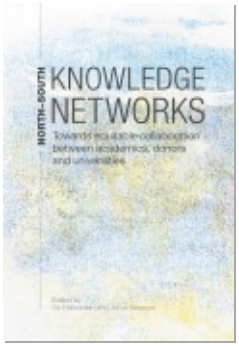
North-South Knowledge Networks Towards Equitable Collaboration Between



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CHAPTER
3

Research training, international collaboration, and the agencies of Ugandan scientists in Uganda

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In this chapter, I compare three models of PhD training available to Ugandans today. The three models are: full-time programmes abroad, full-time programmes in a Ugandan institution, and the so-called sandwich model,[1] which combines study abroad with study in Uganda. I pay particular attention to how these models strengthen or curtail the agency of Ugandans who subsequently pursue scientific careers in Uganda.[2] My findings have relevance for other countries where the means for carrying out scientific research (including funding, equipment, and advanced training opportunities) originates primarily from international sources.

In many ways, completing a PhD degree is a rite of passage towards becoming an independent researcher who can design research projects and compete for research funding. And while completing a doctorate in the Ugandan context is no exception, it does differ from studying in wealthier countries in the sense that universities are dependent on foreign governments and organisations to fund and support PhD training. After decades of structural adjustment and other neoliberal policies that have shrunk state funding for research and tertiary education in favour of fee-based financing mechanisms, Ugandan university budgets are stretched exceedingly thin. This, combined with a drastic

expansion in the size of the student body, which far outpaces increases in faculty numbers, means that universities have very little core funding to invest in infrastructure, equipment, curriculum development or postgraduate supervision (Kabeba Muriisa 2010; Mamdani 2007; Obong 2004).[3] As a result, PhD opportunities for Ugandans, and for many in other sub-Saharan African countries, arise only to the extent that funding can be mobilised from foreign universities and/or development organisations (see Bradley 2008; Moyi Okwaro and Geissler 2015). This reliance on foreign funding fundamentally undermines the credibility and status of higher education institutions as research universities (Halvorsen 2010).

For many scientists in lower-income countries, beginning their PhD training is an opportunity to permanently move abroad, to a country where salaries, infrastructure and incentives are more conducive to carrying out research (Gaillard and Gaillard 1997). My focus, however, is on the experiences of Ugandan scientists who study locally or return home after obtaining their PhDs abroad. By foregrounding Ugandan scientists' experiences of, and reflections on, their PhD training, this study offers a vantage point from which to better understand the manner in which local and foreign actors participate in the co-production and reproduction of Uganda's research environments.

In the spirit of Ferguson's (2006) entreaty that scholars pay more attention to the ways in which African actors contest their marginalisation in a globalising world, I show how Ugandan scientists turn their experiences of transnational mobility and cultural immersion in higher-income countries into assets in the context of their later work in Uganda. Drawing on actor-network theory (Latour 2005) and the application of science studies to low-income-country contexts (Donovan 2014; Rottenburg 2009a; Zink 2013), I show that the actants, and the relationships between them that matter in the assemblage of Ugandan science, include scientific equipment, supervisors and empirical material, as well as cultural and gendered engagements with kin, colleagues, places and histories. Based on a comparative analysis of three models of PhD training I reflect on the different degrees to which each model facilitates Ugandan scientists' efforts to assemble and

maintain actor-networks that align with their own goals, and with the continued decolonisation of knowledge production in Uganda.

Participants in the study

The interviews and participant observations that inform this chapter were carried out with 45 Ugandan scientists between 2013 and 2015. The group included men and women, all of whom were well-connected internationally, and their ages ranged between 25 and 70 years. Trained in fields related to health, agriculture, and natural-resource management, they were all enrolled in or had completed their PhDs. Most were married, and many had had children prior to beginning their PhDs. Most had published at least one journal article in an international peer-reviewed journal by 2013, and were engaged in research, development and/or consultancy projects with foreign partners.

In addition, I conducted a survey among a partially overlapping population of Ugandan scientists during 2014. The survey included 40 multi-part questions on their experiences of higher education and research collaboration; 57 completed questionnaires were received. The study presented here also forms part of a larger study pursuing similar lines of inquiry in Zimbabwe and Ghana.

Overview of research training models in Uganda

For the purposes of this chapter, I divided the PhD training programmes that are available to Ugandan scientists into three groups based on patterns of mobility and supervision. The first is full-time PhD programmes in Uganda supervised by at least one senior faculty member at a domestic institution. The second is full-time foreign PhD programmes carried out at an institution outside Uganda, and supervised by at least one faculty member at that institution. Students who enrol for full-time foreign PhDs tend to spend nearly all their time, with the possible exception of visits for vacations and fieldwork or data–collection, outside Uganda. The third is sandwich programmes that are

characterised by co-supervision by faculty members at a Ugandan and a foreign institution, with the PhD candidate regularly travelling between the two institutions. 'Sandwich students' usually collect data in Uganda and complete courses abroad, while doing analysis and writing in both countries. Such students can receive their degree from either the foreign or the Ugandan university, or both.

