of scientific research, scientometric indicators and GDP in EU and non-EU countries. Scientometrics. 74, 237-254.

[208]   Vogel, I. (2011). Research Capacity Strengthening Learning from Experience. London: UK Collaborative on Development Studies (UKCDS).

[209]   Wager, E. and Kleinert, S. (2012). Cooperation Between Research Institutions and Journals on Research Integrity Cases: Guidance from the Committee on Publication Ethics (COPE). Acta Inform Medica. 20/3: 136 - 140.

[210]   Whitworth, J., Kokwaro, G., Kinyanjui, S., Snewin, V., Tanner, M., Walport, M., and Sewankambo, N. (2008). Strengthening capacity for health research in Africa. The Lancet. 372/9649: 1590–1593.

[211]   World Health Organisation. (2015). Research Capacity Strengthening and Knowledge Management. Geneva: World Health Organisation.

[212]   Wight, D. (2008). "Most of our social scientists are not institution based… they are there for hire." Research consultancies and social science capacity for health research in East Africa. Social Science & Medicine. 66/1: 110-116.

[213]   Wight, D., Ahikire, J. and Kwesiga, J. (2014). Consultancy research as a barrier to strengthening social science research capacity in Uganda. Social Science and Medicine. 116: 32–40.

[214] Woodward, A., Sheahan, K., Martineau, T. and Sondorp, E. (2017). Health systems research in fragile and conflict affected states: a qualitative study of associated challenges. Health Research Policy and Systems. 15/44: 1-12.

[215] Ynalvez, M. and Shrum, W. (2011). Professional networks, scientific collaboration, and publication productivity in resource-constrained research institutions in a developing country. Research Policy. 40/2: 204-216.

[216] Zaman, K. (2015). Quality guidelines for good governance in higher education across the globe. Pacific Science Review B: Humanities and Social Sciences. 1: 1–7.

[217] Zeelen J. (2012) Universities in Africa: Working on Excellence for Whom? Reflections on Teaching, Research, and Outreach Activities at African Universities. International Journal of Higher Education. 1/2: 157-165.

[218] DFID (2014). Assessing the Strength of Evidence. How to Note March 2014. DFID: London.

[219] Sanyal, C. and Varghese, V. (2007) Knowledge for the future: research capacity in developing countries. Paris: UNESCO and IIEP.

[220] Falk, E., Harber, T. and Roberts, L. (2014). DRUSSA Benchmarking Report 2014: Summaries and analysis from the 2014 DRUSSA benchmarking survey and Leadership and Benchmarking Conference. DRUSSA.

[221] INASP. (2016). Local ideas and expertise strengthen research systems: lessons learned form a collective problem solving approach. April 2016. Available at: https://www.inasp.info/sites/default/files/2018-04/LRI%20%E2%80%93%20WTSR.pdf. Last accessed: 17 June.

[222] Moss, C. (2016). The next generation: Ideas and experience in African researcher support. April 2016. Available at: https://www.thebritishacademy.ac.uk/sites/default/files/Nairobi-Process-The-Next-Generation.pdf. Last accessed: 17 June.

[223] Koch, S. and Weingert, P. (2016). The Delusion of Knowledge Transfer: The Impact of Foreign Aid Experts on Policymaking in South Africa and Tanzania. Cape Town: African Minds.

[224] Shin, J. and Lee, S. (2014). Evolution of research universities as a national research system in Korea: accomplishments and challenges. Higher Education. 70/2: 187-202.

[225] Ivwighreghweta, O. (2012). An investigation to the challenges of institutional repositories development in six academic institutions in Nigeria. International Journal of Digital Library Services. 2/4: 1-33.

[226] Harle, J. (2011). Foundations for the Future: Supporting the early careers of African researchers. December 2011. Available at: https://www.acu.ac.uk/publication/view?publication=429. Last accessed: 17 June.

[227] Collingwood, R. (2007). Challenges and/or Opportunities Facing Academic Staff in PHEA countries: Highlights from 'African Higher Education: An International Reference Handbook'. January 12. Available at: http://foundation-partnership.org/ulf/resources/challenges.pdf. Last accessed: 17 June.

