

LIRA 2030

Africa

LEADING INTEGRATED RESEARCH FOR AGENDA 2030 IN AFRICA

Learning from Practising Transdisciplinary
Research for Sustainable Development
in African Cities



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EXECUTIVE SUMMARY

The Leading Integrated Research for Agenda 2030 in Africa (LIRA 2030 Africa, implemented from 2016 to 2021) programme provided a unique opportunity to learn about the potential of transdisciplinary (TD) research approaches for advancing sustainable development across African cities.



The LIRA research projects demonstrated the diversity of understanding and practices of transdisciplinary research. Research was adapted to suit local contexts, using different modes of transdisciplinary engagement for different stakeholder groups and different purposes. Stakeholder engagement in the early stages of project co-development was especially useful in order to build trust and foster long-term collaboration. The process of implementing transdisciplinary research was considered as important as the final outcome, with the knowledge co-production process itself seen as an agent of change. Transdisciplinary research was gradually understood as more than a method, but rather as a political and social practice, with explicit acknowledgement of the need to shift power relations in research from extractive towards more participatory practices.



Through processes of co-learning and adaptation, the transdisciplinary approach allowed research teams to respond to lessons learned on the ground and adjust accordingly. Gaining understanding of the problem being researched in a certain context and input from stakeholders challenged assumptions about how change happens and created opportunities for new learning. The factors affecting these kinds of changes typically resulted from relations and resources, such as new partners, changes in budget and uneven or unexpected stakeholder engagement. Flexibility in funding structures was crucial for allowing for adjustments in project design. Training on theory of change and guidelines provided by the LIRA programme also encouraged self-reflection and adaptation.



Given the relational nature of transdisciplinary processes, key factors that enabled the success of projects and allowed for change to occur included good communication, capacity development, and the availability of different types of resources. Leveraging personal and partner networks

was important for securing the buy-in of stakeholders, especially within the policy community, as was making most of windows of opportunity to amplify and elevate projects' efforts.



The complexity of transdisciplinary research, with its iterative characteristics and inclusion of numerous actors, demanded competencies that straddle the scientific, organization, social and political dimensions of such research. Transcending disciplinary boundaries and effectively integrating knowledge from multiple disciplines and diverse stakeholders with different interests all created challenges for the project teams. Managing projects in university systems unaccustomed to working across disciplines, or with other sectors or countries, also created delays, particularly with regards to access to funding. Limited time and resources made it difficult to engage meaningfully in two different countries, and to sustain investments in relationships, partnerships and knowledge generation over the duration of the project. The COVID-19 pandemic presented the greatest challenge to the transdisciplinary process during the programme, particularly affecting joint activities and stakeholder engagement.



The LIRA programme enabled researchers to develop the skills and knowledge necessary to carry out transdisciplinary projects. Grant provision, capacity-building activities, and peer-learning and networking were highlighted as the programme's most important benefits. Despite the challenges of publishing transdisciplinary research and the lack of reward systems for collaborative work, all LIRA project researchers stated that they want to continue doing transdisciplinary research. Overall feedback on the programme was very positive and researchers also shared recommendations that could be considered in the design of future transdisciplinary research funding programmes. These include increasing the duration and size of research grants, as well as flexibility to accommodate changes that occur during the emergent transdisciplinary research process. There is a need to allocate resources for partnership building, capacity building and networking activities, and to recognize that transdisciplinary engagement processes might not result in immediate tangible outputs but could lead to longer-term change.



The LIRA projects generated an extensive range of knowledge and data relevant to the 2030 Agenda for Sustainable Development. The results of the programme are not only of academic interest but also useful for local communities and policy-makers. The programme resulted in more

than 60 academic articles, as well as policy briefs and contributions to books, reports and other publications. Other knowledge products include Master's and postgraduate degrees, GIS maps, databases, training courses and tools, as well as blogs, documentaries, photo stories and exhibitions that have been developed to make the research and its findings more accessible to a wider audience.



The LIRA programme has contributed to shifting dominant centres of knowledge production on Africa from the Global North to Africa itself.

The scientific and societal goals of projects were driven by local priorities, addressing conceptual and delivery deficits in local areas, while simultaneously highlighting persistent knowledge gaps on urban processes in Africa, and blind spots in global policy agendas that are inadequately aligned with the complexity of African cities.



The LIRA programme helped to build capacities both on the individual and societal level, and enhanced opportunities for the researchers involved.

Researchers reported that the programme had deepened their knowledge of the fundamental principles of transdisciplinary research and skills its practical application. The programme also influenced their professional development, with researchers gaining increased self-confidence and recognition in their home universities and wider research community, being exposed to policy-making process, and strengthening their networks internationally. Researchers also used novel, reflexive methods of stakeholder engagement and knowledge generation that helped to shift preconceived assumptions, resulting in new insights and interventions.



There is evidence that the projects resulted in structural changes and/or influenced decisions at the local level.

While it is difficult to ascertain and attribute direct impact to the research projects, particularly over a short time-frame, the transdisciplinary approach allowed for holistic locally-grounded responses to problems. The project outputs that have applications for policy-making are expected to influence change in policy over the longer-term.



The transdisciplinary approach played a key role in meeting the projects' aims to understand and address the complexities of urban areas in Africa, and ultimately to advance research on sustainable development

in African cities. Transdisciplinary research helped understand community needs, establish where knowledge gaps exist, and ultimately generate research that could address the most pressing societal challenges, drawing on knowledge from different stakeholders and disciplines to co-produce solutions fit for each local context. The approach also gave different societal actors a sense of ownership of the project, deepening social relations and fostering trust, goodwill and commitment among various groups which helped improve the acceptability of research findings and their potential for impact. The transdisciplinary approach also encouraged the teams to reflect on the need to understand not only the governance landscape but also the structural issues that affect governance, such as power, gender, political processes or poverty. This reflection enabled a better understanding of the causes of problems, and of why responses to these problems may be delayed or may not exist at all.



Key learning from the LIRA programme was that TD research requires changes within existing funding practices, supporting not only the production of knowledge products but also engagement processes that might not result in direct tangible outputs but that could lead to mindset change in a long-term. The TD research funding programmes as well as funders should also be flexible enough to accommodate changes that occur during the emergent TD research process. There is also a need for a shift in research and capacity-building funding from the short-term and project-based to a more sustained long-term process. Although the LIRA programme proved an innovative and promising funding model for supporting TD research from outset to implementation, turning TD research into a mainstream endeavour cannot be achieved solely by experimental research programmes like LIRA. Continuing strategic dialogues with key actors, including science funders, universities and science policy makers are key to creating a more conducive environment for TD research on the continent.

INTRODUCTION

The Leading Integrated Research for Agenda 2030 in Africa (LIRA 2030 Africa) programme is a unique research funding programme that sought to build capacity of early career researchers (ECR) in Africa to undertake transdisciplinary (TD) research and to foster scientific contributions to the implementation of Agenda 2030 in African cities. It is the first programme to support TD research in African cities at a continental scale.

The programme was implemented during 2016–2021¹ by the International Science Council (ISC)² together with its Regional Office for Africa in partnership with the Network of African Academies of Sciences (NASAC) and with the financial support from the Swedish International Development Cooperation Agency (Sida). The Robert Bosch Foundation provided support for additional LIRA capacity-building activities.

The LIRA programme is distinctive because it:

- ➔ promotes TD research and partnerships,
- ➔ builds scientific capacities for TD research,
- ➔ fosters collaboration between two African cities in each project,
- ➔ links local knowledge with global scientific and policy processes,
- ➔ seeks to increase institutional and financial support for TD research in Africa.

In the context of LIRA, TD research is understood as a knowledge co-production process with key stakeholders that generates formal knowledge on societal problems as well as actionable knowledge for problem solving (Hadorn et al., 2006; Lang et al., 2012).

The rationale for promoting the TD approach is that it seeks to grasp the complexity of the problems involved, and to consider the diverse scientific and societal views of the issues. A growing body of research shows that the investigation of sustainability challenges, and the identification of solutions, requires novel methods of knowledge production that acknowledge the complexity, uncertainty and contested nature of sustainability challenges (Kates et al., 2001; Polk, 2015; Schneider and Buser, 2018).

As the scientific evidence cannot be separated from the political, cultural and social debate that surrounds societal challenges (Horton et al., 2018), producing this evidence cannot be entirely within the sphere of any single actor.

Furthermore, TD research involves social experimentation outside controlled settings. This is important given the uniqueness of African cities, whose

1 The original timeframe of the programme was five years, but the programme was extended by one year due to the COVID-19 pandemic. Furthermore, to enable LIRA grantees to publish their articles in open access beyond the programme timeframe, a LIRA open access fund was created for 2022–mid 2023.

2 Initially the programme was implemented by the International Council for Science (ICSU) in partnership with the International Social Science Council (ISSC) and the Network of African Academies of Sciences (NASAC). In 2018, ICSU and the ISSC merged to form the International Science Council (ISC).

development is complex and multidimensional. African cities comprise diverse neighbourhoods and interactions that no single discipline or stakeholder can understand, explain or address adequately.

Therefore, urban challenges require novel methods of knowledge production. These should cut across sectors, disciplines and cultures, and acknowledge the complexity, uncertainty and contested nature of urban development.

Furthermore, the complexity and uniqueness of African cities means that more scholarship on African cities from Africa is needed. Urban issues in Africa are distinctly different from those of other regions, yet today's urban knowledge is predominantly shaped by research on and from the global north. Although many frameworks and tools for generating knowledge are relevant to African contexts, more attempts should be made to support the development of African research theories and framing, to grasp the problems and solutions in their specific context. The goal of the LIRA programme was to build the capacity of the next generation of African scientists to lead the innovative re-thinking of urban futures on the continent, work with local communities, policy and practice and stimulate the new context-specific evidence required for practice and policy-making in sustainable urban development.



Several assumptions underlie the programme's focus on transdisciplinarity, including the benefits, challenges and processes through which transdisciplinarity provides alternate and enriching approaches to complex urban sustainable development challenges.

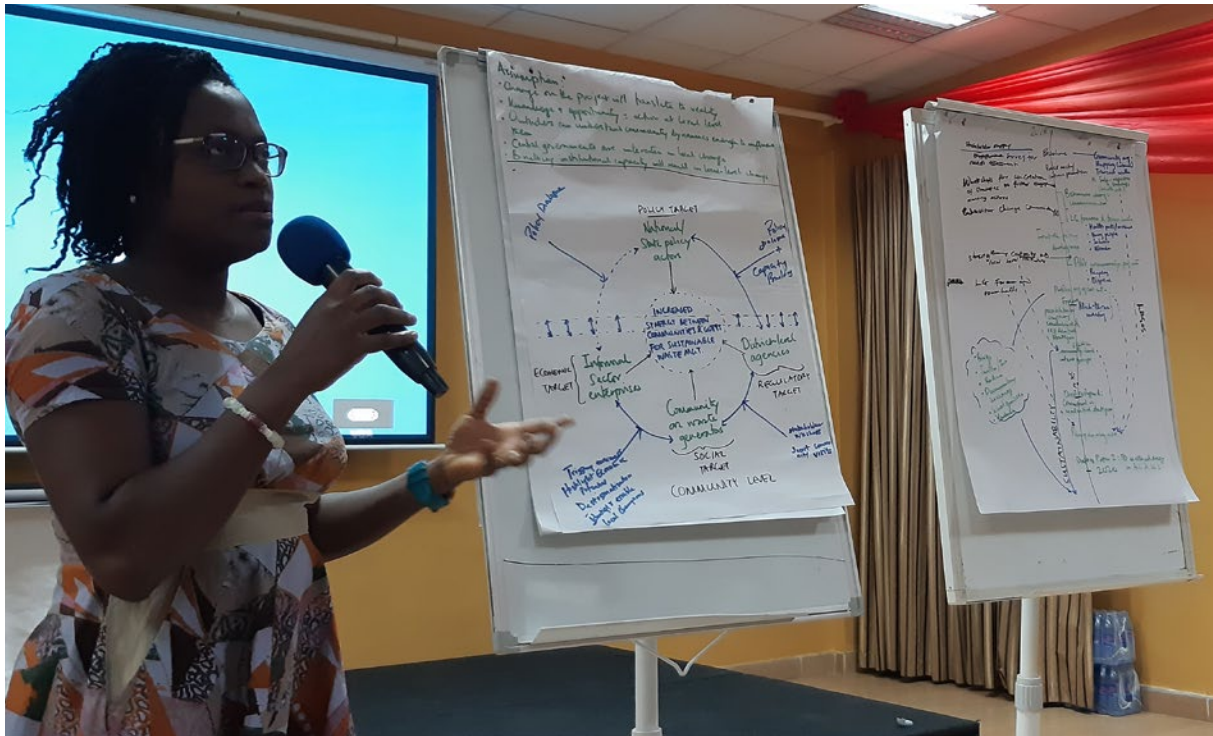
TD training workshop,
Kampala, Uganda,
August, 2017.
Photo: ISC

However, these challenges, perspectives and varied assumptions have not been adequately tested, specifically in African contexts. As such, the LIRA programme provides an opportunity for learning from the application of TD approaches across 28 collaborative projects implemented in various African urban contexts.

Another opportunity for learning offered by the LIRA programme is its unique funding design that has been put in place to support the projects and emerging African scholars. While the funding for projects is provided by Sida, the aim of developing capacity among emerging African scholars is delivered by the ISC and NASAC through a series of TD training workshops, annual research fora and ongoing research support throughout the lifespan of the projects.

The LIRA programme team soon realized the value of capturing these learnings and initiated this learning study, which was not part of the original programme design. The conceptual framework for the study was developed by three TD experts: Zarina Patel (University of Cape Town, South Africa), Flurina Schneider (Institute for Social-Ecological Research, Germany) and Coleen Vogel (Global Change Institute, University of the Witwatersrand, South Africa).

Project Coaching Workshop, Ghana. Photo: ISC



LEARNING STUDY GOALS

The primary focus of the learning study was to collect key learnings from across three cohorts of the LIRA projects on the role of TD approaches in addressing complex urban issues in African cities. A second focus was to understand the value of the programme design that combines research funding with capacity development and peer-learning, while linking local projects to global processes.

More specifically, the study had five learning goals. The first four aimed at the project-level learning and the fifth goal focused on programme-level learning:

1. To demonstrate the diversity of understanding and practices of transdisciplinarity across the LIRA research projects;
2. To understand how the acquired learning about the problem, framing, context and input from stakeholders influenced the choice of action over two years;
3. To identify key enablers and challenges for TD research in the African context;
4. To identify and categorize the range of results emerging from the LIRA projects and to understand the role of TD in achieving project objectives;
5. To assess the role of the LIRA programme in influencing the projects' capabilities of engaging in TD research.

