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India-Africa Cooperation in Agriculture Science, Technology and Innovation: New Avenues and Opportunities

Introduction

India and Africa share a long history of friendship and cooperation and are viewed as two prominent developing regions of the world. India is now a key trading partner of Sub-Saharan Africa, importing almost US$ 21 billion worth of goods and commodities and exporting goods of over US$ 10 billion to Africa in 2010.[1] India's development cooperation with Africa expanded significantly in 2005, when India became the first Asian country to become a full member of the African Capacity Building Foundation (ACBF) which is based in Harare. The ACBF has emerged as one of the premier organisations for sustainable development and poverty alleviation for Africa. India has contributed US$ 1 million for strengthening the work programme at the ACBF.[2]

Given the huge landscape and diversities, both the regions have immense potential for growth. The recent OECD-FAO Agricultural Outlook (2013-2022) projects that the developing countries are expected to be the leading source of demand for agricultural products.[3] However, as is evident from the 'State of Food Insecurity in the World' Report, Sub-Saharan Africa remains the region with the highest prevalence of under-nourishment, while Southern Asia and Northern Africa show slow progress.[4] Both the regions are facing certain common challenges. The most common of these challenges are, of course, related to food and nutrient security, enhancement of productivity, reduction of losses and raising the economic returns for the farmers. The other important challenge relates to using technology to improve productivity and applying modern biotechnology for developing varieties with specific traits to meet the diverse needs of farmers in different agro-climatic zones. Since the agro-climatic conditions are similar in the two regions, with common challenges confronting the agricultural sector, Africa and India can opt for similar approaches in addressing them.

These common challenges and trajectories give huge complementarity for tapping the Africa-India cooperation in various fields for finding out common solutions. Towards this, the first India-Africa Forum Summit (IAFS) was held in New Delhi in 2008. This Summit led to the issuance of Africa-India Framework for Cooperation, of which the pronouncement of Africa-India Science and Technology Initiative holds great significance, as it played a major role towards institutionalising Africa-India Science, Technology and Innovation (STI) cooperation. This sort of cooperation is primarily based on the idea of sharing Indian experiences and best practices in the field of STI with Africa. As it emerges from the following discussion, along with the technology transfer and capacity building in the areas such as infrastructure, education and training, there is also a need for making concerted efforts towards

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creating an institutional framework for facilitating partnerships across academics and institutions.

Broad S&T Cooperation Framework

The Africa-India STI cooperation offers an opportunity for agricultural growth through value-addition to agricultural produce. This may also need bilateral cooperation for facilitating the application of scientific knowledge along with promoting the entrepreneurial activities in the two regions.[5] In this context, the established mechanisms need to be explored. For instance, the IAFS-1 in 2008 set the ball rolling through setting up of the Africa-India Science and Technology Initiative, under which the Department of Science and Technology (DST) in partnership with the Ministry of External Affairs (MEA) broadly outlined the contours of Africa-India collaborative engagements in consultation with the African Union (AU).

These included organising India-Africa S&T Ministers Conference, strengthening of S&T institutions in Africa, transfer of appropriate technologies, training and provision of educational fellowships.[6] The IAFS-2, held at Addis Ababa in 2011, adopted the Africa-India Framework for Enhanced Cooperation, which resulted in establishment of the India-Africa Technology Partnership Programme (IATPP) through the Confederation of Indian Industry (CII). The objective was to create a mechanism to facilitate transfer of Indian technology to the African nations, build long term science and technology partnerships, create an enabling environment for Indian industries to gain access to African markets, and build capacity in the recipient nations to absorb the new technologies through: (a) partnership development activities/ studies/research/web portal; (b) capacity building, i.e. technology management training programme and intellectual property rights training programme; and (c) technology transfer and deployment.[7] Regarding cooperation in the agriculture sector the statement issued in 2011 stated as follows:

