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Science and technology in sub-Saharan Africa: regional co-operation in a post-national environment

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INTRODUCTION

There is a growing recognition of the important role of knowledge in socio-economic development and in power relations in the world (Strange, 1988, Stehr, 1994; Vorster & Nel, 1995; Singleton, 1996; *World Development Report 1998/99*). A number of studies have been carried out to highlight the importance of science and technology in the socio-economic development of Africa, and developing countries in general (Forje, 1989; Wad, 1984; Ndebbio, 1992; Jugessur, 1994, Abiodun, 1998)[2]. Over the years conferences have been held (regionally and globally) that reiterate the need for African countries to develop their scientific and technological capabilities individually and collectively to enhance their economic growth and development. The most notable ones include:

- United Nations Conference on the Application of Science and Technology to the Development of Less-Developed Countries, Geneva, Switzerland, 1963.
- The International Conference on the Organisation of Research and Training in Africa in Relation to the Study, Conservation and Utilisation of National Resources, 28 July to 6 August, 1964, Lagos, Nigeria.
- Symposium on Science Policy and Research Administration in Africa, 10-12 July 1967, Yaounde, Cameroon.

[1] Paper written for and delivered at the 3rd Annual Conference of the Warwick University-ESRC Centre for the Study of Globalisation and Regionalisation, 16-18 September 1999.
[2] Under the Lagos Plan of Action for Economic Development of Africa, 1980-2000, the African Heads of State and Government emphasised the importance of systematic and integrated development and the use science and technology by the countries and people of Africa to spearhead development.

- The Regional Symposium on the Utilisation of Science and Technology for Development in Africa, 5-16 October 1970, Addis Ababa, Ethiopia
- The Conference of Ministers of African Member States Responsible for the Application of Science and Technology to Development (CASAFRICA I) 21-30 January 1974, Dakar, Senegal.
- The United Nations Conference on Science and Technology for Development (UNCSTD) 20-31 August 1979, Vienna, Austria.
- The Lagos Plan of Action for the Economic Development of Africa (1980-2000) Lagos, Nigeria.
- The Second Conference of the Ministers of African Member States Responsible for the Application of Science and Technology to Development (CASAFRICA II) 6-15 July 1987, Arusha, Tanzania.
- Abuja Treaty for the Economic Community of Africa and its Protocol on Science and Technology, 1991, Abuja, Nigeria.
- The First African Regional Conference on Science and Technology (ARCST), 4-9 November 1995, Addis Ababa, Ethiopia.
- World Conference on Science for the Twenty-First Century, 26 June to 1 July 1999 Budapest, Hungary.

These conferences and studies often pinpoint the need for African countries to evolve continental and regional institutional mechanisms for co-operation. It has been suggested that this could be done by forging stronger bilateral ties and through multilateral agreement, either on their own efforts or with international institutions. These developments have led to calls for international, continental and regional co-operative agreements with the requisite institutional mechanisms among African countries and with Africa's development partners. As Forje (1989:189) puts it "any African country which elects to reject technological and scientific co-operation and progress is bound to be bypassed by world events because of the fierce competition among nations and in view of the many varied advances in scientific and technological achievements. This is more true as interdependence increases so that each country is

more dependent on others for some of the resources needed to maintain and even increase its output."

Sadly, the national systems of innovation (NSI) of many of the countries in this region are either in crisis or are suffering under severe constraints. Attempts to pool resources, and to co-operate in the fields of S&T, have not been able to offset the negative consequences of the decline in S&T resources and outputs.

Measured against all standardised indicators, sub-Saharan Africa (South Africa included) is fairing poorly in the Science and Technology (S&T) stakes. Although the overall validity of some of these indicators as measures of knowledge in- and output can and have been challenged, the cumulative picture that emerges from them is that S&T in SSA is seriously lagging behind most other regions of the world, including some developing regions.

Although gross expenditure on R&D (GERD) in SSA was up from US$1,09 billion in 1992 to US$2,3 billion in 1994, and as a percentage of GDP increased from 0,4 to 0,5%, these modest increases have not prevented SSA from sliding back on other input indicators, and in terms of outputs.

