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EMERGING ISSUES IN SCIENCE AND TECHNOLOGY FOR AFRICA'S DEVELOPMENT

Science, Technology and Innovation for Meeting Key MDGs

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Emerging Issues in Science and Technology for Africa's development [(1)]

I. INTRODUCTION

The Challenges of the Millennium Development Goals

1. Achieving the Millennium Development Goals (MDGs) and sustainable development in Africa constitute major challenges including poverty reduction, food security, health, water and sanitation, productivity and international competitiveness. Africa is largely failing to meet these challenges, which cannot be met without a much greater use of science and technology, which in turn requires strengthened scientific, technological and innovation capabilities on the African continent.

2. Modern developments in agriculture, medicine, industry, communications and materials are driven by science. Science is one of the most productive systems created by man, resulting in unprecedented progress – both material and social - for those societies that have embraced it as the major engine of growth and incorporated it into their own economies, cultures and traditions (Salam, 1989). In contrast, the majority of African countries which have not taken this conscious step have remained stagnant in their social development and have even deteriorated in their economic progress.

3. How can Africa benefit from advances in science and technology, both global and local, in order to develop, transform and modernize, and to create better, more sustainable livelihoods as other societies have done? What strategies, policies, capacities, institutions, programs and projects must be put in place? And how can ECA help African member States harness science, technology and innovation to meet these above challenges?

4. A new scientific, technological and innovation regime is required for meeting these daunting challenges. This new regime raises difficulties that are so complex, severe and pervasive that the most effective strategy to address them is to make progress simultaneously on many fronts. Indeed, the underlying principles of the sustainable development paradigm, which underpins development goals and strategies, call for policies that are, among other things, 'greener' or pro-environment, pro-poor and pro-innovation. On the other hand, Africa's integration into the global economic system

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1 -This report draws on work carried out by ECA in the last two years, including the following reports:

- UNECA. 2003. The State of Food Security in Africa: Progress Report, Third Meeting of the Committee on Sustainable Development, Addis Ababa, October.
- UNECA. 2003. Towards a Green Revolution in Africa: Harnessing science and technology for sustainable modernization of agriculture and rural transformation (SMART/AGRI).
- UNECA. 2003a. Report of the *Ad Hoc* Expert Group Meeting on Science and technology: Towards a Green Revolution in Africa'.
- UNECA. 2003b. Report of Workshop on Identification and Assessment of African Green Revolution Indicators and Design, Kampala, Uganda, 8-12 December.
- UNECA. 2004. Principles, methodology and strategy for promoting a Green Revolution in Africa: A Design and Training Manual (unpublished).
- UNECA. 2004a. Report of the Ad hoc Expert Group Meeting on Science and Technology Issues: Principles, methodology and strategy for promoting a Green Revolution in Africa, Addis Ababa, Ethiopia, 16-18 November.

requires policies that foster international competitiveness and greater participation of the continent in the world trading system. Progressing simultaneously in many areas of science and technology policies in order to achieve sustainability and competitiveness appears to be the most viable strategy available to African policy makers at this particular juncture.

The poor state of Africa's science and technology

5. The United Nations Development Program (UNDP) has produced a technology achievement index which measures technology creation, technology diffusion and the human skills that go with harnessing technology. The index rates Africa poorly. Of five categories, no African country is in the highest two. Four are in the middle category, five are in the second to bottom category, described as "marginalized" technologically, and the rest---the other 46 African countries---are in the bottom category, tagged "below marginalized".

The need for a new scientific and technological regime

6. African countries must improve their competitiveness not just by relying on their low labour costs, but also by improving their technological levels. In short, harnessing science and technology is the key to facilitating the transition to sustainable development.

