Edited by
**Rigas Arvanitis** and **David O'Brien**

# THE TRANSFORMATION OF RESEARCH IN THE SOUTH

## Policies and outcomes

IRD Éditions

éditions des archives contemporaines

# The Transformation of Research in the South

# The Transformation of Research in the South

## Policies and outcomes

Scientific editors

**Rigas Arvanitis and David O'Brien**

With the assistance of **Michael Graham**

IRD Éditions

éditions
des archives
contemporaines

Éditions des archives contemporaines (eac)
41, rue Barrault
75013 Paris, France
www.eac.ac

Institut de recherche pour le développement (IRD)
Le Sextant
44, boulevard de Dunkerque
CS 90009
13572 Marseille cedex 02, France
www.ird.fr

---

ISBN EAC : 978-2-8130-0303-4

ISBN IRD : 978-2-7099-2800-7

Avertissement / Disclaimer :

The present publication was made possible through a grant from the International Development Research Centre (IDRC), Ottawa, Canada, the support of the Institut de Recherche pour le Développement (IRD), France, and funding and support from Labex SITES (funding from Agence Nationale de la Recherche, France) managed by the Institut Francilien Recherche-Innovation-Société (IFRIS) . The opinions expressed herein do not necessarily represent those of IDRC or its Board of Governors, or those of the other bodies involved in financing this work. The texts published in this volume are the sole responsibility of their authors.

———

La présente publication a été réalisée grâce à une subvention du Centre de recherches pour le développement international (CRDI), Ottawa, Canada, le soutien de l'Institut de Recherche pour le Développement. (IRD), France, et du Labex SITES (financement de Agence Nationale de la Recherche, France) géré par l'Institut Francilien Recherche-Innovation-Société (IFRIS) Les opinions exprimées aux présentes ne représentent pas nécessairement celles du CRDI ni de son Conseil des gouverneurs, ni celles des autres instances ayant participé au financement de ces travaux. Les textes publiés dans ce volume n'engagent que la responsabilité de leurs auteurs.

**Acknowledgements**

Conference Committee : Rigas Arvanitis, Colleen Duggan and David O'Brien.

Organizational and financial support for the conference
and for the publication of this book was provided by :

— Centre Population et Développement (Ceped) (IRD & Univ. Paris Descartes), France
— International Development Research Centre (IDRC), Canada
— Institut de Recherche pour le Développement (IRD), France
— Institut Francilien Recherche-Innovation-Société (IFRIS), France
— OECD Development Centre

The Conference Committee would like to extend appreciation to the following people for their contributions to the organization of the conference : Yanuar Nugroho, Indonesian Government ; Phillipe Larédo, IFRIS ; Jean-Marc Châtaigner, IRD ; Ann Weston, Trish Wind and Gussai Sheikheldin, IDRC ; Mario Pezzini, Dominique Guéllec, Federico Bonaglia, Myriam Grégoire-Zawilski, OECD ; and Georgia Prountzou, IFRIS. Finally, we would like to acknowledge the contribution of Michael Graham who worked with all the authors to format and edit their conference papers and presentations to adhere to a common format.

**Contributors to this volume :**

**Fadzilah Binti Abdul Majid** — University Malaysia Sabah, Malaysia
**Eduardo da Motta e Albuquerque** — Centro de Desenvolvimento e Planejamento Regional, Universidade Federal de Minas Gerais (Cedeplar-UFMG), Brazil
**Jaime Alvarez** — National Council of Innovation for Development, Chile
**Leandro Alves Silva** — Centro de Desenvolvimento e Planejamento Regional, Universidade Federal de Minas Gerais (Cedeplar-UFMG), Brazil
**Rigas Arvanitis** — Centre Population et Développement (Ceped), Institut de recherche pour le développement (IRD), and French Institute Research, Innovation and Society (IFRIS), France
**María Balarin** — Group for the Analysis of Development (GRADE), Peru
**Danièle Barret** — Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), France
**Catherine Beaudry** — Department of Mathematics and Industrial Engineering, Polytechnique Montréal, and Centre interuniversitaire de recherche sur la science et la technologie (CIRST), Canada
**Michael Braun** — Vietnamese-German University, Vietnam
**Gustavo Britto** — Centro de Desenvolvimento e Planejamento Regional, Universidade Federal de Minas Gerais (Cedeplar-UFMG), Brazil
**Annadel Cabanban** — University of the Philippines Diliman, Philippines
**Claudio Carvalho** — Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Brazil
**Sachin Chaturvedi** — Research and Information System for Developing Countries (RIS), India
**Diego Chavarro** — Science Policy Research Unit (SPRU), Univ. of Sussex, UK

# Préface

Jean Lebel[(1)], Jean-Paul Moatti[(2)]

(1) President IDRC, Canada
(2) President-Directeur général IRD, France

Cet ouvrage recueille les travaux présentés lors d'un colloque organisé en commun par nos deux institutions, le CRDI et l'IRD et témoigne de la proximité de nos approches sur les questions et les actions que nous menons en matière de recherche et de soutien à la recherche dans les pays de la zone intertropicale et méditerranéenne. Nos organisations se sont trouvées à plusieurs reprises dans les mêmes « pays en développement » –comme nous les appelions autrefois – pour accompagner et soutenir la recherche scientifique naissante, puis la consolidation des systèmes d'enseignement supérieur et de recherche de ces pays. Ainsi, nos deux institutions ont vécu cette transformation des systèmes de recherche des « pays des Suds » qui est l'objet de ce colloque.

Nous avons vécu un changement profond de la notion de « recherche pour le développement » (RpD). En effet, après les indépendances, quand se forgeaient les premières institutions de la science nationale, la RpD désignait des formes d'assistance technique ainsi que des programmes essentiellement financés par les pays riches qui se déroulaient dans les pays pauvres. L'urgence du développement, les impératifs de la croissance, les besoins de l'agriculture et de l'industrialisation, la mise en place des systèmes de santé guidaient les priorités de la recherche. En d'autres termes, la recherche dans les pays « en développement » Sud était pensée comme un outil de développement socio-économique. Cependant, le renforcement du potentiel scientifique, comme cela était voulu dans l'après-guerre en Europe ou aux Etats-Unis, était moins évident : la recherche « fondamentale » (« basic » research) semblait être un luxe auquel les pays « en développement » ne pourraient avoir accès que de manière exceptionnelle.

Progressivement, l'appui à la formation d'organismes publics et d'universités de recherche, le renforcement des capacités scientifiques propres (« capacity building ») s'est imposé comme une des principales missions de la RpD. L'espoir était que les pays « aidés » produiraient leur propre capacité de recherche dans une logique de rattrapage, dans ce domaine comme dans les autres, du développement des pays riches. Les institutions internationales, les organisations spécialisées dans l'appui à la recherche dans les pays des Suds, les agences de financement de la recherche pour le

développement ont toutes mis en pratique leur propre interprétation du renforcement de capacité où les ressources humaines tenaient une place centrale. Il fallait contribuer à former les chercheurs, les enseignants, les fonctionnaires de l'Etat mais aussi les élèves et les étudiants. Il fallait atteindre une « masse critique » (terme issu de la physique nucléaire), combattre le phénomène de « fuite des cerveaux » (brain drain) des Suds vers le Nord, reconnu comme un obstacle majeur au progrès scientifique de ces pays dès le début des années 1960, et faire des choix dont la légitimité était toujours un sujet de débat et de dissensions politiques. Il a fallu se résoudre à reconnaître que les politiques pensées comme une aide bienveillante au développement recouvraient souvent des enjeux politiques et geo-stratégiques, correspondant aussi aux intérêts des pays du Nord.

Les crises des dettes en Amérique latine, en Afrique et en Asie, les programmes d'ajustement structurels, les crises sanitaires mondiales comme celle du SIDA, marquèrent la fin de cette perspective quelque peu paternaliste et irénique qui imprégnait les programmes d'aide au développement, y compris dans le champ de la recherche. Ces crises coïncidaient avec la fin de la bi-polarisation héritée de l'après-guerre entre les blocs occidental et soviétique, et l'éclatement du modèle centre-périphérie. Des nouveaux pays émergents et donc de nouvelles formes d'hégémonie apparaissaient dans ce contexte multipolaire. La recherche eut elle aussi à connaître une profonde et rapide transformation pour s'ajuster à ce nouveau contexte géopolitique. C'est aussi à ce moment qu'elle dut convaincre de la nécessité d'actions globales pour assurer un développement durable.

Ces crises profondes, le retrait de l'Etat et la faiblesse du financement national dédié à la recherche dans la plupart des pays des Suds avaient révélé, plus que jamais, que la recherche ne pouvait pas être installée comme le serait une technologie clé en main. Aucun transfert technique, aucune assistance économique et technique, aucune forme de renforcement des capacités imposée de l'extérieur, même avec les meilleures intentions, ne pourrait satisfaire les besoins de connaissance nécessaires au développement durable et aux innovations, technologiques mais aussi sociales, culturelles et institutionnelles qui peuvent le favoriser. L'Unesco fit faire des diagnostics sur les systèmes de recherche dans les pays intermédiaires pour appréhender la situation de la recherche à travers le monde plusieurs années après les crises de la dette. L'une des plus surprenantes conclusions de ce travail considérable est que la recherche nationale dans les pays du Sud est moins liée à la seule croissance démographique des enseignants et des chercheurs ou à l'abondance des financements qu'à une série de choix politiques : les Etats, quel que soit leur niveau économique de développement, soutiennent la recherche avant tout par choix politique, de manière volontariste. Tout se passe comme si ce choix politique découlait d'un pacte social passé entre les élites académiques en formation et le système politique.

Pour les pays des Suds qui ont effectué le choix de soutenir significativement la recherche scientifique, reste à trouver la bonne organisation, celle qui convient au pays, et de trouver les meilleurs moyens d'allier le besoin de financements et la collaboration scientifique internationale dans des partenariats équilibrés. De même, pour les pays du Nord, il s'agit de s'associer étroitement aux communautés scientifiques des

pays partenaires moins par philanthropie que pour répondre aux défis planétaires et pour réduire les différentes formes d'inégalités qui perdurent entre pays, car tous nos objets de recherche sont aujourd'hui mondiaux et que la recherche participe de la définition des relations internationales. Il s'agit alors de co-construire des programmes en partenariat, de participer à des co-financements, d'établir des objectifs partagés et équitables. Ainsi, la transformation des politiques de recherche est de ce fait très profonde dans ce contexte mondial complexe, où les financements privés deviennent de plus en plus importants, où les demandes de participation sociale directe des populations et des communautés au déroulement des travaux de recherche deviennent pressantes et tangibles et où la valeur de la science doit être réaffirmée par son enracinement social.

Ces questions ont été au centre des débats du colloque organisé en 2016 dans les locaux de l'OCDE. Les nombreux partenaires ont pu présenter des expériences issues de tous les continents. Les thématiques du colloque indiquent l'ampleur des débats en cours sur les nouvelles politiques de recherche et d'innovation, l'organisation et le financement de la recherche et le rôle des agences nationales et des divers acteurs dans le monde de la recherche ; sur le besoin de renforcer la recherche universitaire ; sur les moyens qu'il faut déployer pour assurer une plus large participation au sein de la recherche et satisfaire aux exigences de la science ouverte (open science) ainsi que les changements dans la collaboration scientifique internationale. Le colloque a aussi permis d'ouvrir à nouveau le débat sur la mesure de l'impact de la recherche, un débat lancé au début des années 90, auquel nos organisations sont systématiquement amenées à réfléchir.

Ces questions sont au cœur de la mise en œuvre des Objectifs du Développement Durable (ODD) adoptés en Septembre 2015 pour l'horizon 2030 par les Nations Unies comme cadre de référence de l'action multilatérale. Elles sont essentielles pour une contribution critique mais aussi directement utile, de la science à ces ODD. Plus spécifiquement pour ce qui est de nos deux organismes, elles sont au cœur des orientations définies dans le Plan Stratégique 2015-2010 du CRDI et le Plan d'Orientation Stratégique 2016-2030 de l'IRD. A la lecture de cet important ouvrage, nous sommes convaincus que nos partenaires seront heureux, comme nous, de partager ces débats avec un public plus large et de poursuivre ces réflexions à l'échelle globale.

# Foreword

Jean Lebel[(1)], Jean-Paul Moatti[(2)]

(1) President IDRC, Canada
(2) President-Directeur général IRD, France

This book is a collection of the work presented during a symposium organized by our two institutions, IDRC and IRD. Our collaboration reflects the proximity of our approaches to the issues and actions we address through research and support for research, in particular in tropical regions and the Mediterranean area. Our organizations have repeatedly found themselves in the same "developing countries" — as we once called them — accompanying emerging scientific researchers and supporting the higher education and research systems of these countries. Both of our institutions have seen first hand the transformation of the research systems in the "Southern countries," which was the subject of this symposium.

We have experienced a profound change in the notion of "research for development" (RfD). In fact, following independence, when the first national science institutions were being forged, RfD referred to forms of technical assistance and programs financed mainly by rich countries in poor countries. The urgency of development, the imperative of growth in agriculture and industry, and the establishment of health care systems guided research priorities. In other words, research in "developing" countries in the South was seen as a tool for socio-economic development. By contrast, strengthening the scientific potential — as pursued in the post-war period in Europe or the United States — was less apparent : "basic" research seemed to be a luxury, something that "developing" countries only had access to in exceptional cases.

Over time, providing support to public bodies and research universities, i.e., strengthening the system of scientific capacity, became a new mission of RfD. The hope was that the "assisted" countries would build their own research capacity— in this domain and in others — as a way of catching up with rich countries. International organizations, development cooperation agencies, and specialized agencies that fund research for development have all put into practice their own interpretation of capacity building with human resource development playing a central role. Work was necessary to help train researchers, teachers, government officials, and students. A "critical mass" (term derived from nuclear physics) had to be reached to fight the phenomenon of "brain drain" from the South to the North, which was a major obstacle to these countries'

scientific progress starting in the early 1960s, and to make choices whose legitimacy was still a subject of political debate and dissent. It had to be accepted that policies conceived as development-friendly often concerned political and geo-strategic issues, which also reflected the interests of the Northern countries.

Debt crises in Latin America, Africa and Asia, structural adjustment programs and global health crises, such as AIDS, all marked the end of this somewhat paternalistic and irenic perspective that permeated development aid programs, including in the field of research. These crises coincided with the end of the Cold War polarization between the Western and Soviet blocs, as well as the breakdown of the core-periphery model. New emerging countries and therefore new forms of hegemony appeared in this multi-polar context. The organization and conduct of research underwent a deep and rapid transformation in reaction and in response to this new geopolitical context. It was also at this moment that research began to demonstrate the necessity of global action to ensure sustainable development.

These profound changes, the withdrawal of the State, and the scarcity of national funding for research in most Southern countries had revealed, more than ever, that research could not be viewed as a turnkey technology. No technical transfer, no economic and technical assistance, no form of externally-imposed capacity building, even with the best of intentions, could satisfy the need for knowledge required nationally to produce the technological, social, cultural and institutional innovations to promote sustainable development.

Several years after the debt crisis, UNESCO led an ambitious study to assess the state of research systems in a number of low and middle-income countries. One of the most surprising conclusions of this considerable work is that the strength of national research systems in the South is determined by political choice more than it is by absolute numbers of teachers and researchers or available research funding : states, regardless of their economic level of development, can create a supportive environment for research. Such choices are shaped by a social pact between the academic elites and the political system.

The Southern countries that have made the choice to significantly support scientific research still struggle to find the right internal organization, one that suits the country, and externally, find the best ways to combine the need for funding and international scientific collaboration into balanced partnerships. For the Northern countries too, international collaboration has changed. Increasingly, for researchers it is a question of associating themselves closely with the scientific communities of their partner countries, not so much through philanthropy but through research addressing shared global challenges – as all of our research topics are now global, research collaboration contributes to the definition of international relations. To collaborate effectively, researchers have to overcome different forms of inequalities that persist between countries,. This involves co-building programs in partnership, participating in co-financing, and establishing shared objectives and fair partnerships. Thus, the transformation of research policies is very profound in this complex global context, where private funding is becoming increasingly important, where requests for the direct social participation of

populations and communities in research work are becoming more and more pressing and tangible, and where the value of science must be reaffirmed by its social roots.

These issues were at the centre of the debates during the symposium organized in 2016 in the offices of the OECD. We welcomed the opportunity for numerous partners from different institutional settings to share experiences from all continents. The themes of the symposium indicate the extent of ongoing debates on new research and innovation policies, the organization and funding of research and the role of national agencies and various actors in the research world ; on the need to strengthen university research ; on how to ensure broader participation in research and meet the requirements of open science, as well as changes in international scientific collaboration. The symposium also reopened the debate on measuring the impact of research, a debate launched in the early 90s that our organizations continue to follow closely.

These issues are at the heart of the implementation of the Sustainable Development Goals (SDGs) adopted by the United Nations in September 2015 and targeted for implementation by 2030 as a reference framework for multilateral action. They are essential for a critical, but also directly useful, contribution, from science to the SDGs. More specifically, for our two organizations, they are at the heart of the goals defined in IDRC's 2015–2020 Strategic Plan and IRD's 2016–2030 Strategic Orientation Plan. After reading this important book, we are convinced that our partners will be happy, as we are, to share these debates with a broader audience and to continue these reflections on a global scale.

# The Transformation of Research in the South : An introduction

David O'Brien[1] and Rigas Arvanitis [2]

(1) International Development Research Center (IDRC), Canada
(2) Centre Population et Développement,
Institut de recherche pour le développement (IRD)
and French Institute Research
Innovation and Society (IFRIS)
France

What indications are there of notable transformations in low and middle-income countries, how and why do research systems transform, what are the consequences ? The title of this book derives from a conference that invited academics, practitioners, and policy makers to share their insights and analysis on such questions, with an emphasis on the organizational and institutional changes that are shaping and supporting research in the South. Following decades of neglect, and in the aftermath of the 2008 financial crisis, government research policies and programs appeared to be charting new positive directions across Asia, Africa and Latin America. Given the important contribution of higher education and research to supporting knowledge-based growth and development, signals that governments were rethinking their support for research merited further attention.

Researchers rightfully celebrate the universality of the scientific enterprise. In our digital age, research outputs are increasingly borderless, and open science is facilitating international collaboration in new and beneficial ways. But public funding for public research does not trespass borders, except under exceptional circumstances. For far too long, government support for research production has been highly unequal across countries. The preface to the World Science Report 1993 by MGK Menon characterized this geographic divide as follows : "the distribution of scientific and technological capacity, and of its fruits, remains very uneven from region to region and from country to country. Over four fifths of research and development activities are concentrated in just a few industrialized countries. In 1990 expenditure on R&D as a percentage of the gross national product was 2.9% for the industrialized world as a whole, whilst many developing countries could barely manage one tenth of this level."

This global distribution of investment in research has been long running with cumulative effects. Science has flourished in Europe, North America and Japan, commented Menon, because its foundations were steadily nurtured since the Industrial Revolution. Prior to that investment, Menon remarked there were only "bursts of scientific activity without any consistent self-sustaining growth process." [1] At the time of his comments, a parallel could be drawn to the state of research in low and middle-income countries : bursts of creativity in the face of systemic challenges. "Islands of competence" was a similar characterization by the Brazilian sociologist Oliveira to underscore uneven capacity within national research systems. [2] The formation of scientific communities in the South was difficult to promote, particularly where research professions were not socially valued and recognized, and publicly supported by national governments. [3] Facing the constraints posed by underinvestment in the South, many researchers and graduate students left their countries of origin and migrated to high-income countries. For much of the 20th century, this migratory brain drain from the South was symptomatic of the cumulative impact of geographically skewed government investments and a general disinterest in supporting research systems. [4]

Signs of change in the South emerged early in the 21st century. The 'innovation agenda' became a pervasive public policy narrative that pinned future growth and development to the formation of a knowledge society and an endogenous capacity for science, technology and innovation. This new development consensus became common place in national development plans and regional pacts like the New Economic Partnership for Development in Africa. With varying emphasis, these roadmaps underlined the need for tertiary education, business innovation and public research capacity. [5] Such drivers for change broke the silence and inaction that had long characterized political discourse and budget allocations in many low and middle-income countries.

The 2008 financial crisis brought this transformative moment into global perspective. With tighter budgets, high-income countries' share of global government expenditure on R&D started to decline. This was not a case of collapsing research budgets in North America and Europe. On the contrary, in constant dollar terms high-income countries registered year over year increases in R&D expenditure. Rather their declining world share was due to proportionally higher investments from countries like Malaysia, Mexico, India, Brazil, China, Turkey, and other large middle-income countries. According to UNESCO data, in 2007, high-income countries accounted for 80% of global R&D investment but by 2013, this share dropped to under 70%. During this period, every other income grouping (upper middle, lower middle, low income, and least developed country groups) increased their share of world expenditure on research. The North-South divide was narrowing. [6]

1. UNESCO 1993, 2.
2. Oliveira 1985.
3. Many examples were examined by Gaillard, J., V.V. Krishna and R. Waast (éds.). 1997.
4. Van Noorden. R. 2012. Research by Weinberg (2010) concluded that of the most highly cited scientists from 1981 to 2003, one in eight of which were born in developing countries but subsequently, four of five had relocated to a high-income country to conduct their research.
5. Mouton, J. and Waast, R. 2009. The synthesis report with regional overviews of the 54 middle-income countries is available at `http://academic.sun.ac.za/crest/unesco/data/Synthesis\%20report.pdf`
6. UNESCO 2015, Table 1.1.

In the meantime, international research cooperation – at least as measured by co-authorship in articles – grew to unprecedented levels. [7] The emerging geographic patterns of co-authorship broke with past practices as we witnessed the formation of entirely new networks that went hand in hand with this new global distribution of research activity. Implicit in this changing pattern of scientific collaboration is the nature of participation and leadership of researchers from the South. The increase in South-South collaboration, for example, was driven by the strengthening of national scientific communities and their increased capacity to design and develop research programs. Increased domestic funding also played an important role in these regards. With more national governments establishing new funding agencies or reforming existing ones, this created opportunities for researchers to co-fund or finance their own research and collaborations.

Another transformative catalyst is the rise and significance of private foundations. These new actors are so numerous, their financial impact is so important that one could talk of the 'research for development' paradigm as supported by official development assistance being supplanted by global philanthropy. [8] The new coexistence of numerous philanthropic agencies working alongside or in partnership with public funding bodies to support research has transformed the post-war institutional framework. There is no easy characterization of how global philanthropy is transforming research in the South as there is no common approach such agencies adhere to. That said, global philanthropy has made a mark by funding numerous large-scale global research programs that link local and global research and national and international actors, and they have done so by introducing new ways of prioritizing research programs and selection processes, by expanding eligibility criteria for who participates in research, and how they support and communicate research programs. In this expanded and more diversified research landscape, accountability pressures and measuring research effectiveness or assessing impact is ever present. Methods and ways of demonstrating the value of science have become more complex, giving rise to numerous frameworks and sophisticated methods that have developed into a field of its own. [9]

To probe the potentially transformative nature of the institutional, organizational and financial changes beginning to emerge, we invited researchers, practitioners and policy makers to make sense of the changing research landscape in their countries and organizations. If substantive changes were occurring, what were the consequences in terms of building scientific capacity and the broader application of results from scientific research, and what were the emerging lessons for public policy and research management ?

7. Gaillard, J. 2010.

8. See, for example, Vessuri, H. 2017.

9. The topic of the value of science has been fiercely debated in many fora. See, for example, Science Europe's 2017 'Position Statement on a New Vision for More Meaningful Research Impact Assessment' (`https://www.scienceeurope.org/wp-content/uploads/2017/07/SE_PositionStatement_Impact.pdf`) which calls for a more diversified assessment of research outputs. Zenda Ofir, see chapter in this book, was involved in the development of IDRC's RQ+ framework, which is an assessment tool that explores the broader impacts of research, Lebel, J and R. McLean. 2018.

To encourage comparison across countries, we highlighted themes of particular interest to the foundational support, operational performance and assessment of research systems. The following serves as a high-level introduction to the five themes.

Developing Research Policy Frameworks – There is considerable interest and debate on how countries prioritize, organize, fund and evaluate their investments in research. Many important changes have emerged in recent years like opening research to new actors, increasing private funding, developing international collaborations, and modifying the way research is funded. These actions imply transformations in professional values, professional careers, management practices, international collaboration, mobility and exchange of information, and policy-making processes, all of which are commented on by the contributing authors. There is a need to understand these changes, how they came about, how they are formulated in strategy documents and specific policies, and points of departure from previous policy frameworks. Taken together, what significant policy transformations are emerging for research and for development strategies more broadly ? Increasingly, research and innovation are prominent features of national development agendas but their contributions have received little attention. The contributors in this section analyse national and supranational experiences in developing research policy frameworks, the design of new and reforming existing institutions, and evaluations of those policies.

**Strengthening Academic Research** – In most countries, public science is synonymous with university-based research. While many universities still struggle with delivering quality education, some countries are experimenting with new ways of strengthening their scientific capability. Incentives for researchers, national programs to establish research chairs or centres of excellence, prioritizing and funding research programs of national interest, mobilizing the international scientific diaspora, and supporting research infrastructure are some contemporary examples. Typically, such efforts favour natural and life sciences and raise questions about the balance and breadth of a country's science base, in particular when comparing these disciplines to the humanities and social sciences. The papers in this section examine government efforts to improve research management at universities, schemes that improve the skills and linking potential of faculty and students, survey findings on the perceptions of the next generation of researchers, and the influence of community-driven research in shaping research priorities.

**Expanding Public and Private Participation in Research** – Traditional distinctions are blurring between who generates and who utilizes research results. The scientific method is no longer the unique source of legitimate knowledge, as knowledge emerging from non-scientific groups or populations (also known as "indigenous" or local knowledge) is progressively gaining acceptance. By actively dismantling barriers to participation in science, public policy is redefining (explicitly or implicitly) the social contract between science and society. Public research institutions are being encouraged to work more closely with industry, or with societal / not for profit organizations to drive commercial and social innovation. Contested knowledge and new lines of research have been generated in the process, and further interactions with actors from both academic and non-academic backgrounds is becoming the rule rather

than the exception. Some policies encourage this expanded participation in science by designing 'open innovation' platforms that promote collaboration and accelerate problem solving in technical and social domains. The contributions to this section explore national agenda-setting and capacity strengthening initiatives to promote academic/non-academic collaboration, and tensions that can emerge.

**Assessing Research Performance and Impact** – Research performance and impact have until recently been measured and valued almost exclusively in terms of the knowledge production validated in the scholarly environment (peer reviewed publications, citations, journal impact factors and more). Many quantitative indicators do not accurately capture the significant qualities of research, such as the anticipated societal impacts to which research is expected to contribute. In the wider interaction between public and private actors, and between different constituencies, the "traditional" measures of research impact are increasingly being questioned by researchers themselves. Private and public research organizations, as well as funding agencies, are seeking to demonstrate the value of public investments, and need new assessment tools, both to validate their own strategies and to evaluate the effects of research on society. [10] The contributions in this section make a call for rethinking current methods and to suggest new frameworks. A bibliometric analysis comparing different databases, illustrates their biases as a tool for accounting for research evidence and steering future research. The papers proposing new methods for assessing research quality and impact make novel contributions to the pressing need to better understand the multiple pathways of research impact and its measurement.

**Transnational cooperation in research** – While numerous countries have long-standing interests in promoting international scientific cooperation, far fewer can point to sustained initiatives even though international mobility for training or research is known to be a major contributor to building research capacity. There is, however, a shift occurring, with middle-income countries playing a leading role in designing and funding international research cooperation. As the research capacity of these and other countries have strengthened (institutions, research groups, universities, and private or NGO R&D), governments and research institutions have utilized scientific cooperation agreements and policy tools to support their own strategic objectives. This has led to a proliferation of bilateral science-based programs with North American and European countries, as well as a range of new South-South and so-called triangular cooperation programs. Through these diverse partnership arrangements, countries seek to advance a range of interests including strengthening scientific expertise, acquiring technology, promoting diplomatic relations, and tackling shared challenges like pollution, water scarcity, climate change, biodiversity, or disease prevention and control. Contributing authors explore how domestic capacity can be strengthened through international collaboration, and the strategies and rationales for international collaboration. The topic of South-South collaboration is explored in the Asian and African contexts to examine government-led and researcher-led initiatives, their challenges and contributions.

10. An interesting academic endeavour on this topic is the work done by the Manchester Institute of Innovation Research on evidence on the effectiveness of research and innovation policy (`http://www.innovation-policy.org.uk/compendium` ).

**Organization** – The chapters in this book are shortened versions of longer conference papers and presentations. We introduced guidelines during the editing process so that we could include all the contributions in a reasonably sized manuscript. This imposed constraints on the authors that the editors take responsibility for. In general, we minimized theoretical and conceptual discussions and privileged empirical contexts and findings. As many contributions provided insights for future research, research management and public policy, we created space for the authors to draw out their observations and recommendations. Finally, we eliminated extensive bibliographies, opting instead for key reference and where available, references to related publications for the interested reader.

## References

Gaillard, J., V.V. Krishna and R. Waast (Eds.). 1997. *Scientific communities in the developing world*. New Delhi & London : Sage.

Lebel, J. and R. McLean. 2018. A better measure of research from the Global South. *Nature*, 559 (7712), 23-26. doi : 10.1038/d41586-018-05581-4

Mouton, J. and Waast, R. 2009. Comparative study on national research systems : Findings and lessons. In V. L. Meek, U. Teichler and M.-L. Kearney (Eds.), *Higher education, research and innovation : Changing dynamics*. Kassel : International Centre for Higher Education Research. 147-170. `http://horizon.documentation.ird.fr/exl-doc/pleins*textes/divers10-12/010049939.pdf`

Oliveira, J.B. Araujo. 1985. *Ilhas de competência. Carreiras científicas no Brasil*. Sao Paulo : Editora Brasiliense & CNPq.

UNESCO. 1993. *World Science Report* 1993. Paris : UNESCO.

UNESCO. 2015. *World Science Report : Toward 2030*. Paris : UNESCO.

Van Noorden, R. 2012. Global mobility : Science on the move. *Nature*, 490, 326–329. doi :10.1038/490326a.

Vessuri, H. 2017. From science as 'development assistance' to 'global philanthropy'. In D. Tyfield, R. *et al.* (Eds.), *The Routledge Handbook of the Political Economy of Science*. London : Routledge.

Weinberg, B. 2010. Developing science : Scientific performance and brain drains in the Developing World. *Journal of Development Economics*, 95 (1), 95-104.

# Research policy in Arab countries

## International cooperation, competitive calls, and career incentives

Rigas Arvanitis[(1)], Sari Hanafi[(2)]

(1) Centre Population et Développement
Institut de recherche pour le développement (IRD)
and French Institute Research Innovation and Society (IFRIS), France
(2) American University of Beirut, Lebanon

## 1 Context

Arab countries have underinvested in science and technology, and as a consequence have scientific communities and institutions that underperform in terms of scientific production and broader societal application. Against this historical backdrop, there have been recent reforms across the region in the creation of new research-funding agencies and how they fund research. This paper seeks to understand the scope of these policy changes, their causes, and consequences.

In recent years, Arab countries have modified their policy frameworks. From Morocco to Qatar, countries have identified national research priorities, with more or less dedication, and introduced some important changes in how public funding for research is allocated. An important driver of these changes has been the growing European influence in promoting scientific collaboration. In the development of funding various Arab-European funding schemes, Arab countries have had to prioritize scientific domains, and adopt new principles for how research is funded and conducted.

Whereas Arab research-funding agencies had relied on block funding to universities and public research organizations to support research, the newly created agencies introduced new processes. Instead of transfers to research institutions, a significant percentage of the new funding was targeted through open competitions, assessed by peer review, and meritorious proposals funded individual research grants led by identified researchers. The transparency of the process and the identification of researchers

and topics was a significant departure from prevailing practices and widely welcomed by researchers.

Within this general trend, there are distinctions between Maghreb and Mashreq countries, owing in part to the legacy of French and Anglo-American approaches to research governance.

## 2 Empirical Approach and Main Findings

This work draws on an investigation of the policy framework and research institutions in Qatar, Jordan, Lebanon, Egypt, Tunisia, and Morocco. This research was conducted in 2015 by a team of ten specialists in science-policy analysis, coordinated by the authors. It involved field visits, interviews, and desk-based research. The details from this work are situated in the broader trends across the Arab region published in a recent book by the authors entitled *Arab Research and Knowledge Society.*

To appreciate the significance of the recent changes in the Middle East and North Africa, it is important to establish the context. In the recent past, government agencies and researchers in most Arab countries have pleaded for substantial public investment in scientific research. Broadly speaking, the research community seeks recognition, longer term political commitment, support, and stability. Government arguments stress the need to transition toward a knowledge economy, where investments in science and technology provide some of the impetus. International support to governments in the region are largely supportive of these arguments. Where support for economic and social reforms occur, foreign donors have promoted ICT infrastructure and applied liberal and competitive institutional frameworks to economic institutions, including research programs. Although research is part of this knowledge economy, it is not at all certain that the new mandate will effectively benefit researchers in the region.

That said, the funding context in Arab countries is changing very quickly. One expression of this change is the emergence of new funding agencies and programs in recent years. With the exception of Lebanon that has had a permanent funding program since 1963 managed by the National Council for Scientific Research (CNRS), all other countries in our investigation have created new full-fledged public funding bodies supporting research. These organizations are the funding program of the Académie des Sciences Hassan II (Morocco), the Science and Technology Development Fund (STDF, in Egypt), the Scientific Research Support Fund (Jordan), and the research program of the Qatar Foundation. Paralleling these changes, several existing national agencies launched new funding programs. Prominent examples include the *Fond national de la recherche scientifique et du développement technologique (FNRSDT)* managed by the CNRST in Morocco, and the RDI fund managed by the Ministry for Higher Education and Research in Egypt.

These new agencies and programs were established in a context of relatively flat growth in gross expenditure on research and development (GERD), which is still the main source for research across Arab countries. GERD has been low for almost four decades ranging from a meagre 0.1% to a high of 1.2% of GDP across the region. By contrast, OECD countries devote about 2.2% of GDP to research and develop-

ment. There are signs of change, however. Egypt's GERD hovered around 0.2% before the Arab Spring when the government announced it had planned to raise it to 1% over 5 years. Although the revolution interrupted this investment, it seems that this new impetus supporting science and technology will be maintained. Tunisia has also increased investments in GERD since 2000. By 2007, it was the leading Arab state for research and development intensity, exceeding 1.0% of GDP. Qatar had figures of 0.33% of GDP, although apparently increasing (figures are unclear, published information is inconsistent, and sources diverge ; and our intent to obtain more precise data was inconclusive).

Interestingly, the apparent differences between the Maghreb (rather centralized) and Mashreq (rather decentralized) modes of organization, hide a profound similarity in terms of science policy being largely determined by the political decisions of central state authorities. Despite the market orientation of the Gulf countries compared to the Maghreb, we find the same authoritarian approach to policy development and a clear orientation toward more commercial application across the region. Where differences exist, they lie in the size of the research systems and their dynamism, a feature that depends on the accumulated capabilities in research and the historical trajectories of the institutions as well as the political willingness to support research, even in the absence of immediate economic benefits.

Another change to the research system is how Arab research-funding agencies support research. Past practices of block funding to research organizations and less than transparent tendering and selection processes are being replaced by open calls for proposals that are competitively selected. Closer collaboration with European countries through bilateral and multilateral cooperation agreements has been a driving force for this change. European countries and the European Union (EU) have established a network of contact points within the science ministries, research councils, and universities. Through negotiating joint funding programs, European agencies introduced new practices into the Arab research system. The EU framework programs, for example, encouraged researchers to form alliances and compete for funding. The scale of such programs and the principles they adhered to have had wide-ranging impacts on how Arab funding councils, research performing agencies, and Arab researchers now conduct and manage research grants.

As our historical analysis and interviews showed, this change would never have happened without the push from national researchers : the growth of the national academic population, its willingness to engage in serious research, and (in many cases) its active participation in international research programs regardless of public support, were the political basis of this very profound change. In other words, it would be unfair and false to attribute the changes to the sole policy interest of the EU. Rather, one could argue that the policy effort of the EU met a very attentive, open and willing academic population to engage in foreign collaborations in the Arab region.

Europe and the United States are the main partner regions for international research collaboration in the Arab region. Europe has shown increased commitment in recent years, and this is accompanied by a renewed emphasis in various domains such as environmental research, biotechnological research, biomedicine, and other less common

fields in the Arab region, which has privileged engineering and physical sciences. More recently, the Qatar Foundation has encouraged some bilateral research collaboration with neighbouring countries but, on the whole, overall national funding to research projects is usually limited to their nationals and activities within their country.

