FAO Regional Meeting on Agricultural Biotechnologies in Sustainable Food Systems and Nutrition in Sub-Saharan Africa, to be held in the African Union Conference Center, Addis Ababa, Ethiopia, 22-24 November 2017 (http://www.fao.org/africa/events/detail-events/en/c/1035227/)

Abstracts of the presentations from the plenary and parallel sessions on 22-24 November 2017. (This file will be updated gradually as more abstracts are provided by the speakers. The file was last updated on 14 November and 23 abstracts were available at that time). All abstracts will be provided on the meeting website as they become available.

22 November 2017

Plenary Session 3: The state of application, capacities and the enabling environment for agricultural biotechnologies in Sub-Saharan Africa

State of agricultural biotechnology applications, capacities and enabling environment in sub-Saharan Africa

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This presentation summarizes results of a background study of SSA countries commissioned by FAO. The study examined research and applications of a range of technologies covering four sectors (crops, livestock, forestry and fisheries/aquaculture) and the capacities available for research and use, and the extent to which the environment underpinning these practices is enabling or not. The treatment of biotechnology in the study is broad, covering: 'low-tech' (e.g. conventional crossbreeding, bio-fertilisers, AI in livestock, polyploidy in farmed fish); 'medium-tech' (e.g. use of PCR tools or DNA marker-assisted selection – in crops, livestock, forestry or fishery sectors, ET in livestock, tissue culture in crops and trees); and 'high-tech' (gene editing, genome sequencing; genetic engineering; and cloning of livestock). The study was based on secondary data – from comprehensive literature review, questionnaire surveys and consultations of stakeholders. Overall, only a small number of countries (notably South Africa, Kenya, and Nigeria) are consistently strong. A number of countries (30-40% of countries) are in the medium category, while 45-55% are consistently very weak to weak in all sectors. Applications and capacities in forestry and fisheries were consistently low across most countries – even where their relative contributions suggest otherwise. Human capacity, facilities, policies, poor intellectual property (IP) environment, awareness and public participation, and under-investment in technology commercialization were the major gaps. Human capacity represents the greatest opportunity because it has potential to catalyze resolution of the other challenges.

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Low productivity is common feature of African agriculture. Major factors responsible for this include low adoption of improved technology, declining soil fertility, prolonged drought, high incidence of pests and

diseases, use of traditional agronomic practices and rain-fed agriculture. Also responsible are inadequate human capacity and limited application of modern biosciences in agriculture sector. Realizing the importance of biosciences in agriculture transformation elsewhere, a number of strong biotechnology initiatives have been implemented across the continent since the beginning of this century by establishing national and regional centers of excellence such as: African Center of Excellence (ACE I & II), East African Agricultural Productivity Program (EAAPP), West African Agricultural Transformation Program (WAATP), Southern African Network for Biosciences (SANBio) and Biosciences eastern and central Africa-International Livestock Research Institute (BecA-ILRI) Hub. These Centers provide access to state-of-the-art biosciences research facilities and trainings to African scientists who conduct research for the transformation of African agriculture. Moreover, these centers support conducive frameworks for increased intra-African cooperation and linkages with international centers, standardization and harmonization of policy and regulations, improved access to quality energy and internet, and improved capacity to generate, use and translate biological data into products and value addition.

The state and application of Biotechnology for the production of veterinary vaccines and diagnostic tools