7. Science and technology have become pervasive in all sectors of human endeavour. They shape the way we grow our food and eat it, the way we dress, the way we travel, the way we learn and work, the way we communicate, and the way we make war and peace. In the last century alone, science and technology generated more knowledge than in all the epochs of human existence put together. Hundreds of millions of people have already enjoyed the fruits of this progress in enhanced health, education, life expectancy, reduced maternal mortality, labour saving, and entertainment.

8. And yet this may only be the beginning. The line between science and science fiction is becoming blurred, and non-experts can only watch with awe. In the 20th century, humans were intelligent observers of nature. In the 21st century, humans are changing nature. In the 20th century, humans depended on natural resources for wealth. In the 21st century, they create wealth by mastering the three revolutions of physics, information intelligence and biomolecular science, and the way they converge.

9. The quantum leaps of the 20th century will accelerate more rapidly in our own time. New discoveries (science), and their applications (technology), are going to drive agriculture, medicine, income growth, and new materials in ways that can barely be imagined. Fearless forecasts predict that by 2020 we'll have computers that we can wear, cars that can see, precision agriculture, health implants, and bionics. The creation and manipulation of intelligence on demand will become possible. The awesome, almost frightening, ability to repair and manipulate life will also become possible. Crops that produce greater yields have been developed and soon those crops will resist pests and diseases while offering positive nutritional, health, and environmental attributes. In the 20th century, ways to curtail mother-to-child transmission of

HIV/AIDS and to slow down the virus with anti-retroviral drugs have been found. In the 21st century, it is not unrealistic to expect that a potent vaccine could soon be developed against HIV and other diseases, which decimate Africa's human capital.

10.There is also a need to attach special importance to innovation in the area of Green Revolution technologies and other related technologies, including GM seed technology, irrigation technology, biofertilizer and biopesticide technology, storage technology, food processing and packaging technology and a host of other supporting technologies. Sustainable development in Africa cannot be achieved without realizing the Green Revolution. New biotechnological development must also contribute to improving animal breeding and animal health.

11. What Africa needs is nothing less than leadership and democratization. If the region is going to truly mobilize science and technology for sustainable development, all key stakeholders must be involved in both policy formulation and implementation. That's the way to avoid academic and elitist policies. That's the way to define and strengthen the role of public institutions, international partners, universities, NGOs, women organizations, civil society and the private sector. And that's the way to ensure that policies are tailored primarily with a view to meeting the specific needs of end-users and clients.

The need for an African Green Revolution

12. The most fundamental development challenge in Africa today is the attainment of food security and the reduction of poverty. In this regard, the data are both dispiriting and embarrassing. With 4 out of every 10 people living on less than US$1 per day, Africa is the poorest continent, despite being one of the most richly endowed. The continent includes 25 of the world's 30 poorest countries, and sub-Saharan Africa is host to 32 of the 48 least developed countries. Worse, poverty is gaining in importance. Indeed, the number of Sub-Saharan Africans currently living below the poverty line (over 180 million people) is expected to exceed 300 million by 2020; these are people without adequate access to food, housing, education and health care. Overall, while the world may meet the MDG of cutting the proportion of people living in poverty from 22 percent today to 11 percent by 2015, Africa will likely be stuck at around 37 percent---more than three times the projected global average.

13. Without any question, the key to reversing this trend is to recapitalize and develop agriculture and industry through science, technology and innovation and through the realization of a Green Revolution. African agriculture displays the lowest yields in the world. Less than 6% of Africa's arable and permanent cropland is irrigated, compared to an average of 33% for Asia. The data are even worse for sub-Saharan Africa. It's only too obvious, then, that African agriculture has failed to keep pace with human population growth and in most cases, it has actually under-performed the pre-independence period. African industry, on the other hand, is weak, composed of mainly micro and small enterprises, largely informal and its future development is constrained by a highly competitive industrial China.

14. Sub-Saharan Africa is the only major developing region where per capita food-grain

output has declined over the last four decades. In the few cases where high per capita production is observed, growth is mostly a result of area expansion, with yield increases accounting for less than 2 percent. Overall, to underline this unhappy reality, Africa today depends on imports for 25 per cent of its food grain requirements.