National-led efforts to understand and modify their national research systems overlapped with this period of increasing European influence. The Tunisian case is a noticeable example of introducing assessment methods to measure scientific performance and the impact of policy changes. Introduced in 1996, Tunisia started independently evaluating the production of research performing organizations, identifying research units inside the universities, and allocating funds based on performance indicators. This government-led change has had a profound positive impact on academic production in Tunisia over a short time. A fourfold increase of scholarly publications can be identified between 1998 and 2008, which is mirrored by a similar increase in the number of research units.

There is little evidence of bottom-up reforms, led by scientists or scientific communities. Where reforms have occurred, they have emerged from government initiatives. And the timing of such reforms does not seem to be caused by political upheavals or liberalization. Maghreb and Mashreq countries have been strengthening their scientific research and knowledge producing organizations by reforming their policy frameworks, including earmarked budgets dedicated to research (as opposed to the former situation where research was lumped together with teaching and other related activities).

## 3 Main messages for policy and practice

Universities, public research organizations, and sometimes even NGOs and public and private enterprises have participated in the growth of scientific activity across the Arab region. The diversifying institutional framework has been influenced through international scientific collaboration and domestic efforts to reform how government agencies organize and support R&D.

However, when science, technology and innovation policies are placed alongside other national priorities, pressure from researchers to invest in R&D has not shifted its overall prioritization in public funding. In the countries investigated, there is an emerging discourse on how research policy might support national development. This orientation has not produced uniform policy responses in these countries but there is widespread support from policy personnel who agree that research-funding levels are inadequate and should be increased. The urgent task of national development is a top-of-mind concern for governments, and research can be a driver of change : call it research for development, innovation, competitiveness, or the knowledge economy. Arguments for funding research, under various forms, are rarely contradicted (*if you think research is expensive, look at the cost of disease* were the words of a Secretary General of a research council we interviewed). Nevertheless, how this funding increase might be structured to support research-performing institutions is still very much under debate.

Over the last decade, there have been noticeable changes that have overhauled the organizational structure of research-funding agencies and how Arab researchers and their home organizations compete for, manage, and conduct research. Some countries in the region are adopting new assessment frameworks to understand the impacts of their reforms, but more concerted effort is required to fully understand the impact of these changes. With some exceptions like the Tunisian example, performance expectations for researchers have largely remained intact. Further work is needed to reorient career incentives, cultivate flourishing scientific communities, and engage researchers in mission-driven research to understand and potentially address issues raised by society, such as the demands given voice during the Arab uprisings.

## Related Resources

Arvanitis, Rigas, and Hatem M'henni. 2010. Monitoring Research and Innovation Policies in the Mediterranean Region. *Science Technology and Society*, 15(2), 233–269.

Hanafi, Sari, and Rigas Arvanitis. 2016. *Knowledge Production in the Arab World : The Impossible Promise*. Routledge, London.

# Science-granting councils in Sub-Saharan Africa

## A typology of diverse science funding configurations

Johann Mouton

Centre for Research on Evaluation Science and Technology
and DST-NRF Centre of Excellence in Scientometrics
and Science and Technology Policy
Stellenbosch University
South Africa

## 1 Context

Science granting councils (SGCs) (and agencies with equivalent missions such as national commissions for science and technology, national science councils and national academies of science) are essential actors in national systems of innovation. In well-defined and clearly articulated systems of innovation they perform a number of crucial functions that contribute to the effective and efficient functioning of such systems. Ideally, such councils act as fair and disinterested agents of government while, at the same time, representing the interests of the scientific community nationally, regionally and internationally. They are crucial 'intermediaries' in the flow of international funding and technical support to R&D-performing institutions in a country.

There is now a renewed realization by most role players in recognizing the importance of developing STI capacity in developing countries. [1] The creation of Science Granting Councils and Competitive Research Funds is of a rather recent origin in SSA. Over the past decade, however, we have seen an increase in either the establishment of dedicated science granting councils or agencies or promulgation of policies which stipulate that such agencies must be established in the foreseeable future. All of this points to a

1. See for example the African Union's *African Innovation Outlook* (2010) and the UN Rio+20 Report (United Nations 2012).

general and emerging consensus as to the necessity of having such councils as part of the national science system.

Despite the significance of these organizations and a growing body of scholarship about the nature, roles, functions and impacts of such bodies, few systematic studies of SGCs and related organizations in Africa have been done.

## 2 Empirical Approach and Main Findings

Against this background, the Centre for Research on Evaluation, Science and Technology at Stellenbosch University examined the strategic priorities, objectives and practices of SGCs in 17 sub-Saharan African countries. [2] SGCs are embedded in the science and innovation systems of their respective countries. In sub-Saharan Africa, the STI systems vary significantly with regard to socio-political histories, geography, political and economic (in)stability, colonial legacies and, most importantly (for this study), the degree of institutionalization of R&D (Gaillard & Waast 1988 ; Mouton 2008).

One of the first results of our study was to 'map' key milestones in S&T governance and policy development in each of the countries included in the study. Most African countries obtained their independence during the 1960s. But the establishment of a national ministry of science and technology (or equivalent ministry) would have to wait, in most cases, for another 20 years to materialize. In fact, in four countries (Namibia, Rwanda, Tanzania and Uganda) there is as yet no such dedicated ministry. In most of these cases, the S&T portfolio is located in a ministry of higher education. One country, Cameroon, does not have a science policy document. These facts may point to a lack of commitment to prioritize S&T matters in these countries. On the other hand, we also found evidence of a recent commitment to prioritizing S&T as illustrated by the fact that nine countries have revised their S&T policy documents since 2010.

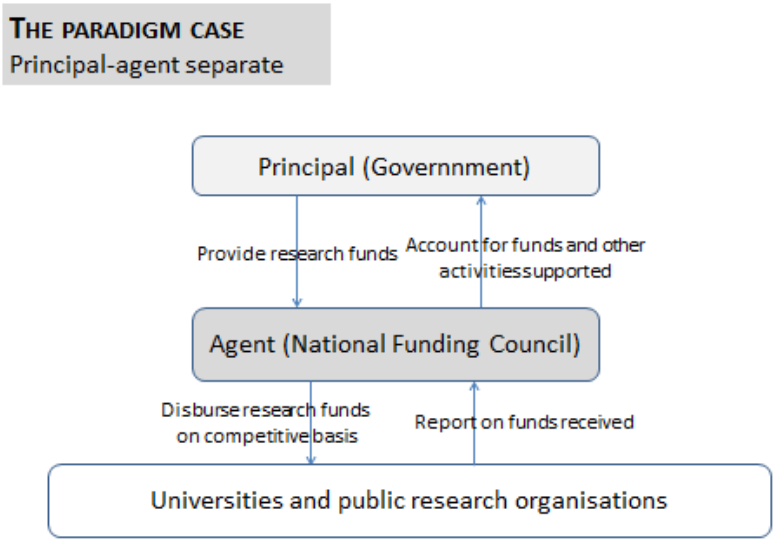
Another result of the study was applying the principal-agent framework to identify science and research funding configurations or models. The table in the Annex summarizes the high-level results of our analysis of national STI funding arrangements in the 17 countries of interest. Within this sample, we identified at least six different funding models, which are briefly summarized below.

**The paradigm principal-agent model** — The "paradigm" or "model" case of science funding is the simplest manifestation of the principal-agent principle. The government delegates its responsibility for science or research funding to an autonomous body (usually a national research or science foundation or council) that receives its funds directly from government and accounts for these funds on a regular basis. It derives its autonomy through a statutory act and the appointment of a separate board or council. This council establishes structures, policies, and procedures to ensure fair, transparent, and efficient disbursement of funds to public universities and research organizations. Foundations typically use different "funding instruments" (e.g., scho-

2. This study was funded by the International Development Research Centre in 2012.

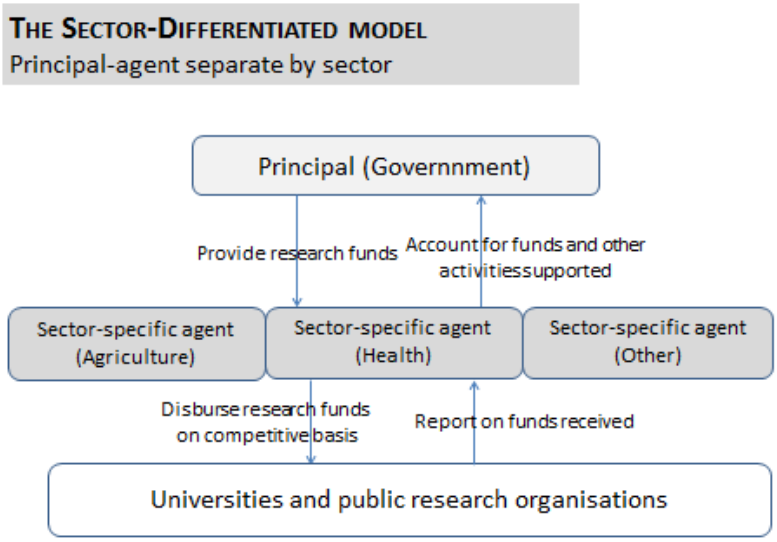
larships, bursaries, travel grants, grants for emerging and established scholars, and capacity-building grants).

The best example of the paradigm case is the *South African National Research Foundation.* Other countries with similar arrangements are Senegal, Côte d'Ivoire and Namibia where a science granting council under this model should be established in the very near future.




**The sector-differentiated model** — Many countries have sector-specific funding agencies, particularly in agriculture and health. In this case, governments have established different research funding councils or foundations for different sectors in the science system. With this configuration, the funding agencies report to the different "principals" within Government. This model often causes challenges around co-ordination in science funding in the science system.

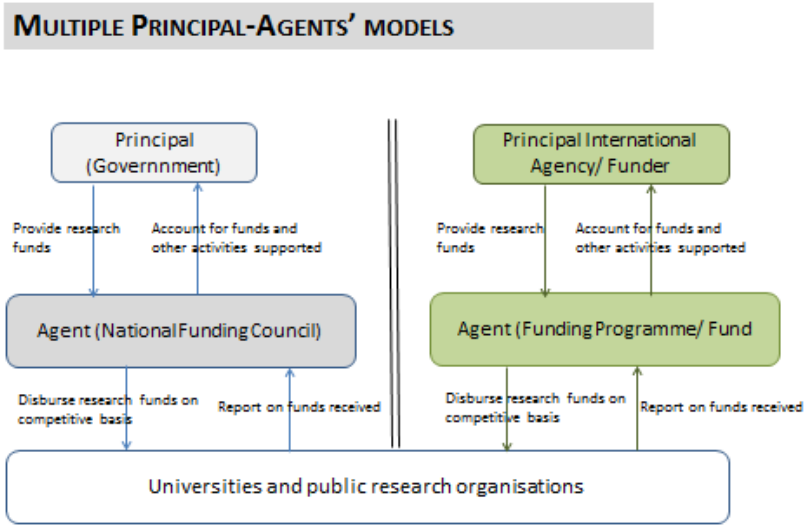
There are several examples of this sector-differentiated model in Africa. In the case of Burkina Faso, three funding agencies report directly to their respective ministries : FONRID reports to the Ministry of Scientific Research and Innovation ; FONER is responsible to the Ministry of Secondary and Higher Education ; while FARES reports to the Ministry of Health.



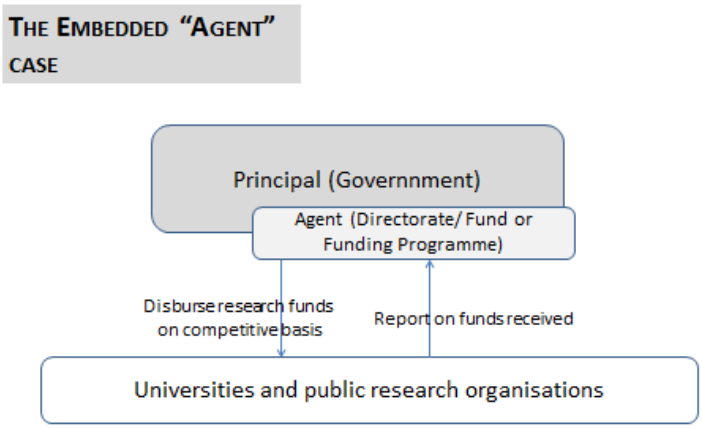

**Multiple principal-agents model** — A "popular" configuration of the paradigm case found in labelled the "multiple principal-agents" model. In addition to the funding that is channelled from government (via some council or fund) to the universities, there are also various other "principals" at work in the national science system. These are typically international funders, foundations and development agencies that all channel funds predominantly to universities and research institutes but also to NGOs in African countries.

In the representation below we emphasize that these two configurations are often found to co-exist (like "parallel universes") in the same system. We found that there is often very little or no co-ordination or interaction between these two funding channels. Such a situation obviously raises many questions : about priority setting, parallel lines of reporting and accounting, duplication, and so on.

There are a number of variations on the multiple principal agent's model. We distinguish two such variations. The most common variation is the *non-equivalent model* where there is relatively weak government and strong non-government funding. Within the *equivalent model*, there is greater equivalence or parity between the government and non-government funding models. In fact, in some cases governments (such as Côte d'Ivoire) actively collaborate with other governments (Switzerland) to manage the parallel fund. And finally, the "green" section in the "multiple principal agents model", can also be included in the embedded principal agent model to form a variant of the latter. This means that there is not only one, but two, additional variants of the "embedded principal-agents model" : the one described above as well as a "sector differentiated embedded agent model". This variant would refer to more than one ministry with an embedded research fund in each.




**The embedded principal-agent model**—- A different configuration of the Paradigm Case exists when the "agent" is not institutionally separate from the government (Ministry or Department of Science and Technology/ Higher Education). We labelled this the "embedded agent".



In cases such as these, it is typical that the "agent" is (1) either a sub-department or directorate within a Ministry or Department of S&T ; or (2) a Fund/ Funding Program that is administered by a department. It is evident that here the agent is an extension of government with no obvious autonomy or independence from the department in which it is located. One could argue that the agent, under this model, is not a proper "agent" (as suggested by the principal-agent framework) as it acts more as a commissioning agency than a disbursing agency.

Examples of the "embedded principal-agent" are found in Tanzania, Senegal, Ethiopia (the Local Research and Development Grant) and Mozambique (Fund for Poverty Research).

## 3 Main messages for policy and practice

The differentiated landscapes of research funding models found in this study are not only the result of different histories in science-policy development and different trajectories in the institutionalization of a science ministry in the respective countries, but also different science governance models. These governance models are related to the historical roots of these systems in the British and French models of science management.

A dedicated science funding council is largely a feature of the STI systems of countries in the Anglophone tradition (e.g. Kenya, South Africa, Uganda, Zambia and Zimbabwe). In the Francophone countries, such as Rwanda and Cameroon, there are no STI funding councils (although a project to establish a National Fund for Research and Innovation is currently being discussed in Cameroon). Burkina Faso, Côte d'Ivoire and Senegal, however, have dedicated funding agencies. In the case of Côte d'Ivoire and Senegal, funding systems promoting agricultural research have been recently established.

In many of the countries included in the study, the national landscape is characterized by a multitude of funding agencies, programs, and instruments often organized around sectoral interests (e.g., health and agriculture). In addition, these councils face a variety of challenges (e.g., resource constraints, governance issues, lack of clarity on institutional differentiation, lack of coordination within science systems, and marginalization of influence). There is little evidence of sharing of expertise and experience among SGCs — often within the same country, but definitely within regions and across the continent.

Within this environment, we found that SGCs in sub-Saharan Africa perform a wide range of functions : disbursement of research grants (various categories) ; disbursements of scholarships and loans (mostly masters and doctoral students) ; funding support for infrastructure development ; communication of results (dissemination and uptake of research reports and findings) ; supporting scientific publishing and scientific journals ; advocacy for STI ; collection of data and statistics on S&T and R&D ; capacity building and training of researchers ; policy advice ; setting research agendas and research priorities ; management of scientific collaborations and agreements ; and coordination of the national innovation system.

The relatively poor investment in R&D in many sub-Saharan Africa countries, which has a direct impact on the science funding models, points to different levels of commitment to science in different countries as well as to different values afforded to science. Some governments clearly recognize the value and importance of science, and therefore invest in science funding and the establishment of a national funding agency. However, many governments have not (at least until very recently) judged science to be of sufficient value and importance to invest in the establishment of a relatively autonomous agency to disburse state funds for R&D. The fact that there has been a surge of interest in reformulating existing science policies, and in the establishment of separate ministries of science, may be indicative of a change, even among those countries that have been slow to invest in R&D.

## Related Resources

African Union. 2010. *Africa Innovation Outlook 2010.* Tshwane : African Union.

Gaillard J & Waast R. 1988. La recherche scientifique en Afrique. *Afrique Contemporaine* 148 : 3-30.

Mouton J. 2008. Africa's science decline : The challenge of building scientific institutions. *Harvard International Review*, 30(3).

United Nations. 2012. *Report of the United Nations Conference on Sustainable Development.* New York : United Nations.

# 4 Annex 1 : Funding bodies in the 17 selected countries

| | Ministries / departments | Funding councils / intermediaries | Funds / funding instruments |
|---|---|---|---|
| | *l'Enseignement* – PASE) | | FARP) |
| | | | Fund for the Development of Cocoa and Coffee Sectors (FODECC) (Fonds de Développement des filières Cacao et Café) |
| | | | Competitive fund to reward researchers, including for Scientific Research and Innovation Excellence Week (JERSIC) (Journées de l'Excellence de la Recherche Scientifique et de l'Innovation au Cameroun) |
| | | | Fund to Support Research, the University Fund for Dissemination of Scientific and Technical Information (FUDIST) |
| **CAMEROON** *(Proposed)* | Ministry of Scientific Research and Innovation (MINRESI) | | National Fund for Research and Innovation (*Fonds National de la Recherche et de l'Innovatio*n – FNRI) |
| **CÔTE D'IVOIRE** | Ministry of Higher Education and Scientific Research | Strategic Support for Scientific Research Programme in Côte d'Ivoire (*Programme d'Appui Stratégique à la Recherche Scientifique* – PASRES) | |
| | Ministry of Agriculture | Interprofessional Fund for Agricultural Research and Council *(Fonds Interprofessional pour La Recherche et le Conseil Agricoles* – FIRCA) | |
| **CÔTE D'IVOIRE (Proposed)** | Ministry of Higher Education and Scientific Research | National Fund for Scientific and Technological Research *(Fonds National de la Recherche Scientifique et Technologique - FNRST)* | |
| **ETHIOPIA** *(Current)* | Ministry of Science and Technology (MoST) | | Local Research and Development Grant |
| **ETHIOPIA** *(Proposed)* | Ministry of Science, Technology and Innovation | National Science, Technology and Innovation Council (NSTIC) | |
| **GHANA** (Current) | Ministry of Environment, Science and Technology (MEST) | Council for Scientific and Industrial Research (CSIR) | Science and Technology Research Endowment Fund (STREFund) |

| | Ministries / departments | Funding councils / intermediaries | Funds / funding instruments |
|---|---|---|---|
| | Ministry of Education | | Ghana Education Trust Fund (GETFund) |
| **GHANA** *(Proposed)* | | National Research Funding Council (apex body) | |
| **KENYA** *(Current)* | Department of Science and Technology in the Ministry of Education, Science and Technology (MoHEST) | National Council for Science and Technology | Science, Technology and Innovation (STI) Fund |
| **KENYA** *(Proposed)* | Department of Science and Technology in the Ministry of Education, Science and Technology (MoHEST) | National Commission for Science, Technology and Innovation (NACOSTI) | National Research Fund (NRF) |
| | | | Kenya National Innovation Agency (KENIA) |
| **MOZAMBIQUE** *(Current)* | Ministry of Science and Technology (MCT) | | Fund for Poverty Research (*Fundo de Investigação sobre Pobreza* – FIP) |
| **MOZAMBIQUE** *(Proposed)* | Ministry of Science and Technology (MCT) | | National Research Fund (NRF) |
| **NAMIBIA** *(Current)* | Line ministries fund research, researchers and research institutes operating with the ministries | | |
| **NAMIBIA** *(Proposed)* | Ministry of Higher Education | National Commission for Research, Science and Technology (NCRST) | National Research Fund (NRF) |
| | | Council for Research and Innovation (CRI) | |
| **NIGERIA** *(Current)* | Research funding by the various ministries i.e. Federal Ministries of Health, Agriculture, and Environment | | |
| | | | Tertiary Education Trust Fund (TETFUND) |
| **NIGERIA** *(Proposed)* | Ministry of Science and Technology | | National Research and Innovation Fund (NRIF) |
| | | National Research and Innovation Council (NRIC) | |
| | | State Science, Technology and Innovation Council (SSTIC) | |
| | | National Council on Science, Technology and Innovation (NCSTI) | |
| | | | Education Trust Fund Research Fund (ETF) |

| | Ministries / departments | Funding councils / intermediaries | Funds / funding instruments |
|---|---|---|---|
| **RWANDA** *(Current)* | Directorate of Science, Technology and Research (DSTR) in the Ministry of Education (MINEDUC) directly funds research in the country | | |
| | Ministry of Education (MINEDUC) | | Rwanda Research Innovation Endowment Fund (RIEF) |
| **RWANDA** *(Proposed)* | Directorate of Science, Technology and Research (DSTR) in the Ministry of Education (MINEDUC) directly funds research in the country | National Commission for Science, Technology and Innovation | National Research Fund |
| **SENEGAL** *(Current)* | Ministry of Higher Education and Research | Fund to promote Scientific and Technical Research (*Fonds d'Impulsion de la Recherche Scientifique et Technique* – FIRST) | |
| | Ministry in charge of Agriculture | National Fund for Agriculture and Agrifood Research (*Fonds National de Recherches Agricoles et Agro-Alimentaires* – FNRAA) | |
| **SENEGAL** *(Proposed)* | Ministry of Higher Education and Research | National Fund for Research and Innovation (FNRI) | |
| **SOUTH AFRICA** | Department of Science and Technology (DST) | National Research Foundation | Various funding instruments |
| | | Technology Innovation Agency (TIA) | Four funding instruments |
| | Department of Health (DoH) | Medical Research Council (MRC) | Various funding instruments |
| | Department of Water and Environmental Affairs (DWEA) | Water Research Commission (WRC) | Two funding instruments |
| **TANZANIA** *(Current)* | Ministry of Communication, Science and Technology | Tanzania Commission for Science and Technology (COSTECH) | National Fund for the Advancement of Science and Technology (NFAST) |
| **TANZANIA** *(Proposed)* | | Tanzania Commission for Science and Technology (COSTECH) | National Research Fund (to replace NFAST) |
| **UGANDA** | Treasury | | Presidential Science Initiative (PSI) |
| | Ministry of Finance Planning and Economic Development (MoFPED) | Uganda National Council for Science and Technology (UNCST) | Science, Technology and Innovation Fund (STIF) |
| | | | National Innovation Fund (NIF) |
| **ZAMBIA** *(Current)* | Department of Science and Technology in the Ministry of Education, Science, Vocational Training and Early Education (MESVTEE) | National Science and Technology Council (NSTC) | Two funding instruments (Strategic Research Fund and Science and Technology Innovation Youth Fund) |
| | | National Technology Business Centre (NTBC) | National Technology Business Fund (NTBF) |

| | Ministries / departments | Funding councils / intermediaries | Funds / funding instruments |
|---|---|---|---|
| **ZAMBIA** *(Proposed)* | Department of Science and Technology in the Ministry of Education, Science, Vocational Training and Early Education (MESVTEE) | National Research Council (NRC) | None, as it will not be a funding agency |
| | | | National Research and Innovation Fund (NRIF) |
| | | National Technology Innovation Agency (NTIA) | Unknown |
| **ZIMBABWE** | Ministry of Higher & Tertiary Education, Science & Technology Development | Research Council of Zimbabwe (RCZ) | Two funding instruments (Small research grants for M&D students and large research grants open to all) |
| | | | Research and Development Commercialisation and Innovation Fund (RDCIF) |

# Production, circulation, and use of social research in Bolivia, Paraguay, and Peru

María Balarin[(1)], Ignacio González[(2)], Fernando Masi[(2)], Belén Servín[(2)], Natalia Peres[(3)], Miguel Vera[(3)]

(1) Group for the Analysis of Development (GRADE), Peru
(2) Centro de Análisis y Difusión de la Economía Paraguaya (CADEP), Paraguay
(3) ARU Foundation, Bolivia

## 1 Context

Social research can help promote public policies that are more transparent, democratic, and sustainable. In many developing countries, the importance of connecting research and policy is now a core element for development and the consolidation of democratic systems of governance. However, the common indicators used to assess research environments may not be suitable for developing contexts, where institutions tend to be weaker, patterns of social organization are less differentiated, and research production often operates in different ways. This study was designed to compare the social research environments and research-production dynamics of Bolivia, Paraguay, and Peru.

## 2 Empirical Approach and Main Findings

The case studies considered the following elements : factors structuring research production in each country (norms, policies, institutions, funding characteristics) ; the characteristics of the demand and supply of research (who are the producers and users of knowledge and what kinds of research they produce and demand) ; and the dynamics of research production, circulation, and use to which these factors give rise. In addition, the studies considered the impact of such dynamics on the nature of research agendas (fragmented or consolidated), and on the types (applied, academic) and quality of the research that is produced in these countries. Together with documentary analysis, interviews played a central role in developing the case studies. Policymakers, male and female researchers, heads of research departments in universities and research institutes, and members of the international cooperation community

and civil society organizations were interviewed (23 in Bolivia, 28 in Paraguay, and 19 in Peru).

**Social research in Bolivia, Paraguay, and Peru** — In Latin America, Peru, Bolivia, and Paraguay have low level of research production as measured by the number of publications. However, within these three countries, their output of social sciences research as a percentage of total research output is relatively high. The weakness of research output of many countries in the region can largely be traced to their low level of public investment in science and technology (S&T) as a percentage of GDP, which in LAC countries, averages about 0.8%. Bolivia, Paraguay, and Peru spend considerably less than this regional average. The low levels of public investment in S&T helps explain the weakness of research input into science policy. In addition, investment in social science research in particular is much lower, and often non-existent, in the official national budgets for R&D.

**Environment for social science research** — All three countries are characterized by a historical absence of public funding for research, and a lack of state presence in the development of policies for scientific and technological development. During the structural reform period of the 1990s, the social sciences in all three countries started to provide empirical support for the emerging technocracies. This gave rise to the creation of new research centres and think tanks, and to a shift in some universities to generating research evidence for policymaking. While this has led to a rise in the number of consultancies and evaluations aimed at providing information and data for decision makers, programmatic funding to develop long-term research agendas in the social sciences is still lacking. When comparing Peru and Paraguay during the second decade of the 21st century, there are important differences in the long-term aims and in the inclusion or exclusion of the social sciences from science and technology policies and public funding strategies. Whereas Peru excludes the social sciences from its national portfolio for research funding, Paraguay includes them, albeit at a small scale. In Bolivia, although recent science and technology policies share features similar to those in Peru and Paraguay, the policies do not include funding for the social sciences.

**The production of social knowledge** — The role played by universities in the production of social research is similar in the three countries. Historically, universities have been teaching-oriented, and by exerting their autonomy resisted efforts to alter the status quo. Lately there have been regulatory efforts in Peru to restructure and improve the quality of higher education and to stimulate research production in universities. Some private non-profit universities have made efforts to promote research to distinguish themselves from other universities and to consolidate their elite status. In Bolivia, there have not been comparable efforts to reorganize the higher education sector, which is characterized by an increased number of private universities (many of low quality) and the absence of public universities in development-policy discussions. Because of the weak role played by universities in the production of social research, independent research centres have been the main institutional sources of social science research in all three countries.

**Quality, circulation, and use of social research** — In Bolivia, despite the adverse research environment, knowledge production has improved. There are more documents, reports, studies, and evaluations, albeit with diverse quality standards. This can be attributed to the role played by international agencies to promote research production. In Peru, the lack of research policies, together with a marked increase in the demand for non-programmatic and consultancy-type research on the part of the state, has led researchers to focus mostly on producing knowledge "on demand" for decision-making. In Paraguay, private institutions have set the research agenda in the social sciences with some influence over the generation of public policies.

In all three countries, the research agenda is highly fragmented. In general, research agendas emerge from disperse funding opportunities, personal interests, and current economic, political, and social situations, steering researchers toward "academic consultancy" opportunities. Fragmentation results from the diverse needs of funding agencies and the lack of coordination to consolidate more autonomous research agendas, which are crucial to move research from a focus on specific problems to a focus on larger, structural processes and toward conceptual development.

The three countries differ in the processes of institutional development and the mechanisms that exist to promote (good quality) research in universities and research centres. In Peru, processes of institutional development, change, and consolidation have been pushed forward by the institutions themselves. In Bolivia and Paraguay, the sustainability of research centres still depends on the leadership of key figures. This may help explain why associative or second-tier institutions, which play an important role in Peru, have not emerged in these two countries.

Stronger institutional development in Peru has led some institutions to develop internal incentives for improving research quality that have enabled a comparatively greater professionalization of careers in social science research. In Paraguay and Bolivia, in contrast, research career paths are less professionalized, and the portrayal of a research career as a "personal calling" continues to dominate the public imagination.

The training of new researchers occurs outside rather than within research centres and does not constitute a clear career option for young university graduates in the social sciences. Another common element in the three countries is that the supply of social research stems mostly from research centres located in capital cities, and not from universities or institutions in the provinces. Researchers in all three countries describe their experiences as isolated or even solitary.

Beyond policies and regulations, the demand for research has a strong influence on the research environment in each country. In Bolivia, demand for research is almost non-existent, and the little demand that does exist comes mainly from the international donor community seeking consultancy products. In Paraguay, demand is quite diverse, and comes from the both the state and the international donor community, advocacy organizations, grassroots organizations, and, to some extent, businesses that rather atypically have public policy concern. In Paraguay, research centres have also played a key role in generating greater demand for research from the state and other

key institutions. In Peru, the main actors are the state and the international donor community.

## 3 Main messages for policy and practice

The case studies portray an image of the social sciences in Bolivia, Paraguay, and Peru as a "blind spot" in the development of science and technology policies, which, in turn, leads to the lack or scarcity of public funding for social research. In all three countries, this is accompanied by a vision of social research, especially on the part of the state, as being aimed at either the provision of information for decision-making or at ideas for specific political projects. In this context, the possibility of developing critical and relatively independent social science research, capable of identifying and elaborating on social issues, and not just answering top-down agendas dictated by the state or by international donors, is considerably weakened.

In all three countries, there is a lack of programmatic funding and of shared standards of quality that go beyond the specific and immediate relevance of social research. Public funding for independent social research, guided by quality criteria that do not focus exclusively on immediate relevance but rather on the contribution that research can make to theoretical or conceptual knowledge and to identifying and explaining social phenomena, is absent in all three countries.

A symptom of the current situation is the lack of discourse about why social science research is produced. This situation points to the urgent need to generate discussion and debate on the issue. It is important to emphasize the role that the social sciences can play in the identification and formulation of problems, and in the generation of critical ideas.

The study also raises questions about the relationship between research centres (or think tanks) and universities in the production of knowledge. If research centres emerged partly in response to the weak research orientation of universities, what happens now that some countries are trying to reorient universities toward research production while research centres are being pushed toward the production of applied, policy-relevant research ? What will be the gains and losses in this process ? Current institutional dynamics and capacities need to be considered in any reform process to capitalize on existing capacities for research.

The differences found in the three countries suggest the need to consider context when attempting to generate policy debates about these matters. The development of a set of common indicators capable of both measuring and promoting the development of more robust social research environments should take into account the interactions between the supply and demand of research, the identities of researchers as both academics and consultants, and the nature and quality of the knowledge that is produced.

# Evolution of science policy in South Africa

Michael Kahn
Centre for Research on Evaluation
Science and Technology. South Africa

## 1 Context

In the 21st century, science policy must itself innovate by changing the institutional landscape for research and innovation, and by setting priorities, framework conditions, and incentive regimes. An explicit or implicit contract between science and society characterizes the institutional landscape. International organizations such as UNESCO and OECD have also supported various initiatives to advance thinking on how the idea of a social contract for science has informed science-policy debates and approaches over the years. In addition, international declarations such as the Sussex Manifesto in the 1970s, the Bangalore Declaration in the late 1990s, and the Johannesburg Declaration in 2002 have helped focus international attention on the funding of scientific research and its associated S&T policy.

In the early 1990s, South Africa jettisoned the apartheid system. The key issue that confronted its researchers and policymakers was the future orientation, shape, and size of the inherited research and innovation system. In South Africa, before 1994, the science system was characterized by the separation of S&T into a highly fragmented system with very limited stakeholder representation. That system might be characterized as one in which "science walked on two legs" : one leg being that of own science, and the other leg being science for the apartheid state. Post-1994, South Africa looked to construct a new science policy that was both socially responsive and enabled international competitiveness. A white paper at that time served as the point of departure for subsequent policy development and analysis, and set out a bold agenda of change. It started with the premise that adoption of the innovation systems approach would serve the transformation agenda. Implementation of this white paper was slow, and some recommendations are still at an early stage 15 years later. The second major policy statement was the National R&D Strategy in 2002, which adopted a linear model, rather than the non-linear innovation systems approach. It argued for a set of new missions : poverty reduction ; a focus on knowledge-intensive new industries ;

advanced manufacturing ; leveraging resource-based industries ; and developing new knowledge-based industries. The third policy statement was a Ten-Year Plan for Innovation 2008–2018. This was more a vision than a plan, as it lacked detail, budget, and mechanisms for implementation. These ideas then fed into the National Development Plan. That plan stated that the best solution for science would be for the state to play an active role in both funding and guiding the type of research and development that the private and public sectors conducted ; however, it noted that the freedom of scientists to investigate and of entrepreneurs to innovate is critical. This position reveals a somewhat contradictory notion of the social contract.

## 2 Empirical Approach and Main Findings

The social contract is the glue that binds the components of the innovation system into a coherent whole. The nature of the social contract for science will be evident in the choices of policymakers and the voice of organized science. Documentary evidence and STI indicators suggest that the post-apartheid era social contract combined the freedom to pursue own science with a strong component of state-directed science, or big science. In this sense, science continues to march on two legs. To verify the above conjecture a structured interview schedule was developed and administered to 16 senior scientists who had a prior or present role in the formulation and implementation of science policy. Twelve had backgrounds in the natural sciences and engineering, and four in the social sciences and humanities. These questions were addressed : How would you characterize science policy pre-1994 ? Was there a social contract, implicit or explicit ? What were your expectations of science policy post-1994 ? What is the nature of contemporary science policy ; is there evidence of a social contract ? Who benefits/losses from current science policy and what are the reasons for such benefit/exclusion ? What changes might be needed in science policy ?

**Pre-1994 science policy and the social contract** — The strongest level of agreement concerns the nature of the pre-1994 social contract, with most respondents agreeing with the two legs characterization. A typical comment was that the social contract promoted research and innovation that supported the strategic goals of the apartheid government. However, two respondents rejected the qualifier “social” because they felt that this implied a non-existent commitment to the greater good.

**Post-1994** — Post-1994 expectations were uniformly optimistic. The new policies at the time set out to promote inclusion and to be open to all. They included inclusive decision-making, evidence-based decision-making, and coherence. There was wide expectation that all sectors would be mobilized and that this would lead to significant change in public research organizations as part of the stated agenda of science for development. A massive restructuring did not come to pass. Instead, selective reforms advanced the cause of competitive funding instruments and performance measurement. As well, there was a shift from open consultative policy debate, to one conducted within the confines of government departments. The interviews confirm the implicit post-1994 social contract with its two legs — continuity of own science and the onset of big science.

**Current nature of science policy and the social contract** — It was widely argued that the main beneficiaries of the new policy dispensation were academic researchers who enjoyed the support of the journal subsidy scheme, the National Research Foundation rating system, and the South African Research Chairs Initiative and the Centres of Excellence programs. Essentially those positioned to lobby successfully have benefited and were able to improve their own positions substantially. Current negative concerns include poor country performance on innovation scoreboards, the perceived absence of an inclusive innovation agenda, a generally dysfunctional education system (pockets of excellence notwithstanding), lack of coherence at the topmost level of government, and uncritical adoption of foreign science policy instruments.

There was a convergence of opinion on two items that need to change. The most promising way to strengthen the delivery and alignment of science policy would be the implementation of the National Development Plan built on a competent, capable state and improved social capital. The second need was for mechanisms to specify demand, to foster cooperation, and to promote policy learning.

