IT'S NOT STI: IT'S ITS

THE ROLE OF SCIENCE, TECHNOLOGY AND INNOVATION (STI) IN AFRICA'S DEVELOPMENT STRATEGY

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1. Introduction

A major current policy issue in development discourse is about the role that research expenditure plays in helping to boost economic production (and hence incomes and employment) in many of the poorer parts of the world. Linked to this is a more recent tendency to emphasise the corresponding role of innovation (I), in the Schumpeterian sense of more efficient ways of turning inputs into outputs. This short working paper concerns an intriguing feature of this debate, a growing tendency to conflate science, and technology, on the one hand, with innovation on the other, and to focus policy analysis on a variable that appears to link all three, viz. STI (science, technology and innovation). Recent reports coming out of the African Union (AU) and New Partnership for Africa's Development (NEPAD) are cases in point. While the original NEPAD strategic plan published in 2006, was about S (science) &T (technology) only, by 2014 the corresponding documents had become about "STI". Similar focuses may be found in national policy documents. Three from Ethiopia and Nigeria are referenced below.

The paper will focus largely on sub-Saharan Africa where much attention in recent years has been paid to appropriate and relevant policy strategies. On April 2014 the African Union produced its guideline strategy document *On Wings of Innovation*, (STISA-2024), a publication designed to "place science, technology and innovation at the epicentre of Africa's socio- economic development and growth" (p8). The publication was designed to enhance "technical and professional competencies, innovation and entrepreneurship, and providing an enabling environment for STI development in the African continent" over a ten year period, itself a precursor to a longer time horizon reaching as far as 2063.

We believe the document to be flawed in so far as it relegates "innovation" to a secondary category linked largely to expenditure on science. Why has "I" suddenly appeared after "S" and "T"? They are, after all quite different concepts. In some cases they are linked quite closely (say in industries with a strong science base such as pharmaceuticals) but much innovation has little to do with formal research and may indeed be only marginally linked to new technology. Is there perhaps a hidden agenda at work? By tacking "I" at the end of "S and T" might there be the idea that the best way to make economic systems more productive is to increase expenditure on science? Are we indeed back to the old linear days where the only proper type of knowledge is that derived from research in laboratories? Or are there, perhaps, vested interests at work, designed to promote greater funding for science regardless of its use?

The paper will use as a relevant case study a recent research programme funded by DFID over the period 2006-2012. For some time the Research and Evidence Division (RED) of DFID had been concerned with the usefulness of research it had been funding in the natural resources sector. Between 1995 and 2005 some £220 million was spent on 1600 projects designed to assist developmental prospects for poor subsistence farmers. But there was little evidence that this knowledge (allocated ostensibly for development purposes) had been used productively. The Research into Use (RIU) programme was designed to put at least some of this knowledge into use through allocating funds explicitly for this purpose. A sum of £37.5 million was committed to a series of projects in south Asia and sub-Saharan Africa (SSA) with the two-fold aims to promote use of this (previously acquired) knowledge and in doing so, to find out how

best relevant research funding should be executed. In that sense the RIU programme was an exercise in promoting more efficient science policy.

This paper will argue that in the course of the programme the RIU was able to show that far from their research promoting innovation and development, useful knowledge was mainly called upon where the context was appropriate. Far from leading to innovation, research based knowledge (and the scientists who originally helped to produce it) was brought in only where necessary as part of a wider innovation system that had many components. The paper will go on to summarise the African strategic documents cited above. Although nominally about "STI", in practice arguably, they amount to little more than a plea for more research resources for scientific institutions. Our argument here is that to the extent such strategies are adopted they represent a potentially serious misallocation of scarce national development resources, since the centre of policy gravity is thereby moved away from where innovation is needed (to promote production, incomes and employment) to centres of scientific research where the relevance is more nuanced. Hence while the DFID programme was primarily concerned with foreign aid its message is equally relevant to national development investments in SSA countries. The paper concludes with some suggestions about how this issue may be modified in policy practice.

