2013 ECOSOC Annual Ministerial Review

Regional Preparatory Meeting for Africa

"Innovation as Enabler for the Achievement of the Millennium Development Goals (MDG) and Sustainable Development"

BACKGROUND NOTE

This paper draws extensively from the work of GetachewMengistie, IP consultant & Attorney and Prof. NyasseBarthélemy, University of Yaoundé I,in the paper they prepared entitled "*Innovation and IP in Africa: The Role of IP in Supporting the Objectives of Fostering Science, Technology and Innovation for Africa's development*" and presented at the WIPO Conference The African Conference on the Strategic Importance of Intellectual Property (IP) Polices to foster Innovation, wealth creation and Competitiveness", on March 12-13, 2013 in Dar esSalaam, Tanzania. The work of the UN System Task Team on the Millennium Development Goals and post-2015 Development Agenda is also acknowledged.

I- Introduction

At the summit of the African Union in 2007 the then Malawian President BinguwaMutharika said that the only sure way to break the long standing cycle of extreme poverty that has gripped the African continent for so long was to build capacity in science and technology. "We have depended on donor countries for scientific development for so long . . . It is time we committed more resources in our national budget to advance S&T."

The innovation and technology challenge for Africa is more acute, more urgent and more critical than elsewhere. Here, addressing the challenges of achieving the Millennium Development Goals (MDGs) and sustainable development facing the continent with the transformational power of the application of new ideas is both an opportunity for rapid change, as well as an urgent necessity. As we stand on the threshold of a new phase in the global approach to development we should reflect on how to align policy interests around the goals that we seek to achieve. What is the role of science, technology and innovation in achieving the development goals of Africa? How do we ensure the adequate support and incentives systems are in place to deliver the benefits of innovation?

II- Science, Technology and Innovation for Promoting Sustainable Development

Creativity and innovation, as the basis for strengthened science, technology and innovation frameworks are essential to tackling the key challenges facing us in the future - global growth, health, the environment and food security. Innovation is a central driver of economic growth, development, and better jobs. It is one of the key factors that enable firms to compete successfully in the global

marketplace, and the process by which solutions are found to social, environmental and economic challenges.

Innovation is important not only to the economic dimension of development, but also in terms of its social and environmental benefits. Innovation helps to share information, provides new adapted solutions and supports value creation and competitiveness. Greater innovation canaccelerate progress on the MDGs and become an important elementinthe post-2015 development agenda, given its impact on key areas such as poverty eradication, food, water and energy security, public health and education, and environmental sustainability.

Innovation also acts as a 'fast-forward' mechanism that allows countries and people to benefit from what has already been learned and discovered to progress and meet their needs ever more sustainably. Innovation also has the capacity to respond to very specific national needs while at the same time drawing from global advances in knowledge so it helps break down development gaps. This makes science, innovation and technology the keystone of sustainable development strategies.

Mobile phone technologies are a typical example of an innovation that has helped 'jump' ahead and facilitate the lives of millions.For instance, the rapid growth of mobile banking in certain African countries is a powerful driver of future growth. The strength of mobile banking in Kenya is well known. However, mobile banking has also expanded in other countries.More than 50% of adults in Sudan and Gabon report using a mobile phone for money transactions, and more than 25% of adults in Republic of Congo, Somalia, Uganda and Angola.[1] Furthermore these rates of use of mobile banking services are rising rapidly across the region.

III- Local Knowledge, Innovation and Sustainable Development in Africa

Changing trends in innovation, with emerging economies and developing countries increasingly becoming innovation incubators, mark a significant opportunity for Africa. Strong innovation in the region can help support regional development priorities but supporting African innovation can also make the region a hub of solutions for other regions facing similar issues.

Current evidence shows that while there is significant innovation potential in Africa, it is not well realized. The picture is however complex, as data may only capture certain forms of innovation and not be able to render an accurate picture of what may be happening in all sectors, or for all forms of innovation, in particular that which is not the product of formal scientific processes. It also does not necessarily take into account the innovation that countries may benefit from but which is not originating from Africa. This is important as it affects the understanding of what innovation is available to entrepreneurs, governments, students and others in their undertakings.

However, this gap between the potential for innovation and what is realized is in fact an opportunity – one that requires realignment and strengthening of innovation systems, a supportive environment and strong national and regional strategies.

Robust data on innovation is not abundantly available and what evidence is available suggests that levels of innovation in Africa are relatively low. The UNESCO Institute for Statistics (December 2011) suggests that R&D intensity in Sub-Saharan Africa (excluding South Africa and Tunisia) is less than 0.4% of GDP – very far from the level recommended by UNESCO. Further, only a very small proportion of the R&D expenditure is directed to infrastructure, including laboratories and journals. Despite the importance of science and technology for the development of Africa, in 2000 Africa as a whole accounted for less than 1% of the world's expenditure on R&D.

Figures also point out to regional specificities in terms of how R&D investment is structured. The 2010 African Innovation Outlook noted that over 50% of R&D is done in the public sector in Africa, a pattern that is different from other regions. It also noted that in most cases, most of R&D funding was from government sources and foreign donors. In the face of budget constraints for governments,

[1] http://siteresources.worldbank.org/EXTGLOBALFIN/Resources/8519638-1332259343991/world_bank3_Poster.pdf

understanding how other sources of investment can be brought to bear could be an avenue to increase R&D activity and investment in the region.