My analysis of these three different groups highlights the differences in student mobility patterns, time spent researching and writing, as well as the location of the supervisor or supervisors. In the pages that follow, I show that social, economic and political relationships with foreign actors and institutions are integral aspects of the actor-networks that produce PhD degrees across all three models.

Sandwich programmes and full-time foreign PhDs are generally financed via international development-aid programmes – as part of capacity-building initiatives, or as sub-components of ongoing research collaborations between institutions and researchers. Full-time domestic training opportunities, even if not always explicitly incorporated into a foreign-funded research-capacity-building programme, are also often the result of ongoing international research and/or training collaborations. The lack of domestic investment in equipment, supplies and supervision means that opportunities for students who enrol for PhDs at universities in Uganda are often sustained on the crumbs of foreign development programmes.

In 2012, approximately a thousand Ugandans with PhDs were living in Uganda. A survey carried out by the Ugandan National Council for Science and Technology, tracing the careers of more than half of these individuals, found that 47 per cent had received their degrees from foreign universities located mainly in the United Kingdom and the United States (UNCST 2012). The remaining 53 per cent had received their degrees from Ugandan institutions, primarily from the famous Makerere University (formerly the University of East Africa) in Kampala (Sicherman 2005; UNCST 2012).

That more than half of the Ugandans who have a PhD graduated from a Ugandan institution should not be taken to imply a degree of independence from foreign funding and partners. A large portion of the Ugandan degrees came about as a result of international

collaborations, whereby students are trained in two institutions, one in Uganda and one foreign, with supervision by at least one Ugandan and one foreign supervisor. Sweden is a strong advocate of the sandwich model, and at least 20 per cent of Ugandans who received their PhDs from a Ugandan institution had participated in a Swedish–Ugandan sandwich programme, sponsored by Swedish development funding (Sembatya and Ngobi 2014). Although the data are scarce and incomplete, my own survey and the two other surveys cited all indicate that in 2013, 70 to 80 per cent of the PhDs held by individuals at Ugandan higher education and research institutions were awarded at a foreign university in Europe or North America, or through sandwich programmes involving partner institutions in Europe. It is important to note that only about 20 per cent of all PhD holders in Uganda are women (UNCST 2012). This reflects the social and cultural barriers to access and success in higher education for women in Uganda.

Full-time training abroad

In terms of acquiring in-depth and cutting-edge scientific knowledge from internationally respected scientists, as well as the skills to use advanced scientific equipment, many of my informants saw full-time study abroad as the optimal path for PhD studies. For example, Dr Mbazira[4] leads a scientific institution that works at the interface of research and its application, but not long ago he was training towards a PhD in the medical sciences in the US. Sitting in his neat air-conditioned office in a newly constructed building away from the hectic streets of Kampala, he told me that for Ugandan scientists pursuing a full-time PhD abroad, and in the US in particular, the 'advantages are enormous'. He went on to explain:

> One, you get state-of-the-art knowledge. Two, it is excellent for networking. You interface with the global experts in almost all of the fields. And this is regardless of which university you are studying at because there are all of these conferences and meetings, and they give you an opportunity

> to interact with specialists … That is something that you cannot put any price value to because you never know what some interaction or network that you made at one time in life … you never know when it is going to materialise, and things keep coming up. (interview, 17 October 2014)

Study programmes such as the one pursued by Dr Mbazira offer students an opportunity to acquire a deeper knowledge than might be possible in Ugandan programmes. This is partly related to the easy availability of journals, books, reliable internet connections and access to scientific equipment. In addition, supervisors and fellow PhD students have time, and are willing to make themselves available, for meetings and discussions.

Beyond this privileged access to the human and material actants that facilitate the completion of a PhD, the special advantage of full-time training abroad is that it is relatively easy to create contiguous stretches of time to concentrate on one's own work. A three- or four-year foreign PhD programme removes young Ugandan scientists from their social and economic obligations to most of their family, friends, colleagues and institutions in Uganda. This drastic and often emotionally painful curtailment of their sociality creates a vacuum that can be filled with lab time, reading, writing and networking with other scientists. Few PhD programmes leave any space for the extra jobs or consultancies that have become the norm for academics in Uganda, and work permits are rarely included in student visas anyway.

