Monitoring the composition and evolution of the research networks of the CGIAR Research Program on Roots, Tubers and Bananas (RTB)

Javier Ekboir, Genowefa Blundo Canto and Cristina Sette

ILAC Brief 27 July 2013

Several tools have been developed in the last three decades to manage not-for-profit research activities. Most of these tools have focused on research outputs or outcomes, while few have analysed the processes of research and innovation to identify emerging problems and opportunities during the course of a project. This brief presents a cost-effective methodology that can be used to monitor changes in research networks. Since these networks change as the research projects mature (Kratzer, Gemuenden and Lettl, 2008), tracking the network structure provides information on the nature and evolution of research activities.

Introduction

CGIAR's change process aims to develop new approaches for research and innovation to alleviate poverty, improve health and increase the sustainable management of natural resources. CGIAR plans to achieve this by making the research activities more focused and by increasing the collaboration among centres and with external partners (CGIAR, 2011). An essential component of this process is the creation of 16 CGIAR Research Programs, including Roots, Tubers and Bananas (RTB). RTB brings together four CGIAR centres (Bioversity, CIAT, CIP and IITA) and many other partners. It includes research on six sets of crops: bananas (and plantains), cassava, potatoes, sweet potatoes, yams and other roots and tubers. Achieving CGIAR's goals will require adaptive management and timely information on the evolution of the change process (Christensen, Anthony and Roth, 2004; Davila, Epstein and Shelton, 2006; Patton, 2010).

A recent pilot project developed an easy-to-use methodology based on social network analysis (SNA) to monitor changes in RTB and provide information about progress along its impact pathway. This information is critical for RTB's management and stakeholders. The methodology can be used by other CGIAR Research Programs, CGIAR as a whole and other research organizations.

Project objectives:

- To help RTB understand how its research products are developed, how other actors in the agricultural innovation system influence (and are influenced by) the research portfolio and how the research outputs are diffused;
- To provide a baseline for monitoring the evolution of the RTB research networks by identifying the main partners, research topics and methods, and the geographic distribution;
- To develop a methodology that can be used to monitor RTB's learning along its impact pathway.

This brief summarizes the process and the results achieved when this methodology was applied to RTB's collaborative research networks. There are indications that, in its short life so far, RTB has already made an important impact, fostering greater interaction among CGIAR centres and inducing beneficial changes in the focus of research projects.

Methods: Analysis of research networks

RTB researchers were asked to complete an online questionnaire listing the formal and informal collaborations they engaged in during the past 12 months while conducting their research, including collaborations with researchers and non-research actors. They were asked to provide names, the organization the partners worked for, and to characterize their collaborative activities. Complete and valid survey forms were received from 92 of the 126 invited researchers (73%). The available self-reported data were analysed with simple statistical tools and SNA methods.

Types of research collaborations reported by RTB researchers

The survey identified 624 individual collaborators (this number includes the 92 researchers who completed the questionnaire), representing 302 distinct organizations. There were 702 collaborative links between pairs of individuals. Most of the collaborations (650 or 93%) had research objectives, while 444 (63%) included capacity-building activities and 200 (28%) incorporated advocacy goals. In terms of types of partners, 558 collaborations (79%) involved national research organizations, CGIAR centres and/or advanced research institutions, while only 75 collaborations (11%) involved disseminators of technical information, and 69 (10%) involved policy-makers.

Focus of RTB-induced collaborations: The 702 documented collaborations included 134 (19%) that were induced by RTB. The influence of RTB is associated with important differences in the patterns of interactions and collaborations, especially within CGIAR. Approximately half (51%) of the RTB-induced collaborations were among CGIAR centres, compared with just 22% of non-RTB-induced collaborations. Meanwhile, RTB-induced collaborations were less likely to involve advanced research institutes, national research organizations, universities and non-research partners. In terms of topics, germplasm conservation and gender issues accounted for a larger proportion of the RTB-induced collaborations, while biotechnology, value chains, breeding, and pest and disease management were more common in non-RTB-induced collaborations. RTB has influenced the type of research CGIAR centres perform: a larger share of the RTB-induced collaborations between CGIAR centres can be characterized as what is usually known as 'downstream' research while a smaller share involved 'upstream' research. The different focus among RTB-induced collaborations, in terms of partners and topics, reflects the need to bring together a diverse group of projects and researchers that operated under a different organizational structure before CGIAR's change process.

