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Building a critical mass of researchers in the least developed countries: new challenges

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Knowledge is at the heart of development and qualified researchers are necessary to produce a broad base of knowledge relevant to the solution of current and future practical problems. How to create and maintain a critical mass of researchers who are able to consistently and systematically contribute to and absorb such a knowledge base? This is the focus of this chapter, with special reference to the least developed countries. It is argued that it is very unlikely that LDCs will be able to build the research capacity they need simply by adopting the research training schemes developed in the advanced countries and offered by development cooperation agencies. The reasons for this are presented and illustrated with a case study of Nicaragua.

1 Introduction

There exists a common and widespread belief that a research career begins with a doctoral degree. Therefore, governments concerned with ensuring an adequate supply of highly qualified personnel are expected both to fund and regulate graduate training programmes. Training researchers has long been seen as the primary benefit universities can provide to an innovation-oriented productive sector, as well as to society.[2] In order to carry out this task, research training schemes were created in the advanced countries, in many developing countries, and are on the 'agenda for the future' of those poorer countries that have not yet been able to do much in this direction.

Despite differences in structure, organization and quality, graduate programmes worldwide have tended to converge on a model whereby the doctoral degree is granted to a candidate who has successfully performed original research in a specific scientific

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2 Pavitt (1998).

discipline – something that was once estimated to require at least four years.[3] Since this model was set up and became widely accepted, ideas and theories about knowledge production and use have changed. This chapter departs from the argument that such changes pose important challenges to the prevailing research training model. Specifically, it is concerned with the implications of the changes in knowledge production for the least developed countries and their task of achieving a critical mass of competent researchers.

It is a truism that knowledge is at the heart of development. It is also common sense that qualified researchers are necessary (albeit not sufficient) to produce a broad base of knowledge that is likely to form the background to the solution of current and future practical problems and to meet society's needs. Indeed, without such researchers, development strategies can hardly be knowledge based. How to create and maintain a critical mass of researchers who will consistently and systematically contribute to and absorb such a knowledge base seems to be a fundamental challenge faced by every country.

2 The changing nature of knowledge production and use

It is a recurrent idea in the literature that the research world is in transition, and a number of different models have been proposed to reflect this.[4] One such model that has become influential is the thesis advanced by Gibbons *et al.*,[5] that a new regime of knowledge production, called mode 2, is emerging alongside the more traditional and familiar mode 1, in which research problems are set and solved in a context governed by the interests of the academic community.

Mode 1 is a linear model in which research is seen as the starting point of innovation and there is a clear separation between knowledge producers (researchers) and users (firms, government, society at large). The model also assumes that research results produced in line with theoretical frameworks and prescribed methodologies of relevant disciplines ought to be utilized by end users because of their scientific validity. This validity is ensured through scientific peer review and reflected in publication of articles, preferably in mainstream journals.

Mode 2 knowledge production, in contrast, entails a broader conception of transdisciplinary knowledge, generated in the context of application.[6] It addresses

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3 Rip (2002).

4 For example, the 'triple helix' model (Etzkowitz and Leyderdorff, 2000); 'research systems in transition' (Ziman, 1994); 'national systems of innovation' (Freeman, 1988; Lundvall, 1992; Nelson,1993); and the 'post-modern research system' (Rip and van der Meulen, 1996).

5 Gibbons *et al*. (1994).

6 'Application is more than just product development carried out for industry […] and the processes operating to determine what knowledge is produced are much broader than is normally implied when we speak of taking products to the marketplace. The main idea of application is that knowledge is produced if, and only if, interests of various actors are taken into account. Actors are defined as industry, government and society more generally' (Gibbons *et al.*, 1994: 4).

problems identified through a process of continual negotiation between actors from a variety of settings. It is thus a systemic, interactive model in which knowledge is produced in the course of cognitive and social practices. It recognizes the existence of multiple knowledge sites, and of various skills and experiences that need to be brought together to solve particular problems. Quality is assessed by both experts and non-experts, not only in terms of scientific merit but also of the usefulness or relevance of the knowledge produced, being more socially accountable and reflexive.