15. The very spatial distribution of population and poverty and the structure of the majority of African economies are the other reasons Africa must fight poverty through a Green Revolution. Despite the exponential population growth in most African cities, three out of four Africans still live in rural areas. Some 70 percent of all poor Africans are rural and, despite rapid urbanization, it is expected that a majority of the poor will still be rural in 2020.

16. Directly or indirectly, the income and livelihood of almost the entire rural population depend primarily on agricultural enterprises. On top of this, urban poverty and rural poverty are inter-linked with rural-urban migration. So for the majority of African households today, domestic food and agricultural production, processing and marketing remain overriding determinants of overall income, availability of, and access to, food.

17. A related point not adequately taken into account by policy-makers is that a Green Revolution cannot be realized by people who are unhealthy and who must spend large proportion of their incomes and time fighting old and re-emerging diseases that are savaging the workforce and are directly affecting food security throughout the continent. To improve agriculture, in other words, it is imperative to combat ill health.

Science, technology and globalization

18. Given the small size of many of its economies and given its weak capacity in technology, Africa needs to be more effectively integrated in the global trading system in order to take full advantage of larger and more dynamic markets, including technology markets. Developing countries that have integrated effectively into the global economy have done so through outward and forward oriented and market friendly policies that allow them to benefit from increased competition, foreign investments, technological innovation, cheaper imports, larger export markets and expertise of expatriates.

19. Nonetheless, the integration of the least technologically developed countries, of which more than thirty are African, remain problematic in the absence of special assistance. A special effort must be made to shape technological development for increasing Africa's participation in the global economy. So far, Africa has not been able to harness its vast natural resources and biodiversity potential, which is presently challenged by important scientific and technological developments occurring outside the African continent. These advances are rapidly transforming international trade and the way business is done.

20. Technological innovation is a chronic disturber of traditional comparative advantages and the rules of the game are rapidly changing. The emerging trends have far-reaching implications for Africa's sustainable development and competitiveness. Global firms are steadily upgrading their technological capacity and performance and progressively raising entry barriers to new entrants. In this process, inefficient producers are often squeezed out. Africa's

competitiveness in its traditional areas of comparative advantage is eroding. This is well documented: the continent's share of global export trade fell from 5.9% in 1980 to less than 2% at the end of the 1990s, while sub-Saharan Africa's market share of global manufacturing value added (MVA) was halved from 0.6% in 1970 to a low 0.3% in the 1990s. Globalization and liberalization compel companies to compete not only in foreign markets in order to prosper, but also in their own national markets. Africa, therefore, needs to act promptly to counter the possibilities of this double - internal and external – squeeze.

21. The weak scientific and technological capacities of African countries are at the core of the erosion of competitiveness of the continent. Indeed, Africa is almost invisible on the world research map as it accounts for a tiny fraction of the world's research and development effort. Investments in technological acquisition and innovation are also extremely low. This impairs the continent's capacity to utilize and transform its natural resources. It also limits possibilities for forward and backward technological linkages and constrains its capacity to diversify away from its traditional exports and exploit its rich biodiversity.

22. The abundance of natural resources and low-cost labor do not necessarily constitute, in itself, decisive comparative advantages anymore for the continent, as the parameters of international competitiveness are more and more science and technology-based. Indeed, the entire technological landscape of the world is witnessing significant transformations, revealed dramatically by the growth of knowledge-intensive and high technology products and trade in these products, with substantial research and development inputs and innovation efforts.