Collaborations according to partners' capabilities: Among all the 702 collaborations, 270 (38%) were between CGIAR centres, and 81 (30%) of these were RTB-induced. Collaborations between CGIAR scientists accounted for a larger share of the collaborations in areas where they have traditionally had strong capabilities (e.g., breeding and germplasm conservation), new areas that are critical to the change process (e.g., research management, impact assessment and gender issues) and 'emerging' areas that don't require major investments (e.g., geographic information systems and climate change). On the other hand, there was a comparatively higher proportion of collaborations with non-CGIAR research organizations in areas where the latter have stronger capabilities, such as biotechnology (in the case of advanced research institutes), and innovation platforms, seed systems and post-harvest (in the case of national research organizations).

Location of collaborations: Survey respondents were also asked to report the setting of each collaboration. Approximately a quarter of the collaborations took place in advanced laboratories (24%), a quarter involved desk work (24%), and another quarter occurred in farmers' fields (23%), while the remainder were at experimental stations (17%), in regular laboratories (8%) or at the partner's location (e.g., market or ministry; 4%).

Informal versus formal collaborations: Approximately two thirds of all the collaborations were based on a formal agreement between organizations. Informal interactions – the other third – are important for the most connected researchers; just 31 of the 92 respondents reported informal collaborations and 28 of them had more than 6 partners.

Gender distribution: Among the 624 collaborators, 24% were women. A slightly higher proportion of collaborations involving women occurred in advanced laboratories (29% versus 23% of collaborations with men), while collaborations involving men were somewhat more likely to occur at experimental stations (19% versus 15% of collaborations with women) and in farmers' fields (24% versus 20%). Overall, one in four collaborations involved women.

Geographic focus: While collaborations with a global focus predominated (34% of all collaborations), RTB was shown to have an especially strong presence in Africa (33%) and in Latin America (20%). RTB activities in Asia, Europe and North America are limited. As shown in Table 1, collaborations with a research focus

Table 1. RTB's research and non-research collaborations by region

	Africa	Asia	Europe	Global	Latin America
Not induced by RTB					
Research	153 (84%)	45 (80%)	10 (100%)	166 (94%)	85 (75%)
Non-research	30 (16%)	11 (20%)	0 (0%)	11 (6%)	29 (25%)
Total	**183 (100%)**	**56 (100%)**	**10 (100%)**	**177 (100%)**	**114 (100%)**
Induced by RTB					
Research	32 (74%)	10 (71%)	0 (NA)	54 (100%)	20 (87%)
Non-research	11 (26%)	4 (29%)	0 (NA)	0 (0%)	3 (13%)
Total	**43 (100%)**	**14 (100%)**	**0 (NA)**	**54 (100%)**	**23 (100%)**

NA, not applicable.

dominate in all regions. Among RTB-induced collaborations, those with non-research organizations were most common in Asia (29%) and Africa (26%). Meanwhile among non-RTB-induced collaborations, non-research-oriented collaborations were most common in Latin America (25%) and in Asia (20%).

The structure of RTB's research networks

The survey was administered to RTB researchers, but collaborators named by the respondents were not contacted for further information (this was beyond the scope and resources of the project), so it was not possible to map all connections in the network. Separate network analyses were conducted for (a) the whole data set of 624 individuals (survey respondents and named collaborators), (b) the subset of the 92 survey respondents, and (c) interactions based on CGIAR centres rather than individuals.

a. Analysis of the whole data set

The complete data set includes all the 624 '**nodes**' (i.e., individuals) and 702 '**links**' (i.e., collaborative relationships linking two individuals), which together form the '**network**'. Social network analysis (SNA) concepts – including degrees, components, density, centrality, betweenness centrality and clustering – can deepen our understanding of how collaborations occur and function.

Degrees: This is the total number of connections an individual has. The analysis showed that a small number of individuals reported many collaborations, but most respondents named just a few links and no individual was mentioned by a large number of respondents, i.e., there were no central receivers of information. In addition, no node was found to have a strong influence; even the best-connected person sent information to just 3.4% of the people in the network, and received information from just 0.8% of them. Findings indicate that information does not flow easily through personal relationships within RTB.

Components and connectedness: A component is a subset of nodes connected through one or more paths (a path is a continuous sequence of alternating nodes and links), but with no connections outside this group. Each component of RTB's network is shown in a different colour in Figure 1. RTB's network is disconnected, comprising one main component involving 90% of the nodes (dark blue in Figure 1) and 14 small separate components of 2–11 people each. All collaborations with a global focus were part of the main component, indicating that information of global importance can circulate to most nodes in the network. The small components were largely made up of partners working at experimental stations or in farmers' fields and with a regional focus, indicating that these components may be relatively local, resulting from isolated projects.