Analysis of the collected data for the first four goals was led by Zarina Patel, and for the fifth by Flurina Schneider, with contributions from Katsia Paulavets, the LIRA programme manager.

The LIRA projects, the members of the LIRA Scientific Advisory Committee (SAC) and the LIRA programme management team were the main contributors to the study, by sharing their experiences and lessons learned.

CONCEPTUAL APPROACH: OPERATIONALIZING THE STUDY GOALS

This section provides a brief rationale for the choice of goals based on current debates in the literature.

Diversity of practices of transdisciplinarity

Although there are multiple definitions of TD research,³ the LIRA programme used the following as a starting point:

A TD research process links societal problem solving with scientific knowledge production in a process of co-producing knowledge (td-net). Transdisciplinarity is a reflexive research process that address societal problems by means of interdisciplinary collaboration as well as the collaboration between researchers and extra-scientific actors; its aim is to enable mutual learning processes between science and society (Lang et al., 2012).

The LIRA programme promoted TD research that is focused on societal problem-solving, through in-depth interactions between academic researchers across disciplines and various actors. The value of these interactions lies in the bringing together of diverse knowledge types with the purpose of stimulating sustainable change in African cities.

Although support for the need for TD approaches between diverse urban actors (including and beyond the academy) to utilize multiple knowledge in societal problem-solving is becoming increasingly established, the mechanisms through which these interactions can and do occur are less well understood. Although some authors claim that knowledge co-production can result in the 'flattening of power relations' in urban research between researchers and other urban knowledge brokers, it is also acknowledged that there is a politics to knowledge co-production (Oldfield and Patel, 2016), and that power dynamics are more likely to be flattened over the period of a project rather than in any one instant in the project cycle.

3 Including the work of Nicolescu (2002), including ethical, metaphysical and mystical perspectives, and Nowotny et al. (2001), research aimed at designing solutions to 'real world problems', see Bernstein (2015).

The term transdisciplinarity is used to capture a diversity of collaborative processes. These processes have in common the integration of experiences, expertise and knowledge from different urban actors to co-create solutions to societal problems (Polk and Kain, 2015).

Transdisciplinary projects have as their aim transformation for the benefit of society, yet, there is a range of ways in which this can be achieved:

- **Project initiation** (How were partners and problems co-identified, and who initiated the partnerships?): includes detailing the process of partnership development and how the projects were set up.
- **Project intermediaries** (What is the role, if any, of project intermediaries in bridging between science and policy): includes identifying roles within and beyond the project teams.
- **Creating knowledge at the boundaries** (How does knowledge generation and learning occur between different actors? What are the processes of boundary crossing, i.e. moving across areas of expertise and focus? What is the role of knowledge artefacts (including policy briefs, research articles, dissertations, op eds, among others) – or boundary objects – in TD research?): includes an analysis of the processes of engagement in working across disciplines and institutions.
- **Spaces for engagement** (How were interactions between diverse knowledge brokers set up to integrate different knowledge types?): includes an analysis of the geography, frequency and participation intensity in engagements between different urban knowledge bearers.

Recognizing that there is no 'right way' of doing TD research, and that the African context might result in practices that have not been extensively documented in the literature, the study aimed to capture the diversity of TD practices across LIRA projects and to learn from them.

Linked to such wide-ranging understandings of TD approaches, there is also the need for an expansive view on 'learning'. Ultimately the LIRA programme sought to deepen not only the knowledge and learning about African urban challenges but also to add to the compendium of understanding of how we can 'learn' about complex wicked problems.

Learning from diverse approaches to change

All LIRA TD projects aim to generate action-oriented knowledge that would contribute to addressing a specific challenge in a particular African urban context. For that, each project outlines in the proposals a strategy (mindful that this may be a very emergent process that cannot always be neatly organized) and a set of actions that the research teams believe would help achieve project goals. However, as the research teams start implementing their projects, they will acquire more knowledge about the problem, and learn more about its underlying causes and the context and perspectives of different stakeholders. It was anticipated that that this learning within projects would require the teams to review their assumptions of how the change can unfold and adjust their activities accordingly. This reflexive practice is a continuous process of learning by doing and critical reflection, which allows the projects to continuously adapt

their assumptions and to (re)tailor their pathways to change, thereby improving the effectiveness of project interventions.



The learning study team anticipated that some projects, for example, might assume that implementation of sustainable development in African cities requires changes in actors' values and perspectives, hence, they might implement multi-stakeholder processes for joint learning. Other projects might assume that more knowledge on certain issues will enable policy makers to take more informed decisions, hence, they might produce policy briefs and organize hearings for politicians. It might even be the case that some learning can be acted on through project adjustments, but not others.

The learning study aimed to track the diversity of approaches among the projects, as well as the driving forces informing choices of actions at the project level.

The assumption was that each project has a unique approach to change, because they work in different contexts towards different goals. Each approach might include the following elements (Vogel, 2012; Green, 2016; Thornton et al., 2017):

- ➔ **Transformation vision** (What is the problem that you want to address and what change do you want to achieve and why?) It involves descriptions of more desirable situations, including necessary changes in actors' attitudes and behaviour, social norms, laws and policies, access to resources, why those changes are important and what impact those changes should enable. It also involves defining the concrete transformation goal of the project.
- ➔ **Knowledge gaps** (What kind of knowledge is missing regarding the transformation vision?).

Zarina Patel at the LIRA transdisciplinary research training in Abidjan, Côte d'Ivoire. Photo: CMAPPING

- **Assumptions about how societal change unfolds and the role of knowledge processes** (What do you see as the underlying causes of problem? How can and should knowledge influence change?) Different involved actors' ideas, hypothesis and theories of change, and sphere of influence. It also involves assumptions about what are appropriate roles of researchers and other societal actors.
- **Context knowledge** (What is the context for change?) This involves knowledge concerning involved actors and their problem perspectives, worldviews, agency and activities, power relationships, institutions, history, positive change examples, barriers and opportunities for change (drivers and restraints) and skills and practices to deal with them.
- **Transformation pathways** (What strategies you believe will accomplish expected outcomes? What kind of approaches and specific activities might lead to the envisioned change?) This involves a sequence of logically linked conditions/events/activities leading to change (not only singular measures or outputs).
- **Monitoring and evaluation procedures** (How do you learn about the impact of our activities and changes in the context? What indicators will you use to measure your achievements?) Indicators, regular time-outs to take stock.

To develop reflection on the points above, the LIRA programme organized coaching workshops on theory of change for research teams, starting from cohort 2. The programme also developed a template for a self-reflection workshop that research teams had to annually participate in during the two-year project.

Enablers and challenges for change in the African context

Transdisciplinary research is premised on the assumption that multiple knowledges will result in more useful research and practice outputs. However, the pathways between new knowledge derived through TD processes, and societal problem-solving as reflected in sustainable urban change are not solely dependent on knowledge. Structural changes within and between institutions have been shown to be as significant as new knowledge insights in fostering change. New knowledge can only be taken up if the institutional setting and culture is able to respond to and act on this knowledge to give it effect.

Understanding factors influencing structural change among diverse research partners has been shown to be dependent on several factors. The literature has begun to detail some of the enablers and challenges for TD research, including time demands and limitations, the role of the individual in co-production processes, institutional mismatches (including the different conditions under which individuals and organizations can participate in collaborative processes) and communication barriers between diverse actors (Polk, 2015).

Less well documented and understood are the factors influencing urban change in African cities. African cities display unique characteristics, which may or may not have a role in shaping knowledge co-production practices but nonetheless

have a role in shaping the outcomes and hence effectiveness of co-production efforts (Greyling et al., 2017). These features include weak governance systems, inadequate capacity, high levels of inequality, corruption, increasing levels of informality (presenting a data challenge) and informal governance systems (Parnell and Pieterse, 2014). African cities also face a range of 'wicked challenges' and opportunities including those changes that intersect in messy and entangled ways, e.g. factors generating poverty, energy provision, basic services provision, climate change and disasters. The learning study aimed to investigate the extent to which some of these factors, including but not limited to knowledge, act as enablers and or challenges for knowledge co-production in the African context.

Capturing impacts

Aiming to investigate the links between TD research and sustainability impacts, the report builds on studies of societal impact (Godin and Dore, 2005; Bornmann, 2013; Miettinen et al., 2015). Since about 1990, such studies have developed a broad variety of frameworks. These frameworks usually consist of a series of stages such as inputs, research processes, direct outputs and further outcomes, which are connected over various feedback loops. Recently, sustainability researchers have begun to apply such frameworks, operationalizing them with more specific categories or indicators (Wiek et al., 2014; Mitchell et al., 2015; Kaufmann-Hayoz et al., 2016).

To investigate the effectiveness of the TD approach in helping to address complex, wicked challenges in the African urban context, the learning study used the following categories to capture impact:

- **Knowledge products:** where relevant and appropriate, involves publications, action plans, handbooks and training manuals, media, innovative technologies, both for research and society.
- **Enhanced capacities and learning:** where relevant and appropriate and indeed 'measurable', includes documenting any new knowledge, changed perspectives, values, motivations and expectations, improved (practical) competences, ownership; learning can be cognitive, normative, emotional, individual or collective. Learning can be single-, double- or triple-loop.
- **Network effects:** includes new contacts, expanded/strengthened networks, trust, relationship building, new collaborations and community identity.
- **Structural changes and decisions:** where relevant and appropriate, contribution to policies/laws, changed practices and norms of groups and organisations, delivery of infrastructure, rules of collaboration and improved ecological, social or economic performance.

Finally, this study was interested in whether experiments undertaken in the African context reveal any insights not previously well known.

Role of LIRA programme in influencing projects' capabilities of engaging in TD research

Transdisciplinary co-production of knowledge is an important focus of the LIRA programme. The key goal of the LIRA programme is to build a new generation of scientists with the ability and capacity to produce and communicate integrated solution-oriented and policy-relevant knowledge. The study sought to investigate the value of LIRA activities in strengthening projects' capabilities of engaging in TD research.

Therefore, the study intended to examine the programme's design (e.g. two-stage call) and activities (including TD training workshops, collaborative research grants, annual research fora, project coaching workshops and scientific leadership opportunities) and assess their appropriateness for stimulating TD research and for building capacities of early career scientists to undertake this form of research, and identify what has been/can be learned from these processes and what improvements can be made.

LIRA project in Abidjan,
Côte d'Ivoire.
Photo: CMAPPING



REPORT STRUCTURE

The report is divided in two parts. Part I focuses on the project-level learnings. It includes methodology and a synthesis of key findings for the first four goals across three LIRA cohorts of projects. The methodology and key findings concerning the programme learning are presented in Part II.



PART I

Project-level learning from the application of TD approaches in various African urban contexts



This part focuses on project-level learning from the application of TD approaches in various African urban contexts, including methodology and a synthesis of key findings.

Methodology

Through three open calls, the LIRA programme supported 28 projects, which were divided into three cohorts:

- **Cohort 1 (eight projects, awarded in 2016):** Understanding the 'energy-health-natural disaster' nexus in the urban context in Africa.
- **Cohort 2 (eleven projects, awarded in 2017):** Advancing implementation of SDG11 in cities in Africa.
- **Cohort 3 (nine projects, awarded in 2018):** Pathways towards sustainable African urban development.

The first four goals of the learning study are based on the input collected from these three cohorts. The following documents prepared by principal investigators (PIs) during the lifespan of the research projects were used for a desktop analysis:

- a project proposal,
- two annual progress reports,
- two self-reflection workshops (for cohorts 2 and 3),
- a final project progress report.

The project proposals were used as a baseline of what was intended with respect to project design and assumptions. The annual reports reflect on achieved results, enablers and challenges. They highlight changes in research design and learning. The self-reflection report template was specifically designed by the learning study team to generate data that were relevant to the study goals. The findings are limited by the level of detail contained in the written reports from PIs. Further probing on experiences and insights was undertaken during the LIRA Annual Research Fora in Senegal, 2019, and in Ethiopia, 2020, and through LIRA webinars in 2020 and 2021.

Data analysis was conducted thematically. The conceptual framework for the learning study outlined in the previous section was based on literature reviews (Schneider et al., 2019). Several sub-themes were identified for each of the study goals, which in turn contributed towards the development of an analytical framework to assess individual projects. Data from the reports detailed above were extracted as appropriate to populate the analytic grid. Analysis across the projects in each cohort was then conducted in order to identify high-level trends and patterns.

The geographical spread of projects was predominantly East African in cohort 1. There was a shift to an increasing number of projects located in West Africa in cohorts 2 and 3, with South Africa consistently represented across the three cohorts. This expanded geographical spread meant an increased language spread, with anglophone countries working together with more francophone and lusophone countries in cohorts 2 and 3. This was both an opportunity and a challenge in the TD work.

The list of projects can be found in Annex 1 and cities that worked together are presented in Figure 1.

COHORT 1	COHORT 2	COHORT 3
Nairobi, Kenya, and Addis Ababa, Ethiopia	Lagos, Nigeria, and Accra, Ghana	Accra, Ghana, and Kampala, Uganda
Goma, Congo, and Buea/Limba, Cameroon	Kampala, Uganda, and Nairobi, Kenya	Cape Town, South Africa, and Kumasi, Ghana
Dar es Salaam, Tanzania, and Lilongwe, Malawi	Dar es Salaam, Tanzania, and Durban, South Africa	Wa, Ghana, and Niamey, Niger
Abidjan, Ivory Coast, and Kampala, Uganda	Ouagadougou, Burkina Faso, and Tamale, Ghana	Accra, Ghana, and Johannesburg, South Africa
Kampala, Uganda, and Mwanza, Tanzania	Windhoek and Gobabis, Namibia, and Lusaka, Zambia	Abuja, Nigeria, and Nelson Mandela Bay, South Africa
Johannesburg, South Africa, and Kitwe, Zambia	Durban, South Africa, and Luanda, Angola	Accra, Ghana, and Lagos, Nigeria
Kigali, Rwanda, and Dar es Salaam, Tanzania	Stellenbosch, South Africa, and Accra, Ghana	Makhanda-Grahamstown, South Africa, and Kumasi, Ghana
Nairobi, Kenya, Kampala, Uganda, and Stellenbosch, South Africa	Luanda, Angola, and Maputo, Mozambique	Cotonou, Benin, and Lomé, Togo
	Durban, South Africa, and Harare, Zimbabwe	Mbour, Senegal, and Korhogo, Ivory Coast
	Kisumu, Kenya, and Kumasi, Ghana	

FIGURE 1

Geographical reach of three cohorts



Findings

This section presents a synthesis of key findings structured around four goals of the learning study.