## 3 Main messages for policy and practice

This study examined the working hypothesis that the idea of a contract between science and society is a useful tool for exploring the nature of science policy. The social contract in South Africa can be viewed as walking on two legs. In the apartheid era, the legs were own science and science for the apartheid state, while in the present these have become own science and state-driven big science, both of which centre on basic research. The intent to promote science for social development, what might be termed welfare science, has gained little traction.

The field research supports the claim that there was a dual agenda at work before 1994. Post-1994 was a period of good intent and lofty goals that in the mix of financial realities and competing interest groups saw the continuation, if not strengthening, of the own-science agenda, with big science gaining some prominence. What comes through from the research is that the construct of the social contract is a useful analytical device.

The question of the social benefit of science activity must also be addressed. It might be averred that addressing social deficit is hardly a matter for basic research. The provision of potable water, primary healthcare, acceptable education, and environmentally appropriate housing does not entail advanced science. Failure in these domains is largely political rather than arising from a poverty of technology. This negative view misses the crucial point that the science community has prospered and has continued to pay its social dues. For example, in its response to the HIV pandemic, where despite the active denialism of government, scientists somewhat quietly got on with the task of understanding the aetiology of the disease and seeking testable responses. A second example is the ongoing provision of sound advice from the science community to government on issues such as energy, environmental impact, and genetically modified organisms. These examples speak eloquently to socially responsive science. These activities have allowed the science system to maintain its world standing and

in certain fields, such as infectious disease and mathematics, to be above the world average.

In parallel, as part of its commitment to, and in recognition of its leadership role on the African continent, South Africa has seen its approach to science policy being exported, first into the Southern African Development Community, and then into the African Union *via* the New Partnership for Africa's Development. However South Africa's export to Africa is not science for development but rather big science. This big science mainly calls forth basic research, rather than use-oriented basic research or applied research. How and why this agenda will evolve presents many research questions, especially regarding the way that this export might reinforce local scientific elites.

# Instruments shaping policy design
## Sectoral Funds and Argentina Innovadora 2020

Ana Pereyra, Solange Martinez Demarco

Ministry of Science, Technology and Productive Innovation, Argentina

## 1 Context

Argentina's Ministry of Science, Technology and Productive Innovation (MINCYT) was created in December 2007. This produced transformations at the organizational, functional, and human resources levels, and affected the instruments for policy implementation. Among these instruments, two mechanisms stand out : the National Plan for Science, Technology, and Innovation (Argentina Innovadora 2020), which reflects the main policies and strategies in force since 2012 ; and the Sectoral Funds (SF), a financing instrument for public–private partnerships (PPP) beginning in 2011.

This study reviewed the interplay between these two policy instruments by utilizing the public policy instruments (PSPI) approach and the conceptual framework of national systems of innovation (NSI). There is often a gap between policy formulation and implementation. The classic argument holds that the gap is a result of two different processes characterized and governed by different logics, actors, and rules of the game. However, in this case, the coherence and consistency between policies and instruments is based on the mutual influence exerted on each other over the period 2007–2015.

## 2 Empirical Approach and Main Findings

This study adopted an exploratory, descriptive case-study strategy, and a qualitative methodology to analyse the creation, production, and evolution of the SF and Argentina Innovadora 2020. It was exploratory for two reasons : the lack of previous studies ; and the short timeframe since the implementation of both instruments. The questions guiding this study were : what are the sectoral funds and what is the National Plan

for STI ; how have both policy instruments developed ; why have they developed this way ; and how has the NSI affected their implementation (and to what extent) ?

This research analyzed primary and secondary qualitative data sources and triangulated the evidence to validate the main findings. In addition, three in-depth and semi-structured interviews were carried out with present and former authorities of the MINCYT and the Argentinean Sectoral Fund (FONARSEC) of the National Agency for Scientific and Technological Promotion (ANPCYT). They provided access to non-written information, tacit knowledge, values, attitudes, and ideologies. The PSPI and NIS approaches were employed to analyse the instruments in terms of their construction, embedded values, objectives, impacts, framing of the STI, and their interplay and effects on STI policy. The objective was to focus on how the SF and the National Plan for STI were developed and how they have affected each other.

The public policy instruments (PSPI) approach understands instruments as a set of coordinated rules that structure the behaviour of the actors. As such, they may reduce uncertainty, determine opportunities and constraints, reward certain actions and actors, and provide a stable frame of the issue. Instruments produce their own effects — they tend to both resist outside pressures and stimulate policy changes. This approach brings politics back into the study of public policy and proposes to complement classical analysis of policy implementation by concentrating on the instruments. Therefore, it was employed to study the development of both instruments, examining each of them independently and also addressing their interactions, which is a novel way to study STI policy. The National System of Innovation (NSI) framework embodies two main ideas : economic actors are rationally bounded agents that (inter)act in an uncertain atmosphere due to the lack of complete information ; and institutions such as R&D organizations and infrastructure, educational, financial, and legislative systems are extremely important as framework conditions for spurring innovation and, ultimately, economic growth and national competitiveness.

**Values, Objectives, and the National Innovation System** - The government's commitment to achieving sustainable development and social inclusion based on the contributions of STI was demonstrated by transforming the Secretary of Science, Technology, and Innovation into a Ministry. The mission of MINCYT is to guide national STI by formulating policies and plans that addressed the main social and sectoral problems to be solved and the requisite technological capabilities. The goal of the Ministry is to help generate a new production model guided by the knowledge society while improving the competitiveness of the Argentine economy. The selection of the new Minister was in line with these purposes. Lino Barañao was a well-known researcher with extensive experience in connecting the scientific and business sectors. To confirm his political commitment to enhancing innovation in selected productive areas and responding to social priorities, the Minister set as his objective to rebalance public funding from a more neutral to a more selective policy approach.

Since 1998, the NSI approach has been the conceptual background for a set of policy measures to develop the Argentine STI sector. It provided the justification for government intervention based on the assumption that knowledge, science, and technology are the tools to foster innovation and competitiveness. This approach stresses that

solid institutions, better coordination, and consultation with stakeholders are necessary to achieve either a critical mass or dynamic comparative advantages. This was the thinking that guided the design of the Sectoral Funds.

**Constructing the Structural Funds** - Structural Funds are a common instrument adopted in many Latin American countries to promote innovation. They have a thematic or sectoral focus and involve public and private actors who adopt ad-hoc consortia to implement high-tech projects. Argentina adopted the SF approach used elsewhere in Latin America, but with three important differences. The financial resources involved were based on World Bank and InterAmerican Development Bank loans instead of on the National Treasury ; they funded only experimental development, high-technology innovation, and pilot plants and demonstrative projects ; and all funding was allocated through the MINCYT-ANPCYT. This new policy instrument sought to generate new technologies and technological applications in the productive and social sectors. The approach was original in terms of its management because it was the first to be administered jointly by the government body formulating the policies (MINCYT) and the agency in charge of implementing the policies (ANPCYT-FONARSEC). The ministry was responsible for the political negotiation process that culminated with the technical specifications (theme, objectives, and expected outcomes and impacts) of the projects. In turn, ANPCYT through FONARSEC, generated the calls for projects, evaluated the proposals, and monitored and assessed their financial execution.

The complexity and novelty of the implementation of this instrument explain the time it took to produce the first calls for projects for the High-Technology Sectoral Funds (HTSF). Only in 2011 was the ANPCYT able to organize the first competitive processes. However, the bargaining process began as early as 2007-2008 because for both, the Argentine government and the banks, investing in the Sectoral Funds was considered a high-risk activity. This apprehension was a product of the amount of money devoted to each project (USD 5–10 million), the lack of previous examples of successful PPP to assess risk and reward, and the absence of evidence demonstrating that the selected technologies and sectors could impact on productivity and competitiveness of the country.

**Dynamics between the National Plan for STI and SF** - The asynchronous deployment of the National Plan for STI and the SF illustrates the capacity of SF to influence politics and to design policies. The SF has contributed to many of the distinctive features of the National Plan for STI — focus, public–private cooperation, civil society consultation — as well as to the management devices used to produce the policies present in that plan.

The PSPI approach enabled us to understand that as institutions, these instruments provide an understanding of how to develop the Argentine STI sector while reducing uncertainty and providing incentives for new actors. Furthermore, as these instruments have structured the behaviour of the actors, they have presented new demands that resulted in the implementation of new policies and policy instruments.

## 3 Main messages for policy and practice

The approach adopted in this study facilitated our understanding of a series of important issues. The adoption of a foreign and highly selective STI instrument was adapted to the local context, needs, and resources. It took about 3 years from the first conversation between the officials of the ministry and the banks to negotiate, agree upon the implementation procedures, and implement the first call for proposals. The bargaining processes expanded beyond the boundaries of the traditional STI actors and included representatives from other state institutions. The implementation of the SF required a high level of technical and political articulation and coordination between actors. The operation of this type of public–private partnership instrument has created new management tools and institutions (Sectorial Technology Councils and FONARSEC). These organizational innovations fulfilled the need for functional specialization to ensure its successful implementation. This institutional learning led to the acquisition of new skills and the use of a high-level expertise to identify priorities and issues worthy of consideration by these funds.

The ministry adopted a participatory model of policymaking to generate consensus. This bottom-up process of policy and strategy formulation was deliberately implemented to promote partnerships between the private sector and traditional STI actors. Although the consultative methodology adopted for setting the policy agenda may appear to be at odds with the narrow focus of the financing instrument, the result was positive. The opening up of the process of formulating the National Plan and the SF programming phase identified opportunities for collaboration and coordination that enhanced the performance of the SF and to the development of a highly articulated NSI.

It is important to highlight the effects of public–private cooperation. The core idea of the SF was to promote knowledge and technology co-production in line with the consolidation of the NSI. The SF gave voice to a dormant actor in the STI sector — the private sector, which was empowered through its interaction with the S&T actors to formulate and design policies and projects. Once part of the policy formulation process, the private sector influenced the direction of important STI policies. Moreover, the staff of the Ministry, the ANPCYT, and the banks adapted their behaviour. When faced with unprecedented challenges, these actors demonstrated flexibility and openness to negotiate and coordinate their heterogeneous interests, logic, and operational objectives.

## Related Resources

Del Bello, Juan Carlos. 2014. Argentina : experiencias de transformación de la institucionalidad pública de apoyo a la innovación y al desarrollo tecnológico. In *Nuevas instituciones para la innovacion : practicas y experiencias en América Latina*, pages 35–83. Rivas, Gonzalo and Rovira, Sebastián (Eds). Santiago de Chile : Naciones Unidas.

MINCYT (Ministry of Science, Technology and Productive Innovation). *Argentina Innovadora 2020. Plan Nacional de Ciencia, Tecnología e Innovación. Lineamientos Estratégicos 2012–2015*. Buenos Aires : MINCYT.

MINCYT. 2013. *Argentina Innovadora 2020. Plan Nacional de Ciencia, Tecnología e Innovación. Síntesis ejecutiva*. Buenos Aires : MINCYT.

# Developing and implementing a research and innovation policy framework in Vietnam

Nguyen Thi Thu Oanh[(1)], Michael Braun[(2)]

(1) Fostering Innovation through Research, Science and Technology (FIRST) Project
Ministry of Science and Technology of Vietnam
(2) Vietnamese-German University, Vietnam

## 1 Context

The status and challenges facing Vietnam's National System of Innovation (NSI) and its Research and Innovation Policy Framework (RIPF) are in many ways typical of economies in transition. Science and Technology (S&T) capabilities were almost non-existent when the Vietnam war ended in 1975 but increased steadily thereafter with government support. However, recent indicators show that despite progress made the country still lacks the advanced S&T skills and technologies necessary to develop a modern technology-intensive economy.

Vietnam's government recognized the importance of S&T soon after the country became independent by prioritizing higher education, research and innovation. Over a period of four decades, Vietnam's NSI emerged stepwise, starting with efforts to develop basic S&T capacities that were urgently needed for the transition from a rural to an industrial society. In parallel, first legal and administrative regulations were formulated, which are the foundations of today's RIPF.

Meeting the challenges of the global and networked economy requires a system-oriented approach. Future success requires better interaction between S&T stakeholders who must work together in seamless innovation chains. Research produces new knowledge and technologies that are successfully applied and commercialized by their users, especially enterprises. To initiate and enable this development, Vietnam must now initiate the next step in the development of its NSI and RIPF.

## 2 Empirical Approach and Main Findings

To fully appreciate Vietnam's development and to also derive lessons for other countries in transition, it is important to understand the evolution from its post-war beginnings with almost no S&T resources to its current status as a lower-middle-income country with an emerging NSI. Understanding this development provides valuable insights into the strengths, weaknesses, opportunities, and challenges that Vietnam faces today, and provides valuable "lessons learned" and possible development pathways for other emerging countries.

The development of Vietnam's RIPF can be described in four development phases.

**Phase 1 : Building basic research competencies and capacities (1945–1986)** — The initial focus until 1964 was training scientists and engineers and constructing universities and research institutes. By 1965, the Government established 23 universities and 16 research institutes, including 6 social sciences research institutes. In the decade that followed, S&T goals shifted toward promoting scientific and technological development to increase labour productivity and food production, develop and maintain transportation, local industrial capacities, and a health system.

When war ended in 1975, social and economic reconstruction was the priority and S&T activities supported the development of industry, agriculture, forestry, fishery, construction and transport sectors. Under the centralized economy, the state had the exclusive right to organize S&T activities, and a division of labour emerged : research organizations performed scientific research activities, and universities and colleges provided the training.

**Phase 2 : Integrated NSI and support for socioeconomic development (1987–1995)** — A profound rethinking of the government's centralized S&T management started with the beginning of economic reforms ("Đôi mới") in 1987. Decrees on foreign technology transfer (1988) ; on organizational and individual rights to enter into contracts or to cooperate in S&T activities (1992) ; on external grants in support of S&T (1994) ; and on the protection of copyright, industrial property rights, and a legal framework for technology transfer (1995) changed the organization and orientation of S&T and increased the autonomy of researchers. This period marked a shift toward market-based S&T management and its orientation to multi-sector socioeconomic development. The goal of S&T was to build strong competencies and capacities and to use these to contribute to the development of priority industrial sectors. During this period, the number of research institutions almost doubled from 170 in 1985 to 334 in 1995. In 1992, a decree on the management of S&T prescribed that at least 2% of the state budget should be set aside for S&T.

**Phase 3 : Reform of state management of S&T, and capacity building for policymaking (1997–2010)** — In 1997–2000, the government framed S&T as the foundation and driving force for industrialization and modernization of the country. S&T policies sought to encourage investment and to strengthen the links between research and its application. To accelerate these efforts, international S&T cooperation was expanded. Research institutes were given greater autonomy to pursue international and domestic linkages. Government policy and funding increased the number

of S&T institutions. During this expansion, two weaknesses became evident : the absence of a framework for coordination and limited transparency and accountability of S&T investments.

In response, the government formulated a law on science and technology and launched its first 10-year S&T strategy. These developments served as an umbrella for complementary detailed regulations on issues such as intellectual property and technology transfer. During this phase, there was a move toward open policy dialogue and debate that aimed to involve stakeholders in a participatory policymaking process approach.

**Phase 4 : Toward comprehensive NSI and RIPF and integration into global S&T (2011–present)** — The second ten year S&T strategy (2011–2020) sets ambitious objectives. Vietnam aspires to fully develop natural sciences and engineering, as well as social sciences and humanities, to become the key driving forces for modernization and growth. The objective is that by 2020, S&T in Vietnam will reach an advanced level in key areas, comparable with other ASEAN countries. Policymakers realize that this will require a dedicated effort that combines an accelerated development of research, enhanced transfer of new knowledge and technologies from research, and improvements in the technological level and innovation skills of enterprises.

Policymakers now seek to complement the initial focus on building research performance by enhancing technology transfer and commercialization. High priority is being given to developing the capabilities of enterprises to absorb and apply new scientific knowledge and technologies. S&T collaboration with partner countries is now gradually shifting from a traditional research-project orientation to longer-term integrated joint programs that seek to promote innovation in priority areas.

## 3 Main messages for policy and practice

This review of Vietnam's efforts to develop its RIPF and NSI shows that further progress and reforms are required. Immediate action in priority fields must be complemented by longer-term reorientations of the current RIPF. These immediate actions must focus on the following areas.

**Improvement of research performance and restructuring of the research system** — A major shortcoming of the current research system is low research output, not only compared with high-income countries, but also with other Asian countries. Improvement measures include increased R&D financing and investment in improving the qualifications of researchers and the human resource base for S&T. But this alone is not enough. S&T policymakers can influence research performance and output in three ways : by providing performance incentives to research organizations ; by increasing transparency about research performance and results ; and by restructuring the research landscape. Addressing structural challenges is a major area for policy action, and this mainly relates to overcoming fragmentation. Vietnam has a high number of S&T institutions and staff but research output is low.

**Science–industry collaboration, technology transfer, spillovers, and the role of foreign enterprises** — Recent high GDP growth rates suggest that Vietnam has a dynamic industrial sector. The government has enacted regulations on techno-

logy transfer within Vietnam, from foreign countries to Vietnam, and from Vietnam to other countries. At a first glance, this policy has been very successful. Vietnamese firms have attracted significant foreign direct investment leading to economic growth and job creation. However, this development has led to a dependency of Vietnam's manufacturing sector on foreign investors, and the hoped-for spillover to close the technology gap with indigenous enterprises is not evident. Domestic technology transfer is low in Vietnam, especially when compared with OECD countries. Many indigenous enterprises, especially small- and medium-size enterprises (SMEs), lack the technological level necessary to compete internationally and suffer from a lack of resources. Many still work with outdated equipment and have low productivity.

**Modernization of industry and enhanced technological capabilities of enterprises** — Following the liberalization of the economy, the number of enterprises in Vietnam has grown at an average annual rate of 28% since 2000. The number of private sector enterprises is growing fast, even if state-owned enterprises (SOEs) still account for a large part of the overall number of enterprises and of employment. But the capability of Vietnamese enterprises to absorb new scientific knowledge and technologies, to apply them efficiently, and to implement product, service, process, and other innovations is hampered by their low R&D spending, the absence of adequate S&T competencies and capacities, and the lack of commitment to S&T as a source of competitive advantage. The potential for a 'technology push' is also limited. Researchers have limited interactions with firms and further effort is needed to stimulate the promotion and transfer new knowledge and technologies.

**Human Resources for S&T** — Vietnam's authorities are fully aware of the key importance of higher education for the development of innovation capacities and for sustainable economic development. To remain competitive in global markets and to integrate into global supply chains, enterprises must be able to master technological change and integrate new technologies at an ever-faster pace. But despite reforms, Vietnam's higher education system is not graduating sufficient numbers of graduates with skill sets to meet current demand. Qualitative development has not always kept pace with the impressive quantitative growth of a number of universities and graduates. A number of plans, projects, and policies to reform the higher education system have been promulgated and implemented. Recent policy measures recognize that in addition to technical skills, technology management skills are important to improve the skills set of Vietnamese workers. Reforms to reduce the fragmentation of tertiary education seek to complement efforts to improve education quality.

**Reform of the S&T governance system to move toward evidence-based policymaking** — Development and technology cycles, global innovation and supply chains, and associated globalization trends are accelerating at a pace that place additional demands on Vietnam's efforts to strengthen its NSI. Vietnam must further improve its ability to react to these challenges by improving and streamlining the S&T governance framework, and by removing current bottlenecks in cross-agency coordination, decision-making, and transparency. Three areas require action : (1) reduce fragmentation of the governance system and improve coordination and collaboration between all authorities at the national and regional level that formulate and implement

S&T policies; (2) introduce performance-oriented management that couple financing mechanisms with result-oriented research performance; (3) enhanced transparency of research activities and impact, and efficient use of research funds. S&T evaluations have supported progress along these lines but it is a relatively recent policy tool. Further work is needed to increase the number of experienced evaluators, build accurate performance data, stakeholder acceptance of evaluations, and use of evaluation results for better decision-making.

Beyond these short- to medium-term priorities, our findings suggest that Vietnam, as well as other developing countries, should reconsider the long-term orientation of its NSI. First, Vietnam needs a long-term strategic view of the country's competitive position in the global economy, what position in global value chains it can take, and how S&T can support this position. Most industrial production still takes place in sectors with high labour intensity and low value added, like the garment sector which compete on the basis of low wages. Production of technology-intensive goods is also growing fast, but it is typically limited to assembly of final products. Assembly work boosts employment in lower-skilled labour but it neither generates high margins nor does it contribute to building advanced technological capabilities. Changing this requires investment in S&T.

Second, development and implementation of this strategy must be inclusive. In a well-working NSI, all stakeholders, especially producers and users of new scientific knowledge and technologies must learn to work together from scientific discovery *via* technology development, to protection of intellectual property, and successful commercialization. The task of S&T policy is to stipulate and support this "moving closer together" and to provide the necessary framework conditions and incentives.

Overcoming current limitations and reaching this described next NIS level requires that Vietnam rethinks the traditional barriers between different policy domains. A well-working new generation NSI requires that S&T policy, innovation policy, educational policy, industrial policy, and other policy domains (e.g., environmental, energy, urban development, and traffic) learn to work hand in hand to pursue shared overall high-level objectives. Traditional silos must be replaced by a system-oriented approach.

# Strengthening innovation and development-research capacity in African universities

## The case of AfricaLics

Ann Kingiri[(1)], Rebecca Hanlin[(1)], Margrethe Holm Andersen[(2)], Aschalew Tigabu[(1)]

(1) AfricaLics Secretariat, Africa Centre for Technology Studies, Kenya
(2) Globelics Secretariat, Aalborg University, Denmark

### 1 Context

Innovation is increasingly recognized as a catalyst for economic and social development in Africa. Universities are key actors both to promote innovation, creativity, and entrepreneurship through the curricula, and to promote innovation through research and development (e.g., spinoff companies). This approach is often framed within the context of university–industry links and entrepreneurial universities. Universities can also promote innovation more broadly and for the specific benefit of society. Universities in Africa often struggle to develop viable spinoffs, sustained industry partnerships, or train graduates effectively so that they are employable. Many universities in Africa still face major deficiencies in infrastructure, increasing class sizes, and the loss of their best academic staff to other countries attracted by higher salaries and research funding.

Discussions about Africa's development tend to focus on the role of innovation and how it can accelerate development to reduce poverty and increase job creation. There is also increasing recognition that innovation, particularly in the African context, is not only the domain of universities but often of existing firms. Just as in developed countries, innovation in developing countries is determined by the interactions and capabilities of public and private actors and formal and informal institutions and is a

powerful driver of economic growth. Of course, the role of universities in producing higher labour productivity cannot be underestimated. In addition to developing human capital (skilled workers), universities are expected to undertake research and play a role in research exploitation or commercialization (entrepreneurial universities).

So-called *developmental universities*carry out training and research activities in response not only to the demands of local industries but also to the needs of marginalized and less-empowered sections of society. They recognize the need to generate new and relevant knowledge and innovations that respond to local needs but also the need to build the capability of communities to absorb this new knowledge. African universities are increasingly asked to play generative and developmental roles to ensure economic development. However in most cases, university–government–industry links are absent or highly fragmented. Furthermore, despite numerous efforts to improve the contribution of Africa's education systems to meaningful economic development, there are multiple challenges that remain to be tackled.

The focus of much training is misaligned with the needs of employers and society. Despite several efforts to build research capacity within universities in Africa, there are still insufficient efforts focused on : building a wider research culture beyond science, technology, engineering, and mathematics (STEM) ; increasing the number of employable graduates ; and focusing attention on the wider developmental role of universities through enabling graduates to become better critical thinkers and innovators.

**The AfricaLics project : building research capacity on innovation in Africa** — The African Network for Economics, Learning and Competence Building (AfricaLics) was set up in 2012 to increase training in a neglected area of research in social science, specifically innovation studies. This project tackles some of the wider capacity-building issues that dominate debates about the role of universities in development and how capacity building of universities should take place. The project provides training for PhD students and PhD supervisors, and supports a visiting fellows program. It promotes high-quality research and networking through conference opportunities, small collaborative research grants, and online forums, and new curricula development in the area of innovation and development. AfricaLics is based on two key elements — it adopts a low-cost approach and focuses on the analysis of innovation activities.

## 2 Empirical Approach and Main Findings

This study is based on an internal review of project documents. This was supplemented by a survey of 15 key AfricaLics network members at various stages of their career (PhD students, junior researchers, and more established researchers). The survey asked six qualitative questions to assessment the impact that their participation in the AfricaLics network on their own capacity development and on their ability to influence policy.

An initial baseline survey of the STI research community in Africa highlighted a number of surprising facts about the state of research and training in the area of STI

in Africa. This survey found that despite encouraging trends, the field of innovation and development has not sufficiently established itself in African institutions. Very little research and teaching are being done specifically in the area of innovation studies or on the links between innovation and development. The study found there were very few PhD holders or lecturers in innovation studies, few programs were being taught, and few dedicated research grants were available.

**Achievements** — Since 2013, AfricaLics has provided : short-term research training to nearly 80 PhD students studying ; support to 11 PhD students through a visiting fellow's scheme ; training and exchange workshops for over 40 PhD supervisors working ; help to expand curricula in the area of innovation and development ; and seed funding for collaborative research activities across universities and countries in neglected areas of innovation and development research. Reports on individual activities show that there is generally a high level of satisfaction with the opportunities provided through the network.

Survey respondents were asked about the knowledge they had acquired in the area of innovation and development from their participation in AfricaLics. All respondents reported that the knowledge they had acquired increased their research and research-reporting capabilities, such as writing skills. On average, respondents had published two articles each in the area of innovation and development as a result of AfricaLics activities over the last three years. Virtually all (93%) respondents reported that their participation in AfricaLics activities built their international research networks, particularly, but not exclusively, the Global Network for Economics of Learning, Innovation, and Competence Building Systems (Globelics). All respondents reported they had played some role in raising awareness of innovation and development at their host institution. These roles included : efforts to establish postgraduate training in innovation and development ; paper presentations in seminar series on innovation issues ; lectures and informal chats to students and staff on innovation and development ; and publicizing AfricaLics and Globelics activities. The respondents have facilitated co-supervision of PhD and Masters theses and launched multidisciplinary research projects. In addition, 40% the survey participants indicated that their experiences with AfricaLics research capacity-building events had helped them change the direction of research within their university. Nearly half (47%) of respondents also reported that the knowledge they had gained from AfricaLics had influenced knowledge flow from their institution to society and industry by linking university agencies to farmers and small-scale businesses, engaging with community-based organizations, and providing consultancy services.

These observations are generally consistent with the results of an external evaluation of Globelics and AfricaLics activities commissioned by the Globelics Secretariat. This external evaluation reported that the AfricaLics network had promoted understanding of innovation and learning in the context of Africa fairly well. A similar level of achievement was reported in the case of capacity building in terms of research related to innovation and learning. Overall, respondents were confident that they could make a long-term impact over time, especially through teaching and research.

## 3 Main messages for policy and practice

AfricaLics's activities show signs of what appears to work and what can be scaled up or considered elsewhere. Notably, the experiences of AfricaLics highlight the contribution of shorter-term PhD and Masters training activities to building both individual and institutional capacity. Overall, four key lessons that appear to demonstrate success.

**You do not have to focus on traditional full PhD and Masters training activities to add value.** AfricaLics Phase 1 did not provide sponsorship for full PhD or Masters level training. Instead, it focused on augmenting the skills and opportunities for students by providing additional support that was lacking in the students' home universities. This was done in collaboration with home universities, and individual discussions between students and supervisors were necessary to ensure support was targeted where it was needed most. The result was the ability to target a wider number of students, focus on competence building at both the individual and institutional level, and build stronger networks across institutions through increased opportunities for collaboration.

Emphasizing institutional capacity building and buy-in is a key to successful individual capacity building. The AfricaLics project activities highlighted the importance of building institutional-level capacity within individual universities. It also acknowledged the importance of networks of partnerships among universities in Africa and between the North and South. Buy-in from senior academic and institutional support was needed, and involvement of active research staff accounted for the program's contribution to individual capacity building.

Over the first 3 years, the focus has been on working to build one-to-one relationships with senior administration members of partner universities, and a set of PhD supervisors from different universities across the continent. These relationships worked to strengthen the emphasis placed on innovation and development training within institutions, and to add an interdisciplinary perspective to provide a broader, more appropriate lens for studying innovation and development issues in the context of individual African countries.

**Strengthening networks of researchers across universities and countries is essential**. Networking is an essential requirement for successful capacity building partnerships within and across universities. The AfricaLics project activities highlighted the importance of networking activities that enabled researchers to interact informally through both spontaneous and more channelled networking activities. The pressures of teaching and the lack of resources to enable African researchers to attend international conferences often limit their ability to interact with other researchers. AfricaLics provided researchers of all ages and stages of their career, networking opportunities. Some of this research-grant activity generated new networks of researchers. In other cases, informal networks of researchers were created, often across countries and career stages, that led to new research projects and co-authored publications.

**The importance of building an African innovation and development research community** – AfricaLics built research capacity that was focused first on Africa, and second on innovation and development. This was needed to redress the

balance between promoting innovation and entrepreneurship at the expense of analysing innovation activities and their contribution to economic and social development needs of African nations. AfricaLics is a Southern-driven research network but not at the exclusion of Northern partners. Ownership and the direction of activities have been through the AfricaLics scientific board — an advisory body made up of senior innovation and development scholars from or working in Africa.

**Southern intellectual leadership is needed to drive new thinking.** New theories, research methods, and indicators are needed to develop appropriate development strategies adapted to the changing situations in African countries and the changing interactions and increasing number of South–South partnerships. Building the capacity of researchers in these new emerging economies, and their trading partners in Africa, is essential for successful development and use of new analytical tools.

## 4 Concluding remarks : ensuring innovative activity leads to equitable economic and social development

A number of wider points can be drawn with regard to the relationship between innovation and development activities. Although strides have been made in many OECD countries, the innovation landscape in Africa is weak compared to other regions. This shortcoming is related to weak or missing institutional arrangements that foster innovation and learning activities, which necessitates scientific research on how to create and nurture such institutional and organizational systems. A further key element is to ensure that training and learning on innovation is related to development and social need. Most existing theoretical, as well as methodological, approaches commonly applied in African contexts were developed for application in OECD and other industrialized countries. These cannot be directly and uncritically applied in the African context.

New theories and methods suitable for African contexts can be developed and existing approaches can be adapted. But, this will only be possible if African researchers have opportunities to network among themselves and with researchers internationally. Researchers must also be able to access research grants and train the research leaders of tomorrow in critical thinking. These activities will enable much greater levels of analysis of innovation and development issues. Specifically, they will strengthen the opportunity for innovation and development research to not only ask : “how can innovation best take place ?” but to address questions such as “best for whom ?” and “why is innovative activity important for economic and social development ?”

## Related Resources

Adebowale, B. A., Diyamett, B., Lema, R., and Oyelaran-Oyeyinka, O. 2015. Innovation research and economic development in Africa. *African Journal of Science, Technology, Innovation and Development,* 6(5), v–xi. DOI :10.1080/20421338.2015.1010774

Adwera, A., Hanlin, R., and Johnson, H. 2013. Developmental education for innovation : lessons from an experience in Kenya. *International Journal of Technological Learning, Innovation and Development*, 6(3), 244. DOI :10.1504/IJTLID.2013.056311

Kraemer-Mbula, E. 2013. *Mapping Africa's research capacity in the field of innovation and development : Baseline report*. Nairobi : AfricaLics.

# How people's movements have influenced research priorities in India
## Illustrative case studies

Padma Prakash[1], Padma Deosthali[2], Sangeeta Rege[2]

(1) IRIS Knowledge Foundation, India
(2) Centre for Health and Allied Themes (CEHAT), India

## 1 Context

The systematization of social science research in India under the state began in the 1950s and 1960s, although high-quality noteworthy research had been conducted by independent scholars for many years. The earliest institutions were those set up by central ministries essentially with the objective of conducting research in areas relevant to the county's development. The Planning Commission (now disbanded) provided the first impetus to initiating research relevant to policy making. It produced a wealth of policy-relevant research, mostly in the field of economics and management, and essentially focused on deriving policy recommendations and rarely touched on larger issues or conceptual and methodological questions. A notable exception is the large body of globally recognized poverty studies over the decades.

The Indian Council of Social Science Research (ICSSR) was set up almost 20 years after independence. Even by 2007 of a total of 417 research institutions listed by ICSSR, there were no university, ICSSR or government-funded research institutions specializing in minorities and scheduled castes and tribes, women, health-related subjects, or history. The general perception has been that the quality of research in formal institutions had deteriorated, and that there is a general reluctance to conduct independent research on critical and sensitive issues. Health-services research and health-systems research have been conducted under the Indian Council for Medical Research, the premier body funding medical and health research. But these are a small number and

mostly in medical institutions. The ICMR's focus has been on medical research rather than health care in its broad definition.

The indirect fallout of the general neglect of such research in government-funded institutions, especially in some areas, has been a proliferation of privately funded social sciences research organizations. There has been no systematic assessment of the research undertaken by NGOs and independent institutions. This research is most often glibly regarded as being of poor quality, biased by the funder's requirements, or not sufficiently rigorous. And yet it is these institutions where research has focused on issues relevant to vulnerable groups and sensitive social issues. Two major research areas that have developed in this sector are health and women's issues.

**People's movements and research production** — Among the earliest movements that had an impact on law, governance, and research was in Kerala on the threat to fisherfolk livelihood due to increased use of mechanized trawlers. The movement, which began in the 1970s, later broadened to include impacts of the ocean environment and fish stocks. It then catalyzed a wide-ranging research program, in universities and among independent social scientists, on the impact of trawling, purse seining, and ocean pollution and on the economic and social organization of fisheries.

In parallel, over the years young professionals, who were disenchanted with their institutional settings and their lack of engagement with the people and their needs, have established outposts outside academia to conduct socially relevant research. This is perhaps the beginning of the emergence of the concept of "lokvidya" or people's knowledge that reinforces local knowledge traditions in technology, science, arts and crafts, and society and community. Less recognized is the fact that there has been considerable thought given to the methodological, philosophical, and epistemological issues within these movements. Unfortunately, in the Indian context, these discussions have mostly remained within closed circles. They have neither as yet enhanced the knowledge base nor informed pedagogy in these fields.

The Narmada Bachao Andolan, a protest movement against the building of a series of large and small dams on the River Narmada, lead to better assessment of the needs of the displaced, dismantled the well accepted techno-economic basis of building large dams, and exposed the poor scientific understanding of hydrology and seismicity on which the decisions were based. It had a major impact on the development decisions of the Indian government, prompted the World Bank to reform how it approved grants, and because some issues were challenged in court, it produced considerable legal literature.

Within the health sector, the Medico Friend Circle (MFC) emerged in the 1970s to address the abysmal Medicare available in villages. These young medical professionals brought into focus several problems in the delivery of rural health care, in particular medicines and the unethical practices of the pharmaceutical industry. The MFC critically reviewed pharmaceutical literature, and encouraged ideological debates across the political divide on issues of medical care. MFC made many contributions to path-breaking research, and even more importantly, it consistently and systematically established the connection between people's health and their social and economic

conditions. In 2000, the health movement became more formalized as Jan Swasthya Abhiyan, which campaigned for health for all now, and viewed health as a fundamental right. It has taken up several public issues in healthcare from a rights perspective and made use of research studies from various institutions.

The women's movement has encouraged an interdisciplinary approach to the study of gender issues. Gender studies centres are mandated within all public universities, and in 1983, the Indian Association of Women's Studies was established by scholars working in universities and colleges. The Indian women's movement is one area where there has been a symbiosis of movement-led research and research emerging through formal scholarship.

Alternative knowledge streams generated by movements and their institutions have : posed a challenge to the state and markets ; produced evidence to challenge existing paradigms of development ; informed policy change ; filled gaps in knowledge to counter the deliberate silences of the establishment ; served to critique science and society connections and thereby helped to ground science in social policy ; and contributed to the formation of alternative perspectives.

## 2 Empirical Approach and Main Findings

Two case studies illustrate the processes and pathways of alternative knowledge creation and its influence on policy. The first demonstrates the outcome of the early coalescing of the health movement with the women's movement. The second shows research output around a recognition of how India's healthcare models and plans have consistently ignored the growing private sector.

**Case Study One** — The issue of violence against women became a broad public concern in the 1980s. The Forum Against Rape (now, Forum Against Oppression of Women, FAOW) undertook a qualitative research study, a first of its kind, in June 1980. Interviews of 100 working-class and middle-class women showed the wide prevalence of violence against women in their own homes across social and economic classes. The study destroyed the myth that domestic violence was a poor people's issue or that only certain communities indulged in such violence. Violence against women was shown to be widespread but well hidden, and domestic abuse of women became a public issue.

