Technology Policy and Development in Africa[1]

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I Introduction

It is now well understood that African development is still well below its potential although there are signs that things are changing, especially with the liberalising continental trade discussions that are on-going at the Africa Union [AU]. But there is still more talking than action at relevant government levels. This paper starts from the position that unless more economic production takes place in, through and by local entrepreneurs there will continue to remain a lack of overall development at all levels, and African countries will continue to be at the mercy of global commercial influences over which they have little control. This of course involves many factors, but technology development is key.

The paper has been written partly as an input into programme developments at the African Centre for Technology Studies [ACTS] and also as an input into helping to achieve the aims of the Calestous Juma Legacy Foundation [CJLF] set up recently to help build relevant capacities in small scale sectors of African economic systems. The paper argues that while knowledge is necessary for technology development, embedding this knowledge in economic production requires perhaps new forms of intervention to build production systems that intervene more interactively, at all levels of knowledge application and use. This is especially so in the semi-informal and subsistence sectors where it has so far proved hard to introduce and support such interventions, in comparison with larger scales where some progress has been made, albeit usually with the assistance of global firms.

II Institutional Developments

There was very little focus on S&T and African development before 1980. What generally happened was for countries to copy the West and build "OECD like" bodies. The beginnings of change occurred in 1979 through a high-level meeting of countries leading to the Lagos Plan of Action (LPA) for the Economic Development of Africa [1980–2000]. The LPA was essentially a blueprint on how to foster collective self-reliance and sustainable development of the continent. It led to a few subsequent regional conferences (such as CASTAFRICA II) organised by UNESCO/OAU/ECA which brought together 26 African ministers and experts of science and technology, for the purpose of developing strategies for the economic recovery of Africa. Others included OAU: Africa's Priority Program for Economic Recovery

[1] I would like to acknowledge the contribution of Professor Martin Bell [Emeritus Professor, SPRU, University of Sussex, UK] who has contributed greatly to this paper. It was he who suggested and developed the diagram used to clarify many of the main arguments raised and discussed. However, he did not wish to be considered as an author at this stage.

(1986-1990), the African Alternative Framework to Structural Adjustment Program for Socioeconomic Transformation (AAF-SAP)–1989, the African Charter for Popular Participation in Development and Transformation [Arusha 1990] and the OAU Re-launching of Africa's Economic and Social Development: the Cairo Agenda for Action (1995). [2]

This was followed ultimately by the formation of the Africa Union (AU) and the *New Partnership for Africa's Development (NEPAD)* established in 2001. NEPAD was subsequently adopted by the AU in 2002 as a set of development programmes whose aims were: "to eradicate poverty, promote sustainable growth and development, integrate Africa in the world economy, and accelerate the empowerment of women". One of these programmes was about science and technology [S&T] whose implementation was passed to a Council of Ministers in charge of Science and Technology (AMCOST) which met in 2003 and agreed to produce a consolidation plan of action (CPA) designed to embed S &T within the African region. The CPA was finally published in 2006.[3] It is in this document that "innovation" really appears for the first time and it does so as an add-on to science (S) and technology (T), becoming of course STI [science, technology & innovation].

As such it now appears routinely in all texts and conversations relevant to economic development. What started from the CPA was then continued with detailed survey work funded largely by international aid agencies at country level up until 2014 when the NEPAD produced a series of reports on indicators of innovation and related aspects of STI. The main published result of this work is *On Wings of Innovation* [STISA] published in April 2014. Effectively that document has summarized what the AMCOST has since been doing in response to the dictates of the CPA. However, the STISA is now about to be brought up to date in a process to be managed by Professors Tom Ogada [ACTS, Nairobi] and John Ouma Mugabe {University of Pretoria]

III Innovation Policy and Practice

A useful way of portraying innovation may be seen with reference to the diagram appended at the end. The first column summarises the main institutional categories, the second how they are conventionally described and the third how they impinge on STI policy analysis. They can be summarised into 5 broad categories, [i] innovations that are incorporated from S/T improvements brought in from separate bodies such as universities and public organisations funded by the state [category A], [ii] improvements that occur through targeted investments in design and engineering by firms and associated bodies that significantly change operational processes of production [category B], and [iii] improvements "on the job" whereby innovations

[2] See Adesola et al [eds] [2021]
[3] See Mugabe & Ambali [2006]

take place in the workplace through various types of learning and organisational change [categories C, D, E]. Such processes are interactive of course and will impinge in different macroeconomic and political contexts.