Whether this transition from mode 1 to mode 2 refers to the actual dynamics of knowledge production, or to a change in our understanding of the process of knowledge production and utilization, or a mix of the two, is a matter of debate.[7] Some have even expressed doubts about the overall thesis put forward by this model.[8] However, one does not have to subscribe wholesale to the 'mode 1 and mode 2' vision to perceive a variety of ways in which the boundaries between academic and other worlds are becoming blurred, and to conclude that this is a growing trend. Actually, even the critics acknowledge 'the [uncontroversial] thesis of the diversification of the loci of scientific production',[9] the intensification of inter-sectoral collaboration, the increasing interdisciplinary character of contemporary science and the changing normative systems governing the work of researchers.[10] All such trends are in accordance with the features of mode 2 knowledge production. To this extent, there is significant agreement among authors that, in historical terms, we are witnessing a gradual shift in the relative space occupied by mode 1 and mode 2 knowledge production, with a steady expansion of the latter.

Under mode 1 knowledge production the task of S&T policy makers to ensure the supply of qualified researchers looked much simpler. It was agreed that governments had to devote resources (or obtain complementary resources from elsewhere) to help young people go into higher education, to maintain quality universities and graduate programmes, and to provide an environment conducive to research by putting in place competitive grant schemes and fostering a reward structure based on merit and controlled

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7 Some authors contend that in practice mode 2 knowledge production has actually been predominant since the 18th century. They argue that mode 1 and its associated ideology of 'pure science', was promoted in the late 19th century and reinforced in the early 20th century as a way to 'defend and protect' the scientific establishment from external control. Since then, these two research modes have existed in parallel. Thus, these authors imply that what is in transition is our understanding of knowledge production, not the actual process (Weingart, 1997; Godin, 1998; Pestre, 2000; Etzkowitz and Leyderdorff, 2000). For a response of the proponents of 'mode 1 and mode 2' to the critics, see Nowotny (2000).

8 A major resistance to this thesis is related to its value judgement or normative character: mode 2 research is manifestly better adapted, more relevant and more efficient than mode 1, and thus should be used to inform policy making.

9 Despite disagreements with Gibbons and colleagues, Godin and Gingras (2000: 274) recognize the increasing distributed character of knowledge production and of intersectoral research collaborations. They found that in the 1990s the number of papers having non-university authors increased considerably, and so did the papers co-authored by researchers in different types of organizations.

10 There is plenty of evidence that the processes of allocating research funds and evaluating results have, in the last decade, incorporated other criteria than the judgement by peers (the sole *ex-ante* and post-evaluation mechanism in mode 1). For an overview of how research funding agencies have contributed to changes in the normative system of science, see Benner and Sandstrom (2000).

by reputable researchers. In terms of research (graduate) training, the task was to bring students to the research frontier of a particular discipline and to make sure that in this process they were socialized into the academic profession.[11]

The above directive was valid for all countries. For developing countries, the alternatives were to create their own graduate programmes along these lines, or to send their brightest and best young talents to be trained abroad, or a combination of the two. The latter was the path chosen by the better-off developing countries, including Brazil, China, India, South Korea and others, but even this strategy was fraught with difficulties. Most developing countries did not have the necessary resources either to establish their own graduate programmes or to send students abroad for advanced studies. But those talented young people who did go abroad were unable to find a favourable research environment on their return home, and thus the brain drain became a serious problem. What was needed was not in dispute: researchers were to be trained in postgraduate programmes and these were shaped by, and for the primary purpose of reproducing the academic profession.[12]

To the extent that mode 1 was the basis of university research and corresponding training structures, it is reasonable to say that mode 2 knowledge production calls for a 'reform' of the system. Actually, in the advanced countries, postgraduate education is increasingly influenced by the debate about the extent to which societies experience, or are expected to change, their mode of knowledge production. In the new regime (mode 2) research training is said to require the development of a broader set of capabilities, including communication and presentation skills, collaborative skills (with colleagues in other disciplines, or with actors in other sectors), understanding and management of intellectual property rights, and negotiation skills. Training in a scientific or scholarly specialty (and four years doing this on a master-apprentice model) as traditionally defined, is arguably much less relevant today.[13] The research training function of higher education and the transfer of knowledge through the young generation are thus loaded by a number of major debates about academic and scientific work, and about universities and their changing nature and roles. In policy terms, research training is being 'decoupled' from its strong association with academic careers and the reproduction of the academic profession.[14]

Obviously the above transition affects different countries in different ways. Those that have functional universities, established systems for training researchers (postgraduate

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11 The process of socialization into the academic profession meant the internalization by the student that the 'most deeply held value of scientists is the extension of certified knowledge'. To achieve this, the researchers must behave according to a set of norms (Merton, 1973 [1942]). These norms are changing and thus constitute a new regime for science (Ziman, 1994; Etzkowitz, 1998). See also Ronayne (1997), Rip (2002).