The public health system was also under considerable critical attention because of its lack of gender sensitivity when dealing with reproductive and sexual health needs of women. Both the health movement and the women's movement demanded a change in practices and attitudes. As well, they pointed out the abysmal state both of forensic procedures and of the treatment accorded to the survivors of rape and sexual assault.

The Centre for Health and Allied Themes (CEHAT) approached the issue of violence against women based on the experience of the women's and health movements. It recognized that the public health system was the first point of reference for women subject to violence, even when they did not directly report the violence. Violence leads to not just physical but psychological health consequences that bring women to the health providers seeking care. In 2001, CEHAT engaged with the health system

through a partnership with the Bombay Municipal Corporation (BMC) to set up a hospital-based crisis center (Dilaasa). This was easier said than done because it meant developing gender-sensitive training programs for the entire public hospital staff, and understanding violence as a public-health issue. Women survivors who came to the system rarely admitted to being subject to violence ; therefore, the program attempted to develop skill sets among the staff to help them identifying such women and point them to relevant care, such as immediate psychological first aid.

An important function of the crisis centre was to provide crisis-intervention services, including counselling. There was a dearth of documentation related to the counselling approach used by the women's movement ; therefore, Dilaasa developed its crisis counselling methodology from the literature published in the developed countries on feminist counselling and adapted it to the Indian context. The important issue of "attempted suicide" was located in the health setting through the crisis intervention program of Dilaasa. This was an important contribution in constructing gender-sensitive diagnostic tools for cases of "accidental consumption of poison."

An external evaluation of the Dilaasa crisis centre 10 years after its establishment (2010) showed that the location of the crisis centre within a hospital enhanced its accessibility and led to early detection of violence against women. A large number of women were identified in the first 2 years of facing abuse. Women of childbearing age had contact with the health system that made it possible for health providers to identify violence in their antenatal visits. This sustainable model has been globally recognized, and is being replicated in several states such as Meghalaya, Gujarat, Madhya Pradesh, Karnataka, and Uttar Pradesh and has been adopted by the WHO.

Another major contribution to literature and practice is in the realm of the medico-legal response to survivors of sexual violence. The women's movement in India had been voicing its concerns about the archaic methods of examination to determine whether there had been sexual assault. CEHAT approached the issue of sexual violence from a rights-based perspective. Intervention research was carried out while implementing a SAFE (sexual assault and forensic examination) kit in three municipal hospitals of Mumbai. The kit ensured the correct collection of evidence and its preservation, recording, and examination. Although this kit was developed in 1998, it took a decade of advocacy to have its use made mandatory. The collaboration of CEHAT with the BMC through the Dilaasa hospital-based crisis centre played a critical role in the system's acceptance of the kit.

**Informing Research** — The analysis of the medico-legal records brought to light important facts about sexual violence, the unrecognized larger health consequences of sexual violence, and the circumstances in hospital and forensic practice that resulted in the loss of medical evidence. Lack of injuries was a major reason why courts denied that sexual assault had taken place. An important finding of the study was to show that only a third of the survivors sustained genital or physical injuries due to delays in reporting to the hospital, being too scared to resist the perpetrator, and being rendered unconscious. These circumstances must inform the current medico-legal practice in India in the context of sexual violence.

**Informing Practice** — Armed with this rigorous analysis, CEHAT lobbied and advocated for change in the existing archaic medical practices. It has played a critical role in redrafting medico-legal protocols for the care of survivors of sexual violence under the Government of India's Ministry of Health and Family Welfare. Simultaneously, CEHAT has expanded an earlier gender review of Indian forensic textbooks.

**Case Study Two** — An analysis of time-series data (from 1951 for all states and the central government) on health care services revealed the gradual withdrawal of state expenditures on health care that belied the avowed policy intentions. This gave impetus to the demand for increased state resources for health care and a reassertion by the state of its welfare responsibilities. Recent studies have shown that there has been an increasing trend to private expenditure, which is largely out of pocket. Investment in the public sector for health has been inadequate, and the state has never committed more than 3.5% of its resources to the health sector.

**Defining the issue through research** — In the 1980s, the Foundation for Research in Community Health showed that that public spending on health had risen by only 1.1% over 30 years, while private household health expenditure was INR182 annually (7.6% of all consumption expenditures). Given that two thirds of the population lived at subsistence levels, this was huge. A series of studies on health financing and health expenditures of both the government and the private health sector showed that state policies had systematically nurtured the private health sector by offering subsidies, loans, and tax waivers, but had done little to regulate it or ensure that it was affordable and accessible. This ran parallel to the neglect and gradual withdrawal of the state from public health.

**From research to advocacy** — Starting in 1994, CEHAT began to focus on the lack of regulation of the private health sector and carried out research and advocacy projects to build evidence of the poor quality of care being provided by the private sector, and their apathy to any regulations. Such studies of the private health sector have informed the movement in many ways. This work has been transformed into advocacy and recommendations to governments, medical associations, and other agencies to strengthen the demand for regulations in the private sector and to make health care affordable.

## 3 Main messages for policy and practice

Since the 1980s a variety of people's movements have produced a rich collection of social research. Their subject matter has always been informed by the immediate needs of the movement. This study has shown that movement research has often wrested the initiative from state agencies and actors to propose and act upon innovative solutions to social challenges.

This research has produced a large body of theories, conceptualizations, and methodological innovations that have not been fully explored or addressed. Movement research has primarily been used to bring about policy change or programmatic innovations. Important as this is, it is imperative for the growth and development of the enterprise of social sciences that movement research be better recognized. For example, its

role in contextualizing and "Indianizing" concepts and theories, such as in the area of domestic violence or on the issue of large dams and water management, needs better recognition and integration into the mainstream of research and teaching.

This will not happen as a matter of course. Movement research emerges from a perspective that is by and large critical of dominant ideologies and frameworks. However, in India at least, there has been a resurgence of people's movements that are forming an alternative political platform for debate and action and nudging the state toward accommodation and transformation. Social science research emerging from people's movements needs to be explored for setting new agendas for academia. It is imperative that bridges be built to create opportunities for a symbiosis of mainstream and alternative research.

India is undergoing tremendous economic, social, and cultural change. Such large-scale and rapid change is bound to disturb conventional pathways of knowledge formation. The social context of knowledge accumulation is inevitably changing as are the terms of social and intellectual discourse. The current dissatisfaction in academia about the quality of research partly stems from the fact that social distance is widening between those who pursue social research and those who may benefit. The social contours of academia are also changing to allow for the entry of new perspectives. In these circumstances, the growth of research that challenges existing and predetermined constructs will become inevitable and lead to conceptual innovations and new theoretical understanding. In this context, platforms and processes for a genuine engagement between research in academia and within the movement must emerge.

# How young scholars in four ASEAN countries forged successful research careers

Catherine Beaudry[(1)], Carl Saint-Pierre[(2)]

(1) Department of Mathematics and Industrial Engineering, Polytechnique Montréal and Centre interuniversitaire de recherche sur la science et la technologie (CIRST), Canada
(2) Polytechnique Montréal, Canada

## 1 Context

Becoming fully established as a member of the academic profession and attaining a permanent position is a career goal for many young scientists. Closely intertwined in the career development of young scholars is their early career performance, which will pave the way for their future successes. This study reports on the second phase of The Global State of Young Scientists (GloSYS), which was launched by the Global Young Academy (GYA) in 2013. This second phase investigated the career paths of young scientists and researchers in four research systems in Southeast Asia (Indonesia, Malaysia, Singapore, and Thailand). The study examined the different conditions and obstacles, including : career development in an era of increasing competition and expectations ; how national support mechanisms influence productivity and success ; and young scientists' perceptions of their situation and their personal motivation to pursue an academic career. The existing literature focuses only on the challenges and opportunities of young scientists in select countries and largely neglects the research systems of developing and emerging nations.

This study examined the disparities and the differences in opportunities hazards that academic careers hold in these countries. Also reviewed were the concerns of young scholars about their career paths within their national contexts. The study examined country disparities in science, and within this context considered factors such as age and gender. This study reflects on the increasingly mobile and international careers of young scientists, who are working in a profession where knowledge is produced in a globally competitive context but also in environments strongly shaped by local and national institutions. A number of ideas are proposed that consider the contemporary,

global challenges and opportunities that young scientists face when pursuing career advancement in different parts of the world.

## 2 Empirical Approach and Main Findings

Several factors influence research performance, which ultimately contributes to building a research career. A number of these factors are socio-demographic (e.g., age and gender) others are related to the choices made by the researchers (e.g., collaboration and funding).

**Age** — Views on the relationship between aging and research productivity fall into two groups. The first group generally advocates that younger researchers are more productive and more likely to be cited than their older colleagues. The second group argues that it is not younger researchers but mid-career and older researchers who produce the most research and have a greater scientific impact. Both theories have some merit and there is evidence that the effect of age varies between different disciplines. With this in mind, our first hypothesis was : H1 (Age) : Older young scientists are more productive in terms of research output.

**Gender** — A vast literature highlights the poor research performance of women in relation to men. On average, women publish fewer papers than their male colleagues ; women seem to be less productive in the first decade of their career, but are more productive after ; articles authored by women receive fewer citations than those of their male colleagues ; and a smaller proportion of women benefit from research funds. A number of explanations for these discrepancies have been put forward : women with young children are less mobile, have fewer networking opportunities and collaborate less than men ; research funding, access to graduate and postdoctoral students are biased against women ; women devote more time to teaching and administrative duties than men ; and women specialize less than men. Our second hypothesis was : H2 (Gender) : Female researchers are less prolific in terms of scientific output.

**Funding** — Public funding of university research has a positive effect on scientific production and can be perceived as a signal of quality, not only of the funded researchers, but of their university. Universities and departments that have been awarded public grants have larger teams and attract more government funding. This enables researchers to build research infrastructure, hire new researchers or students, or to establish and expand scientific networks. Some studies have found that industrial research and development (R&D) contracts and funding from private sources have an impact if they represent a small proportion of total funding. In addition, it has been suggested that philanthropic funding from not-for-profit (NFP) organizations can have a positive impact on scientific production. Our third hypothesis was : H3 (Funding) : Researchers with a higher proportion of funding from (a) public national organizations will also generate more scientific output ; whereas, researchers with a higher proportion of funding from (b) private organizations or (c) philanthropic organizations will generate more technological output.

**Collaboration** — Networking and collaborating both benefit scientific production. Collaboration is also a powerful means to raise funds, and consequently, scientific

collaboration and research funding are intertwined. The fact that most papers are now written in collaboration may contribute to reducing gender differences. Collaboration should have a positive impact on research production, but because women work in smaller or more localized teams their research may be less numerous. Our fourth hypothesis was : H4 (Collaboration) : Researchers who collaborate will also generate more research output.

**Mobility** — The mobility of academic staff is an important aspect of the internationalization of research systems. Mobility is generally associated with positive effects for the institution and for mobile individuals. Mobile researchers generally have a larger international network ; perform better than their non-mobile peers ; publish and are cited more often ; and have better access to funding. Our last hypothesis was : H5 (Mobility) : Researchers who have spent some time abroad, for study, research, or work-related purposes, will be more prolific.

**Data** — Data were collected using an email questionnaire sent to young researchers in the main research institutions, both public and private, in Indonesia, Malaysia, Singapore, and Thailand as well as some researchers working in other parts of the world. Our sample included 68 researchers currently working in Indonesia, 189 in Malaysia, 45 in Singapore, 255 in Thailand, 25 in developed countries, and 13 in the rest of the world. Our analysis compared the sample means of each country or region and of each gender.

The study examined the motivation to enter a research career and the satisfaction of such a career choice. Regarding motivation, relatively few differences were noted between countries. Of the 12 characteristics reviewed, flexibility of working hours, research itself, training the next generation, and applying knowledge to improve society were more important for Malaysian researchers compared with their Thai colleagues. In contrast, more Thai researchers than Malaysians chose academia or research because no other job was available. Singapore researchers stood out for ranking the lowest on all the motivation factors. When comparing genders, men gave more importance to research ; whereas, women gave more importance to job security. The only other notable difference was that women tended to choose a career in research less often than men because no other job was available.

Although job security was a distinguishing factor for women as a motivation to enter a career in research, it did not discriminate between men and women as a satisfaction factor. Job security was one of the most important satisfaction factors for Thai researchers compared with their Malaysian colleagues. In contrast, Malaysian researchers favoured income and working hours. One satisfaction factor ranked in the top two for most Asian countries : the flexibility of working hours. Not surprisingly, we found that men appeared more prolific in terms of research outputs than their female colleagues (hence supporting what is generally acknowledged in the literature), but the difference between the two genders was not significant. The poor performance of Singapore was rather surprising and was probably due to the poor response rate to our survey.

There were some differences in access to research funding between the countries. In Malaysia, the highest proportion of the funding came from local and national sources, when compared with Thailand and the other Asian countries. In Thailand, the importance of private and philanthropic research funding was significantly higher than in Malaysia. With the exception of private funding, favoured by men, no significant difference was noted in terms of the proportion of funding from different sources.

Individuals who devoted more time to research were more likely to produce more scientific output. Research was the most time-consuming task, and on average, researchers devoted more than 20 hours per week to research. Women devoted more time to teaching and administration, and slightly more to research than men. In contrast, men spent more time in consulting and fund-raising activities.

Research collaboration, reflected by the number of co-authors per article, has increasingly become the norm. Both men and women collaborated with colleagues in their own organization and sometimes with colleagues from their own country but in other disciplines. Men collaborated slightly more than women with foreign colleagues and with private companies. Malaysian researchers surveyed collaborated "rarely" to "sometimes" with researchers from other countries ; whereas, in Thailand, the frequency was closer to "rarely." To account for various types of collaboration on research output, we considered three factors : collaboration with researchers from other countries ; from other disciplines, fields, or gender ; and from their own university or country. No gender differences were noted, and the same higher values for collaboration were observed for both Malaysia and Thailand.

**Model** — Four potential dependent variables were identified : traditional research output measured by the number of articles, book chapters, and conference presentations ; the number of pending and granted patents ; the number of commercialization related outputs ; and the number of outreach activities. Regression analysis identified the significance factors contributing to higher research output. As anticipated from the descriptive statistics, gender did not influence productivity. When interacted with the number of years since PhD graduation, being female had a negative effect on research output, although having graduated for a longer period slightly offset this negative impact. Having children was associated with greater productivity. Women with a greater number of children were, however, less productive than men with an equal number of children. Compared with childless men, both men and women with children were more prolific, but the effect was less pronounced for women.

The analysis also implied that a greater proportion of time spent teaching (in comparison with the other tasks) had a positive effect on research output. Being older decreased this effect without completely offsetting it. There was a negative impact of fundraising activities on research output. As researchers aged, spending more time performing research activities was associated with increased research output.

Researchers who received a higher proportion of funds from international sources were likely to be more prolific. Moreover, a higher proportion of private funding had a similar impact. Nonetheless, higher frequency of collaboration at the national level was positively associated with greater scientific output, but not foreign collaboration. The

frequency of foreign collaboration only became significant when interacted with the inverse of the proportion of working hours devoted to fundraising. As the proportion of working hours spent fundraising increased to its maximum value, spending more time fundraising increased scientific output as the frequency of foreign collaboration increased.

In terms of technological production in the form of patents, devoting more hours to teaching, having a greater proportion of funding from international sources, and collaborating more often with compatriots all had a positive impact. Being a woman had no particular impact, but being a woman and devoting more time to research had a negative impact on the number of patents generated. Compared with non-mobile men, mobile men produced fewer patents, and non-mobile women produce even fewer patents. An interesting result of our regressions relates to the moderating effect of the proportion of hours devoted to research on the relationship between the number of patents and the frequency of foreign collaboration. Although time devoted to research had a positive impact amplified by foreign collaboration, as more time was spent on research there was a negative impact of more foreign collaboration.

Technological output was expected to be very closely related to commercialization output as the two variables were highly correlated. By and large, this was generally observed. There was no impact from having children on technological output ; however, when it was time to commercialize these technological outputs, more "maturity" as measured by men with children had a positive impact ; whereas, being a woman with children had a strong negative impact. Finally, in terms of outreach activities, women with children were less active than their male counterparts. Although patenting might have been construed as being part of scientific output, or at least applied science output, when it came to spending more time and effort to commercialize and to perform outreach activities, the time devoted to family and children left very little margin for women. It appears that women simply do not have the time or interest for these activities.

## 3 Main messages for policy and practice

We set out to examine five hypotheses impacting research production. Hypothesis H1, that age increased productivity was only partially supported. We compared real age with PhD age and chose the latter as yielding better and more robust results. Only when interacted with gender and with the proportion of hours dedicated to various tasks, was PhD age significant.

The second hypothesis (H2) that female researchers are less prolific was only significant when a moderating variable was used (i.e., PhD age, the number of children ; the proportion of hours devoted to research, foreign collaboration, mobility). As such, H2 was rejected. Consistent existing research, women who had more children were less productive than their male counterparts. Our results showed that men with children were more productive (followed by women with children). Furthermore, female scientists who collaborated with foreign partners did not reduce their technological output (patents) and outreach activities as much as men did when they collaborated with foreign colleagues.

Our funding variables highlighted the importance of private funding and of international funding for research output. Hypothesis H3(a) that national funding would be more important for productivity was rejected, as private and international funding mattered more for classic research output. Surprisingly, private funding had no impact on technological output, commercialization, and outreach activities. Therefore, hypotheses H3(b) and H3(c) could not be validated. For all four categories of output, international funding had a strong positive relationship with scientific output. Thus, the importance of national funding in the literature may not be appropriate for developing countries.

The only hypothesis that was wholeheartedly supported was H4, which validated the close relationship between collaboration and research output. A higher frequency of collaboration was clearly associated with higher research productivity. Because of the importance of international funding, foreign collaboration was included in the regressions. The impact of foreign collaboration did not impact research productivity on its own but required moderating effects from other indicators (e.g., the number of hours devoted to research or to fundraising, PhD age, or gender). This points to the need for a more complex framework to fully capture the influence of such indicators.

The last hypothesis (H5) on mobility was not significant on its own. There was, however, an interesting interaction between gender and mobility. Compared to non-mobile men, mobile men produced fewer articles ; whereas, mobile women did not fare any worse, but non-mobile women produced even less. Mobility would appear to be beneficial to women, but not to men. The fifth hypothesis was therefore only partially supported.

This research was based on a single survey on the perception of researchers about their career and research outputs. As such, it had a number of limitations. First, out of the 750 responses, only 338 are usable for the regression analysis. The questionnaire was too long and the results suffered from respondent fatigue. This will have to be remedied in future similar studies. Second, because of the poor response rate in Indonesia and Singapore, the results were not representative of these two countries. Third, the survey was entirely anonymous and as a consequence, we could not verify the true output of these researchers using bibliometric tools, but more importantly, the survey cannot be used to further study these researchers to see whether their perceptions had an impact on their future career.

In terms of policy, it is clear that foreign funding plays an important role in increasing research productivity in the countries examined. Foreign collaboration and mobility were also positive factors but the complex relationships merit further research. These foreign relations are important and may compensate for deficiencies in the local science system.

# Institutional restructuring in South Africa

## Centralizing research management to influence policy and practice

Harsha Dayal

Department of Planning, Monitoring and Evaluation
Government of South Africa

## 1 Context

The capacity to generate, translate, communicate, and use research evidence to improve public policies that impact quality of life remains weak or uneven across countries of the South, especially in Africa. More than 20 years into South Africa's democratic transition, there is an opportunity to learn from its experience, specifically the significance of changes in research policy. Following several rounds of institutional restructuring, there is a need to understand how the national system of innovation (NSI) contributed to national priorities and to identify systems and institutional constraints that hinder the use of research evidence in policy development. This in-depth analysis of South Africa holds potential relevance to the experiences of other countries of the South. Specifically the emergence of South–South cooperation has enabled emerging middle-income countries to collaborate with their peers to provide leadership and strategic direction on common challenges.

## 2 Empirical Approach and Main Findings

This investigation drew on both quantitative and qualitative data examining the influence of public science systems and research on national developmental agendas. There were six parts to this case study : research policy review ; analysis of actors within the NSI ; capacity of government to generate research evidence and knowledge ; outcomes and challenges of publicly funded research ; information and knowledge-management systems in the public sector ; and the state of policy-relevant research.

**Research policy development** — Research policy has evolved in South Africa since 1994 in the context of a transformation agenda that broke sharply with apartheid policies to construct a democratic, peaceful, and productive society underpinned by human rights and dignity. Prior to 1994, the role of science, technology, and research received little public debate. Breaking with this tradition, the government introduced a White Paper on Science and Technology in 1996 and in 2002, the national research and development strategy detailed how S&T should be funded and governed. This strategy led to the creation of a dedicated S&T ministry.

Although the need to position and strengthen R&D in the economy was recommended, and a 1% target of gross expenditure on R&D as a percentage of gross domestic product was agreed to, this target has not been met. There remains a funding gap between South Africa and countries with similar knowledge-driven economies. In addition, for South Africa to meet its economic and social goals, its NSI must focus on long-term objectives. Understanding South Africa's shifting social dynamics and the role of science in stimulating growth and development are important in these aspects. There are signs this is occurring. For example, the most recent National Development Plan called for increased R&D expenditure, improved partnership between government and the private sector, and a move from a resource economy to a knowledge economy.

**National System of Innovation** — The NSI concept is an inclusive framework of research and innovation agencies engaged in higher education, the private sector, government and non-governmental organizations (NGOs) as knowledge-generation actors. The functioning or performance of the system depends, among other factors, on how these actors promote coherent policy and work together.

South Africa examined international practices for supporting public science and nurturing a national system of innovation. The country is a competent player in the international field of research, science, and technology development. At the same time, research policy recognized that indigenous (or local) knowledge systems were integral to knowledge generation in South Africa. As such, two systems (science-based and local knowledge) inform policy development and application of knowledge in various spheres.

Extensive legislative and policy reforms over 20 years have changed the mandates of executive branch agencies. In addition to the creation of an S&T ministry, government-wide strategic planning, policy coordination and performance oversight was moved to the Department of Planning, Monitoring and Evaluation (DPME) in the Presidency. These agencies have responsibilities for policy direction, funding, coordination and performance assessments of South Africa's research system and NSI.

**Performance of the NSI** — The government led two formal performance reviews of the NSI. An OECD review in 2006–2007 found that the NSI was making an inadequate contribution to poverty reduction and that the knowledge infrastructure was underfunded. A Ministerial Review in 2011–2012 reported similar findings and highlighted the need for effective agenda setting and prioritization of the NSI. The review proposed the establishment of a National Council on Research and Innovation (NCRI)

to set the NSI agenda, oversee the system, and conduct high-level monitoring of its evolution, outcomes and impact. With the government becoming the largest funder of R&D activities since 2008, there are significant levers to shape the development agenda, improve value for money, and manage public research.

In sum, South Africa has a well-established research system and has developed research capacity, world class economic infrastructure and technology. Yet, these characteristics co-exist with the triple challenges of poverty, inequality, and unemployment as acknowledged in the recent Twenty Year Review of Government performance.

## 3 Main messages for policy and practice

The contribution and impact of research and other forms of evidence on developmental outcomes and societal progress is being questioned by both policymakers and the research community in South Africa. Several weaknesses have been identified in the NSI. The role of government needs to be defined and strengthened in this wider research system. There is a major gap in the generation of relevant research that informs how policies are translated into programs and interventions. Innovative methodologies are also needed to measure efficiency, effectiveness, contribution, and impact of research on the national developmental agenda.

**New institutional arrangements need to be pursued** — With the introduction of new structures of government and the restructuring of existing institutions, it is necessary to review roles and responsibilities to effectively implement research policy and manage knowledge. This defines the context within which evidence is promoted, generated, communicated, and used in government to influence policy. Institutional arrangements also include informal practices, which in turn shape research-policy interfaces and intergovernmental relationships. These feature have a bearing on research uptake, especially when knowledge is politically contested.

**Build knowledge-management systems to influence evidence uptake** — Effective knowledge-management systems are integral to well-functioning organizations in the public and private sectors. Knowledge products have become valuable assets within the knowledge economy. Empirical evidence suggests that several departments in South Africa have weak or nonexistence systems for managing knowledge. They also have poor analytical skills, which are further confounded by disconnected storage of research and other forms of evidence, constrained access, and poor dissemination practices.

Access to data and information is fundamental to any scientific inquiry. Generally, monitoring data are of poor quality within government. There is a need to access data derived from publicly funded research and to use this information in policy development. Access arrangements should promote explicit, formal institutional practices and should also be responsive to factors such as the characteristics of data, their potential value for research purposes, and the level of data processing. There is thus much work to be done on regulating and managing publicly funded research.

**Inclusion of social innovation as a performance measure** — Recent work on the measurement of innovation in South Africa has found that the current NSI

survey instruments do not adequately capture non-technological innovation. Social innovation is not captured by national surveys yet it contributes to social development and environmental sustainability. New methods and indicators need to be developed to measure social innovation.

**Increase the supply of policy relevant research** — Reviews of the NSI have questioned the extent to which policy-relevant research inform the development of national policies and priorities. The social sciences sector is underfunded in relative and absolute terms compared to other sciences yet it is important to understanding social systems (e.g., understanding of citizen views, behaviour changes, political economy, and power dynamics) and supporting policy development. Investments are needed to support methodological developments and capacities to undertake social research and on the public policy dimensions of social change. This field of work requires serious attention by both government and academic organizations.

**Centralization of research management for policy influence** — Where research policy is introduced to restructure and build state capacity and a functioning knowledge economy, as in the case of South Africa, there is a degree of centralization needed to coordinate, promote, and regulate public research. Five centralized responsibilities require attention by those implementing research policies : research standards and quality assurances ; innovation in policy research methodology ; agenda setting, networks, and partnerships ; knowledge management and brokering ; and capacity building. The way in which government carries out these functions can be an enabler in the functioning of a NSI and how research is taken up in the policy space.

## Related Resources

Alessandro, M., Lafuente, M., and Santiso, C. 2013. *The role of center of government : a literature review.* Inter-American Development Bank. Technical Note : IDB-TN-581.

Lundvall, B.J., Johnson, B., Anderson, E.S., and Dalum, B. 2002. National systems of production, innovation and competence building. *Research Policy*, 31, 213–231.

Manzini, S.T. 2015. Measurement of innovation in South Africa : An analysis of survey metrics and recommendations. *South African Journal of Science*, 111, 11–12.

# Strengthening the interactive capabilities of public research institutes in South Africa

Glenda Kruss

Human Sciences Research Council
South Africa

## 1 Context

In South Africa, public research institutes (PRIs) face the dual challenge of linking their national system of innovation (NSI) to global knowledge flows and the frontiers of science, while seeking solutions to context-specific development problems. This study examined how five research-performing and -funding PRIs, responded to these growing demands of responding to the country's growth and development agendas. It draws on research that explored the changing roles of science councils in the NSI by analysing patterns of interaction, and the organizational, institutional, and policy factors that constrained and enabled these interactions.

The international literature on PRIs reveals a recent concern to understand their shifting mandates, roles, funding, and organization in a number of countries. Innovation policymakers have sought out research that focuses on identifying how PRIs can play a more effective role in economic development, and how firms, government, and other knowledge actors can form more effective links with PRIs. Academic research has examined these policy-oriented concerns by : investigating the transformation of, and changing roles of, public research institutes ; examining how PRIs can function more effectively in relation to firms ; and by looking at mechanisms that can enhance both the organizational effectiveness and transformation of PRIs. Policymakers and researchers continue to grapple with contemporary shifts in the social contract between knowledge institutions, public and private users, and society.

## 2 Empirical Approach and Main Findings

The research design and methodology focused on interaction, capabilities, learning, and innovation to identify forms of interaction, and their associated benefits or risks for institutions and the NSI as a whole, for both private and public goods. The

framework for this study was situated in a body of research in developing countries designed to investigate the types of relationship, channels, outcomes and benefits, and barriers to university interaction with firms. To be more appropriate to Southern African contexts, the framework was extended to include social and economic inclusive development imperatives, and in addition to firms and the industrial sectors, included a wider range of external partners (e.g., farmers, the informal sector, and government and civil society actors).

The framework classified interactions based on the goals that motivated firms, universities, and PRIs. Firms are driven by either passive (to meet immediate needs of a specific firm) or proactive (longer term and in sectoral interests) innovation strategies ; whereas, universities and PRIs are driven to interact by financial (funding) or intellectual (academic and scientific discipline related) imperatives. A third driver was added for academics and scientists — a commitment to inclusive development or research that is socially useful.

It is important to focus on the substantive nature of universities and PRIs. For universities, the analytical framework builds on the premise that responding to external actors is of greater benefit and less risk when collaboration expands the knowledge base of a discipline. Interaction with external partners and users is integral to the mandate of PRIs, and their knowledge-related activities span the full range from basic and applied research to technology development and innovation. PRIs performs a variety of roles, in complex combinations, with a trend toward increasing diversification in response to multiple demands. In late-developing countries, universities and PRIs were the first channels to link these countries to international flows of science and technology (S&T), and initially relied on and absorbed knowledge generated in the advanced economies. As new demands and opportunities have arisen, PRIs and universities have become more complex, and more differentiated. While maintaining international connections, they strive to solve more complex local problems. At the same time, they face direct demands from government to support private sector development.

The research examined the capabilities of PRIs to build links and flows of knowledge and technology across the NSI. Based on an empirical understanding of the organizational conditions in PRIs, the analysis of interactive capabilities studied the will to interact, as reflected in mandates and strategic policy ; and the capacity to build links, as reflected in specific organizational structures and incentive mechanisms that promoted and supported the interactive activities of scientists.

In-depth qualitative case studies were conducted for five agencies (Agricultural Research Council, Council for Mineral Technology, Council for Scientific and Industrial Research, Medical Research Council, and the Water Research Commission). Government policy documents and secondary sources were analyzed to situate the case studies in historical context. Semi-structured interviews with senior managers, heads of units, and directors were conducted in each science council to gain insight into the strategies, structures, and mechanisms instituted to promote interaction. This was complemented by analysis of key documentary sources to provide insight into organizational history, mission, and structures.

**History and policy imperatives** — The interactive capability of a science council is shaped by its history and by the traditional knowledge and technology practices and priorities built up over time. There have been three main periods in the history of growth and development of universities and PRIs in South Africa. In the first period, the late nineteenth century, PRIs were established in response to local developmental challenges. Many current PRIs can trace their origins back to this period of responding to mining and agricultural concerns in a resource-based colonial economy. The second period from the 1940s onwards saw the creation of science councils in their current form, and was shaped by the industrialization of the economy and the global rise of big science. Period three was shaped by marketization and calls for greater public accountability. From the late 1980s, the apartheid government created new science councils oriented to the minerals and agriculture sectors, and compelled science councils to seek independent sources of income to complement their statutory grants. This ended the system under which science councils had been completely funded by government. After 1994, PRIs were redefined in a reconfigured S&T landscape. Science councils were to undertake research activities that the private sector or universities could not. The post-apartheid government, concerned that science councils were not responsive to new inclusive national development priorities, sought to forge new forms of interaction with actors in the informal sector and impoverished communities, in relation to livelihoods and the welfare of citizens.

**Balancing and prioritizing roles** — Science councils currently have a three-fold mandate : contribute to science and the body of knowledge, connect to global knowledge systems ; contribute to technology, innovation, and competitiveness of the private sector to promote inclusive economic growth ; and contribute to innovation of government and of communities in relation to the quality of life and to promote inclusive socioeconomic development. A review in 1998 suggested that most science councils needed to reorient their organizations and scientific activity to align with this new policy mandate.

**Balancing strategic roles and multiple imperatives** — Common to the new mandates of each science council was that research should provide solutions to identify tangible problems, whether for government, industry, or the communities they serve. Each science council was challenged to extend and shift its traditional scientific mandate, orientation, and focus to respond to the new inclusive developmental demands, the reduced core public funding allocation, and the imperative to strengthen their scientific contribution. Scientists, managers, and leaders grappled to balance the simultaneous demands, and researchers often experienced a sense of being pulled between contrasting mandates, particularly between inclusive development and market drivers. The Agricultural Research Council (ARC), for example, grappled with a new mandate to support small-scale, resource-poor farmers. The Council for Mineral Technology (Mintek) illustrated the challenges of serving the interest of national priorities by taking public users and beneficiaries into account. The analysis of the five science councils revealed that three PRIs grappled to reorient their mandates, and reconcile the tensions between multiple imperatives. A second set had clearer organizational mandates, facilitated by strong historical links to mining and industrial value

chains, and were oriented more strongly to the mandates of global competitiveness and scientific excellence, and driven more strongly by financial imperatives.

**Interactive capabilities** — Each organization's mandate has unique imperatives, which drive interactions with a different set of actors and require different interactive capabilities. Internal structures and mechanisms that promoted and supported interaction were for the most part tacit and ad hoc. There were varying degrees of fragmentation and a lack of internal coherence and coordination between units. For example, the Council for Geoscience (CGS) was dispersed across six provinces, with a high degree of unit autonomy. The Agricultural Research Council (ARC) was also dispersed geographically. Long-established identities of these research institutes reflected specific regional, agricultural, or environmental problems and priorities. In both cases, lack of centralized coordination led to fragmentation and incoherence. The analysis of the Medical Research Council (MRC) revealed a virtually identical pattern, with units and scientists operating in silos in an unstructured manner. The Mintek model was most structured and formalized, with a strategic mix of centralized and decentralized structures and decision-making mechanisms, and was most effective in supporting interactions to achieve strategic mandates. Weak internal mechanisms led to fragmentation and a lack of coordination, particularly in periods of organizational flux.

In terms of knowledge and industry partners, most science councils had external mechanisms that promoted formal contracts with knowledge partners (i.e., universities and other PRIs). External structures to interact with small-scale economic agents, marginalized communities, and related civil society partners were not well developed. The reach and practices of the technology-transfer and innovation-oriented mechanisms were not extended to include interaction with small-scale farmers, informal firms, cooperatives, or community-based livelihood projects.

Incentive mechanisms took the form of performance monitoring and promotion systems that included criteria to promote interaction. However, incentive systems were not transparent and changed frequently, which reportedly caused resentment and conflict. Publications and contribution to science were rewarded most highly, and hence in practice, interaction with universities and firms was promoted most strongly. This was particularly true in science councils that were attempting to improve scientific quality and grow reputations. Incentives like special awards for patents or collaboration were evident on a very small scale. Some had specific incentives to promote interaction with small-scale informal producers and communities, but these were not as highly valued as the intellectual incentives.

In practice, most scientists were driven to pursue interaction by their individual or unit interpretations of intellectual, financial, and developmental imperatives, for intrinsic rather than extrinsic reward. Organizational structures and mechanisms that can promote a better balance, or greater responsiveness, to government and market imperatives are embryonic or missing, particularly those that orient research to inclusive development priorities and to internal alignment of research priorities with strategic goals.

**Constraints in the NSI** — This examination of the five science councils points to blockages and risks at the macro-level. These may constrain the leadership and management of a science council from achieving their mandates, despite their best organizational efforts, which in turn, may constrain the S&T system within the NSI. With a decline in core public grants, financial imperatives drive scientists to seek funding from private sources, whether donors, clients, or other stakeholders. This leads to the risk of funder- and individual-driven research agendas, which potentially leads to organizational incoherence and misalignment with strategic goals. It can also constrain applied research from developing solutions in the public interest or block the use of funds to maintain infrastructure and equipment. One distinctive role of PRIs in the NSI is the maintenance of national collections and repositories, which require dedicated funding streams and consistency over long periods of time. The risk to the NSI of inadequate funding is substantial, as these repositories are used for regulatory and safety purposes and provide crucial services to firms, local government, communities, and individuals. This issue of continuity of funding is equally important. Rapid changes in organizational fortunes were often in response either to a lack of funding or to new funding sources. This creates a risk for promising scientific work that may require longer periods to mature.

Mission overload on science council leadership, cascading down to scientists, was evident. Expectations are that science councils will respond to initiatives from multiple government policy actors, and there is evidence of a constant cumulative addition of requirements, without prioritization, alignment, or coordination across government to respond to new national policy frameworks. A related potential blockage is the capability of government departments to focus research agendas. The potential for synergy and building a critical mass of scientists from distinct disciplinary traditions to address more strategically complex social and economic problems is comprised.

## 3 Main messages for policy and practice

This research provides a basis for policy actors at the national and organizational level to introduce change in a manner that addresses gaps and blockages in existing practice. The science councils generally had weak internal mechanisms to coordinate scientists and align research priorities with a set of external mechanisms. Individual intellectual and financial imperatives drive interaction more strongly than socioeconomic development imperatives or strategic organizational mandates. For organizations without strong interactive capabilities, national funding constraints and over-burdened policy expectations make a strategic balance even more difficult to achieve.