Density: Density is the number of reported links divided by the maximum possible number of links in the network. The analysis revealed that RTB's network has a

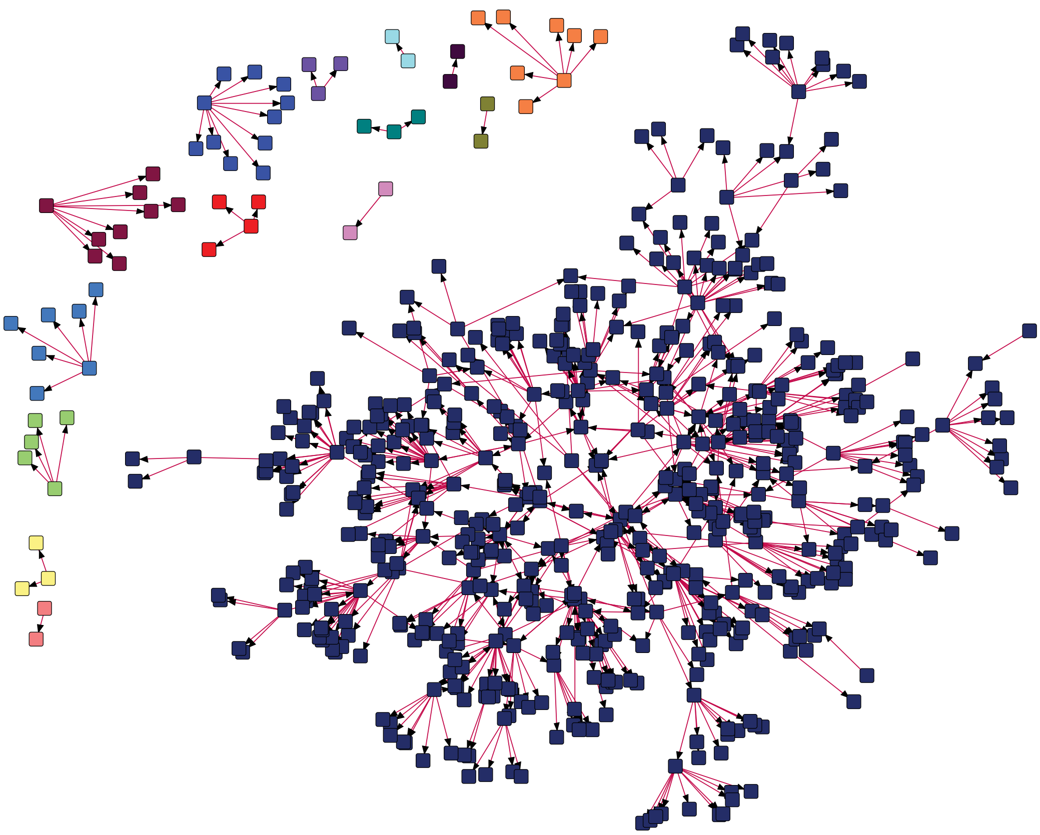

Figure 1. Map of the 15 components of the whole network (624 nodes and 702 links)

Note: Each of the 15 components is a different colour to facilitate visualization.

low density, indicating that it is sparsely connected. This is partly a consequence of the large size of the network; humans have limited time to interact, so in a large network, each person's actual number of links cannot come close to the maximum number of possible links. But the main component of RTB's network (dark blue in Figure 1) was relatively well connected; a message sent by a node could reach any other node in no more than 10 steps (4 steps on average). A network with low density can be fragile; the removal of an important node ('**cut-point**') can break the network into separate '**blocks**'. The main component has four cut-points and six blocks, but it is still quite robust: the removal of a cut-point would have little effect on the network structure since it would only eliminate the cut-point itself and his or her collaborators. This indicates that no researcher held a particularly central role (see also Centrality).

Centrality: A node is globally central if it lies at short distances from many other nodes (distance refers to the shortest path between two nodes). The RTB network did not have any globally central nodes (i.e., someone with a clear intermediary role), as shown in Figure 1.

Betweenness centrality: For node *i*, this is defined as the number of shortest paths between any pair of nodes that passes through *i*; it indicates the node's intermediary power. The analysis revealed that a few individuals play an important role in facilitating communication between nodes in RTB's network (although alternative longer paths that bypass those individuals also exist). As the RTB research network becomes more integrated (i.e., as the number of links and the density increase), the intermediary power of these individuals should become less important (i.e., the betweenness centrality will fall), because there will be a greater number of possible shortest paths.