Sub-Saharan Africa produced only 11,142 scientific journal articles in 2008, placing the continent bottom of global scientific production. Of these, South Africa produced almost half (46.4%), followed by Nigeria (11.4%) and Kenya (6.6%). In other words, these three countries alone accounted for about two-thirds of Africa's output of scientific articles.

Table 1. Patents/Publications/R&D expenditure

Country	Publications in 2008	Patents to African inventors by USPTO in 2008	GEDR (%GDP) in 2008	Military expenditure (%GDP) in 2008
Benin	153			1
Botswana	138		0.5	3.5
Burkina Faso	179		0.1	1.8
Cameroon	463		0.1	1.5
Cote d'Ivoire	171		0.1	1.5
Ethiopia	364		0.2	1.5
Gabon				1.1
Ghana	264			0.7
Kenya	763	4		1.7
Madagascar	141		0.1	1.1
Mauritius		1		
Nigeria	1869			
Senegal	211		0.1	1.6
South Africa	5248	134	0.9	1.4
Tanzania	376			0.9
Uganda	354		0.4	2.3
Zambia	121			1.8
Zimbabwe	194	4		3.8
Egypt		2		
Morocco		4		
Tunisia		2		

Table 2. Applications by geographical region 2010

	% IP			
Region	**Trademark**	**Patent**	**Industrial designs**	**Utility model**
Africa	2.3	0.6	0.7	0.02
Asia	41.1	51.3	81.8	88.5
Europe	35.6	17.4	9.1	10.5
Latin America & The Caribbean	9.5	2.6	1.9	0.7
North America	9	26.6	5.1	
Oceania	2.5	1.6	1.1	0.3

Looking at innovation more broadly, African performance also compares unfavourably with the rest of the world. The Global Innovation Index, co-published by INSEAD and the World Intellectual Property Organization takes a broad view of innovation as driver of economic growth and prosperity and includes indicators that go beyond the traditional measures of innovation. These broader measures,

such as institutions; human capital and research; knowledge and technical; outputs; and creative inputs; also indicate a low base for science, technology and innovation in the African continent.

Table 4: Heat map for GII regional group averages (0–100)

Regions	GII	Institutions	Human capital & Research	Infrastructure	Market sophistication	Business sophistication	Input	Knowledge &Techn. outputs	Creative inputs	Output	Efficiency
North America	57.3	90.05	53.28	55.64	77.63	58.65	66.05	51.22	45.94	48.58	0.74
Europe	47.93	72.69	48.89	47.73	48.73	47.07	52.95	43.03	42.78	42.91	0.81
South East Asia & Oceania	41.16	60.33	39.46	41.93	51.30	47.45	48.09	35.96	35.51	34.23	0.71
North Africa & Western Asia	35.96	58.56	40.18	35.55	39.40	39.01	42.54	26.97	31.80	29.39	0.69
Latin America & Caribbean	31.84	48.96	29.16	35.51	34.96	38.52	36.82	21.44	32.89	26.87	0.73
Central & Southern Asia	27.60	41.85	27.13	27.36	32.05	32.19	32.12	23.52	22.65	23.09	0.73
Sub-Saharan Africa	26.16	47.77	24.17	21.65	29.12	32.76	31.09	20.39	22.11	21.33	0.69

However, within Africa the GII also indicates large disparities between the capabilities of different countries.

Table 3: African Innovation Index rankings

Country	Score (0-100)	Rank
Mauritius	39.2	49
South Africa	37.4	54
Tunisia	36.5	59
Namibia	34.1	73
Botswana	31.4	85
Morocco	30.7	88
Ghana	29.6	92
Kenya	28.9	96
Senegal	28.8	97
Rwanda	27.9	102
Egypt	27.9	103
Gabon	26.5	106
Zambia	26.4	107
Mozambique	26.3	110
Zimbabwe	25.7	115
Lesotho	25.7	116
Uganda	25.6	117
Mali	25.4	119
Malawi	25.4	120
Cameroon	25	121

Burkina Faso	24.6	122
Nigeria	24.6	123
Algeria	24.4	124
Benin	24.4	125
Madagascar	24.2	126
Tanzania	23.9	127
Gambia	23.3	130
Ethiopia	23.3	131
Cote d'Ivoire	22.6	134
Angola	22.2	135
Togo	20.5	136
Burundi	20.5	137
Niger	18.6	140
Sudan	16.8	141

While the overall position of Africa in the global innovation landscape could be improved, nonetheless there are widespread examples of creativity and innovation in the African continent that demonstrate capabilities, especially in key sectors.