A few lucky candidates may be able to bring along and support a spouse and perhaps a young child on their modest stipends. But those with larger families and/or spouses who have careers of their own must generally leave even these closest relations at home. This means that, apart from intermittent Skype connections, the time that would otherwise be spent eating, playing with children and attending weekend events with the family no longer competes with research time. Furthermore, invitations to funerals and weddings that often oblige Ugandan-based researchers to leave their stations for a few days or a week at a time, to attend to their commitments to their extended

families, no longer hinder the completion of an experiment, attendance at a seminar, or the finishing of a draft text.

Despite these advantages, and partly because of their immediate social and economic costs, 75 per cent of participants in this study indicated that they would prefer a sandwich programme or an entirely domestic programme to full-time study abroad. This is explained by the fact that the fulfilment of Ugandan scientists' aspirations (and those of scientists from other sub-Saharan countries) is not exclusively dependent on access to the most expensive and advanced scientific equipment or the ability to produce new knowledge for audiences at the wealthiest of universities. Too often, such paths lead away from Uganda, via the brain drain, and spending years abroad can make reintegration into professional and family networks exceedingly difficult (Gaillard et al. 2015).

For scientists who intend to live and work in Uganda, full-time training abroad can work at cross-purposes to their goals to live in and contribute to improving the quality of life in their homeland, to support their families, and someday build a home to which they can retire. For most scientists that I met, and for women in particular, the prospect of spending several years in a foreign country, far from their immediate and extended families, was an unwelcome idea. Women who had studied abroad full-time generally did so when they were young and before they had children. Dr Kisembo, for example, explained that 'problems related to families would be the main problem' for students who enrol in full-time training programmes. She hoped donors would note that

> these programmes where someone has to go away from home for over six months, for the ladies especially, they are not good … You can go, and [when you] come back the marriage can't work anymore. (interview, 1 May 2014)

Men who studied abroad full-time, and missed out on seeing their children for years, generally described their separation as a personal hardship, but prevailing gender norms mean that such separations are less risky for the stability of their marriages. While a man might expect

support from his wife for deciding to spend several years abroad studying for a PhD, it is rare for a Ugandan woman to be able to justify to her husband that she should do the same. In general, gendered cultural norms with respect to duties towards children and spouse were the primary factors that women scientists identified as limiting their advancement in academic careers.

Beyond risking family and social relations, full-time study abroad can also significantly undermine individuals' chances of obtaining work in Uganda after completing their degrees. The learned and embodied knowledges obtained abroad sometimes replace other forms of knowledge that are essential for success in Uganda. With experience of training for a masters degree at an elite university in Europe, and later for a PhD in another African country, Dr Nalwanga reflected on the dangers that full-time studies can pose to the relevance of Ugandan scientists in their own country:

> I've seen colleagues that do high-tech science in molecular biology. They get a very advanced degree and they have handled all these machines … But then they come back to a lab where they don't even have a PCR machine, which is a routine thing. So how are they going to manage? … You don't want to train abroad and then come back and you seem to be redundant … yet you are not. (interview, 28 April 2014)

The redundancy that Dr Nalwanga describes occurs as a result of training programmes that encourage scientists to engage in research related to the scientific priorities of their supervisors in the host countries. Redundancy can also result from the tendency to become overly reliant on scientific equipment that is standard in foreign countries, but which might not be available in Uganda due to prohibitive costs and/or the lack of infrastructure.

To cope with laboratories characterised by a scarcity of technicians and spare parts, as well as an intermittent supply of electricity and an overabundance of dust and humidity, Ugandan scientists require the kind of knowledge and creativity seldom cultivated in wealthy research environments. On returning to Uganda, the networks and knowledge

that one imagined might open doors to international research funding and opportunities are often undermined by the impossibility of assembling the tools and human resources perceived to be necessary to facilitate local research. Hence, while the facts produced by scientists may travel across continents in the form of 'immutable mobiles' (Latour 1990), the actor-networks that Ugandan scientists enrol in (and are enrolled by) to produce PhD degrees are not nearly as adept at making the same kinds of transcontinental transfers.

From the perspective of training leaders in scientific research in Uganda, full-time study abroad can be disastrous. As Dr Mugisa, a Kampala-based scientist explained, his institution has had serious problems with PhD programmes that enrol their researchers in full-time studies abroad:

> We tend to lose a lot of our people to that environment. Even though in academics now we are saying that … with globalisation we can't have brain drain … and that wherever you are you can contribute to the global knowledge. But, looking at it from a selfish point of view, this institution goes over there to train and build its capacity, and it keeps losing its best scientists to other environments. (interview, 5 May 2014)

Dr Mugisa's critical stance towards full-time study abroad is based on its power to weaken social ties and alter scientific subjectivities. He is not alone in this view. Another recently retired professor explained that those who do eventually return are often so disoriented that many are lost to science, while others require months or years before they can begin to be productive. Another influential senior academic was vehement that Ugandan institutions should 'scrap these people' who had trained abroad full-time and had no pre-existing position in Uganda to return to.