Appendix A – Key concepts

Table 10. Definitions

Indicative Definitions
Research system: the national, or regional, environment that defines, enables and promotes research. It would include at least the set of practicing institutions from the public and private sectors, strategy and policy frameworks, practices, and structures that either facilitate or hinder the production, diffusion and uptake of research.
Research funding organisation (RFO): A research funding organisation is a public or charitable organisation that provides funding for research in the form of grants, fellowships or scholarships. RFOs may include government departments, national funding agencies, private foundations and philanthropic individuals or organisations. In contrast to contract research funders, RFOs do not typically lay claim to the intellectual property arising from the research that they fund.
Research performing organisation (RPO): Research performing organisations include public or private institutions, such as universities, science councils, research institutes or company research departments, irrespective of their legal status (organised under law) or way of financing, whose primary goal is to conduct fundamental research, industrial research or experimental development.
Researcher: Professionals engaged in the conception or creation of new knowledge through research, improving or developing concepts, theories, models, techniques, instrumentation, software or operational methods (OECD 2015).
(Research) production: The process through which research is created by researchers and research organisations, including the necessary inputs and activities which directly enter the production function (GDN 2017).
(Research) diffusion: The communication of research findings and products; and the channels through which academia, policymakers, civil society and the private sector interact to discuss and share these findings. It involves generating interest, forming attitudes and changing behaviour to support the adoption of research (GDN 2017).
(Research) uptake: The exploitation and adoption of research-based products for practical use or the application of research results and methods in specific and direct ways (GDN 2017).

Table 11. Key concepts related to research question 1 (research systems)

Macro issue	Indicative list of issues	Keywords
Political economy barriers	- Income inequality and access to research (cost of developing & accessing research) - Structural inequality (opportunities to engage in higher education & research) - Geographic inequality (e.g. urban/rural divide) - Corruption and poor governance - Political instability and conflict - Human rights and limits to freedom of thought, belief, religion speech and expression	Access to research; access to education; participation in education; income inequality; structural inequality; geographic inequality; urban-rural divide; corruption; bad governance; political instability; conflict; human rights; freedom of thought; freedom of belief; freedom of expression
Enabling environment	- Policy commitments on research investments - Economic contribution of research (including interventions) - Attitude towards research (government and other stakeholders) - Systems and policies aligning research with national development strategies and other public policy - Incentive structure for researchers (i.e. to perform high quality research, to publish etc.) - Assessments of research performance	Public policy; research investment; research funding; economic development and research; researcher attitude; role of research; use of evidence in policy / government; author incentives; research quality; research assessments; research performance
Structures and networks	- Systems, processes and networks that support use of research in policymaking - Systems, processes and networks that support use of research in commercial contexts - Systems, processes and networks that support use of research in civil society	Research impact; technology transfer; research commercialization; commercial research; research and development; technology transfer; research and innovation; evidence in policymaking; university-business collaborations; social innovation and research;

	Development and role of learned societies • Systems, policies and networks to align research with private sector and civil society	research and local communities; research infrastructure; digital revolution; learned societies
Interventions	• Interventions strengthening national research systems • Interventions strengthening regional research systems • Interventions affecting all the other issues that are part of the research question	All of the above + interventions

Table 12. Key concepts related to research question 2 (research organisations)

Macro issue	Indicative list of issues	Keywords
Research principles and approaches	• Organisational research strategies, policies and principles • Cultural and structural incentives underpinning research integrity and research ethics • Networks and attitudes affecting good research practice • Approaches to fair and equitable recruitment of researchers • Early-stage development of research ideas and proposals	Research strategies; research principles; research culture; research integrity; research ethics; structural incentives; recruitment policies and practices; research governance; research collaborations; research proposals
Research management	• Organisational policies and procedures affecting the financial management of research (efficiency, effectiveness and transparency) • Organisational policies and procedures affecting the management of research staff • Approaches to training and responsibilities of researchers • Policies, procedures and systems underpinning the	Financial management; research funding; financial transparency; financial efficiency; research management processes / procedures; research training; research data; data protection and privacy; monitoring and enforcement of organisational policies; doctoral training, research information / research management information; research development / research business development; research

	- management of research data, data protection and privacy - Workloads and teaching buyouts - Availability of funding for and access to equipment, travel and conferences - Approaches to research development and research business development, - Research support systems - Research information and research management information systems - Doctoral training and researcher development	support; access to equipment; access to travel, conferences and networking; researcher workload; administrative burden; teaching buyout
Research dissemination	- Level of access to international literature and data - Organisational policies, procedures and systems underpinning scholarly communication - Organisational policies, procedures and systems supporting IP protection - Publication incentives (quality v quantity)	Access to research; open access; research publications; subscriptions to research publications; scholarly journals; intellectual property; publication incentives
Interventions	- Interventions supporting the development of good practice principles and approaches - Interventions strengthening research management - Interventions strengthening research dissemination	All of the above + interventions

