From 'Research' to Poverty Reducing 'Innovation'

A Policy Brief from SRA Ltd

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Introduction

Development agencies are currently very concerned about the "impact", or "take up" of the research they finance. They are right to do so. Expenditure on research may be justified on many grounds, but when the funds come from development agencies, whose mission is to reduce poverty, the research is justified on the grounds that it will result in changes in policy or practice. But recent research in industrialised countries on "national systems of innovation" suggests that a number of the mechanisms that aid agencies are currently adopting to increase the impact of research may be misplaced. The body of theoretical and empirical literature emerging from the innovation systems approach is gaining ground as a framework for evaluating research and for guiding the management and allocation of future research funds.

The literature on national systems of innovation ("NSI") started with the attempt to explain the differences in the role that science and technology plays in the economic performance of major industrial countries. Why was the UK successful in producing Nobel Prize winners, but less successful than, say Japan, in harnessing new knowledge to increase international competitiveness. The resulting literature provides a guide to 'best practice' on how to innovate successfully, and ultimately how to increase the impact of research.

The essential insight of the NSI approach is to switch attention from "research" to the "processes of innovation". Research becomes just one element of a wider process of innovation. It emphasises both the importance of a large number of key actors and institutions involved with successful innovation, and the importance of the links between these actors that enable them to operate as an effective 'system'. This is in sharp contrast to the more "linear model" which characterises much current practice within the development community: typically funds are allocated to researchers to do "research" and then, often in a separate exercise, the research results are handed to "extension agents", trainers, or "communications professionals" to deliver them to "the target audience".

Communications and extension will of course remain important parts of the innovation process, but much current practice is like pushing more knowledge down a hose pipe, in the hope that at least some of it will come out of the other end - rather that investing in the quality and effectiveness of the pipe, worrying about where the knowledge needs to emerge and investing in the processes, mechanisms and institutions that will utilise the knowledge once it emerges from the end of the pipe.

What is Innovation?

Much can be said about the nature and meaning of "innovation". But in this context it means the use of new ideas, new technologies or new ways of doing things in a place or by people where they have not been used before. The distinction between "invention" (creation of new knowledge) and "innovation" (in the sense of first commercial use) is crucial. Experience over many years shows that "working with and re-working the stock of knowledge is the dominant activity in innovation"[i]. Indeed the essence of innovation in most circumstances can be described as *'creative imitation'*.

Similarly, the term "research" is itself open to a wide interpretation, but in so far as it is a generator of new knowledge, it is important to consider two types of knowledge: "tacit knowledge" and "codified knowledge". The former is associated with human skills and experience, while the latter is documented, or in some other way systematised (for instance in blue prints, manuals, instructional videos or computer programmes). Innovation usually requires both types of knowledge: for instance, it would not be possible to build a jet engine solely using blue prints and other codified knowledge. Similarly, farmers have been shown to contribute importantly to the innovation process with their tacit knowledge of local circumstances and years of farming experience[ii].

Technology and Knowledge.

Improvements in technology provide the means for producing more (or better) goods and services with less resources and effort. It is now widely accepted that the mastery of technology and the processes of innovation are major sources of international competitive advantage[iii]. Furthermore, mainstream organisations such as the OECD now go as far as to argue that the capacity to manage these processes of technical change to advantage increasingly defines the huge divide between industrialised and developing countries[iv].

National Systems of Innovation

The ideas associated with national systems of innovation as they relate to developing countries are perhaps most effectively summarised by Arnold and Bell (see reference in footnote [i]). They provide a highly simplified diagram of the major elements of a successful innovation system. (see next page).

