Making science and technology work for Africa's sustainable development

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Abstract: This introductory paper pulls together the key strands of the contributions to this book. It offers an overview of several major issues relating to the role of Science, Technology and Innovation (STI) in achieving Sustainable Development (SD) in Africa. However, it notes that understanding the nature of the underlying problems, challenges and opportunities in Africa is a very difficult task especially for many people looking inside from the outside.

1 Overview

Since the beginning of modern science, from Galileo's time onwards, researchers have not relented in seeking new knowledge about the state of nature; how nature manifests itself and how mankind impact, and is in turn impacted upon, by nature – the thrusts of Sustainable Development (SD) (Nwankwo *et al*., 2009), the question that arises is: what system of producing and managing knowledge will more suitably help. In contemporary settings, the capacity to generate and use new knowledge has tended to confound many of the world's fragile states including Africa, where most economies are heavily rural-based and agriculture-dependent. Today, much faith is put on Science, Technology and Innovation (STI) to guide strategic actions for dealing with the problems of development. Undoubtedly, science and technology, as systems of knowledge, have stimulated greater sensitivity to SD and have proved to be a salutary canvass around which revolves various societal hopes and anxieties. For countries in Africa that have continued to back-slide in many facets of 'modern development' (Nwankwo and Richards, 2004), what system of producing and managing knowledge is more likely to help generate and communicate a comprehensive understanding of SD and, very importantly, in ways to which they can relate (*i.e.*, contexts, relevance and impact)?

Over the past decades, many new development initiatives have been introduced in Africa, each of which has been heralded as a new era in Africa's development, but all of which have failed to produce the much anticipated results. Africa seems to have come full circle to a position of real promise in the four decades since most countries in the region attained independence (Ahmed and Cleeve, 2004).

Across the world, it is recognised that Africa is clearly one of the richest continents with incredible resources in terms of agriculture, water resources, minerals, forestry, as well as fauna and flora reserves, yet it is still considered the poorest part of the world's economy and even described as a scar on the conscience of the world by the former UK Prime Minister, Tony Blair in his Commission for Africa report. Nowhere has less growth and development taken place than in Africa, especially Sub-Saharan Africa (SSA). Therefore, how to overcome such anomaly of having the richest continent with the poorest people remains a flagship policy and research agenda. Per capita GDP in Africa has declined by more than 1% per annum since 1980, and the gap between the per capita GDP of Africa and the average for all low-income developing countries has widened to more than 6%.

As development moves from resource-exploitative to technology-enabled paradigm, Africa, today, stands at a crossroads. Although the continent is richly endowed with enormous natural resources – probably more than any other continent of the world – but these have not provided a robust platform for sustainable growth and development. Of course, arguments around resource-endowment paradigms are hugely contested. The fact is that Africa still suffer a disproportionate amount of deprivation when compared with the rest of the world in spheres such as healthcare, education, social services, basic economic infrastructure – all of which are pointers to the dysfunctionalism in the traditional model of SD which many countries pursued since the attainment of political independence. Now, however, the continent craves for a 'great leap forward' in STI but lacked the absorptive and enhancement capabilities. Therefore, progressing the SD agendas through STI, whilst desirable and compelling, is fraught with complications – in the same way as taking recourse to resource-endowment model is equally problematic.

Africa's efforts to achieve SD have traditionally been hindered by poor technology development, transfer and management which, in turn, hampered attempts to improve low levels of productivity. Evidently, technology development and transfer are the critical determinants of success in Africa's renaissance, with particular effects in areas such as employment, food security, export earning and provision of raw material.

The UN World Summit on Sustainable Development, held in Johannesburg (SA) in 2002, provided the essential principles and the programme of action for achieving SD in Africa based on concrete actions for the implementation of Agenda 21 in Africa (see UN, 2002). The World Summit Declaration includes actions at all levels to:

- promote technology development, transfer and diffusion to Africa and further develop technology and knowledge available in African centres of excellence
- support African countries in developing effective science and technology institutions and research activities capable of developing and adapting to world class technologies

- enhance the industrial productivity, diversity and competitiveness of African countries through a combination of financial and technological support for the development of key infrastructure, access to technology, networking of research centres, adding value to support products, skills development and enhancing market access in support of sustainable development.

It is for all these reasons that this volume of the series is devoted to recent research activities exploring different aspects of the topic, as highlighted hereunder:

2 Science technology and innovation

Science and technology are considered the most effective means to enhance growth and socioeconomic development of nations and can make substantial contributions to the effective development of Africa. Technological development has a profound and long-term impact on income distribution, economic growth, employment, trade, environment, industrial structure and defence and security matters (Stoneman, 1987). Moreover, the acquisition and use of science and technology are critical for the achievement and sustenance of food security.