> *"Africa and India reaffirm their commitment to cooperate for increasing agricultural output and achieving the Millennium Development Goal of halving the proportion of people who suffer from hunger and malnutrition by 2015. They emphasise the importance of harnessing the latest scientific research for raising productivity and for the conservation of land and the environment in order to ensure food security for their people and to bring down the currently rising cost of food prices so as to make food affordable for all. In this respect, they agree to collaborate in the implementation of the Comprehensive Africa Agricultural Development Programme (CAADP)."*

The first India-Africa S&T Ministers Conference was held in New Delhi on 1-2 March 2012. It was organised by the DST, MEA, Federation of Indian Chambers of Commerce and Industry (FICCI), and African Union Commission (AUC). Over 150 delegates from over 40 African countries attended the conference, including 30 African Ministers dealing with S&T, representatives from the African Union Commission, and representatives from the African Regional Economic Communities. In the Joint Declaration issued after the conclusion of this conference, both African and Indian Ministers identified four major areas for cooperation. They are as follows:

- Capacity Building in S&T in Africa
- Improving policy enabling environment
- Human resource development
- Institutional development
- Science, Technology and Innovation for Development
- Knowledge Transfer and Adoption
- Identification of Common Research Priority Areas

India has also been actively involved with many African countries through various platforms. One such important platform is IBSA (India-Brazil-South Africa), where India is collaborating with South Africa. The first Meeting of IBSA S&T Working Group under trilateral IBSA MoU was held at Pretoria, South Africa in October 2011, where R&D proposals in identified priority areas for trilateral research and development projects, involving scientists from India, Brazil and South Africa, were invited. Some of these priority areas are: health (HIV, AIDS, TB, Malaria); biotechnology; indigenous knowledge systems; alternative and renewable energy; ICT and nanotechnology. Box 1 brings out the various other bilateral initiatives launched by the two regions in the realm of STI.

Cooperation in Agricultural Technology

Among the important initiatives for agriculture in Africa is the support programme for cotton-growing countries. India has been extending support for the development of cotton sector in the Cotton Four (C-4) countries (i.e. Benin, Burkina Faso, Chad and Mali) and also in Nigeria, Uganda and Malawi where India is providing cotton technical assistance, support and cooperation. India's assistance includes:

(i) assessing the requirements of partner countries in the areas of capacity building, technology transfer, and R&D in the cotton sector; (ii) sharing the expertise developed in Indian R&D; and (iii) formulating the effective cooperation programme and exploring business and investment opportunities in these countries.[8] Infrastructure and Leasing and Finance Services Ltd. (ILFS) is the lead agency providing support from the Indian side. In other programmes, the main emphasis is on capacity building. The Energy Research Institute (TERI), New Delhi has been actively involved in the Indian Technical and Economic Cooperation (ITEC) programme offering African students courses on applications of biotechnology and its regulation. In 2010-11, TERI-ITEC programme had 43 per cent participation from African region alone.[9]

There are also some significant Africa-India initiatives undertaken at multilateral level, particularly in the domain of South-South cooperation. Sub-Saharan African countries and India have established collaboration in the health biotechnology.[10] Some significant Africa-India cooperation in agricultural biotechnology is being done under the aegis of the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and International Livestock Research Institute (ILRI).

ICRISAT, a CGIAR (Consultative Group on International Agricultural Research) Center headquartered at Hyderabad (India), conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. The recent initiatives taken by ICRISAT include enhancing public-private partnership (PPP) and developing entrepreneurship. Through its Agri-Business and Innovation Platform, it envisions enhancing prosperity of farmers through promoting market-oriented innovative product development such as exploring new business opportunities for soybean and millets. It has established Agri-Business Incubators and Value-Chain Incubators in six African countries by partnering with local bodies.[11]

ILRI, also a CGIAR Center, works to improve food security and reduce poverty in developing countries through research for better and more sustainable use of livestock. Some of the ILRI's ongoing India-Africa programmes are: IM Goats (India-Mozambique), Milk IT (India-Tanzania), Value-Chain Development (India-Tanzania, Ethiopia, Mali) and South-South Dairy Development (India-Kenya). Its India-Africa Knowledge Management mechanism emphasises on dissemination of technologies, tools and approaches.[12]