Diversity of understandings and practices of transdisciplinarity across the LIRA research projects

The term 'transdisciplinarity' is often used to capture a diversity of collaborative processes. What these processes have in common is the integration of experiences, expertise and knowledge from different urban actors to co-create solutions to societal problems (Polk and Kain, 2015). In bringing multiple knowledges to bear on addressing societal problems, LIRA's focus was on the mechanisms through which interactions between diverse urban actors can occur. Themes explored under this goal include how partners and problems were co-identified; how projects were set up; the roles, if any, of project intermediaries; how knowledge is created at the boundaries; spaces for engagement; and processes for knowledge integration.

Project set-up and understandings of TD research

All projects were led by researchers, with a PI responsible for implementing activities in one city and overseeing the entire project implementation, and the co-PIs responsible for research activities in another city. The researchers were requested to undertake an initial co-design process with stakeholders during the proposal application process.

In cohort 1, most project proposals were built on previous PhD research and postgraduate networks or other tertiary-level training. In all cases, the PI was institutionally based in one of the two project cities and, in most cases, the research teams in the PI's city were more established than in the second city. In some cases, the PIs and co-PIs had not previously met physically. In two projects, the research team included partners from outside Africa: the Chest Research Foundation in India and the University of Birmingham.

In contrast to cohort 1, where most proposals were built on PhD research, and or postgraduate networks, proposals of cohort 2 were built on existing research projects or partnerships. The PIs indicated that existing projects and networks proved an effective means to initiate projects. The PIs from cohort 2 were more established and confident, with track records of having managed or participated in large research projects. They were not always resident in either project city.

In projects where teams constituted new partnerships, PIs emphasized the importance of investing time from early on in building relationships between research partners to build trust, agree on a common purpose and foster sustained productive partnerships.

The institutional anchors for the projects show a shift in cohort 2, to include an increased number of university research centres (e.g. African Centre for Cities, Climate Systems Advisory Group, West African Science Services Centre on Climate Change and Adapted Land Use, and Centre for Complex Systems in Transition) as opposed to disciplinary departments, with research councils and NGOs featuring as key research partners (e.g. Human Sciences Research Council and Development Workshop). Partners from beyond the continent

were leveraged in one case, for which an existing partnership with the University of Sydney was included.

Despite the varying modes for identifying project partners within cities and between the two project cities, in general, all projects identified the significance of conducting desktop reviews (of the literature and existing policy frameworks) as well as site/field visits to focus the research questions and ensure they were relevant to all stakeholders.

In some cases, a desktop study was conducted in the pre-proposal stage, while in others the identification of research gaps emerged from previous or ongoing studies, which also offered opportunities for field visits prior to the development of the proposal. Irrespective of the history of projects, once awarded, all projects nonetheless conducted in-depth project specific desktop studies and field visits. Stakeholder mapping exercises and/or multisectoral workshops were also carried out as a means of triangulating and diversifying project partners. Intermediaries were identified as entry points into community groups. For example, the University of Nairobi worked with Mwamko Children's Centre to gain access to collaborations and facilitate exchanges.

In setting up the projects, the PIs applied varying approaches to questions of gender and sustainability. Gender was predominantly considered in the establishment of the research teams, where gender representation was a key criterion; while other projects identified gender inequality as a key part of the research problem. For example, the impact of poor sanitation for the health and safety of women and children was a key driver for the investigation into the sustainable use of shared sanitation facilities in Ghana.

The cohort 3 used a systems approach to better define, engage with and address challenges of sustainable development in African cities, which are facing high levels of informality. Research approaches echoed the complexity of these challenges, which are sometimes framed as 'wicked problems'.

LIRA transdisciplinary
research training in
Abidjan, Côte d'Ivoire.
Photo: CMAPPING



Projects considered issues from water-energy-food (WEF) resource availability to diarrhoeal disease burdens exacerbated by climate change and attitude changes towards water reuse, among others.

Research teams applied a flexible approach to defining and redefining the concept of transdisciplinarity iteratively and in the local context, which meant that research methods could be responsive to local needs. Many projects borrowed definitions of TD research from the literature, for example, on WEF nexus thinking (Leck et al., 2015; Scott, 2017), on prioritizing inclusivity in research (Hanson and Polk, 2018), on reflexive and collective processes (Roderick, 2014; Popa et al., 2015), Nicolescu (2010) on mode 2 style research practices, Scharmer's (2009) U-theory on presencing, and enabling an 'open mind, open heart and open will with regards to the subject matter and project approach' and Pohl and Hirsh Hardorn (2008) on 'goal-oriented' definitions of transdisciplinarity.

In each case, the projects adapted definitions in the literature to suit the local context, thereby reconceptualizing transdisciplinarity as part of preliminary workshops with research partners and at different junctures in the research project process. Similarly, one project noted that 'even though the team had a shared/common understanding of TD, a different degree of understanding was apparent. Rather than trying to come up with a single definition, the team members could reflect and voice how they see TD manifesting in the project'. Another project 'adopted a working definition of TD as a reflexive process of enquiry'. The significance of having an open and dynamic approach was further summed up: 'team members were of the view that TD can be an open approach to research'. The value of this flexible approach meant that the process of (re-)defining the concept of transdisciplinarity iteratively in the local context allowed for methods that are responsive to need in the local area.

The responsive characteristics of TD research are demonstrated by the understandings by the projects as a political practice, an explicit

Project Coaching workshop, November, 2019, Accra, Ghana. Photo: ISC



acknowledgement that there is a 'need to change power relations in research and shift from extractive to participatory research' and, by doing so, to 'yield sustainable and locally-relevant societal impact'. One project noted that the TD approach 'sharpens the focus of the project on key societal challenges identified by the societal actors and thus making it possible for the research to make an immediate contribution'.

The LIRA experience demonstrates the diversity of application of TD approaches. Furthermore, the flexible approach to defining and redefining the concept of transdisciplinarity iteratively and in the local context allowed research methods to be responsive to local needs.

Creating knowledge at the boundaries

This included an analysis of the processes of engagement in working across disciplines and institutions: how does knowledge generation and learning occur between different actors? What are the processes of boundary crossing that are moving across areas of expertise and focus? What is the role of knowledge artefacts (including policy briefs, research articles, dissertations and op eds) or boundary objects in TD research?

All research teams were interdisciplinary. Cohort 1 included scientists and experts with disciplinary specialisations in the hard sciences (e.g. epidemiology, engineering and hydrology). The disciplinary background of experts in cohorts 2 and 3 differed from cohort 1 and included many more: urban planners, urban geographers, social scientists, architects, humanitarian engineers, anthropologists and project managers. All three cohorts included a broad range of stakeholders.

In cohort 1, projects focused on specific local contexts, underscoring the importance of fine-grained local research. All projects had a focus on health, and there was a deep resonance with 'brown agenda' issues. This term was coined at the Rio Earth Summit in 1992 and refers to pro-poor urban development and environment challenges that are most prevalent in developing countries. Research teams consciously included knowledge from communities, policy makers and technology producers. The scientific goals of the projects focused on generating empirical data that documented risk, vulnerability and resilience in areas that are under-researched. There was a further defined focus on women and children with regards to vulnerability.

Some projects saw knowledge co-production as a governance opportunity and set up steering committees. The PIs consequently had multiple roles. In their role as project co-ordinators, they were key intermediaries with knowledge communities. High-level reports, policy briefs, citizen science as well as the testing of new technologies (e.g. chimneys and stoves) were used by some projects in bridging the science-policy-society boundary.

In cohort 2, projects shared the goal of generating empirical data on urban processes and dynamics in informal and peri-urban areas. Their primary focus was sectoral, considering innovation in service delivery through local level experimentation in energy, water and sanitation, waste management, housing, health and climate change. Much focus has also been placed on understanding the policy context for delivery. Questions around governance, skills and capacity

development were regarded as critical in order to understand potential pathways to transformation. It was important to document community perceptions and engage community partners so they could help to collect data or to shape the implementation of alternate infrastructure delivery options. For example, two projects have demonstrated the benefits of alternate approaches to sanitation on site, providing tangible benefits to communities and compelling evidence of alternatives for policy uptake. Similarly, another project developed alternate housing delivery prototypes that simultaneously meet scientific and societal goals.

Processes of community engagement showed that the outcomes of addressing societal goals were dependent on the results being disseminated appropriately. Social media platforms were identified as helpful tools for disseminating messages, and there was an increased awareness among local community and policy-making partners of the nature, scale and possibilities for addressing urban challenges.

Some projects used boundary objects to navigate the boundaries of knowledge and expertise. In a number of cases, the innovation and/or technology being introduced (e.g. briquettes, house design and sanitation technology) became the object that was used to bridge different knowledge domains. In other instances, photography and other artistic representations were useful boundary objects used to mediate cross-disciplinary learning. In one project, the convergence of different research traditions and methodologies enabled the project to come up with a hybrid approach known as transdisciplinary visual ethnography (TVE), which relies on co-producing visual depictions in different media, including photography, technical drawings, symbols and maps – with storylines from local community actors. This more democratic and egalitarian means of producing knowledge shifts the power dynamics in knowledge production. Similarly, a project in Uganda used the principles of visual ethnography. The visual representation of how communities give meaning to the Sustainable Development Goals (SDGs) resulted in the development of the Local Agenda 2030 for Kampala City, which captures shared interpretations of the goals and targets.

In cohort 3, projects framed TD research as an opportunity for practitioners and researchers to move away from siloed and sectoral responses to urban challenges, particularly in cases where multiple actors (public and private, formal and informal) were involved in the delivery of goods and services. Instead, they applied a systems approach and incorporated groups that are typically structurally excluded from engagement. Several projects purposefully oriented research design to consider gendered experiences of urban challenges. This also actively increased the diversity of stakeholders invested in the research process.

Transdisciplinary design features deployed, including spaces for engagement and processes for knowledge integration

All three cohorts included a range of TD modes of engagement, with different formats used over the lifespan of the projects. The variety of methods used demonstrated a broad understanding of the TD approach to research.

In cohort 1, engagements included inception workshops; co-design workshops; focus group discussions; cross-disciplinary scientific engagement; policy

dialogues; parallel scientific, social and policy studies; exploratory visits; and co-creation of solutions with affected communities. The spaces and modes of engagement and integration indicate a spectrum from consultation to information sharing across disciplines and stakeholders to co-generation of data and/or outputs.

In cohort 2, PIs used different formats for different stakeholder groups and for different purposes. Efforts to engage communities and policy as research partners included training project partners in data collection, co-creating solutions and management approaches to service and infrastructure delivery, multi-stakeholder workshops, co-design workshops, landscape analysis workshops, social embeddedness, themed workshops, community studios, focus groups and field visits. Some PIs emphasized the need to use different formats for different stakeholder groups and for different purposes: 'all formats were effective for their own respective purposes'.

The PIs emphasized the significance of face-to-face engagement, and the vital role of processes aimed at building trust. Stakeholder engagement was especially useful in the early stages of the projects – in project co-design and the framing of the research questions. The extent to which engagement was useful later in the project depended on each project's goals.

There are also reflections on the significance of space, and where, when and how engagement happens. One PI noted that 'the creation of space is necessary for alternatives to emerge'; another stated that they changed the venue for the policy dialogues to lunch time to be more inclusive. The significance of dialogue, physical meetings and connections between partners in order to integrate different knowledge types was highlighted by almost all PIs.

In cohort 3, the PIs used a combination of surveys, interviews with key stakeholders, workshops and analysis of quantitative data. Some projects adopted more creative interventions, with a view to considering the 'fluidity of African contexts', assisting dissemination and impacting behaviour change beyond traditional academic circles. These included an Instagram-based photo competition to encourage grassroots storytelling, the establishment of a food garden to improve nutrition access for children, using upcycled vertical farms, documenting the evolution of a project through photography and a video, radio talk shows and pamphlets printed in local languages. For example, through photography, participants could express themselves across languages, beliefs, cultures and space and time, drawing out shared lived experience as well as what makes them unique.

Many projects in cohort 3 tried to broaden participation from multiple stakeholders, to mitigate power asymmetries and to ensure an 'equality of voice' by hearing and recording dissenting views without prejudice rather than suppressing them or insisting on consensus. Addressing existing power imbalances in response to urban challenges became explicit in methodologies in several projects. One created a platform within the Accra Municipal Assembly to formalize and streamline the activities of informal waste-pickers. Similarly, another project developed a platform for different knowledge partners 'to collectively produce, verify and share knowledge on current electricity use practices, as a basis for co-designing interventions for sustainable energy transition'. This was seen by participants as a form of empowerment.

Furthermore, the projects produced outputs that reflect the different voices, and make visible (and audible) often marginalized contributions from the informal sector. These design features also focus on wide dissemination of findings through innovative methodologies – seeking to influence perceptions, attitudes and ultimately behaviour change through more inclusive knowledge and the dissemination thereof.



Of significance in cohort 3 is evidence of a deep engagement with the meaning and practice of transdisciplinarity in context. Transdisciplinarity was approached as more than a method and was understood in addition as both a political and a social practice. The emphasis on power-relations and engagement with achieving 'equality of voice', while recognizing power asymmetries, marks a shift away from the guidance on joint and equivalent participation inherent in the 'art of co-' that typically underpins TD thinking.

The 'art of co-' was apparent across the projects: co-production and the accompanying 'co-s' (e.g. co-design, co-option, co-analysis, co-construction, co-monitoring and co-creating) demonstrated the breadth of the collaborative endeavours across the projects.

Furthermore, the focus on 'open hearts, minds and wills' to shape engagements points to a markedly different set of skills and leadership competencies required in TD engagements. The value of the open ended and iterative nature of TD research was borne out in cohort 3, as they had to revisit and pivot all activities due to the global COVID-19 pandemic. Given the relational nature of transdisciplinarity, the restrictions on mobility and gathering had the potential

Vivi Stavrou, a TD trainer, at the LIRA transdisciplinary research training in Abidjan, Côte d'Ivoire. Photo: CMAPPING

to derail projects. However, PIs were able to turn this crisis into a window of opportunity and used social media and other digital platforms to sustain engagements, to focus on dissemination and deepen the impact of project results. The challenges faced by this cohort with the pandemic highlights the labour of TD research, and the diversity of skills and competencies required by PIs and project teams in straddling the knowledge, political and social dimensions of transdisciplinarity.

Learning from diverse approaches to change

All LIRA projects aimed to generate action-oriented knowledge that would contribute to addressing specific urban challenges in two different African cities. Each project proposal outlined a strategy and set of actions that the research team believed would help them to achieve that project's goals. In keeping with the acknowledgement that TD research is by its nature emergent and iterative, it was expected that as project teams acquired new knowledge about the problem, developed new networks, learned more about underlying causes and responded to contextual factors, that adjustments would be made to projects in the process of implementation. This learning within projects required the teams to review their assumptions of how the change can unfold and adjust their activities accordingly.