Clustering coefficient: Another indication of the structure of the network is the presence of local '**neighbourhoods**', measured by the clustering coefficient – the number of links among the nearby nodes divided by the number of links that could possibly exist among them. The clustering coefficient for RTB's overall network was very small, indicating that RTB researchers tend not to interact intensively with small groups of collaborators (Figure 1). The results were the same when analysed by geographic location, type of relationship and main subject of research, indicating that most researchers were engaged in multidisciplinary networks. There was some clustering based on the specific location of the research activities, such as in a laboratory or farmers' fields.

Women-centred sub-network: The role of women in RTB's network was analysed by identifying the components centred on female researchers. There were 20 women researchers among the survey respondents, and their combined collaborations form a sub-network of 163 individuals and 154 collaborative links. The analysis showed that women collaborated more intensively with other women than with men.

Sub-network of RTB-induced collaborations: As previously mentioned, RTB induced the creation of 134 collaborations. This sub-network of collaborations includes 131 nodes distributed among 16 components (Figure 2). The largest component, with 42 nodes, is highly multidisciplinary. Most of the collaborations had a global focus (65%), half occurred on a monthly basis and about 70% involved desk work. The second-largest component (32 nodes) had Latin America as the focus of about half of the collaborations, while the third-largest component had an African focus. The relatively dispersed structure of the RTB-induced sub-network reflects RTB's origins as a combination of pre-existing projects. As RTB reorients research according to its priorities, the isolated components should become more interconnected.

Influence of RTB on links among its four member centres: One goal of the CGIAR change process is to help the 15 CGIAR centres to better implement research for development by forming partnerships with a diverse set of collaborators. In the short term, however, the objective has been to better connect CGIAR researchers. This effect has already been observed in the relationships between Bioversity and CIAT, Bioversity and CIP, Bioversity and IITA, and CIP and CIAT – about half of all these interactions were RTB-induced (Table 2). In terms of collaborations among scientists working for the same centre, few were induced by RTB, with the exception of Bioversity.

Table 2. Links between and within RTB's four member centres

	Total links	RTB-induced links
CIP–Bioversity	39	18 (46%)
CIP–CIAT	24	12 (50%)
CIP–IITA	26	8 (31%)
CIAT–Bioversity	23	12 (52%)
CIAT–IITA	9	1 (11%)
Bioversity–IITA	13	7 (54%)
CIP–CIP	20	4 (25%)
CIAT–CIAT	4	0 (0%)
Bioversity–Bioversity	9	6 (67%)
IITA–IITA	1	0 (0%)

Bioversity, Bioversity International; CIAT, *Centro Internacional de Agricultura Tropical* (International Center for Tropical Agriculture); CIP, *Centro Internacional de la Papa* (International Potato Center); IITA, International Institute of Tropical Agriculture.