Technology Regulation and Management

Developments in technology open up new opportunities to enhance agricultural productivity at the same time they also necessitate changes in regulatory frameworks. For countries that want to leap frog with new technologies this poses enormous challenges in regulation and capacity to apply

Box 1: Recent Africa-India Initiatives on Science and Technology Cooperation

- 135 Candidates from 30 African Countries have been awarded C V Raman International Fellowship for African Researchers.
- Training courses on biomedical sciences for two batches of African Researchers were completed in 2011.
- Training Course on Technology Innovation was conducted during October-November 2012.
- Training Course on Energy, Environment and Sustainable Development was organised by The Energy and Resource Institute (TERI) during April-May 2013.
- Pan African e-Network, launched in 2008, has been extended to 48 African countries so far.
- CII organised a Technology Show in New Delhi in March 2012, and conducted two training programmes on Innovation and Technology Management. 50 candidates from 13 African Countries participated.
- Under Grants-in-Aid, Indian government has supplied computers and peripherals, laboratories equipment, medical equipment to various African countries.
- There is a proposal for establishing 5 India-Africa Food Processing Business Incubation Centres in Africa.
- There is a proposal for establishing permanent Institute for IT Training at Ghana

Source: RIS based on Saran (2012) and Bangar (2013).

technology. Both in India and Africa, the major technology options are either traditional breeding or techniques such as tissue-culture or modern biotechnologies such as genetic modification (GM). In 1990s, in many African countries, there was a state of continuing food crisis and deficit. This alarming situation led many countries to promulgate the policy of import substitution, thus bringing new technological options to the forefront. Countries such as Nigeria, Cameroon, Gabon, Ghana, Ethiopia, and Kenya along with SADCC countries (Southern African Development Community) adopted a mixed approach in handling the issue of food security. Both technology options, viz. traditional breeding techniques and modern biotechnology, are being implemented in these countries. A case study of Kenya's agricultural research strategy since 1990s shows adoption of both technologies.

Food crops such as maize, millet, sorghum, cassava, potatoes and pulses comprise the main staple foods of Kenya. It was felt that there is need to produce these food crops in ever increasing quantities to satisfy the increasing demand of the population. Besides, Kenya relied heavily on cash crops for generation of foreign currency as agricultural production made up about 70 per cent of all exports. These contingencies made the application of advanced breeding methods and biotechnology to the agriculture an activity of considerable importance in Kenya. The main objective of these technology applications was to achieve higher yield and higher stress/disease tolerance crops.

Tissue culture has also become an important factor in horticultural production in Kenya. This technique has been applied to a number of horticultural crops such as citrus fruit, passion fruit, strawberries and cut flowers. A great amount of horticultural crops is exported from Kenya. Export of cut flowers is by far the most important component constituting 45 per cent by volume and 57 per cent by value of total fresh horticultural exports in 2005.[13] Kenya is the fourth largest exporter of flowers in the world, but its share is only 6 per cent, while the top-ranking Netherlands accounts for 54 per cent. Interestingly, the flower industry is the second largest foreign exchange earning sector for Kenya.[14] The various challenges that play a dampener in full-blown development of Kenya's floriculture are the non-tariff barriers such as phytosanitary (plant health) control, quality and grading standards, labelling requirements, trade related environmental and safety issues, pest and weed control.[15]

In spite of these technology interventions in the area of agriculture in Kenya, there seems to be certain problems that impede and restrict its agricultural growth. Among these problems, the major ones are related to the availability of limited genetic variability, slow progress in R&D in tissue culture, lesser investment in advanced techniques and R&D, and lack of supply of healthy, certified and disease free planting material to small farmers. While these problems are not unique to Kenya, by applying different technologies in biotechnology African countries are trying to address the challenges in increasing yield and enhancing productivity. For example, they are using DNA market and mutation breeding in addition to GM technology.[16]

India has already a well-established national research system, seed sector and testing laboratories in place. In this scenario, an enhanced Africa-India STI cooperation can play a significant role in facilitating African countries for building R&D infrastructure which is mutually recognised and brings in necessary Mutual Recognition Agreements (MRAs), shares successful mutual practices and expertise, and supplies appropriate planting materials. India has already provided better sugarcane germplasm to Ethiopia for higher yields.