Health

The African Network for Drugs and Diagnostics Innovation have mapped the landscape of African health innovation and found that capabilities in health product R&D, including commercialization, do exist.[2] Examples of the ability of African institutions to discover and commercialize new diagnostics tools or vaccines include:

- Kits for specific antibody detection for diagnosis and screening of schistosomiasis, fascioliasis and hydatidosis produced by the Theodor Bilharz Research Institute (TBRI)
- Vaccines and antivenons from VACSERA (Egypt)
- An HIV immune-enzymatic test by Camdiagnostics (Cameroon)
- Multidrug resistant tuberculosis line probe assays (MDR-TB LPA) by the University of Stellenbosch (South Africa)
- A rapid diagnosis of the rabies virus and an immunochromatographic strip for the detection of visceral leishmaniasis made by the Institut Pasteur of Tunisia
- A Heptatis B surface antigen screening test (HEPCELL) by KEMRI (Kenya)
- A visually-readable portable malaria dipstick test developed at the University of Ghana.
- A rapid diagnostic test for schistosomiasis (Noguchi Institute, Ghana),
- Some in medical devices, such as those from A to Z (Tanzania),

Agriculture

Agriculture is the largest source of employment in Africa and responsible for over half of export earnings. It underpins the livelihoods of over two thirds of Africa's poor and assumes even greater importance in Africa's least developed countries. Innovation is a priority area for the sector, in particular in the face of the increasing impacts of climate change. Several initiatives are underway to promote the development of technologies that can have an impact on productivity, livelihoods, and quality of life. For instance, the Forum for Agricultural Research in Africa (FARA) has promoted the integrated agriculture research for development (IAR4D) approach based on an innovations systems framework. This brings together multiple actors along a commodity value chain to address challenges and identify opportunities to generate innovation. The approach creates a network of stakeholders who are able to consider the technical, economic, social, and institutional and policy constraints on an environment. The network facilitates research and learning that not only generates new knowledge products of technologies but also ensures the use of research products.

[2]Nwaka S, Ilunga TB, Da Silva JS et al (2010): Developing ANDI: A novel approach to health product R&D in Africa. PLoS Med. 7(6):e1000293

Examples of agriculture innovators

Benin
One agricultural biotechnology application with promising potential is what is known as New Rice for Africa (NERICA), a new variety of hybrid rice. Scientists at the Africa Rice Center (WARDA) in Benin have created NERICA by crossing Oryzasativa (Asian rice) with Oryzaglaberrina (African cultivated rice). Farmers have been able to select new rice varieties from the resulting germplasm, with qualities such as higher yields, shorter growing seasons, resistance to local stresses, and higher protein content than traditional African varieties.

Dhlamini Z., "the role of Non-GM Biotechnology in Developing World Agriculture" Policy Brief (February 2006) www.scidev.net

Ethiopia
Among its many strengths, Ethiopia's National Veterinary Institute has the capability to study and screen micro-organisms for biological compounds that could have applications in vaccines and other therapeutic purposes. The institute produces viral vaccines against Rinderpest, Sheep-pox, Newcastle disease, African horse sickness, foot and mouth disease. It also produces bacterial vaccines against contagious Bovine pleuropneumonia, anthrax, and blackleg, among others. It has developed a recombinant DNA-based vaccine against Rinderpest in collaboration with University of California, Davis. The Institute is also a regional office for quality control of livestock vaccines for the Food and Agriculture Organization of the United Nations (BIO-EARN, Biotechnology Product Development and Diffusion in Eastern Africa: Case Studies on Product Development Partnerships.

Kampala, Uganda: BIO-Earn, 2005, www.bio-earn.org

In other sectors the application of new technologies can help to confront some systemic challenges facing many African countries. Of particular note is the application of mobile technology to the financial sector – bringing financial services to a broad cross section of the population.

Kenya
In 2007 Safaricom launched an SMS based money transfer system – M-Pesa. This allows users to load money onto their phones and then send it to another phone using a simple text message. The introduction of M_Pesa coincided with the explosive growth of mobile phone usage across many African countries. Today, nearly 70% of Kenyan adults transfer money to each other vai their mobiles – the highest percentage of any country in the world. More than $320 million are transferred in this way each month.

In addition to money transfer services, Kenyan innovators have created M-Farm, a service that gives farmers real-time information such as current market prices, weather alerts and agro supplies in their area and brings farmers together to buy and sell products in groups, helping them gain access to larger markets. Similar applications enable large groups to share information via email, social media or text message. Ushahidi was created to share crisis-related information in response to the Kenyan 2007 post-election crisis and can help to plan policy response to crisis situations

Increased efforts to better understand and measure innovation in the region could also significantly help draw a more accurate picture of the innovations taking place. Most may be occurring in the informal sector, and not be the result of formal scientific research. Innovation can take place in the field, by tweaking and changing processes and techniques, and those innovations adopted without a formal way to record this change.

Developing national and regional ability to assess innovation is thus very important so that the picture at hand can be more accurate and more detailed. African Union leaders have recently made efforts in that direction, in particular with the creation of an African Observatory on Science, Technology and Innovation (AOSTI).

IV- Traditional knowledge for inclusive innovation

There are many areas where sustainable development can be driven by traditional knowledge. Forms of traditional knowledge, codified or not, can be both transferred through customs and traditions or deeply embedded in local culture and social behaviour. As a cross-cutting and community-based driver of development, traditional knowledge can have a substantial impact on progress towards the MDGs and the integration of the three dimensions of sustainable development. This form of knowledge is often an important element of innovation, especially in the areas of health and agriculture, as it forms the basis for social perceptions which can either advance or inhibit certain aspects of development agendas. An example of this can be seen in the implications and responses to climate change.