Protection of Intellectual and Biodiversity Capital

23. Harnessing science and technology for sustainable development requires protection of intellectual capital and access to technology, which are governed by a number of complex international agreements, including a number of new ones. These include the Convention on Biodiversity, which, in its Article 8, recognizes explicitly the importance of traditional knowledge and creates a framework for ensuring that local people share the benefits arising from the appropriation and use of such knowledge and of the biological resources of their environment. Plant breeder's rights and farmer's rights are equally recognized in the Convention. These resources are of great importance for Africa's sustainable development and they must receive adequate attention. Plant varieties, which are protected by the International Convention for the Protection of New Varieties of Plants (UPOV) and the International Undertaking on Plant Genetic Resources (IUPGR), constitute unique instruments from which Africa can strengthen its capacity in science and technology.

24. In addition to national political sovereignty, these instruments give countries sovereign rights over their genetic resources and traditional knowledge. Moreover, a model law on community rights and access to biological resources has also been prepared under the auspices of the African Union. The African Model Legislation for the Protection of Rights of Local Communities, Farmers, Breeders, and for the Regulation of Access to Biological Resources aims at establishing a framework for national laws to regulate access to genetic resources. Although the model law has been severely criticized for putting African countries on

the defensive and for being too complex and cumbersome for countries at an early stage of development, it can be useful for grasping the issues at stake.

25. All these instruments provide standards, norms, guidelines and options, which African countries can rely on for protecting their indigenous knowledge, technological know-how and biological resources, which can be used in many instances as a springboard for economic growth and sustainable development. ECA encourages African countries to avail themselves of these instruments.

26. The significance and importance of these instruments were discussed at a recent meeting of Experts held at ECA, from which it clearly emerged that African countries need to increase their capacity to deal effectively with the complex issues facing them in this area. There is a great deal of debates on how best African countries can, at the same time, benefit from and respect property rights on intellectual and genetic capital. This is an important policy area for potential help through the NEPAD, in collaboration with other partners, such as the World Intellectual Property Organization (WIPO), the African Regional Industrial Property Organization (ARIPO) and the *Organisation Africaine de la Propriété Intellectuelle* (OAPI).

27. In any case, to acquire the scientific knowledge and technology required for a new technological regime, Africa will have to strengthen its capacity to use wisely a mix of channels, including copying, imitating/duplicating, intelligence gathering, reverse engineering, licensing, FDI, partnering, networking with the Diaspora, overseas studies, technical assistance and international and regional cooperation.

28. With regards to trade and technology, the Doha Ministerial Declaration recognizes the special structural difficulties that least-developed countries (LDCs) face for their effective inclusion in the global economy and it commits World Trade Organization (WTO) member States to improve their participation in the multilateral trading system. This involves negotiations and requires actions for which there is a crying need for increased technical capacity in Africa. With January 1, 2005 set as the completion date for most of the negotiations, the quality, content and intensity of technical assistance provided to African countries in the coming months will be critical for the formulation of effective and equitable positions, policies and strategies, including those relating to various aspects of technology, such as trade-related and intellectual property rights.

Science popularization and technology diffusion

29. There is a need for a “democratization” and “domestication” of science and technology. All key stakeholders must be involved, through national dialogues, in the policy formulation and implementation process, so as to transcend policies that tend to be too narrowly focused on a few number of isolated, ill-equipped and underpaid researchers and academicians. This will contribute to moving away from “elitist” policies, and to defining and strengthening the respective role of public institutions, international partners, universities, NGOs, women organizations, civil society and the private sector. It would also ensure that policies are tailored primarily with a view to meeting specific needs of end-users and clients. In this regard, the fight

against illiteracy should also aim at giving girls and boys the same chances of being empowered through science and technology.

30. Various means should be promoted to reach all the relevant science and technology stakeholders, such as radio programs on relevant science and technology for the farmers, media training for scientists, public libraries with an emphasis on science and technology, booklets and other printed materials, schools science days, inter-schools science competitions, public lectures, science fairs, academies and associations, adult education, demonstration centers, national merit awards in science, science quizzes, science newsletters, exhibitions, science clubs, science festivals, etc.