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Animal health is potentially the most important aspect of animal production and any development in the area of biotechnology will greatly benefit the industry. Biotechnologies are used in animal health to increase the precision of disease diagnosis as well as for disease control and treatment. It offers a range of tools to improve our understanding and management of genetic resources for food and agriculture. Biotechnology is already making a contribution to breeding and conservation programs and to facilitate the diagnosis, treatment and prevention of animal diseases. Genetically engineered vaccines are being developed to protect fish and livestock against pathogens and parasites. Recombinant DNA (rDNA) technology has indeed made tremendous breakthrough in the discovery of various vaccines or diagnostic antigens. Enzyme-linked immunosorbent assays have become the standard means of diagnosing and monitoring many animal diseases worldwide. In the past fifteen years, veterinary diagnosticians have incorporated new molecular techniques such as the polymerase chain reaction and Western blot, and improved older techniques through the use of recombinant antigens, monoclonal antibodies and synthetic peptides. Simple hand-held devices that rely on the binding specificity of monoclonal antibodies or recombinant antigens to diagnose infection may be easily adapted for use in settings without running water, refrigeration or electricity. This presentation will review the current and potential uses of biotechnology in veterinary vaccine production and diagnostics.

Parallel session 1: Biotechnologies for the characterisation, conservation and sustainable use of genetic resources for food and agriculture

How genomic characterization of livestock populations can benefit smallholder livestock keepers

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Livestock production in Africa is predominantly comprised of smallholder farmers, who depend on this practice as a means of livelihood. Major barriers to income security include low productivity per head of animal as a result of poor quality feed, heat stress, and high prevalence of disease and parasite burden. The application of genomic methodologies and technologies has the potential to improve production, through the discovery of important adaptive variants that help maintain consistent production for smallholder farmers.

The application of genomic technology such as genome wide association analysis and signatures of selection, first steps towards characterization of local animal genetic resources, can set the framework for informed strategic breeding programmes that enhance the rate of genetic improvement of indigenous livestock. In addition, use of crossbreeding or advanced breeding with cheap marker panels can maintain

presence of adaptive traits, while allowing the introgression of associated favourable genes for increased productivity traits.

However, developing a critical mass of highly skilled professionals, strengthening of institutions with relevant mandate and creating awareness among the farmers is vital to the deployment of these technologies in order to achieve improvement in livestock productivity and livelihood of the smallholder livestock keeper in the target African region.

Parallel session 2: Capacity, knowledge and reaching farmers regarding agricultural biotechnologies

National capacity building initiatives for biotechnology development: The case of Ethiopia

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Food and nutrition security are utmost challenges in many Sub-Saharan Africa countries, including Ethiopia. This is further exacerbated by population growth, climate change and depletion of resources, which contributed to low and inefficient productivity of the agricultural sector. Harnessing biotechnology to modernize agricultural production is one of the most plausible means to respond to agricultural challenges and enhance the productivity of the sector.

Given the huge biodiversity Ethiopia has, application of biotechnology is expected to give the country a competitive advantage in the global biotechnology market. Recently the government of Ethiopia identified biotechnology as an engine that can drive the country's social economic development. Accordingly, a Ministerial Steering Committee was established along with National Biotechnology Taskforce and developed Biotechnology Roadmap for coming 10 years, which gives emphasis on the need to build national capacity for biotechnology, and has set specific goals. The roadmap was developed based on expert group survey of the current national status of biotechnology R&D, national potential in the sector, national Growth and Transformation Plans (I, II & III); development needs of the country, benchmark visits and experience sharing with various developing country.

Following the roadmap, implementation documents have been prepared as part of the National Biotechnology Research and Development Plan including Curriculum Review and Development (BSc, MSc, PhD, short-term training); Laboratory Infrastructure; Regulatory Framework Guidelines; Biotechnology Investment and Marketing; Biotech Module and Laboratory Protocol for high school teachers. For proper implementation of the plan, the government has established the Ethiopian Biotechnology Council and Ethiopian Institute of Biotechnology (EBTi) to lead and coordination the national R&D endeavors. All the documents point towards technological leapfrogging and fast track approach to develop biotechnology products and services in agriculture and other relevant sectors. As biotechnology is capital and knowledge intensive, proper investment as well as coordinated effort will lead to reap its benefits for national economic development.