Participatory research with indigenous communities has been carried out on the impacts of climate change and the corresponding role of traditional knowledge and related agro-biodiversity, cultural and spiritual values and customary laws in climate change adaptation. One case study undertaken in coastal Kenya provides insight into the role of traditional knowledge and traditional crop varieties in adaptation to climate change.

The findings show that the maintenance of diverse traditional crop varieties and access to seeds has been essential for adaptation and survival by poor indigenous farmers severely impacted by changes in climate, including drought, with serious consequences for crop production and food security. Traditional varieties used include maize resistant to unpredictable weather and new pests in coastal Kenya.This study highlights the close interlinkages and interdependence between traditional knowledge and genetic resources, and their role in adaptation to climate variability and change.

New technologies and traditional knowledge are not necessarily at odds but instead often can complement each other. For instance, one emerging pathway for climate change adaptation places cutting edge technologies, such as information and communication technologies (ICTs), at the service of traditional knowledge holders. These tools allow them to determine which data to collect, which questions to ask, and can guide interpretation of results. In National Parks in southern Africa, local trackers have successfully used Cybertracker, a GPS/computer device, to monitor wild game.

The aspect of cost and accessibility also plays an important role when it comes to choosing medical treatment: “More than 80% of Africans use some form of traditional or herbal medicine for their basic healthcare needs. In addition, ,” Ms Ngosi, Director of the Department of Human Resources, Science and Technology of the African Union, points out that traditional medicine is not just a makeshift treatment that African populations resort to in the absence of modern medication. “Traditional medicine is an important source of material and information for the development of new drugs,” she says. “It can significantly reduce the amount of research necessary for the development of modern medicines. According to WHO estimates, 25 % of modern medicines are made from plants first used traditionally.” This shows that where traditional knowledge and innovation go hand-in-hand, significant benefits can be achieved.

Nevertheless, harnessing the potential of traditional knowledge is not always straightforward and involves inherent risks. The main risk of harnessing the potential of traditional knowledge is the exclusion of communities from the benefits or rewards which result from the provision of their own knowledge – especially in regards to medical and agricultural products (e.g. biopiracy). Past experiences have made evident that the respective local communities must be appropriately involved in the decision-making of whether to capitalize on their knowledge or not and precisely how. Additionally, inclusion of community members in the planning and implementation processes as well as in the negotiation on the sharing of benefits is important to the continued and successful engagement of communities and their plethora of traditional knowledge.

Some countries have tried to codify traditional knowledge to prevent the filing of patents which are based upon illegally or unfairly appropriated knowledge.

In order to address the question of intellectual property rights of rights holders, particularly of traditional communities and indigenous peoples, in their traditional knowledge, genetic resources and

traditional cultural expressions WIPO conducted fact finding missions in several countries in different continents and established the WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore, in 2000. It aims at protection of intellectual property in traditional knowledge from third party misappropriation and unauthorized use on one hand and on the other to enable and offer capacity building of the rights holders to make use of intellectual property rights positively for their benefit. The IGC is promoting agreement on an international legal instrument which will ensure the effective protection of traditional knowledge, traditional cultural expressions and genetic resources.

V- The Importance of IP in Innovation Promotion and its Exploitation

While almost all African countries have laws and institutions that deal with the protection and enforcement of intellectual property rights, the contribution of IP to the development of these countries has been negligible. This is partly due to the absence of national IP frameworks, which could ensure a meaningful contribution to the realization of national development plans. That gap is now being addressed with countries such as Mozambique, Rwanda and Zambia having policies in place, and countries such as Ghana, Kenya, Malawi, Mauritius and Seychelles in the process of establishing such policies. Such IP policies can help to spur the commercialization of publicly funded R&D or at least ensure that where it is commercialized the originators have a proper reward for their inventiveness and creativity. There are a number of cases where research results generated by African public sector research institutes have been commercialized but the benefits have not flowed back to the institutions concerned because of a lack of intellectual property strategy.

Examples of commercial exploitation without benefit to R&D institutions

In **Burundi**, the Institut des Sciences Agronomiques du Burundi (ISABU) developed a new sorghum variety, which is being commercially exploited by a local brewery factory with no return to the research institute.

In **Cameroon**, the Institute of Agricultural Research and Development (IARD) reported that it generated valuable IP assets such as improved cassava variety and sweet potato, which are widely disseminated and freely used in and outside of Cameroon.

In **Uganda**, the National Agricultural Research Organization (NARO) developed a new and improved sorghum variety, which is commercially exploited by Nile Brewery to make a lager beer called “Eagle” but with no benefit to the research institute and the researchers.

Specific reference to Mengistie and Barthelmy

Furthermore, even where results have not been commercialized, disputes over intellectual property have the potential to disrupt partnerships and jeopardize research results. Having a clear IP policy in place from the outset facilitates the commercialization of results.