12 Henkel (2002).

13 This argument has been put forward in a number of documents resulting from discussions between researchers and research policy institutions in the US and Europe. For a flavour of the arguments on the need for changes in graduate education see www.esf.org and CHEPS (2002) for Europe, and www.grad.washington.edu/envision for the US.

14 Blume (1995).

programmes), a private sector that contributes to R&D and employs graduates, are talking about reform and adaptation. They are also discussing extending research training rights to other organizations such as private companies, hospitals and consultancy firms, and are training researchers to take jobs in the private sector, etc. But how does this debate on the changing nature of knowledge production and use affect research training in the least developed countries (LDCs), which have not yet been able to develop a critical mass of researchers, nor have the educational structures to train them?

This group of developing countries faces some major questions. Is it possible to create research capacity in mode 2 *only after* a country has established training structures in mode 1?[15] Is it possible to create capacity in mode 2 directly (is this leapfrogging, and if so, is it possible/desirable)? Would it be more appropriate to aim at the co-existence of both modes of knowledge production? The replies to these questions pose crucial challenges to LDCs that need to build their knowledge base and critical mass of researchers.

Another challenge for the LDCs is that their economic performance severely restricts their expenditures on S&T – and the increasing cost of scientific activity will probably widen the scientific and economic gap between them and the advanced countries. Thus, whatever replies a country gives to the above questions, the lack of resources may limit (or hinder) the implementation of a corresponding research training strategy. It is here that development cooperation has played an important role: capacity building in the LDCs has been the focus of many donors. However, what donors understand by capacity building and the form of support they offer depend on their views concerning knowledge production and utilization. Such views may be in line with mode 1 or with mode 2, and each influences accordingly the decisions made by the recipient country concerning the form and content of research training modes.[16]

The remainder of this chapter reflects on these questions and, in doing so, argues that creating research capacity in mode 1 in the LDCs, following the path of the advanced countries, is unlikely to be feasible. The reason is that it takes too long, it requires resources not available in those countries, and it does not attend to criteria of social relevance which are currently required of public universities. Moreover, as research capacity building in LDCs is somewhat dependent on development cooperation, the views and the educational structures of the cooperating Northern country tend to dominate the relationship and bring further complicating factors into the picture.

The argument is illustrated with an analysis of the case of research capacity building in Nicaraguan public universities with support from SAREC, the department for research cooperation of the Swedish International Development Agency (Sida). SAREC's modality of support to capacity building in the South has a cadre of followers in the

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15 Some authors claim that academic training, excellence and standards of education can only be established through mode 1 (Krishna, 2004)

16 To the extent that sponsors influence the nature of research and the behaviour of researchers, it is to be expected that they have a considerable influence in shaping the conduct of research and the types of capacity being built in the countries where they operate (Benner and Sandstrom, 2000).

donor community and is applied in many LDCs. This, added to the fact that the partnership between Swedish and Nicaraguan universities has been going on for over 20 years, makes it an illuminating case of the problems of research capacity development and the complexity of such effort.

The following sections present a brief picture of the socio-economic, political and university context of Nicaragua, the partnership, and its outcomes and impact, and the main problems with SAREC's modality of support to research capacity building. The concluding section draws lessons from the case study and proposes new grounds on which to build modalities of support to research capacity building in the South.

3 Cooperation between Swedish and Nicaraguan universities

The partnership between Swedish and Nicaraguan universities, as mediated and supported by SAREC, started in 1981. Over the last 20 years SAREC has fostered cooperation programmes between the four public universities in Nicaragua[17] and a number of universities in Sweden, covering a wide range of scientific fields in agriculture, engineering, medical sciences, geology and ecology.