2. Relevant Africa Union (AU) Developments

African initiatives designed to promote STI can be traced back to the early days of independence when a number of countries formulated loose plans to promote S&T in the belief that to do so was in some sense necessary for long term development. In practice this meant creating universities and research institutes in the mould of well-established organisations in the OECD countries, but these tended often to be isolated and underfunded with few organic links to national development activity. The *AMCOST S&T Consolidated Plan of Action (STCPA [2006])* cites an early 1974 UNESCO survey as reporting that

> "the number of research institutes in African countries grew from a few hundred in 1963/64 to over 2,000 in 1969/70 with a research work force of about 11,000 which came out to be an average of 5.5 workers per institute. Throughout the 1980s and 1990s, science and technology investments were not prioritised despite considerable empirical evidence from South-East Asia and other regions showing that investment in science and technology yields direct and indirect benefits to national economies." (p 8)

It was largely due to this perceived deficiency that in 2003 the NEPAD set in motion a regional initiative that culminated in the establishment of an African Ministerial Council on Science and Technology (AMCOST). The initiative was organized by the NEPAD Secretariat with the support of the South African Department of Science and Technology (DST) and UNESCO. Out of this and again mobilized largely by the NEPAD, followed a series of further activities (projects and workshops); these were designed to embed S&T investments much more directly into economic development planning throughout sub-Saharan Africa and in so-doing enhance prospects for greater production and employment in countries that were falling rapidly behind in terms of poverty indicators such as those set out in the Millennium Development Goals (MDGs). The STCPA document was published in 2006 and set out programmes on a range of areas such as

energy, biotechnology, materials science and ICT where institutional development and capacity building would become the cornerstone of a resurgence in technology growth across the continent.

It was also the document where the idea of innovation was brought out really for the first time. This took the form primarily of a programme designed to develop science, technology and innovation (STI) indicators. These were held to be “crucial for monitoring Africa’s scientific and technological development. They are useful for formulating, adjusting and implementing STI policies. Indicators can be used to monitor global technological trends, conduct foresight exercises, and determine specific areas of investment” (p 51). They were to be used to enable data to be gathered that would allow statistics to be gathered on regional activities connected to topics such as R&D and capacity building that would provide an international platform for planning and dialogue. What is noteworthy is that very little is said about “innovation” as such, nor about what practical measures could be taken to improve it. Most of the discussion is really about science and how resources devoted to science can be measured and compared. Nevertheless it became the guiding blueprint for innovation policy over the ensuing decade.

A review of recent documents reveals much the same story. The *African Innovation Outlook II (2014)* provides some statistics and comments about STI in Africa and it is clear that these are based almost entirely on R&D figures as the indicator of innovation. There is some recognition (para. 2.5.4) that "few country's STI policies mention the importance of innovation in their economy, and the call to governments has been to support R&D and not innovation or both." And then at the start of Para. 2.5.5, there are 2-3 lines of comment about the fact that R&D and innovation are different things, and R&D-based innovation is a relatively small part of innovation activity. But these qualifications never appear again in the 160 pages of reporting of the data or in the concluding section at the end. Similarly the *AU Science, Technology and Innovation Strategy for Africa - 2024 (STISA-2024)* which presumably has the full backing of AMCOST, is mostly concerned with boosting resources to R&D.[1]

Finally a quick survey of country-level documents (in this case Ethiopia and Nigeria) tells us exactly the same story. In the Nigerian document (2012) the report begins by talking only in terms of STI, makes no attempt to specify how this relates to innovation potential and devotes most of its recommendations to measures to expand R&D. There are some general statements about the need to involve firms but nothing offered on how exactly this will be done. The Ethiopian document (2012) spends a bit more time on issues of technology development (including foreign technology) but again is weak on policy instruments needed to achieve its goals. Overall it is hard to avoid the conclusion that at official levels at least the orientation of African innovation policy has been, and continues to be, a process of re-defining “innovation” as an offshoot of science policy, labelling it as “STI” and assuming that one way or the other innovation activity will just happen. The danger of this in our view is that it takes attention away from areas of direct developmental relevance (i.e. generating increased levels of production, incomes and employment) and towards scientific institutions. The fact that such institutions in Africa are well known to be often dysfunctional in a developmental sense is quietly ignored.

