EDITORIAL

Scientific and Technological Challenges Facing Africa in the Era of Globalization*

ABSTRACT

The basic assumption of this paper is that the acquisition of science and technology is a critical determinant of the developmental status of countries. Those countries that have excelled in science and technology are the most developed, whilst those with a weak scientific/technological base are the least developed. Given the economic backwardness of most African countries south of the Sahara, it is imperative that a series of concerted actions be adopted and/or sustained to permanently institute a **scientific/technological culture** in Africa. This may involve developing a coherent science policy, stepping up funding for scientific education and research, setting up viable networks for scientific information exchange and mutual support, integrating science into the developmental strategies etc. Above all, African decision makers must give science and technology the highest priority in their strategies since no development is possible without scientific know-how. It is only through the judicious use of science and technology that African countries can cope with the stiff competition brought about by the globalisation process which is rapidly integrating the national economies and cultures into a continuum, where only the fittest are likely to survive.

RESUME

Le présent article postule que l' acquisition des sciences et de la technologie constitue un facteur déterminant du niveau de développement d'un pays. Evidemment, les pays disposant d'une base scientifique et technologique solide sont les plus développes. Par contre, ceux qui accusent un retard en la matière sont les moins avances. Au regard des faiblesses économiques de la majorité des pays de l' Afrique subsaharienne, il est indispensable qu 'une série d' actions concertées soit adoptée et/ou poursuivie en vue d' instituer et de consolider une **culture scientifique/technologique** sur le continent. Ainsi, il s'agit de définir pour le domaine scientifique une politique cohérente, d'améliorer les ressources destinées à l'enseignement et a la recherche scientifiques, de créer des réseaux fonctionnels pour des échanges d'informations scientifiques et l'assistance mutuelle, d'incorporer les sciences dans les stratégies de développement, etc. En conséquence, les décideurs africains doivent mettre les sciences et la technologie au premier plan de leurs stratégies car aucun développement n'est possible sans la maîtrise des sciences. Seule une utilisation rationnelle des sciences et de la technologie permettrait aux pays africains de faire face à la concurrence déloyale engendrée par le phénomène de la mondialisation, leurs économies et leurs cultures se trouvant entra1nées dans un labyrinthe ou chaque peuple tient sa survie à sa capacité de production.

What is globalisation ?

Imagine that we were all seated at a great banquet; with so many people that one could not count them all by simply looking across the hall. Imagine that the tables were all set and the hall glitteringly decorated with all the guests nicely seated and chatting among themselves. The food is already laid out in one corner of the hall and the guests were only waiting for the **chef** *and her staff to call them to approach the table and be served. Just at this moment when the guests were salivating and looking forward to a sumptuous meal someone shouts at the top of his voice, "Watch Out! Fire!"*

What would you expect to see? Some people will try to rush out of the hall to safety; others may desperately approach the fire with whatever water they found on their tables to put it out. A few of the guests may not have heard of the fire outbreak and would continue with their meal. Yet others may have heard and thought it was a lie, it did not matter, or it was not serious. The reactions can be very different in such situations.

I chose this non-biblical parable of the banquet to illustrate my understanding of globalization. The destinies of the peoples of the world have been brought together more closely than ever before. Through satellite television, the internet, fax, phones, e-mails - in short modern means of communication, we become aware of events in distant places within minutes of their happening. Great strides in transportation technology have made it possible to circumnavigate the earth in a matter of minutes, and to travel to almost any country in less than 72 hours. Our togetherness has been further consolidated by the realization of shared destinies. We all depend on the dwindling resources for which demands are

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increasing by leaps and bounds as the population continues to grow. The environment which used to be a reservoir of hope, is seriously threatened by increasing demands of an escalating population.

If I return to the parable of the banquet some of the guests are well dressed, better fed, healthier, better educated, live longer and were sitting in a part of the hall marked reserved. A majority however, are poor, hungry, uneducated, threatened by disease and are not even able to approach the banquet hall, let alone the table. This analogy dramatizes, I believe, the divide between the haves and have-nots in the global village - and one must ask why such a difference.

Globalization can be defined as a process by which the rapid means of communication are bringing the peoples of the world together. As a result of globalization the economies and cultures of the various nations are becoming more integrated with fewer boundaries between them. Through agencies like the UNO, the WTO, the World Bank and IMF International norms of governance and management are imposed across national boundaries giving substance to the imagery of a global village.

Reasons for Africa's backwardness in the age of globalization.

I believe that the single most important explanation for the large and ever-increasing gap between the developed and developing countries lies in their different degrees of the mastery of science and technology. No matter by whatever index you compare the two, the developed world produces more scientific and technological innovations than does the developing. In this comparison Africa turns out to be the last. Whether you are counting the number of scientists and engineers, publications, patents and inventions, or investment in science and technology Africa lags behind (see table).