SAREC's objective is 'to strengthen research capacity and support research which can contribute to the solution of important development problems of Nicaragua'.[18] In order to achieve this goal, SAREC has focused on providing opportunities for faculty members of Nicaraguan universities to pursue Masters and PhD degrees at Swedish universities, using the 'sandwich model'.[19] The latter is the name given to a type of graduate training that combines course work and periods of study at the Swedish partner institution with research work at the home institution, with the final degree granted by the Swedish university. Table 1 shows the contribution of the cooperation to the staffing situation of the four Nicaraguan universities in the last 20 years.

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17 Universidad Nacional Agraria (UNA), Universidad Autonoma de Nicaragua-León (UNAN-León), Universidad Autonoma de Nicaragua-Managua (UNAM-Managua), Universidad Nacional de Ingeniería (UNI).

18 Sida/SAREC (2000: 6).

19 Sida (1998).

Table 1. Staff at Nicaraguan universities with MSc and PhD degrees obtained through the SAREC programme (1980-2000)

	Completed		Underway	
	MSc	**PhD**	**MSc**	**PhD**
UNA	22	2	-	10
UNAN-León	13	1	5	9
UNI	6	-	9	4
UNAN-Managua	-	-	-	5
Total	41	3	14	28

Sources: Synthesis documents provided by the universities.

It is difficult to judge the impact of such numbers, but it was certainly different at each university. At the National University of Agriculture (UNA), 25% of teachers with an MSc obtained their degree in the framework of this cooperation programme. At the older universities like UNAN-León, the impact of the SAREC programme has been much less impressive – only 8% of existing MSc holders in 2001. This contribution added to a larger effort by Nicaraguan universities during the 1990s to develop their human resources. Between 1990 and 2000, the proportion of faculty members with an MSc increased from 12% to 28%, and those with a PhD doubled from 4% to 8%,[20] although these figures are still well below Latin American average.

In addition, the analysis of the programme indicates that even if there was an increase in research capacity at the universities, the dynamics of knowledge production did not change very much during these years. Of course, the reasons lie mostly in the complexity of the problems faced by Nicaragua, including the economic crisis, institutional weaknesses and the political climate. However, the findings also point to a number of limitations of the model of research capacity building. The impact of the partnership on research capacity presents a number of problems derived from its own design and implementation.

4 Modes of knowledge production and research capacity

In designing the modality of cooperation in the early 1980s, SAREC recognized that a great deal of innovation takes place in the developing world, and thus it was essential to build local research capacity to support it.[21] Nonetheless, the process leading to innovation was believed to be a linear one whereby researchers must identify society's needs, translate those needs into researchable problems, work scientifically on them, disseminate the results to some kind of intermediary institution (a firm, government institute, extension organization, etc.), which would then make use of the results by incorporating them into an innovation. This, in effect, describes mode 1 knowledge production.

[20] Porta (2004).
[21] SAREC/IDRC (1991: 5-7).

The new conception of mode 2 knowledge production has, *in discourse*, been adopted by some donors, including SAREC. Policy documents have referred to the 'focus on systems and a systems approach to development'.[22] 'Participatory methods', 'demand orientation', and 'local knowledge', have became the new buzzwords of development cooperation. The importance of linkages among stakeholders is also often highlighted.

In *practice*, however, donors find difficult to change their way of operation. On the one hand, the idea of the linear model is powerful and is upheld and forcefully defended by researchers, who are a strong interest group.[23] On the other, modalities of North–South cooperation that foster research capacity in mode 1 are much easier to implement, monitor and evaluate than those in mode 2. Selecting individual research projects on the basis of scientific criteria, monitoring the performance of graduate students, checking for publications in mainstream journals are well established practices in the research world. But the participatory methods necessary for mode 2 programmes are messy and difficult, the path from a practical problem to a research problem is not straightforward, and what is socially relevant is a matter of debate – in short, there is considerable uncertainty associated with mode 2 and donors prefer not to take risks. Ultimately, donors are accountable to their governments, and are usually required to adopt a results-based approach in their operations. By the same token, many recipient countries do not have a clear idea of how they want to go about building their research capacities. Research capabilities are often not included in national development plans, and are seen as questions to be decided by the universities.

Support to graduate education does not seem to allow much room for interaction between social actors. Yet it is generally believed that 'research training at doctoral level is the longest, most important and comprehensive form of training given to young graduates from developing countries to prepare them for careers and future leadership in research […] such trainees provide the indigenous expertise and competence that all countries need for their national self-reliance'.[24] Without disputing the importance of highly qualified researchers for any country, it may be useful to reflect on the problems with this emphasis on doctoral training.