In the course of my research, I met several scientists who had resigned from positions at Ugandan research institutions to take up scholarships to study abroad full-time, and had then experienced great difficulties in returning to their careers in Uganda. This was partly due to a mismatch between their new expertise and the local science

infrastructure, but it was also linked to bureaucratic obstacles that prevent the absorption of qualified scientists who do not have existing employment contracts. Scientists who were offered a temporary leave of absence from their positions to undertake full-time study abroad were more easily, but seldom unproblematically, reabsorbed if they chose to return.

In general, the scientists I interviewed appreciated the quality of training they could gain by studying abroad, but they found the erosion of their scientific, social and economic ties in Uganda too costly to merit the sacrifice. And while full-time study abroad has the potential to equip scientists with the skills, networks, resources and ambitions to produce forms of scientific knowledge that are internationally appreciated and publishable, it does not necessarily equip them with the skills, networks, resources and ambitions that help them thrive in contemporary Uganda. Hence, despite the rapid advances in internet and related technologies that ease communication across great distances, long-term physical absence for training abroad significantly challenges Ugandan scientists' abilities to sustain their place in the actor-networks that matter most to them in Uganda.

Full-time training at home

If full-time research training abroad is generally perceived to be contrary to the interests of scientists in Uganda, and to the interests of Uganda's scientific community more broadly, then full-time training at home might be expected to offer a solution. Post-colonial critiques of international science and development highlight the value of indigenous knowledge systems and the importance of resisting the domination of the modernist ideologies that originate in the metropoles (Kelly 1979; Tikly 2004). Other voices call for 'South–South' collaborations, whereby partners from several Southern countries pool resources to address problems of shared importance (Hassan 2001). In both instances, those who advocate the de-linking of scientific training from Northern actor-networks are concerned that African scientists forfeit too much of their own agency when they enrol (and are enrolled)

in higher education institutions in the North. However, for the researchers and professors that I met in Uganda, the advantages of full-time training at home relate less to the avoidance of what Eric Wolf (1966) might call patron–client ties with a global reach than they do to strengthening and maintaining their own local social, kinship and economic relations.

Dr Mugisa, who studied abroad for his PhD and whose current professional position affords him insight into the experiences of a range of Ugandan PhD candidates registered at multiple institutions, describes the main advantage of staying home as follows:

> The basic advantage is that you are at home, which is familiar ground for you. You don't deal with issues of being away from home and missing your family. And at work everyone knows you and you are familiar with the facilities. You can multi-task and do any number of things. Many people will pursue their social careers as well and get good jobs at the same time that they are students. (interview, 5 May 2014)

Mugisa's references to family, 'social careers' and employment speaks to the entanglement of personal, entrepreneurial and scientific aspects of Ugandan scientists' lives. The attainment of a PhD is not only, or even primarily, a rite of passage in becoming an independent producer of new knowledge. Instead, it is a component of the broader project of producing material wealth and reproducing nuclear and extended family networks. Scientists who are firmly emplaced in the Ugandan context, and thus able to negotiate, reproduce and expand the actor-networks that underpin their work, often also have certain advantages in accessing the empirical materials that are central to the success of knowledge production. As Dr Ochieng explains, his local emplacement facilitates the collection of samples for his agricultural research:

> The advantage is that you are in your local environment. You can move around easily to all parts of the country, and collect strains of the virus from all over. I have contacts all over. I

> can contact district officers and then go to the farms, and it is not a problem. (interview, 7 May 2014)

According to Dr Ochieng, the institutional gatekeepers, who guard the material basis of much agricultural and medical research in Uganda, are more likely to grant access to local PhD students, who are also employed by public institutions and whose local social networks are still intact. Conversely, researchers, from Uganda or elsewhere, who are explicitly attached to foreign research or training programmes, will have more difficulties in this regard.

However, while long-term integration into the local context does seem to simplify some matters for those who embark on a local PhD programme, the scientists I consulted generally agree that full-time domestic programmes are a poor alternative to the sandwich programmes described in more detail below. These scientists cited low salaries, sporadic supervision and limited opportunities for personal engagement with scientific communities outside of Uganda to explain their views.

Salaries and supervision are related. Salaries earned by academics at public universities in Uganda are considered by the scientists themselves to be insufficient to support their livelihoods. Even full-time employees spend a considerable amount of time on activities that generate additional income so that they can achieve what they see as an acceptable standard of living.[5] One consequence of this is that local supervision of PhDs is done on a more or less voluntary basis – in the words of Dr Mugisa, it is as if 'someone is just doing you a favour'.