Appendix B – REA country selection

The rapid evidence assessment was tasked to look at research systems and organisations in low and medium-income countries. Using the World Bank's listing, in 2017 139 countries were classified as low and medium income (LMIC). Within such a large group, the socio-economic differences and the differences in the stage of research system development are such as to make comparisons meaningless.

For this reason, and given the large availability of literature on the topic, we had to apply criteria for prioritising what studies would be included in the REA. In order to define a subset of LMICs with comparable research systems, two factors were considered:

-   The country's income level (GDP per capita)
-   The country's level of investment in research and development (GERD)

The REA prioritised studies from low or lower-middle income countries, as defined in the most recent World Bank classification (see below).

Table 13. LMICs groupings by income level (world Bank)

Threshold	GNI/Capita (current US$)
Low-income	< 995
Lower-middle income	996 - 3,895
Upper-middle income	3,896 - 12,055
High-income	> 12,055

Using this definition, the list of countries prioritised in the REA includes 31 Low-income countries and 52 Lower-middle income countries. We further refined the list by removing small island states and countries with a population of less than 3 million.

For each country we then considered the Gross Expenditure on Research and Development (GERD) and the GERD per capita. Despite common commitments to spend substantially more, we did not find that any country spent more than 1% of its GDP on research – showing a strong correlation between income and investment in research. For the countries where no GERD data was found, we assumed that the socio-economic conditions were sufficiently homogenous to be included in the study.

The final list of 68 LMICs that have been prioritised in this study is presented below. Most of these countries are located in Africa, but significant groups are also found in South and South-East Asia.

Table 14. LMICs considered in the study and relevant socio-economic indicators

Country Name	GDP per capita (US$)	GERD as a % of GDP	GERD per capita (PPP)*
South Sudan	$ 237.44	0.10	12.98

Burundi	$ 292.01	0.12	3.69
Malawi	$ 338.48	NA	NA
Niger	$ 378.06	0.21	9.38
Central African Republic	$ 418.41		
Mozambique	$ 426.22	0.16	2.12
Madagascar	$ 449.72	0.01	0.22
Congo, Dem. Rep.	$ 462.78	NA	0.48
Somalia	$ 478.34	NA	NA
Sierra Leone	$ 499.53	NA	NA
Afghanistan	$ 550.07	NA	NA
Eritrea	$ 582.78	NA	NA
Uganda	$ 606.47	0.44	38.93
Togo	$ 610.15	NA	NA
Burkina Faso	$ 642.04	0.22	3.69
Chad	$ 662.50	0.32	
Liberia	$ 694.32	NA	NA
Gambia, The	$ 709.08	0.37	11.28
Guinea-Bissau	$ 723.61	NA	NA
Rwanda	$ 748.29	NA	NA
Haiti	$ 765.68	NA	NA
Ethiopia	$ 767.56	0.60	8.29
Tajikistan	$ 801.05	0.52	12.31
Guinea	$ 823.49	NA	NA
Mali	$ 827.01	NA	NA
Benin	$ 827.39	NA	NA

Nepal	$ 849.01	0.10	5.73
Tanzania	$ 936.33	0.13	2.02
Yemen, Rep.	$ 1,106.80	0.27	7.70
Mauritania	$ 1,136.76	NA	NA
Lesotho	$ 1,154.44	0.04	1.38
Kyrgyz Republic	$ 1,219.82	0.10	35.46
Myanmar	$ 1,256.66	0.30	5.88
Senegal	$ 1,329.30	NA	NA
Zimbabwe	$ 1,333.40	NA	NA
Cambodia	$ 1,384.42	0.11	4.14
Cameroon	$ 1,451.87	NA	NA
Zambia	$ 1,513.28	NA	NA
Bangladesh	$ 1,516.51	NA	NA
Uzbekistan	$ 1,533.85	NA	NA
Cote d'Ivoire	$ 1,537.50	NA	NA
Pakistan	$ 1,547.85	0.03	1.35
Kenya	$ 1,594.83	0.78	19.06
Congo, Rep.	$ 1,654.01	NA	NA
India	$ 1,942.10	0.61	38.00
Nigeria	$ 1,968.43	0.24	12.30
Ghana	$ 2,046.11	0.02	2.32
Syrian Arab Republic	$ 2,058.04	0.11	3.67
Nicaragua	$ 2,221.81	NA	NA
Timor-Leste	$ 2,279.25	0.27	3.76
Moldova	$ 2,289.88	0.13	17.43