**Incentives** — Policy instruments are needed to promote a more effective balance among the three core substantive roles of science councils. The challenge is to integrate and balance activities and functions by generating, transmitting, applying, and preserving knowledge and technology for the direct benefit of external audiences in ways that are consistent with science council and unit missions. At a systemic level, a positive intervention would be to convince scientists that such partnerships and networks have value, while not being detrimental to their scientific reputations. In this regard, there has been extensive debate about the need to integrate outreach

with the core missions of teaching and research. There has been much active policy development, advocacy, and experimentation around community engagement within South African universities, and consensus is emerging around the value of working within a framework of engaged scholarship. A similar national debate, coordinated vision, and strategic instruments to promote engaged S&T is missing from the science council space.

**Enhancing interactive capabilities** —Dynamic interactive capabilities are important if science councils are to be active agents within the NSI. Science councils need to balance their functions and activities in a more strategic manner, and manage the potential tensions between multiple imperatives. A number of structures and mechanisms are within the power of science-council leadership and management to change : strengthening internal coordination and alignment between individual business units in alignment with organizational goals ; prioritizing (and giving organizational authority to) structures and mechanisms that support scientists to extend their research outward, and to link different kinds of external partners and beneficiaries into their knowledge and technology opportunities in appropriate ways ; and providing incentives for individuals and units to engage with organizational mandates in a more strategic manner.

**Framework of innovation and inclusive development** — All science councils accepted the policy imperative that their work should contribute to inclusive socioeconomic development, which was evident in their expanded mandates, strategic objectives, or dedicated programs. If South African science councils are to balance their mandate to link to global knowledge flows, enhance economic competitiveness, and address complex problems arising from high levels of poverty and inequality, they will need to develop their capabilities to interact with marginalized and vulnerable communities and informal sector actors. What is needed is a national policy framework or strategy, aligned with existing mechanisms and linked to public funding programs that can promote and support ways to extend the benefits of research and technology development in a more inclusive manner.

## Related Resources

Kruss, G., Haupt, G., Tele, A., and Ranchod, R. 2016. *Balancing multiple mandates : The changing role of science councils in South Africa*. Cape Town : HSRC Press.

Kruss, G. and Haupt, G. 2016. Luring the academic soul : promoting academic engagement in South African universities. *Higher Education Research and Development*, 35, 755–771.

Kruss, G., Visser, M., Haupt, G., and Aphane, M. 2013. *Academic interaction with social partners : investigating the contribution of universities to economic and social development*. Cape Town : HSRC Press.

# Enhancing innovation for inclusive development of national research councils in Southeast Asia

## Process and outcomes

Segundo Joaquin Eclar Romero, Jr.

Development Studies Program
Ateneo de Manila University
Philippines

## 1 Context

For decades, governments, the private sector, and non-governmental agencies (NGOs) in Southeast Asia have dedicated themselves to bringing about "inclusive growth" or "inclusive development" in their economies and societies, but overall, the results have been unsatisfactory. The concept of a national system of innovation (NSI) has been proposed recently to encourage inclusive growth or development. Inclusive development that transforms societies requires collective impact. Collective impact for inclusive development requires the creation of working national systems of inclusive social innovation that bring together government, private sector, and academe into a grand problem-solving network to take on the intractable problems of societies, economies, and even polities. Inclusive NSIs are now looked to as the source of dramatic changes in the lives of the poor and marginalized.

Universities and national research councils (NRCs), as both generators and repositories of knowledge, are expected to help demonstrate the desirability, feasibility, and viability of inclusive development for societies over the long term. Universities and NRCs in developing countries, however, appear to be under-performing in terms of their potential contribution to inclusive innovation recognizing their resources, influence, and prestige in society. Increasingly, universities in developing countries have been challenged to have broader societal impact. Similarly, scientific R&D councils

have limited capacities and resources to direct national R&D and innovation agendas and policies toward more sustainable and equitable development. Questioning their social relevance, purpose, and impact is happening amid the genesis of new research and organizational models that deal with "creative and interactive problem-solving" to deepen the development impacts on groups of greatest need and vulnerability in developing countries.

**UNIID-SEA project** — The Universities and Councils Network on Innovation for Inclusive Development in Southeast Asia (UNIID-SEA) project started with the premise that the contributions of universities and research councils to inclusive development could be significantly enhanced. The project engaged universities and NRCs in Indonesia, Malaysia, the Philippines, Thailand, and Vietnam in strategic dialogue, experimentation, and program and policy development.

The university-directed component was carried out by the Ateneo School of Government (ASOG) ; whereas, the NRC component was led by National Research Council of the Philippines (NRCP). The project sought to promote and develop innovation for inclusive development (IID) as a distinct field of study and policy action. IID is broadly defined as : innovation that reduces poverty and enables all groups of people, especially the poor and vulnerable, to participate in decision-making, create and actualize opportunities, and share the benefits of development. IID is expected to generate income and employment, help alleviate poverty, and in the long run, lead to more inclusive development.

The goal of the project was to help universities and NRCs in Southeast Asia reorient their roles and functions to support IID. Universities were expected to introduce IID in their teaching, research, and extension activities, and the NRCs were to mainstream IID in research policy, grant-making, and advisory functions. The NRC partners were the Dewan Riset Nasional (DRN) of Indonesia, the National Research Council of Thailand (NRCT), the National Council on Science and Technology Policy (NCSTP) of Vietnam, and the NRCP of the Philippines. The project introduced IID to universities, NRCs, and related organizations in Southeast Asia and built a network of 128 network fellows from 10 countries, and 21 institutional partnerships with universities, NRCs, NGOs, and government offices.

## 2 Empirical Approach and Main Findings

UNIID-SEA was an action-research project to understand the challenges and opportunities of enabling NRCs to promote inclusive development in their societies. The objectives were to : introduce the concept of IID ; demonstrate IID as a lens for NRCs research granting and research agenda-setting activities ; and promote IID in their policy-advisory activities. The university and NRC components of the project developed separate and joint capacities for pursuing IID initiatives.

**Process** —NRCs in Southeast Asia typically set research agendas, implement research programs, grant research funding, and provide policy advice to government. Poverty alleviation and inclusion of vulnerable and marginalized sectors are explicit or implicit in these functions and programs but IID was an entirely new concept

to the NRCs. The first task was to support activities in these institutions to introduce the concept of IID and to discuss its relevance and usefulness. The second task involved the design and prototyping of a more IID-oriented research grant process in NRCs. Because the NRCs would eventually exercise some control or influence on research-granting agencies, the project engaged all of them in the IID Research Grant Challenge. The third task was the IID Fellows Program, which involved the identification of "force multipliers" — development and intermediary agents (individuals, groups, and organizations) from the public, private, and NGOs who were producing research and training materials for the poor and marginalized sectors in their societies.

The implementation of the IID Fellows Program and the IID Challenge Program demonstrated a replicable way of increasing and networking the capacities of both the co-implementing institutions (ASEAN University Network for the IID Fellows Program, and the NRCs of Indonesia, Philippines, Thailand, and Vietnam), and the selected grantees. In its implementation, the IID Challenge Program introduced these innovations in the administration of grants by the NRCs : expansion of the list of eligible research proponents ; introduction of IID criteria for research evaluation ; and inclusion of the community as a target user of the research output. Of the 81 entries received from Indonesia, the Philippines, Thailand, and Vietnam, four were chosen : Innovative Accessibility Map Applications for People with Disabilities in Ho Chi Minh City ; Science Field Shops in Indonesia — Agrometeorological Learning and the Provision of Climate Services to Rice Farmers in Indramayu ; Motorcycle Taxi Drivers as Community Surveyors ; and Sustainable Food Systems of Indigenous Peoples in the Philippines — Linking Nutrition, Agroecology, and Culture Toward Food Security and Resilient IP Communities.

**Initial outcomes** — The NRCs responded to the IID initiative in different ways. The Dewan Riset Nasional Indonesia (DRN), when introduced to the concept of IID concept, identified similarities with four government programs they considered IID-oriented — a poverty reduction and community development program ; a program to develop infrastructure and strengthen national communications to support disadvantaged areas ; a program to strengthen access to education and health for all groups ; and a program to develop credit access for small- and medium-size enterprises. One major program was the National Community Empowerment Program, which since 2007 had worked in 72,700 poor rural communities and involved 750,000 people, of which 63% were women who acted as agents of change.

During the project, DRN members continued to understand inclusive development as essentially community development or sustainable development. Some 80% of DRN members are scientists and engineers who do not usually deal with social problems. The UNIID-SEA involvement of the DRN occasioned no structural changes. It has, however, empowered the Commission on Social Sciences and Humanities of the DRN to more aggressively promote social concerns among the other commissions as part of the national research agenda. In fact, the Commission recently advocated "inclusive development" as one of the themes in the national research agenda for 2015–2019. There is growing awareness among DRN members of the need for social scientists to collaborate more engineers.

For DRN, this insight to increase the interaction between social scientists and engineers and physical scientists proposed modifications to the organizational structure of the councils. To promote IID in Indonesia, the key opportunity is for DRN to encourage and support the various regional research councils to identify specific innovations (products and processes both social and technical) that respond to the needs of the poor and marginalized in the regions (provinces, districts, sub-districts, and villages). There is also a role to be played in promoting, diffusing, and disseminating IID-oriented research targeted to specific communities.

The National Research Council of the Philippines (NRCP) was the lead for implementing the UNIID-SEA project. Arguably, it was the least prepared to advocate IID. Despite the various project activities to promote IID, the NRCP has been unable to cascade the framework to the NRCP members as was envisioned in the project. The IID framework has not so far been adopted in the research work of the NRCP or used to provide policy advice to the national government. The opportunity for IID-oriented organizational change in NRCP has not been realized in its research, policy advocacy, and operations. Nevertheless, there has been some progress, as IID will the theme for the NRCP General Membership assembly in 2016. Due to the limited exposure of the NRCP membership to the IID concept, research by members is rarely IID-oriented. Many are aware of the existence of the project, but few have participated in its activities. So far, there is no conscious effort on the part of NRCP to fully adopt the IID framework in its research agenda and operations. The NRC has undertaken a series of strategic planning workshops facilitated by the UNIID-SEA Secretariat, so far with no visible organizational results.

The IID framework and strategy has found its greatest resonance in the National Research Council Thailand (NRCT). Beginning in 2014, the NRCT collaborated with the Thailand Research Fund (TRF) to broaden their research framework to include a community-based innovation program. This program aims to support national institutes and agencies involved in research management for social and local community development and to have good collaboration with university networks and policy-making agencies. NRCT has also adopted the IID Challenge Program through its community-based innovation program.

The NRCT is a major player in the S&T and R&D systems in Thailand. The NRCT's broad mandate involves formulating national research policy and strategy, promoting research, enhancing research standards, monitoring and evaluating research, and serving as the national centre for research information. The resonance of IID comes from the early top-level policy decision to use science and technology to reduce poverty and inequality in Thai society. Universities have been harnessed to support this policy, and innovation curricula have been introduced in many universities.

NRCT, as a funding agency, implemented an IID research framework that covers the following themes : product innovation for well-being ; social innovation management that helps vulnerable groups ; and links for innovation scale-up and diffusion of ideas nationwide. The NRCT developed a new design framework for its IID program. The design of its Challenge Grants introduced several changes : the evaluation grid included plans for scaling social innovation ; the expanded eligibility criteria encouraged

broad participation such as social policy and marketing actors ; finally, the duration of the grants allowed research teams to collaborate to test, solicit feedback and scale innovations.

Several constraints to IID-oriented work were identified : lack of close cooperation between innovation-related organizations in the government and the private sector ; lack of understanding of the real problems of local communities ; and lack of awareness of using appropriate communication tools to scale innovations. To overcome these constraints it is necessary to empower problem-solving in local communities by : strengthening relationships with related organizations ; ensuring participation of local community leaders along with academics and researchers, the private and government sectors, and organizations that are socially responsible ; and utilize appropriate communication methods.

The National Council on Science and Technology Policy Vietnam is also strategically positioned to promote IID. The council is responsible for advising the prime minister on STI issues. Mainstreaming an inclusive development framework is a challenging but familiar task. The philosophy of balanced social development is well-established in Vietnam and pursued through a number of specific programs.

The NCSTP realizes the constraints to IID promotion, such as the agenda-setting process for research is largely independent of social development goals. To overcome these constraints, there is a need to : combine top-down and bottom-up approaches in setting research agendas ; change how R&D and STI policy is developed ; and explore new types of links, such as public–private–community partnerships (PPCPs). There are also opportunities to use research and development activities to support similar projects such as the "inclusive innovation" program under the Ministry of Planning and Investment (MPI) that aims to involve more SMEs in innovation for the benefit of poor and low-income people.

The NRCs that were selected as partners in UNIID-SEA were chosen on the basis of their being "the" NRCs. A look at the organizational charts of the departments or ministries of science and technology of these four countries, however, shows that the chosen councils were only part of complex, largely fragmented, multi-player STI systems. The NRCT and the NCSTP were strategically positioned compared to the NRCP and DRN to articulate and cultivate an IID agenda linking research, reforms and application.

## 3 Main messages for policy and practice

The UNIID-SEA project sought to enhance the IID-readiness of NRCs in Indonesia, the Philippines, Thailand, and Vietnam by : convening activities ; designing and implementing an IID Challenge Grant process ; and an IID Fellows Program. It is too early to assess the full outcomes of these engagements. Nevertheless, it is possible to say that the concept of IID has resonates with the governments in Indonesia, the Philippines, Thailand, and Vietnam. There is pressure on them to respond to urgent domestic and international initiatives to reduce poverty and the marginalization of peoples in the region.

The UNIID-SEA project showed that the NRCs, as well as the universities involved in the project, have a long way to go to being 'IID-ready' and effective instruments for 'IID-promotion'. Further, the UNIID-SEA experience suggests that the traction of initiatives to transform research requires a transformation in S&T and R&D governance structures, arrangements, and dynamics, especially the way institutions work together, and in the way appointments (leaders and managers) and appropriations (funds and resources) are distributed. The NRCP and DRN cases illustrate the effects of neglect in long-overdue organizational redesign and development. In addition to inter-institutional issues, there is also a need to redress the divide between the social and natural sciences in problem-solving for inclusive development, or more properly, the marginalization of the social science component of IID.

## Related Resources

Dator-Bercilla, J., La Viña, A.G.M., Angeles-Mendoza, B.J., Osir, E., and Santos, M.G.P. 2012. *Pathways out of poverty : innovating with the BOP in Southeast Asia.* Quezon City and Ottawa : Ateneo School of Government (ASoG) and International Development Research Centre (IDRC). www.idrc.ca/en/book/pathways-out-poverty-innovating-bop-southeast-asia

*Inclusive Innovation Hub.* This open-access platform contains multimedia resources on the emerging concept of Innovation for Inclusive Development (IID). www.inclusiveinnovationhub.org

Universities and Councils Network on Innovation for Inclusive Development in Southeast Asia (UNIID-SEA). See Website for additional information on the network. www.uniid-sea.net

# Looking for Transformative Innovation in the South

## The Case of the Chilean Mining Sector

Gonzalo Rivas, Jaime Alvarez, Dan Poniachik

National Council of Innovation for Development, Chile

## 1 Context

Development must achieve more than economic growth, it must promote solutions that are environmentally friendly, preserve biodiversity, and promote social inclusion and equality. This case study examined an initiative to broaden perspectives on the development of copper mining and its related industries in Chile.

**National System of Innovation (NIS)** — In Chile, the Comisión Nacional de Investigación Científica y Tecnológica (CONICYT), under the Ministry of Education, supports the development of advanced human capital and scientific and technological research ; whereas, Corporación de Fomento de la Producción (CORFO), under the Ministry of Economy, fosters productive development. Together, these agencies manage the largest portion of the public budget allocated to science, technology, and innovation (STI). The Consejo Nacional de Innovación para el Desarrollo (CNID) provides strategic guidelines to promote innovation, and acts as an advisory body to the president. The Council of Ministries for Innovation was established to coordinate public action for the support of innovation. Expenditure on R&D was about 0.39% of GDP in 2013.

Most CONICYT funding is allocated to scientific research projects (lasting 2–3 years) that are selected based on excellence criteria and on topics defined by the researchers. This mechanism, which fosters curiosity-driven research, has been in place since the 1980s. Starting in the 1990s, new funding instruments were created for longer-term research in priority areas and for interdisciplinary proposals, but budgets for these

activities were relatively small. Finally, the government recently created a Strategic Investment Fund (FIE) within the Ministry of Economy to finance public and collective goods that may have a strategic impact developing new competitive sectors.

## 2 Empirical Approach and Main Findings

**Copper mining as a development factor in Chile** — Copper and its by-products represent more than half of the country's total exports. The industry is driven by substantial foreign investments, and mining is dominated by large companies. The main one is CODELCO, a state-owned enterprise responsible for 30% of total copper production. The relevance of copper for the Chilean economy is clear, but its contribution to national development has been a matter of controversy. Although special taxes are applied to copper exploitation, the impression remains that mining firms make excessive profits. The impacts of mining activity on the environment and neighbouring communities have also been a source of tension. Mining activity requires moving huge amounts of soil and makes intensive use of water, which leads to air and groundwater pollution. Conflicts with neighbouring communities, particularly indigenous peoples over environmental impacts or because of the use of water resources, have resulted in an increasing number of lawsuits.

The link between mining activity and the development of a national goods and services supply industry emerged as a public-policy issue toward the end of the past decade. The experience of countries, such as Australia, which were able to develop a broad spectrum of companies that exported machinery, equipment, and engineering services linked to mining activity, was a source of inspiration.

**Agreement on mining as a platform for Chilean development** — Three elements have prevented Chile from making more decisive progress in terms of innovation : the lack of agreement on whether or not the State should promote selective policies ; the division and lack of trust among policymakers and the scientific community regarding the orientation and the role of science in development ; and the excessive focus of innovation policy on financing mechanisms, and the scarce attention to standards and regulation that can drive change.

CNID sought to overcome these elements by reaching broad agreement that would focus efforts on economic sectors for national development. Copper mining was a natural candidate. The nature of copper mining makes it difficult to generate technological breakthroughs in existing operations. Decisions on technology are made when exploitation is planned, and there is little scope to test new technologies because the costs of interrupting operations are too high. Therefore, companies seek to use proven technology. To broaden local development, it was necessary to address the technological challenges of new operations, whether they were new deposits or expansions of those in existence.

Conversations with the mining companies identified their willingness to advance the development of local technology. To help develop a strategic agreement that would benefit all parties, CNID established a commission to provide the government, and the country as a whole, with proposals for public and private stakeholders to ad-

dress the challenges of mining and its contribution to national development. In 2014, representatives of various stakeholders, including indigenous peoples, scientists, environmental non-governmental organizations, mining companies, local suppliers, and labour unions, presented a document to the government that reaffirmed that Chile's development needed the mining sector, but that it was imperative for the mining companies to change the way they were running their businesses, particularly regarding their relationship with neighbouring communities and local suppliers, and the impact of their activity on the environment.

**The agreement** — After 3 months of debate and negotiations, *Mining : A Platform for Chilean Development* was submitted to the president. The document presented a vision for developing a sustainable and inclusive mining industry capable of improving the quality of life for present and future generations. This vision was translated into a set of goals to be achieved by 2035 and a detailed action plan. A short-term agenda, including actions to be initiated during the government's mandate, was part of the document.

The document stated a number of goals to be reached by 2035 : export a minimum of 130–150 billion tons of copper and other minerals in the next 20 years ; position 80% of this production in the first two cost quartiles of the global industry ; have 250 suppliers exporting world-class technology and knowledge-intensive services for a total of USD $10 billion per year ; establish Chile as a worldwide leader in sustainable mining ; reduce the demand for fresh water and energy, and greenhouse gas (GHG) emissions, compared to the base year projected (2010) ; and accomplish a zero net biodiversity impact during the period.

To fulfil these goals, an action plan was prepared to address strategic priorities and layout initiatives that needed to start in 2015. Ten commitments adopted by the signatory institutions were publicly endorsed by the president : create a public–private entity (a council) to promote and supervise actions needed to fulfil the vision and goals of the action plan ; promote dialogue to build a shared vision of mining's future ; build and finance collaborative R&D initiatives by mining companies and their suppliers to address relevant technological challenges ; expand and enhance the ongoing program for the development of world-class mining providers ; produce a major productivity study of the mining sector ; improve the regulatory framework for free, ex-ante, and informed consultation with indigenous peoples and initiate dialogue on matters questioned by them concerning regulation ; strengthen the availability of geological information and improve the access to mining property to create a database on mineral exploration and geological resources ; fortify the capacities of environmental institutions, by designing and implementing a program for the accreditation of laboratories and environmental services, developing environmental standards, regulations, and recommendations, establishing world-class research centres to analyse the state of the environment and ecosystems, and launching a plan for strategic environmental assessments in locations declared a national priority ; propose standards of conduct for all actors in the mining industry in relation to labour, production, and social and environmental issues ; and conduct studies cofinanced by mining and electricity (ge-

neration and transmission) companies to determine the energy requirements of the mining industry.

**Implementing the agreement** — It is important to highlight some important changes that took place in 2015. The significant drop in the price of copper had a strong effect on the Chilean economy, particularly fiscal income, and structural reforms initiated during 2014 put pressure on public expenditure. The drop in the price of copper also affected mining companies, which reduced expenses and personnel.

The group that developed the action plan, plus the ministers of Economy, Environment, and Mining and executives of CORFO and CONICYT, formed the *Consejo de Alianza Valor Minero* (AVM) as a permanent public–private association to promote the implementation of the agenda. The AVM has become an important actor for establishing dialogue with the government's highest political authorities (the Ministry of the Interior), civil society actors, mining companies, and the judicial branch to explore alternative ways of dispute resolution.

**Progress achieved** — Four areas linked to innovation and the development of scientific and technological capacities were reviewed : increase the development of suppliers ; enhance cooperative R&D programs of mining companies ; increase the number of mining researchers ; and strengthening capacities in environmental institutions.

Parallel to the creation of the AVM, CORFO established a set of strategic programs to foster competitiveness in selected sectors with public and private participation. One of these sectors was mining, and to avoid duplicating efforts, work to develop suppliers and a shared R&D agenda was undertaken within the same framework by adding the CORFO director to the AVM board. The strategic program for mining promoted by CORFO is executed through Fundación Chile and called Alta Ley.

Alta Ley maintains a technology roadmap that defines the challenges and gaps faced by the sector. To that end, the sector's stakeholders were convened to create a steering committee for the process. This approach has faced two problems : it is a lengthy process and some participants lost interest ; and the mining companies (particularly the multinational companies) have their own ideas of the issues that should be addressed. As a result, companies have reduced their level of representation in Alta Ley, which has reduced the possibilities for addressing challenges and modifying relationships between mining companies and local suppliers. Those in charge of Alta Ley have realized this situation. In response, a project has been prepared to achieve real-time monitoring of environmental impact and structural stability on tailings. As well, mining companies are supporting projects aimed at two issues that are not part of their core business : recycling tires, batteries, and motor oil ; and dust abatement. None of these activities involves a great challenge in terms of technological innovation. A more promising possibility may come from CODELCO, which is working jointly with CORFO to promote the automatization of underground mining. Likewise, a commission has just been established to evaluate foundries and refineries, with the goal of assessing the potential us of solar energy.

The largest contribution of public funding was expected to strengthen capacity for environmental evaluation of large investment projects (including mining). Two ini-

tiatives are important in this regard : building capacities to guarantee the quality of water, air, and soil quality measurements ; and generating baseline studies to characterize ecosystems to have a common framework for evaluating the impact of investment projects (). Both initiatives have faced several issues. Fiscal adjustments and budget reductions have reduced funding for these projects, and there have been issues with preparing the projects because the Ministry of Environment does not have the technical capacities to undertake such a large task in addition to its regular duties. The 2016 budget does include additional resources for financing approximately 25 new researchers (US $3.5 million).

## 3 Main messages for policy and practice

Although still at an early stage, some lessons and challenges can be highlighted.

**Leadership** — The Commission's access to key stakeholders in the public sector, in companies, and in civil society undoubtedly helped maintain the participation of different stakeholders. Likewise, it was important to open up new spaces for dialogue with actors who were not part of the initial effort, but who have a very relevant role to play, such as the judicial branch. The active presence of former President Lagos in the initiative also helped attract participation.

**Collaboration** — Joint work between the AVM team and the CNID has sustained the attention of the different ministries and public-sector services regarding the tasks they must execute to achieve the established objectives. In several cases, this collaboration has provided technical and political support to public agencies to build their capacity to contribute.

**Technical Weakness** — Despite efforts to support collaborating agencies, technical capacities were over-estimated. The Ministry of Environment, for example, did not have the necessary technical teams to prepare the proposals to be submitted to the FIE. The agencies in charge of fostering STI (CORFO and CONICYT) are important in terms of their relationships with the private sector and the research community, and CORFO is currently working on too many fronts at once, which weakens its contributions.

**Coordination** — The ability of public institutions to work in a coordinated manner has proven to be more difficult than expected, and demanded greater energy from the AVM and the CNID. One reason for this is the lack of central coordination. For example, CONICYT and CORFO are part of different ministries that have not established as a first priority making progress to a common agenda.

**Resource restrictions** — The sharp drop of copper prices negatively impacted the ability of government and mining companies to finance activities outlined in the Platform. Progress has been made, albeit at a slower pace. The stakeholders understood that this program had long-term objectives and would face challenges along the way. Unfortunately, funding challenges occurred at the beginning of the effort and delayed the attainment of early victories.

Together, these challenges have slowed implementation of the innovation agenda for mining. Some obstacles are temporary and are being addressed through corrective measures. The structural challenge is modifying the conceptual framework within which the public sector defines its role in catalysing innovation. The traditional approach has corrected for market failure through specific interventions and, to a limited degree nurtured coordination among innovation actors. This case study highlights an integral approach that recognizes and strategically incorporates stakeholders' interests, particularly those of mining companies, and mobilizes political support. Mining companies do not need financial support to advance a powerful R&D agenda — they need to be induced, or pushed to do so. To date, Chile's experience is limited in these regards, although by organizing a continuous dialogue among different actors, this experience may prove critical to supporting an innovative mining industry supported by Chilean society.

## Related Resources

CNID. 2014. *Mining : A Platform for Chile's Future : Report to the President of the Republic of Chile Michelle Bachelet*. Comisión Minería para el Desarrollo, Consejo Nacional de Innovación para el Desarrollo, Santiago, Chile. www.cnid.cl/category/comisiones/mineria

# Mechanisms to enhance dialogue among communities involved in STI policy
## The Latin American experience

José Miguel Natera[(1)(2)], Gabriela Dutrénit[(2)]

(1) Consejo Nacional de Ciencia y Tecnología (CONACYT), Mexico
(2) Universidad Autónoma Metropolitana, Xochimilco, Mexico

## 1 Context

Research that seeks to explain the performance of a STI system or public policies that seek to promote innovation frequently identify relationships among STI communities as an important determinant or goal. At the same time, research is lacking on how dialogue processes emerge and function, and the inclusiveness of these processes in Latin America. The prevailing view is that there is weak stakeholder participation in designing and implementing STI policies. The relationships among the various actors are neither stable nor clear, which hinders the implementation of actions and the achievement of expected benefits.

The Ciencia y Tecnología para el Desarrollo (CYTED) network created the COM-LALICS programme with the aim to strengthen dialogue on science, technology, and innovation (STI) policies by defining and implementing methodological guidelines. COM-LALICS was designed to analyse and compare country dialogue processes involving the productive sector, the academic sector, civil society, and the public sector. Twelve countries participated in the study (Argentina, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, El Salvador, Spain, Mexico, Peru, Uruguay, and Venezuela). This paper summarizes the conceptual framework and introduces the focus of three country case studies.

## 2 Empirical Approach and Main Findings

The COM-LALICS program articulated the following objectives : (1) identify the most relevant actors involved in the design and implementation of STI policies within the four communities ; (2) identify the most suitable conceptual frameworks to analyse the processes of dialogue between communities ; (3) generate a flexible set of guidelines for analysing the processes of dialogue ; (4) analyse the processes of dialogue between different actors around public STI policies in the participating countries ; (5) conduct a comparative analysis of different dialogue processes that occur in the participating countries ; (6) disseminate the lessons learned about the process of dialogue to different communities ; and (7) strengthen the synergies between the groups in the network for joint creation of knowledge.

**Understanding communities** — Defining communities involved in STI dialogues was an important first step. The approach integrates concepts from sociology and complex-systems literatures. Within the complex-systems literature, the concept of community is based on levels of interaction between individuals. From a network perspective, the level of proximity of the nodes determines the existence of communities. An important contribution of this literature is the recognition that individuals may belong simultaneously to different communities and have different behaviours in each community. As a starting point, communities were defined from the perspective of individuals. Organizations are groups of individuals. If individuals belonged to more than one organization, they were considered to be complex actors. If organizations included complex actors, they were considered complex organizations.

**Relevant STI communities in Latin America** — A complex and multidimensional view of communities was adopted, which allowed actors to belong to more than one community. Four communities were identified : the productive sector ; the academic sector ; other sectors of the civil society ; and the public sector. The productive community included stakeholders who provide goods and services (whether or not they operate under a corporate structure). The academic community included researchers and teachers in higher education institutions, public research institutes, and members of scientific societies (e.g., Academies of Science or the Association of Rectors). The public-sector community included policymakers and civil servant who formulate and implement policies and programs. Other civil-society communities were those capable of obtaining, using and generating knowledge, or participate in the generation of STI.

**Dialogues between communities** — The Organization of American States (OAS) and the United Nations Development Programme (UNDP) define democratic dialogue as embodying genuine interaction among participants, where the validity of each other's claims are recognized. In this framework, the process of democratic dialogue is characterized by four consecutive stages : exploration ; design ; implementation ; and monitoring. The COM-LALICS program modified this framework, principally by characterizing the dialogue process as having three characteristics : the topic of the dialogue ; the features of the dialogue process ; and the lessons learned. By applying this modified version of the UNDP methodology, CYTED network members have been able to codify and analyse different dialogue process in the region, as reflected in the three summary cases below.

**Costa Rica** (Jeffrey Orozco, CINPE-UNA) — This study reviewed the dialogue process and its direct and indirect impacts on the generation of national STI indicators in Costa Rica. The development of STI indicators began in 2008 and evolved in several stages. The process commenced as a part of a request for extra STI funding by the Ministry of Science and Technology (MICITT). MICITT conversations with the Ministry of Finance highlighted the lack of baseline indicators and estimates for reaching STI goals. Even the goals needed clarification as the government's Development Plan only mentioned the expenditure goal of reaching 1% of R&D with respect to GDP, without articulating strategies to reach this goal.

To address these gaps, MICITT convened different stakeholders with the goal of measuring R&D in the country. Following several meetings, the group proposed to generate a more complete set of indicators of STI. MICITT designed a law to create a national commission for the generation of STI indicators. The commission included political representatives of the main state and private organizations with interest in these indicators. A technical committee was also established with representatives of the same agencies and organizations. Through ongoing dialogue, a methodology was developed, funding was secured, and a process established to generate the information needed to calculate the indicators.

The work of these bodies led to the creation of STI indicators from 2006 to 2014. Annual dialogues continue with discussions on developing new indicators, methodologies, and analysis of results, and consider opportunities for policies and strategies for the different stakeholders. Directly and indirectly this dialogue process has contributed to open, parallel processes of dialogue for changing the institutional framework of STI and for influencing government planning processes in this sector.

**Mexico** (Gabriela Dutrénit and Marcela Suárez) — STI policy is confronting the challenge of becoming mainstream public policy in Mexico, and stakeholder participation is necessary for this to happen. In spite of the growing literature around the subject and practical experiences, there is still a long way to go to institutionalize stakeholder participation. STI policy design is set through a top-down governmental process and it is difficult to recognize the voices of other communities. The aim of this study was to discuss the practical experience of stakeholder involvement to inform the design of STI policy, and extract lessons learned from this process. The experience consisted of holding a dialogue between young knowledge-based entrepreneurs and policymakers in Mexico about the challenges they face and the implications this has for STI public policy. This experience enabled a discussion of the methodological aspects of participatory processes.

**Uruguay** (Melissa Ardanche, Mariela Bianco, Soledad Contreras, Claudia Cohanoff, Maria Goñi Mazzitelli, Lucía Simon, and Judith Sutz) — The study of dialogue processes in the context of STI policies is especially relevant because most Latin American societies suffer from systemic failures that hinder the design and implementation of consensual strategies regarding STI objectives.

This study examined a dialogue process to develop a wind power policy in Uruguay. This policy was the major component of a national energy diversification strategy

to develop renewable energy sources. The strategy was initiated by the Uruguayan government in 2005 and extends to 2030. The successful development of an energy policy that created local capacities for the generation of wind power was based, to a great extent, on a process of dialogue among multiple actors from different sectors (public and private enterprises, government, and academic community). Three phases in the dialogue process (diagnosis, design, and policy implementation) were identified and different stakeholders played diverse roles in different social, political, and institutional contexts. In addition, the analysis of the dialogue process showed the development of circles of trust and the emergence of particular conflicts and their resolution. Finally, the analysis addressed the extent to which this dialogue favoured the development of interactive learning spaces that enhanced Uruguayan capacities to sustain the energy transformation process.

## 3 Main messages for policy and practice

The COM-LALICS program was motivated by a need for deeper analysis and new tools to understand the formation and implementation of STI policies. This paper introduced the methodology and the focus of three country case studies. The research is ongoing and preliminary findings are emerging. From a methodological perspective, the characterizations of communities and the framework for analysing dialogue processes allowed CYTED members to apply the methodology to heterogeneous contexts and dialogue processes.

The matrix methodology proposed by the UNDP could help structure the analyses of the dialogue process in Latin America. Nevertheless, some important modifications are needed : the topic of the dialogue should be described ; the different roles of the actors should be analyzed ; and a compilation should be made of the lessons learned. This study design undertakes a more complex and inclusive characterization of the dialogue process, for example by highlighting the roles played by organized civil society.

Finally, the preliminary codification of some dialogue processes in Latin American have revealed the heterogeneity of dialogue processes in the region. Different levels of aggregation, agendas, and capabilities of the relevant actors are important findings to emerge from flexible methodological guidelines. At the same time, this heterogeneity has allowed perspectives on the STI policy process to be reconfigured, and led to new ways to understand inclusive STI dynamics in the region.

## Related Resources

Additional information on the CYTED network (COM-LALICS) can be found on the lalics.org Website. : These resources include a description of the network, a list of groups involved, a series of working papers, and a number of videos (mostly in Spanish).

# How research groups cope with gaps in science, technology, and innovation policy in Colombia

## The case of a nanotechnology research group

Astrid Jaime[(1)], Constanza Pérez Martelo[(2)], Bernardo Herrera[(3)], Gonzalo Ordóñez[(4)], Dominique Vinck[(5)]

(1) Universidad Industrial de Santander, Colombia
(2) Universidad Central, Colombia
(3) Pontificia Universidad Javeriana, Colombia
(4) Universidad Externado de Colombia, Colombia
and University of Twente
Netherlands
(5) University of Lausanne, Switzerland

## 1 Context

The success of science, technology, and innovation (STI) programs depend on the contributions of researchers, their networks and interactions with policymakers and implementers. Despite this recognition, the literature on STI policy retains a top-down focus. A bottom-up perspective is needed to appreciate how the research community responds to a given policy or program and the influence of the research environment.

We argue that STI policies should be evaluated in the broader context of the institutional framework, and pay attention to both policy design, implementation and response from the research community. To assess the impact, contributions, and limitations of policy instruments, it is important to investigate who the research community and local actors interact with, and the influence of the institutional framework. It is essential to understand local strategies and practices within this broader context of regional, national, and international influences that might impact how the research community or research groups respond to given policies or funding opportunities.

## 2 Empirical Approach and Main Findings

The overarching research question asked what are the survival strategies of research groups (RGs) in the context of policies and instruments to promote STI at the national, regional, and institutional levels ? The study focused on 'survival' because the scarcity of resources emerged as the key issue. Within this question, we investigated how researchers adapt to different policy instruments and funding sources, and the role of the research group leader and home institutions.

**Methodology** — Our examination of STI policies and instruments from a bottom-up perspective utilizes a detailed case-study of a research group based at a Colombian public university. The research groups was devoted to the development of nanocomposites to decontaminate water. Semi-structured interviews and document analysis (STI policies, policy instruments, project documents, scientific publications, press releases and work documents) informed our research.