Too few African students make it to the tertiary level, or engage in technical and vocational education on the secondary level. Although the percentage of tertiary students studying in S&T subject compares well with other developing regions, the real problem is that so few African students get a tertiary education. Available figures (for the early 1990s) show that the PRC has a better ratio than 14 SSA countries, and that the best performers (Congo, Zimbabwe, and South Africa) still lag behind Singapore by a factor of between five and seven (see African Development Bank: *African Development Report 1994*).

The UNESCO *1996 World Science Report* shows that Africa as a whole in 1994 had only four research and development (R&D) scientists for every 10 000 of the population, as opposed to the global average of eight. A study in 1992 estimated that Africa had only 20 000 scientists and engineers that represented 0.36% of the world total. Comparatively, Japan, the United States and Europe have between twenty to fifty scientists and engineers per 10 000 population, while some parts of Africa have only one scientist or engineer per very 10 000 of the population (UNESCO, 1999).

The manpower problem has also been reflected in the global output of scientists and engineers in terms of publications. In 1995 the Science Citation Index (SCI) and Compumath databases provided the following figures on the distribution of scientific activity in the world: North America (38.4%), Western Europe (35.8%), Japan and the newly industrialising countries (NICs) (10.1%), the Commonwealth of Independent States (4.0%), Central and Eastern Europe (2.0%) and Sub-Saharan Africa (including South Africa) (0.8%) (World Science Report, 1998:24). According to these statistics Sub-Saharan Africa had lost 19% of its world output since 1990. SSA (South Africa *excluded)* was down from 0.5% in 1985 to 0.3% of world output in 1995.[3]

In terms of registered patents, which "indicate the level of inventiveness and creativity in technology for industrial purposes" (Papon & Barré, 1996:12), SSA's share in the two major patent centers, Europe and the USA, declined throughout the 1990s. Using 1990 as a base year, patents originating from SSA and registered in Europe declined by 4% between 1990 and 1995. In the case of patents registered in the US, SSA's contribution was down a whole 22%. In 1995, SSA's share of patented innovations in these two centers was only between 0.1% and 0,2% (*World Science Report* 1998:26).

There are a number of contending explanations for these states of affairs. The one favoured by most analysts is that SSA's poor showing is the result primarily of inadequate state policies and low levels of investment in S&T. While financing of research and development activities in the developing countries of Africa increased by 700% between 1970 and 1985, and the number of researchers grew by almost 1000% (Gaillard & Waast, 1993), this growth was off very low bases, and grossly inadequate compared to S&T inputs elsewhere in the world. The 1970s and 1980s were decades of major attempts by African states to set up "national systems of innovation" (NSI) and create state policies to support them (Adeboye, 1998:168). These policies failed to translate the output of the NSI's into commercial use, and many of the needs-driven research institutions became little more than extended state bureaucracies, suffering the same levels of nepotism and of corruption experienced by the state sector in SSA is general. The fact that some solid basic research is still being done in these state institutions is surprising against this background. In the absence of a functioning industrial-development policy based on the cultivation of manufacturing industries,

[3] *The Nation* (Nairobi) 24 June 1999.

there is little incentive for committed scientists to engage in applied and strategic research. State policies also failed to get more African students to study at the tertiary level, or to engage in technical and vocational education on the secondary level.

Thus, as African states became weaker, the argument goes, they lost the capacity to draw benefits from their original relatively large investments in S&T, and have failed to develop the policy mixes that have helped other developing regions to improve their stock of human capital, and to harness S&T in a clear industrial development policy.

A related, but often overlooked factor in the relatively poor showing of SSA in the S&T stakes, is the little success that SSA has had in stimulating cross-border S&T co-operation in the region. The policy-problems faced by SSA in S&T are therefore not only nationally anchored, but have a distinct regional dimension to them. In this paper, we want to focus on this regional dimension, as a correction to the literature that tends to concentrate almost exclusively on the problems encountered by NSIs.

This paper thus attempts to stimulate a debate *beyond the state* about S&T in Africa. The time for such a debate has come. The 1990s have witnessed a revived interest in SSA for regional co-operation in S&T, following on the signing in 1991 of the Abuja Treaty whose aim is to create an integrated economic community in Africa. This revived interest in S&T co-operation have led to a number of initiatives, including a proposed protocol on S&T co-operation, and the resuscitation of the Scientific Council of Africa (SCA). Below, we review and evaluate some of these developments, with the intention of generating some policy suggestions.