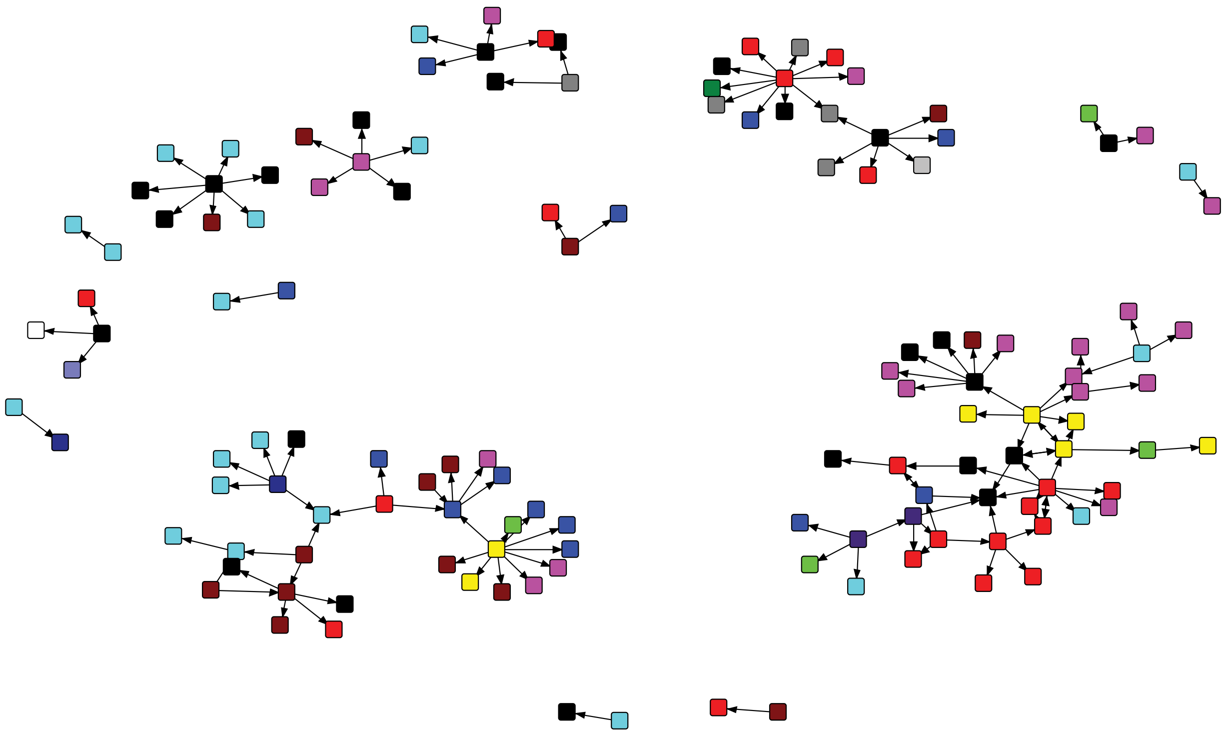

Figure 2. RTB-induced sub-network and components (nodes colour-coded by discipline)

Note: Nodes colour-coded to represent disciplines and affiliations: brown = plant breeding, blue = agronomy, red = social science, black = research management, grey = nutrition/health, pink = plant pathology/plant biology/entomology, dark green = post-harvest, light green = agriculture system research, light blue = genetics/molecular biology/genomics/biotechnology, yellow = communications/ICT/bioinformatics, light purple = government, dark blue = biology/biochemistry, dark purple = geography/GIS/meteorology, olive green = donors, opaque green = livestock, orange = private sector/non-governmental organization, white = forestry.

Geographical sub-networks: When analysed by geographical focus, RTB's sub-networks have clear distinguishing features. The **global sub-network** was composed of 212 individuals with 238 collaborations, and the work was conducted mainly at desks (where social scientists and research managers predominate) and in advanced laboratories (geneticists and plant pathologists). Additionally, global collaborations were less multidisciplinary than the collaborations in the regional sub-networks. Meanwhile, research with a regional focus (Africa, Latin America and Asia) was conducted primarily in farmers' fields and at experimental stations, while most of the research with a focus on developed countries was conducted in advanced laboratories. Each geographic sub-network had one large component held together by a few individuals with strong intermediary roles (high betweenness), whose removal would break the component into smaller, unconnected blocks. This feature indicates that while information can circulate within the component, the fact that it has to pass through the central nodes limits the volume and type of information that can be shared. The **African sub-network** was the largest and most interconnected regional sub-network, including 241 people and 231 collaborations. The **Latin American sub-network** involved 163 individuals and 141 collaborations. The **Asian sub-network** was the smallest and least connected, comprising 83 people and 72 collaborations.

Sub-network of CGIAR researchers who are linked with non-research actors: This sub-network included 114 individuals and 80 links. The nodes included 40 researchers, 35 extension agents, 23 representatives of public organizations and policy-makers, and 16 people from the private sector (Figure 3). Only 11 researchers (28%) collaborated with more than one type of non-research partner. Additionally, most components were very small, involving just two or three collaborators. This lack of diversity is to be expected when the collaborations are not part of multi-actor innovation processes. Collaborations with non-research actors show three clear features: they have a strong geographic focus (mainly Latin America and Africa), they are predominantly research-based, and few researchers work with the same collaborators, as would be expected if their research projects followed a more integrated strategy.

b. Analysis of the sub-network of survey respondents

An analysis of the 92 survey respondents (and the 91 links among them) was used to explore particular features of their interactions. Collaborations within this sub-network of RTB researchers were quite sparse, with many isolated researchers and very few reciprocal links, indicating that RTB still lacks an integrated research portfolio. There was one main component comprising 55 nodes (60%) but all the remaining nodes were isolates with no links at all within this sub-network (i.e., they work with non-RTB researchers). No individual held a powerful intermediary position in this sub-network since most nodes could be reached by more than one path (i.e., via connections with other people).