Vietnam	$ 2,342.24	0.44	26.09
Egypt, Arab Rep.	$ 2,412.73	0.60	70.18
Lao PDR	$ 2,457.38	0.03	0.82
Honduras	$ 2,480.13	0.01	0.68
Papua New Guinea	$ 2,488.90	0.13	9.00
Ukraine	$ 2,639.82	0.18	13.17
Sudan	$ 2,898.55	NA	NA
Philippines	$ 2,988.95	NA	NA
Morocco	$ 3,007.24	0.33	4.01
West Bank and Gaza	$ 3,094.73	NA	NA
Bhutan	$ 3,130.23	NA	NA
Cabo Verde	$ 3,244.41	0.07	4.35
Bolivia	$ 3,393.96	0.15	8.02
Tunisia	$ 3,464.42	0.17	2.93
Mongolia	$ 3,717.47	0.71	45.77
Indonesia	$ 3,846.86	0.08	8.45
El Salvador	$ 3,889.31	0.14	11.32

* GERD per capita is calculated as the actual expenditure on research and development at current prices and parity purchasing power (PPP).

Appendix C - Summary of RCS initiatives

The table below presents a summary of some donor-funded research capacity strengthening initiative. It also presents their main intervention strategy and the needs or problems they have sought or are to address. The list, which includes both ongoing and recently completed programmes, is not meant to be exhaustive but merely to provide a rapid overview of the landscape.

Table 15. Non-exhaustive list of recent RCS Initiatives

Acronym	Strategy *	Status	Main funder(s)	Description
AAP	VRP	Active	Wellcome Trust	Africa and Asia Programmes (AAP) – over the past 30 years, Wellcome have invested in 5 major research programmes in Africa and Asia. RCS support is embedded in these programmes in Kenya, Malawi, South Africa, Thailand and Vietnam.
ACBI	PAR	Active	Royal Society / DFID	Royal Society-DFID Africa Capacity Building Initiative (ACBI) which aims to strengthen the research capacity of universities and research institutions in sub-Saharan Africa by supporting the development of sustainable research networks.
ACE	COE	Active	World Bank	The World Bank's African Higher Education Centres of Excellence (ACE) projects in West and Central Africa (ACE I) and Eastern and Southern Africa (ACE II) seek to train experts in various research fields to find solutions to regional developmental challenges. It strengthens post-graduate programs for a regional student body, offer specialized courses for industry professionals, provide learning resources and labs, establish linkages with companies, government agencies and research centers and collaborate with partner institutions.
ACU	TRA	Active	Association of Commonwe	The Association of Commonwealth Universities (ACU)'s Benchmarking research management processes facilitates sharing of experiences and good practice with respect to university management processes. The process features two in-person events, over two years and, in each case, rely on preparatory work by the participants to record their current practices. No more than 16 participating universities participate at a time. Each session produces a series of good