In order to build in a reflexive practice within the projects, the LIRA programme delivered training to PIs and co-PIs on the theory of change and designed self-reflection guidelines for PIs to use with their research teams twice during the research process. The findings in this section draw on the two self-reflection reports compiled by the PIs, which reflect on the extent to which projects were able to continuously adapt their assumptions and the extent to which they were able to (re)tailor their pathways to change in order to improve the effectiveness of project interventions.

In cohort 1, changes to project plans were mostly made as a result of 'ground truthing' or 'getting into the field'. Monitoring, evaluation and self-reflection conducted by the project teams were significant. New partners, changes in budget and uneven or unexpected stakeholder engagement were all factors requiring project teams to make adjustments.

The kinds of actions or changes that were made to project plans included changes in project goals, changes in project variables, introduction of new project partners, changes in the duration of engagement of stakeholders and/or the duration of the projects, the sequencing of activities and deployment of new research tools.

One of the most significant learnings was the realization by projects that research design could not be 'cut and pasted' across the two project cities. Context matters and impacts on project design between the two cities. They also learned that TD approaches allowed them to access the real needs of communities and that these could differ from the needs as perceived by the research team at the outset.

Of interest is that the factors affecting change fall within the realm of relationships and resources. It does not appear that the science or evidence that was generated resulted in new actions.

In cohort 2, internal reflection, monitoring and evaluation processes all led to project design changes. The co-design phase was identified as a critical juncture for learning between partners and sometimes resulted in changed actions.

The kinds of actions or changes that were made to projects include adaptation of the research instrument to meet contextual needs (including local knowledge and languages), changes in venues and timing for policy dialogues to be more inclusive, changes in stakeholders and changes in geographical scope including additional sites or switching from one city to another.

In some cases, the triggers resulting in change created significant learning moments within the projects. For instance, one project used the term 'informal' in the framing of the research questions. The team received negative feedback from communities, because describing local energy enterprises as 'informal' raised questions among authorities regarding taxes, licensing and regulations. Consequently, dialogues with policy makers and communities were held. This led to renaming the project to reference 'low income' rather than 'informal'. Another project had to change collective workshops to stakeholder engagement on a more individual basis to minimize the project delays by recurrent elections in Mozambique.

Overall, the self-reflection workshops provided an important opportunity for PIs and project teams to reflect and recalibrate their research processes. The PIs identified the value of these workshops as follows: '[the self-reflection workshops] helped us take stock of where we are and where we want to go' and 'they provided a distance view of the project progress, and forced the team to understand and construct an image of the entire project and possible trajectory it will take'. The workshops have 'enriched our appreciation of the process and the impacts on both the scientific and non-scientific partners, which should be encouraged'.

In cohort 3, the projects were most directly affected by the onset of the COVID-19 pandemic. Transdisciplinary work is relational, and requires the building of trust, which is typically assumed to be established through direct engagement. When the pandemic inhibited direct engagement, projects had to use online platforms for engagements, which presented a different learning opportunity and perhaps a different set of data. Although they initially seemed a poor substitute for the original project plans, they sometimes turned out to promote community participation and ownership more than would have been the case.

Moving to online platforms helped to continue engagements. WhatsApp groups worked well since they allowed sharing of information during COVID-19, and it was also possible to raise questions and have concerns addressed quickly. Some people were hesitant to take part in physical meetings or could not attend due to COVID-19 restrictions.

Using a TD approach allowed for flexibility in project design – especially at the co-design phase. It also enabled adapting roles within project teams. Flexibility in funding structures was key to supporting changes in approach as and when they occurred.

'COVID-19 has presented novel and significant challenges to how research in general is conducted, but more importantly, how we do TD research... We think that this messiness... presents us with an opportunity to compare data and contribute to learning on how research can be conducted optimally under what is likely to be the new normal for the foreseeable future.'

While each project was unique, there were common learning opportunities and triggers across projects and cohorts for changing actions within projects. The PIs cited the self-reflection workshops and other individual internal monitoring and evaluation processes as triggers for change.



Enablers and challenges for TD research in the African context

Transdisciplinary research is premised on the assumption that multiple knowledges will result in more useful research and practice outputs. However, the pathways between new knowledge derived through TD processes and societal problem-solving as reflected in sustainable urban change are not solely dependent on knowledge. Structural changes within and between institutions have been shown to be as significant as new knowledge insights in fostering change. New knowledge can only be taken up if the institutional setting and culture is able to respond to and act on this knowledge to give it effect. This section focuses on the non-knowledge related factors that impact on the TD research process.

Project Coaching workshop, November, 2019, Accra, Ghana.
Photo: ISC

When it comes to enabling factors, in cohort 1, a dominant theme across the projects was the significance of leveraging personal networks in securing the buy-in of stakeholders, especially the policy community. The knowledge and use of local languages was a beneficial factor in building trustful relationships with communities. Learning between disciplines and stakeholders was seen as an opportunity for change.

Co-funding and in-kind contributions from host and partner institutions were seen as key to providing project stability. In-kind contributions were an important type of practical support and included the provision of laboratory and meeting spaces, provision of equipment and training, as well as direct capacity development for laboratories, PIs, community members and postgraduate students. For instance, community residents in Nairobi and Addis Ababa were trained to use portable particulate-matter sensors to assess their exposure to particulate matter both indoors and outdoors.

In cohort 2, projects highlighted the significance of building relationships and gaining trust and buy-in to the project process through frequent communication, use of social media platforms and regular small meetings. Another enabling factor was a shared understanding of the project and processes between the PI and co-PI, which can be secured through frequent communication and the free flow of information between the cities and partners.

In-kind contributions, for example laboratory space, venues for meetings, office space and administrative support were important enablers, and were further enhanced when PIs had a credible track record of previous or ongoing projects. The credibility built up by research teams and the confidence gained by empowered communities resulted in deeper policy engagement. Windows of opportunity were identified as pivotal moments for projects to amplify and elevate their efforts and to diversify project partners and influence. Projects could amplify their efforts through association, for example when partners received an award or when the timing of a project coincided with an opportunity to give input to a policy intervention. For instance, two projects used the opportunities for policy interventions such as inputs into the Voluntary National Review on the SDGs in Mozambique and feeding research findings into a review of the informal settlement upgrading policy of eThekweni Municipality.

Furthermore, training of staff from local authorities helped projects to begin to bridge the science-policy divide.

In cohort 3, good planning and leveraging on existing networks and relationships were seen as the key enabling factors. Engaging with stakeholders individually before a workshop and building two-way reciprocal relationships were important strategies for ensuring efficient discussions. It also helped prompt an 'equality of voice'.

Identifying key resource persons at a relevant institution (e.g. mayors, queen mothers and city officers) was also important as they helped to increase the visibility of the project to the city authorities, to strengthen the commitment and to leverage leads at other institutions and additional resources for further research.

Partnering with credible partners and platforms was a further enabling factor.

For example, partnering with the ICLEI platform in the organisation of virtual workshops and the Instagram photo competition enabled the project to reach a large audience from the continent. The LIRA reputation and influence also enabled some PIs to leverage additional resources for further research and advance their careers within universities.

Overall, key factors that allowed for change to occur included good communication (everything from engagement to the languages used), the availability of different types of resources and capacity development.

All projects also had to navigate significant challenges caused by the complexity of TD research with its iterative characteristics and with the inclusion of numerous actors. Several tertiary institutions found it challenging to manage the project funding. The difficulties of transferring funds between universities (between the two cities) were a significant stumbling block, delaying work in another city. Protracted procurement processes also led to delays.

‘Project management and accountability in transdisciplinary research is clearly challenging in university systems that are not set up for working across disciplines, beyond the university and between different countries.’

The two-year time span was an issue for many projects across the cohorts. It proved too short to complete the research, but it also proved a long period in which to keep stakeholders engaged with TD research. The fluidity of partner participation over the timeline of the projects also created challenges around expectations, understanding of the project’s goals and keeping partners engaged with the process.

In cohort 1, it was evident that existing data were poor, therefore many projects focused on generating knowledge. When personnel and roles changed over the duration of the project, challenges arose. Political unrest and tense political climates caused delays in some cities. Communication and cultural differences became apparent between partner cities, especially when mixing anglophone with francophone or lusophone countries. It was consequently sometimes difficult to meet stakeholder expectations and come to a shared understanding.

Engaging a range of stakeholders over an extended period required an acceptance that there will be differing levels of investment in the project. Maintaining engagement was typically managed by PIs engaging in ongoing conversations. Ensuring that project stayed on track required strong facilitation skills from the PIs. They also had to show an element of dexterity, a nimbleness in ‘addressing and balancing the diversity of interests, values and goals of the different interested and affected stakeholders in the project.’

Transdisciplinary research also takes time and patience to achieve a common goal among various stakeholders. Finding a suitable time for all stakeholders was another practical challenge. The TD process can therefore be slow.

One of the main challenges was 'the creation of convergent knowledge from diverse ideas provided by stakeholders during discussions. Putting academics and non-academics together is not a problem but finding a common knowledge at the borders of each discipline or profession is'. Translation not only across different languages but across different disciplines and their associated jargons presented difficulties with the 'transcription of scientific language into accessible language to interact with the stakeholders', as well as 'understanding jargon from different disciplines'.

Siloed bureaucratic structures also posed challenges to projects to work in the policy arena to advance the solutions.



In cohort 2, the differences between the project cities were highlighted as a learning opportunity, but also as a significant challenge. Different political situations and different levels of policy development or of connectivity made it difficult to synchronize activities in partner cities. Elections in one of the two partner countries (or even in both over the duration of the project) posed delays. Furthermore, synchronising activities between the two cities was challenging, as context-specific delays were experienced in convening meetings, reporting and data gathering.

The challenges of language were more pronounced in cohort 2 due to a larger spread across anglophone, francophone and lusophone cities. Even where the two cities both had Portuguese as a common language, elderly stakeholders showed a preference for local languages. A further language challenge was the difficulty of translating TD and sustainability concepts across the different languages while maintaining meaning.

Tobias Buser, a TD trainer, at the LIRA transdisciplinary research training in Abidjan, Côte d'Ivoire. Photo: CMAPPING

Time and resources were cited as the main challenges facing the projects. Transdisciplinary research requires time for building relationships and resources for processes that do not always yield tangible outputs. Two years was considered too short to bring projects to fruition. Responding to a question on the future of the LIRA 2030 programme, the PIs all indicated that a second phase should serve to consolidate research findings, deepen engagement and enhance societal outcomes of the projects.

Obtaining ethics approval for a project that is iterative and emergent was also a challenge for some projects. It was difficult for researchers to provide the level of detail and certainty in method required by the ethics procedures of their institutions. To address this, separate ethics applications were made for different parts of the research project.

Over the two-year period, PIs identified the fluidity of partners' participation as a research challenge. Challenges identified include different partner agendas and expectations, competing conceptions and understandings of the project goals, competing partner commitments and keeping partners engaged throughout the process. Finally, projects highlighted the fragility of relationships – it was easy to lose legitimacy and credibility if something went wrong in the partnership. Therefore, PIs had to work hard to maintain relationships, through consistent engagement among the research team as well as participatory processes with stakeholders.

Projects in cohort 3 also had challenges with language, both between researchers and in transcribing scientific terminology into accessible language for stakeholders.

Cross-country partnerships were affected by administrative bottlenecks, such as delays in funds transfers. One project noted that the differences in academic calendars between the two partner universities resulted in asynchronous research processes. Changes in personnel (partners and stakeholders) also affected collaboration and commitment, as new staff did not often have sufficient background and experience with the project.

Administrative bottlenecks were also experienced when working with non-academic actors, particularly in terms of gaining access and approvals from relevant ministries, departments and agencies. Conflicting agendas within government departments, the non-responsiveness/opacity of government structures and the lack of continuity in the tenure of civil servants sometimes led to a loss of institutional memory regarding the project.

Research fatigue and over-research of local communities was another challenge for PIs. When working with communities, some projects experienced issues of trust. The teams had to repeatedly demonstrate good faith with communities and civil society, while explaining the limits of what one project could practically achieve with the resources available. Overall, managing stakeholder expectations was a challenge for almost all PIs. To deal with distrust issues, some projects recruited members from local communities to be research assistants and used uniforms with university logo t-shirts for identification of field workers.

Three projects were affected by political instability. Most significantly, cohort 3 was directly impacted by COVID-19. For most projects, it affected the conduct

of activities and limited physical interactions. University laboratories that are key for experimentation and generating data to support the research had to be closed. Projects had to shift from face-to-face engagements to smaller groups, virtual meetings and telephonic interactions. One project noted that even when restrictions were lifted, the team was too scared to go out for any form of social data collection and also highlighted that university protocols for safely conducting research were slow to emerge, which delayed the collation of data.

Range of results

The learning study tried to identify and categorize the range of results emerging from the LIRA projects and to understand the role of TD in achieving the projects' objectives. Understanding and assessing the impact of TD projects is complex and contested terrain. Tangible outputs are not the only indicator of effectiveness, and there are often lags before changes in mindsets and structures become evident. Furthermore, questions of attribution are difficult to discern because multiple factors converge in the process of fostering change. In investigating the effectiveness of TD approaches in helping to address complex challenges in African urban contexts, the study sought to capture knowledge products produced, capacities enhanced, network effects explored and structural changes and decisions made.

Knowledge products

The science and knowledge generated through the LIRA projects are extensive. The focus of knowledge generation was mainly in the area of systems knowledge, describing the nature and extent of the problem in the respective projects. In-depth data collection provided a compelling picture of urban challenges in African cities and provides insights into the kinds of urban science required to foster sustainable pathways in African cities. Of significance are the new data and empirical evidence generated through the projects on areas that are not usually subject to scientific investigation.

All themes dealt by LIRA projects are central to Agenda 2030 and of global significance. The LIRA projects are an illustration of the translation of global agendas at the local level. The knowledge and data generated are not only of academic interest, but also of significance for local communities and policy makers. The scientific and societal goals of projects were driven by local priorities, addressing conceptual and delivery deficits in local areas, and simultaneously contributing to highlighting blind spots in global policy agendas that are misaligned to the complexity of African cities. The projects also highlighted the extent to which there is still a knowledge lacuna about the functioning and systems underpinning urban processes in African cities (Patel et al., 2022). The projects provided the evidence and basis for theoretical development from the global south by engaging critically with the gaps between theory and practice in conceptions of urban transitions. The researchers highlighted the significance of the LIRA programme in shifting the dominant centres of knowledge production on Africa from the global north to Africa. The projects also generated knowledge on what it takes to undertake TD research in diverse African contexts.

Over 60 articles have been published that involve LIRA grantees. In addition, through LIRA cross-project collaborative grants, eight articles were published

that compare and/or synthesize knowledge from different LIRA projects as well as experiences of TD research in different African contexts.