African policy-makers are increasingly recognising that progress towards SD and the integration of Africa into the global economy cannot be achieved without the adoption of a new technological regime (UNECA, 2003a–b; UN, 2002). It is expected that this new technological regime will usher in new processes and perspectives necessary for Africa to meet the Millennium Development Goals (MDGs) of reducing poverty, hunger, illiteracy and lack of access to water and sanitation. Such a regime needs to address several key challenges such as:

- 'democratisation' and 'popularisation' of science and technology
- integrating science and technology and innovation policies with overall development policies
- strengthening of science and technology policy-making and development institutions
- building of an efficient science and technology infrastructure and strengthened funding, popularisation and extension, as well as managerial, entrepreneurial and innovation capacities
- enhancing international cooperation by liasing, networking, partnering and collaborating with industrialised, industrialising and developing countries of other regions
- using internationally agreed standards and methods, Africa needs to develop and implement better mechanisms to monitor science and technology development within the continent.

Consistently, available reports (*e.g.*, Global Monitoring Report, 2008) indicates that the major reason why Africa has been backsliding in achieving the MDGs and SD is due to weak science and technology capacities. Limited technological learning, absence of

appropriate technology policies, inability to fully grasp the challenges of globalisation and appreciate the key issues that continue to shape world development today compound the problems.

Productivity and efficiency of the agricultural sector in particular are central to any programme of economic recovery. Despite the dominant role of agriculture in the national economies of most SSA countries (contributing up to 70% of GDP), agricultural productivity is extremely low and does not exceed 30% of the level attained in research farms (see Ahmed, 2004). Concomitantly, rapid industrialisation is the key to increasing Africa's participation in world commerce in order to enhance structural transformation competitiveness in an increasingly globalised economy. However, the level of Africa's industrialisation remains low, as illustrated by three key facts:

1 there are only a handful of countries where manufacturing as a share of GDP exceeds 25% the benchmark for considering a country as having achieved the threshold of industrial take-off

2 the export composition of African countries continues to be dominated by primary rather than by processed or semi finished products

3 the ratio of public expenditure and private investment in scientific research and development remains minuscule as a percentage of GDP in all African countries (see UNECA, 2003a–b).

3 Research and Development (R&D)

In most SSA countries, there is a wide separation of Research and Development (R&D) from production, and this gap reinforces the preference of firms for foreign technology. The gap is enlarged further by a lack of functioning network of communications between governments and scientists on the one hand, and industries and other technology users on the other. The technological gap between the developed countries and Africa generally appears to be growing, with few exceptions.

One of the many challenges confronting many African countries today is to develop, use, and disseminate appropriate endogenous scientific and technological capacities relevant for improved productivity (particularly agricultural) and output (Ahmed, 2004; 2007).

Technological dependence in SSA is severe and pervasive, primarily because of colonialism and continued poverty. With a shortage of technical and managerial skills, turnkey technology transfer promotes dependence on unmodified imported technologies, which are rarely mastered through learning by doing. However, an inadequate base of skills and the absence of both a socioeconomic and technological infrastructure prevent necessary learning activities from taking place.

It is also evident that knowledge generated in the developed world may have little relevance to the pressing needs in food production, healthcare, clean water and education. Endogeneity is far more important to successful innovation in Africa than transfer and adaptation of technology developed elsewhere. Therefore, it is vital for SSA countries to focus on their locally produced technology in order to increase productivity. The selection of appropriate technology is critical to fostering economic growth and SD.

4 The role of university

To a significant extent, the failure in achieving the MDGs in Africa, *vis-à-vis* reverses in strategic initiatives for growth and development, are deeply intertwined with the broader question of how the university sector is evolving in many African nations and the implications for SD. As both a citadel and cradle of social and economic regeneration and the 'nervous system' for national capacity development, the university sector in Africa is expected to play its role as a major agent in the realisation of the MDGs. Although the university houses the largest concentration of highly trained scientists capable of conducting research on topics of national importance, but existing potentials of human resources are not fully applied for research purposes. Instead, is seeming gross under-utilisation of capacity and profound disincentive among university staff to do research in many African countries.

To achieve a genuine strategic turnaround, Africans universities will need to strengthen their present research capabilities for planning and implementing system-building strategies in research policy, organisation and management. This requires the best utilisation of academic staff of the different national universities.

5 Information and knowledge management

The transfer of information and knowledge from developed to African countries is one important source of support for SD under current conditions. And while education and knowledge are considered the chief currencies (the essence of modern age), a strategic resource and a lifeline for African SD, the scarcity of literature in educational and research institutions is a serious problem in the face of overwhelming need for better access to information.