			alth Universities	practice statements, against which participants and the wider higher education community can review their current practices.
AERC	TRA	Active	Consortium	African Economic Research Council (AERC) to enhance capacity building for economic policy research and graduate training in sub-Saharan Africa through biannual research workshop capacity building activities, joint/shared facilities for graduate training electives, senior policy seminar, and national workshops.
AESA	TRA	Active	Consortium	The Alliance for Accelerating Excellence in Science in Africa (AESA) is implementing programmes designed to shape ideas and careers of young researchers through in-country leadership, mentorship and training opportunities. AESA also seeks to empower scientists by funding grant programmes that support novel but scalable ideas; provide networking and research advocacy opportunities for young researchers; and build high-quality research management and financial practices.
AIMS	NET	Active	Consortium	African Institute of Mathematica Sciences supports industry-research linkages and incentivises universities to work with the private sector, through e.g. joint calls with sectors outside the academic sector. It has research, training and public engagement components.
ASADI	NET	Active	Gates Foundation	The Africa Science Academy Development Initiative aims to enhance cooperation among African science academies improve relationships between science academies and governments to foster an appreciation of the value of evidence-based policy advice and develop rigorous procedures for providing policy advice.
ASTII	NET	Active	NEPAD	The Africa Science, Technology and Innovation Indicators (ASTII) implemented by NEPAD, aims to develop and promote the adoption of internationally compatible Science, Technology and Innovation (STI) indicators; build human and institutional capacities for STI indicators and related surveys; enable African countries to participate in international programmes for STI indicators; and inform African countries on the state of STI in Africa.
ATLAS	PAR	Active	Royal Society	The Royal Society's Atlas of Islamic-World Science and Innovation explored the changing landscape of science and innovation across a selection of Muslim countries in the Middle East, Africa and Asia. The project charted the interplay between science, innovation, culture and politics and explored new opportunities for partnership and exchange with the wider world. It offered an independent assessment of how their science and innovation capabilities are changing, and the opportunities and barriers to further progress; and explored new opportunities for partnership and exchange.
BCURE	PAR	Ended	DFID	Building Capacity to Use Research Evidence (BCURE) supports the use of research in decision making by working with intermediary and policymaking organisations

CARI	PAR	Active	Gates Foundation, NIHR	Coalition for African Research & Innovation (CARI) – an initiative set up with AESA, NIHR and Gates to catalyse more investment from African sources.
CIRCLE	PAR	Active	ACU, DFID, AAS	Climate Impacts Research Capacity and Leadership Enhancement aimed to strengthen research capacity that addresses the environmental, social and economic impact of changes in climate. It sought to facilitate the capacity of African researchers to develop relevant local solutions and improve uptake and use in local, national and regional policy and implementation. It also worked to enhance the output of African researchers by increased training and publications.
CODERSIA	VRP	Active	Consortium	The African Citation Index implemented by the Council for the Development of Social Science Research in Africa (CODESRIA) aims to make knowledge production in Africa accessible and visible. "CODESRIA considers the Index as a continental infrastructure, available to institutions, decision-makers, regional and international bodies, researchers, students and partners interested in gaining a more realistic understanding and knowledge of the field of African research. It also asserts itself as a tool to deal adequately with African issues on the basis of the realities of African knowledge."
CoMMAL	NET	Ended	NWO	Supporting a research support centre to forge links with the Ministries of Health and Education and the Pharmacy, Medicines and Poisons Board in Malawi (CoMMAL project under the NACCAP programme, NWO-WOTRO).
COSMTECH	COE	Active	Islamic Development Bank	The Islamic Development Bank (IDB) support to COMSTECH, the Organisation of Islamic Cooperation's Science and Technology standing committee, to strengthen centres of research excellence across North and West Africa, the Middle East and South Asia.
DELTAS	NET	Active	DFID, Wellcome Trust	Developing Excellence in Leadership, Training and Science Initiative (DELTAS) – capacity building programme developing scientific and research leaders. DELTAS supports 11 African led research consortia.
DRUSSA	COE	Ended	DFID	Development Research Uptake in Sub-Saharan Africa (DRUSSA) was a five-year, DFID-funded programme supporting 22 universities across Africa to strengthen the management of research uptake. Its purpose was to help improve the capacity of universities to contribute research evidence in pro-poor policy and practice through sharing learning on institutional change and research uptake strategy, supporting training of university staff in research uptake and communication, and through facilitating and strengthening networks between DRUSSA universities, other research management bodies, external stakeholders and research users, including policymakers.