PHASES OF S&T DEVELOPMENT AND MANAGEMENT IN SSA

Recent steps towards a deeper, and perhaps more sustained attempt at inter-national cooperation in S&T on the African continent, form part of a broader pattern of change in what can be called scientific development and management. As can also be detected in other parts of the developing world, the evolution of S&T in Africa has gone through a number of phases. Expanding somewhat on the useful, but somewhat restricted analysis of Gaillard, Krishna and Waas (1997), we can detect at least four such phases: pre-colonial, colonial, national, and post-national.

The first, and still most uncharted one, is a **pre-colonial** phase that was characterised by a range of knowledge activities, ranging from the informal to the formal, and a near absence of attempts to deliberately manage the production, storage and dissemination of knowledge. This changed dramatically with the introduction of formal S&T into Africa by **colonialism**, and the concomitant attempts by colonial rulers to manage research and development in the colonies in such a way that the motherland would reap maximum scientific and material benefits. The colonial era also witnessed the introduction of forms of "inter-national" or, perhaps more correctly put, trans-border co-operation in the S&T field.

The colonial administrations of Africa did not help Africa in building its own scientific and technological capability, even for increasing and improving its basic food crops (Okigbo, 1991; also see Gaillard, Krishna and Waast, 1997). In terms of the number of territories they controlled in Africa, the British and French were the major colonisers. As such, they were in a position to build the first regional S&T institutions.

During the British rule, prominence was given to the agricultural sector of the colonies and institutions were created that linked a number of colonial territories. Among these were the West African Cocoa Research Institute (WACRI), West African Oil-Palm Research (WAIFOR), the West Africa Maize Research Unit (WAMRU) for Anglophone West Africa, and the East African Agricultural and Forestry Research Organisation (EAAFRO), the East African Freshwater Fisheries Research Organisation (EAFRO) among others, for the Anglophone countries of Kenya, Tanzania and Uganda. These broadly fell under the West African Research Organisation (WARO) and the East African Common Services Organisation (EACSO) respectively which were the overall co-ordination bodies (Forje, 1989:194).

The French colonial authorities operated mainly through the Office de la Researche Scientifique Technique Outre-Mer (ORSTOM) which had research organisations for Francophone Africa. These included the Institute for Research in Tropical Agriculture (IRAT), the Institute for Research on Oil and Oil-bearing Plants (IRHO), and the Institute for Research on Cotton and Textiles (IRCT). Generally, ORSTOM was responsible for basic research carried out in the various areas of coffee, cocoa, tea, tropical forests, rubber etc. (Forje, 1989:195). Most of these institutions had been

established to extract and promote exports crops as raw materials for industrial production in Europe, to the detriment of basic food crops.

The foundation of intergovernmental co-operation in science and technology in Africa was laid by the six colonial powers, which were ruling in Africa in 1950 (that is, Belgium, the France, Federation of Rhodesia and Nyasaland, Portugal, the United Kingdom, and the Union of South Africa). This co-operation led to the formation of the Commission for Technical Co-operation in Africa South of the Sahara (CCTA) and the Science Council for Africa South of the Sahara (CSA)[4]. The CCTA had its headquarters in London and the CSA in Zaire (Odhiambo, 1991:82).

Between 1960 and 1990, scientific development in Africa entered what can be termed a **national** phase of development. This era saw the introduction of national S&T policy frameworks, the cultivation of NSIs, and the creation of mostly state funded institutions whose main focus was the particular developmental needs of the particular state. Part of this nationalising and indigenising of S&T, attempts were made to transform trans-border co-operative institutions from the colonial era into truly African (and pan-African institutions). As time passed, however, and as the fiscal problems of African states became ever more daunting, co-operative efforts increasingly played second fiddle to NSIs and their growing needs. These trends became particularly prominent in the 1980s, and as the decade wore on, state-sponsored S&T co-operation on the African continent stagnated.