**STI policies in Latin America** — From the nineties, science policy in Latin America has focused on strengthening S&T as a means of increasing economic productivity. In 2009, Colombia altered this singular focus by passing a law that directed the STI system to support economic development while promoting public welfare and regional development. The expanded ambition of the STI agenda, however, was not supported by a larger budget. The budget as a percentage of GDP remained one of the lowest in the region.

The law promoted the notion of a system and networks, consistent with social studies of science that underlined the importance of networking and informal exchanges to the generation of knowledge and innovation. Personal social networks facilitate access to resources and sharing of knowledge. Likewise, negotiations with funders allow researchers to understand their priorities and mobilize resources. In Latin America, the evaluation of STI policies has privileged scientific production, and the incentives created by this approach have directed attention away from linking science to the local context and socioeconomic objectives. Consequently, research and use of knowledge generated by scientists often has little relevance. As the links between science and industry can be strengthened, there is an opportunity to build capacity to make effective use of social knowledge.

**STI policy instruments** — STI policy instruments include research grants and subsidies for laboratories and institutes, and support for networking. With the increasing emphasis on competitive grants and scientific cooperation, there is a growing need for management skills, especially for large research projects, and for communication capabilities to reach industry, politicians, and the public. At the same time, the intended purpose of research grants now includes resolving broader societal problems such as poverty, conflict and environmental sustainability.

STI investments seek to promote technological development and application but there is little funding support to scale innovations from the laboratory to commercial use and/or broader societal impact. Moreover, university promotion criteria and incentive mechanisms reward academic publishing rather than societal impact. In the technology development field, for example, these funding and incentive schemes help explain

why university spinoff companies are still scarce. Field research points to the need to align funding instruments and incentive schemes to support policy objectives.

**Research Groups Strategies** — RGs interact with STI policies and their instruments, learn from these interactions, and develop their own strategies. Research groups have been shown to promote research quality, allowing affiliated researchers to reach national and international standards, and collaborate internationally. Moreover, researchers who participate in collaborative networks are also better positioned to access resources than those working in relative isolation. Within such groups, intellectual and organizational leadership is important. The leader plays a significant role to the entrepreneurial and intellectual culture and performance of RGs.

In Colombia, policy instruments have been implemented since the mid-1990s to encourage RGs, and quality criteria have been established. It is important to understand how RGs react, organize, and make decisions when faced with changes in the policy landscape. The organizations to which RG members belong can also exert an influence and can play a role in bridging the gaps between national STI policies and the instruments that affect RGs.

**Colombian RGs and STI policies and programs** — This study investigated a RG created in 2004 in the field of fundamental and applied physical chemistry within the Universidad Industrial de Santander. This group worked on the development of nanocomposites to decontaminate water. The study examined the Research Group's interactions with national STI policies, program, and instruments, and analyzed the role played by its home institution.

**Adapting and balancing research agendas** — In the presence of multiple policy instruments (e.g., institutional, regional, national funding schemes), RGs must respond to opportunities and adapt their research program to build their capacity. In the case-study, the RG maintained a core research agenda, supported in part by their teaching commitments and the university operating budget for their laboratory. Initially, the RG worked on short term projects to mobilize resources. This was enough to keep members active and develop projects with longer-term potential.

In this scenario, building a research core that was adaptable to multiple funding opportunities was a central element of the group's survival. This RG learned to leverage resources to support exploratory directions where there was no funding. Researchers and RGs learned to diversify their funding portfolio by capitalizing on personal and informal networks. International connections provided further possibilities for accessing additional resources. However, the lack of stable long-term funding has been detrimental to retaining graduate and doctoral students who left the RG prematurely.

The RG developed by performing a juggling act with available STI policy instruments. Internal and external funds were used to seed new directions that were important to the group. As such, the researchers made their research agendas more flexible in the short-term to achieve long-term goals. Through this juggling act, the RG balanced exploitation and exploration tactics to advance their research agenda.

**The role of the home institution** — The support of the home institution allowed the group to continue its work, even in the absence of externally funded research projects. To build capacity, the university provided grants for masters and doctoral students, and invested in infrastructure and laboratory equipment. University funding allowed researchers to meet with external peers and explore future project ideas. Through its infrastructure development program, the university's support of a technology park allowed the RG to extend its network and access specialized equipment. Access to this infrastructure and expertise allowed the RG to further strengthen its capacity and pursue international collaborations. Therefore, university funds provided some necessary resources for exploration, and this was further complemented with other programs that supported project management.

The intellectual leadership, adaptive capacity of the RG, the expansion of members' networks and collaborative activities, and the support provided by the home university allowed the RG to strengthening of over time. The national STI policy landscape provided numerous opportunities for researchers to develop but gaps in these instruments can slow scientific progress. The case study demonstrated how a RG responded to these gaps and what factors enabled the RG to develop.

## 3 Main messages for policy and practice

This case study looked at the role of RGs, their leaders, and their home institutions in addressing the gaps and tensions among different STI policy instruments. One observation was the importance of a strategy in guiding the RG to utilize short-term projects to build a longer-term research agenda. In this case, the group maintained a core research agenda while exploiting short-term financing. It was a juggling act between exploration and exploitation of funding sources in a context of scarce resources and limited national support. This balancing related to processes of knowledge generation and the way policy instruments and funding sources and conditions were combined.

Capitalizing on personal and informal networks enabled the RG to take advantage of some policy instruments. This case provides insights into the role of networks in building capacity to take advantage of STI policies. Learning how to develop and mobilize these linkages and combine different policy instruments was important.

Research outcomes with potential economic and social impacts resulted from the cumulative influence of several policy instruments, rather than a single discovery. In this sense, policy impacts were generated through the actions of the RG and their home institutions. By adapting and balancing activities to overcome funding gaps, the RG was able to demonstrate its contributions to the stated policy objectives of the funding program. The case study illustrated the "dance" among actors in the implementation of STI policies, a point that is not usually considered in the impact analysis of STI policies.

The assessment of STI policies and instruments tends to be narrowly focused on a given policy or program. This study highlights the importance of a long-term perspective as significant results can emerge from RGs who utilize multiple programs.

Evaluation of STI policies must take into account the interdependence of funding mechanisms and their cumulative influence on desire policy outcomes. In Colombia, little is known about the capacities and contributions of RGs and universities based on their interactions with different policy mechanisms. This study showed how a RG learned to navigate and utilize different policy instruments, and overcome gaps in the system in pursuit of a long-term research agenda that enhanced the skills and contributions of affiliated researchers.

## Related Resources

Jaime, A., Lizarazo, M-L., Pérez, C., and Herrera, B. 2016. Innovación y tradición : Dinámicas de construcción de pertinencia para un desarrollo de descontaminación de agua basado en nanotecnologías en Colombia. In : Foladori, G., Invernizzi, N., and Zayago, E. (éds.). *Investigación y mercado de nanotecnologías en América Latina*. México : Grupo Editorial Miguel Ángel Porrúa.

# Governing science–industry relations in the South

## From networks of power to developmental coalitions

Keston K. Perry

School of Oriental and African Studies
University of London
United Kingdom

## 1 Context

Policymakers in the South are searching for new developmental models and strategies to address their own difficulties. Some emerging countries, especially China, have witnessed outstanding improvements in science and technology (S&T) performance, and created new optimism for technological catch up and development. The international development community and Southern governments have therefore turned to S&T policies to help reduce poverty and improve prospects for improving productive capabilities and transitions to value-added, sustainable economic activities.

Policies that support the deepening of university–industry coalitions have become a critical component of a country's development strategy. From this perspective, S&T policies refer to intentional efforts by government to improve research and technological capabilities that are germane to the needs of societal actors, including firms, citizens and non-governmental organizations, industry groups, research institutes, and the state bureaucracy. Within the context of developing countries, informal structures are pervasive and have implications for developing domestic industrial capabilities, given the weak links of firms to research, fragmented administrative institutions, and institutional performance in meeting broad-based developmental objectives. The role of the state is often hindered by its limited governance capacity to coordinate relations between university researchers and industry players.

**Searching for an S&T development model** — Latin American scholars have increasingly sought to explain the widespread underperformance of S&T institutions in the region. Based on the innovation systems approach, they outline missing links or systemic failures to the effective design and implementation of S&T policies as a common feature in the poor performance of these countries. Innovation systems scholars often gloss over the critical role of politics in shaping outcomes and implementation of S&T policy. Transformation based on S&T investment depends on a number of variables, links, and processes that spur an indigenous process of capitalist transformation.

**Networks of power and coalitions in developing countries** — Relations among the scientific community, industrial sectors, and governance apparatus are structured by impersonal bureaucratic structures and informal channels. Relations are also shaped by the distribution of power and technical capabilities across different economic, bureaucratic, and political organizations. These observations reflect the political nature of S&T governance, and recognize that the nature of such interactions influence the process of learning and innovation.

In the STI domain, the actors and institutions in the network exercise varying levels of influence. The distribution of power can help to explain, for example, the influence of the business sector on STI policies, the capacity of industry associations to gather information and generate knowledge, the susceptibility of public-funded universities to policy or political struggles, or whether industrial research programs are subject to patronage and bargaining.

The state can use its power to design and implement policies that foster collective action and developmental coalitions to address productivity constraints and social development goals. The emergence of coalitions in various settings can result from deliberate efforts made in policy or from serendipitous reactions from informal networks. They respond to specific institutional, technological, and economic forces and triggers that prevail in a society to address particular problems.

## 2 Empirical Approach and Main Findings

To understand the historical and institutional evolution of S&T institutions in relation to Trinidad and Tobago's industrial development, the evolution of university – industry coalitions in domestic knowledge creation and human capital formation was examined.

**S&T institutions and industrial development in Trinidad and Tobago** — The institutional foundations for S&T were initially laid in the colonial period with the establishment of a number of research and administrative arms of the state. During this time, the British colonial government held the reins of power in terms of administration, policy stances toward industrial development, and the general direction of the economy. The Imperial College of Tropical Agriculture and the Cocoa Research Unit were both established and have since been integrated into the University of the West Indies. Since the declaration of independence in 1962, a series of Five-Year Development Plans have been developed with goals that oscillated between wooing fo-

reign industrialists through incentives and tax concessions to establish manufacturing operations in the country, to state led efforts to support domestic industries.

The offshore petroleum sector has continued to be an important sector, and it has remained largely in the hands of foreign capitalists. Most of the technological inputs and engineering and management capabilities were sourced from abroad with some expertise drawn from the local context. In 1968, the government established the National Scientific Advisory Committee (NSAC), which was instrumental in the resource-based transition from a petroleum economy to natural gas. A coalition of state, private companies, technology partners, and technical staff at the University of the West Indies (UWI) worked together to monetize natural gas in Trinidad and Tobago. In addition, in 1970, the Caribbean Industrial Research Institute (CARIRI) was established with support from UNIDO and UNDP. Until 1975, the main agents driving investments in S&T in the petroleum sector were state agents who comprised task forces and committees with links to the university and foreign companies. They were able to gain important concessions from the government for exploration and production activities. In its natural gas thrust, foreign consultants played an important role in framing decisions for government.

Efforts to institutionalize S&T in the economy were furthered by the creation of the National Institute of Higher Education, Research in Science and Technology (NIHERST) in 1984. NIHERST has become the focal point for research on S&T indicators and science popularization activities, but political changes that have weakened its statutory mandate.

In the 1980s with the onset of the debt crisis, and the end of the boom years, the government had to make adjustments, and invited the International Monetary Fund (IMF) and World Bank to assist. An important S&T development during the 1980s occurred at the Trinidad and Tobago External Telecommunications Company Limited (TEXTEL) and Trinidad and Tobago Telephone Company Limited (TELCO). TELCO had established an R&D department led by a locally trained engineer. The R&D department staffed with significant research, technical, and engineering capabilities were responsible for the engineering, installation and maintenance of the Digital Multiplex Switching (DMS) Systems, which placed the company at the forefront of this technology in the Americas. During this period, there were also collaboration among private-sector associations, namely the Coconut Growers' Association and CARIRI, which worked together to find a technological solution to dehusking tropical coconuts. Their collaboration lasted approximately 10 years before they invented a device by mere serendipity that automatically removed the outer shell of the coconut. This invention supported the growth of the coconut sector. These advances in the industrial research capabilities of local S&T institutions were then adversely affected by structural adjustment that reduced manufacturing activity.

Formal efforts to create an S&T policy in the early 2000s have been subjected to intra-organizational conflict, limited inter-agency collaboration across government, and little political commitment. In 2004, the Ministry of Science, Technology, and Tertiary Education was set up and sought to bring together stakeholders across government, the private sector, and the research community, but it had limited internal

expertise and lacked traction at the political level. In 2004, an S&T policy report outlined a number of measures, including greater funding and new institutional structures. There is presently some renewed vigour around university–industry partnerships in the UWI's Engineering Department and the promotion of energy services. Such proposals do not seem to have received wide support. The earlier coalitions that develop technologies for local problems have not been easily reproduced. Efforts have been stuck at the policy-design stage, impeded by powerful players, thereby curtailing efforts to nurture a thriving S&T ecosystem.

## 3 Main messages for policy and practice

This analysis has implications for creating the right mix of policies, institutional reforms, and political actions necessary for S&T in Trinidad and Tobago, as well as other developing countries. It is clear that political commitment and demand from private players matter. Though some policy input is necessary to spur interest from the private sector, this cannot be externally driven. Complex interactions and power dynamics are at play in university-industry coalitions and the governance capabilities of the state to coordinate and support those efforts is needed. In this way, developing country policymakers and actors can gradually build their S&T capabilities through collective action, cognisant that their local experiences matter in the promotion of developmental outcomes.

It is important to learn from in-country experiences to understand the political conditions, historical transitions, and institutional mechanisms that created periods of progress. In addition, identifying the constraints to sustained action is essential. Changing institutional and political contexts have transformed relations among the scientific community, government agencies, and the industrial sector. The coordination capabilities of the state need to be improved. Although multilateral bodies need to play a role, their distance from the process leaves them with little knowledge of the contextual specificities and the modus operandi that has fostered coalitions in the past. Their increased role cannot be ignored but their funding and technical support should in no way supplant local knowledge and experimentation, reduce the need to reinforce domestic capability building efforts in research and productive exchanges, or lead them to direct the process.

# Managing research for impact

Zenda Ofir

School for Public Leadership
University of Stellenbosch
South Africa

## 1 Context

Amid diminishing resources and growing competition among nations, research supported by public funds is facing worldwide calls for renewal and change. Demands to ensure (and assess) "impact" and "value for money" are becoming more commonplace, yet research incentive systems remain powerful barriers to change. Incentives are determined by how research is conceptualized and valued, and in the current closed, "science-centric" view of research — and in spite of the proliferation of funding opportunities to address "grand challenges" in research — scientists continue to place value almost exclusively on narrowly defined notions of technical credibility and impacts in the scientific domain. As a result, there has been very little emphasis on *how to manage* research programs and grant portfolios for impact beyond the scientific domain. This will have to change although it will inevitably place an additional burden on researchers, and especially on those working in resource-poor institutions in the South.

Evaluative approaches can support a shift toward managing for impact. It can be much more than a charge aimed solely at satisfying bureaucratic demands for compliance or accountability. It has potential to become an indispensable part of the effective and empowering management of research programs and grant portfolios toward impact.

## 2 Empirical Approach and Main Findings

**A systems perspective on research** — Science tends to deal with complexity by examining things in their constituent parts, often to the detriment of understanding their interrelationships, and the effects of their interactions. Research enterprises must be understood using a holistic, broad, long-term view cognisant of how people (structured as agents through teams, programs, organizations, or networked relationships) interact with one another, with their histories, and with the contexts in which they

operate. Experiences in practice, including the results of multiple evaluations of research and its uptake beyond the scientific domain, have highlighted that use-focused basic and applied research that aims to find solutions to complex real-world problems amid evolving societal dynamics compels a complex systems perspective on the whole research-to-impact endeavour — including with respect to the conceptualization, and hence assessment, of "research quality" or "research excellence."

This view of the research enterprise has several important implications. First, there are relationships between science and society that influence perceptions around the integrity, relevance, and legitimacy of the research (e.g., information may be scientifically relevant, without being decision relevant). Second, research performance trajectories are not linear, and different types of contexts and other dynamics must be accounted for when conducting, managing, and evaluating research for impact. Third, pathways to research use, influence, and impact are often convoluted and unpredictable, complicating understanding of the contributions of multiple collaborations and networks across sectors, worldviews, and disciplines. This understanding of the research enterprise has important implications for efforts to manage research for societal impact.

**The feasibility of managing research toward impact** — Efforts to do high quality research that has an impact on society must be fully cognisant of the unpredictability and messiness of decision-making environments. This is most evident in the policy environment, which is widely seen as the most challenging in this regard. Policies develop out of ongoing interactions among groups of people and organizations interested in a specific issue, and policy choices are made when streams of information and possible solutions are brought together. As such, many argue that managing research toward impact is neither desirable nor feasible.

Yet studies over the past two decades have shown that it is possible even in complex policy environments to plan and conduct work in a manner that will enhance the possibility of research uptake and use. A perfunctory nod to decision makers through the dissemination of materials, or a one-off interaction at a conference or workshop will usually not be enough. Instead, many case studies echo the need for early stakeholder engagement and for contextualized, nuanced approaches to knowledge translation. A large-scale IDRC study, Knowledge to Policy (Carden 2009), as well as a swathe of other recent empirical analyses point to practical steps that researchers can take to increase their prospects of influencing policy and practice. Devising and executing a strategy for influential research may turn on a few recognizable practicalities — as long as the complex systems nature of the research enterprise is acknowledged.

## 3 Main messages for policy and practice

**Value and provide incentives to context-sensitive, engaged, boundary-spanning research** — A systems perspective on the research enterprise means that context-sensitive, boundary-spanning, engaged scholarship across disciplinary, ideological, sector, and stakeholder boundaries should be encouraged and rewarded. But to structure incentives and rewards systems accordingly, research program managers must understand and be explicit about the extent to which each research effort is expected to focus on working toward impact. Such an approach to managing research

programs requires stratification and mapping of programs, and/or of research outputs, based on the types and attributes of the research and, as a result, expectations of impact. The resulting maps can, for example, account for : critical influences on performance ; the extent to which the research is multi, inter, or transdisciplinary ; pioneering work in a new domain ; and/or its relevance to frameworks such as the Sustainable Development Goals. Maps can highlight the composition and balance of a portfolio, and enable assessments of progress and performance that are both nuanced and useful to all involved. They can also help establish simple measures to nudge relevant research initiatives toward impact. For example, when the National Research Foundation in South Africa initiated the Centres of Excellence funding support program in 2004, its Service Level Agreements required these university-based centres to focus on impact outside the academic environment. These expectations played an important role in how the centre directors planned and conducted their work, which in turn led to a much greater focus on, and success in, managing for impact.

**Do not seek "impact" without a strong focus on "quality" that is appropriately defined** — Research excellence is most often defined as encompassing both research quality and research effectiveness. From a systems perspective, these concepts are indeed interconnected and overlapping — how the attributes and importance of quality are defined and perceived by different stakeholders will have an influence on their interest in using the research. "Quality research" must be a precondition for working toward impact, yet this notion is often lost amid efforts to achieve and evaluate research impact.

A complex systems perspective of research demands reconceptualization of what is meant by "quality." A recent effort in this regard is the Research Quality Plus (RQ+) Assessment Framework, developed and tested by IDRC as part of their pursuit of a useful and more nuanced approach to defining and assessing research quality (Figure 1). The so-called "RQ+ approach" to research assessment acknowledges that research quality has meaning only in context, that an assessment of scientific merit alone is not enough to confirm the quality of the research, and that scientists can, where appropriate, be held accountable for positioning the research for impact. It espouses making sure that a holistic approach to quality is promoted from inception of a research effort. It focuses not only on technical integrity, but also on the legitimacy of the research from key stakeholders' perspectives, on the importance of the research, and importantly on its positioning for uptake and use toward impact. It accounts for contextual influences on research performance, and applies classification, mapping, rating, and assessment of performance based on qualitative and quantitative data captured in a set of research performance rubrics.

In its test phase, the RQ+ approach highlighted several advantages of efforts to manage research toward impact. It brings clarity on what is meant by research quality or excellence ; provides the flexibility needed to tailor the assessment frameworks and indicators to organizational mandates and values ; cultivates common understanding among participants and partners ; enables comparative assessment within and between portfolios ; and improves the quality of assessments. Importantly, it can be prospecti-

vely applied during planning processes (which is ideal), during implementation, and retrospectively during summative evaluations.

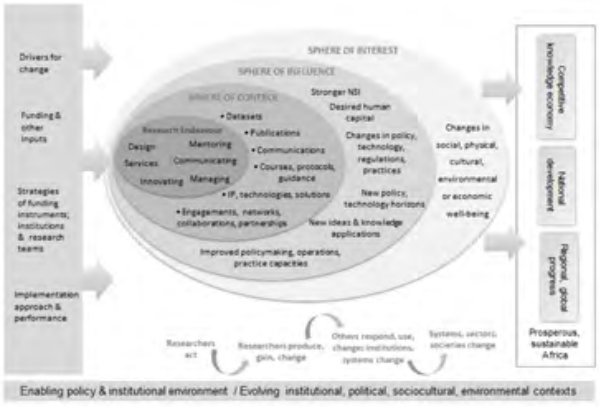



Figure 1 – Research Quality Plus (RQ+) Assessment Framework, developed and tested by IDRC (Ofir 2010, Ofir and Schwandt 2012).

**Establish clear boundaries for accountability for impact** — It is important to draw distinct accountability boundaries for planning and evaluation. A three-spheres framework for research (spheres of control, influence and interest ; Figure 2) is a useful non-linear way to conceptualize and organize the outputs, outcomes, and impacts that may flow from research initiatives, and to establish the boundaries for stakeholders' accountability for results. The three spheres highlight that the progression from the inception of the research process to the eventual impact of the new knowledge is non-linear. Theory-based and mixed-method evaluation designs using comparative case studies, process tracing, and contribution analysis can be used to trace research contributions to outcomes and impact in the spheres of influence and interest. These approaches tend to be time-consuming and have to be carefully built into evaluation systems to ensure that they provide meaningful and timely results. However, they are also rigorous, useful for learning about how to manage for impact, and valuable for tracing examples of instrumental, conceptual, and tactical use of research.

A key point is that researchers cannot be held accountable for the impact of their research, but they can be held accountable for conducting and positioning the research in a manner that enhances the chance of impact. The work in their "sphere of control" thus has to be done mindful of the need for impact. This notion is applied in the RQ+ Assessment Framework.

Managers and funders of research should encourage a comprehensive approach to positioning research for impact ; funding allocations should recognize the complexity of positioning research for impact, and the expertise required for this purpose ; preconditions that can facilitate uptake of the research should be identified from experience ; and organizing frameworks such as the three spheres and theories of change can help encourage researchers to think beyond outputs and short-term outcomes, and work accordingly — yet ensure that they are not held accountable for achieving impact.


Figure 2 – A three-spheres framework for research (spheres of control, influence and interest).

**Use adaptive management and maturity models to steer programs and grants portfolios toward impact** — Efforts to manage research program and grant portfolios toward impact can make use of systematic "theory-based evaluation" approaches to facilitate decision-making and adjustment in strategy and tactics. Well-designed external reviews and evaluations can play an important role in providing targeted, context-sensitive information about progress and impact, and about reasons for success or failure. But it is even more important and empowering to combine these external evaluative activities with regular reflection and structured self-evaluation by the management team (with partners and stakeholders if feasible) based on useful quantitative and qualitative monitoring information. Such information can be used as part of risk management, and support research or program performance. It can help the team to track and understand the trajectory along which a certain project or program is making progress toward high-quality outputs and appropriate impacts. Much of science is by its very nature about iterative processes of experimentation, observation, reflection and learning, and adjusting. Researchers and managers in this domain are therefore extraordinarily well positioned to ensure that evaluation is an empowering, meaningful activity on their road to impact.

In this process, the RQ+ Assessment Framework can be usefully expanded into a Research Quality (Plus) Maturity Model (Table 1) that can guide adaptive as well as strategic management from the inception of a research project or program. As demonstrated in Table 1, a maturity model is a set of structured levels that describe how well the behaviours, practices, and processes of an organization or partnership can reliably and sustainably produce required outcomes. It can be used to trace a program or portfolio trajectory toward outstanding research quality or research quality maturity. It can be expanded to encompass research performance and effectiveness within the spheres of control, influence, and interest, and can help identify weaknesses, strengths, and risks, and guide management strategies at various levels toward research excellence.

**Table 1.** Selected research-quality rubrics in a RQ+ Maturity Model for program and grant portfolio management.

| RQ+ Subdimension | Not applicable | Level 1 – Underdeveloped | Level 2 – Growing | Level 3 – Accomplished |
|---|---|---|---|---|
| **1.1 Research Integrity** | — | Research has little to no scientific merit. Defensibility of approach is questionable. Severe lapses in methodological rigour of literature review, data collection, and analysis. | Evidence of efforts to meet methodological standards, but do not fully succeed. Major shortcomings in justification for choice of design and methods. | Accepted methodological standards in design and execution of research have been / are being met. |
| **2.1 Potentially negative consequences and outcomes for affected populations** | Nature of research is such that negative consequences or outcomes are extremely unlikely. Or risk has not yet emerged. | No apparent effort to consider or address what could be potentially negative consequences from research process or results. Researchers appear insensitive to this aspect. | Signs that researchers are sensitive to potentially negative consequences or outcomes from research process or results. Some efforts have been made to address what could turn into negative consequences or outcomes. The extent of success not clear. | Researchers are sensitive to potentially negative consequences or outcomes from research process or results. Some appropriate measures taken in key instances to eradicate or mitigate them. |
| **2.2 Gender-responsiveness** | Nature of research is such that gender is not relevant (e.g., molecular level developments in biotechnology). | No indication gender was a consideration. Insufficient attention to gender in research design, data collection, analysis, and interpretation of findings. Research might reinforce previous or existing gender based discriminations, without new insights into gender aspects of social or technological change. | Gender was consideration in research design, data collection, analysis, and interpretation of findings. Not enough done to address previous or existing gender based discriminations, or to understand gender aspects of social or technological change. | Gender considered across all aspects of research design, data collection, analysis and interpretation of findings. Some issues related to gender aspects of social or technological change might need further examination. |
| **3.1 Originality** | Nature of research is such that it is not intended to advance existing knowledge or generate new insights (e.g., systematic reviews) | Little or no evidence that research reflects originality in terms of building on and extending existing knowledge, breaking new ground, or making improvements in existing technologies and/or methods | Project is pertinent and significant but not particularly novel, original, or ambitious. Primarily concerned with adding to what is already known in the field (via extension, new applications, critique, etc.). Although not innovative, research is useful, adding to what is already known. | Entire project is reasonably ambitious. Presents fresh, groundbreaking idea, brings an innovative approach to solving existing challenges, and/or deals with new, emerging issue worth pursuing. Challenges taken-for-granted assumptions. |
| **4.1 Knowledge accessibility and sharing** | — | Little or no evidence that research was initiated and conducted with use in mind, i.e., no evidence of understanding of context(s) within which results are likely to be used; no evidence of stakeholder or user mapping or engagement. Little or no evidence of attention to making research findings available in formats and through mechanisms suited to well-targeted audiences. Potential users will struggle to know about, and access these knowledge products. | Evidence of efforts to map and understand potential user groups, and some efforts to understand larger context in which they operate. Some attention paid to making research findings available in appropriate formats to well-targeted potential user groups. Little or no effort to engage in timely, context-sensitive manner, and/or, findings perceived relevant to one particular user group although not necessarily so. Little effort made to engage others. | Significant efforts made to map potential user groups. Researchers have credible understanding of user contexts. s of some engagement during the research process, and strong focus on making findings appropriately available to different groups. Questions as to whether those targeted are influential, or whether communication is sufficient to enable easy access for key users. |

This study focused on a few key issues to encourage urgent consideration of systems perspectives on research management and evaluation, and fresh thinking about how to manage research for impact. This can help the research community to arrive at a conceptual platform that can sharpen understanding of how to do this. Most importantly, the study aimed to stimulate debates that can lead to changes in practice by those powerful actors who design and manage incentives and rewards systems for research performance. Only then will research systems be transformed to enable much more effective efforts to address the challenges faced by societies around the world.

## Related Resources

Carden, Fred. 2009. *Knowledge to Policy*. Sage Publications, IDRC.

Ofir, Zenda. 2010. *External Evaluation : The Policy Influence of LIRNEasia* : Final Report. International Development Research Centre (IDRC), Canada.

Ofir, Zenda and Schwandt, T.S. 2012. *Understanding Research Excellence at IDRC : Final Report*. International Development Research Centre (IDRC), Canada.

# Under-reporting research relevant to local needs in the South

## Database biases in rice research

Ismael Ràfols[(1)(2)], Tommaso Ciarli[(2)], Diego Chavarro[(2)]

(1) Ingenio (CSIC-UPV), Universitat Politècnica de València, Spain
(2) Science Policy Research Unit (SPRU)
University of Sussex, United Kingdom

## 1 Context

Science is increasingly expected to help address grand challenges and societal problems such as tackling obesity, climate change, and pandemics. It is important to understand the different research options than can help to tackle these problems, and to consider the directions in which scientific research should be developed. Bibliometrics can provide helpful tools for developing representations of the existing "supply" of science. However, these representations depend on the data and methods used. Bibliometric tools or indicators, therefore, often reflect choices made in data collection and treatment. Conventional bibliometric analyses are biased against non-English languages, applied research, the social sciences and humanities, and interdisciplinary research. This study investigated the biases of available databases in the representation of research topics, particularly those related to developing countries and topics potentially relevant to disenfranchised populations.

In spite of notable differences between the Web of Science (WoS) and Scopus, comparisons between these two main databases have produced similar rankings of publication production by country in different fields. When intergovernmental agencies benchmark science, these two databases continue to be used. However, the partial coverage of these main commercial databases may lead to serious misrepresentation of science in developing countries. There is a need to improve scientometric indicators to properly evaluate global science.

Agricultural research is an important endeavour in developing countries. Scientists are under considerable pressure from stakeholders to solve local problems rather than contribute to the development of "universal" knowledge. This study focused on rice because it is a staple crop for millions of people across the world. Rice research was at the core of the green revolution and it sparked numerous controversies relating to the impoverishment of diets, overuse of water, exhaustion of soils, and pollution. Given the applied orientation of rice research, the local specificity of the topics, and the relative lack of relevance of the topic for many developed countries, rice research is an interesting case to test the extent of coverage by the main bibliographic databases.

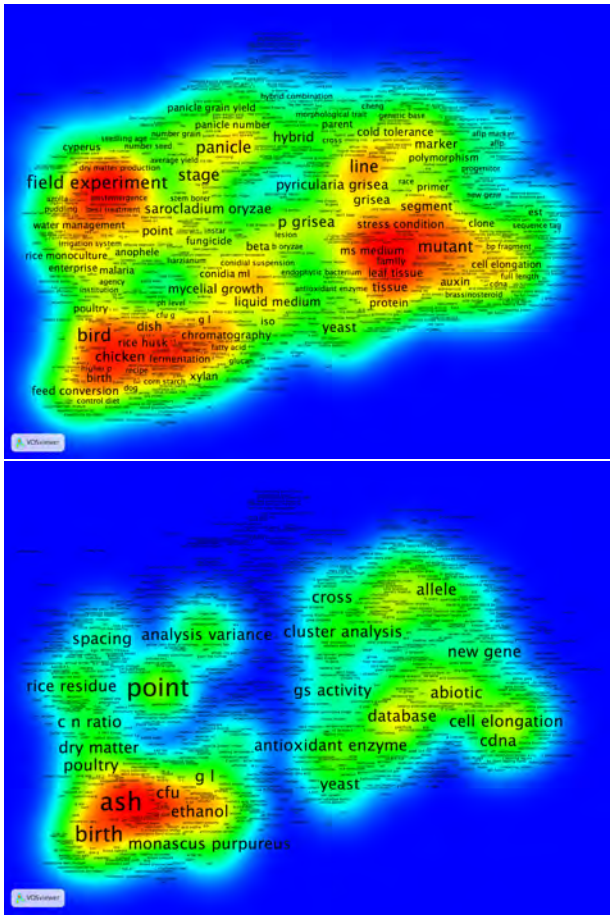
This study investigated biases in rice research by comparing coverage of WoS and Scopus with CAB Abstracts (Centre for Agriculture and Biosciences International, CABI), which is a specialized agriculture and environment database with a broader coverage of developing countries. The second contribution was to describe a substantive bias in coverage of different research topics. Third, the potential effects of these biases on policy were explored.

## 2 Empirical Approach and Main Findings

WoS and Scopus are well-known databases provided by large information and publishing companies, Thomson Reuters and Elsevier, respectively. CAB Abstracts is a database focused on environment and agriculture. It is run by CABI, an intergovernmental, not-for-profit organization with a mission to provide information to practitioners and apply scientific expertise to solve problems in agriculture and the environment.

Publications on rice were manually downloaded from WoS by searching "rice" or "oryza" in the topic field. Scopus records were also manually downloaded by searching in the title, abstract, and keywords fields ("rice" OR "oryza"). Similarly, documents with "rice" or "oryza" were searched in the title and abstract fields of CAB Abstracts. The records of the different databases were matched with multiple matching algorithms. The analysis was carried out using the program VantagePoint, the statistical package R, and the visualization program VOSviewer.

First, descriptive statistics were used to provide information on the number of publications by document type, language, and year. Second, the analysis compared the number of publications by country and the research topic of the publications. The author affiliation was used to retrieve information on the country. An important caveat is that CABI only reports the affiliation of the first author. In the case of WoS and Scopus, the affiliations of all authors are included. As a result, countries numbers will tend to be higher in WoS and Scopus. This effect was not corrected. The error was estimated (using small document samples) as 10–30% over-representation, depending on country. Third, rice research was clustered into six fields on the basis of the co-occurrence of terms in abstracts and titles. Each publication was then fractionally assigned to a cluster and estimates were made of the number of publications per cluster and country.




**Document characteristics : year, type, and language** — There were differences between the documents retrieved from each database. Trends over time showed that CABI historically had a much broader coverage than WoS and Scopus. Before the 1980s, coverage by WoS and Scopus of publications on rice was very limited. CABI showed a great increase in rice publications from the post-war until the mid-1970s, particularly after the mid-1960s driven by the green revolution. Post-war expansion was followed by a period of slow growth from 1975 until 2000, when renewed growth was observed (perhaps in coincidence with the advent of genomic studies). Since the mid-1990s, WoS and Scopus have been catching up with CABI, and by 2012 WoS had reached 80% of CABI and Scopus 86% in total number of publications, although with substantial non-overlapping coverage. We carried out the rest of the study only for the period 2003–2012, which was more relevant for policy analysis.

Each database classifies documents into different type categories. We downloaded all document types. Of these, journal articles were the dominant type (94% in CABI, 95% in Scopus, and 91% in WoS). The second most important document type was

conference proceedings and papers (6.2% CABI, 4.6% in Scopus, and 7.0% in WoS). In terms of language, CABI was much more comprehensive, with 25% of publications in languages other than English, compared with 11% of Scopus and 4% of WoS.

**Comparison of coverage across countries** — Researchers in India, China, Japan, and the United States (US) publish the most rice research. China's publications on rice have sharply increased in the last 20 years, while the shares by India, Japan, and the US have decreased. All three databases agree on these trends. However, there were major differences in the overall proportion of publication assigned to each country in each database. In the case of CABI, India was the most productive country until it was caught by China in 2004. Whereas India's publications made up 18% of the total in 2003–2012 according to CABI, they represented 11.2% and 9.6% in Scopus and WoS. Similarly, China's publications were 26% of CABI's publications, but only 22% and 18% in Scopus and WoS. In comparison, US publications were only 6% in CABI, but 10% and 11% in Scopus and WoS. The differences in coverage between databases have narrowed in recent years, but there is still almost a two-fold difference in the share of publications assigned by CABI and WoS for the US and India.

The percentages of publications from countries with a smaller number of publications on rice showed that developing countries had much higher coverage in CABI. Industrialized countries had a much higher coverage in WoS. Middle-income countries in Asia scored similar shares in all three databases. From the analysis, it follows that WoS and Scopus cover research published in North America and Europe ; whereas, CABI is much more comprehensive in developing countries. As a result of CABI's larger coverage, the relative contribution of Western countries to scientific production on rice is much smaller than is usually acknowledged when using standard publication databases such as WoS and Scopus.