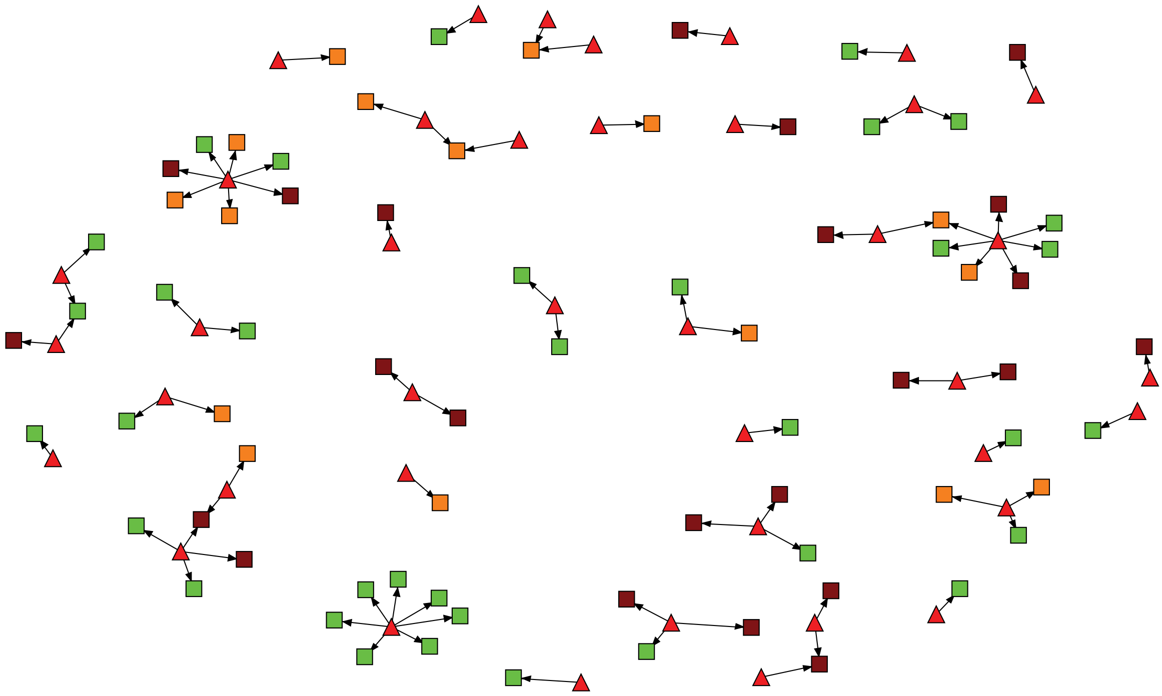

Figure 3. Collaborations between researchers and non-research actors

Note: Nodes colour-coded by the type of institution/occupation they represent: red = CGIAR centres, green = extension agents, brown = public organizations and policy-makers, orange = private firms.

Of the 91 links in the main component, only 11 were reciprocal. All but one of the reciprocal interactions involved researchers from different institutions, and most were related to social sciences. The main component could be viewed as two clusters of approximately equal size (27 and 28 nodes). One was very oriented towards research in agricultural sciences, while the other was more oriented towards the social sciences. Both clusters were very multidisciplinary and had a global focus. The large proportion of RTB-induced interactions in both clusters (close to 60% in each) is a good indication that RTB, in the year since its inception, has contributed to fostering collaborations among a core group of researchers. An expansion of this core group over the next few years will indicate that RTB is reshaping research patterns, which is one aim of the CGIAR change process.

c. Centre-based analysis

Further insights on the structure of RTB can be gained by viewing the nodes not as individuals but as affiliates of one of RTB's member centres: Bioversity, CIAT, CIP and IITA. As expected, there was a very high level of centralization because almost all nodes belonged to one of these four centres. Only one node not belonging to any of these centres was an important intermediary, bringing to the network 16 people who have otherwise been isolated. As shown in Figure 4, CIP had the highest level of intermediation, followed by Bioversity, CIAT and IITA.

Analysis of the network density shows the strength of the interactions within and between centres, and with other actors. CIP was the centre with most interaction within itself, while Bioversity had the most external interactions. In particular, Bioversity interacted strongly with CIAT and CIP. The strength of this behavioural pattern is also measured by the External–Internal index (E–I index), which takes the value of 1 when all links are external to a group (a CGIAR centre in this case) and –1 when all links are internal. For the whole data set in this study, the E–I index was 0.368, indicating a predominance of external links. Bioversity and IITA were the most externally oriented (E–I indices 0.742 and 0.733, respectively), while CIAT was externally oriented to a lesser degree (0.571) and CIP was more inwardly oriented (–0.014).

Conclusions

The CGIAR Research Programs were created with the expectation that over time they would reshape the CGIAR research portfolio. The process of designing RTB in 2010–2011 forced CGIAR researchers to interact intensively among themselves, creating opportunities for new partnerships, and this trend was reinforced during 2012, RTB's first year. RTB's current structure, therefore, reflects both prior engagements and new partnerships.