This means that PhD supervision is not only provided in a begrudging and inconsistent way, but also creates a kind of indebtedness to the supervisor. Students are expected to service this informal 'debt' through the co-authorship of publications and the rendering of unpaid assistance in the form of teaching and research. This further slows down the students' progress towards completing their degrees. As such, the relationship between supervisor and PhD student can be

understood as belonging to a substantive cultural economy characterised by transactions linked to scientific recognition, knowledge and labour (see Halperin 1994).

With a handful of exceptions, most PhD candidates in Uganda enrol at the country's oldest and most prestigious higher education institution, Makerere University. At Makerere and elsewhere, local PhD programmes depend directly or indirectly on foreign funding. Funds might be earmarked for PhD training or cobbled together by senior scientists from one or more different projects from which they can allocate small amounts of funding towards supporting a PhD student's fieldwork and analysis. Either way, research priorities are strongly influenced by the interests of the foreign partners, but in such cases, the PhD student seldom benefits from direct engagement with those partners. Thus, completing a PhD exclusively in Uganda narrows the range of people, as well as the material and symbolic resources, that can be incorporated into the actor-networks that produce the degree, without significantly reducing the students' or the universities' dependence upon foreign resources.

Institutional hindrances to accessing primary empirical data sources may be less formidable for local PhD students, but laboratory equipment and consumables that can assist their analysis, together with access to such basics as electricity and transport can be difficult. And while it is rare for anyone to complain about the quality of supervision available in Uganda, it is widely acknowledged that the small number of trained and experienced scientists in Uganda limits the breadth of disciplinary expertise that PhD students can draw upon. The result is that local PhDs are perceived by Ugandan scientists as taking far too long to complete and as constrained by inadequate tools. While still dependent upon foreign resources, local degrees also offer too little exposure to foreign collaborators and research environments. The skills developed from such exposure, perhaps more so than specific personal relationships, were perceived by respondents in this study as essential for success in subsequent efforts to mobilise international funding for further research.

The sandwich-training model

On an icy winter afternoon in 2014, David Ebine and I sat in a busy European café talking about his PhD training. At the time, he was nearing the end of a sandwich programme and he compared the opportunities he had to study at home with programmes spent partly or wholly abroad:

> I also wanted to study abroad. The reason being that doing a PhD in Kampala can take you, if you are not careful [laughing], ten years. I think it is a systems issue, mixed with one's own personal commitments. So, most people who would like to do PhDs prefer doing them abroad because usually the turnaround time is short. It is almost half of the time it would take [in Uganda]. (interview, 14 February 2014)

Here, Ebine reiterated a common criticism of local PhD programmes and identified a key advantage of sandwich programmes and full-time study abroad: PhDs are finished far more quickly abroad than they are in Uganda.

For Dr Mpagi, an agricultural scientist who is active in several international and regional professional networks, the sandwich model has the added advantage that 'in the end you become relevant' (interview, 28 April 2014). For him, this relevance is a direct outcome of the multi-site nature of the training and of the PhD student's mobility.

Time spent abroad offers brief but significant respites from a wide range of social and economic commitments and obligations – from extra teaching at a private university, to managing a small business, to attending family events. As a result, PhD students tend to be far more focused and effective in the months they spend abroad. At the same time, the brevity of these interludes means that ties to place, family, and colleagues are not significantly eroded, nor are the capacities for creativity and patience that are essential for successful work in Ugandan institutional contexts. Meanwhile, continued dependence upon supervisors and, often, data collection in Uganda, counter the temptation to

design and carry out research that might be highly valued in foreign institutions but not so much in Uganda.

As such, the sandwich model offers training in a liminal space that is neither mainly Ugandan nor mainly foreign. This liminality can be an asset to anyone seeking to broker disparate actor-networks while maintaining some creative space in which to achieve their own goals. Successful Ugandan scientists who continue to work in their homeland after completing their PhDs have learned to navigate and manipulate opportunities in a liminal zone that amalgamates local and foreign influences in ways that exceed the traditional bounds of what might be called a field of science (Bourdieu 2004).

To borrow from Sheila Jasanoff (2004), the Ugandan research environment is co-produced through the actions of individuals, organisations and material actants with diverse geographical origins. Sandwich-training models tend to be preferred by Ugandan scientists because these models are well suited to the environment. Sandwich models offer high quality training while preserving scientists' social and material ties to their home country. The model thus also favours the cultivation of a scientific subjectivity that seeks to engage with research questions that are closely tied to issues of concern in Uganda, while permitting the mobilisation of a variety of resources from both near and far.