As far as technology regulation is concerned, India and many countries in Africa have institutional structure to regulate biotechnology. India has an apex body called Genetic Engineering Appraisal Committee (GEAC). GEAC has been constituted in the Ministry of Environment and Forests under 'Rules for Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells 1989', as per the Environment Protection Act, 1986. The Rules also define five competent authorities: the Institutional Biosafety Committees (IBSC), Review Committee of Genetic Manipulation (RCGM), Genetic Engineering Approval Committee (GEAC), State Biotechnology Coordination Committee (SBCC), and District Level Committee (DLC) for handling of various aspects of the rules. This structure is likely to be replaced by a comprehensive authority as envisaged in the Biotechnology Regulatory Authority Bill, if the bill is enacted.[17]

Africa has the following pan-African actors which are actively engaged in modern biotechnology and biosafety. They are: New Partnership for Africa's Development (NEPAD), High-level African Panel on Biotechnology (APB) and African

Biosafety Network of Expertise (ABNE). They provide technical assistance, organise bi-lateral and multi-lateral programmes in biosafety and risk management besides providing assistance in addressing policy issues.

Both Africa and India have concerns about the biosafety and risk issues related to modern biotechnologies such as GM technology. In both regions, the need to build robust regulatory frameworks is well accepted. In many African countries too, such steps have been initiated to regulate the use of modern biotechnology.[18] Hence, Africa and India can share the lessons learnt in regulating biotechnology so that both the regions can successfully co-evolve the regulatory framework to ensure human and environment safety. Such frameworks based on sound scientific principles and experiences in regulation are better than frameworks that are based on experiences or frameworks that are brought in from elsewhere.

Other major area for Africa-India cooperation could be in the field of standardisation. Chaturvedi (2007) argues that compliance with external eco-standards set by developed countries often necessitated the import of inputs and technology, which were likely to raise the cost of production and price of output.[19] In this context, the setting of standards for the movement and development of agricultural plant materials, laboratory-practices and testing is an imperative for furthering meaningful R&D collaboration, market access and trade avenues.

Seed Sector Cooperation

There are some significant ventures already made by multinational seed companies such as DuPont Pioneer and Syngenta. DuPont Pioneer bought 80 per cent of South African seed company Pannar in early 2013 and Syngenta has recently announced its plan to invest US$ 500 million in African agriculture over the next decade as it targets to sell more than US$ 1 billion worth of its seed and crop-protection products.[20] The emergence of African private sector seed companies is making inroads into addressing the yield gap in many parts of Africa but with the exception of hybrid maize and some vegetables, they generally lack breeding (R&D) capacity. In Africa, most seed systems are informal (farmer-based) and low-yielding, and the local demand is not being met by local production.[21] The seed sector in Africa, particularly in Sub-Saharan Africa, is yet to develop into a mature sector.

According to a study by International Food Policy Research Institute (IFPRI), there is role for both private and public sector in supporting R&D, extension activities, establishing standards and in testing and labelling in seeds. While government need not get involved in each of these activities, there is a strong case for government facilitating private sectors and market channels in seed sector.[22] An analysis of maize seed market in four countries shows that the role of private sector is increasing as hybrids are preferred by them and emergence of national seeds trade associations will facilitate organising of seed sector.[23] According to Niels P. Louwaars *et al.,* formal seed sector in sub-Saharan countries meets less than 20 per cent of the demand and that too in limited number of crops and varieties. They call for applying Integrated Seed Sector Development (ISSD) model which envisages policies on varietal release, seed quality and plant breeders' rights.[24]

In Africa, the seed sector should be seen as an important component for ensuring food security. Realising this, the African Union formulated an ambitious and comprehensive plan for seed sector in the 2008, called the African Seed and Biotechnology Programme (ASBP). The objective of this Programme is to enable comprehensive development of the seed sector and related biotechnology in Africa, taking into account the different needs of the countries and regions.[25] Under this programme there is good scope to engage in collaboration in seed sector and biotechnology as this programme has different components that address various needs in seed sector, ranging from germplasm collection and storage to quality assurance. For example, India can help in developing certified seed programmes for crops because good quality seeds can give impetus to agricultural growth through increased yields and returns.