Political Commitment and Policy Integration

31. The new and strengthened technological regime requires strong political leadership and a better integration of science and technology and innovation policies -- which are cutting across many sectors -- with overall development policies, including economic, financial, budgetary, fiscal, labour, agriculture, industry, micro-enterprises development and others.

32. This has far-reaching consequences for policy-making, as it implies that science and technology should move from the periphery to the center of the development policy processes and pervades all relevant policy areas impacting on the development and utilization of science and technology. Success in this realignment and 're-centering' requires strong political commitment vis-à-vis science and technology and the full engagement of the science and technology community, as experienced by ECA through its support to the former Presidential Forum on Science and Technology.

33. This 're-centering' may be facilitated by the setting up or strengthening of Parliamentary Committees on Science and Technology (PCST) – already in existence in a few African countries – such as South Africa, Uganda, Nigeria and Kenya. It may also be facilitated by the appointment of high profile and highly credible and respected science and technology advisors to the President. The creation of Interdepartmental Science and Technology Fora (ISTF), comprising science and technology focal points of various ministries and governmental institutions dealing with issues related to science and technology may also be useful in "demonopolizing" science and technology responsibilities and in bringing science and technology issues to the center of the development policy process. ECA is encouraging the diffusion of these best practices throughout the continent.

Innovation Infrastructure and Capacities

34. Africa's sustainable development depends more and more on its capacity to find innovative solutions to its particular problems, including in the area of food, and to produce and market competitive and innovative products and services. In this regard it is important to put in place policies that will reinforce National Systems of Innovations (NSI), by filling gaps in the

systems and by strengthening interactions between critical elements of the systems. Entrepreneurial capacities should be reinforced, inter-firms partnerships should be encouraged and linkages between the public and the private sectors should be strengthened. In this regard ECA has completed a study on best practices in this area and will encourage and support African countries to undertake such studies in their respective countries. The lack of technological innovation in African countries explains to a large extent the lack of competitiveness and the stagnation of their economies.

35. The new technological regime calls for special attention to be paid to key areas such as agriculture, industry, energy, and water. In these areas, the generation of new knowledge, the development of new technologies and the promotion of innovation are crucial for achieving food security, diversifying manufactured products, reducing poverty and protecting the environment and the natural resources base.

36. In this regard, ECA is in full support of the New Partnership for Africa's Development's (NEPAD) commitment to creating sub-regional Centers and Networks of Excellence for higher education and research, with a view to promoting science and technology in areas and niches of high priority for sustainable development. Useful can also be the experience of ECA in initiating or sponsoring the creation of more than a dozen regional technology centers in Africa. As half of these centers have been unsustainable and had to be closed down or merged with other centers, sustainability must remain the main concern in creating any new sub-regional institutions.

Policy-Making and Human Resources Development

37. A renewed STI regime also requires the strengthening of science and technology policy-making and development institutions. These institutions are weak in many African countries, particularly the smaller ones. Here again, within the framework of NEPAD, ECA could contribute to improving the situation. Countries like Eritrea, Chad, Mauritania, Liberia, Sierra Leone, Gabon, Libya, Djibouti, Swaziland, DRC, Angola, Gambia and many others could benefit from a program that addresses institutional capacity gaps for science and technology policy formulation and implementation. STI policy and operational institutions that were created in the 1960's and 1970's with the assistance of ECA need to be reviewed in light of the new challenges of globalization and technological innovation.

38. The new STI regime requires the development of adequate human resources and the development of an appropriate knowledge base to shoulder an open economy competing on the world market. Addressing brain-drain issues and taking advantage of the Diaspora is also necessary. Some African countries may also consider easing immigration regulations and procedures in order to facilitate the mobility of international experts, in particular, African expatriates.

II. AFRICA'S RESPONSE

Science and Technology Systems: Challenges of Structure and Capacity

39. Africa's efforts to build endogenous science and technology systems for the service of her people continue, with limited success. Recent statistics show an Africa with extremely low capacity indicators in science and technology (DST 2005).