Mobility, training and understanding one's future partners

Another advantage of scientific mobility, and one that is often missed in studies on science research in low-income countries, is the value of exposure to new social and cultural environments (for an exception, see Ynalvez and Shrum 2009). Temporary mobility offers scientists an insight into the fractured geographies and uneven advantages of different research environments, while at the same time offering them opportunities to cultivate understandings of other cultures and academic traditions. In other words, immersion in foreign research, education and cultural contexts, equips Ugandan scientists to better

understand and negotiate with foreign collaborators later in their careers.

Acquiring some life experience in countries such as the US, the UK, the Netherlands, Sweden or Japan can improve Ugandan scientists' abilities to participate in internationally-sponsored projects, and to further their own individual and institutional interests within the context of such projects. These skills can be deployed in managing the kinds of known-unknowns that sustain partnerships with foreign actors despite the 'inherent political-economic contradictions' that lurk just below the surface of many collaborative research projects (Geissler 2013:13). A personal experience of mobility and immersion in another culture can also be an advantage to scientists who return to Uganda and seek to build collaborative research architectures that include the boundary objects (Star and Griesemer 1989) and slippery spaces that are necessary for facilitating the flow of resources across actor-networks and towards partly, or wholly, contradictory ends (Zink 2013).

As such, sandwich programmes can be an asset in the decolonisation, if not endogenisation (see Crossman 2004), of Ugandan science even as it continues to engage with global networks. Instead of reproducing and embodying power inequalities in new Ugandan PhDs, the sandwich model, through its periodic mobilities, offers researchers experiences and tools to engage and negotiate more successfully with foreign actors and their science agendas in Uganda. Unlike PhD programmes abroad, which can create significant hiatuses in Ugandan scientists' networks in Uganda, sandwich programmes seldom undermine the potential for graduates to become powerful actors in Uganda. The sandwich model also differs from local PhD programmes that, while firmly embedded in local social and scientific networks, obliquely disempower students through their indirect dependence upon foreign funds and research interests.

Reflecting on his PhD training in Europe, Dr Oloya noted that one of the greatest rewards of his experience was the sense of empowerment that allowed him to see himself as an equal to his European colleagues. It was while studying overseas that he first realised 'Hey! I'm not stupid after all,' and allowed him to see himself as an expert

when offering guidance to foreign colleagues from other countries and foreign institutions. As he explains:

> When you talk about genetic sequencing and DNA technology, you say, 'Ah, that is core science, that it is very tough. We can't do it, it is for the Europeans, and it is for the Americans.' But through training abroad you realise 'OK, I can also do it'. And then the Europeans, the fellow students, they say, '[Oloya], I'm finding a problem here and here, how do you do solve it?' Then you go through this and you solve the problem. You say 'OK, I can also help somebody.' It gives you confidence. (interview, 13 May 2014)

For Oloya and others, this confidence was cultivated further by foreign supervisors who invited Ugandan PhD students into their home, personally served them a cup of coffee or tea, and asked them how they would tackle a research issue or encouraged them to pursue their own ideas. Several respondents compared this with their experiences of supervision in Uganda, which tend to reproduce existing hierarchies and favour obedience above independence. Of course, not all Ugandan students enjoy such warm relations with their foreign supervisors. However, to the extent that collegial relations and friendships do develop across geographic and political-economic spaces, supervisor–student relationships are demystified, and hierarchies begin to erode (albeit even partially), thus enabling Ugandan scientists to engage and negotiate more effectively with international collaborators.

Later, when PhDs have been completed and graduates are continuing with their careers, experiences abroad also help Ugandan researchers to understand and accommodate what might otherwise seem to be irrational behaviour on the part of their foreign collaborators. Dr Nalwanga, for example, described her foreign colleagues' loss of confidence on encountering what to them were shocking research conditions in a Ugandan hospital's maternity ward:

> They said: 'you mean a woman can deliver on the floor? … How do we go and talk to such a woman to participate in a

> research project? … How will we conduct research in a centre which delivers a hundred [babies] per day, when in our centre [in Europe] we have a hundred per month? How will we be able to take the samples? How are we going to counsel [the women]?' … They said all those kinds of things. But to me these things are normal. I've done research [in such contexts]. (interview, 28 April 2014)

Having trained in their country through a sandwich PhD programme, Dr Nalwanga knows the environments that European researchers are more familiar with. She has experienced the clean hallways, ample beds and basic comforts of European hospitals, just as she has experienced conditions in regional public hospitals in Uganda. Her experience has enabled her to assist and advise her foreign colleagues, and to facilitate the continuation of their scientific work. She explained that foreign partners often