Weak communication and social infrastructure not only block information flows in most African countries but ultimately stifle social and economic development. Information and Communication Technologies (ICTs) are crucial for the knowledge-based society of the future and the nucleus of the globalised economy. With a shortage of technical and managerial skills, turnkey technology transfer promotes dependence on unmodified imported technologies, which are rarely mastered through learning by doing. Attention to human capital at the national level and to learning mechanisms at the firm level is the imperative for technological development (for more discussion of the impact of technology on the productivity in Africa, see Ahmed, 2004; 2007).

Most African countries recognise that much of their economic future will depend upon the understanding of the global technological forces at work and their long-term implications. However, evidence also shows that the benefits accrued from the utilisation of ICTs over the recent years have been inequitably distributed with Africa facing deeper levels of marginalisation. As a consequence, there is a profoundly evolving new form of poverty, *information poverty*, within these countries. There is no doubt that some African countries are rich in traditional knowledge while some others are doing very well even in the technologically most advanced fields.

The lack of deliberate technological learning and implementation of technological policies that are in line with domestic economic problems and the challenges of globalisation are overwhelming. Also overwhelming is the continent's continuous failure to learn from the Newly Industrialised Countries (NICs) and to address properly the key issues that have shaped the development paradigm in those countries. Meanwhile there is also an overwhelming evidence for the disparity in scientific output between the developed countries and DCs particularly Africa. Africa has not made any significant contribution and supplied less than 1% to the global scientific output (see Ahmed and Nwagwu, 2006; Ahmed, 2007).

The gulf in the levels of science and technology between the developed countries and Africa will tend to widen further with the rapid expansion of the internet in the West and the speedy transition to electronic publishing. This could eventually lead to an increasing marginalisation of science and scientists in Africa, with a growing gulf in technological proficiency and economic development between rich and poor. For African countries, keeping up with these changes, and involvement in research, are both vital. According to recent UN reports, millions of people in Africa have never made a telephone call and without the ability to communicate Africa will remain poor and isolated, lacking the basic means to participate in the global society (World Telecommunication/ICT Development Report, 2006).

6 The way forward

It is obvious that socio-economic and technical analysis alone will not provide a satisfactory solution to the type of problem presented in this book as these issues and problems also have political, cultural, ethical and industrial relations dimensions. Therefore, solutions proposed must seek to change the behaviours of individuals and institutions. To do this it is necessary to recognise all the dimensions of global scientific, technological and SD trends and to seek to deal with them.

The main conclusions and recommendations of this book are:

- Africa needs stronger research institutions and capacity to be able to select and access appropriate technologies as well as advancement in ICTs. While the digital divide has been recognised as a threat to the global economy, the pattern of scientific activities tends to show that we might end up with entering a new Dark Age, unless we re-design an information-oriented democracy in the 21st Century. Whatever might emerge as a global economy will be skewed in favour of the information-haves, leaving behind the rich resources of Africa and other regions, which are often regarded as information have-nots. As a matter of fact, the current pattern of the globalisation process is leaving something very crucial behind, namely the multifaceted intellectual 'wealth' and 'natural resources' of Africa. The beauty of a truly globalised world would lie in the diversity of contribution by all country members of the world.
- One of the many challenges confronting African countries today is to develop, use, and disseminate appropriate endogenous scientific and technological capacities relevant for improved productivity and output. Developed countries can help by assisting African countries to diffuse scientific and technological advancement to enhance food security in the continent.

- Africa must increase its agricultural productivity to attain food security, reduce poverty, provide employment, increase exports, produce raw material for industrial transformation and conserve its natural resources base. To raise the scientific and technological level of subsistence and small-scale commercial agriculture, one has to increase the supply of modern agricultural equipment to this sector.
- Many analyses have treated all African countries as the same, which is grossly misleading. For example, while much of the infrastructure is reasonably well developed and political instability is low in South Africa, the neighbouring Zimbabwe (under the present dispensation) is of no attraction to any foreign investor. Several countries in the region have achieved significant progress towards SD and particularly the MDGs, demonstrating the feasibility of progress in even the most resource constrained environments. Therefore, the positive lessons that can be drawn from these countries' experiences should be disseminated and, where relevant, applied by other countries in the region as a first step towards ensuring that the collective status of Africa's performance improves.
- Sadly, to many people in the West as a whole, Africa is familiar only as a place of coups, crises and famines. It is time for the worldview of Africa to meet that of Africa's realities. At the same time, it is equally important that the international community delivers its promises and commitments to Africa on debt relief, generous aid, opening markets for wider trade opportunities, and increasing investment.
- Africa faces problems more severe than any other region in developing infrastructure.

Finally we hope that the outcome of this book will help to outline the major issues that frame the current state of science technology and innovation in Africa and contribute to better understanding of such an important role that STI can play in African sustainable development.

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