40. From the 1970s, aided mainly by UNESCO and UNECA through the CASTAFRICA Process, African countries have created science and technology policy and management institutions (Jugessur 1990). Starting with National Research Councils, some have upgraded through National Councils for Science and Technology, Commissions (some at cabinet level), and finally some to Ministries of Science and Technology, indicating maximum integration of science and technology in the development process. Nine countries have also developed academies of science, which, with the recent focus of the UN (Juma, 2004) and the Bill and Melinda Gates Foundation (2005), may well develop the science and technology advisory function to a new level in Africa.

41. The main policy challenge for African S&T is that it is too elitist, focusing on the minuscule science and technology community and not on the mass modernization of the 80% of the population, which is rural.

Research and Development

42. Very little R&D capacity exists in many sectors except agriculture. Many African indigenous food crops and animals, on which over 80% of the Africa population depends, have reaped few benefits from modern R&D on their breeding improvements, agronomy, processing and commercialization. Great untapped opportunities await Africa in this field. The African Green Revolution Initiative, could offer new hope in this regard. There is very little industrial R&D in Africa, with less than 10 countries having serious institutions in this sector. The effort of Zimbabwe in building the SIRDC in the 1990s, the Kenya Medical Research Institute (KEMRI) and the Technopole in Senegal stand out as important developments.

Capacity and the Brain Drain

43. Because of low training capacity both in human and institutional resources such as small, outmoded laboratories, a large proportion of African S&T experts are still trained outside Africa, making them vulnerable to possible brain drain. Millions of African science and technology experts are known to be working in Western countries as part of this brain drain, while Africa employs at least 100,000 expatriates at a cost of US$ 4 billion per year (UNECA, 2000).

44. Lack of capacities pervades all parts of the African S&T system. Predatory recruitment raids by developed countries, such as that of UK on doctors and nurses from English-speaking African countries such as Zimbabwe, do not help. Some countries, including Uganda, are attempting to build up their scientific capacities by giving preferential scholarships to science students, and by retaining scientific manpower through the payment of higher salaries/wages to scientific workers.

45. Africa should look more at how it can utilize the African Diaspora to improve her lot. Challenges include how to mobilize the Diaspora to make a contribution to Africa's development, using their considerable intellectual and financial resources. Opportunities and innovations in this area remain to be harnessed.

46. In this area, ECA is promoting the UN Intellectual Capital Fund for Africa (UNICFA), a proposed superfund mechanism targeted at facilitating participation of the African Diaspora in Africa's development. The UN S&T cluster would help formulate it in collaboration with NEPAD, African Academy of Sciences (AAS) and the Inter Academy Council.

Fascination with South Africa

47. The African S&T community remains fascinated by post-apartheid South Africa. A free South Africa has inherited a modern scientific, technological and innovative system, in contrast to most African countries, who inherited a 1960s platform which they have barely improved upon. The strength of the South African system could be used to uplift the rest of Africa through judicious and negotiated partnership and collaboration.

International and Regional Cooperation

48. There is no doubt that most African countries have so far been too weak to design, construct and run viable science and technology systems. They thus recognize the need and opportunities that may accrue from regional approaches. In all areas of S&T national and regional professional associations have been formed but have generally been weak. However, they present a basis for possible regional strategies for development of collaborative programs that would be effective regionally.

49. There is much to be gained by liaising, networking, partnering and collaborating with industrialized, industrializing and developing countries. ECA is making notable efforts in this regard, through proactive interactions with a number of international organizations and partners, including the G8, so as to raise significantly the profile of Africa on international agendas. Official Development Aid (ODA) and technical assistance should be geared toward strengthening science and technology capacities in African countries. This is an area where progress is called for.