> don't know much about the local setting, and it is up to us to really tell them the true picture. [And] it matters! Otherwise some of them, at one point, feel like they are exploiting patients. They are like, 'how do we come then and take all these samples for DNA analysis … when a women can't even feed herself?' (interview, 28 April 2014)

For Dr Nalwanga, the conditions in which her research is conducted is one of the reasons why her research matters. Like many of her colleagues, she was once a doctor working at a hospital with few medical resources, and treating a seemingly never-ending queue of individual patients with frighteningly advanced medical conditions. What was, for her, the depressing prospect of spending her career reacting to individual cases without being able to effect systemic change in terms of preventative healthcare was one of the factors that motivated her to pursue a career in clinical research. Through her research, which is carried out in collaboration with foreign partners and using foreign funds, Dr Nalwanga is hopeful that she might be able to help mitigate future suffering rather than merely reacting to avoidable and preventable

medical emergencies. Dr Nalwanga believes that her experience abroad makes her a more effective support to her foreign partners, whose funds and equipment are essential to the success of her research.

While Dr Nalwanga's example is dramatic, others are more amusing. Dr Tumushabe recalled a flushed and frustrated Scandinavian researcher in a northern Ugandan town who stood in the street demanding a receipt from a *boda boda* [motorcycle taxi] driver:

> If you only studied here in Uganda, then you would be wondering 'is he crazy, looking for a receipt from a *boda boda*?' [*laughing*]. Yet, the *boda* driver is taking your money. Maybe he has worked with you the whole day and you are going to pay him 30 000 shillings. That is a lot of money. Money you cannot receive later [without a receipt]. So, [training abroad and] learning among those environments helps you to know how to respond to and understand a different culture in the future. Scandinavian people are strict [*chopping the side of one hand against the palm of his other*]. If you have been with them, you won't wonder why they are irritated, why they are not renewing your project [when you can't show receipts for some project costs]. (interview, 1 May 2014)

The *boda boda* story is comical, but it also highlights two serious issues. First, foreign collaborators' concerns and actions sometimes make little sense in a Ugandan context. Second, understanding those actions and their implications can be important for the sustainability of future research and collaboration opportunities.

Understanding partners' and funders' perceptions of the legitimate costs involved in a research project and of how those costs should be accounted for, is fundamental to building trust in international collaborations. Only after spending months in Scandinavia, getting to know Scandinavian researchers, their research environments, and their version of audit culture (Power 1994), does a sweaty argument with a *boda boda* driver make any sense. In the long run, being able and/or willing to try to make sense of the underlying assumptions inherent in such encounters is a skill that helps make transnational collaborations

sustainable in contexts where very research might otherwise seem impossible.

Conclusions

The research-training programmes described here are elements within a larger transnational economy of scientific knowledge production whereby labour, equipment, data and access to empirical material are exchanged between local and foreign actors and institutions. While some foreign institutional and individual partners might engage with Southern researchers for altruistic reasons, significant material and symbolic rewards are available to foreign actors who engage with the Southern science community. Many Northern scientific careers, commercial innovations, and medical breakthroughs rely on access to the plants, animals, viruses and social and physical processes that are only, or most easily, accessible in the South. Meanwhile, in the securitised North, where low-income countries are viewed as potentially destabilising sources of disease, refugees and environmental pollution, access to and expertise about these countries is a priority for wealthy governments seeking to neutralise or curtail such threats.

Despite occasional periods of political tumult and violence, Uganda has long been an attractive research site for scientists from Europe and North America. It has offered (and continues to offer) a welcoming political, social and physical climate in tropical Africa with access to plants, animals, bacteria, viruses and human bodies that are the essential raw material for much Northern research (Elliott et al. 2015; Tilley 2011). By offering foreigners access to such material, Ugandans can garner rewards such as funding, equipment, access to training opportunities abroad, and foreign expertise. These resources have the potential to contribute to the renewal and development of research capacity, enabling Ugandans to carry out scientific research and to speak with increasing authority in both local and international fora. Meanwhile, the rising number of highly trained researchers in Uganda, combined with the growing influence of local institutional review boards and the Uganda National Council for Science and Technology, permit local

researchers to demand more meaningful and beneficial collaborations in exchange for allowing foreign researchers and institutions access to Ugandan sites.

Both historical and contemporary evidence shows that scientists in lower-income countries are able to wield influence and agency in (and sometimes against) foreign actors from the North (Lowe 2004; Osseo-Asare 2014; Pollock 2014; Prince and Marsland 2014; Rottenburg 2009b; Tilley 2011; Zink 2013). However, the balance of power between research collaborators still obviously favours actors in the wealthier countries (Crane 2013; Droney 2014; Olukoshi and Zeleza 2004; Tousignant 2013). Both my own informants, and the publications of a diverse group of scholars (see, for example, Elliott et al. 2015; Juma and Yee-Cheong 2005; Osseo-Asare 2014), seem to agree that it is important and necessary for African scientists to foreground their own priorities for science research in Africa. In my view, opportunities for scientists from low-income countries to participate in sandwich research training programmes are clearly an asset in this struggle.