In the case of well-established firms, innovations will continue as part of the normal process of production. Success and failure will be determined by market impact. What was key to the success of many of the East Asian countries in the 1970-90 period was the ability of governments to foster complementary conditions that facilitated change, though often firms themselves were pro-active. Bodies such as STEPI [Korea][4] provided support funded by central government to change the trade and production context in such a way that individual firms could collectively benefit as recipients of external economies they could not have funded individually.

The problem that many African countries now face is that what was possible in the 1980s and 1990s has now changed. Not only has technology in general become more complex, but there has also emerged the practice of subcontracting specialist activities to outside bodies that are not closely associated with the firms needing their services. The essential interactive relationships that are often so important for innovation are often cut off at source. It is this second category of innovation investment that has tended to be neglected in the analysis of developmental change, sometimes summarised under the heading "management capabilities". It is here that firms often continuously invest in various types of learning and organisational change that permit them to maintain competitiveness in a constantly evolving global environment.

Innovation will usually operate along a spectrum involving all the categories outlined in the diagram. To the extent that they are strongly science related they will depend strongly on R&D as conventionally understood and technology inputs will play a strong role in both the public [A] and private [B] sectors. Even here, however, the innovation will only become realised once scaling up considerations are dealt with such as those found for example in many new types of biotechnology where the introduction of innovations is often hampered by the costs involved in scaling up production technologies. To the extent this requires radical infrastructural reform a whole raft of innovations will normally be needed at this level as well [category ii], involving adaptation and training to develop the new skills and related management capacities needed. Finally at the level of more conventional [and often smaller scale] types of production, innovations can often take place simply because of normal production methods being improved [categories C, D, & E], as can be seen in the examples of *kaizen* advocated by recent Japanese aid[5] practice. This is so since it focuses on the wide range of improvements that firms continuously make simply through improved learning and communications within the firm itself.

[4] See Juma & Yee-Cheong [2005]
[5] See Hosono et al [2016]

The *kaizen* story is particularly relevant since its adoption and use has been shown to have been instrumental in many developing countries. A recent text [6] provides details of the approach that concentrates on what this means in practice with lots of examples. It recommends that all firms adopt a production culture that favours allowing all workers to seek small improvements in how basic tasks are done and to encourage adoption at all levels of hierarchy. Capability management then becomes closely integrated horizontally into firm structures with "continuous improvement" as the core philosophy. A good example may be seen in the case of Ethiopia. Between 2009 and 2016 and support from Japanese aid [JICA] the Ethiopian government introduced a set of investment support policies that focused on very basic production inputs and how the opportunities here were capable of radical productivity improvements that are in a sense independent of new technological inputs but reflect continuous change. The approach has been labelled as *"kaizen"* and should be understood as one that concentrates on the wider innovation context rather than the technologies themselves for overall success to be achieved.

It is my view that by tending to focus on category [i] types of investment African countries have so far been unable to fully incorporate the necessary capabilities needed to realise categories [ii] and [iii] sources of innovation. Indeed, it is only recently that attention has been drawn to the need for institution building enabling innovation in small scale and informal sectors. Of course, these are only general factors and do not always apply, for example where local production is influenced by overseas companies. Nevertheless, attention is now being paid to the importance of type [ii] and type [iii] interventions and how these may be supported by relevant forms of government intervention, including importantly infrastructure reform.

For developing Africa what this means is the introduction of relevant complementary policies that permit S/T to function as a means to effective innovation. For example, we have begun to see many cases of the use of solar energy to promote and foster small scale enterprise and employment at local levels. Currently many of these remain relatively isolated but analysts like Kaplinsky[7] [2021] and Kraemer-Mbula [2022] have begun to show how targeted support in related areas such as precision agriculture show the promise of much greater economic return than has previously been obtained. At medium and large-scale levels what is needed are mechanisms to involve global technology sources with national government involved to ensure sustainable progress. But what is probably needed at smaller scales is for greater public support at local levels. This will certainly include the development of new types of institution designed to facilitate incorporation of new knowledge directly into production.