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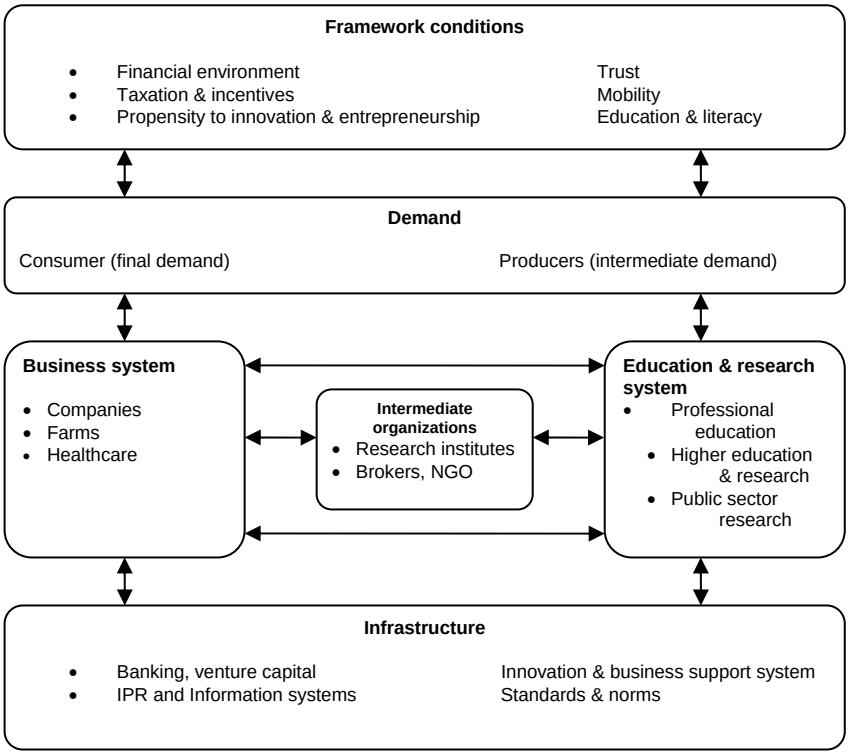

The diagram is used to emphasise

- the importance of **both** the *"supply push" of the research community and the "demand pull"* of the users of new knowledge. Indeed the succesful system requires a constant interaction between the organisations and actors of the left of the diagram – which for simplicity can be called the 'users' of knowledge – and those on the right – predominantly the 'suppliers' of codified knowledge.

- the importance to succesful innovation of *networks* that provide effective communication channels linking the various organisations and individuals that make up the system. Such networks can be both formal and informal. But informal links appear to particularly important, particularly where they foster trust between the various parties, and thereby lower the transaction costs of the interactions. Trust relations result in both parties knowing each other's needs, knowing the nature and quality of the goods and services on offer, and may even obviate the need for legal contracts and reduce the risk of none payment. This need for successful innovation systems to establish low transaction cost trust relationships has been observed to lead to the "clustering" of actors in the same location for certain types of innovation (such as Silicon valley in California, the Cambridge Science Park, or even the surgical instrument cluster in Sialkot, Pakistan [v])

- The importance of *Intermediate Organisations* in finding out what producers (and their customers) want and searching through the range of options within the stocks of existing and new knowledge to find what best meets the need. These tasks of intermediation can in principle be carried out by any of the organisations listed on the diagram, but they tend to be undertaken by consulting or design organisations, brokers (sometimes known as "technological midwives"), and even non-government organisation (NGO) or applied research institutes and research associations (when operating in consulting or facilitating mode). Arnold and Bell suggest that they "typically have low status compared with universities and basic science institutes" (page 296). Increasingly small and micro enterprise support organisation (those that supply "business development services") are performing this role in successful economies, often with an element of government subsidy.

- The *"framework conditions"* and the basic infrastructure of the system (shown at the top and bottom of the diagram) have also been seen to be crucial elements of the system. Indeed it is often the ways of working, aspects of culture, the social value placed on innovation and entrepreneurship, banking "ethos", that most effectively explain the difference between countries that innovate and those that do not. Weaknesses in the infrastructure often form the major constraint to the effectiveness of much research in developing countries. Indeed in a number of countries these capacities are actually deteriorating, further reducing the likelihood that research alone will result in poverty reducing innovation.