In comparing the three different models of PhD training that are available to Ugandan scientists, Dr Mugisa succinctly encapsulated the perspective of most of the scientists I encountered in my investigation:

> I think if you compare the three modes: the one at home, which now tends to create capacity but over a long period of time, and also does not create capacity with a richness of experiences. Then you have the sandwich programme, which shortens the length of stay on the programme but then with a very high probability of people coming back to their stations. Then the other one where you have probably even a shorter stay on the programme, but chances of fleeing the station, people not coming back. I think the one that we really would prefer is the sandwich programme up until the capacity at home is grown – the capacity to supervise, the infrastructure, and the resources. (interview, 5 May 2014)

Dr Mugisa points to the richness of experience and the likelihood of return as key factors informing his preference. His emphasis on the importance of scholars returning to their 'stations' might surprise observers who see the 'brain drain', and the constant flow of people from resource-poor to richer research environments, as a natural phenomenon. However, his view resonates with my observations of, and conversations with, scientists in Uganda, who frequently pointed out the beauty of their country and the value they place on being at home.

I found a consensus in Uganda that the sandwich model of training offers Ugandan scientists opportunities to strengthen their positions in Uganda's scientific community and in society more generally. These programmes also provide opportunities for Ugandan scientists to improve their positions in relation to international partners and counterparts. Given that Uganda's research environments are, and will in all likelihood continue to be, co-productions between actors and actants from both inside and outside Uganda (as well as inside and outside of science) (Latour 1987), the power of Ugandan scientists to act as strong agents is strengthened, not weakened, by their exposure to multiple scientific and cultural contexts.

These insights should also serve as a caution to institutions that would like to accelerate the shift towards local PhD training models, based on the growing number of qualified and experienced scientists in low-income countries. In my view, PhD training opportunities in the South should continue to expand to the extent that they can derive resources from international collaborations that are primarily *scientific* in nature (as opposed to those focused on capacity building), and to the extent that national governments direct funds to their own PhD training programmes. A shift to a full-time local model by international actants supporting science capacity building has the potential to erode the agency of scientists if it takes place before the following conditions are met in lower-income countries:

- National institutions must be well-equipped with the tools necessary for research.
- Reliable conduits must be established through which scientists

can access the reagents and other consumable resources that research depends on.
- Significant national funding is directed toward locally defined research priorities.
- Academic salaries are sufficient to enable individuals to focus on research and not need to seek other sources of income that consume their time and their energy.

These conditions are not yet met in Uganda or in most sub-Saharan African countries. As such, the sandwich model, through its co-produced, multi-local and liminal learning and research environment is better suited to the goals of institutions that aim to strengthen the agency of scientists who are working in lower-income countries.

Lastly, it is important to acknowledge that the costs and values associated with the three models differ widely. The costs of full-time training programmes abroad are high while their value for science in Uganda is relatively low, given that so few of their recipients return home. Meanwhile, if we apply the narrow models of financial accounting that have become normative in understanding value in contemporary audit culture, the sandwich model may seem prohibitively expensive when compared to local PhD programmes. Sandwich PhDs entail high salary costs for foreign supervisors, as well as airfares and living stipends for students in high-income countries. However, the actor-network theory approach used here highlights the value of various kinds of relationships, knowledges, skills and hands-on experience with modern scientific equipment, that are commonly externalised in conventional calculations of the return on investment from the different training models. My findings indicate that these elements of PhD training are precisely the ones that become key assets for Ugandan scientists as they attempt to further decolonise science in their country. Consequently, until local research environments are further improved, a substantive economic calculation of value clearly favours sustained investment in sandwich models of PhD training.

Notes

1 I use the term 'sandwich model' rather loosely to cover PhD programmes where degrees are awarded by a foreign institution, a domestic institution, or jointly by more than one institution. The important aspect is that the PhD is supervised by senior scientists who are based locally and internationally, and that the PhD candidate is mobile, spending significant amounts of time abroad and at home during the course of their PhD programme.

2 I have limited my observations to the science sector as my research focused on academics working in the health sciences, agricultural sciences, and in natural resource management.

3 See also Chapters 4, 5 and 6 in this volume.

4 Pseudonyms are used for all of the interviewees quoted in this chapter; their anonymity was guaranteed as a condition of their participation in the research.

5 This includes paying for their children to attend the more expensive primary and secondary schools that have more chance of preparing pupils for university study.

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