**Comparison of coverage across research topics** — WoS has a wider coverage of the biomedical sciences ; whereas, Scopus has relatively better coverage of the social sciences and humanities. CABI is expected to have a more comprehensive coverage of agronomy and environment. The problem for making a comparison across disciplines or topics is that a shared disciplinary classification across the three databases is needed, but each database provides its own classification. To have a shared topic view across the three databases with a classification relevant to rice research, all publications with abstract for the period 2002–2012 (78,225 articles) were pooled, and terms were clustered using the freeware VOSviewer. Given potential problems with this bottom-up method of classification, an alternative clustering algorithm was also used. The clusters differed slightly (e.g., the consumption cluster split between food processing and human nutrition), but the overall findings were consistent.

Six research topics were found : a consumption cluster that includes human nutrition (e.g., diet) and food processing (e.g., starch) ; a cluster of productivity and plant nutrition that includes research to increase crop yield, and socioeconomic issues ; a molecular biology cluster that includes genomics and transgenic research ; a genetics cluster that appears to reflect hybridization approaches ; a cluster describing plant characteristics (e.g., panicle and grain length) ; and a cluster related to diseases, pests, and related efforts to protect the rice plant.

A closer look at the coverage of the different databases per research topic showed that CABI's coverage remained above 80%, except for the topic of consumption (65%). The coverage of Scopus was above 70% for molecular biology and consumption, but in the range of 30–50% for rice production, pests, and plant characteristics that are more directly related to improving yields. Similarly, WoS coverage was very low (20–30%) for production-related topics, but higher for molecular biology and consumption (50–60%).

Why is there such a disparate degree of coverage between topics by mainstream databases? An initial hypothesis is that the topics with low coverage are those where developing countries publish relatively more, and those with high coverage are those where developed countries publish more. Low-income countries tend to focus on productivity; whereas, most developed countries focus on molecular biology. Interestingly, some middle-income countries (e.g., Thailand and Malaysia) had a high percentage of publications in consumption, which had high coverage by WoS and Scopus. In general, there is a loose relation between lack of coverage by Scopus and WoS, and most of the topics relevant to developing countries, with the exception of consumption.

Whatever the reason, there is no doubt that the low coverage of many low- and middle-income countries in the mainstream databases results in a very distorted perspective of the research they carry out. For example, the publication portfolio of rice for Iran in CABI shows expertise in rice production and consumption, with some work on genetics, but in WoS, only the consumption side shows up. Similarly, the publication portfolio of rice for Cuba is atypical, but interesting, because it shows that Cuban publications in molecular biology are not covered in WoS or Scopus.

There are a number of limitations in the empirical strategy adopted. At this stage, the data have not been corrected for the fact that CABI only reports the affiliation of the first author. Second, although CABI coverage of publications is possibly the largest on a subject such as rice, publications still represent a subset of the research actually carried out. In research on agriculture, many research outputs are not accounted for in publications and a lot of research is done by private companies and public organizations. Third, a bottom-up classification in terms of research topics is inevitably open to debate, although the same findings were obtained with a different clustering method.

## 3 Main messages for policy and practice

This study shows that previous assumptions about the stability of indicators across databases of scientific production may be incorrect. This case study on rice research confirms the view that publication statistics per country are very dependent on the database used. A new finding of this study on rice is that there is also a serious bias in coverage of research topic. These differences are likely to apply as well to other fields of agricultural research, particularly those related to crops less relevant in the temperate climates of industrialized nations. These results are potentially important for international organizations that work on agriculture and human development. Nevertheless, the findings do not come as a surprise given the proliferation in the last two decades of journal indexing systems at the regional level (e.g., Scielo or Redalyc)

that aim to provide visibility to local journals, often in languages other than English. These journals indexing systems exist to compensate for the fact that local science and its journals are not perceived as participating in international science.

Knowledge representation can play a significant role in framing evaluation, research strategies, and technological development policies, and this study demonstrates that topic bias in the dominant bibliometric databases deserves further conceptual and empirical discussion. This is an important issue to discuss, because biases in the representation of knowledge may inform research strategies. In particular, bibliometric reports of developing countries using dominant databases could lead to inappropriate assumptions and choices regarding domestic science bases and capabilities.

At the heart of this debate lies the question of how organizations or countries should manage and assess research priorities so as to better align science "supply" with societal needs or "demands." Because bibliometric studies are part of the governance of science and innovation, the way they represent knowledge is bound to have an effect on the understanding and prioritization of research. Judgements about the relative worth of research are influenced by dominant norms in science that tend to value more universal over local findings, pure over applied, and laboratory work over field work. The topic biases reported here may further reinforce these biases with the ultimate effect of making science and technology less appropriate for the local needs of farmers in the South. For these reasons, we believe that this apparently technical study is relevant for discussion of how the governance of science relates to inclusive innovation.

## Related Resources

Arvanitis, R. and Chatelin, Y. 1988. National scientific strategies in tropical soil sciences. *Social Studies of Science,* 18, 113–146.

Velho, L. and Krige, J. 1984. Publication and citation practices of Brazilian agricultural scientists. *Social Studies of Science*, 14, 45–62.

Vessuri, H., Guédon, J.C., and Cetto, A.M. 2014. Excellence or quality ? Impact of the current competition regime on science and scientific publishing in Latin America and its implications for development. *Current Sociology*, 62, 647–665.

# Assessing impacts of agricultural research for development in countries of the South

L. Temple, D. Barret, M.-H. Dabat, A. Devaux-Sparatakis, G. Faure, E. Hainzelin, S. Mathé, A. Toillier, B. Triomphe

Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), France

## 1 Context

The ImpresS (Impact of Research in the South) project was developed within CIRAD (French Agricultural Research Centre of Cooperation for International Development) to explore the methodological frameworks underpinning the assessment of research impacts. The objective was to develop a novel approach tailored to agricultural research in partnership with stakeholders in developing countries.

We assumed at the outset that the impact-pathway approach would be a key element of our approach as it accounts for interactions among diverse actors involved in innovation processes. The second building block was the role of institutional and organizational components involved in the transformation of research outputs by stakeholders. The development and testing of the approach to assess research impact utilized a participatory case-study approach.

CIRAD's ImpresS task force was launched in January 2014 after three years of preliminary work to develop a methodology suitable for assessing the development impact of agricultural research. Through this methodology and its application, the task force sought to cultivate an "impact culture" within CIRAD and more widely, to contribute to raising awareness among applied research institutions on how their research planning and programming impact development outcomes.

## 2 Empirical Approach

**An impact pathways approach** — ImpresS relies on a contribution analysis of the causal relationships between research inputs and impacts, structured around the iterative construction of impact pathways. The impact-pathway approach proceeds by

inference to reveal causal relationships linking inputs, outputs, outcomes, and first-level and second-level impacts, and the internal and external factors that contribute to those impacts. This process and the resulting causal chains are complex, non-linear, and not necessarily chronological, with interactions and feedback between outputs, outcomes, and impacts. This contrasts with the classical impact-pathway framework, which largely fails to account for such feedback.

**A participatory approach** – A participatory approach to evaluation helps to account for the opinions of the various stakeholder groups (those who benefit from innovation or those who are excluded) and often identifies impacts not identified by the major innovation players and leaders. The stakeholders are asked to characterize the impacts using their own descriptors, which usually consist of short statements that reflect impacts they have felt or observed.

**A case study approach** — Thirteen case studies were analyzed. They came from four continents (eight cases in Africa, two in Latin America, two in Asia, and one in Europe), and tackled a variety of innovation types and processes. Nine cases were *ex-post* case studies and four were ongoing (actual impacts still forthcoming as of 2016). Inclusion of the ongoing cases made it possible to consider initial outcomes and emerging impacts and to formulate impact hypotheses and impact-pathway scenarios. This was seen as a useful contribution to better supporting ongoing innovation processes and to creating the basis for a future impact culture within the community involved in this project. Learning situations were studied in each case.

## 3 Main Findings

We analyzed the generated the case study results in terms of four interactions that structured the impact pathways.

**The interactions giving rise to the research outputs** — A first step was to properly characterize the outputs of research activities. In some cases, outputs consisted of prototypes developed in laboratories or research stations. In other cases, they were coproduced by interactions between researchers and other stakeholders. In fact, some of the outputs related to ways of facilitating interactions between the actors to coproduce the outcomes, which were routinely developed as part of CIRAD's research partnership approach.

These results illustrated the need to analyse the system of actors as soon as the research outputs were developed. At that point, the iterative and multi-actor process allowed researchers to interact with those involved in the innovation process, to adapt their action, and to anticipate potential risks and obstacles.

**Contribution of research to the outcomes of the innovation process** — The results suggested that a systemic assessment model needs to be built and gradually refined and fine-tuned. In this model, we defined outcomes as resources building on research outputs and employed by non-researchers at different stages of the innovation process — rather than at the diffusion stage as proposed in the linear model. Outcomes arise from a research activity and therefore, at least in part, from a research intention.

These outcomes may generate feedback effects in the generation of some outputs, in the adoption and transformation of technologies by actors, and in the processes leading to first-and second-level impacts. The systemic model used by ImpresS shows that research is necessarily involved in the generation of these outcomes, and so must be evaluated from that point of view. The outcomes can also help structure institutional and policy environments that affect technological development policies. The weight that outcomes play in the innovation process varies across the case studies, and in particular depends on the importance of the technological dimension, the type of partnerships between research and other actors, and the institutional context. The study of these learning situations highlights the production of a major outcome — development capacity.

The analysis of the case studies confirmed the usefulness of a dynamic model for assessing research impacts. The structure of such a model is based on interactions between the inputs, outputs, outcomes, and impacts. The results show how the outcomes generated become key resources that enable impact generation in particular *via* learning situations. Through an improved understanding of how impacts emerge from different types of outcomes, researchers should be better able to frame research questions, implement research protocols, and anticipate the prerequisites and interactions of targeted research. CIRAD is keen to develop an impact culture among its scientists and partners to improve their ability to sustain fruitful interactions and results throughout the research process.

The results of our work provide various insights that may be useful to different stakeholders. The following list summarizes our main recommendations :

— For agricultural research institutions, research programming should take full account of the societal demands and the institutional contexts shaping innovation pathways ;
— For institutions supporting the innovation process, intermediary systems or platforms that share research results with stakeholders have a diverse and important role in achieving impact ;
— For the scientific community in charge of evaluation, the quantitative methods should be better integrated with qualitative approaches that can assess impact pathway processes to measure impacts ;
— For research managers and donors, the existing methodological frameworks should be renewed, diversified, and adapted to the specificity of research activities ; and
— All stakeholders should be given access to available databases to enrich our comprehension of the causal links between research and development.

## Related Resources

*The Impact of Research in the South (ImpreS)* Website provides background, case studies, and additional resources. `http://impress-impact-recherche.cirad.fr/impress/what-is-impress`

Joly, P-B., Gaunand, A., Colinet, L., Larédo, P., Lemarié, S., and Matt, M. 2015. ASIRPA : A comprehensive theory-based approach to assessing the societal impacts of a research organization. *Research Evaluation*, 24(4), 440–453.

Temple, L., Barret, D., Dabat, M-H., Devaux-Sparatakis, A., Faure, G., Hainzelin, E., Mathé, S., Toillier, A., and Triomphe, B. 2017. A systemic method for assessing the impacts of agricultural research for development. *Research Evaluation*, 7(2), 2018, 157–170

Temple, L., Biénabe E, Barret D, and Saint Martin G. 2016. Methods for assessing the impact of research on innovation and development in the agriculture and food sector. *African Journal of Science, Technology, Innovation and Development*, 2016, 1–12.

# Mapping international knowledge flows

## Three dimensions for a framework to evaluate transnational cooperation in research

Leonardo Costa Ribeiro[(1)], Leandro Alves Silva[(2)], Márcia Siqueira Rapini[(2)], Gustavo Britto[(2)], Eduardo da Motta e Albuquerque[(2)]

(1) Instituto Nacional de Metrologia Qualidade e Tecnologia (Inmetro), Brazil
(2) Centro de Desenvolvimento e Planejamento Regional
Universidade Federal de Minas Gerais (Cedeplar-UFMG), Brazil

## 1 Context

The internationalization of science and technology (S&T) has increased in the last few decades, and magnified the tension between national systems of innovation (NSIs) and transnational technology. This internationalization of science and technology has two main drivers : the cosmopolitan nature of science, which connects universities from different NSIs, and the international operation of large transnational corporations (TNCs). The shift that has taken place in the production and application of scientific knowledge has important implications for countries in the South. This study investigated the current level of tension between NSIs and transnational technology, and explored the evidence for the rudiments of a global innovation system. The conjecture was that the level of internationalization of S&T achieved thus far might be underestimated. This may explain why there is only limited literature about a global innovation system. An important public policy challenge for the South is how to support domestic investment in S&T and ensure inclusion in international knowledge flows.

## 2 Empirical Methods and Main Findings

Three avenues were pursued to investigate the rudiments of a global system of innovation : transnational corporations and their networks of firms and subsidiaries, which are a source of significant knowledge flows ; international patents, which offer

information about cross-border knowledge flows ; and international cooperation in the authorship of scientific papers.

**An emerging global innovation system** — Current changes in the global economy stress the growth of both internationalization and knowledge about economic dynamics. Those combined changes —with positive feedbacks between them — prepare the ground for an emerging global innovation system. There is a considerable and growing literature on the internationalization of R&D that suggests there has been an increase in the level of internationalization of R&D and international knowledge flows. However, recent statistical analysis of the internationalization of R&D suggests that this process might have reached a turning point. A question emerges : can we actually capture all forms of internationalization that are taking place ?

TNCs are key entities that connect different NSIs in very dynamic ways through both subsidiaries and universities distributed in different countries. Of course, the specific knowledge flows around or within TNCs do not include all possibilities. Science in itself is an international endeavour, exemplified by the foreign exchange of students, scientists, books, and papers. International collaboration in science, as measured by papers with co-authors from different countries, is growing. TNCs may now have the ability to connect research efforts globally, using channels of information that go beyond published papers.

Other indirect relationships may exist between a TNC and a foreign university through a local firm that interacts with a local university and has a technical or economic relationship with a firm headquartered abroad. Another international flow might be an acquisition by a TNC of a firm that is a spinoff from a foreign university. This mosaic of international knowledge flows clearly illustrates the diverse sources of tensions between transnational technology and NSIs.

## 3 Empirical Approach and Main Findings

**TNCs and their subsidiaries** — The spread of networks of TNC subsidiaries multiplies the sources of internationalization. As multinational companies continue to develop international networks to exploit foreign centres of excellence, these networks become the basis for productive and innovative global networks. Data from Orbis, a database that collects information about private companies in a wide range of countries, was used in this study. The database covers more than 96 million companies in 210 counties. Almost 90% of these firms are from the manufacturing industry, which consists in all enterprises not listed as financial, insurance, or as any type of commercial business, including non-financial services. Data from more than 1400 variables grouped in 21 categories can be obtained about these companies.

The data used was a subgroup of the Orbis data. The concept of Global Ultimate Owner (GUO) was used to identify companies that either directly or indirectly own more than 50% of their working capital. Companies controlled directly or indirectly by a GUO were considered subsidiaries. In this case, a subsample of 874 of the world's largest GUO, ranked by number of employees, revenue, and profit, were selected. Theses GUOs controlled 139,541 subsidiaries, of which 87,344 operated overseas and

were ultimately controlled by 784 multinational enterprises (MNE). The home country of the largest number of GUOs was the USA, with 262 companies, followed by Japan with 211 companies, the UK with 58 companies, and Germany with 44 companies. In all, 55 countries hosted the headquarters of MNEs, of which 26 were developed countries and 29 were developing counties. Considering foreign subsidiaries, the USA is home to 232 companies and hosts 412 GUOs controlled by foreign countries.

The ranking of countries by the number of MNEs did not differ significantly from that of the total number of GUOs. Considering subsidiaries only, 262 GUOs located in the USA controlled 47,695 companies, of which 25,036 were located abroad. The UK hosted the largest number of foreign subsidiaries (9417), which are controlled by 511 GUOs around the world. The USA hosted 9161 companies, which were controlled by 412 GUOs abroad. The ratio between the number of subsidiaries controlled abroad and the number of subsidiaries hosted provides clues as to each country's status in terms of internationalization. For example, this ratio for the USA was 2.7. This is in stark contrast to Japan, where the ratio was over 10. The same ratio for Europe as a whole was 1.2, and ranged from 0.7 for the UK to 3.8 in Switzerland. When developing countries were considered as a group, the ratio was 0.5, consistent with an inward pattern of internationalization. However, some countries, such as South Korea and Taiwan, had ratios of 1.4 and 1.5 respectively, which were a lot closer to European standards. China was a case apart with a ratio of 0.06 (it hosted 4436 subsidiaries, but its TNCs controlled only 278 subsidiaries abroad).

Advantages stemming from access to capital, scale economies, organization, technology, and expertise in international operations, allow firms to overcome barriers of entry to foreign markets. Therefore, the number and the variety of countries in which subsidiaries of MNEs operate can indicate the advantages of the host country that can be exploited by companies from abroad.

**Triadic patents as indicators of international flows** — Triadic patents are patents that are filed for the same invention in the USA, Europe, and Japan patent offices. While their value is debated, they serve as a useful guide to evaluate technological performance of nations and sectors. Patstat's database, with data from 2000 to 2010, was the source of data on triadic patents. Four established and two new internationalization measures were used. The four established measures are : assignee-author, GUO-assignee, co-author, and co-assignee. In addition, the two new measures were : citation of foreign ISI-indexed papers, which grew from 1.5% in 2000 to 2.5% in 2010 ; and the citation of foreign patents, which in 2000 showed that a total of 88% of the triadic patents had at least one citation of a foreign patent, a proportion that peaked at 2005 with 91% and in 2010 was in 90%.

Regarding the four internationalization indicators used in the literature, the results for 2010 were : international flow Assignee-Author 11% ; international flow GUO-Assignee 4% ; international flow co-authorship 7% ; and international flow Assignee-Assignee 1%. These data are higher than reported in the literature. There has been a consistent increase in patents with non-patent references (NPRs) — from 53.7% in 2001 to 69.5% in 2010. Those NPRs may be a source of important information about the relationship between technology and science and engineering fields.

**ISI-indexed papers and TNCs in international flows of science** —Data on co-authored papers between universities and research institutions in different countries reveals linkages between different systems of innovation. According to the National Science Foundation (NSF), in 2012 the world published 2,019,563 ISI-indexed documents (articles and abstracts) and 329,190 had at least one cross-border co-authorship (16%). The USA led in both papers and papers with international co-authors. The main difference compared with the ranking of patents is China, which was in second place in terms of both total articles and articles with international co-authors. Countries at the periphery generally moved down in rankings in total papers and internationally co-authored papers : India (from 9th to 17th), Brazil (from 13th to 15th), Turkey (from 16th to 30th), Iran (from 17th to 25th), and Russia (from 18th to 21st). These data suggest that immature NSIs have problems with their international connections.

International networks of scientific institutions connect different systems of innovation, and are a source for creating new international interactions with firms and universities. Firms also invest in basic science and publishing research results. Preliminary data analysis shows that at least 71,671 papers were published by firms (about 1.74% of global scientific production). Findings show that the leading firms are from the pharmaceutics and biotechnology and electronics and computing sectors, and include firms in Japan, China, and South Korea. Papers published by companies may involve three different types of international knowledge flows : a cross-border flow between two subsidiaries working together ; a flow between a MNE laboratory and a foreign university ; and a flow between a subsidiary and a local university. Co-authorship between firms in different countries showed that the majority are co-authored between two units within a transnational corporation.

**South–South international flows** — A preliminary evaluation was made of three different tensions between the international knowledge flows and the national innovation systems. The first source was the TNC itself. Transnational firms have grown larger and more global — 874 TNCs have 87,344 subsidiaries abroad. These subsidiaries are more distributed throughout the world and over time begin to have more autonomy and initiative, which leads to more interactions within the innovation system that hosts them. The size of those networks, which connect tens of thousands of subsidiaries, erodes the notion of a 'national'innovation system. The second source is the technological and innovative activities of transnational firms when TNCs integrate their subsidiaries in cross-border R&D to take advantage of specializations and contributions of different national systems of innovation. The third source is the scientific infrastructure, an increasingly international system that connects universities, research institutions, and firms. Research always crosses borders and integrates teams from different countries. The complexity of international networks increases the myriad of possible interactions between universities, firms, and research institutions.

This study presents some introductory hints about the participation of the South in international knowledge flows. Ten countries in the South ranked among the 30 leading countries with TNCs ; 7 countries in the South were within the 30 leading positions in the ranking of triadic patents ; and 9 countries in the South were among the 30

leading positions in the ranking of ISI-indexed documents. These relative positions are the basis for participation in international flows.

Regarding TNCs and their subsidiaries, 172 firms had their GUO located at the periphery, and among them, 148 TNCs also had subsidiaries located at the periphery — a total of 2766 subsidiaries were located at the periphery. Those South–South connections represent flows of tacit knowledge. Regarding triadic patents, international flows captured in cross-border patent citations showed the position of the South. In terms of pairs of countries sharing patents, South Korea and Taiwan were ranked 80th globally, with China and South Korea (87th), China and Taiwan (180th), India and South Korea (356th), Brazil and South Korea (384th), Russia and Taiwan (472nd), Taiwan and South Africa (474th), and China and India (510th). Of course, countries from the South that formed pairs with developed countries were in better positions (South Africa and USA 127th ; Brazil and USA 149th ; and India and USA 83rd). Regarding international co-authorship of ISI-indexed papers between countries, in the first 40 positions, there were 8 pairs with one country from the South. China's pair with the USA led the ranking. Pairs between countries from the South began at the position 68th (China and South Korea with 2056 papers). Other examples of South–South pairs were Egypt and Saudi Arabia (122nd), Brazil and Argentina (233rd), India and China (237th), Brazil and China (252nd), Iran and Malaysia (347th), Brazil and Mexico (348th), Brazil and India (387th), and Brazil and South Africa (459th).

The provisional conclusion is that the South has identified links with the ongoing process of internationalization of S&T, which are smaller than the links between developed countries. But the identified links show that the South is contributing to the broader internationalization process, a key component of the emerging global knowledge economy.

## 4 Main messages for policy and practice

The important shift in the production and application of scientific knowledge has deep implications for countries in the South (low and middle-income countries). There are two major implications : first, as technology becomes more dependent on science, significant investments in scientific infrastructure are a precondition for technological catch up ; and this growth in the scientific dependence of technology goes hand-in-hand with an increase in the internationalization of knowledge flows. Therefore, the South may be facing a new challenge as a consequence of an emerging global system of innovation. Those two major implications have one important public policy challenge for countries in the South : investments in S&T must be made domestically with a clear international strategy to promote international knowledge flows.

The research tools explored in this study may contribute to the planning and monitoring activities of policy analysts and decision makers. Further development of those tools may help understand sectors, S&E fields, and how a combination of challenges, weaknesses, and strengths may guide transnational collaboration in research and strengthen the formation of a global innovation system.

The use of different techniques to quantify and map international knowledge flows helps to evaluate the multidimensional nature of transnational cooperation in research. The use of information on TNCs, their headquarters, and the spread of their subsidiaries help to map the complex transfer of tacit knowledge, key for both new technologies and for putting forward new problems for scientific institutions — maps of those flows can contribute to an assessment of the resources of the South, and the direct links between countries at the periphery. The use of patent statistics highlighting how internationalized those flows have become an element probably underestimated in other analysis, and also indicated the presence of flows that link countries of the South. Finally, the analysis of ISI-indexed documents and articles, as predicted, indicated the most internationalized flows were those linking universities, firms, and countries.

Transnational flows of tacit and codified knowledge connect different NSIs and create the rudiments of a global innovation system. It is a challenge for policy analysts and decision makers who must begin to realize that this international dimension is a topic of growing importance and of relevance for the day-to-day activities of scientists and engineers.

## Related Resources

Britto, G., Camargo, O.S., Kruss, G., and Albuquerque, E.M. 2013. Global interactions between firms and universities : global innovation networks as first steps toward a Global Innovation System. *Innovation and Development*, 3(1), 71–88. Ribeiro, L., Kruss, G., Britto, G., Bernardes, A., and Albuquerque, E. 2014. A methodology for unveiling global innovation networks : patent citations as clues to cross border knowledge flows. *Scientometrics*, 101(1), 61–83.

# Dynamics of South–South cooperation in health biotechnology

Halla Thorsteinsdóttir[(1)], Sachin Chaturvedi[(2)]

(1) Small Globe and Institute of Health Policy Management and Evaluation
University of Toronto, Canada
(2) Research and Information System for Developing Countries (RIS), India

## 1 Context

South–South cooperation (SSC), or cooperation between low- and middle-income countries, has been high on the development agenda for decades, but there is now increased expectation that such cooperation will involve research that provides solutions to regional and global challenges. Multilateral fora, such as the United Nations, are calling for increased SSC as a strategy to implement the Sustainable Development Goals. With the growing economic might of emerging economies, there are expanded opportunities to work together in a wide spectrum of areas ranging from education, to social development, to science intensive endeavours. These countries have become emerging donors and are shaping a new frontier of development cooperation. Despite the increased recognition that SSC is playing a growing role in promoting social and economic development, the evidence is still sparse on the dynamics of SSC and what strategies are needed for this cooperation to have impacts. Many climate induced problems, health problems, and other modern challenges demand concerted international research efforts to address them in an efficient manner and to use limited resources effectively.

Cooperation between low- and middle-income countries started to grow after World War II, when many countries obtained their independence and wanted to decrease their trade reliance on Northern markets. Although Southern countries are vastly different in size and economic development, they share many common environmental, health, and climate-induced problems. SSC affords the possibility of learning from one another to address these challenges. Although SSC constitutes a promising venue for low- and middle-income countries to strengthen their scientific and economic status, there is a need to evaluate its potential to address shared challenges.

A number of key principles and objectives of SSC have been identified since the 1950s : strengthen national and collective self-reliance ; reap mutual benefits ; do not interfere in the domestic affairs of cooperating countries ; be demand driven ; increasingly involve the private sector ; and promote sustainable development. Although these principles define the parameters of SSC, the question that still remains is : how can science-intensive cooperation be an effective agent of change and development ? For science-intensive cooperation to be effective, it cannot be perceived to be only between individuals, firms, or institutions. Instead, for innovation to take place, it must be aligned with, and involve, interactions among the larger set of institutions that contribute directly to new arrangements and innovation.

Innovation systems include formal institutions such as universities, research centres, health centres and clinics, firms, and government, including state policies and regulations such as biosafety and intellectual property (IP) laws. They also include informal institutions such as social and cultural norms. Interaction among these institutions contributes to a process of innovation that is non-linear and multidirectional. Learning and problem solving are central concepts of innovation systems. Learning-by-doing, by-using, and by-interacting among producers and users of knowledge is characteristic of the cumulative and continuous nature of innovation systems.

## 2 Empirical Approach and Main Findings

This research examined SSC from an innovation system perspective to understand how collaboration can cultivate new solutions, products, or services in the health biotechnology sector. The research was guided by two questions : how is SSC in health biotechnology shaped by the stated principles of SSC ; and, how is SSC in health biotechnology shaped by cooperation with the innovation systems in the participating countries ?

The research involved further analysis of an earlier large-scale project on SSC in health biotechnology in collaboration with researchers from Brazil, Canada, China, Egypt, India, South Africa, and Zambia. Health biotechnology is a science-intensive sector that typically involves active contributions from both public and private institutions. Many of the agreements developing countries are making single out cooperation in health and biotechnology. The research used multiple methods : a survey of biotechnology firms about their SSC ; a scientometric analysis of research collaboration using co-authored publications in international peer reviewed journals ; and case-study research on health biotechnology in 13 developing countries that examined both research and entrepreneurial cooperation.

Data collection was aimed at examining the opportunities, challenges, and impacts of the SSC and identifying strategies to strengthen cooperation and its contributions to global health and innovation. The cases examined bi-national cooperation between two low- or middle-income countries. Data were collected on existing health-biotechnology cooperation to learn from researchers and entrepreneurs who had direct experience with SSC. The research focused on these cases of bi-national cooperation : Brazil with Argentina and Cuba ; China with India, Thailand, and Cuba ; Egypt with China and

Jordan ; India with Brazil and Bangladesh ; South Africa with Kenya and Zambia ; and sub-Saharan Africa (Kenya, Nigeria, and South Africa) with China and India.

The case study research relied heavily on interviews with health-biotechnology researchers and entrepreneurs who were asked about their cooperation experiences. In each country, policymakers, representatives from drug regulatory agencies, and intellectual property rights experts were interviewed to gain better insights into : the policies and programs in place to promote SSC ; and how institutions such as the regulatory and intellectual property regimes impact SSC in health biotechnology. A total of 348 individuals were asked in face-to-face settings about their views on SSC and their specific collaborative projects. All interviewees were also asked how to strengthen SSC, how to improve health impacts on local populations, and how to strengthen local innovation.

In addition, other sources of data such as background information, policies, statistics, scientometric data, and firm-survey data were used. The analysis of the case studies combined qualitative analysis gleaned from the in-depth interviews with descriptive quantitative indicators such as policies, statistics, and scientometric data. This research identified some key impacts of SSC on health biotechnology that may help understand how this collaboration is being shaped.

**Extended capacity in health biotechnology** — A strong message was that SSC helped countries to build capacity in this science-intensive field. This confirmed that a number of developing countries have built capacity in health biotechnology that is in demand in other low- and middle-income countries and can be deepened through their cooperation. Capacity building was important to different groups. Researchers obtained training in advanced methods through their SSC and technology was transferred systematically between firms through their entrepreneurial cooperation. The capacity-building impact of SSC was important both to countries that are relatively weak in health biotechnology and other countries that have strengths in the field. The capacity-building emphasis of the SSC reflected the principle that the SSC should strengthen the self-reliance of low- and middle-income countries. Southern countries are working together to expand capacity in this science-intensive field and lessen their reliance on imports. This was true both for countries with limited capacity in health biotechnology and for countries with greater strength in the field.

**Focus on local health problems** — This research provided considerable support to the notion that SSC strengthens the ability of developing countries to address common health problems themselves. By working together, researchers gained access to each other's expertise, samples, research infrastructure, and other resources and enhanced their ability to form a critical mass to focus on their shared health problems. The research identified a number of examples of diseases that SSC focused on that were regional or predominantly afflicted people in developing countries (e.g., cholera, malaria, and Chagas disease). SSC frequently involved low-income countries, for example, in Africa where cooperation has focused on HIV/AIDS and malaria, and in Bangladesh and eastern India on cholera.

There was a strong message in the case-study research that SSC was more likely to focus on health needs of developing countries than North–South cooperation. Ac-

cording to the interview evidence, SSC is likely to be more focused on a Southern research agenda and make greater attempts to improve health problems prioritized by developing countries. SSC therefore appears to be shaped by the principles of being demanded driven and promoting mutual benefits. It is, however, a complex and risky process to develop new health solutions. SSC could reduce the risk by stable and dedicated resources. Governments have so far allocated relatively few resources to fund cooperation between developing countries and the interviewees stressed that this had hindered collaboration. In general, resources for North-South cooperation were more easily available and typically provided by high-income countries.

**Ability to leverage local resources** — Research identified the enhanced ability SSC to leverage local resources. This was the case when countries had particular biodiversity or traditional knowledge that could be harnessed for developing health products and for economic means. Some countries such as China and India have been able to develop an industry based on their biodiversity and traditional medical knowledge. With increasing global demand for such medicines, there is growing interest among developing countries, particularly in Africa, to start systematically harnessing these resources. Researchers in some low- and middle-income countries felt that that they lacked the scientific grounding to harness their traditional medicine and wanted to learn from countries such as China and India. The demand could be for technical expertise on how to isolate and screen plant extracts and on how to analyse and synthesize compounds. In other cases, there has been a demand for SSC to learn how to commercialize products based on traditional medicine and biodiversity.

Southern countries seek to build expertise in diverse aspects of the commercial process : regulating traditional medicine based products ; standardizing traditional medicine products and production ; arranging for patent protection ; managing traditional medicine databases ; learning how benefit sharing can be arranged with those who possess the original knowledge ; and preventing exploitative practices, both domestically and internationally. There have been some impacts of SSC in strengthening the ability of Southern countries to exploit their traditional medicine and biodiversity, but it is at an early stage and growth of SSC is likely, particularly if global demand remains strong. The emphasis on leveraging local resources reflected the principles of strengthening self-reliance through SSC and of increasingly involving the private sector in commercialization.

**Availability of relatively affordable health products** — The main driver for SSC reported in the survey of biotechnology firms was to gain access to each other markets. In general, trade between developing countries has been increasing. Interviewees reported that the products disseminated by SSC were generally lower in price than those supplied by multinational pharmaceutical firms. Internet searches supported this observation. SSC reflected the principles of reaping mutual benefits for both participating countries and involving industry in the cooperation.

It can be challenging for firms in developing countries to enter each other's markets. For collaboration involving manufacturing or development of health products, it can be a challenge to deal with regulatory systems in both participating countries. Some of the countries had immature regulatory systems, which added a special difficulty for

putting health products on the market. In other cases, some tests had to be repeated or different types of information were required for the regulatory process. Other challenges commonly cited were the excessive time and the high cost of moving products or ingredients across international borders. These challenges represent misalignments between the innovation systems in the participating countries and reflect how the characteristics of these systems are shaping SSC.

## 3 Main messages for policy and practice

The research reported here shows that SSC in health biotechnology can : extend capacity in this science-intensive field ; strengthen innovation potential ; and provide future health benefits. The cooperation is both shaped by the stated principles of SSC and the characteristics of the innovation systems in the participating countries. Enhanced capacity in health biotechnology has expanded the scope for SSC in this science-intensive field and opened the door for South–South learning. Shared health needs encourage SSC and result in growing research that is focused on needs of developing countries. SSC can both provide health solutions to developing countries' problems and contribute to economic gains based on harnessing a science-intensive field. The cooperation appears to be well aligned with some of the key principles of SSC such as, strengthening self-reliance, reaping mutual benefits, being demand-driven, and increasingly involving industry and the private sector.

Cooperation is shaped by the alignments (or lack thereof) of the innovation systems in the participating countries. Based on this research, the proposed framework involves looking at SSC as interactions between the innovation systems in the participating countries. For SSC to have impacts, attention needs to be placed on calibrating the systemic alignments to allow knowledge and other resources to flow between the countries.

First, to strengthen SSC there is a need for a greater dialogue between developing countries. Developing nations need to consider SSC to be a part of their science, technology, innovation, and health promotion plans. When the cooperation is better integrated in the innovation systems of the participating countries, it increases the likelihood of impact both in health and other science-intensive sectors.

Second, there can be funding misalignments when one participating country provides considerably more resources to the cooperation than the other. This can inhibit joint initiatives between the countries, as one country may not be able to finance the collaboration. It can also lead to unequal roles in the cooperation as the country providing the resources may have greater influences on shaping the partnerships. In general, governments need to invest more in SSC to allow their countries to work together, particularly on research. Another possibility is to explore the potential of triangular cooperation involving high-income countries.

Third, there are misalignments in entrepreneurial cooperation. When firms in two countries are engaged in joint development of a health product, the regulatory process may be unnecessarily cumbersome. If the regulatory systems have the opportunity to collaborate, exchange information about each other's requirements, and align their

processes, development is likely to be less challenging. There were also systemic misalignments in the customs systems in developing countries, resulting in exporting and importing taking a relatively long time. Innovation is increasingly global and takes place in more than one country to take advantage of diverse comparative advantages. The lack of alignment in regulatory systems and customs procedures can thwart this global innovation process. To promote innovation it is not enough for governments to sign agreements and set up joint funds ; they must work together to align their innovation systems and pay attention to their interactions.

## Related Resources

Chadurvedi, S. 2015. *The logic of sharing : Indian approach to South–South cooperation*. New Delhi : Cambridge University Press.

Chaturvedi, S., Fues, T., and Sidiropoulos, E. (Eds.). 2012. *Development cooperation and emerging powers : new partners or old patterns*. London : Zed Books.

Thorsteinsdóttir, H. (Ed). 2012. *South-South collaboration in health biotechnology : growing partnerships among developing countries*. Ottawa and New Delhi : IDRC and Academic Foundation. Available on www.idrc.ca

Thorsteinsdóttir, H., Ray, M., Kapoor, A.K., and Daar, A.S. 2011. Health biotechnology innovation on a global stage. *Nature Reviews Microbiology*, 9(2), 137–143.

Thorsteinsdóttir, H., Melon, C.C., Ray, M., Chakkalackal, S., Li, M., Cooper, J.E., Chadder, J., Saenz, T.W., de Souza Paula, M.C., Ke, W., Li, L., Madkour, M.A., Aly, S., El-Nikhely, N., Chaturvedi, S., Konde, V., Daar, A.S., and Singer, P.A. 2010. South–South entrepreneurial collaboration in health biotech. *Nature Biotechnology*, 28,Pages : 407–416.