5 Problems with the emphasis on graduate education in LDCs

As far as the developing countries are concerned, there is no undisputable evidence that the number of Masters and PhDs, and the number of papers they publish in refereed journals, are related to either economic or social development. Brazil, for example, has made considerable investments in building and strengthening a scientific system since the 1960s. The graduate schools in Brazilian universities are regarded with a mix of envy and pride by all Latin American country neighbours: they produce over 6000 PhDs and

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22 Sida/SAREC (2000: 23).
23 Tait and Williams (1999); Benner and Sandstrom (2000); Etzkowitz and Leydesdorff (2000).
24 Nchinda (2002: 1705).

20,000 MSc degrees every year.[25] The scientific contribution of the country to mainstream science jumped from 0.4% in 1986 to 1% in 1999.[26] Yet, a recent analysis of the Brazilian experience in using knowledge for development concluded that 'Brazil's potential in the global knowledge economy remains largely unrealized. Its competitive position is weak and the country is definitely on the fragile side of the knowledge divide'.[27] In order to cross the knowledge divide, it continues, Brazil has to strengthen its innovation system, particularly 'by establishing effective links with industry and ensuring that results are turned into commercially viable products'. In terms of human development, in 2002 Brazil was ranked 73rd among 162 countries, far behind poorer cuntries like Colombia, Costa Rica and Venezuela,[28] illustrating that a strong scientific system does not lead automatically to innovation or social development.

A second problem with the emphasis on formal graduate training is that PhD research is not the most efficient manner to stimulate teamwork in the conditions that prevail in developing countries. Thus, if research is to be linked to innovation and social change, it must be a collective endeavour. In the advanced countries, PhD candidates usually work under the leadership of a professor who has a broad conception of a problem, promotes regular discussion, and encourages students to see the connections among their work. Nicaraguan graduate students in Sweden, however, carry out their research in Nicaragua, in the conditions of their own university, and are probably the only ones working on the topic. In addition, they have little opportunity to acquire tacit knowledge.[29]

A third problem is that not every research problem is an adequate topic for a PhD dissertation. Although there is no doubt that relevant research has to be of an acceptable scientific standard, not all relevant research meets the scientific requirements for a PhD. Thus, Nicaraguan faculty members are expected to select their research topics using scientific criteria rather than according to their social and economic relevance.

In addition, while PhD degrees serve a clear function in the advanced countries, this is not the case in most LDCs. In the former, a PhD is an important 'market' indicator and an entrance requirement for positions in academia and some industrial R&D labs. Basically, people in the North invest in a PhD in order to be able to pursue a career that would be unattainable otherwise. Therefore, a PhD candidate's incentives depend mainly on his or her career potential after graduating.[30] In Nicaragua, the title PhD has no functionality: candidates are already tenured university teachers, and obtaining the degree does not

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25 See CAPES (2002, http://ged.capes.gov.br/Agdw/silverstream/pages/frPesquisaColeta.html). In 1999, the US awarded about 41,000 PhDs, 30% to foreign students (*Science and Engineering Indicators 2002*, table 2-26).

26 *Science and Engineering Indicators 2002*, table 5-43. Latin America saw the largest increase in scientific publications in the period 1986-1999, due to the Brazilian and Mexican contributions.

27 OECD (2001: 7).

28 UNDP (2001).

29 Scientific knowledge is created by a combination of codified (explicit) knowledge and tacit knowledge (Polanyi, 1958). Codified knowledge is contained and transmitted in books, articles, manuals, reports, etc. Tacit knowledge includes experience, personal skills, attitudes and scientific craftsmanship (Collins, 1995). To obtain tacit knowledge, one has to work with those who possess the knowledge, since it is not transmitted through codified sources

30 Mangematin (2000).

bring promotion. Therefore, while they may have some incentive to enter a PhD programme (personal pleasure of learning, opportunity to travel, enhance their visibility), they have no incentive to finish it.