[1] We are grateful to Martin Bell for drawing our attention to these points.

3. Research into Use[2]

An interesting alternative approach to innovation policy may be seen in a relatively recent aid programme over the period 2006-2012. In the early 2000s the UK Department for International Development (DFID) had become increasingly concerned about its research expenditure in the natural resources sector. Under its Renewable Natural Resources Research Strategy (RNRRS) it had funded some 1600 projects costing some £220 million between 1995 and 2005, largely in UK research organisations; but it seemed impossible to demonstrate how and to what extent the resultant "knowledge" had resulted in practical low income country (LIC) development. The RIU was initially implemented in 2006 as an attempt both to "scale out" this knowledge and at the same time to understand better how to improve associated science policy. This was budgeted at some £37.5 million. It ended in December 2012.[3]

At its inception it is clear from internal documents that the RIU had begun to think about its work in "science push" terms. This took the form of going back to the original project reports and assessing how their outputs could be "put into use". The original project leaders were asked to state which projects were suitable for this in principle but it quickly became evident that this would not be an easy task. Many "outputs" took the form of academic papers or reports that were written to satisfy the original funding body. Others were narrow in focus and were best seen in more general informational terms[4]. For these and related reasons RIU management then decided to narrow down the field of suitable "use" candidates, managing to end up with some 280 possible candidates. A consultant was then hired to indicate which of these would be suitable for further inputs, but unfortunately reported back that he could not find any that fitted the bill. It was at this point that the decision was made to introduce activity on the "demand" side.

For Africa this was to be achieved in two ways. First was the establishment of national "innovation coalitions" and "innovation platforms" in selected countries (eventually 6 were chosen with cross-continental representation).[5] The former were groups of local stakeholders that liaised with RIU management and made decisions about project choice. The latter were areas that then became the focus of projects. For example, In Nigeria the coalition consisted of scientific, private sector and government representatives led by the agricultural research council and the choice of focus was on cowpea storage and aquaculture. In Tanzania the lead organisation was a local NGO and the initial focus was on poultry and agricultural engineering. Project choice was expected to be strongly influenced by at least some of the original RNRRS project outputs, though it was anticipated that other technology inputs would often be necessary adjuncts. The second mechanism was the development of a small, entrepreneurial investment programme designed to exploit likely innovations that showed a good chance

[2] Details on the RIU experiment can be accessed from Frost A (2013), Clark et al (2013 and 2011)), Gildemacher et al (2013).
[3] Though many of the projects are still operational either as they were originally programmed or as they have evolved subsequently. Indeed a conclusion drawn from RIU experience indicates that technology development needs time to have its full impact, which of course also means backstopping over quite long periods, something that does not fit well with relatively short project cycles.
[4] To be fair to the RNRRS programme, funding routinely took place on a 3-year project cycle basis. Inevitably this meant a report back process that encouraged this result.
[5] In fact there were also other factors including the need to fit country choice with DFID strategic priorities at that time.

of developmental success. This was called the "Best Bets" programme and we shall concentrate on this for the bulk of this paper's analysis.

The inspiration for the RIU Best Bets initiative came from the successful and popular BBC television programme *Dragons' Den*. Versions of this programme had been broadcast around the world under a variety of local names (*Money Tigers* in Japan; *Shark Tank* in the USA). The basic concept is that would-be entrepreneurs pitch their business ideas to a panel of wealthy and successful entrepreneurs who, subject to satisfactory due diligence, invest their own money and expertise in proposals that they find convincing in return for an equity stake in the business. RIU Best Bets took the central tenet of ideas being pitched to an expert panel and rigorous due diligence, but in other significant aspects the procedure and principles varied significantly. A major difference was that the RIU Best Bets panellists would not invest their own resources; rather they would make recommendations as to how RIU should invest its programme money.[6]