The experience of the LIRA projects confirms that publishing a TD article takes time, and doing it within a two-year project timeframe is not always feasible, especially for early career scientists. A number of manuscripts were submitted for review. To enable all LIRA grantees to publish their articles in open access beyond the timeframe of the programme, the LIRA Open Access Fund has been created for 2022–mid 2023.

Other scientific knowledge products produced by projects include postgraduate degrees, GIS maps and databases. Some projects developed training courses and tools (e.g. a course on theory and practice of the WEF nexus, and training tools for intersectoral action for health).

In addition, the LIRA PIs developed and contributed to the development of various books, reports and publications.

SOME EXAMPLES OF PUBLICATIONS:

- Localizing the SDGs in African Cities. 2022. *Sustainable Development Goals Series*. Springer, Cham. [www.doi.org/10.1007/978-3-030-95979-1_3](https://doi.org/10.1007/978-3-030-95979-1_3)

- Marrengane, N., Croese, S., 2021. *Reframing the Urban Challenge in Africa: Knowledge Co-production from the South*. London and New York: Routledge.

- Kushitor, S.B et al. 2020. *Systems approaches to food and nutrition security and urban resilience: Lessons from Cape Town and Kumasi*.

- Keneiloe Sikhwivhilu: *A Feasibility Study: Understanding the Water-Energy-Health Nexus in Urban Contexts in Africa*. Towards Biogas-supported Decentralized Water Treatment System for Communities in Diepsloot (South Africa) and Chambishi (Zambia)

- Sylvia Croese was a lead author for the Africa chapter of the UCLG GOLD V report 'The Localization of the Global Agendas'.

- Alice McClure contributed to the development of POSITIONING PAPER: *Transdisciplinarity and Engaged Scholarship*

A group of LIRA grantees also developed a report entitled [Advancing the 2030 Agenda in African cities through knowledge co-production: urban experiments led by early-career African scientists](#), which sheds light on what it takes to co-produce TD knowledge on sustainable urban development in Africa.

At the policy level, numerous policy interventions were identified, including the development of policy briefs (at least 20), technical reports and tangible building codes. A policy brief – [Bolder Action for Health in Africa](#) – was disseminated to delegates of the 2019 Inter-ministerial Conference on Health and the Environment through the Regional Office for Africa of the World Health Organization.

At the societal level, knowledge products including photo stories, documentaries and blog posts, visual and verbal narratives of communities, exhibitions and websites were developed to make the research and its findings more accessible to a wider audience. A number of tools were developed to facilitate stakeholder engagement, for instance the Urban Dream Workshop tool developed by the project in Namibia. Another project created a platform for sharing perspectives on intersectoral planetary health strategies in Africa ([Making the 'Urban' Better](#)).

Enhanced capacities

Capacity development resulted from features built into the projects, as well as from the LIRA programmatic design, which included a specific objective around the capacity development of early career researchers. All PIs were ECRs and most did not have prior experience with TD.

Almost all PIs undertook various capacity-building activities as part of their projects either on TD research or on specific thematic issues related to research, such as novel new research tools and methods. These activities targeted either Master students or postgraduates within projects' universities, or non-academic stakeholders, including community members and policy makers. For instance, one project in Nairobi from cohort 1 delivered a training on air quality management for health technical officers from the environment and the health departments of the Nairobi City County Government. Capacity building for stakeholders, especially local government officials and local communities was a particular focus of many projects from cohorts 2 and 3. For instance, the project in Angola and Mozambique organized capacity building on localization of SDG achievement at urban scale for local authorities. The project in Benin organized a training on the ecological system of sanitation and hygiene for groundwater quality restoration and protection, and on waste recycling and biogas production for local communities in Cotonou and Lomé. The project also engaged safe water companies in the monitoring and control of water well quality and in advising communities on a more sustainable use of water wells. Another example is the delivery of the Scenario Workshop in Accra to develop competencies among city stakeholders, practitioners and planners, the private sector and NGOs in the design and use of WEF scenarios to inform decision making and planning for WEF infrastructure investment and governance in Accra and Kampala. Some projects also acquired new equipment and the teams learned how to use them.

In the final survey, almost all PIs indicated that the LIRA projects and programme training activities provided opportunities for them to gain skills in engaging with various stakeholders, including local communities and policy makers. Stakeholder management was highlighted as a key skill developed by all PIs. Other abilities, skills and experiences acquired by the researchers include the following:

- deepened knowledge in the fundamental principles of TD research and skills in the practical application of TD approaches,
- ability to link research with local needs, priorities and interests,
- exposure to policy processes,
- ability to break out of academic silo and to work with non-academics in identifying a collective problem,
- enhanced interpersonal and group communication skills for collaborative problem-solving,
- community engagement and facilitation skills,
- critical thinking and evaluation abilities,
- access to broader theory, literature and use of data collection, research methods/tools and analysis techniques from various disciplines,

- leadership skills, experience in leading a complex regional project involving TD research team,
- team building skills and diversity management,
- supervision of TD research undertaken by Master students,
- serving as field researchers,
- improved grant application skills,
- financial and project management skills,
- networking skills,
- scientific writing skills,
- ability to be published in peer reviewed journals.

‘The LIRA programme has helped to deepen my understanding of TD research and also how to effectively manage project across international borders within Africa. It has also helped me to better appreciate the nuances and complexities involved in TD research, beyond the theoretical and conceptual abstraction of the term. I’m really very much better placed to undertake TD research going forward. Very importantly, drawing on the insights and knowledge I have gained through the LIRA project, I have been able to write much better integrated TD research proposals, and two of such have been funded.’

The PIs indicated that the LIRA projects helped them to become more reflexive researchers. A lot of reflection was dedicated to questions of legitimacy in knowledge production. Several projects focused their activities on local ownership of the research, challenging the researchers’ ‘preconceptions about the poor and the knowledge they hold’.

As a result, projects changed household survey practices to allow not just collection of data but also to acknowledge community members as knowledge producers and experts of their lived experiences. This helped to improve interest in and support for the projects, alongside changed practices of households, for instance with regard to energy saving.

The TD approach also encouraged the teams to reflect and pay attention to the need to understand not only the governance landscape but also the structural issues that underpin governance, such as power, gender, political processes and poverty. This reflection enables a better understanding of ‘the causes of problems, the blockages that cause bottlenecks in responses to these challenges and the logics behind government responses or the lack thereof’. The TD research also helped to ‘bridge distances between institutions’

through the collaborative nature of framing problem spaces and shaping research questions. One project noted that the TD process 'brought duty bearers and right bearers together to engage'.

Transdisciplinary practice also stimulated social experimentation and social learning processes. Novel, reflexive methods of stakeholder engagement and knowledge generation, such as Learning Labs and Transdisciplinary Visual Ethnography – which combine ethnography, systematic observation and interaction with groups in their own environment, using spatial techniques for mapping neighbourhood activities and urban sociology – have shifted preconceived assumptions, resulting in new insights and interventions.

Through engagements, TD approaches also enabled new insights into conducting research. For instance, the process of conceptualizing TD research helps to point out flaws in proposed research methodology, its feasibility, reliability and validity. Through processes of 'co-learning and adaptation', the TD approach allows for research to be responsive to lessons learned in the field: 'learning by doing and adjusting accordingly'.

While this responsiveness to learning facilitates improved research questions and implementation of responses, the project PIs noted that this flexibility in response also requires certain skills that can balance diverse interests, power and values of the various actors involved. Because this role of skilled facilitator was played by the PIs, they acquired this skill by practising it.

The PIs reported that the LIRA projects and programme helped them build their confidence and leadership skills. Several PIs received career promotion. On average, especially in cohort 2, several PIs published 2–3 articles over the period of the grant, with plans for further publication. Some PIs have a publication plan in place with a commitment to deliver in the near future.

The PIs also indicated that they strongly benefited from the cross-project collaboration as they learned about different TD experiences, practised in working with various teams to produce a shared output.

'The cross-project collaborative grant was really a rich and useful experience I very much appreciated. The grant opens the door to the team members to expand their network of partnerships across Africa and to cement the ground for future collaboration. The long time spent with LIRA colleagues working on the joint papers provided us a unique and rare opportunity to co-engage and to continue to progress intellectually in our scientific careers.'

All PIs participated in conferences and workshops, at international, national or local levels. Conferences and workshops were cited as important networking and dissemination opportunities, opening up new research opportunities, while providing platforms to test and disseminate new ideas and research findings.

‘I am now part of an incredibly strong network of African TD researchers, which is invaluable. I’ve developed a much better understanding of the variety of TD approaches (through the cross-project papers). Working within and across teams from many different places (within our project team as well as the broader programme) has increased my emotional intelligence, empathy and understanding of different contexts. I have applied a critical perspective of TD, which has helped deepen my TD practice as an African researcher who is interested in solving complex urban problems.’

Network effects

The LIRA experience strengthened existing networks while facilitating the establishment of new networks, both within and outside the LIRA community. The PIs indicated that the projects helped to strengthen collaborations between universities in project cities and with local partners.

‘Network effects’ was a dominant theme emerging from LIRA projects, especially from cohorts 2 and 3; LIRA helped expand the ‘partnership portfolio’ of cities, highlighting the value of cross-country knowledge exchange, and learning between partner cities, PIs and co-PIs.

Networking was most developed in cohort 3. New partnerships were established that included platforms, nexus fora, training centres, water quality laboratories, academic groups with a diversity of expertise, a regional scientific consortium for TD research and collaborations with media, civil society organisations and local start-ups. For instance, in Accra, the WEF Nexus Forum created by participants of a project co-design workshop became a platform for continuous engagement of the different stakeholders for the management of the WEF resources in the city. The LIRA project in Benin is putting in place a West African scientific consortium for TD research with focus on coastal cities and creating the West African coastal database on sanitation, hygiene, water and public health. Another example is a project in Lagos which had significant interaction and cross-fertilization of ideas between the research team and civil society organisations, local start-ups and media, which helped to shape project approach to public engagement. As a result, the project came up with innovation in sustainable, bottom-up waste management and recycling solutions owned by local communities.

There are multiple examples of new collaborations established between universities within and across countries. These partnerships primarily provide a platform to foster the exchange of knowledge, skills and experiences between various partners, and to ensure sustainability of project outcomes. For instance, several LIRA grantees were involved in the development of a joint book *Localizing the SDGs in African Cities*, edited by one of the LIRA PIs, Sylvia Croese,



and the chair of the LIRA Scientific Committee, Susan Parnell. Several PIs are involved in a new project entitled the New African Urban University that develops a research agenda to strengthen the role of African universities to advance just and sustainable urban transitions in African cities and explores ways of enabling and supporting TD research practices within African universities. A group of LIRA grantees received a grant from the Volvo Research and Educational Foundations to design and deliver an online course for postgraduate students in African universities.

Project Coaching workshop, November, 2019, Accra, Ghana. Photo: ISC

Partnering with stakeholders also enabled some projects to leverage additional resources, capabilities and funding. Engaging stakeholders at different levels also made it easier to access key resources, such as data, facilities, staff time, equipment and transport. Some projects mobilized additional financial support for projects (e.g. fellowship grants, training toolkits, publication costs, communication activities and conference travel). At the same time, interacting with decision makers provided an opportunity for project outputs to be mainstreamed into policies and strategic plans.

Beyond the project cities, networks across projects were developed through the LIRA Training and Annual Research Fora events, as well as through cross-project collaborative grants. Networks with the ISC, the Network of African Science Academies, UN agencies and international research institutes were identified as positive enhancements to these networks. The PIs could participate in global events as well as promote their research through these global platforms. Some projects established strong connections with global research initiatives, such as Future Earth. For instance, several PIs contributed to the development of the Future Earth Health Knowledge Action Network in 2017, took part in Future Earth Seedbeds Conference in 2019 and were involved in Future Earth's Pathway Forum on Knowledge Co-production in 2022.

Structural changes and decisions

Although the duration of projects was relatively short (two years) and many projects conducted activities during the COVID-19 pandemic, there is evidence that the projects resulted in varied levels of structural changes and/or influenced decisions at the local level. Although impact and attribution are difficult to ascertain, there are some clear examples of direct impact of two-year projects, falling into two categories: new knowledge and new processes and structures.

In cohort 1, new data and empirical evidence were generated through the projects on areas not usually subject to scientific investigation. Numerous policy interventions included the development of policy briefs and tangible building codes, for instance an earthquake building code for Goma. One air-quality citizen science project significantly contributed to progress on developing the air quality law in Kenya. At a societal level, projects produced photo stories, websites, documentaries and blog posts, all designed to make project findings accessible to a wider audience.

The PIs from cohort 2 reported various outcomes that directly and indirectly resulted from the process of conducting the research. New knowledge and data generated by projects were not only of academic interest, but also of significance for local communities and policy makers. The PIs noted that decision makers now feel they have evidence-based arguments with which to shape decisions. Knowledge uptake was cited by PIs in both the policy and the community realms. The 'development of a community voice' was cited as an important outcome. In addition to the new knowledge and data, PIs also noted the significance of new methods for data gathering, and for dissemination and communication.

They also noted new processes and structures. For instance, the project in Lagos catalysed structural changes in operations at the State Urban Renewal Agency by facilitating synergies and collaborations across agencies. In Mozambique, the project was instrumental in facilitating the preparation of the SDG Voluntary National Reporting and contributing to a collective Voluntary Local Review for municipalities. In Durban, transformative adaptation was added as an agenda item to meetings of the Environmental Health Services as a result of their engagement in the Learning Labs. While, in Harare, a climate change desk was established under the Town Clerk. In Angola, the project was invited by the government to support the development of the National Housing Policy, and in South Africa the results are being fed into a review of the informal settlement upgrading policy of eThekweni and the team has been included in the South African COVID-19 informal settlement policy and technical platform. The PIs attributed these successes to use of the TD approach, as it allowed for holistic responses to problems.

Other examples of innovations include introduction of sanitation technology solutions, improved energy technologies coupled with changes in energy use practices and development of double-storey housing designs. In addition to the introduction of these new interventions, some findings could be considered innovative because they shift preconceived assumptions. For example, in Uganda, the research yielded new insights into defining and assessing adequate housing. Community engagement has resulted in new criteria for measuring decent housing in contexts of informality.

Projects from cohort 3 also reported that their findings were being used to inform decision making, despite most projects working under the global pandemic. In Cape Town, for example, the prototype of the vegetable garden developed by the project was included in the City of Cape Town's housing architecture. Projects also developed valuable tools for city planning and responsiveness to urban challenges, especially in cities with substantial informal sectors. This includes context specific and locally derived indicators and databases (e.g. an indicator framework for the WEF nexus, database on sanitation, water, health risks and socio-ecological mechanisms and database of market vendors). In some instances, these data led to associations or collectives being formed, which consequently had an impact on behaviour change. For instance, as a result of the project in Ghana, informal waste-workers in Accra were formally registered as a co-operative within the municipality to help the city deal with waste management, thus making a substantive difference in the status and agency of informal workers who have traditionally been ignored or criminalized by state actors. The project also facilitated the establishment of a waste management committee in the host community in Lagos. This committee has been leading the behaviour change campaign established by the project on the ground, and is expected to continue in this role after project expiration. This volunteer-driven structure is the first of its kind to be established for waste management purposes in this community.