This analysis of RTB's research networks provides a picture of how its activities are currently distributed across geographic regions, disciplines and institutional landscapes, and it also provides a baseline that can be used to monitor future changes over time. This information can help RTB to assess how it is moving along its impact pathway, in particular, whether (a) new partnerships are created, (b) existing collaborations are closed and (c) interactions between RTB and external

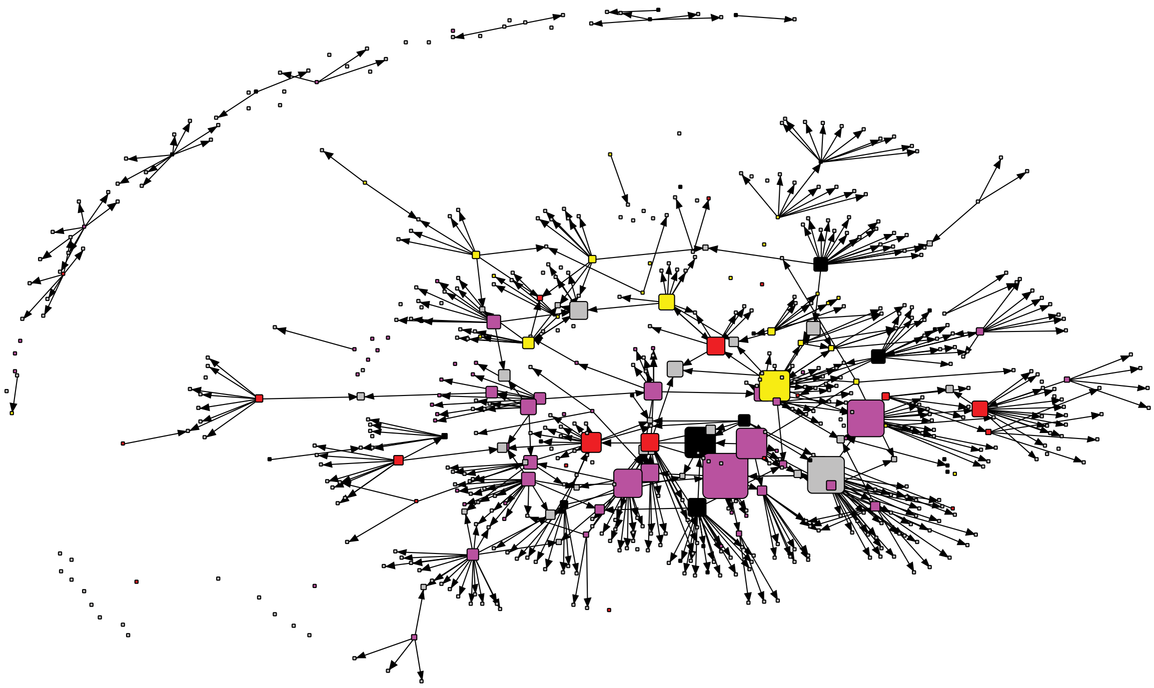

Figure 4. Intermediation (betweenness) of CGIAR centres

Note: Nodes colour-coded by centre affiliation: yellow = Bioversity, black = CIAT, pink = CIP, red = IITA, grey = other centres.

partners are strengthened. This knowledge is important for the implementation of adaptive management approaches that take corrective actions as needs and opportunities emerge.

Key findings:

- While RTB is not yet a consolidated research programme, there are strong indications that it is fostering greater interaction among CGIAR centres, and refocusing partnerships according to relevant capabilities and RTB's priorities.
- RTB's research portfolio still lacks coherence, as reflected in the network's sparse connectivity and a dearth of reciprocal interactions. This architecture hampers the sharing of information across RTB and with partners that play an essential role in applying the research within innovation processes.
- Informality was important for a relatively large number of researchers, especially the senior ones, in contrast to the trend towards formalization of research activities and clear definition of the expected outputs and deliverables demanded by managers and donors. RTB should explore new organizational settings that balance accountability with informality in order to foster creativity and the search for new research methods.

Research questions for further investigation:

- *What should an effective impact pathway for research for development organizations look like?* How many collaborations should be included and what is the right proportion of research and non-research partners? What types of research are more effective in different circumstances?
- *How can changes along the impact pathway be monitored?* Progress in research projects is reflected in changes in research networks (Kratzer, Gemuenden and Lettl, 2008), but there are no well-defined approaches to link these changes with progress along an impact pathway in not-for-profit research organizations. Procedures must be developed for learning from and making use of the observed changes in CGIAR Research Programs' research networks in order to improve the management of research for development.
- *How can RTB address the lack of diversity in its research network, to improve productivity and creativity?* RTB should explore new approaches for sharing different types of information among more types of actors. For example, not just sharing scientific information with non-scientists (e.g., extension agents), but also passing information from non-scientists to researchers.
- *How does CGIAR actually participate in research and innovation activities, and what lessons can be learned to improve the structure and management of the CGIAR Research Programs?* Future research should include mapping several CGIAR Research Programs over time, exploring and comparing their links, structures and composition, and how these change. This will shed light on the dynamics of individual Programs as well as on their interactions, and the modes in which CGIAR engages partners, providing important input for a flexible management process, and enabling CGIAR to respond rapidly to emerging problems, needs and opportunities.