The ideal of "deep" co-operation in science and technology could not be sustained after most of the colonies gained independence and broke up into small national units. They lacked critical mass of experienced scientists and were unable to attract and retain first class scientists (ibid.). In addition, the former territorial institutions, which had served different territories, were taken over by the newly independent countries and sub-regional headquarters became national centres. The West African Cocoa Research Institute at Tafo in Ghana serves as an example.

The CCTA and the CSA were transformed in 1962 into organs of the Organisation of African Unity (OAU), where the CCTA became the Scientific, Technical and Research

[4] The Scientific Council for Africa (CSA) was formed at the initiatives of individual scientists who were working in the colonies. But it became the main consultation and advisory body to CCTA (see Odhiambo, 1991).

Commission (STRC) and the CSA became the Scientific Council of Africa (SCA), as the science advisory body. This means that regional co-operation in Africa also started with a mechanism for scientific and technological co-operation. In fact, Article II Sub-section 2 of the OAU Charter on co-operation emphasises that Member States shall co-ordinate and harmonise their general policies especially in the following *fields*:

1. Political and diplomatic co-operation
2. Economic co-operation , including transport and communications;
3. Educational and cultural co-operation
4. Health, sanitation, and nutritional co-operation
5. Scientific and technical co-operation**;** and
6. Co-operation for defence and security

Scientific and technological co-operation falls under the Department of Education, Science, Culture and Social Affairs (ESCAS). ESCAS has five Specialised and Technical Offices, based in Lagos, Nairobi, Conakry Ouagadougou and Yaunde to help it promote and coordinate the application of S&T for development in Africa.

However, Odhiambo (1991) notes that the STRC (based in Lagos) was little known outside a small circle of dedicated specialists and governmental planners in Africa, as it lacked presence and credibility. Its advice rarely drew attention; and therefore, it ceased to be an effective intergovernmental organ for technical co-operation in Africa.

The Scientific Council of Africa (SCA), which replaced the CSA as the science advisory body, was similarly less known as it met only twice in the 1980s for a whole decade.

However, as we noted above, the 1990s have been characterised by attempts to breath some new life into S&T co-operation in SSA. Some examples of this are the resurrection of the SCA since 1994 under the auspices of the OAU/STRC as the main science and technology policy advisory organ of the OAU (Odhiambo, 1996:138). This development comes in view of the effective regional co-operation as envisioned in the Abuja treaty in 1991 for the establishment of an African Economic Community by 2025. Under the treaty various policy protocols are needed to foster regional and sub-regional co-operation, including one for science and technology. Initial attempts to set

in motion a process to have a draft protocol discussed and ratified have so far not been successful, though.

Co-operation was also taken further in 1994 with the creation of the African Foundation for Research and Development (AFRAND) in the course of the second annual session of the Presidential Forum on Management of S&T for Development in Africa. The headquarters of AFRAND is based in Lilongwe, Malawi. It has created three bodies: the Roundtable of Science Advisors for Science-led Development in Africa, the Roundtable of Technology-Oriented Entrepreneurs in Africa and the Roundtable of Capacity Building Leaders in Africa as mechanisms to enhance co-operation and development of S&T in Africa. Part of its programme is on Distressed and Expatriate Scientists and Scholars from Africa aimed at mobilizing African brainpower resources worldwide. AFRAND initiated programmes in 1995 to raise funds most of which would be invested as an endowment fund with the income towards support for projects deemed as having strategic importance to Africa (Odhiambo, 1996:141).

The most important feature of this fourth phase in the evolution of S&T in Africa is perhaps not these renewed attempts by states to place regional co-operation on a surer footing. What makes this era significantly different –and constitutes it as a truly *post-national* era, are the following:

Firstly, the introduction of structural adjustment programmes in a number of SSA countries has had contradictory results for the development of S&T on the continent. On the one hand, the programmes preferred by multilateral and bilateral donors have in the case of certain states led to an increase in the amount of R&D investment in those countries, despite the fiscal discipline imposed by the SAPs. Part of the explanation is that the acceptance of SAPs has made these states more attractive for foreign donors, and that most of these donors have targeted specific S&T areas where they would like to see their donations being spent. While this provided a lifeline for struggling NSIs, it has the effect of undermining the capacity of local policy makers to determine S&T priorities, and to replace it with “international” priorities, often geared at he commercial interests of the donors (Enos, 1995).