The similar agro-climatic and socio-economic conditions prevailing in Africa and India create potential scope for enhanced cooperation in the seed sector through supply of tropically-adapted varieties from India to Africa. One way of building on this scope can be through partnering African seed companies with public sector breeders, and the other solution could be to look outside the continent to partner with overseas private breeders.[26] There is significant market potential in Africa but current demand is not being met by local varieties; in contrast, some crop varieties from India are performing very well in Africa and farmers in Africa will benefit more if such varieties are introduced

widely'.[27] According to C.L. Laxmipathi Gowda, Global Theme Leader, Crop Improvement and Management, ICRISAT, some companies have formed an Alliance for Green Revolution in Africa (AGRA), which is funded by Bill and Melinda Gates Foundation and Rockefeller Foundation together. They have formed this alliance for promoting green revolution in Africa. They are trying to train and develop traders for supply of seeds and fertilisers. He argued that Indian seed companies have much better chance of success. Box 2 provides lessons for Africa that can be learnt from India. Farmers in Africa are spending lot of money for hybrids, which are coming from Europe or the USA. These varieties are not easily adaptable to tropical conditions of Africa; whereas Indian hybrid varieties can be adapted as weather conditions are similar. They can be adapted to west and east African countries. The Indian seed firms are presently experimenting hybrid seeds in East and West African countries. Sorghum, pearl millet, rice, maize, sunflower and vegetables are some of the crops that are under experiment stage.[28]

Way Forward

The way forward has to be built upon current initiatives, and by identifying new ones, building synergies and, in general, incentivising Africa-India cooperation by bringing more actors from public sector, private sector and academic and research institutions.

Among the ongoing initiatives, the Africa-India Science and Technology Initiative has been a significant mechanism, established to foster the collaboration in the field of science, technology and innovation. The Africa-India STI cooperation has enhanced opportunities for advancement in the field of development, adoption and diffusion of technologies, facilitating entrepreneurial collaboration and standard-setting. India and Africa need to jointly strategise the integration of STI with the vision of promoting business. In other words, along with scientific and technological cooperation agreements, there is a need to provide financial resources simultaneously to the poorer countries so that they don't get left out of any such cooperation between the two regions. Also, there is a need to prioritise areas of collaboration, and in this regard the area of agricultural technologies proves to be a strong option. Given India's success story in achieving food self-sufficiency and its vast experience in development and application of various agricultural technologies, varying from traditional to modern, Africa-India cooperation through partnerships among academicians, researchers, and institutions can pave the way for collaborative research, development and innovation.

Facilitating Material Transfer: In the field of technology management and regulation, both the regions have ample scope to address common problems/issues. Their prime focus is to develop high-yielding and high disease/stress tolerant crop varieties. They have more or less the similar agro-climatic and socio-economic conditions. In this endeavour, Africa-India STI cooperation provides

Box: 2 Lessons for Africa from the India's Experience in Agriculture

1) Develop a crop seed development plan including Coordinated Crop Improvement Programmes and national notification systems involving seed companies in public and private sector, for, trial and evaluation of new varieties.
2) Enact a comprehensive legal framework that enables regulating seed market, enforces quality control and price control for different category of seeds.
3) Seek the support of foundations, UN agencies and public sector institutions like Indian Council of Agricultural Research (ICAR) for setting up national level coordinated crop improvement and research programme. For example, a consortium for development of agriculture can look into techno-economic dimensions of agriculture in Africa.
4) Establish platforms and initiatives under IBSA and BRICS and give seed sector and agriculture a new thrust through them involving public and private sector.
5) Bilateral collaboration in manufacturing farm machinery, application of ICT in agriculture, advisory services in seed testing, soil quality testing should be encouraged. Public-Private Partnership model can be used in this.