The findings of this study have important consequences for the management and evaluation of research programmes and CGIAR. While the centres and the CGIAR Research Programs are the operative and administrative units, increasing CGIAR's impact will require focusing strongly on cross-CGIAR Research Program collaborations. From the perspective of evaluation, the findings indicate that looking only at isolated CGIAR Research Programs may overlook important issues regarding effectiveness; in other words, understanding coalitions of CGIAR Research Programs and the changing interactions between research and non-research actors should be an important component of the evaluation of the CGIAR Research Programs.

Lessons learned:

Repetition of this survey and analysis in the future should help to determine whether RTB is evolving to become a more integrated research programme, and the same methods could be applied to other CGIAR Research Programs. If the methods described here are used again, the data collection could be improved by: (i) raising awareness among the potential respondents about the importance of the exercise, and (ii) collecting information for all CGIAR Research Programs at the same time, to prevent some researchers from having to complete the survey multiple times and also so that the information reflects the state of all parts of the network at the same time, which will be helpful for monitoring the evolution of networks.

Due to the complexity of the research processes and the novelty of the CGIAR Research Program structure, it has not been possible yet to identify the full set of indicators to monitor the movement of the CGIAR Research Programs along their impact pathways. A minimum set of indicators should include: network size, combinations of different types of collaborations, gender dimensions, degree distribution, connectivity, analysis of components, cut-points and blocks, reciprocity, composition per discipline, and evidence of 'small world' and/or 'scale-free' properties.

Acknowledgements

The authors wish to thank Sophie Alvarez, Claudia Oriolo and Joslin Isaacson for invaluable research support, and also Graham Thiele, Gordon Prain, Graham Durant-Law, Douglas Horton and Rick Davies for useful comments. This project was part of RTB's research portfolio on partnerships (Theme 7). It was jointly financed by RTB and ILAC with grants from the Ministry of Foreign Affairs of the Netherlands (Directorate-General for International Cooperation) and the International Fund for Agricultural Development (IFAD).

References

CGIAR (2011) *A Strategy and Results Framework for the CGIAR*. CGIAR Consortium Board, Montpellier, France. Available at: http://library.cgiar.org/bitstream/handle/10947/2608/Strategy_and_Results_Framework.pdf?sequence=4

Christensen, C.M., Anthony, S.D. and Roth, E.A. (2004) *Seeing What's Next: Using the Theories of Innovation to Predict Industry Change*. Harvard Business School Press, Boston, MA, USA.

Clauset, A. and Moore, C. (2003) *How do networks become navigable?* Available at: http://arxiv.org/pdf/cond-mat/0309415.pdf

Davila, T., Epstein, M.J. and Shelton, R. (2006) *Making Innovation Work: How to Manage It, Measure It, and Profit from It.* Wharton School Publishing, Upper Saddle River, NJ, USA.

Kratzer, J., Gemuneden, H.G. and Lettl, C. (2008) Revealing dynamics and consequences of fit and misfit between formal and informal networks in multi-institutional product development collaborations. *Research Policy*, 37: 1356–1370.

Patton, M.Q. (2010) *Developmental Evaluation: Applying Complexity Concepts to Enhance Innovation and Use*. Guilford Press, New York, NY, USA.

White, D.R. and Houseman, M. (2002) The navigability of strong ties: small worlds, tie strength and network topology. *Complexity*, 8(1): 72–81.

ILAC
INSTITUTIONAL LEARNING & CHANGE

CGIAR
RESEARCH PROGRAM ON
Roots, Tubers and Bananas

The Institutional Learning and Change (ILAC) Initiative (www.cgiar-ilac.org), hosted by Bioversity International, seeks to increase the contributions of agricultural research to sustainable reductions in poverty. The ILAC Initiative is currently supported by the Ministry of Foreign Affairs of the Netherlands and the International Fund for Agricultural Development (IFAD).

ILAC Briefs aim to stimulate dialogue and to disseminate ideas and experiences that researchers and managers can use to strengthen organizational learning and performance. An ILAC Brief may introduce a concept, approach or tool; it may summarize results of a study; or it may highlight an event and its significance. To request copies, write to ilac@cgiar.org. The ILAC Initiative encourages fair use of the information in its Briefs and requests feedback from readers on how and by whom the publications were used.

Editing, design and layout: Green Ink (www.greenink.co.uk)