In several projects, the outcomes were maximized by either combining projects or leveraging one project's network to extend its impact beyond the timeframe of LIRA. At the same time, PIs acknowledge that it takes time to see the impact of projects seeking to influence policy to come to fruition. It is expected that project outputs, such as policy briefs, technical manuals and partnerships built have the potential to influence change at policy level in a long run.

'Although these may not be readily seen or realized in the short term/the project cycle, we believe the knowledge products including policy briefs and publications have the potential to contribute to the structural changes and decisions.'

'We are convinced that the shift in thinking (of the stakeholders) in the direction of the WEF nexus approach will persist beyond the project, and hopefully lead to policy reforms.'

Value of transdisciplinarity in African cities

The TD research approach was valued by all LIRA projects. The PIs stressed that this approach contributed to improved knowledge sharing across stakeholder groups and resultant improved skills and capacity, learning between cities and

enhanced institutional collaborations and network building. Working between two cities demonstrated the extent to which emergent TD research processes require the flexibility in research design in different contexts within projects sharing the same goals and objectives. The PIs underlined that context drives process and how solutions and processes that generate success in one context cannot simply be 'cut and pasted' into another. Capturing these differences across different sites through the TD approach proved valuable.

The PIs from cohort 1 stressed the value of TD research for generating new knowledge, providing evidence of urban functioning and dysfunction in under-researched areas in African cities. The approach highlighted areas where established knowledge was limited and provided opportunities to fill the gaps. Although TD is often considered a slow process, several PIs stressed that the TD process was effective and time saving, as cause and effect could be identified simultaneously.

Using TD approaches demonstrated the benefits of synergies between different knowledge types (scientific/community and practitioner). Partnering with stakeholders helped to reduce research costs, for instance by mobilizing external capacities, facilities and resources. The approach improved the acceptability of new technologies and/or policy options among stakeholders.

'The [TD] approach yielded more authentic results than traditional projects that proffer technological solutions to... [waste management]... problems, often in isolation from the lived realities of target groups.'

Learning between cities and enhanced institutional collaborations were identified as beneficial. These collaborations and increased evidence resulted in building the credibility of ECRs, which in turn helped to build new partnerships.

In cohort 2, the value of TD research approaches for understanding and addressing urban complexity in African cities was endorsed by all PIs. In addition to new knowledge generation, cohort 2 focused on TD practices and processes and their role in realizing the goals of the individual projects. The PIs saw the TD approach as a learning opportunity. They highlighted that the TD approach helps to maximize the impact and areas of collaboration, identify obstacles and stakeholders at the start of a project and frame the scope of the project. It further allows for smooth community entry, strong partnerships and continuous improvement of study through reflection. The close engagement fostered through TD methods allowed for informed changes in research ambition, strategy and understanding of community needs. Through the collaborative nature of framing problem spaces and shaping research questions, TD research also helped to bridge distances between institutions and foster learning among partner institutions.

The process of knowledge co-production ensures that 'solutions are fit for purpose for each local context'. The research flexibility offered by TD and its emphasis on the local context were seen as vital for fostering greater

receptiveness from stakeholders, thereby improving the quality of the research and its potential for impact.

The 'open process' of TD allows projects to make use of opportunities that arise over the course of the research. However, PIs also realize that when working with power differentials in TD projects, stakeholders do not arrive at the process equally. Similarly, not all stakeholders contribute or benefit in the same way from the project. Therefore, clearly articulating the benefits to each partner of the TD process is important. Addressing these differences requires strong leadership and coordination from the PIs.

In addition to the value of engaging diverse forms of expertise, PIs also reflected on the benefits of engaging different disciplines. These include a better articulation of research goals, integrative generation of knowledge and decision making and building collaborative relationships.

Despite these benefits, PIs also noted structural barriers to engaging across disciplines which serve as disincentives for ECRs, including the lack of reward

Water testing in Abidjan.
Photo: CMAPPING



for TD research within universities that are still structured along disciplinary lines, as well as finding outlets for publishing TD research. Other concerns raised focused on the sustainability of the investment in relationships, partnerships and knowledge generation once the project funding cycle is complete. Although new and novel ways of working have emerged, impacts and societal benefits are often delayed. Momentum is required to ensure the full benefit of projects.

Generation and sharing of locally grounded knowledge between different actors and stakeholders was highlighted as an undoubted key benefit of TD. Some considered TD as transformative, as processes can act as a catalyst that allows local and policy communities to express themselves through the process of partnering. The TD approach 'considers both top-down and bottom-up approaches' as well as informal processes that have responded to infrastructural and service needs in cities. However, PIs cautioned that changing ways of thinking and working of actors is very challenging.

Through the self-reflection workshops, PIs generated a number of insights into what can be learned from the application of TD in African cities. These are summarized through the following 'revelations':

- flexibility in approach is crucial,
- partner early and often,
- one research domain is never enough,
- learn from your mistakes,
- look for policy windows, although there might not be guaranteed wins,
- a well written report or policy brief is not enough,
- there are no easy wins.

In cohort 3, project teams reflected on the importance of trust and mutual respect, which are essential to forging connections between research and practice. The bridging role of the TD nature of the projects was emphasized. Using the projects as a platform for collective discussions and consultation, communities were brought closer to service providers, which afforded service providers an opportunity to obtain feedback about their work and roles. The projects were often an interface between different groups of stakeholders, and different stakeholder groups felt empowered through their participation.

While this relational process makes the research process slower than it would otherwise have been, it helped projects to get to the root of what appears to be an intractable problem and jointly identify likely solutions.

The investment in relationships across stakeholder groups and disciplines was valued as a means to change the knowledge and governance landscape shaping African cities. In summary, the shifting configuration of research actors in the research processes resulted in a sense of ownership of the project by the societal actors. The depth and longevity of the partnerships built through the projects were identified as valued attributes of TD. The PIs noted that institutionalizing these relationships and engagements is key to them transcending personal networks and becoming more democratic, transparent and accountable in the long term.

Owing to the TD approach, projects in all the cohorts engaged with a wide range of stakeholders. By doing so, project teams learned that engaging a broader group of stakeholders than in normal stakeholder methodologies could improve the validity and acceptability of research findings because more viewpoints were considered when framing research questions and addressing challenges. The deep engagement and emphasis on power relations to achieve 'equality of voice' while recognizing power asymmetries was a shift from typical TD thinking, which focuses on the 'art of co-' and equivalent participation. The PIs and project teams needed a diversity of skills and competencies to straddle the knowledge, political and social dimensions of transdisciplinarity.

'We have... learned the value of humility, in the sense that we have had to strip ourselves of numerous assumptions we had prior to going into the 'field', and instead pay attention to the wisdom from the lived experiences of other stakeholders.'



PART II

The role of the LIRA programme in influencing the projects' capabilities of engaging in transdisciplinary research



This part presents insights for the fifth goal of the learning study which focused on assessing the role of the LIRA programme in influencing the projects' capabilities of engaging in TD research.

To achieve this goal, the learning team led by Flurina Schneider examined the programme's designs and activities (including TD training workshops, collaborative research grants, annual research fora, project coaching workshop and scientific leadership opportunities) and assessed their potential for stimulating TD research.

The analysis focused on four questions:

1. What are key features of the LIRA programme (structures, activities and underlying change theory)?
2. What are potentials and limitations of the programme design and activities in enabling TD research and capacity building of ECR?
3. To what extent could these learnings be incorporated into the evolving programme features (evolution over the three cohorts)?
4. What are lessons learned for future programmes supporting TD research?

Methodology

To address the four questions above, a mixed methods approach was used. The generic model of a TD research funding programme developed by Schneider et al. (2019) served as a conceptual framework.

First, an overview of the programme's key features including theory of change, basic structure and activities was developed. This step was mainly based on a document review of existing programme documents (e.g. programme website, programme proposal, calls for project proposals and annual programme progress reports for Sida) and interviews with the management team and the SAC. By evaluating these data, the learning team adapted the generic model of a TD research funding programme (Schneider et al., 2019) and depicted key moments and activities of the LIRA programme over time. In addition, to understand the LIRA programme's theory of change, insights from document review (programme proposal) were combined with the interview data.

Second, the learning team investigated the potentials and limitations of the programme's activities from the perspective of the different actors involved. The perspective of the grantees was captured through assessment of course evaluations (e.g. training course evaluations by participants) and a survey with all PIs towards the end of each LIRA cohort to collect their insights on their perceptions and understanding of the value of the LIRA programme's activities in building their capacities to undertake TD research and in providing opportunities for showcasing their work.

Investigation of the perspectives of the programme-level actors was based on interviews with the programme management team (three interviews) and the SAC (three interviews), and a review of the annual programme progress reports to Sida. In addition, the learning team conducted participatory observation of the events and comparison with insights from the project-level study, led by Zarina Patel.

Third, to investigate to what extent the LIRA programme incorporated the learnings, the team referred to the interviews with the programme management team, the SAC and the programme documents (e.g. calls, SAC meeting reports, reports to Sida and workshop agendas). By doing so, the team could capture the involved actors' perspectives (e.g. what they learned) as well as changes manifested in the actual programme implementation (e.g. how the call descriptions or workshop agendas changed).

Finally, to answer the fourth question, the insights of the previous steps were combined with the deliberation with the programme management team.

Findings

Key features of the LIRA programme

Overview

Since its inception, the LIRA programme launched three thematic calls for funding on different sustainability topics:

- Understanding the 'energy-health' and 'health-natural disasters' nexuses in African cities (2016),
- Advancing SDG 11 in Africa (2017),
- Pathways towards Sustainable African Urban Development (2018).

Hence, the programme has supported three cohorts of research projects, in total 28 projects, to the value of up to €90,000 each over two years. Each project brought together cities in at least two countries in Africa to foster research collaboration across African research institutions, and learning across cities. A particular emphasis was ensuring participation of low-income countries in research collaboration. The projects covered 22 countries in Africa: Angola, Benin, Burkina Faso, Cameroon, Democratic Republic of Congo, Ethiopia, Ghana, Ivory Coast, Kenya, Malawi, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

The total programme funding volume was about €5 million over six years, with over 60% of the total funding allocated for TD projects.

In addition, the programme supported the projects through various means, such as training, peer-learning and networking activities.

Implementation of the programme, in particular activities of cohort 3, were affected by the global COVID-19 pandemic.

KEY ACTIVITY FIELDS

Collaborative research grants

These grants were provided to African early career scientists to undertake interdisciplinary and TD research on global sustainability across African cities that is policy-relevant and helps to tackle urban sustainability challenges. Moreover, they were expected to foster research collaboration at the regional level between different African countries and research institutions, including low-income countries.

TD capacity-building activities

Capacity building was an integral part of the programme and aimed to ensure that early career scientists have the necessary skills and knowledge to develop and undertake policy-relevant TD research. Furthermore, the programme encouraged the projects to undertake TD capacity building as part of their project activities. The programme delivered TD training for PIs and **for co-PIs, coaching workshops** with modules on, for example, theory of change, the ethics of doing TD research, strategies for publishing TD work, project and financial management of TD projects, science advice to governments, science-policy interactions, science communication and scientific writing.

Leadership and career advancement

The programme also aimed to foster international career development opportunities for the early career scientists by nominating them for international scientific committees and conferences, working groups and inter-governmental policy processes and global reports (e.g. at the UN Science, Technology and Innovation Fora, High-level Political Forums on Sustainable Development and the Intergovernmental Panel on Climate Change Cities and Climate Change Science Conference). Opportunities for participation as well as funding opportunities were regularly shared with the LIRA community. The programme also supported the PIs with project outreach to the broader public via ISC-led production of blogs, videos and webinars.

Peer-learning and network building

To foster community building and peer learning, the programme organized annual three-day research fora. These fora brought together PIs and co-PIs of all projects, TD and urban experts as well as representatives of global research initiatives. Capacity-building modules were integrated into the meetings, for instance on science advice to governments, science-policy interactions, science communication and scientific writing. Building a network of African TD sustainability scientists including the 28 selected research projects to enhance south-south collaboration and to foster participation in global sustainability research endeavours such as Future Earth was another key aspect. The network included the 28 selected research projects.

Mobilizing institutional and financial support for TD research

To enhance the context conditions for TD research globally and in Africa and to mobilize further funds, the programme held strategic meetings with funding agencies, such as

national science funders, development agencies, foundations, key regional institutions and other relevant partners. Under the framework of the LIRA programme, two fora were organized to discuss with science funders how to increase the impact of science on the implementation of the SDGs, during which the critical role of TD research and building associated capacity in the global south was emphasized.

Learning study

Transdisciplinary research funding programmes are still a niche phenomenon, and suitable structures and activities need first to be defined. Therefore, the LIRA programme conducted this accompanying learning study aiming to foster continuous reflection and learning concerning how TD can be supported through such a funding programme and how the implementation of the programme can be improved, both at project and programme levels. To collect learnings from projects, self-reflection workshops were introduced, which research teams attended twice during the course of their projects.

Cross-project collaborative grants

To foster collaboration and learning across different projects, the programme funded eight cross-project collaboration grants. These grants allowed comparing and synthesizing knowledge from different LIRA 2030 projects as well as experiences of TD research in different African contexts.

Site visits

To understand the progress and challenges of the projects, the programme management organized site visits of several projects and their institutions on an annual basis. With the COVID-19 pandemic, these visits became virtual. These visits made it possible to witness projects' progress on the ground and to discuss management issues, needs and challenges, and maintain strong links with projects' leadership and partners.

Open access fund

Given that publishing TD research takes time and that the pandemic slowed project activities, the programme created an open access fund for LIRA grantees to publish their articles in open access beyond the programme lifetime.

Final LIRA evaluation workshop

To assess the effectiveness of TD approach in generating the actionable knowledge on sustainability challenges across African cities, the programme initially planned to undertake a LIRA evaluation workshop at the end of the programme, inviting the entire LIRA community for reflection on achievements and challenges. However, due to the pandemic, this event could not take place. Instead, a series of virtual webinars were organized. This learning study also served this purpose.

*Activities **in green** were not part of the initial programme design, and were added as the programme unfolded, taking into account project needs.

Theory of change

The LIRA programme's theory of change was described in the initial programme proposal and embraces the following key assumptions:

- ➔ Sustainability challenges are created through reciprocal interactions between global environmental changes and local human activities.