The National Systems of Innovation literature provides a great deal of insight into the way 'learning' takes place, how decisions about innovation are made, and the capabilities required to innovate. These include:

- *Bounded Rationality*: Although much of economic theory assumes optimal and rational behaviour, NSI accepts that in practice decisions makers do not (cannot) know everything and do not interpret perfectly all they do know. It has been recognised for a long time that "the whole life of policy is a chaos of purposes and accidents, it is not at all a matter of the rational implementation of the so-called decisions through selected strategies"[vi],

- *Path dependence* – "what a company or institution can do today depends on what it could do yesterday, and what it has learnt in the meantime"[vii] (Rosenberg). This is

particularly important for developing countries or those companies wishing to break into a new area of activity. If the company does not have the necessary tacit knowledge it must invest to acquire it, or hire people who bring it with them.

- *Organisational learning*. Bounded rationality and path dependence mean that innovators must continuously learn. They continuously test the environment within which they operate by adopting an iterative process in which they embark on a course of action and they modify it in the light of experience. But this learning is not a passive process, but one that requires purposive action and investment in the necessary time and resources.

- *Institutional Learning.* A distinction is made between organisations and institutions: In this context, institutions refer to the "the mechanisms, rules and customs by which people and organisations interact with each other (i.e. the 'rules of the game')" [viii]. The concept of institutional learning refers to finding ways to do things in new ways. It may be the result of analysis and conscious efforts to change the rules of the game (including rules and regulations), but can also include the behavioural changes that occur spontaneously as people try to solve problems and learn from their experience.

- *Technological Capacity*. Organisations can build up these capacities through learning, experience, training, recruiting skilled staff and investing in new equipment or systems. "Crudely, the ability of companies to learn depends on their internal capabilities, and that these capabilities can often be represented by the number and level of scientifically and technologically qualified staff in an organisation"[ix]

- *Absorptive capacity*: "information only becomes knowledge if the receiver perceives it to be so" --- "technology transfer… only works well where the recipient carries out its own related R and D programme"[x].

Been There – Done That!

Many people confronting the national systems of innovation literature for the first time recognise some of its elements from their own discourse. These include:

- Participation (understanding user needs)
- Partnership (changing power relations, reducing dominance of "researchers", and increasing the 'voice' of the users, clients etc)
- Capacity Building
- Trust relations and the reduction of transaction costs.
- Informal networks and social capital

This is hardly surprising as many elements of current best practice in development thinking address some of the same issues as best practice in innovation. But it is perhaps a measure of the dominance of the research community that these ideas have not yet been applied to their own research work, probably because of a fear of a loss of status, and the shift of power from the suppliers of knowledge to the users of knowledge, and the resultant change in the type of research that is needed for effective innovation.

The NSI perspective and Developing Countries

It may be argued that as the NSI approach is derived from the experience of technologically advanced industrial countries, it is not applicable to the very different conditions in developing countries. This is an empirical matter, but a number of insights about improving the effectiveness of both research and development can be obtained from applying the NSI approach to developing countries.

Certainly there are big differences between the innovation systems of developed and developing countries. One of the main differences is that the "demand" side of the system is particularly weak in developing countries - even though much of the policy intervention focusses on the more obvious weaknesses in the "supply" system. In industrialised countries most research is carried out by and within private companies[xi]. This means that productive enterprises can articulate what they need from the rest of the innovation system. In developing countries almost all research is funded by the state in public institutions. In such circumstances the "demand" placed on research organisations by actual or potential users of knowledge is often weak. Whatever demand that there is, often 'leaks' abroad to industrialised countries. Unlike in industrialised countries, it is often difficult to involve 'the demand side' in the governance of research organisations working in or on developing countries. More generally the productive sector, and poor producers in particular, have great difficulty in specifying their needs for new knowledge (and, indeed, in paying for it). In developing countries mechanisms have to be found that can translate the 'needs' of poor people into 'effective demand'.