The objective of RIU Best Bets was to identify promising proposals to take existing agriculture research products and put these into use in ways that would benefit the poor (and others) in developing countries through partnerships in which private sector actors play a major role. The sum set aside for this in Africa was £5 million. Coverage would be on any aspect of agriculture in Africa - including crops, livestock, fisheries or forestry throughout the entire value chain, from production, through processing, storage and input and output markets, to consumption. In September 2009 advertisements were placed in a number of newspapers covering East, Central and Southern Africa inviting the submission of Best Bets concept notes. Applicants were asked to limit these to two pages only; they would state how much financial support they were seeking from RIU, but no limits were specified. Concept notes were required to address four criteria:

- The proposal should be grounded in rigorous research in agriculture, including fisheries and forestry. Much of this would stem from the original RNRRS projects.
- The originators of the research should be involved in the programme in a significant way so that they would be able to apply their tacit knowledge and learning to the programme
- The proposal was expected to achieve significant development impact at scale in East and/or Central Africa (and perhaps beyond)
- The proposal should comprise a consortium of partners (e.g. academic, public sector, NGO) led by an African institution and should include a private sector partner with evidence of support, which could be financial or in-kind

By the deadline for submissions in early October 2009, RIU had received 105 concept notes[7]. These were screened in a process in which RIU was assisted by the London-based *Cambridge Economic Policy Associates (CEPA)* - an economic and financial policy advisory business. A short-list of 15 proposals was developed. In two cases, pairs

[6] The RIU panel who worked like the dragons on Dragons' Den were Judi Wakhungu, Cabinet Secretary, Ministry of Environment, Water and Natural Resources, Government of Kenya; Muchiri Wahome (Chair) Managing Director of Deacons (K) Limited, the leading chain store in the region; Patrick Oketa, Chief Investment Officer at the Kampala based African Agricultural Capital and Ali A Mufuruki, Chairman and CEO of the Infotech Investment Group in Tanzania.

[7] These came from East and Southern Africa. The call then went out to West Africa; this generated 20 more proposals.

of proposals that appeared to offer significant opportunity for synergy (an army worm forecasting system and an army worm control technology; and two aquaculture proposals) were invited to amalgamate their proposals. The lead organization for the short-listed proposals was asked to write a business plan following a format provided by RIU[8]. To facilitate this, a grant of £1,500 was made available which teams used in various ways, such as to bring team members together to enable them to work jointly on their plans. Two representatives from each proposal were also supported to attend the "dragons den" event in Nairobi on 26th and 27th November 2009.

At this event, these two representatives presented their project to the independent panel drawn from leaders in the African business, finance and research and development communities (see note 6 above). The panellists had already read the business plans. Following a ten-minute oral presentation (which deliberately excluded the use of power point presentations), panellists had 20 minutes to interrogate the proposal, followed by a further 10 minutes in private to discuss the proposal among themselves. At the end of the day, the panel announced the proposals they were recommending that RIU should support. Subject to due diligence, RIU accepted these recommendations and proceeded to issuing contracts.

The money that RIU invested in the selected Best Bets was in the form of a grant since RIU's expected return on its investment was not financial; it was to be in the form of learning. The Best Bet proposals that RIU supported would thus become part of an experiment in enabling innovation. RIU researchers would rigorously monitor the Best Bets with a view to teasing out useful lessons; what worked well, what worked less well and why? These lessons would then form an important part of RIU output and would help shape future policy and practice to enable research to have greater impact on small-scale agricultural innovation. The Best Bet teams were also expected to work closely with RIU communication specialists and journalists to achieve widespread coverage of their research into use success stories[9].