Thorsteinsdóttir, H. and Sáenz, T.W. 2012. Tackling meningitis in Africa. *Science*, 338, 1546– 1547.

# Research Cooperation on the Sustainability of the Marginal Seas of South and East Asia

Lourdes J. Cruz[(1)], Mohd. Nordin Hasan[(2)], Toshio Yamagata[(3)], Annadel Cabanban[(4)], Marie Antonette Menez[(4)], Fadzilah Binti Abdul Majid[(5)]

(1) National Academy of Science and Technology, Philippines
(2) ICSU Regional Office for Asia and the Pacific, Malaysia
(3) Applications Laboratory, Japan Agency for Marine-Earth Science and Technology (APL JAMSTEC), Japan
(4) University of the Philippines Diliman, Philippines
(5) University Malaysia Sabah, Malaysia

## 1 Context

The South and East Asian marginal seas are vulnerable to rapid coastal population growth, overharvesting of marine biological resources, and pollution. The region's marine ecosystems have more than 30% of the world's coral reefs and produce about 40 million tons of fish and more than 80% of the world's aquaculture products. The high extraction volume of marine bioresources, rapid population growth, and far-reaching economic development increasingly test the limits of these seas to sustain the ecosystem services that drive economic growth and development in the region. The conservation and management of marine resources and ecosystems, while coping with the pressures of climate change/variability and other global changes either brought about or augmented by human activities, are immense challenges that require cohesive transnational endeavours in the region and the rest of the world.

The Sustainability Initiative in the Marginal Seas of South and East Asia (SIMSEA) is an international alliance of physical, ecological, and social scientists working together to meet the regional challenges of biodiversity conservation, sustainability of marine ecosystem services, and protection of human well-being in light of population pressure, environmental degradation, extreme weather events, and climate change/variability. The objectives are to : co-design an integrative program that would establish the sustainability of the marginal seas of South and East Asia ; and play a catalytic role in projects and programs to facilitate scientific cooperation for the benefit of societies.

The overall goal is to generate knowledge that can bring about transformative change toward sustainability in the marginal seas of South and East Asia, and contribute toward sustainability at the global level.

SIMSEA has adopted the Future Earth design principles of inclusiveness and transdisciplinary research and seeks to align research to meet the needs of the UN Sustainability Development Goals (SDG). Although there is still no framework for promoting scientific collaboration in the region, research institutions from several countries have in the past joined forces to better understand the sustainability challenges facing marginal seas with programs such as the UNEP Regional Seas Programme and the Coral Triangle Initiative, a multilateral partnership of six countries working together to sustain marine and costal resources in Southeast Asia. While currently funded by ICSU and participating agencies, SIMSEA provides another model of collaboration that could be deepened and extended to other areas where science can inform public policy. If South and East Asian nations are to address collective challenges, they need to develop platforms that would enhance multinational research collaboration in the region.

**The Coral Triangle Initiative (CTI)** — The Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CRFF) (Foale *et al.* 2013) is an example of a North–South conservation program involving six countries (Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor Leste). The North includes a consortium of NGOs and bilateral donors that fund projects that will contribute to the five CTI goals : designate and effectively manage priority seascapes ; apply an ecosystem approach to management of fisheries and other marine resources ; establish and manage marine protected areas ; achieve climate-change adaptation measures ; and improve the status of threatened species. Scientists involved in CTI believe that the relationship between the North–South partners of NGOs and national governments is equitable. The South approves and endorses the activities and projects, while the North provides the financial resources and expertise for the projects and activities and provides financial contributions for operations of the Regional Secretariat based in Indonesia.

## 2 Empirical Approach and Main Findings

**Development of SIMSEA** — The idea for a sustainability initiative in the marginal seas of East Asia emerged in 2013 and evolved as a regional initiative that espouses scientific excellence through transdisciplinary research, while promoting inclusiveness *via* co-design and co-production with relevant stakeholders. Several meetings and consultations were held to formulate and refine strategies and plans for the initiative. At a pre-scoping workshop held in February 2014, the participants underscored the importance of having a standardized set of indicators to assess ocean health, the value of transdisciplinary collaboration among natural scientist and social scientists, and the need to encourage and train young scientists to ensure continuity of the program.

An electronic survey was sent to key researchers to come up with a preliminary list of priority areas in preparation for the prioritization workshop. Researchers and scientists with expertise in physical, ecological, and social sciences convened to initiate

the collaborative planning and implementation of research to improve the health of marine and coastal ecosystems and their resilience and to ensure the sustainability of ecosystem services, development, safety and security in the region. The participants agreed on the vision for SIMSEA as an international alliance of physical, ecological, and social scientists working toward the sustainable development of coastal and marine areas. For marginal seas, the vision was resiliency characterized by : sustainable fisheries ; conservation of marine biodiversity ; adaptation to climate change ; blue economy ; nations with ocean literacy ; healthy seas for human well-being ; and appropriate governance. Group discussions resulted in the following outputs : schematic diagrams of the links among physical, ecological, and socioeconomic research topics and clusters of research questions ; a list of prioritized research topics and schedule of implementation ; and a list of transdisciplinary questions/topics for planning the SIMSEA research agenda in 2015-2020 (and beyond) according to the three main research themes of Future Earth (dynamic planet, global sustainable development, and transformations toward sustainability).

The first SIMSEA Regional Symposium will be held on 26-28 September 2016 in Quezon City, Philippines to provide an opportunity to better understand the institutional, political, and economic conditions driving changes in the marginal sea. Over 100 scientist and stakeholders in the region will focus on designing a holistic socio-ecological research program on the marginal seas for sustainability in Asia.

**Organizational structure** — SIMSEA is a key program under the priority area on Ecosystems of the International Council for Science, Regional Office for Asia and Pacific (ICSU-ROAP). A SIMSEA Science Steering Committee (SIMSEA SSC) was established in July 2014, and has reiterated the need to emphasize co-design of solutions-oriented research and to involve more social scientists particularly in the design and conduct of research on transformations to sustainability in the marginal seas of South and East Asia. The SSC is optimistic that inclusive transdisciplinary research will provide a deeper knowledge of phenomena and processes important to the sustainability of marginal seas.

The SIMSEA program office hosted by the University of the Philippines operates using seed funds provided by ICSU. SIMSEA now has six institutional partners (, accessed June 27, 2017) : the Atmosphere and Ocean Research Institute (AORI), University of Tokyo ; the Application Laboratory, Japan Agency of Marine-Earth Science and Technology (APL JAMSTEC) ; the Marine Science Institute, University of the Philippines (UPMSI) ; the Research Unit for Ethnography and Development, Universiti Malaysia Sabah ; the Institute of Oceanography and Environment (INOS), Universiti Malaysia Terengganu (UMT) ; and the Institute of Marine Sciences (IMS), University of Auckland, New Zealand. National SIMSEA alliances are now in different stages of development in Japan, Malaysia, Philippines, Thailand, and Indonesia. Links are being explored with other regional and international institutions such as the Southeast Asia Fisheries Development Center (SEAFDEC).

The initial institutional partners have had long-standing interests in promoting international scientific collaboration ; however, only one or two institutions had been involved in sustained collaborative activities within a regional framework. SIMSEA

will strive to provide this missing regional framework, design a research program, and help coordinate program funding. Through these arrangements, partners will seek to jointly tackle shared challenges such as marine and regional air pollution, resource scarcity, climate change/variability and biodiversity among coastal communities. The creation of SIMSEA is enabling change in collaborative research in Asia and the Pacific to include : the possible emergence of new organizations to steer public research or promote innovation and new programmatic directions within such organizations ; identification of new sources of funding dedicated to research in the marginal seas and in academic settings ; and new domestic and international partnerships seeking to expand participation in and application of research. These are the ideals shared by Future Earth that would create a complex Web of partners within which resources circulate knowledge in ways that are reshaping research systems in Asia and the Pacific.

**Promotion of SIMSEA and Future Earth** — Future Earth recently recognized SIMSEA as one of its programs in Asia. SIMSEA will propose a collaborative platform to share knowledge and expertise (science for society) ; work for solutions to improve livelihoods and enhance resilience to unwanted environmental change/variability, hazards, and disasters ; and support transformation toward sustainability. Members of the SIMSEA SSC have actively promoted SIMSEA and its sustainability goals through presentations and discussions in conferences and meetings, and will continue to do so at national and international meetings.

## 3 Main messages for policy and practice

**SIMSEA as a regional research collaboration** — SIMSEA was initiated by scientists representing North and South who are members of the ICSU Regional Committee for Asia and the Pacific. National funding agencies and ministries provided some initial support in the development of the SIMSEA concept but the bulk of financial support for the development of SIMSEA came from funds provided by ICSU. It is doubtful if national research funding agencies can facilitate transnational cooperation without the prior development of a framework for a regional research program that spans several countries. National funding agencies can then fund that portion of work involving particular countries. SIMSEA national committees can individually host meetings to synthesize research results from individual countries and generate a regional outlook based on the framework that was developed at the beginning of the program. This is the value of adopting the SIMSEA approach when developing a regional research program.

Governments in ASEAN should view the approach adopted by SIMSEA as a model for the development of coordinated collaborative research in the region that can contribute to joint program implementation and joint policy support when a regional outlook is vital for coherent policy development. The recent severe air pollution episodes in some ASEAN countries are related to both human activities and climate variations due to the El Niño-Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD), which originate in the tropical Pacific and tropical Indian Ocean, respectively (Ashok *et al.* 2003). This is a good example of the need for collaborative

research and planning between several countries to contribute to better implementation of mitigation measures including prediction activities at the regional level to combat air pollution.

Most governments do not support research of a regional nature. In the example of SIMSEA, a bilateral collaborative program is being developed but this will enable only two countries to engage and the effect will be limited, unless similar multilateral projects are developed between the North and the South in the SIMSEA region. In addition to funding restricted to two countries per project, we need to pursue funding to support development of borderless regional research. However, the idea of a regional research program such as SIMSEA could only be possible through something like the fund made available through ICSU as a seed budget. The Regional Offices of ICSU can play a key role in serving the collective interests of governments in the region and international bodies including philanthropic foundations.

**SIMSEA as a North–South cooperation** — SIMSEA is being developed in line with the design principles of Future Earth, which emphasize both inclusiveness and transdisciplinary research. Inclusiveness requires involvement of relevant stakeholders in designing a project (co-design), carrying out the study (co-production), monitoring of progress, and equitable sharing of benefits.

From its inception, SIMSEA has involved scientists from the North and South. Although only eight countries participated in the pre-scoping workshop and six in the scoping or research prioritization workshop, the 2016 SIMSEA Regional Workshop is being organized to involve as many countries in the region as possible. Likewise, the level of inclusiveness will be improved in terms of fields of expertise, distribution of age groups, gender and involvement of stakeholders from the community, business sector, government organizations, and NGOs.

North–South borderless collaboration today is a far cry from what it was three decades ago. The history of collaboration in biodiversity and natural products research shows that a united voice from the South initiated a change in the relationship between the well-funded institutions of the North and the institutions of the South that had access to bioresources. Today, North–South collaboration on bioresources is guided by the Convention on Biological Biodiversity and the Nagoya Protocol on Access and Benefit Sharing.

The Coral Triangle Initiative is an example of a well-funded transnational collaboration that was developed by institutional entrepreneurs in collaboration with initial involvement at the highest level of governments. In terms of the design principles of Future Earth, how inclusive is this program ? What is the involvement of communities in the program ? To what extent was this co-designed and at what level ? For medical research, the Council on Health Research for Development has developed the COHRED Fairness Index that provides a recognized global benchmark of good practices in health research collaborations involving LMICs (Musolino *et al.*, 2015 ; http ://www.cohred.org). The aim is to ensure research collaboration where there is equitable distribution of outputs and benefits to all partners. In these regards, further study and adoption of good practices in warranted.

An ongoing concern is when scientists in the North propose a project (especially those related to natural resources and oceans) and include a token list of scientists from the South as a means of gaining access to samples or to research areas for their own ends. SIMSEA aims to address this issue and ensure adherence to international ethical guidelines and the laws promulgated by participating countries for a really sustainable world with people having wellness and well-being. Following the example of COHRED and the CBD, perhaps a code of ethics can be drawn to guide North–South collaborations toward fair and mutually beneficial partnerships.

## Related Resources

Foale, Simon, Debi Adhuri, Porfirio Aliño, Edward H. Allison, Neil Andrew, Philippa Cohen, Louisa Evans, Michael Fabinyi, Pedro Fidelman, Christopher Gregory, Natasha Stacey, John Tanzer, Nireka Weeratunge. 2013. Food security and the Coral Triangle Initiative. *Marine Policy* 38 :174-183.

Ashok, Karumuri, 1zhaoyong Guan, and Toshio Yamagata. 2003. A Look at the relationship between the ENSO and the Indian Ocean Dipole. *Journal of the Meteorological Society of Japan* 81 :41-56.

Musolino, Najia, Janis Lazdins, Jacintha Toohey, and Carel IJsselmuiden. 2015. COHRED Fairness Index for international collaborative partnerships. *The Lancet* 385 :1293-1294.

# New trends in knowledge generation lift research cooperation in Africa

Margaret Wanjiku

Sub-Saharan Africa Research and Policy Institute, Kenya

## 1 Context

A variety of factors have triggered and intensified international research cooperation. Some of these include the severity of current global policy challenges such as climate change, communicable diseases, international financial instability and the fight against terrorism. These are concerns that no single country can effectively resolve on their own. Knowledge sharing is crucial to understand practical experiences and to inform development and policy implementation. An attraction for South–South cooperation arises out of their similar development experiences and challenges, which enables them to understand their collective circumstances better, learn lessons, and adapt with more relevant responses. Domestic research and knowledge sharing can complement international technical assistance and financing as it nurtures local capacity.

There has been a steady rise in international research cooperation across the South and between the South and the North. This cooperation has adopted different modalities ranging from scientific research to knowledge sharing. Knowledge sharing platforms in Africa are crucial to understanding the complexity of global challenges, but the extent to which policy makers utilize use scientific evidence to inform policy is not clear. Knowledge sharing is now increasingly being viewed as a form of development cooperation. Those that are demand-driven and foster mutual accountability can be effective. Examples of South–South knowledge sharing platforms include the African Peer Review Mechanism (APRM), which initiates governance self-assessment by African Union member states, and the Forum on African China Cooperation (FOCAC), which seeks to strengthen relations between African countries and China.

The paper sought to understand the relationship between global challenges and improvements in research cooperation between countries and regions in the South. A review of knowledge generation and dissemination processes, recently formulated re-

search policies, and interviews with representatives from research organizations, point to new trends in African research. The paper concludes that while global challenges have increased the level of knowledge sharing, the use of scientific evidence is formulating government action remains low. However, agencies such as the African Union and FOCAC have been instrumental in triggering transnational research cooperation, which signals a new dawn for scientific research in Africa.

## 2 Empirical Approach and Main Findings

This study included desk reviews of national research policy documents, reports from regional fora and workshops, strategic plans of national science and research councils in Kenya, Ghana, Nigeria, Rwanda, South Africa, Tanzania, and Uganda, and interviews with officials from some of these councils. The main research question was whether global challenges and the need to improve research cooperation and knowledge development in Africa has resulted in government support for research and utilization of research evidence. The study explored trends in government investment in research, and the relationship between sources of research financing and research focus. Data sources included : research and knowledge development platforms where there has been cooperation between countries ; the content of selected knowledge-management platforms ; and the research policies of governments that have been involved in research activities in Africa. Other sources included interviews and focused discussions with institutions involved in research, including regional bodies, universities, and national and cross-national research institutions, such as the National Council for Science Technology and Innovation (NACOSTI) in Kenya, the Uganda National Council for Science and Technology (UNCST), the Consultative Group for International Agricultural Research (CGIAR), and the Alliance for Accelerating Excellence in Science in Africa (AESA).

**Characteristics of research environments** — There is a direct link between the breadth and depth of research and its financing. In recent years, African governments have made some effort to increase research funding. Historic under-expenditure, however, has resulted in the lack of organizational capacity (e.g., poor technical capacity to collect data, analyse performance ; and poor national STI policy frameworks), especially in the least-developed countries.

Each of the countries is this study (Kenya, Ghana, Nigeria, Rwanda, South Africa, Tanzania, and Uganda) has formulated a national STI policy. However, with the exception of South Africa, data collection is infrequent. Although scanty, the data confirm the dismal investment in research by African governments, and a skewed research landscape in which the numbers of male researchers far exceeds female researchers. For Ghana, Kenya, and South Africa, a comparison between 2007 and 2010 indicated a slight increase in the total gross domestic expenditure (GERD) on R&D. In Ghana there was a slight reduction in the percentage of female researchers, but there was a marked increase in Kenya and South Africa. Encouragingly, all the countries, with the exception of Rwanda, reported a significant percentage increase in the number of scientific publications and in publications per capita between 2005 and 2010. African researchers doubled their research output in science, technology, en-

gineering, and mathematics. However, the pace and quality of research needs to be improved.

**Trends in continental and regional research cooperation** — International research cooperation has adopted several approaches : knowledge sharing on common challenges ; undertaking joint research ; establishing and managing peer-review platforms ; establishing think tanks ; promoting inter-university links and exchanges ; and creating government-led regional blocks.

The African Union's Science, Technology and Innovation Strategy (STISA-2024) prioritizes : research and innovation in agriculture and food security ; prevention of communicable diseases such as HIV/AIDS, TB, and malaria ; ICTs and global communication and knowledge transfer ; environmental protection and biodiversity ; harmony, peace, and security ; and trade and wealth creation. STISA-2024 calls for greater resourcing of national, regional, and continental institutions.

At the continental level, major initiatives have been supported by African and international donors. The CGIAR is a long-standing example of national and international collaboration to support research capacity in agriculture. Through its affiliate programs, such as the Climate Change Agriculture and Food Security program, has been consistently generating research findings on climate change-related challenges, such as droughts, famines, environmental degradation, and food insecurity. Even so, policies that are implemented are often those made through political considerations. Workshops, seminars, and conferences have become a major characteristic of knowledge generation and sharing in Africa. Given the fact that most of the research is externally funded, it is most often the donor's interests and not national priorities that dictate the research agenda in these institutions. Government agencies often participate in the knowledge workshops where new knowledge and research outcomes are shared, although this does not translate to use of these outcomes.

In September 2015, African and international partners launched AESA, an initiative that aims to drive Africa's research agenda and build scientific capacity across the continent. AESA was created by the African Academy of Sciences (AAS) and NEPAD with international donor support. The AESA was endorsed by African governments, to support the implementation of STISA and the African Health Strategy (AHS 2015–2030). AESA is focused on health research with plans to expand into other areas. AESA will prioritize research areas, manage funding competitions, and evaluate the impact of research outcomes. AESA is envisioned to be Africa focused and led by Africans to pursue strategic research and partnerships with like-minded organizations. AESA is also intended to invest in building the capacity of local researchers through the implementation of the two grant programs DELTAS Africa and Grand Challenges Africa.

Regional intergovernmental bodies in Africa have all established knowledge and data sharing platforms. The Inter-Governmental Authority on Development (IGAD), the East African Community (EAC), Southern Africa Development Community (SADC), Economic Community of West African States (ECOWAS), and Great Lakes nations

have used such mechanisms to design strategies to counter challenges such as poaching and illegal trade in wildlife products, terrorism, and related criminal activities.

Other continental and regional initiatives supporting research and knowledge sharing include : the International Conference on Illegal Trade in Wild Fauna and Flora, which was organized under the leadership of the Republic of Congo in partnership with the African Union Commission (AUC). The Council for the Development of Social Science Research in Africa (CODESRIA) funds and promotes research for the social transformation and development of the African continent. The Organization for Social Science Research in Eastern and Southern Africa (OSSREA) supports research through training and capacity building and developing links between researchers and policymakers in the region. Finally, the Partnership for African Social and Governance Research (PASGR) aims to increase the research capacity of institutions and individuals in the areas of social policy and governance.

**Country experiences** — The UNESCO Science Report for 2010 on sub-Saharan Africa indicates a positive move by many African countries to improve internal capacity for science and technology. R&D budgets invest heavily in student stipends and researchers' salaries and the residual is directed to research activity. Additional challenges facing advancement of R&D in Africa include inadequacy of the ICT infrastructure leading to limitations in Internet access, low literacy levels, low research capacities, and brain drain, which accounts for a third of all African researchers.

Six country cases are briefly summarized in Table 1. It illustrates the main challenges, characterizes the linkages between research and policy, and priority research foci for Ghana, Kenya, Nigeria, Rwanda, Tanzania, and Uganda.

## 3 Main messages for policy and practice

This study has considered the different modalities of generating and sharing knowledge among African countries. Research supported jointly or separately by different agencies, existing knowledge platforms, and funding mechanisms all themed around the global challenges, have been explored. The complexity of global challenges has indeed led to greater knowledge generation and sharing between countries. Although knowledge sharing between and within countries is significant, it is not necessarily sourced from scientific research activities. The fora through which such knowledge is shared are themselves sources of data as discussions and pronouncements in conferences, seminars, and workshops are often used as the basis of policy and decision-making.

There is a positive shift across the continent that begins with the gradual increase in research funding. The increase in numbers of researchers in general and particularly female researchers is notable. New initiatives such as the recently launched AESA, STISA-2024, and the 2007 endorsement by Heads of State to increase research funding to 1% of GDP are indicators of this shift. The increase in the number of shared platforms for knowledge exchange between countries and new Africa-led efforts to improve research capacity, are all strong examples of gradual but significant steps to improve research. STISA stands out as a positive trigger for African countries to give more attention and invest in STI. Subsequently, national research councils have

received national boosts through more funding, and in Kenya, the establishment of national research funds is a positive development.

Without solid leadership by African governments, the continent will continue to lag behind the rest of the world even in the context of increased South–South and North–South research cooperation. That there is increased research and knowledge sharing within and across countries in light of global challenges is not in doubt. There are areas of concern that governments could address.

National governments need to invest in and prioritize research on national priorities. To the extent they can, governments should encourage and create platforms for international funding agencies to support domestically-driven research priorities. While STEM fields are relatively well supported, social science research has been largely relegated to individual interests and universities, whose funding is often limited. As a result, there is limited capacity for research to inform social policy and domains where social research can by complementary. New STI investments need to support African universities become research intensive and collaborative institutions. They need investments in infrastructure, research funding and incentives to collaborate with non-academic partners and users of research. Related to this, governments need to enhance their capacity to use research evidence. There is clear disconnect between policy and research in Africa, with policies being designed based on political considerations and pronouncements rather than being anchored in solid research.

While noting these concerns and areas for action, the findings noted a shift toward increasing financing, political interest in reforming and creating new national research and innovation agencies, and investing in the capacity for research. These shifts signal a new dawn that opens a path for African governments generate evidence on pressing challenges, support research cooperation and harness insights.

| Country case studies | | | |
|---|---|---|---|
| **Country** | **Transnational challenges** | **Research funding and links with policy** | **Thematic focus of government research institutions** |
| Ghana | Climate change, food insecurity, drug trafficking, and disease outbreaks | Government investment in R&D is low | Mainly agriculture and food security, and recently, mining |
| Kenya | Terrorism, poaching, drug trafficking, climate change, food insecurity, and disease outbreaks | Policy not always linked to research-based evidence<br>In August 2015, a Parliamentary caucus to ensure evidence-based policy and decision-making in Parliament was formed. | Mainly agriculture, ICTs, health, and water<br>No notable links between government financing and research on global challenges |
| Nigeria | Terrorism, poaching, drug trafficking, climate change, food insecurity, and disease outbreaks | Limited interaction between researchers and policymakers<br>Research outcomes hardly used in policymaking leading to low motivation among researchers | Mainly agriculture and food security<br>No notable links between government financing and global challenges |
| *Rwanda* | Poaching, climate change, food insecurity, and disease outbreaks | Country is a good example of South–South cooperation in sharing knowledge, particularly on reduction on HIV/AIDS infant mortality, and malaria and TB | Research is mainly done through government line Ministries and not through a centralized agency<br>Rwanda is positioned as a STI hub and is keen to encourage STI activities<br>No direct links between government financing and global challenges |
| Tanzania | Terrorism, poaching, drug trafficking, climate change, food insecurity, and disease outbreaks | Limited links between policy and research outcomes | Mainly crop development and food security<br>Inadequate attention to socioeconomic areas<br>Lacks a multidisciplinary approach<br>No direct links between government financing and global challenges |
| *Uganda* | Terrorism, poaching, drug trafficking, climate change, food insecurity, and disease outbreaks | Despite tripling of research output between 1997 and 2007, there is no definite link between research outcomes and policy formulation | Mainly health and natural sciences and to a lesser extent, social sciences<br>No direct links between government financing and global challenges |

# When the South comes to the North

## Brazil's and Argentina's international collaboration in agricultural and environmental research in France

Bernard Hubert(1), Roberto Cittadini(2), Claudio Carvalho(3)

(1) Institut National de la Recherche Agronomique (INRA), France
(2) Instituto Nacional de Tecnología Agropecuaria (INTA), Argentina
(3) Empresa Brasileira de Pesquisa Agropecuária (Embrapa), Brazil

## 1 Context

Presently, the global landscape of agricultural research is moving away from relatively concentrated research systems in some industrialized countries toward a worldwide distributed network of individuals and teams, recognized for their research relevance and quality. This shift is changing the paradigm of international research collaboration that has been largely funded and led by the North to a model where the South is proactively shaping research agendas.

Montpellier is among the main locations in Europe oriented toward the Mediterranean and tropical agricultural research. In the early 1990s, the US Department of Agriculture's Agricultural Research Services and Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) setup laboratories in Montpellier. In 2011, the CGIAR Consortium established its headquarters there thus increasing international collaboration and a focus on tropical research [1]. More recently, the Brazilian agricultural research organization (Embrapa) and the Argentinean agricultural research institute (INTA) have established permanent offices at the Agropolis International building in Montpellier in 2002 and 2012, respectively. Active collaborations

1. The Consultative Group on International Agricultural Research (CGIAR) is a consortium composed of 15 Research Centers dedicated to scientific research and, as it states on its Website "is a global research partnership for a food-secure future. CGIAR science is dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources and ecosystem services". Since 2017 it has been renamed CGIAR System Organization.

are taking place among senior researchers of these Brazilian and Argentinean organizations and their French or European colleagues on advanced research topics.

Argentina and Brazil have developed strong agricultural sectors, and agricultural research collaboration is considered an important lever to support related policy objectives including export development. Their commitment to global research networks is also very important, as witnessed by their recent engagement on global issues such as climate change, biodiversity erosion, land degradation, renewable resource scarcity, and contribution to global public goods (e.g., land management and planning, and greenhouse gas emissions, animal/human health).

## 2 Empirical Approach and Main Findings

The French domestic research system in agriculture is mainly constituted by public organizations such as the National Institute for Agricultural Research (INRA) and National Research Institute of Science and Technology for Environment and Agriculture (IRSTEA), and a powerful General Direction for Education and Research at the Ministry of Agriculture which is in charge of a hundred agricultural secondary schools, five veterinary higher education schools, some ten agricultural engineering schools that include three prestigious "higher" engineering schools.

In the early 20$^{th}$ century, agricultural research in France was institutionalized mainly through the creation of INRA's predecessors but also on tropical and sub-tropical areas with a Council on overseas research and two research organizations : the Agricultural Research Centre for International Development (CIRAD) and the Office of Scientific and Technical Research Overseas (ORSTOM), later to become the National Research Institute for Sustainable Development (IRD).

Agricultural sciences have over time moved from a discipline (agronomy) toward a more complex field that attends to both the basic needs at "ground level" (the soil) and the policy mission of food security. The particularities of tropical agriculture, with different forms of organization (access to land and markets, working conditions and organization, etc.) and biophysical conditions, required a different conceptual framing of research. The concept of *Agricultural Knowledge and Innovation System* (AKIS) came to be utilized by French researchers. It framed tropical research in a holistic manner, encompassing various dimensions of research, training, and an appreciation of the organization of the agricultural profession, public policies, and the private sector's role in agricultural production.

Collaboration between French researchers and peers in low and middle-income countries has been supported through numerous programs. For example, INRA's AGRITERRIS laboratory in Argentina, CIRAD's Platforms in Partnership for Research and Training and IRD's Collaborative International labs (LMI) all enable French researchers to collaborate with their peers in developing and emerging countries. In addition, the French government has provided long-standing support to its public research institutes to conduct tropical and Mediterranean agricultural research. By contrast, other large industrialized countries have diminished their support to domestic research institutions dedicated to tropical (former colonial) agricultural research

(e.g., NRI and ODI in the UK, and KIT in the Netherlands). As a result, France has a relatively strong position inside the international agricultural research system.

When Embrapa and INTA established offices in Montpellier, their motivation differed from those of the USDA-ARS and CSIRO. These latter agencies wanted a base in Europe to study pests introduced to their continents from Europe and undertake pest management research. By contrast, Embrapa and INTA sought to deepen contacts with industrialized countries and develop new relations in Sub-Saharan Africa (mainly Francophone and Lusophone countries). Agricultural research collaboration at Montpellier doubled as an instrument for diplomacy and trade promotion, in terms similar to those advanced by European countries in the 50s and 60s.

Established in 1956, INTA was mandated to lead Argentina's agricultural modernization. In the early twentieth century, Argentina was the "breadbasket of the world", but by the 1950s production levels had declined. The strategy of industrialization by import substitution of the 1940s and 1950s did little to develop the agricultural sector. Argentina did not keep pace with new mechanization practices, and genetic and agronomic developments that were being adopted worldwide with the onset of the Green Revolution. In the 1960s and 1970s, the 'desarrollista' model promoted by the UN's Economic Commission for Latin America and the Caribbean emboldened INTA to support middle-sized, mainly family-based farms. Prioritizing modern agriculture as a pillar of national economic development, INTA played an important role in modernizing agriculture. With the advent of the military dictatorship in 1976, INTA lost its financial autonomy and its budget was slashed. The new policy orientation favoured the private appropriation of INTA's scientific work which benefited the most concentrated parts of the agricultural sector. Moreover, the social role of INTA was severely undermined by the dictatorship's technocratic vision.

Today, INTA has a large network of 50 experimental stations, 21 institutes and 354 development and extension agencies spread throughout the country. From the outset, INTA has pursued an external training strategy for researchers, formed alliances with national universities for post-graduate training, and interacted with farmers and rural communities through extension services. Since 2003, INTA has benefited from the renewed government attention to science and technology, a growing budget, the recruitment of researchers and development agents, as well as the return of scientists exiled abroad. INTA's Institutional Strategic Plan (IEP 2005-2015) funds new regional programs and centres (e.g., Ecoregions and Support for Territorial Development program, the Research Center for Family Agriculture) in addition to product specific research, and the strengthening the extension and development sector. INTA has maintained its support for technological and territorial development through the agro-business sector, which has had strong industry links (e.g., seeds, agrochemicals and machinery) since the 1990s. That form of collaboration promoted, for example, extensive mono-cultivation of transgenic soybean and heavy use of glyphosate. INTA has monitored the negative environmental and social externalities of this model and is particularly keen to reorient this production model.

Brazil created Embrapa in 1973. This public research institution has developed a network of 47 research centres throughout the country and employs close to 10,000

people. Embrapa has contributed significantly to agricultural productivity, which over a 40 year period has increased by 172%, and land cultivation has expanded by about 30%. As a result of Embrapa's influence, Brazil is considered a world leader in the production of biofuels, plant fibres and food production for both humans and animals. In response to the increasing global demand for agricultural products and related sustainability challenges (e.g., climate change, soil acidity, emerging crop diseases), Embrapa's research agenda focuses on sustainable intensification practices and biotechnologies to increase productivity and provide environmental services. Agriculture is framed as a key component, not a problem, of a more sustainable future.

Both Argentina and Brazil have created laboratories abroad to support their national research efforts and to contribute their expertise to address common challenges. Starting in the late 1990s, Embrapa developed a new partnership platform or "laboratory without walls" called Labex. The first Labex was created in 1998 in the United States in collaboration with USDA-ARS, and four years later Embrapa's second experiment, Labex Europe, was inaugurated at Agropolis International. Since then, Embrapa replicated the Labex model to formalize research collaboration in Asia with new centres in South Korea and China, established in 2009 and 2012, respectively.

Labex Europe is a tool for promoting collaboration and developing innovative technologies for tropical agriculture. Senior researchers from Brazil are based at Labex centers for 2 to 4 years during which time they lead joint research projects. They must also devote one-third of their time to scoping and dissemination activities (site visits, participation in conferences, etc.) and manage the lab. Seeking to build on the success of the Labex model, Embrapa is now experimenting a new "Reverse Labex", whereby foreign senior researchers are invited to work at Embrapa research centres in Brazil.

The Brazilian model had a demonstration effect on INTA, who created an equivalent program in 2012 called Labintex. Also based at Agropolis International, Labintex facilitates INTA staff participation in European scientific research networks. Labintex organizes its research activities in four thematic areas, each carried out by an INTA researcher who spends four years in Montpellier. Labintex is now a showcase for INTA and Argentina in Europe in agricultural science and technology.

Labex and Labintex are useful to European researchers who have an opportunity to develop new collaborations and understand emerging challenges facing tropical agriculture. The presence of experienced Brazilian and Argentinean researchers, and access to their networks is a direct and quality source of information for European colleagues. An example of the benefits of collaboration to emerge from the presence of Labintex and Labtex in France is the emergence of new paradigms, such as agroecology. https ://www.overleaf.com/4693139459fcgfqxdmmxzz

## 3 Main messages for policy and practice

The "wall-less" laboratories Labex and Labintex in France and their partnerships in other countries, constitute a remarkable re-organization of collaboration between French researchers and their peers in Brazil and Argentina. In this case, Embrapa and

INTA have pro-actively established collaborative research platforms in France to cross-fertilize views, identify emerging issues, and construct shared conceptual frameworks to interpret the dynamics that characterize today's agriculture and territories.

In a new multipolar world, emerging countries are rightfully setting shared agendas for scientific collaboration. Brazil's Embrapa and Argentina's INTA are pioneering examples of research agencies re-shaping international collaboration. The presence of Argentinean and Brazilian researchers in France has proved to be fertile ground for promoting common research cooperation. Their model is having a demonstration effect. University Putra Malaysia, for example, recently established a similar agro-environmental research platform in Montpellier.

Food, nutrition, the environment, and biodiversity are all notions that have different values according to different cultures, histories and geographical locations. We need a diverse scientific community if we are to address such issues on a global scale, and recognize that new ways of promoting scientific communities in the South are needed. The Labex and Labintex models merit further exploration, and potentially with our African partners to enhance collaboration on food or environmental issues that are linked to nutrition, health and the future of the planet's renewable resources.

The status of Agropolis International as a non-for-profit organization has brought together higher education and research establishments in the Languedoc-Roussillon region, allowing foreign research organizations to have balanced relations with French and European counterparts and with the international CGIAR system. We believe the proximity and close contact with research communities from the South, particularly on the other side of the Mediterranean and the Sahara, is needed to understand and address our future challenges. This would require greater inter-institutional collaboration to reproduce the Labex/Labintex model, but such investments are capable of renewing research agendas and the necessary confrontation between temperate and tropical worlds. We should move beyond the traditional building blocks of bilateral research cooperation between countries : the world of research and training needs to be constructed from a global as well as intercultural perspective.

## Related Resources

Hubert B. 2010. L'agronomie, science de l'agriculture ? *Le mouvement social*, oct.-déc. 2010 : 111-125.

Valceschini E., Hubert B., 2014. Un parcours dans les mondes de la recherche agronomique. L'INRA et le Cirad. *Histoire de la recherche contemporaine*, III (2) : 106-112.

# Table des matières

# THE TRANSFORMATION OF RESEARCH IN THE SOUTH

## Policies and outcomes

Edited by **Rigas Arvanitis** and **David O'Brien**

Profound transformations are affecting the research systems around the world. We witness the emergence of new or restructured organizations to steer public research or promote innovation, new programmatic directions within these organizations, increased funding dedicated to research in academic settings, and new domestic and international partnerships and collaborations. A multiplicity of organizations and funding sources have appeared, creating a complex web where resources circulate along with knowledge in ways that are reshaping research systems in the South.

This book gathers a large sample of these changes presented during a symposium organized by IDRC, IRD, IFRIS, and OECD, seeking to better understand their institutional, political and economic drivers. These cases document the building of scientific capacity and the broader use of results from scientific research and presents lessons for public policy. A large variety of case studies of specific research organizations and comparative analysis of the wider research system are presented in Asia, Africa, and Latin America.

IDRC | CRDI
International Development Research Centre
Centre de recherches pour le développement international

Canada

ISBN : 9782813003034

9 782813 003034

IRD Éditions

éditions des archives contemporaines