Partnership for HIV vaccine research: Universities of Nairobi and Oxford

In December 1999, the *British Medical Research Council* (MRC) had filed a patent on the HIV sequences used in the vaccine. It listed the Oxford researchers Andrew McMichael and Tomas Hanke as co-inventors, but no Kenyan investigator. Articles in the Kenyan press expressed concern over the issue of ownership, which affects Kenyan rights to the vaccine, and over issues of inventorship and how credit is given for the work.

In response, the three partners in the project (the MRC, the University of Nairobi and IAVI) issued a joint statement reiterating their commitment to developing an AIDS vaccine together and stating that the original patent was "filed in good faith to protect the candidate DNA vaccine from unauthorized third-party exploitation." But they also acknowledged that the formal basis of the partnership - two bilateral memoranda between MRC and Nairobi and between IAVI and MRC - was insufficient, since there were no written agreements among all three parties. That acknowledgment led to the formation of an Intellectual Property Task Force, which met in November 2000 and April 2001. The Task Force agreed that the partners should be equal owners of the vaccines and share any future revenues they generated.

Levings, B. and Kahn, P. (2001), "Phase I DNA vaccine trial begins in Nairobi." *Biotechnology and Development Monitor*, No. 46, p. 8.

While there is a spectrum of IP legal frameworks and institutional arrangements there are a number of common features. Most notably, in most cases IP offices suffer from a number of capacity related problems. Most of the offices that administer intellectual property are understaffed[3] and poorly equipped. More importantly, it should be noted that most of the IP offices in Africa are staffed with personnel who are not well-versed with the technical fields in which the IP protection is applied for.[4] Most of the IP offices mainly focus on receipt and processing of IP applications. They have no or very limited role in supporting local research and innovation efforts or creating IP awareness. There is little or no linkage between IP offices and R&D institutions. As a result, valuable IP assets are lost. Moreover, the valuable technological information contained in patent documents, is not disseminated to support R&D activities. That said, there are examples of best practice where IP offices are engaged in development oriented activities such as providing advisory and technological information services to support innovative activity and R&D in their countries. These include the Egyptian Patent Office, the Ethiopian Intellectual Property Office and the Kenya Industrial Property Institute.

Capacity constraints also place African nations at a disadvantage when it comes to strengthening R&D by making accessible valuable technological information. Information contained in patent documents can help to solve technological problems by avoiding duplication of effort and waste of resources. Devoting time, labour, infrastructure and laboratory facilities researching problems for which the solution is already publicly available is plainly a waste of resources. Further, it is one of the prime functions of the IP system to ensure that scarce resources are not wasted in this way. Nonetheless, a lack of awareness or availability of information contained in patent documents is a serious problem in many countries. It is estimated that under-exploitation of technical information (an estimated 80% of which is published in patent documentation and nowhere else) costs European industry alone $20 billion each year—simply because the inability to access relevant patent information results in duplication of effort or the creation of products that overlap with prior art.

The use of the technological information contained in patent documents will also enable researchers to re-orient or fine tune inventive, innovative and creative activities. The bibliographic data together with the references to the relevant prior art and the description of the invention in patent documents enables researchers to be informed of current technological developments and findings in their fields and redirect their activity.

[3]Leesti M. &Pengelly T (2002), Institutional Issues for Developing Countries in Intellectual Property Policymaking, Administration & Enforcement, CIPR, Study Paper 9, available at http://www.iprcommission.org

[4]See the case studies by Zikonda A. and Samuel Wangwe et al., CIPR, *Supra note* 44, as example.

There are positive developments in some of African countries in recognizing the key role that Patent Offices may play in the provision of technological information services and promoting the importance of patent documents as valuable sources of technological information. Kenya and Ethiopia, for example, explicitly state that the provision of technological information contained in patent documents is one of the tasks of their Patent Offices. There are entrepreneurs who have improved their products or generated new products through R&D effort using the technological information contained in patent documents. Some of them have established enterprises and begun to manufacture products that replace imported ones, for example the production and manufacture of printing ink in Ethiopia. The information has also been used in higher education, for example, guiding researchers at the Addis Ababa University Faculty of Medicine in the potential use of aloe-vera for wound management and hypertension.

Patent documents as a resource: The case of enset

Starch has many industrial applications in a variety of sectors. It is a finishing and binding agent in the textile and paper industries. It is an adhesive in food and beverage packaging. And it can be a binding agent in pharmaceutical industry. Starch that is widely available in the global market is typically made from corn wheat, cassava or rice. Ethiopian researchers tried to develop a process to manufacture starch usingenset, an endemic Ethiopian plant. A key resource was patent documentation on extraction of starch from corn, potato and cassava, available in the Ethiopian Patent Office. The information helped refine research and overcome technical problems. The research resulted in a process invention, which enabled the successful extraction of a high quality starch from enset and protected by a utility model certificate. The product is now manufactured locally and is meeting the needs of the domestic market.