Despite these differences, all research inevitably takes place within an innovation system whether or not it is described as such – the main difference is that in some countries these systems work well and in others they do not! It is precisely these differences that provide the insights from which researchers and innovative organisation can learn. **The key insight is that if research is to have an impact, then it needs to be carried out in close proximity both to the users of the resulting knowledge, their clients and customers**.

Does it work for Agriculture?

Given its origins in northern industrialised countries, the question inevitably arises as to the relevance of the NSI to other sectors in developing countries, particularly in agriculture. In the agricultural sector, research is often location specific and often involves the adaptation of generic knowledge to local conditions. Furthermore, the mechanisms by which potential users (farmers) gain access to new knowledge are weak and are likely to require state intervention, particularly to meet the needs the poor farmers.

Individual developing countries are – and need to be – close to the science/technology frontier in fields such as agriculture and health care, where problems are likely to be specific to a country or a region. In these cases, there may be fewer opportunities for "creative imitation', and there are good reasons for donors to fund scientific research, in addition to supporting the application of knowledge.

Fortunately, there is now a body of research that demonstrates the relevaance of the NSI to agriculture (see AJ Hall and others[xii]) In particular the NSI approach highlights the importance of researchers working in close partnership with farmers, strengthening the mechanism by which "user needs" can be articulated and understood, and active collaboration with those organisation that make and sell (or

in other ways make available) the goods and services that embody the results of new knowledge.

What about Policy Research?

It might also be argued that 'policy research' similarly deals with unique local problems, and opportunities for creative-imitation may be similarly limited. But here again, NSI provides a number of guidelines for the way such activities are likely to result in behavioural change and other forms of innovation.

A number of researchers are currently exploring the relationship between research and changes in policy[xiii] Many of the conclusions from that work find echoes in the conclusions and insights provided by the NSI approach. For instance, the importance of forming alliances or temporary coalitions, the need to work in close collaboration with the users of the policy analysis and to fashion the output in ways that the outputs are timely, are from sources that the audience regards as credible, and are in a narrative form that is adapted to the needs of the user.

Is the NSI approach applicable only at the level of National Systems?

A more fundamental question is whether the NSI provides useful insights at the sub-national, sectoral or even project level in developing countries. As many researchers have found, impact at the project level is often overwhelmed by weaknesses in a country's infrastructure and framework conditions at the national or local level: access to finance is limited, taxation has adverse incentives, literacy is poor, and so on.

But even in industrialised countries, government action can only operate on part of the innovation system at any one time, but the key issue is that all interventions (however small) take place in the context of a clear understanding of the innovation system and how it can be strengthened.

Whether the NSI approach provides useful insights at the programme level is again an empirical question. At the moment there is only anecdotal evidence. But interesting signs are emerging, for instance, from the DFID-funded Crop Post Harvest Research Programme which adopted the NSI approach as an organising principle in 2001/2. This programme has undertaken a number of case studies of the NSI approach at the project level[xiv] and its effectiveness is currently being evaluated[xv].

Implications - for Developing Countries

The main implication for developing countries is the shift of focus from "research" to "innovation". This in turn requires investing in those people, organisation and institutions that make up the systems necessary for effective innovation, rather than for "research" *per se*. There are well rehearsed arguments justifying state investment in "public good" research on the grounds that the private sector will always invest at levels that are socially sub-optimal[xvi]. But there are even stronger arguments suggesting that there is a legitimate role for the state to help the NSI to work effectively[xvii]. In most countries this will require investments that go beyond science[xviii], universities, and the state sector. It is likely to require a diagnostic mapping the various 'innovation systems' to establish where the main weaknesses and bottlenecks are located so as to guide the most appropriate investment in the:

- mechanisms necessary to increase the demand side of the innovation equation and find ways the users of new knowledge can develop the ability to pay for it. As a first step this will probably involving the users of new knowledge more effectively in the governance of R and D expenditure.
- capacities in firms and on farms to absorb and utilise new knowledge to improve productivity, and the range and quality of goods and services. OECD countries found it particularly effective to encourage the efforts of firms themselves and by encouraging groups of firms to work together
- organisations that perform the "intermediary functions" that make existing knowledge accessible to users,
- formal and informal networks and trust-relationships ("social capital") between the various players that are central to knowledge systems.
- infrastructure and framework conditions that support the innovation processes.