Secondly, foreign donors such as the World Bank and international bodies such as the World Health Organisation have themselves become active participants in the setting up of co-operative projects in SSA. In this they follow an earlier example set by UNESCO; the only and important difference being that these bodies are seemingly much better organised and more successful than UNESCO ever was.

Thirdly, although the data on which to go is almost non-existent, it is surmised that multinational corporations are becoming important players in the R&D field in SSA. This means that S&T on the continent is also subjected to the increasing commodification and globalisation of knowledge production. The logic of these processes is quite simple: the commodification of knowledge leads to the privatisation of knowledge production, which wrenches more and more decision-making responsibility from the hands of the custodians of NSI's, namely states. This process is speeded up by the rapid transnationalisation of S&T activities, driven mainly by the R&D interests of multinational companies, which determine what mode of knowledge production can and should proceed. Despite laudable attempts by some aid donors to assist countries of SSA to adjust to these pressures, the focus of this aid tends to further undermine national authority in favour of a more dispersed authority favouring the commercial interests of the donors. This contributes both to the marginalisation of knowledge production in developing countries, particularly in SSA, and to the undermining of their national policy capacity to explore the otherwise valuable concept of "knowledge for development" (see Etzkowitz and Webster, 1995; Lyotard, 1988).

Ironically, thus, attempts by African states to revive inter-state co-operation in S&T coincides with a fundamental shift in S&T production and management from a national to a post-national dimension in which a number of actors, other than states, becomes important players in the knowledge game. This deepens the challenge to S&T policy makers in the region: not only do they have to try and make up for the poor performance of policy formulation and implementation in the national era. They have to do so in circumstances where they are losing the capacity to do so.

OUTLOOK

In this section of the paper, we make some suggestions about how we believe the challenges of the post-national era in S&T development and management in SSA can

and should be handled. We start off by making a deductive case for strong regionness as a prerequisite.

Regionness

The literature on globalisation in general suggests that the "*widening, deepening and speeding up of the processes of world-wide connectivity*" (McGrew, 1998:302) is drawing forth a range of strategies of accommodation and resistance from agents subjected to this process. One of the strategies which have received considerable attention, and which is the theme of this conference, is that of "regionalisation" or as Bjorn Hettne and Fredrik Söderbaum call it, perhaps more correctly "the pursuit of *regionness*" , that is, "the process whereby a geographical region is transformed from a passive object to a subject with capacity to articulate the interests of the emerging region" (Hettne & Söderbaum, 1998:9). This includes the pursuit of regional co-operation and/or integration as a counter, ideologically and policy-wise, to the erosion of local participation in and responsibility for governance of the global political economy. "Regionness", thus conceived, is a subjective reality, an institutional fact, and a normative ideal. It registers the degree to which agents identify with a region, serves as a measure of the efficacy of the subjective in terms of its institutionalisation, and holds out the ideal of an alternative world order based on the regaining of authority by those affected by its exercise. Although it is usually employed in multi-sector analysis of regional cohesiveness, nothing precludes its application to a specific functional sector, such as S&T.

The representation of the African Continent as a region remains a dilemma. This is a dilemma because in practice, the UN and its specialised agencies see Africa in two: Sub-Saharan Africa and the Arab North Africa. Therefore official development statistical figures present a fragmented Africa and not a region.

Secondly, if regionalism is anything good to go by, the UN Economic Commission for Africa (ECA) activities do not seem to totally promote the existing major sub-regional groupings as indicated by its transformation of the former Multinational Programming and Operational Centres (MULPOCs) in to the Sub-Regional Development Centres (SRDCs). For example the Sub-Regional Development Centre for Southern African (SRDC-SA) comprises 11 countries which will exclude some SADC members (e.g.

Tanzania) a further fragmentation of development efforts in terms of institutional building. Moreover, ECA's subregional committees S&T as part the African Regional Conference of Science and Technology (ARCST) fall under the various SRDCs.