50. As all policymakers know, one of the most stubborn issues in science and technology development is the low level of national resources, which are far too insufficient to create critical masses of national expertise in a given area. Here, sub-regional and regional cooperation and integration are essential as much is to be gained by sharing markets and scientific and technological assets, including in the areas of training, research and demonstration, which cannot always be viable at national levels.

51. In the area of regional cooperation and integration, ECA provided support for the NEPAD Science and Technology Plan of Action adopted in November 2003 in Johannesburg. The plan contains a priority set of flagship programs spanning biotechnology, ICT, energy,

materials, manufacturing, space, water, food technology and desertification. The Plan also has a robust governance structure and management ethos, steered by a Ministerial Council (AMCOST) that reports to NEPAD Heads of State.

52. ECA is participating in the UN Science and Technology cluster for NEPAD whose agreed areas of focus include technological entrepreneurship in higher education institutions, engineering education, African Green Revolution, UN-Biotech/Africa, and Centres of Excellence mapping.

53. ECA is also supporting the African Science Foundation (ASF) – a proposed high-level, continent-wide organ of science, technology and innovation policy, review, advice and grant-giving foundation, similar to the US National Science Foundation (NSF). The UN Science and Technology Cluster would help formulate ASF in collaboration with NEPAD, African Academy of Science (AAS) and the Third World Academy of Science (TWAS).

Monitoring

54. Better mechanisms need to be developed and implemented to monitor science, technology and innovation, using internationally agreed standards and methods. This is also an area where NEPAD could be active, given that current indicators and statistics on science and technology capacity, research and development, innovation and technology flows, are inexistent, poor or totally unreliable for many African countries. NEPAD has initiated an Observatory on African Science and Technology, while ECA monitors progress through its ECA Network for Science and Technology (ESTNET, www.uneca.org/estnet) and is soon to launch an African Green Revolution Monitor.

Way Forward: Leadership Challenges

55. Africa cannot afford to miss the opportunities that science and technology are now offering. It must move from promises to practice, from commitments to concrete projects, from intentions to implementations.

56. Most analysts agree that the main problem of African science and technology is leadership. At national level, the long drawn out instability of many African governments left little breathing space to build and utilize proper science and technology systems and strategies. There were the “lost decades” (roughly 1975-1995) when mediocre leaders suppressed and undervalued S&T experts, saying *Maprofesa ni nini kwetu sisi*? - (Swahili: what are professors to us?) But in recent years, better governance and the establishment of NEPAD may be making a difference. Furthermore, science and technology experts are starting to appear in parliaments, cabinets, State Houses and the AU. In these positions of power, they assist in articulating visions, mission statements, business plans and timelines for S&T, and in producing strategies and policies that can help move the continent forward.

57. In a handful of countries, the S&T structure is almost complete and the capacity

sufficient to cause some modernization. But some gaps must be filled and the S&T engine must be reoriented to be more effective.

58. At the continental level, a few African countries, mainly the "Big 5" NEPAD pioneers (Algeria, Egypt, Nigeria, Senegal and South Africa), with a handful of others following in their wake, have enough capacity to take leadership and help the rest in growing and applying S&T for development. This prime mover model needs further exploration and operationalization.

III. INTERNATIONAL RESPONSES

59. Being the most underdeveloped continent, African science and technology has in the last two years featured highly as an international focus of concern. Two major studies by the Inter Academy Council have made major proposals on how Africa can build its scientific and technological capacity (IAC 2003) and how to apply science and technology to increase agricultural productivity through a "rainbow revolution" (IAC 2004). The Report of the UN Taskforce on Science, Technology and Innovation (Juma 2004) and the Report on "Africa's Green Revolution: A Call to Action" (MDG Technical Support Centre 2004) contain numerous pointers for Africa. Yara Foundation of Norway has established a Prize to highlight and promote the African Green Revolution. The first African Green Revolution Yara Prize has just been won by Ethiopian Prime Minister, Meles Zenawi.