4. Discussion

What have been the broad conclusions of this venture? To begin with it should be made clear that outcomes were patchy with some projects seeing success and others not (or at least they still needed time to prove themselves). For example, a project designed to activate block treatment of infected cattle using university students has now aroused the interest of venture capital sources. In this case the issue is one of dealing with the spread of human infective sleeping sickness by treating the carriers of the parasite (cattle) with insecticides and drugs. These appear to deal with other aspects of animal health and have revealed a strong market among cattle owners. One that has not taken off was the establishment of a franchise system to backstop village level fish farming in one East African region. The problem here was lack of enough adaptive research due to the loss of the original scientists from the project. This combined with the complexity of the activity and managerial issues among the relevant innovation coalition, has meant that it may be some time before widespread diffusion of the technology takes place.

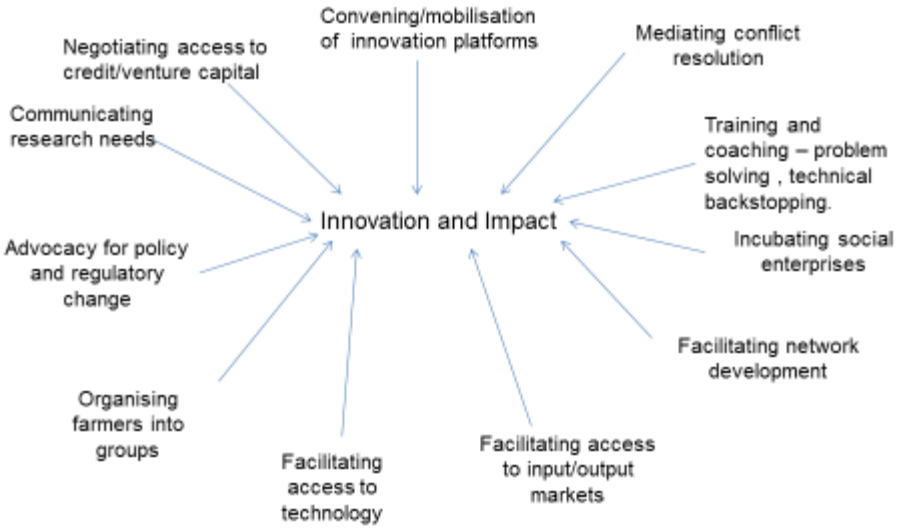
[8] Formally these were not proper business plans but rather a cross between a business plan and a project memorandum but with a heavy bias towards into use and impact

[9] See details in Frost A (2013)

A second conclusion is that it quickly became evident there were no "low hanging technological fruit" emanating from the original RNRRS projects that could easily be put into use. Instead a context had to be created within which the science could be embedded. Most of the initial Best Bet proposals fell at an early stage simply because scientists wished to carry on practicing science and failed to grasp the developmental nature of the required projects. But in the selected projects it became clear that scientists had a major role to play in adaptive R&D and mentorship connected to the original RNRRS projects[10]. In the selected 9 funded best bets over 60 of the original projects were used (despite the apparent lack of low hanging fruit at the start). And so the creation of a suitable context became the key. In effect the RIU had fulfilled a brokerage function that impacted the whole value chain and in which the research was a very small component.

Figure 1 illustrates the complexity of this process. It illustrates the finding that each "innovation" had many components ranging from acquiring pre-investment financial resources, managing risk and uncertainty, mobilising disparate knowledge elements, applications engineering, negotiations with government regulatory bodies, accessing products through imports (in the absence of local production capacity) and dealing with the many problems that always plague new innovative ventures.

Figure1. Innovation Management/Brokerage Tasks undertaken by RIU



There were also significant network links across different types of organisation such that for an innovation to be successful, relevant flows of knowledge and resources needed to be coordinated and facilitated. It showed also ways in which the private sector can make a major contribution to international technology development for the rural poor. It

[10] Relatedly as pointed out by Gildemacher et al (2013, p165), the development of a "potential or capacity to innovate" was an important measure for determining how the RIU had contributed to improving the speed and efficiency of emergence of improved practices in agriculture. This clearly happened in a number of cases.

became clear therefore that the idea of innovation can in no way be summarised under a generalised concept such as “STI”. In fact to do so is not only misleading, it also distracts from what we need to understand about necessary policy and practice in LICs. For example, it allows policy makers to park complex policy issues in bureaucratic terms as a “science funding” problem that can be subcontracted to specialised institutions and “measured” using R&D statistics