Implications - for Donors

While a number of developing countries operate at the frontiers of science and technology in some areas and are largely financed by sources within their domestic economy, many others do not and have research systems that are highly dependent on aid finance.

If aid agencies wish to increase the impact or uptake of the research they fund, the NSI approach suggests that they will have go well beyond funding just the research component. They will have to concern themselves with the large number of other elements that constitute an effective innovation system.

"Communicating" research results will remain important (particularly as remedial action to improve the impact of previous research), but the NSI approach suggests that the scale of project impact is likely to be determined at the start of the funding process rather than just at the end. A first step in the NSI approach would be to assist countries to undertake diagnostic mapping of their innovation systems (probably at a sectoral level) and to identify which parts of the system need strengthening first.

A second important step would be to strengthen the voice of the users of new knowledge within developing countries. All too often the research agenda in many developing countries is driven by the international research community or the local scientific elite. And it is difficult for actors in developing countries, even researchers, to "break into the charmed circle of those that dominate the invisible colleges"[xix]. Donors have a part to play in getting users of new knowledge more closely linked to the governance of research.

But the main task facing donors is the development of capability within developing countries. This will need to take place not only with productive enterprises, but also the intermediary organisations necessary to make new knowledge more accessible to the users. Many bilateral donors have shifted their research funding to building local capacity, but experience in industrialised countries suggests that the processes of strengthening these "capacities" are, however, complex, expensive and time consuming. Some donors have chosen to strengthen particular university departments, or the international agricultural research systems. But the NSI approach and the diagnostic mapping

of innovation systems is likely to prioritise organisations that can tap into the world's stock of existing knowledge and enable productive enterprises (including farms) to use it.

DFID appears to have particular difficulty with building the capacities necessary for innovation in developing countries[xx]. Many of the organisations and institutional arrangements that need strengthening fall under the remit of DFID's bilateral aid to specific countries rather than DFID's programme of centrally funded research. Such capacity building is not, except on the widest definition, an "international public good". But the centrally managed research funds, which are currently being used to build local capacity, are often an inappropriate (and ineffective?) instrument for such long term, sustained and costly activity, where local knowledge and local resources become paramount.

Donors already play a significant role in supporting both formal and informal networks. The NSI approach suggests that this is vitally important to effective innovation. But it also suggests that the range of participants, particularly if limited to 'researchers', is likely to be far too narrow.

At the project level the NSI approach suggests that the way that 'research grants' are tendered needs to be changed. More time and money needs to be provided for project development, so that 'users needs' can be better understood and can be fully integrated into the design. Furthermore, successful innovation is likely to require the formation of 'strategic alliances': with researchers, with intermediate or brokering organisations, and probably with producers of goods and services (if not their customers too).

At the very least the NSI approach suggest that aid fund managers should have modest expectations of the "impact" that a particular piece of "research" should have, particularly if the project is unable to address the many weaknesses and bottlenecks in the local innovation system.

Finally there is one particularly difficult question that has not yet been adequately addressed by donors. This is to decide what technical expertise they will need in future, and how much of this expertise needs to be located in northern industrialised countries. Northern research institutes and commerical companies clearly have a role to play. But it is not yet clear precisely what role they will need to play in the NSI of developing countries -certainly it is unlikely to be the role that they played in the past.

Implications – for Researchers

All this has important implications for researchers working on "development". Researchers, whether in the North or the South will need to identify what is their unique contribution to the processes of innovation, to understand the innovative systems in which they wish to work, and to determine how best to contribute.

It seems there are already many forces at work that will shift the balance of available funding from "research" to the processes that produce innovation. Many northern researchers are already working in partnership with people and organisations in developing countries, but the power relations are such that those areas of local research that prosper still depend largely on foreigners (particularly in the context of structural adjustment[xxi]). This is rarely likely to cost effective, can delay local capacity building, and diverts attention away from the locally determiend needs of the innovation system.