Another problem is that, in the framework of the SAREC programme, Masters and PhD training take a sandwich format (multiple layers of course work in Sweden and thesis work in Nicaragua), and the degree is granted by a Swedish university.[31] This inevitably takes a long time, since it is a *part-time* enrolment for the PhD. When the Nicaraguans are at their home institutions, they teach, attend departmental meetings, supervise undergraduates, and have institutional duties. The sandwich model requires students to have periods of adaptation back and forth. It also makes it more difficult for them to work as part of a team while in Sweden and to participate fully in academic life there. It thus restricts their opportunity to acquire tacit knowledge, as discussed above. It is therefore not surprising that it takes the candidates a long time to obtain their degrees – some PhD candidates have taken over 10 years and MSc candidates take an average of six years.

A further crucial problem is the restriction of support to the degree being granted by the Swedish institution. This has a lot to do with the fact that part of the resources allocated to the programme must be spent in Sweden. Thus, the Swedish universities keep a sizeable proportion of the programme budget, paid as fees and expenses of Nicaraguan students.

Finally, it is possible to attribute most of the problems to the asymmetry in the relation between the partners. A consistent finding of this study was a persistent call from the Nicaraguan side for more autonomy in the choice of research areas, partners, tutors and budget allocations. Why they have not succeeded in achieving what they want has to do with belief, held by both sides that only SAREC funds research in Nicaraguan universities. It is necessary to point out, however, that the four universities involved in the programme receive 73% of a fixed proportion (6%) of government expenditures on higher education, plus additional funding for new buildings and reconstruction, plus exemption from all government taxes and utilities tariffs.[32] This, of course, is to the detriment of other spheres of public spending. In a country where 50% of the population live below the poverty line, and where only 1% of the population are able to attend government-supported universities, the commitment of a fixed budget to universities is a demonstration of the value given to higher education (and research, since most teachers are full-time and are expected to do research). This is true even if the budget of the

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[31] One motivation for the choice of the sandwich model is to foster links between Swedish and Nicaraguan researchers and thus develop capacities on both sides. Another motivation is to avoid the brain drain, as it is believed that if students do research work in their home country, they will work on a socially relevant topic under local research conditions. The sandwich model is also believed to contribute to institutional development because laboratories are built in the Southern institution for the researchers doing their thesis work (Sida, 1998: 29). The practice of sandwich PhD training for Southern researchers has become popular among donors such as DANIDA, NORAD and DFID, as well as the World Health Organization (Nchinda, 2002).

[32] In 2001 the Nicaraguan government expenditures on higher education were US$35 million, of which US$25 million (73%) went to the four universities involved with SAREC. SAREC's contribution to the universities was US$800,000, about 3% of their budgets.

universities is not enough to pay internationally comparable salaries and to fund research activities as desired by the university community. In view of the effort that is asked from society to fund local universities, it is to be expected that the latter will contribute to local development by training qualified human resources where and how the country sees appropriate, and by producing socially relevant knowledge. There seems to be little local awareness (among policy makers and the universities) of the fact that the partnership with Sweden can only take place due to considerable investment from local public funds.

6 Conclusions

In order to close the development gap, countries in the South need to develop their capacity to generate and exploit knowledge, including their capacity to do research. A major challenge for the LDCs is therefore: How to achieve such capacity – i.e. a critical mass of qualified researchers?. This challenge is magnified by two factors. On the one hand, the changing mode of knowledge production means that conventional training schemes are being questioned. On the other hand, the serious economic problems faced by the LDCs limit their internal options for building research capacity, and put them in a difficult position in their negotiations with international donors.

This chapter has argued that it is very unlikely that LDCs will be able to build their research capacities simply by adopting the research training schemes developed in the advanced countries and offered by development cooperation agencies. Such schemes are based on a mode 1 knowledge production and utilization that is, arguably, phasing out.

The collaboration between universities in Sweden and in Nicaragua, with support from SAREC, is a specific case of a North–South partnership for capacity building designed and implemented in line with mode 1. After 20 years, the partnership has produced 3 PhDs and 43 MSc graduates, and is currently supporting 14 MSc and 28 PhD candidates. Many of the latter started their training over 10 years ago, and it is likely that some will never finish. The problems they face to complete stem from the design of the sandwich scheme, the quality requirements of the Swedish universities, the lack of incentives attached to graduate degrees in Nicaragua, and the time constraints imposed by the heavy demands of teaching and administrative duties. In these circumstances, this modality of support offers a limited contribution to building a critical mass of qualified researchers that will be able to change the research environment of Nicaraguan universities.