VI- Looking ahead: priorities for action

Mobilizing, encouraging, and leveraging innovation requires actions across several areas, most of which need government involvement. Education, infrastructure, communication and knowledge sharing mechanisms, regulatory and intellectual property frameworks, access to finance, credit and insurance, as well as good governance are all part of the factors that help spur and direct innovation.

a) A supportive national environment

There is a responsibility upon policy makers to create an environment where development needs truly influence science and innovation priorities and where development policy and practice is appropriately informed by the science and knowledge base. And there is a responsibility on policy makers to create an environment where there are adequate incentives for both the public and private sectors to grow that science and knowledge base and place it at the service of humanity. Creativity and innovation are a natural resource in which every country and every community is potentially rich. The correct policy framework can enable these intangible resources to be transformed into sustainable development assets through the protection and promotion of creativity and innovation. At the most essential level this requires a stable, predictable and transparent regulatory and governance system. But specific tools can also be applied to direct investment in innovation towards national goals, such as through fiscal policy and dedicated government programmes and priority spending.

b) Education and knowledge sharing

Creating the knowledge necessary to tackle these interrelated challenges will require breaking down barriers between disciplines and strengthening the connection between science and society, in particular through education. Secondary and tertiary education systems play a critical role in developing the knowledge intensive skills and innovation on which productivity, job creation and

competitiveness depend. [5] Therefore, strengthening capacity-building in science, technology and innovation, as well as basic technical skills, for both men and women, is an absolute prerequisite.

Creating platforms and systems through which scientific knowledge can be shared; through which centres of learning can access and add to the stock of human knowledge; and through which people can learn about the frontiers of technology must be a priority. A rich body of scientific and technological information exists in patent databases and more needs to be done to increase access and analysis of that data to support innovation. Evidence shows that where scientific and technical information is made available it is a major resource for creating business value. [6]

c) Supportive regulatory systems for innovation

As discussed earlier, beyond the governments priorities and functioning, the regulatory environment, and in particular the intellectual property rights system, is a cornerstone of innovation. A stable, predictable and transparent regulatory system is essential to attract investment, both domestic and foreign, and intellectual property protection systems are needed to incentivise innovation and help bring the products of research and creativity to the public.

d) Access to financial services

Despite the acknowledged importance of a well-functioning financial system as a driver of growth and prosperity, it is estimated that between 50 and 80 percent of adults in many developing countries have inadequate access to financial services[7]. In addition, for small firms in developing countries, only 15 percent of new investments are financed externally, compared with 30 percent among larger firms. Without financial access, small and new firms face obstacles to both entry and prospective growth. This lack of access may arise simply because of distance to financial institutions, or because of the prohibitive costs of doing so.

Across the region, where economic incentives exist, access to the finance necessary to acquire new technologies and innovation is improving, albeit from a low base. Supporting the creation of a commercial banking system adapted to the needs and demand of often low income population is essential to support innovation and entrepreneurship. A more persistent problem exists where economic incentives are limited – and this may be the case in confronting a number of the challenges posed by the MDGs. For example, financing of innovation to tackle neglected tropical diseases may be a market failure because these diseases only affect economically and politically marginalized communities.

Partnerships are critical to overcoming these market failures. In the field of health a range of Product Development Partnerships, several involving the UN system and its agencies, have been formed to promote the development and distribution of treatments, therapies and vaccines for diseases which otherwise would have been "neglected".

The World Bank has suggested that such initiatives could be complemented by an Inclusive Innovation Fund (IIF) to support innovators in developing their ideas to the point where they can raise private finance be that to proof of concept or through prototyping and marketing development. Such Funds are being operated in developing countries at national level, but could be extended regionally or internationally. Given the importance of absorptive capacity in the diffusion and uptake of new technologies in developing and least developed countries, the Climate Innovation Centres piloted by Infodev (www.infodev.org) may also prove important in the diffusion of climate smart technologies[8].

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[5] An estimated 2.5 million engineers and technicians will be needed in sub-Saharan Africa to achieve improved access to clean water and sanitation. UNESCO, Engineering: Issues, Challenges and Opportunities for Development (Paris, 2010)

[6] EPO reference

[7] http://go.worldbank.org/RVNCZB8HL0

[8] UN System task team on the Post 2015 UN Development Agenda "Science, technology and innovation for sustainable development in the global partnership for development beyond 2015" Thematic Think Piece http://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/28_thinkpiece_science.pdf

e) Infrastructure investments

Investment in infrastructure, from research facilities, to power generation, irrigation, roads and telecommunications, is essential to support not only innovation but also the deployment of solutions. A recent study estimated that Africa needed US$ 93 billion a year for its infrastructure sectors, with about two-thirds required for new investment in physical infrastructure and a third for maintenance and operations[9]. Currently, it is estimated that inadequate infrastructure is costing the region by as much as two percentage point each year in per capita growth rate[10].

While traditionally those investments have often represented largely public investment – such as in transport infrastructure – more and more the private sector plays an increasingly important role in those investments. Public private partnerships, joint ventures and other forms of collaborations between public and private sector can represent positive ways to mobilise the necessary investments while benefiting from expertise and know how.

f) Regional and international coordination and engagement

In 2007, the African Union endorsed the landmark Science and Technology Consolidated Plan of Action to provide guidance for regional priorities. This is a strong basis for regional coordination, which can help build synergies and create momentum across a range of activities.