ECWS	TRA	Active	IDRC, SIDA, UNESCO	Building the capacity of women scientists (IDRC's Early Career Women Scientists (ECWS) fellowships in partnership with UNESCO's Organisation for Women in Science for the Developing World (OWSD) and SIDA).
EDCTP	COE	Ended	Consortium	The European & Developing Countries Clinical Trials Partnership (EDCTP) supports networks of excellence across sub-Saharan Africa to encourage collaboration and good practice in clinical research, leveraging buy-in and financial support from African governments to ensure their long-term sustainability and local ownership
EP	TRA	Ended	UKRI	Equitable partnerships – UKRI held a workshop in Tanzania with southern researchers in Sept 2018 on equitable N-S research partnerships. The workshop report identifies a number of recommendations for research funders. UKRI also funded a project by the Rethinking Research Collaborative on 'Promoting Fair and Equitable Research Partnerships to respond to Global Challenges' which produced a report and learning resources.
ESSENCE	NET	Active	WHO	ESSENCE on Health Research is an initiative that allows donors/funders to identify synergies, establish coherence and increase the value of resources and action for health research. Since its inception in 2008, the evaluation, impact, use of evidence – and ultimately the improvement of health outcomes – have been a focus of the initiative. ESSENCE has facilitated dialogue among all partners and piloting a number of innovative approaches to achieve its goals
GCRF	PAR	Active	UKRI, Royal Society	Global Challenges Research Fund (GCRF) Grow Capability Programme - £225m invested in 37 projects focused on 11 challenge areas with 69 partner countries. It included various RCS work such as training and Massive Open Online Courses (MOOCs).
GDN	VRP	Active	Global Development Network	Global Development Network (GDN)'s Doing Research Programme aims to identify barriers to good, policy-relevant research being produced and used in developing countries and to benchmark these systems, with the ultimate goal of improving research policies and underlying conditions for carrying out research. Assessments of research systems were undertaken in 11 countries, using different approaches. Based on its conclusions GDN developed a framework which assesses Research Systems in terms of their 3 main functions – Production, Diffusion and Use – and in 5 areas: Context, Inputs, Activities, Outputs and Outcomes. GDN plan to pilot this framework in three countries, one each in Africa, Asia and Latin America. GDN aim to generate an interactive publicly available dataset, benchmark social science research systems, and produce a periodic global report on doing research in social sciences in developing countries.
GFGP	PAR	Active	Wellcome, EDCTP, MRC(UK)	Good Financial Grant Practice - engaging with the GFGP to look at reducing the burden of audit and due diligence on partners. Investment into to the Good Financial Grant Practice (£0.5M) which has enabled the development of the newly launched portal to permit LMIC institutions to log their due diligence assessments

HERANA	NET	Ended	NORAD, Ford Foundation, Carnegie Corporation	The Higher Education Research and Advocacy Network in Africa (HERANA) sought to establish how national and institutional stakeholders conceptualise the role of higher education and of universities in development. It also aimed to investigate the complex relationships between higher education and economic development in selected African countries with a focus on the context in which universities operate, the internal structure and dynamics of the universities, and the interaction between the national and institutional contexts. It also aimed to identify factors and conditions that facilitate or inhibit universities' ability to make a sustainable contribution to economic development. Lasting ten years, it was managed in three phases, ending in 2017.
HSRI	PAR	Active	DFID, UKRI, Wellcome	Launched in 2013, the Health Systems Research Initiative (HRSI) aims to generate world class and cutting-edge research that addresses key questions on strengthening and improving health systems in developing countries.
INASP (1)	NET	Active	Consortium	Supporting collective action to improve access to research. In Sierra Leone, INASP brought together librarians, IT staff, researchers and research leaders, whilst in Ghana they facilitated discussions between three of the country's leading research centres, IT and library leaders.
INASP (2)	NET	Active	Consortium	Supporting policy dialogue (through knowledge cafes) amongst, think tanks and academia who produce research policy makers who use research, and the media who communicate the policy implications to the public to discuss the evidence base around particular policies (INASP in Zimbabwe).
INASP (3)	NET	Active	Consortium	Building peer networks of women within institutions, countries and regions to enable and facilitate change and connecting change agents. Promoting dialogue about gender gaps in academia and research. Encouraging the integration of gender into government policies (INASP).
INGSA	NET	Active	International Science Council	Support to INGSA (International Network for Government Science Advice) to strengthen capacity for government science advice.
IVTF	TRA	Ended	World Bank	The Vaccines team have been a part of the International Vaccines Task Force (IVTF) recent work on strengthening clinical research capacity to prevent epidemics and helping to take forward recommendations from the Money and Microbes report.
KSI	VRP	Active	DFID	Knowledge System Innovations (KSI) is a programme aimed at understanding knowledge systems and gaps and practical actions for investments in STI. Focus countries are: Kenya, Tanzania, Rwanda and Indonesia. Also supporting capacity development of policy analysts in government agencies and working with the media to promote more