Outside the universities, the impact of the programme is non-existent. The institutionalization of links with end users is not pursued given the prevalent view of the relationship between knowledge production and utilization implied in mode 1. A corollary to this argument is that, in order to have an impact on development, North-South partnerships should consider moving to forms of research training that are more in tune with mode 2 knowledge production. This would mean that capacity building would focus not only on graduate education, but also on creating opportunities for interactions among researchers and between them and other social actors, bringing together different

types of knowledge that are necessary to address a particular problem. The latter would then be identified by directly involving research users and would be selected on the basis of their social relevance, incorporating mechanisms to ensure the quality of the research.

Obviously there are conceptual and methodological uncertainties in devising and implementing capacity building schemes in line with mode 2. In the context of Nicaragua, and of the new dynamics of knowledge production globally, research training has to prepare candidates for roles and skills that have not yet been clearly articulated. A major challenge facing schemes that aim to build capacity for socially relevant research, ultimately to produce useful knowledge that transcends disciplinary boundaries, is not only how to design the training and its contents but also how to measure, in qualitative and quantitative terms, the outputs of process-oriented research with multiple outcomes. For initiatives premised on mode 2 knowledge production, scientific value is only one dimension of quality – social relevance is another. Existing standards of science and scholarship exist to assess the former, including the number of masters and doctors trained, the number of papers published and the quality of research facilities. But capturing the nature of a specific development process that is largely invisible requires more than the usual research techniques. In addition to the traditional skills that the research community has imbibed, a nuanced reading of development that is iterative and gradual entails listening skills, the ability to combine an open and non-judgemental approach with enough understanding to make sense of and draw insights out of what one is observing and a capacity to reflect and intuit underlying movements. Clearly, the conventional quality indicators of academic research cannot grasp all the expected impact of schemes established in line with mode 2 knowledge production.

Concerning the donor–recipient relationship, conventional practice assumes that research capacity is best achieved through partnerships. Although the word ‘partnership’ suggests equal participation, in practice it is accepted that knowledge flows in one direction, from the North (in the case Swedish researchers) who have the knowledge, to the South (the Nicaraguan faculty) who have to create research capacity. As partnerships also embody the idea that both sides must share the benefits, it is assumed that experts (and other material resources) should be provided by the donor country. This limits considerably the recipients’ choice of partners and feeds a passive attitude. A consistent finding of this study was the desire of Nicaraguan participants to enlarge their choice of training institutions beyond Sweden. The scheme offered by SAREC, however, does not allow such alternatives. And the Nicaraguans accepted that. Why?

That was a very intriguing question. But then there is a clear power relation concerning the control of funds and other resources. Donors and recipients (and the words are quite revealing) tend to assume that only donors pay for the partnership – therefore the rationale seems to be that those who pay, make the rules. What is totally forgotten is that Nicaragua contributes significantly, even financially, to the partnership. North–South partnerships always involve opportunity costs. Even ‘free’ outside assistance takes up local resources, demanding counterpart budgets and mechanisms, as well as the time spent on complying with donors’ requirements. More to the point, in the Nicaraguan case, public funds do play an important role in the training of local faculty. Therefore, in order

to meet the demands of the South, the ‘partnership’ assumption needs to be replaced by the notion of ‘ownership by the South’. This means that donors must take up the idea of supporting capacity building without necessarily involving their own country’s experts and institutions. This might not be an easy step for donors, since they are also constrained by their own domestic constituencies and provisions. It seems, nonetheless, to be an avenue worth pursuing when the general interest is development in the South.

The above assumes that countries in the South have the autonomy to decide what they need from donors, and how they prefer to go about meeting their own goals. The most important step towards ownership, however, belongs to the South itself. In Nicaragua considerable public funds are allocated to local universities. In practice, international collaboration is a way for the universities to augment their budgets, but there seems to be no awareness of this. The universities need to develop an holistic approach to international cooperation and to be pro-active when negotiating assistance within the framework of self-designed objectives. The most important challenge, however, is to have a long-lasting and widely agreed national innovation policy framework. This would spell out the role of the universities and how international collaboration could contribute to this. North–South partnerships must be recognized as a complement to the important national effort that Nicaragua makes in allocating public resources to maintain its universities and to build research capacity. Such recognition, however, must begin at home.

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