Thus, on an objective level, the level of S&T regionness in Africa is poorly developed. This is exacerbated by subjective factors, such as a tendency to neglect continental structures and institutions, and a lack of political will to push through and ratify protocols such as the S&T protocol of the Abuja Treaty. The call by Pres Thabo Mbeki at the 35th Summit of the OAU in Algiers for Africa to take its international commitments in terms of the Abuja Treaty seriously, should be taken very seriously (http://www.anc.org.za/ancdocs/history/mbeki 13 July 1999). The following suggestions follow from this emphasis on the subjective commitment that should underlie a strong regionness in S&T.

Strategic Plan

Africa cannot stand aside while some regions are making positive progress through co-operation in science and technology in the world today. Africa as a whole requires a strategic plan to develop its scientific and technological capability, just as any business organisation will do. This plan will enable Africa to build areas of core competence in science and technology. It can be possible partly through the establishment of co-operation policies and plans on science and technology at the regional level through the identification of common priorities. Such a plan could even bring to the fore sub-regional fields of specialisation for the overall development of the continent.

The adoption of a strategic plan for the development of science and technology implies that certain regional or national institutions have to be transformed or new institutions have to be established. This is to reflect the broader regional interests and priorities. However, whether new institutions are created or old ones to be transformed will always involve an element cost. Therefore, African governments should be prepared contribute both the material resources and human resources to sustain such programmes and projects decided upon. For instance, lack of financial support from other SADC member states made the Eastern and Southern African Development Information System non-functional as only the Government of Zambia supported the project with funding as the host.

Adopting a transnational approach

African countries both at the national and regional levels should adopt a transnational approach to the development of the scientific and technology capabilities. This transnational approach means that the private sector including profit and non-profit organisations, should be allowed to play a positive role in the developmental process in terms of supplying material and technical skills. Such an approach would create a congenial environment (economic, political and social) for organisations to participate in the projects and programmes. In the past, most governments have not encouraged the private sector to develop in Africa and therefore their contributions to the development in science and technology have been minimal in African countries. As noted earlier in this paper, the function of the Scientific Council for Africa during the colonial period as consultative and advisory body to the CCTA shows how governmental and non-governmental bodies could work together. The African Academy of Sciences and other non-governmental institutions should therefore, play a positive role in a transnational approach. A transnational approach also takes into consideration that in principle, international scientific and technological relations can be conducted in a variety of ways: professional (typically, scientist to scientist, scientific organisation to scientific organisation), commercial, and governmental. It should be noted that various combinations of these ways already exist in the world of international science and technology.

Co-ordination of scientific activities

We noted earlier that the British and the French in the colonial era could co-ordinate the various activities of the different organisations that were established and also link them to international institutions to derive benefits from such institutions. African regional and sub-regional institutions do not seem able to co-ordinate their activities. This is a major task for the future. Co-ordination will enable Africa to avoid duplication of activities and effective management of co-operation programmes to suit national, sub-regional and regional developmental needs.

To ensure proper, effective and efficient promotion and co-ordination of S&T, the current structure of the OAU Department of Education, Science, Culture and Social

Affairs (ESCAS) has to be transformed. At present, none of the five Specialised/Technical Offices are based in Southern and Northern Africa.

Other challenges include how to develop mechanisms for technology transfer and issues of foreign direct investment (FDI). FDI is being attracted to developed countries than developing countries, in view of their scientific and technological capability, and knowledge in general.

CONCLUSION

In sum, this paper has tried to emphasise the important role of science and technology in the global political economy. The development of scientific and technological capability is critical to the socio-economic development of Africa. The history of colonialism shows that the colonial administrations pulled together both human and material resources in the different territories through scientific institutions. This enabled them to exploit the resources they needed.

However, the current challenges to Africa go beyond mere exploitation, to how these resources can be tapped and developed. The formation of institutions after the OAU has not had any positive impact on the development of scientific and technological capability in Africa. It is time for Africa to move from paper-based organisations to institutions that achieve results in terms of her developmental needs. A prerequisite for this is the re-discovery and cultivation of an African "regionness" in science and technology. In the post-national phase of S&T development and management, Africa better establish such regioness quickly, before its capacity to determine its own knowledge-for-development future is fatally undermined by the transnational knowledge-for-the-market forces of today.

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