At the international level, embedding the importance of science, technology and innovation in the post 2015 development agenda would also provide opportunities to further the innovation agenda at regional and national level by providing policy support.

g) Incorporation of traditional knowledge

Establishing more adequate and appropriate national and international legal frameworks to improve the use of traditional knowledgewould create an environment that promotesdialogue and expands knowledge networks between various communities, scientists, entrepreneurs and the government. It would be mutually beneficial to promote the establishment of formal frameworks to incorporate traditional knowledge.

The integration of traditional knowledge could enhance new innovations for sustainable development, while local communities could enhance their own knowledge base of their livelihoods and benefit from innovations made in the process. Such an exchange could also contribute to the development of locally appropriate technologies, which are more easily adapted than technologies which do not correspond to environmental or cultural particularities. All stakeholders must remain cognizant of the importance of ensuring that all involved parties are benefitting in a fair manner from the use of traditional knowledge.

[9] OECD (2012) Mapping Support for Africa's Infrastructure Investment - http://www.oecd.org/daf/inv/investment-policy/MappingReportWeb.pdf
[10] African Development Bank Group – Africa's Infrastructure: a time for transformation - http://www.infrastructureafrica.org/flagship-report

Science and Technology Consolidated Plan of Action
Vision and Objectives

• To enable Africa harness and apply science, technology and related innovations to eradicate poverty and achieve sustainable development; and
• To ensure that Africa contributes to the global pool of scientific knowledge and technological innovations.

Programmes and projects outlined in this Plan will be implemented through regional, continental and international cooperation in science and technology. They focus on the following:

• Improving infrastructure for R&D and promote sharing of such facilities;
• Creating institutional and policy arrangements that enable African countries to mobilize and share resources to conduct science and generate technological innovations;
• Strengthening the continent's human skills base by increasing the number of scientists, technicians and engineers;
• Improving the quality and intensity of regional cooperation;
• Building a strong political and civil society constituency for science and technology in Africa;
• Improving the quality of science, technology and innovation policies of
African countries through processes that promote sharing of experiences and policy learning;
• Strengthening the capacity of regional economic bodies to mainstream science and technology into their sectoral programmes and projects;
• Promoting the application of science and technology to achieve specific MDGs; and
• Promoting innovative ways and means of financing science and technology in Africa.

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VII- Questions for discussion

- How can public education contribute to effective innovation systems for sustainable development?

- How can the benefits of knowledge sharing and the spreading of innovations be supported regionally?

- How can international development cooperation contribute to building the necessary capacity for strategic innovation policies at the national and sub-national levels?

- How can we better harness the potential of traditional knowledge for development in general and innovations in particular?

- How can we ensure that local and traditional knowledge is reflected appropriately and fairly in innovation policies, especially with regard to health and agricultural innovations?

- How can we better evaluate the impact of innovations and innovation policies on the achievement of the MDGs and sustainable development?

- What can be done to harness the investment potential of the private sector in innovation and to support young entrepreneurs?

Annex I

CPA Programmes and Projects that will involve IP issues

Flagship Research and Development Programme Clusters	Programme Title	Objectives of Programme	Indicative Projects/Implementation Tool	IP Issues
Biodiversity, Biotechnology & Indigenous Knowledge	Conservation and Sustainable use of Biodiversity	Strengthening Africa's scientific and technological capacities for biodiversity conservation and sustainable use focusing on measures that will build a strong conservation science foundation and generate sustainable use technologies. Specific objectives include promoting the development and diffusion of a range of sustainable use technologies	Mobilization and training of scientists	Ownership of research results Benefit sharing Ownership of biological resource
			Strengthening and networking of gene banks	
			Adding value to Africa biodiversity and generate natural products through bio-prospecting	
	Safe Development	Building Africa's	Research and Training into	Ownership, exploitation

	&Application of Biotechnology	capacities to develop and safely apply biotechnology in agriculture, health, mining, industry and other areas focusing on mobilization and integration at the continental level critical mass of physical and financial resources and expertise needed to enable Africa effectively harness and apply biotechnology	gene expression and proteomics	&dissemination of research result
			Building and using capacity for bioinformatics	
			Development of bio pesticides and Bio fertilizers for sustainable agriculture	
	Securing & using Africa's indigenous knowledge base	Strengthening Africa's capacity to harness and apply as well as protect indigenous knowledge and technologies	Development of an African Databank on Indigenous Knowledge and Technologies	Ownership of database Use of data Rights of IK holders Confidential IK
			Promoting education on African indigenous knowledge systems in schools and institutions of higher learning	Differentiation between proprietary & non-proprietary knowledge Rights & interests of IK holders