- ➔ Science, technology and innovation can help tackling these challenges, but there is a considerable gap in many African countries between the demand and supply of scientifically based, country/region-specific knowledge. This gap involves financial resources and scientific capacities, as well as structures for effective collaboration between nations. Moreover, scientists in Africa rarely collaborate with one another but instead seek international partnerships.
- ➔ Scientific and societal responses need to be integrated and coordinated to effectively contribute to sustainability transformations. This calls for research that is highly integrative and solutions-oriented, reaching across disciplines (interdisciplinary) and engagement with other knowledge partners (i.e. TD).
- ➔ The capacity to apply such novel skills, methodologies, approaches and tools needs to be strengthened. Hence, to turn TD research into a mainstream endeavour in African countries, the capacity to undertake this type of research needs to be enhanced.
- ➔ Although recent years have seen the emergence of alternative funding that prioritizes integrated TD research, traditional research funders are not yet sufficiently supporting this type of research, particularly in Africa.

The programme aimed to foster TD research and capacities through the following three pathways:

- 1. Providing collaborative research grants and capacity building to enable African early career scientists undertaking high-quality TD sustainability projects:** The programme assumed that scientists require dedicated funding, but also additional skills and knowledge to successfully develop and undertake TD research projects.
- 2. Providing career development opportunities to support African early career scientists to pursue a career as TD researchers:** The programme expected that African-based TD research can only flourish if TD scientists can establish themselves in the existing science institutions in the long term. Therefore, the programme aimed to foster career development beyond the grants through network building with peers and the creation of a community of practice of experienced African TD researchers, facilitators and trainers (south-south collaboration), leadership training (on issues such as project management, science communication, science advice to governments, scientific publishing and financial project management) and nominations for global sustainability policy and research fora. On a regular basis, the programme shared information about relevant global events, funding calls and other career opportunities. The programme also created an open access fund beyond its timeframe to enable researchers to publish their work.
- 3. Enhancing the context conditions for doing TD research in Africa:** The programme believes that African early career scientists can pursue a career as TD scientists in Africa if TD is better recognized by universities and funding agencies. To this end, the programme sought to synthesize and communicate the experiences of doing TD research in Africa to the broader

science and policy community, promoted TD capacity building in African research institutions and engaged with other science funders to create an enabling environment for TD research and to mobilize resources for science on sustainable development globally, particularly in the global south.

The sections below explore potentials and limitations of the programme design for each of these three pathways and key lessons learned from each pathway that can be considered in designing future TD research funding programmes.

Potentials and limitations of programme design and activities in enabling TD research and capacity building of early career scientists

Potentials

Pathway 1: Providing collaborative research grants and capacity building

Grant provision and capacity-building activities were highlighted by most of the interviewees as the most important benefits of the programme as they enabled the grantees to successfully develop the necessary skills and knowledge for practising TD projects. In this regard, the two-step application process with the TD training course between the pre- and full-proposal and tailored feedback from experts and programme management were considered particularly useful by grantees because they shaped participants' understanding of TD research (its principles, concepts and methods), and strengthened TD project proposal writing skills. The grantees also stated that the training increased their confidence in approaching societal actors and in undertaking similar TD projects in the future. These findings are remarkable as many applicants had only limited or no previous experiences with TD research.

'The capacity-building aspects of the LIRA project have probably been the most impactful for me. I am now more capable and confident in my ability to conduct transdisciplinary research on a range of sustainable development issues. The opportunity to network with fellow researchers from other African countries has also been invaluable. Overall, the experience has been highly enriching and professionally rewarding.'

Many grantees also underscored gains of the capacity-building events at the later stages of the programme, such as the coaching workshop and the self-reflection workshop activity, as they allowed the researchers to deepen their understanding, broaden their methodological approaches, gain a clearer perspective of the project progress, draw lessons learned and re-evaluate the project work-plan. Others stressed the benefits of exchanging with and

learning from their peers, because this showed them multiple ways of doing TD in different contexts.

‘As both an ECR and a PI, I’ve had to be curious and brave. The programme has helped build my confidence and leadership skills. The programme has provided so many opportunities to connect with others (to support potential collaborations) and share my research. I am able to reflect my increased knowledge and skills in project proposals. I have become a critical TD African researcher, with more confidence in this realm, and have made incredible connections across the continent. I have also improved my research and paper writing skills by being exposed to several processes within and across LIRA2030 projects.’

Pathway 2: Providing career development opportunities

Career development activities aimed at supporting African early career scientists to pursue a career as TD researchers were highly appreciated by the grantees. Without exception, all grantees stated that they would like to continue using TD approaches in their future research and that they feel galvanized to pursue a career as TD researchers.

‘The LIRA programme has been beneficial to our career trajectories. Through the programme, my collaborator has been promoted to senior lecturer. We have been able to mentor students and developed their skills in TD research. Most importantly it gives me joy that we could contribute to societal transformation with both tangible and intangible outcomes.’

Highlighted benefits include (a) gained knowledge and skills for doing TD research; (b) leadership experiences for independently implementing an own research project; (c) increased self-confidence and recognition in their universities and research community through their enhanced research portfolio; (d) enhanced involvement in local, national and global policy processes and recognition by decision-makers and community members; and (e) strengthened international networks with peers and high-level actors from the African continent and beyond. Moreover, for many grantees, cross-project collaboration and networking opportunities were cited among the most important benefits they received from the programme.

‘The cross-project collaboration (grant) was a great experience. The grant gave us an opportunity to publish joint papers with LIRA grantees in high impact journals and opened the door to the team members to expand their network of partnerships across Africa and to cement the ground for future collaboration.’

Many grantees were confident that these benefits will help them in their future career to find potential collaborators, acquire new projects and build joint forces for change. Some grantees were awarded with direct career progression and mobility, such as internal promotions (e.g. associate professorship status or fix-term contracts) and external recognitions for their role in TD projects. For instance, Amollo Ambole was awarded an Africa Climate Change Leadership 2018–2020 Policy Fellowship and a Rutherford Fellowship by the University of Leicester. Sylvia Croese was listed among the 100 most influential academics in government by Apolitical.

‘The LIRA programme influenced a lot my professional development by providing me fertile ground for intellectual growth and affording me an opportunity to expand my network across African researchers and beyond.’

Several PIs also secured supplemental funding from alternative sources (e.g. the Belmont Forum, National Research Foundation of South Africa, IDRC, Africa Multiple Cluster of Excellence and German Federal Ministry of Education and Research) to continue the work initiated by the LIRA projects or to disseminate their project outputs.

Pathway 3: Enhancing the context conditions for doing TD in Africa

Benefits (and challenges) of the programme activities aimed at enhancing the context conditions for doing TD in Africa are challenging to assess as they go far beyond the programme’s direct sphere of reach (lacking data), and changes in the context conditions are difficult to attribute to specific programme activities (attribution gap). While recognizing the challenge of attribution and lack of data, the programme received positive feedback on activities undertaken under this pathway. For instance, there was a strong interest in the knowledge products featuring the value of TD for urban development in Africa and learning to perform TD in different contexts on the continent. The programme and projects were also invited to showcase project results and the value of TD research in different conferences and fora. It also communicated project results and the associated role of TD through blogs and videos via the ISC website and global networks.



Furthermore, several grantees stated that their institutions have become more receptive towards TD research. Some indicated that as their institutions are becoming increasingly socially responsive to ongoing social challenges, they have started acknowledging the importance of TD to respond to those challenges. Grantees believe that the implementation of the LIRA projects, including TD capacity-building activities delivered by projects within their institutions and engagement of Master students and non-academic stakeholders in the projects, have contributed to this evolution of attitude.

Flurina Schneider,
a TD trainer with
LIRA grantees,
Project Coaching
workshop, May, 2018,
Port Elizabeth,
South Africa.
Photo: Tobias Buser

Challenges

Pathway 1: Providing collaborative research grants and capacity building

The challenge that grantees of cohort 1 faced at the initial stages was insufficient time between the TD training and the full proposal, preventing researchers fully integrating learnings from the TD training when undertaking initial co-design and improving proposal quality. The time was extended in the subsequent calls. Another challenge was lack of experienced TD reviewers for proposal evaluation. The programme had to engage several reviewers from different disciplines to review each proposal.

Challenges documented by the grantees were mostly related to administrative obstacles (delays in fund transfers between universities, limited institutional support for grant management and intensive reporting), tensions between available budget, lack of time and staff resources and the high ambition regarding scientific and societal impacts. In particular, several



Dan Inkoom, a TD trainer, at LIRA transdisciplinary research training in Abidjan, Côte d'Ivoire. Photo: CMAPPING

grantees stressed that implementation of TD processes with societal actors in two countries with different socio-cultural contexts and languages requires more than two years. Some mentioned that production of TD academic articles takes time, and there are not many avenues for publishing TD work, while others found it difficult to implement the project in addition to their ongoing (teaching) duties. Furthermore, institutional bureaucracy and inefficiencies of their home universities, such as accessing funds and transferring funds between different African universities were highlighted as important challenges.

Pathway 2: Providing career development opportunities to support African early career scientists to pursue a career as TD researchers

While career development opportunities provided by the LIRA programme were highly valued by the participants, securing long-term career development as a TD researcher and supplementary research funding is a challenge for many. As a result, two LIRA grantees informed the programme that they left academia for a career in civil society organizations or foundations. These activities have also been affected during the last two years of the programme due to the COVID-19 pandemic, as a result cohort 3 could not benefit from these opportunities, as all travel was cancelled.

The programme representatives pointed out that more human resources and financial capacity would be needed at the programme level to adequately support such activities. The actual effects of the career development activities are also beyond the programme's control and strongly depend on the overall science context in the different countries on the continent.

Pathway 3: Enhancing the context conditions for doing TD in Africa

Institutional policies and processes within many universities remain unconducive to TD. Limited institutional recognition, disciplinary siloes,

inflexible institutional policies and processes, inadequate administrative support for internal grant management and limited opportunities for long-term TD career development are among factors that still inhibit TD research from becoming a more widespread practice.

Changing this requires a deep transformation of existing institutional structures and processes within universities, science funders and other partners. As a result of engagements with other science funders through the Global Forum of Funders organized by the ISC, there is growing recognition within the science funding community about the need to scale up collective efforts to enable science to effectively respond to the SDGs by the 2030 deadline. As part of this engagement, the ISC developed a framework to unleash mission-oriented TD science for the SDGs, outlining game-changing priorities for science and for transformations of science systems. Programme representatives recognize that this pathway to impact requires long-term strategic and collaborative action from governments, science policy makers, science funders, scientists, the private sector and civil society – much more than a single research programme can do.

Incorporation of learnings into the evolving programme features

The LIRA programme understood itself as a learning entity continuously reflecting its practices and improving its structures and processes. The programme collected PIs' feedback after all activities to better understand project needs and make necessary adjustments for future activities. The programme's self-understanding as a learning organization is considered an important success factor for the fruitful implementation of such an innovative TD research funding programme.

This allowed learning from early experiences and continuously implementing adjustments when necessary. Therefore, the emergent nature of TD research requires that the TD research-funding programmes and science funders are prepared for a certain level of flexibility as well as open to unconventional kinds of outputs and outcomes.

The following learnings were incorporated into the evolving programme design:

- ➔ The two-stage proposal process was continuously improved over the three calls. In particular, the call description became more comprehensive and explicit, making clear what TD is, what the selection and evaluation criteria are and how the proposal should be structured (by providing a template). Moreover, the time between pre- and full-proposal was slightly extended to give more time for co-design of the full-proposals. The call was also translated into French to reach a bigger audience.
- ➔ This learning study was not part of the original programme design. After the implementation of cohort 1, it became evident that there was a significant learning potential from the programme. Consequently, a decision was made to undertake this study.
- ➔ The capacity-building activities for grantees were increasingly extended, focusing on the whole research team (originally, they targeted primarily PIs). A TD training course was also offered to co-PIs and a coaching workshop

for PIs and co-PIs was introduced at the beginning of cohorts 2 and 3. Funding for these activities was acquired from the Robert Bosch Foundation.

- The focus of the capacity-building activities also changed over time:
 - Increasing emphasis on societal transformations and theory-of-change thinking (e.g. introduction of coaching workshops describing theory of change),
 - Increasing emphasis on issues related to research management and the whole research value chain, such as scientific writing and publishing of TD, science communication, ethics of TD, financial accounting and reporting, and knowledge integration (through coaching workshops and adaptation of agendas of annual research fora).
- To stimulate reflection on TD experiences within research teams, the programme introduced annual self-reflection workshops.
- Collaboration across LIRA projects was enhanced through rededicating funds foreseen for single projects of cohort 3 to collaborative projects between grantees.

‘Future programmes should establish cross research collaboration as a core component, to enable early cross breeding and fertilization of ideas.’

- Agendas of single events were also continuously adapted according to the feedback of the grantees and the SAC, e.g. inclusion of site visits and introduction of specific capacity-building modules.
- With the COVID-19 pandemic, projects of cohort 3 could not implement activities and utilize funds as originally planned. The programme had to be open to the revision of project plans and budgets, as well as to accept no-cost extensions.
- A final evaluation workshop with all LIRA grantees was part of the original programme design to discuss the programme and project achievements, to share project experiences and assess the value of TD research in achieving project objectives. However, due to travel restrictions, this workshop had to be designed as a series of virtual webinars.
- Given that publishing TD research takes time and that the pandemic further slowed the publication process, the programme created an open access fund for 2022-mid 2023. All LIRA grantees who published their articles during this period could receive financial support for open access.

Lessons learned for future programmes

This section outlines elements that were particularly valuable in the LIRA programme as well as areas for improvements. These LIRA lessons can be considered in the design of the future TD research funding programmes.

Research grants, capacity building and career development

- **The combination of research grants, capacity building and career development opportunities** is an appropriate programme approach for fostering TD leadership by ECRs, because the grantees (a) gain theoretical knowledge, as well as hands-on experience, by leading their own TD research project and (b) enhance their opportunities to pursue a career as a TD researcher beyond the programme funding.
- **Research grants must match project outcome expectations (funding times and volumes).** Implementation of TD research projects in two countries, including achievement of scientific and societal impact, requires adequate time (more than two years) and sufficient funding for collaboration and coordination activities. This is particularly relevant when institutional, economic and political context conditions are challenging (e.g. bureaucracies, low institutional support, political or social turmoil, different languages or limited infrastructure capacities). Research funding programmes should carefully design project structure and selection criteria to minimize unnecessary complexity and increase project feasibility.
- **Capacity building ideally covers the whole 'value chain' of TD** (including TD research theory, methods and tools) because leading a TD research project requires competencies that most university curricula still do not foster. Required competences include managerial and facilitation skills, but also sensitivity to political issues and handling of different types of people from villagers to government ministers. In addition, capacity building on research management (e.g. project management, basics of financial management and project planning), scientific publishing and science ethics is recommended. To support grantee learning, **capacity-building activities must be adequately phased**, starting with inputs needed to design high-quality proposals (e.g. methods for co-designing research questions), followed by those for operationalization of research (e.g. stakeholder engagement methods) and finally for bringing results to fruition. Combinations of expert inputs, coaching and self-reflection workshops were shown to be key.
- Although research collaboration across countries was enriching, administrative hurdles and differences in languages, institutional, economic and political contexts, made management of TD research challenging for early career scientists. To minimize complexity, future research funding programmes should carefully consider whether **research collaboration should be a requirement from the outset or be introduced towards the end of the research process** (e.g. through cross-project collaborative grants).