It is now more than clear that Africa's backwardness cannot be attributed to some inherent shortcomings in its people. If anything African people are just as well endowed in their genetic make-ups as all other peoples. In a recent International Congress of Biochemistry held in Birmingham UK where 3000 of the top life scientists met, Dr. J. Craig Venter, the one who did more than anyone else to uncover the human blueprint- the human genome, declared that race is not a scientific concept. They had found no significant differences in the blueprint of 5 dominant 'races' studied. Their conclusion was that as humans we are all the same when it comes to the essence of our beings-the **genome or the blueprint**. The apparent differences that exist are mere variations in the same theme, variations due to the physical environment and circumstances of our development. This outstanding discovery of modern science reinforces the image of the global village and at the same time challenges us as Africans to rise and improve our lot. There is nothing basically wrong with us. We are just as good as all others. But then why have science and technology not taken a foothold on the African soil?

Africa's Scientific and Technological Lag

To my mind there are several important reasons why Africa has lagged behind in Science and Technology.

1. **Low Priority Rating of Science.**

Most African countries obtained their political independence in the 1960s and considered factors such as economic progress, national cohesion, development of democracy etc as being more important than S&T. They did not think that S&T were important areas of development. And whilst Presidents and Prime Ministers enjoyed living in air-conditioned palaces, owning flashy cars and jet planes, they did not consider it necessary to develop the competencies that create these luxury goods.

2. **Lack of adequate numbers of Scientists and Engineers.**

Statistics show that we just do not have enough scientists and engineers, on per capita basis when compared to the developed countries. The few that are available do not have the conditions necessary to work. They are poorly funded, isolated, and sometimes wrongly deployed.

3. **Inadequate Funding for S&T.**

Because of the low priority rating of S&T it is often the last department to receive funding and the first to suffer budgetary cuts when the going becomes tough. Adequate funding would enable our scientists and engineers to equip their laboratories, field stations, libraries and procure materials and reagents needed for their work. It has been

Table: Scientific and Technological capacities of Developed and Developing Countries [1, 8]

Parameter	Developed	Developing	Africa
Scientists and Technicians per 1000 population	3.8	0.4	0.4
Percentage of GDP spent on Research and Development	2	0.5	0.1-0.7
Scientific Publications (per capita)	84	16	0.8
Patents and Inventions (per capita)	97	3	negligible

estimated that 1% of the GDP would suffice to keep our engineers and scientists well equipped to do their work. The great scientific nations are spending considerably more of their GDP on S&T.

4. **Poor Organization and Management of Science**
Science thrives in a competitive environment, where merit rather than patronage counts. Most African scientists and engineers owe their positions as appointees of their respective governments. The kind of linkage between productivity and career progression that drives the private sector is missing or hardly present in government/ state run scientific institutions in Africa. What we need is an arrangement that requires the state to define objectives and provide funds, but allows scientists and engineers the freedom to operate and be rewarded on the basis of competence alone.

5. **A weak Educational System accounts for the poor scientific orientation of the Youth.**
Only a few countries in Africa have achieved universal coverage at the primary school level. In practically all-African countries only a tiny fraction of the students progress to secondary school. University education is still a luxury reserved for the select few. Even where they exist the African universities are generally under funded, poorly staffed, ill-equipped for research, over-crowded and inefficient. Such a dismal disposition does not augur well for the kind of atmosphere that produces high quality science (5-8).

6. **The lack of an industrial base**[4]
Most scientific nations have a well-developed service industry that provides the framework for science and engineering. Virtually all the tools of science employed in sub-Saharan countries today are imported! Even the simplest scientific instruments - the test-tube, the scale balance, the ruler or measuring tape, are not manufactured in any of our countries. This holds true for bulk chemicals of all sorts, not to talk of refrigerators, computers and other sophisticated scientific equipment. It seems that opting for science in Africa is tantamount to increasing our dependence on imported goods! The vicious circle has to be broken through a determined effort to begin to make some of the equipment that we need. Examples abound in modern times how erstwhile poor scientific nations have modernized. I am convinced that if we get our priorities right, the rest will follow.

The Way forward
The steps towards a better scientific future for Africa ought to include sound policy formulation, efficient educational strategies, adequate funding, better networking and sound cultural practices. The rest of this presentation will dwell on challenges that we must face and address if we intend to put Africa on the Scientific/Technological map of the world.

1. **A Coherent Policy is necessary to Orientate Africa's scientific and technological development.**
Several policy frameworks have been developed before. The plan of Lagos, various UNESCO policy documents to which African countries are party have appeared (6-8). Singly or in combination they have failed to influence S&T development significantly across the African countries. What we need now is a renewed commitment on the part of decision makers to support, encourage and use S&T as an instrument for development. This may be concretized in strategic plans for S&T in the individual countries, the regions and the continent. More than everything else it must be realized that science pervades all walks of life, and has no alternative in its capacity to enhance development. Our opinion leaders need to be convinced of this and to show it by replacing the traditional guru's so familiar in high places with the Science Advisor. We should also realize that policy formulation alone does not make for good science. It is important to implement these policies. Also policy formulation is dynamic, and structures such as Science Research Councils, Academies and Ministries of Science and Technology ought to engage in a process of continuous proactive planning in the face of the rapid evolution of international science.