Energy, Water and Desertification	Building a sustainable energy base	Enlarge Africa's energy security through the generation and application of scientific knowledge and related technological innovations	Developing an African Databank of Energy Research and Technologies	Ownership & use of data
			Research on and development of bio-energy technologies and other renewable energy sources	Ownership and use of the research result
	Securing and sustaining water	Focuses on water quality, sanitation and water resources management Emphasis is on promoting increased use and production of scientific knowledge and technological innovations	Scientific Assessment of Africa's Water Resources and Systems	Protection of data and information, defining the terms and conditions of use such as Licensing Use of patent documents Access to proprietary technology Protection of research results
			Research and Technologies to Assess and Monitor Water-related Disasters Project will focus on Identifying and assessing existing technologies for flood control to determine their applicability in Africa. Emphasis will be on the kinds of resources required to acquire, modify and apply the technologies in Africa; Developing a databank and	

			disseminating information on the technologies and Conducting research to modify, improve and	
			Knowledge and Technologies to Improve Water Quality and Quantity –project focus include research and development	Ownership and exploitation of research results
	Combating Drought and Desertification	Strengthen the scientific and technical capacities of African countries to combat drought and desertification	Promoting Exchange of Scientific Information on Drought and Desertification - The focus of the project include Developing a standardized or common framework for profiling and disseminating information on the nature and outputs of scientific research being conducted by African and international institutions. Development of a continental databank on scientific research and technologies aimed at combating drought and desertification	Access to and dissemination of proprietary information Ownership of database and use of data Ownership of research result
			Building and Sharing Scientific and Technical Capacities establishing a network of African universities and related R&D agencies to increase the range and quality of scientific skills.	Ownership and exploitation of research results

			Identification and designation of R&D centres and universities as hubs and nodes of an African Drought and Desertification Research and Innovation Network Support students to undertake postgraduate studies and research at the hubs and nodes	
Material Sciences, Manufacturing, Laser and Post-Harvest Technologies	Building Africa's Capacity for Material Sciences	Building Africa's capacity to engage in materials research and related technology development. Its overall objective is to strengthen the existing African network on materials research.	Strengthening postgraduate training and research on materials Objectives include To promote excellence in all aspects of materials research in Africa; to act as a networking centre to stimulate multi-disciplinary collaboration between researchers on the continent; to identify and stimulate international linkages that will act to both broaden and deepen the skills and competence base for materials research in Africa	Ownership and use of research results
			Strengthening African Materials Research society- Focus areas of the project include: Identification of regional hubs and nodes of laboratories to be shared across the regions and continent of Africa and	Ownership and exploitation of IP assets

			establishing explicit links to industry and international research programmes	
	Building Engineering Capacity For Manufacturing	Programme will focus on revitalizing engineering training in African higher education institutions in order to increase the number and quality of engineers	Assessment of Engineering Infrastructure and Curriculum of Higher Education Institutions Specific actions will include: Commissioning a competent agency or network to use the framework and questionnaire to gather data and provide a comprehensive assessment of capacities and needs to improve and increase training in specific areas of engineering	Ownership of data and report
			Promoting University-Industry Partnerships for Engineering Training aim at improving the quality and intensity of university-industry partnerships for engineering	Partnership may involve the generation and exploitation of IP assets
	Strengthening The African Laser Center (ALC)	Programme aims at building Africa's capacity to engage in laser research and technology development as well as related applications. Its overall objective is to strengthen the ALC	Strengthening the African Laser Centre The project will support ALC to: • Design a comprehensive African programme for laser research and innovation; • Increase regional hubs and nodes of laboratories to be	Ownership of research results & innovative activity

			shared across the regions and continent of Africa and Establish links with industry and the international laser research and innovation community.	
			Strengthening postgraduate training and research on lasers The actions that will be taken in collaboration with ALC include "Design of a common/African postgraduate training curriculum for laser research and technology development"	Access to and use of patent documents
	Technologies to Reduce Post Harvest Food Loss	Promoting research to identify, develop and promote diffusion of relevant or appropriate technologies to reduce post-harvest food loss, with initial emphasis on crops	Promoting the Development and Diffusion of Appropriate Food Processing	Access to proprietary technology, use of patent documents, protection of new technologies
			Promoting Industrial Use of Cassava- project will focus on promoting the development, diffusion and application of technologies for industrial use of cassava	Ownership and exploitation of new and improved technologies
Information And Communication Technologies, and Space Science and Technologies	Information and Communications Technologies	Programme will aim at establishing a continental research network on ICTs. It will bring together leading universities	Harnessing and developing software for e-learning	Protection and exploitation of software
			Developing Capacity for e-health-proposed project will:	Ownership of IPR over software

		and research centres to design and implement projects that generate software with African content	• Promote the testing and application of the e-health software; • Design and provide training on e-health; and • Promote the diffusion of the e-health software across the continent	
	Establishing The African Institute of Space Science	Programme will focus on determining the feasibility of establishing AISS and related programmes. Its specific objectives include "Mapping global trends and identifying specific technological opportunities"	The actions that will be taken include: "Establishment of an inter-governmental experts' committee, Establishment of a website and media out reach on space science and their benefits and organization of an African electronic conference on space science	Protection of domain name, content etc.
			Expanding current pan-African Centres and Initiatives- the actions that will be implemented include: "Administrative and software support will be established at the AIMS to ensure that it can effectively operate as the Hub of AMI-Net and provide the required facilitation and support to the AMI-Net Nodes	Ownership of software Linkage with industry

			and Research activities at AIMS and other pan-African centres will be strengthened, and closer ties to industry and to applied sciences developed	