60. The ideas contained in these and other initiatives have already been taken up for endorsement in the UN General Assembly process through the Secretary General's restructuring proposals (UN 2005), and also to the tables of the G8 through the Commission for Africa. What remains is for Africa to follow up with concrete proposals for implementation.

IV. ECA's WORK IN SCIENCE, TECHNOLOGY AND INNOVATION

61. As indicated in some of the above sections, ECA's work in S&T proceeds along the lines of ECA's overall approach to Africa's development, namely policy analysis and advocacy, awareness raising, and capacity building and advice. Programmatically, ECA is concentrating on three themes: science, technology and innovation (STI) policy; the African Green Revolution; and biotechnology.

62. **Science, technology and innovation policy**: ECA continues to advise African countries on building up the structure and capacity of their science, technology and innovation systems. Current thrusts include participation in the restructuring of the Nigerian STI system; Rwanda's S&T policy renewal initiative; and South Africa's system of Human Resource Development for Knowledge Production. At continental level, ECA played a key role in the process of establishing NEPAD's S&T Plan of Action in November 2003. ECA keeps in touch and collaborates with scientific communities, e.g. through its membership on the governing council of the African Network of Scientific and Technological Institutions (ANSTI). Within the

UN, ECA played a leading role in establishing the UN S&T Cluster for the support of NEPAD and is currently the vice-convenor. ECA also participates in the UN Commission for Science and Technology for Development (UNCSTD), the highest UN system-wide policy making organ for S&T.

63. **African Green Revolution:** Following the 21 February 2003 call by UN Secretary General to African countries to promote a Green Revolution, ECA has vigorously promoted an African Green Revolution Initiative as an S&T platform for sustainable modernization of agriculture and rural transformation (SMART). ECA has developed a strategic roadmap for this promotion, involving mobilization of multiple stakeholders. Activities within ECA have included studies, expert group meetings and a Field Project. ECA's SROs, notably SA-SRO and EA-SRO, have joined the promotion. Outside activities have involved outreach and collaboration with other players, most notably ECOSOC, UNU/INRA with joint ECA/UNU Lectures, and the Japanese Foundation for Advanced Studies in International Development (FASID).

64. **Biotechnology:** In this biennium, promotion of biotechnology has moved rapidly by being put on the regular work program of ECA. Activities include group training on intellectual property and biosafety issues. ECA is also participating actively in the Interagency Network on Biotechnology.

Achievements and Impacts

65. In STI policy, ECA is recognized as a knowledgeable contributor and facilitator of high-level visioning, strategic planning, policy-making and advice. Participation in the establishment of the NEPAD S&T Action Plan, where ECA commissioned key expert inputs, was significant. Invitations to participate in the review and restructuring of the S&T systems of Nigeria, Rwanda and South Africa are also key instances.

66. On the African Green Revolution, ECA's main achievement so far is its influence on shifting the global discourse on the Green Revolution and Africa, from: "Oh, poor Africa missed the Green Revolution" to "It was merely delayed; how can we design a GR for Africa?" The other is leading the design effort through producing a Design Manual and facilitating the emergence of African Green Revolution Design Teams in Uganda and Tanzania, who are already applying elements of the Manual. In Uganda, Kenya, Angola, South Africa, Ethiopia, Zambia and SADC, African Green Revolution concepts are being incorporated into policies, strategies, agendas, plans and programs for sustainable modernization of agriculture and rural transformation (SMART). Further proposals are in progress, notably to the Development Account and the Commission for Africa.

V. ISSUES FOR DISCUSSION AND COMMITMENT

67. The following questions are suggested for additional comments:

- How can African member countries build up their science, technology and innovation

systems and capacities in order to meet the MGDs?

- How can African countries participate in the NEPAD S&T Action Plan?
- How can African countries put the African Green Revolution on their development agenda?
- How can ECA improve its promotion of science, technology and innovation for achievement of the MDGs and sustainable development?
- How can Africa's development partners better assist Africa in science, technology and innovation?

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