		Active		evidence-informed public debate on policy issues and raise awareness of the importance of using evidence in making policy decisions.
NF	PAR	Active	Consortium	Newton Fund develops science and innovation partnerships with LMICs and aims to increase the science and innovation capability of partner countries. RCS activities include mobility placement schemes for researchers in UK institutions, sharing research grant and peer review expertise, fellowships exchange schemes, building institutional links, specific skills training and access to specialist equipment. An ICAI review on the Newton Fund was published in June 2019.
PASGR	PAR	Active	Consortium	Partnership for African Social & Governance Research (PASGR) facilitates capacity development and knowledge production for policy relevant social and governance research in Africa through collaborations with researchers based in their home institutions. The programme aims to provide high quality policy relevant research to varied audiences; integrate policy actors into the different phases of the governance research process and institutionalise research-policy communities to facilitate uptake of research evidence in study countries.
PERFORM	NET	Ended	-	The intervention developed a community of researchers and organisations within Albania and Serbia to promote joint grant applications, support a thematic regional research network. It also helped policymakers identify priority issues and linked researchers with policy institutions to promote research use.
ReMPro Africa	COE	Active	Consortium	ReMPro Africa (Research Management Programme in Africa) is a programme to build sustainable capacity in research management in African institutions, led by the African Academy of Science (AAS). It supports institutional research systems work by enabling institutes to apply for the direct cost of research management capacity. There is similar programme in India, managed through the India Alliance.
RIMAIS	PAR	Ended	AECID, EU-LAC	Strengthening health ministries' capacity to use and share health research to improve regional public health (the RIMAIS initiative in Latin America funded by the Spanish aid agency AECID and EU-LAC).
SANBio	COE	Active	NEPAD	Establishing regional networks of centres of excellence (such as the Southern African Network for Biosciences (SANBio) set up by NEPAD's Africa Biosciences Initiative).
SCAP		Ended	IDRC	The Scholarly Communication in Africa Programme (SCAP) was established to help raise the visibility of African scholarship by mapping current research and communication practices in four Southern African universities and recommending technical and administrative solutions based on experiences gained in implementation initiatives piloted at these universities.

SCGI	PAR	Active	DFID, IDRC, SIDA, NRF	The Science Granting Councils Initiative (SGCI) aims to improve the effectiveness of government investments in research in East Africa and other SSA countries by strengthening partnerships between Science Granting Councils and other actors in the science systems and improving knowledge exchange with the private sector.
SORT IT		Active	DFID	Structured Operational Research and Training Initiative (SORT IT) delivered by the TDR special research programme in Colombia, Ghana, Myanmar, Nepal, Uganda and Vietnam, aims to bridge the gap between research and practice by providing training to health practitioners on how to use local and national AMR data. Award £8.2M over 3 years. This complements national AMR surveillance infrastructure through the DHSC Fleming Fund, to generate relevant AMR data shared nationally and globally.
SPHEIR	TRA	Ended	UUK, DFID	SPHEIR is a £45 million DFID fund to support higher education transformation in focus countries in Sub-Saharan Africa, Asia and the Middle East. It aims to deliver systemic and sustainable change within higher education systems, enabling them to meet labour market needs and generate the job-ready, entrepreneurial graduates needed to accelerate development, build inclusive societies and promote strong economic growth.
SRIA		Active	DFID	Strengthening Research Institutions in Africa (SRIA) £20m programme focussed on strengthening research institutions and systems in 7 African countries. DFID recently funded a rapid systems research to inform this programme.
SEDI	TRA	Active	DFID	Strengthening Evidence for Development Impact aims to increase the demand for and use of data and evidence by policymakers in Ghana, Uganda and Pakistan.
SRKS	PAR	Active	DFID, SIDA	Strengthening Research Knowledge Systems (SRKS) improved access to online research and strengthening the capacity of partner countries to secure and manage access in the future by negotiating more affordable access to journals and books for developing country universities and research institutes.
WAHO	TRA	Ended	IDRC, WAHO	Strengthening Research for Health System Development in West Africa built research for health capacity, and in four of its member countries (Guinea-Bissau, Liberia, Mali and Sierra Leone). In each member country, researchers mapped existing research for health capacity/needs, formulated a plan of action, designed a training curriculum for a course on research for health, and deliver the training course. The project also included funding, mentoring and supervising selected research projects. In addition, a research for health information management system has been constructed and implemented (with appropriate training and adaptation) in each of the four countries involved.

* VRP = Vertical research project; PAR = Partnership; COE = Centre of Excellence; NET = Networks / consortia; TRA = Training