Source: Personal communication with Dr. T P Rajendran,and Dasgupta (2011).[29]

avenues for complementing and supplementing each other's efforts in addressing the common issues of productivity enhancement, higher returns for farmers, etc. Setting up laboratories in quality testing and programmes for quality assurance can be integrated in to the STI cooperation framework.

Also, the issues concerning biosafety and risks can be better understood and addressed through dialogue, deliberations and research. The evolution of technology regulation framework in both the regions can learn from each other owing to the similar concerns echoed in both the regions by some civil society organisations and researchers.

Standardisation of agricultural materials, laboratory practices, testing and quality parameters play an important role in enabling collaborative R&D and facilitating market access. India and Africa STI cooperation need to jointly strategise on these issues for smooth and durable partnership.

Entrepreneurial Collaboration: There is need not only to support training and research activities, but also to support collaboration activities of firms or entrepreneurial organisations involving joint development of products and services.

As far as the next steps involved in furtherance of Africa-India cooperation in agriculture technology are concerned, cooperation in the seed sector seems to be a win-win proposition for both India and Africa. As Indian seed companies gain access to new markets; African farmers have access to better quality new varieties and African distributors gain new business. However, there is a need to set up proper institutional structure in place to allow Indian seed industries to venture into more African countries.

The beginning could be made in the form of granting permission to allow the field testing of seeds developed in India by many African countries. The national-level or regional-level platforms or groups can facilitate in such a process. They can identify the needs at the national level and help in testing of varieties that are more suited to that nation/zone. They can also help in developing varieties that address specific needs of farmers and this could mean that varieties are developed with new traits or their efficiency is enhanced.

A cursory survey of literature and activities in seed sector in Africa shows that already there have been many initiatives and programmes and mapping that can help the seed industry in India to identify complementarities and synergies. Seed industry in India should formulate a strategic plan for engaging with African seed sector, not just with the private seed industry and this plan should be linked with India's other programmes in agriculture, S&T and capacity building.

Although as a continent Africa has many countries, the seed sector is not uniformly well developed in all countries. Hence, it should be possible to identify countries at different stages of seed sector development and formulate policies for engagement accordingly. For example, the private sector in India will have to work with public sector in countries where the public sector is often the dominant or perhaps the only major player while ICAR can engage with universities and research institutes in capacity building. This engagement should be done as part of a broader strategy in India-Africa cooperation in agriculture.

India and Africa have already in place a platform in the form of Africa-India Cooperation Framework. This platform should be used to further build and promote the cooperation in R&D and trade between Indian and African stakeholders in the area of seeds. Promising and successful varieties of seeds should gain entry into individual African countries for national performance trials and registration. Regional bodies such as AATF, AFSTA, EAC, ECOWAS and SADC should be engaged further into aiding in the registration process with reduced data requirements for which the existing partnership has prior experience and expertise.

In order to develop a comprehensive agenda to take forward these suggestions a working group can be set up and its recommendations should be given priority.

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The Forum for Indian Development Cooperation (FIDC) is a platform launched to explore various facets of Indian development cooperation policy with its partner countries. The objective is to encourage debate and analytical research on all the broad constituents of India's development partnership spectrum in order to bolster policy making process in this field of critical importance. Thrust of the forum would be to substantially contribute in facilitating an informed debate on policy framework of India and other developing countries.

The FIDC would also try to follow broad trends in South-South cooperation and analyse contributions and impact of Indian policies. The Forum will establish dialogue with the relevant government agencies and academia with a focus on South-South cooperation. The FIDC would also establish linkages and dialogue with international agencies, experts from the partner countries and advanced countries with a view to meet its comprehensive multi-faceted objectives. The FIDC is housed in RIS, New Delhi.

– Strengthening Indian development cooperation policy towards promoting South-South cooperation

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