Such a science policy would identify areas of emphasis which in view of our continent's rich natural resources and its current challenges would include the broad areas of *health, food security, communication, the environment and materials*. A number of cutting-edge technologies are driving advances in these areas and these include *biotechnology, electronics, information technology and materials science*. It is in these areas, among others, that our strategists should focus as they contemplate a science policy for the continent.

2. **Radical Expansion and Improvement of our Educational System is required to produce competent Scientists and Engineers who would achieve our S&T policy objectives.**
It goes without saying that you cannot do science without scientists. A deliberate policy for the teaching and learning of basic science at all levels - primary, secondary and tertiary is absolutely necessary to create the type of base that provides for technological breakthroughs.(see box) Thus good teachers of mathematics, physics, chemistry and biology should be provided with the necessary tools to lay a solid foundation for our youth in the secondary schools. At the university level appropriate doses of these subjects should be included in all the disciplines.

Some Reasons for supporting Basic Science and Technology (2,3)

1. Science and Technology are indispensable for the socio-economic development of countries. They constitute a great instrument for social change.
2. Science is a powerful intellectual resource that allows humanity to understand natural phenomena, and convert them into useful resources for social and economic development.
3. Basic science (biology, chemistry, mathematics, and physics) are absolutely necessary for the development of technology.
4. Science is a powerful liberating tool. It frees the mind from superstition, encourages objectivity and promotes social integration.

It cannot be stated emphatically enough that science is no longer a matter for scientists alone, but a matter for all of us. Perhaps one of Africa's greatest predicaments is that few of its leaders have had a scientific background, and fewer yet have faith in science. The UNESCO's declaration on higher Education outlines eloquently the need to render university training responsive to the world of work without stripping it of its inherent mission of educating the learner to think logically and act responsibly.

With the right prioritization we should step up funding for our educational system with a view to offering access to an ever greater number of learners, improving the quality of our schools and universities and above all making the universities that crucible of ideas and innovation that is crucial for the advancement of society as a whole.

3. **Networking within and between countries is absolutely necessary to create the necessary critical mass of scientists and engineers**.

A hallmark of modern science is its inter-disciplinary nature. Gone are the days when a scientist could be viewed as an isolated eccentric fascinated with nature, but speaking a language that only few understood. The sheer complexity of the problems that we face today imposes an inter-disciplinary approach. It is therefore mandatory to provide the means for communication between ours and the rest of, the scientific communities. Access to scientific journals, the internet', attendance at international meetings has to be stepped up.

Our scientists need to communicate and explain their work and results better to the public in order to win their support. It is certain that for certain types of work no single African country may be able to afford it alone. Therefore regional/continental centers of excellence should be established and sustained in such crucial areas as biotechnology, electronics information technology, material science, indigenous knowledge, and above all the basic sciences - biology, chemistry, mathematics and physics. Where possible 'virtual' universities may be created.

4. **Science and Technology must address the developmental needs and aspirations of the population in order to receive their support.**

Poor health, lack of food and shelter, poverty, ignorance, endemic wars - these are among some of the most acute problems faced by African countries today. African scientists should not only address themselves to these problems, but should be seen to be doing so. I started this article by using the analogy of *a banquet that went wrong*. The fire that was announced in the banquet may be any one or all of the major challenges listed above. The HIV/AIDS pandemic is killing off the most productive sector of our population, whilst malaria and tuberculosis have become even more devastating than before. Our failure to contain these scourges is an indication of our faltering scientific culture.

In the 1980s when the HIV/AIDS epidemic first broke out its prevalence was highest in USA followed by Europe with Africa being the least affected. In 2001 the reverse is true. Africa harbors more than 24 million of the 30 million declared cases of HIV/AIDS. Conversely the incidence of HIV/AIDs has dropped dramatically in the developed countries whilst it has continued to increase in Africa. Why? Since HIV/AIDS has no cure, the simplest explanation is that the developed world heeded the public health messages for prevention, whilst we did not. Yes, we did not because we did not accept the scientific explanations given by our doctors and nurses.

Malaria can be severely curtailed by improving hygiene, and employing bed nets or other barriers to prevent mosquito bites. But we have failed to use these strategies - either we did not know about them or could not afford them. On top of the priorities of our S&T drive must be questions of health.

It is also mandatory to address the problem of food security that has been exacerbated by the population boom, draughts, wars and the rural exodus. African agriculture needs to be modernized, through the applica-

tion of appropriate technologies. It is no longer sufficient to urge the youth to return to the land. They too wanted to stay in the cities and be part of the popular culture that they see on the television. It is inevitable that the farming population in Africa will drop. To sustain food production obsolete farming methods must be replaced by modern ones. Mechanization, the use of biotechnology (both classical and modern) prevention of post harvest losses etc must be harnessed to enhance food production. This is an area full of excitement and relevance that is worthy of the attention of African scientists and engineers.

The development of new materials for building and manufacturing is another area where African scientists and engineers can make a contribution. In this respect organizations such as MIPROMALO in Cameroon, which specializes on valorizing local building materials, need to be encouraged.

We are confident that African Scientists can make a difference if given the chance. Governments should not see scientific activity as a luxury. It holds the key for Africa's survival in the new millennium.

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