In reality, as we all know, innovation is a much more complex activity. The DFID experiment has been one of the first to explore empirically the details of foreign aid innovative interventions in the natural resource sector in LICs. Not all of its projects succeeded in output and impact terms. The successful ones helped create entrepreneurship and employment. Others (still on-going) may evolve into success given more time. Yet others have clearly failed. But the programme has learned a lot. It has for example, shown that an aid agency can manage risk and catalyse technology development in the most unlikely contexts. To do so may require a lighter and imaginative managerial touch. But it will also argue for linking research more directly to production.

5. Conclusions

The DFID experiment has clearly brought out the complex nature of technology development and innovation policy. Far from “I” following “S&T” the Best Bet projects were themselves innovative activities that used technology as one part of a process that included many other inputs. Occasionally these were “scientific”, drawn upon as needed by a context that was highly systemic. At its inception in 2006 the RIU had decided to adopt an “innovation systems” approach for its activities though even at that stage it was unclear what defined such an “approach” or indeed what an “approach” (or indeed an innovation system) actually is. In early discussions there appeared to be a wide variety of views ranging from seeing an innovation system as a scientific theory (with definable parameters that could be estimated through experiment) to a loose metaphor based around general systems theory and used to justify an analytical style that emphasised behavioural networks of stakeholder groups involved in technological change. However, as the programme developed it became abundantly clear that all the projects were systemic in nature and as such, mobilised knowledge and resources from many sources. These included science of course but the R&D involved tended to be a relatively small part of the bigger picture involving the whole value chain.

What does this imply for the policy agenda? In our view it suggests that innovation policies need to focus much more directly on mechanisms directly connected to economic production and that funding of relevant institutions needs new types of incentives. Areas that come to mind are foreign technology acquisition; the use of national and international development banks and aid agencies; fiscal policies encouraging national private sector investments; and a revised role for higher education bodies to establish wider skills among young people, including entrepreneurship. On the latter for example, educational bodies could encourage postgraduate programmes with built in production components (much like the EARTH University in Costa Rica)[11]. One of the Best Bets managed to do precisely this in its use of veterinary students to spend their dissertation period injecting infected cattle in Uganda. This enabled some of them

[11] *https://en.wikipedia.org/wiki/**EARTH_University***

to create small businesses like “agro dealer” shops and service units. The university involved was starting to experiment with new types of programmes similar to those of traditional polytechnics. A recent RUFORUM you tube video demonstrates similar examples).[12]

Measures of this kind may go some way to mitigating a knowledge market which in many parts of Africa appears to be getting out of control, spewing out increasing numbers of graduates who have little hope of gaining useful work. And to those who argue such measures are an attack on science, the response should be made quite plainly. There are probably already enough good scientists and scientific organisations in most SSA countries. What are needed are mechanisms to put them to use and this will only come through a focus on demand. For example, a smaller emphasis on “centres of excellence” would free up resources for governments to fund apprenticeship schemes. Conversely by continuing to emphasise scientific indicators (such as R&D) the strategic balance will become even more skewed. What the RIU programme pioneered by DFID appears to have shown empirically (and really for the first time) is that effective technology development (and related innovation) at least in the natural resources sector, depends upon science being drawn into a systemic context as and when needed, not “pushed out” by R&D bodies in the hopes of finding a market.

It is in this sense therefore that we take issue with what has almost become an STI paradigm. If there has to be such a term it should rather be “ITS” since what is now clearly necessary is to promote innovation and entrepreneurship across SSA and to create a viable future for large and growing numbers of disenfranchised people (especially jobless youth). Of course good science will always be a necessary component in many types of economic development, but to repeat, it can never be the centre of policy gravity it appears to be becoming in recent AU strategy documents such as the STISA (2014). Rather it should correctly be seen as an input drawn where necessary into a wider context of economic production and employment. Failure to realise this could put back African development for decades.

[12] http://lnkd.in/dDzPutv

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