‘This cross-collaborative project was extremely useful and I would recommend that it should form part of any funding programme for TD research. Recommendation would include opportunities for cross-project learning through field visits, opportunity to participate in a multi-year cross-collaborative project spanning beyond paper publication, but this should still form a core part of such collaborative initiatives.’

- **Career development can be fostered through various means** such as mentoring, network building and enabling grantees to participate in high-level political processes and scientific conferences as well as to contribute to international scientific assessment reports (e.g. by establishing contacts, sharing information, connecting to networks and providing funding).

Programme-level activities and support

- **Programme-level activities change throughout the lifecycle of a funding programme** and cover various stages from programme development, the application process, project selection, project support, monitoring and evaluation, as well as internal and external communication. **Activities of the first programme stages (e.g. proposal development and project selection) need particular consideration** as they set the framework and develop capacities and skills for the later stages.
- **To select high-quality TD projects**, a funding call must be very clear regarding TD requirements and criteria, involve TD expertise in the review process and give enough time for co-design of the project proposals together with different disciplines and societal actors. **A two-step application process with a TD research training course between the pre- and full-proposal** and tailored feedback from experts and programme management was shown to strongly improve quality of project proposals. Building a community of reviewers with TD skills is also key.
- **Administrative processes and existing institutional challenges** of many African universities regarding bureaucracy in accessing funds, procurement and financial transfers between countries must be acknowledged. This could include support of the involved institutions, as well as flexible contract conditions (e.g. research material belonging to the project and not the university, making it easier, especially for early career scientists, to switch universities). Project budgets should also include sufficient resources for administrative support.
- **Self-understanding of a programme as a learning organization** is crucial when implementing innovative TD research funding programmes to continuously reflect and improve the programme-level activities. Considering the novelty of managing such experimental programmes,

it was fruitful to establish a concerted monitoring and learning process over the whole programme duration (e.g. facilitated through an accompanying study). **The monitoring and reporting processes should be streamlined and lightened.** Identifying ways of capturing the experience of the non-academic partners in the research process should also be considered.

- **Synthesis of the knowledge produced by all projects is a critical element of a research funding programme.** The synthesis of initial learnings of eight LIRA projects from cohorts 1 and 2 was captured in the report *Advancing the 2030 Agenda in African cities through knowledge co-production*. But the development of a synthesis of all produced knowledge was affected by the pandemic.
- **Programme management requires adequate human resources and financial capacity at the programme level** to design, support and reflectively monitor the various activities.
- **TD research requires changes within existing funding practices.** Research funding should not only support the production of knowledge products but also engagement processes that could lead to mindset change in a long-term. Allocating resources for partnership building, capacity building, networking activities as part of the project budget is crucial in this regard.
- There is also a **need for a shift in research and capacity-building funding from the short-term and project-based to a more sustained long-term process.** While the two-year project timeframe and funding amount were sufficient for building relevant partnerships and co-producing the required knowledge, the amount of funding and its lifespan were not always enough to put the knowledge generated into use. Most projects had to ask for no-cost extension to advance the implementation of their projects and publish their results. The LIRA experience shows that to witness long-term transformative change in cities, research projects and their funding need to be sustained over longer periods. The PIs indicated that at least three years was needed to advance the implementation of project goals.
- **Continuing strategic dialogues with key actors, including science funders, universities and science policy makers, to create a more enabling environment for TD research on the continent is key.**

CONCLUDING OBSERVATIONS

Evidence from all LIRA projects strongly demonstrates the value of TD approaches for stimulating new evidence on the distinctiveness of African urban transitions and fostering deeper partnership relationships that strengthen governance capabilities for delivery. The uptake of findings and approaches in African cities, with evidence of both structural change and shifts in mindsets, has indicated how this scholarship contributes to the science and can also help realize societal benefits.

By addressing the conceptual and delivery deficits in local areas, the LIRA projects have simultaneously highlighted blind spots in global policy agendas that are misaligned to the complexity of African cities. While it is difficult to say whether a uniquely African approach to TD research is emerging, clearly, in translating the global goals of Agenda 2030 at a local level, each project demonstrated unique and contextually derived approaches.

The LIRA projects could be considered as TD experiments that provided an opportunity for learning about the role of alternate knowledge practices in reimagining and reconfiguring urban outcomes. Engaging with the specificity of the 'what' and the 'how' of urban change across diverse African contexts is particularly significant in post-colonial cities, which are urgently in need of policy reform and reconfiguration of service delivery mechanisms, which have historically been incompatible with serving the needs of complex communities in informal contexts.

The value of TD approaches is that they contrast with 'one size fits all' best practice approaches, by requiring deep engagement with local contexts through constituting and nurturing relevant project teams. The uniqueness and individualized approaches adopted across the projects provide a compelling case to show that there will and must be multiple African urban futures. It is important to acknowledge the significant contribution made by LIRA scholars in shifting the political economy of research on Africa, by destabilizing the dominance of research on the continent by scholars from the global north. By contrast, LIRA has fostered 'solutions driven research by Africans in Africa for inclusive and sustainable African cities'. The distinctiveness of LIRA 2030 lies in the scholars, communities, policy makers and sites of research, which are in and of Africa. The extent of uptake of findings and approaches, with evidence of structural change and shifts in mindsets is providing a glimpse of the potential that investments in TD research can have for realizing relevance through research in African cities.

When examining the enablers and challenges facing TD projects, institutional barriers emerged as a significant factor. Specifically, the ability of African tertiary institutions to manage funding with complicated disbursements across cities and institutions proved challenging, impacting on the research process. Challenges of partnering with the policy and local community stakeholders



were also identified. These challenges point towards the need to focus future TD efforts on developing a better understanding of the institutional contexts within which these projects must operate and find ways to support these institutions to better facilitate TD researchers and research.

**LIRA transdisciplinary
research training in
Abidjan, Côte d'Ivoire.
Photo: ISC**

The projects cited a range of benefits to using TD approaches to address their respective research gaps. What emerged from the projects is that the benefits differ at different stages of the research. The results highlight the significance of reciprocity in the TD process, where engagements, responsibility and roles vary through the different research stages. The relational nature of the research process and the significance of communication and first-hand engagement with partners and field sites were identified as factors leading to success. These attributes did raise questions regarding the viability of TD research under the COVID-19 pandemic. However, thanks to creative approaches to engagement and the programme's support, PIs were able to turn this crisis into a window of opportunity and to sustain engagements and redeploy resources to focus on dissemination and deepening impact of project results, despite difficult circumstances. The challenges faced by the projects due to the pandemic serve to highlight the labour of TD research, and the diversity of skills and competencies required by PIs and project teams in straddling the knowledge, political and social dimensions of transdisciplinarity.

In analysing the set-up of the LIRA projects, the role of the PI has been implicit. It is clear that while PIs are primarily disciplinary experts, they also have well developed skills in stakeholder management and relationship building, which are at the heart of TD.

With the programme unfolding, projects demonstrated a deeper engagement with the meaning and practice of transdisciplinarity in context. Transdisciplinarity was approached as more than a method

and was understood in addition as both a political and a social practice. The emphasis on power relations and engagement with achieving 'equality of voice' while recognizing power asymmetries marks a shift away from the guidance on joint and equivalent participation inherent in the 'art of co-' that typically underpins TD thinking. Furthermore, the focus on 'open hearts, minds and wills' to shape engagements points to a markedly different set of skills and leadership competencies required in TD engagements.

Experiences of the LIRA projects demonstrate that existing institutional practices and reward systems remain uncondusive to TD research. Although the LIRA programme proved an innovative and promising funding model for supporting TD research from outset to implementation, turning TD research into a mainstream endeavour cannot be achieved solely by experimental research programmes like LIRA. The LIRA projects demonstrated the value of TD research in dealing with complex sustainability challenges, by synthesizing and making visible TD experiences and achievements. However, there is a need for a shift in research and capacity-building funding from short-term and project-based to a more sustained long-term process to allow for the synthesis of or application of knowledge on sustainability, for development of theory or for continuity of engagement with communities.

The LIRA programme showed that TD projects require support structures, from inception to closure. Funding programmes promoting this type of research should therefore not only include project grants but also integrate support for co-design, capacity building, peer learning and science-policy interfaces. The TD research funding programmes as well as funders should also be flexible enough to accommodate changes that occur during the emergent TD research process. Creating an enabling environment within academic institutions and ensuring that institutional practices and reward systems are more conducive for TD is also key.

Finally, making TD a truly common practice requires a transformation within the science system itself, requiring bold action from science funders, science policy makers, universities and scientists. There is movement in this direction, but it needs to be accelerated and scaled up if science wants to play a relevant role in addressing sustainability challenges.

'The LIRA programme is uplifting, constructive and very useful for vulnerable urban communities in Africa. This programme is also a pathway to achieve the Sustainable Development Goals in Africa. Although of short duration, the LIRA programme also contributed to the reinforcement of the academic capacities of the involved students and the professional aptitudes of the involved lecturers and researchers.'

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ANNEX 1:

LIST OF PROJECTS

Cohort 1

- Co-designing energy communities with energy-poor women in urban areas: case studies in Kenya, Uganda and South Africa
- Biogas-supported decentralized water treatment system for communities in Diepsloot, South Africa and Chambishi, Zambia townships: a feasibility study
- Health effects of indoor air pollution from cooking stoves in Kigali, Rwanda and Dar es Salaam, Tanzania: an assessment and solution
- Assessment and characterization of volcanic and flood hazards and their health implications in the cities of Goma, Democratic Republic of Congo, Buea and Limbe, Cameroon
- Towards reducing human exposure to combustion-derived pollutants in urban communities of Kampala, Uganda and Mwanza, Tanzania
- Mitigating risks to flood-related waterborne diseases in Abidjan and Kampala
- Delivery of clean air strategies for mitigating household air pollution and associated respiratory illnesses in urban informal settlements in Dar es Salaam, Tanzania and Lilongwe, Malawi
- Towards healthy communities: citizen science for improved air quality in Nairobi, Kenya and Addis Ababa, Ethiopia

Cohort 2

- Standardising city-level data gathering towards achieving Sustainable Development Goal 11 in Africa (SCiLeD) (Lagos and Accra)
- Co-creating an urban framework for localised norms on sustainable energy in Kampala, Uganda and Nairobi, Kenya
- Integrating sustainable water and sanitation solutions to create safer, more inclusive and climate resilient cities in Dar es Salaam, Tanzania and Durban, South Africa
- Green spaces and repurposing waste: building capacities for resilience in urban and peri-urban West Africa (Ouagadougou and Tamale)
- Community-led upgrading of informal settlements (Windhoek, Gobabis and Lusaka)
- Management of shared sanitation facilities in low-income settlements (Kisumu and Kumasi)
- Realising the potential of urban density to create more prosperous and liveable informal settlements in Africa (Durban and Luanda)

- Bridging decentralised energy planning with neighbourhood-level innovations in cities of Africa: case studies from Ghana and South Africa (Stellenbosch and Accra)
- Co-producing urban knowledge in Angola and Mozambique through community-led data collection: towards meeting SDG 11 (Luanda and Maputo)
- Transforming southern cities in a changing climate (Harare and Durban)
- Integration of housing and health policies for inclusive, sustainable African cities (Cape Town and Douala)

Cohort 3

- EnsureWEF: enhancing sustainability and resilience of African cities through a water-energy-food nexus (WEF) approach in Accra, Ghana and Kampala, Uganda
- Inclusive metabolism: using co-produced theory of informal decentralised urban infrastructures to transform the delivery of urban food, water and energy services in Kumasi, Ghana and Cape Town, South Africa
- Decentralisation of urban water supply services and access to water under urbanization in West Africa (Wa and Niamey)
- Urban water futures: delineating public perceptions for reuse planning in Accra, Ghana and Johannesburg, South Africa
- Enhancing urban wetland and river ecosystem health to support environmentally sustainable urban development in selected African cities – a systemic-relational (SR) ethical perspective (Abuja Metro and Nelson Mandela Bay Metro)
- Cleaning from the bottom up: inclusive stakeholder participation for integrated waste management in Accra, Ghana and Lagos, Nigeria
- Household energy use practices and potential interventions for sustainable consumption in Makhanda-Grahamstown, South Africa and Kumasi, Ghana
- Optimizing groundwater security by integrated approach of sanitation and hygiene in the coastal cities of Cotonou, Benin and Lomé, Togo
- Reducing diarrhoea burden under climate change in urban contexts: an integrated approach for sustainability in West African medium-sized cities (Mbour and Korhogo)

The Leading Integrated Research for Agenda 2030 in Africa (LIRA 2030 Africa) programme seeks to build the capacity of the next generation of African scientists to lead innovative re-thinking of urban futures on the continent together with local communities, policy and practice. The programme is run by the International Science Council (ISC) together with its Regional Office for Africa and in partnership with the Network of African Science Academies (NASAC). The programme is supported by the Swedish International Development Cooperation Agency (Sida).

Find out more: www.council.science/lira2030

The International Science Council (ISC) works at the global level to catalyse and convene scientific expertise, advice and influence on issues of major concern to both science and society. The ISC has a growing global membership that brings together over 220 organizations, including international scientific unions and associations from the natural and social sciences, and national and regional scientific organizations such as academies and research councils. It is the largest international non-governmental science organization of its kind.

For more information on the ISC, please visit www.council.science

The Network of African Science Academies (NASAC) was established on 13 December 2001 in Nairobi, Kenya, and is currently the African affiliate network for the InterAcademy Partnership (IAP). NASAC is a consortium of merit-based science academies and aspires to make the 'voice of science' heard by policy and decision-makers within Africa and worldwide. Its membership comprises of 28 science academies on the continent. NASAC is dedicated to enhancing the capacity of existing national science academies and encouraging African scientists to establish new academies in countries where none exist.

For more information on NASAC, please visit www.nasaonline.org

LIRA 2030

Africa

Leading Integrated Research for Agenda 2030 in Africa (LIRA 2030) is a 6-year programme to strengthen research capacity for sustainability in Africa.

The programme is implemented by the International Science Council in partnership with the Network of African Science Academies (NASAC).

LIRA 2030 is supported by the Swedish International Development Cooperation Agency (Sida).

To learn more about how LIRA 2030 Africa works visit:



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