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[i] Erik Arnold and Martin Bell *Some New Ideas About Research for Development*, in Danish Ministry of Foreign Affairs: **Partnership at the Leading Edge**: A Danish Vision for Knowledge, Research and Development (April 2001). Page 288.
[ii] **Farmer First**, Edited by Robert Chambers, Arnold Pacey and Lori Ann Thrupp (ISBN: 1853390070, Published By: ITDG Publishing). Martin Bell has also pointed out that farmers play a major part in the innovation process in industrialised countries (personal communication).
[iii] These ideas are associated with the name of Joseph Schumpeter and in our own age with the "neo Schumpeterians" such as Christopher Freeman.
[iv] This definition is drawn from OECD, 1991, **Managing Technological Change in Less-Advanced Developing Countries**, reference 43 91 03 1, Paris. OECD, 1991a, pages 7, 12 and 13. The World Bank's 1998 **World Development Report** starts from the premise that "poor countries – and poor people – differ from rich ones not only because they have less capital but because they have less knowledge" (WDR page1).
[v] See Hubert Schmitz Editor (with Khalid Nadvi) *Industrial Clusters in Developing Countries*, Special Issue, **World Development**, 1999.
[vi] Edward Clay and Bernard Schaffer (1984) **Room for Manoeuvre: An Exploration of Public Policy in Agricultural and Rural Development.**
[vii] See reference i
[viii] See DFID's Sustainable Livelihoods Guidance Sheets http://www.livelihoods.org/info/info_guidancesheets.html.
[ix] See Bell and Arnold reference i, page 293.
[x] Norman Clark, "Innovation Systems, Technology Assessment and the New Knowledge Market: Implication for Third World Development" in **Journal of the Economics of Innovation and New Technology**, Vol 11 (4-5) 2002, pp 353-368.
[xi] For instance, the major life science companies invested some $2.6 billion in agricultural R and D in 1998 "Accessing Modern Science: Policy and Institutional Options for Agricultural Biotechnology in Developing Countries", **World Development** Vol 30, No 6 pp 932.
[xii] A J Hall, B Yoganand, R V Sulaiman, and NG Clark (editors), **Post-Harvest Innovation In Innovation: Reflections On Partnership And Learning.** CPHP, May 2002.
[xiii] Issues of the relationship between social science research and policy reform are examined at the ODI web site http://www.odi.org.uk/RAPID/index.html
[xiv]. See reference xii.
[xv] More generally see: http://www.cphp.uk.com/
[xvi] This is discussed at length in the DfID Research Policy Paper, **Research For Poverty Reduction: DfID Research Policy Paper**. By Martin Surr (team leader), Andrew Barnett, Alex Duncan, Melanie Speight, with David Bradley, Alan Rew, John Toye, Paragraph 240. (http://www.dfid.gov.uk/Pubs/files/pov_red_pol_paper.pdf).
[xvii] Erik Arnold (forthcoming) *Research Evaluation: Evaluating Research and Innovation Policy*: A Systems World Needs Systems Evaluations, a paper originally given at the EVA conference of Nordic evaluators at Håholmen, Norway in September 2001. Erik Arnold works for Technopolis Ltd, 3 Pavilion Buildings, Brighton BN1 1EE, UK +44 1273 204320 erik.arnold@technopolis-group.com and www.technopolis-group.com
[xviii] Although it is important to note that experience in OECD countries suggests that investment in science is particularly important for producing the skilled people necessary for certain types of innovation.
[xix] See reference i page 308.
[xx] See reference xvi.
[xxi] J L Enos, **In Pursuit of Science and Technology in Sub-Saharan Africa: The Impact of Structural Adjustment Programmes, UNU/INTECH Studies in New Technology and Development**, London: RKP, 1995. Quoted by Arnold and Bell.