It is primarily here that the CJLF intends to assist. That is in new activities that are taking place in areas such as small-scale solar power, rapid communications technology, health provision and fisheries, improved

[6] See Ibid. Chapter 1
[7] See especially Chapter 7

supply chains and accessible finance. But there are still many obstacles. A few countries such as South Africa and Kenya could also play a role here in identifying bottlenecks and helping to fund raise for improvement programmes and activities. It could also identify and investigate success stories and explore how central and local government bodies could provide support in specific cases.

Of central importance here again is the growing gap between "knowledge search" and "knowledge use". By this we mean that the application of innovation in a production context needs much more policy emphasis on strengthening the innovation-related interface between universities and associated user communities. For example, in a series of case studies cited by Petersen and colleagues[8] it is often the lack of interaction at user level that prevents successful innovation in practice. Referring to earlier work by analysts such as von Tunzelman and Bell, the authors propose what they call a new *community dynamic interactive capabilities framework* designed to mobilise institutions such as NGOs, churches, and relevant external aid bodies to facilitate and support the types of knowledge interaction needed for technology development at small-scale and informal levels. Much of this needs investment by and through central and local government.

IV Conclusions for Policy Analysis

The broad aim of this short paper has been to suggest a revised perspective for STI policies in Africa, one that focuses more on the direct facilitation of economic production at domestic levels. Following the categories summarised in the diagram below it suggests a shift in the centre of policy gravity from categories A and B, important though these are, to the creation of institutional frameworks designed to embed new knowledge directly into economic production itself, a task for categories C, D and E. Underlying it is the hope that STI as conventionally understood needs to be supplemented by policies that stress facilitation of its use, an argument also made strongly by a recent World Bank publication[9] and indirectly by UNCTAD in its recently published report on African development[10]. This is likely to be especially important in small-scale and informal sectors and will certainly require support on the part of local and national governments [and aid related bodies]. Certainly, the move to Konza could provide an opportunity for ACTS to assist in this. Hopefully we will then begin to enjoy a scenario in which the gross financial inequalities that have beset Africa for so long will begin to be modified to the ultimate benefit of all.

[8] See reference below.
[9] See Camera & Maloney, 2017
[10] UNCTAD, 2023

Different Types and Components of 'Innovation':
Low Income Economies in Africa

	Actors and Activities	Common Descriptions	Emphasis and Practice of STI Policy
	Conventionally but Irregularly Measured (e.g., OECD/Oslo)		
A	Generating new knowledge and developing new or improved production/product/organisation - conducted in: ***Bodies such as universities and public institutes***	Research and Development ('Public')	Main focus of STI policy, typically taking very large share of public STI funding
B	Generating new knowledge and developing new or improved production/product/organisation - conducted in: ***Commercial organisations ('firms'***)	Research and Development ('Private')	Substantial focus within STI policy, but still typically limited practice. Accounting for a low share of R&D expenditure and low/slow transition to a large/dominant share
	Only Infrequently Measured – But Increasing and Expanding Scope		
C	Investment in creating, expanding, improving or adapting processes, products or organisation conducted in: ***Formal sector (firms)***	Project Engineering and Management	Very limited attention in STI policy to creation of necessary skills and experience (But emerging interest - e.g., IREK project at ACTS)
D	Minor improvements to existing production, process or organisation - conducted in: ***Formal sector (firms)***	Production-centred minor change: (e.g., 'Kaizen', 'Below the radar' – Kaplinsky)	Very limited attention in STI policy, but successful JICA project and assessment in 2010s.
E	As in (C) and (D) but undertaken in **–** ***Informal sector actors.***	Informal sector innovation	Virtually no attention in STI policy, but emerging interest in policy-related research (e.g. Kraemer-Mbula] et al., Kaplinsky)

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