Strengthening rural advisory services in Africa, with perspectives on agricultural biotechnologies

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Agricultural biotechnology has demonstrated that it can play a role in the sustainable agricultural production to meet the world's food and feed needs and support the management of natural resources. However, to meet the food needs, agricultural biotechnologies should be considered in tandem with all other technologies, as well as production practices and use of appropriate approaches and tools. In Africa, particularly, the successful development and application of biotechnology for smallholders requires well-functioning research institutions, rural advisory services, markets, farmer organizations and components of the agricultural innovation system.

One of the weak link in the application of technologies in general and agricultural biotechnology in particular are the inherent weaknesses in agricultural extension and advisory services (AEAS), which is critical in scaling out technology application. The AEAS has greatly undergone a paradigm shift and it goes beyond technology transfer to facilitation, beyond training to education, and includes assisting farmer groups to form and organize, innovate and to be competitive, and to deal with marketing issues

and to form partnerships with a broad range of stakeholders. The AEAS are therefore the critical last mile link to uptake and scaling out of biotechnology. They are, however, faced with several challenges, which include the weak policy and institutional arena they work in, the inadequate capacities at all levels (systems, organizational and individual), weak knowledge management systems for agricultural research & development (ARD) & innovations, low funding base and inadequate co-learning opportunities. For effective and profitable deployment of biotechnology products by farmers, the strengthening of AEAS is a precondition.

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Plenary session 4: The role of agricultural biotechnologies in addressing the food security and nutrition challenges in the region

A global perspective on agri-biotechnology research in Africa
Margaret Gill
CGIAR Independent Science and Partnership Council, Rome, Italy

The talk will start by illustrating some biotechnologies which have the potential to help smallholders and provide examples of success from sub-Saharan Africa. It will explore some of the factors which prevent smallholders from adopting biotechnologies and analyse how removal of these could have broader benefits. It will finish with some recommendations as to what this means for research agendas.

Parallel session 3: Improving productivity and resource use efficiency using biotechnologies

Using genomics to bridge the productivity gap: A case study of application in livestock and fish
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Biotechnology tools such as artificial insemination (AI), in vitro fertilization (IVF) and embryo transfer, genomics and gene editing are critical in the quest to bridge productivity gaps due to inappropriate breeds and strains of livestock. We present data on AI preference and adoption in smallholder dairy systems in Eastern Africa and how lack of a recording system has led to poor breed utilization. We present data illustrating how genetic markers can be applied to alleviate the problem. Case studies are derived from a Rwandan dairy program, smallholder dairy farms in Lushoto and Rungwe districts of Tanzania, indigenous pigs in western Kenya and dairy goat populations in central and Nyanza regions of Kenya. Potential usage in fish conservation is also explored. However, closing the yield gap is hampered by a lack of performance records such that there is no effective recording and evaluation systems in Eastern Africa. Most efforts have had small sample sizes and limited geographies such that results are only of localized importance. We present a farmer driven decision support tool for data collection and performance evaluation that can help in the emergence of effective data driven decision making in breed choice and utilization.

Case studies on applications of biotechnology to tilapia and catfish in Nigeria
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Nigeria with its vast natural water resources has ranked 2nd next to Egypt in total fish production by aquaculture in Sub-Saharan Africa. The major fish produced are *Clarias gariepinus, Heterobranchus bidorsalis* and *Oreochromis niloticus.* Among the recent developments in the culture of these fish practiced by many fish farmers mainly in Southwest Nigeria is biotechnology, *i.e*. interspecific hybridization of *C. gariepinus* and *H. bidorsalis* or *H. longifilis* to produce faster growing Heteroclarias or Clariobranchus hybrids and for Oreochnromis, production of monosex tilapia either by hybridization, importation of the genetically improved farmed tilapia (GIFT) or Super YY tilapia or sex reversal using

methyltestosterone or masculinization using steroidogenic plant extracts. These technologies are rather confined to big scale commercial farms which can produce their own hybrid and monosex fry and fingerlings for their own production and sell the rest to small scale farmers. These technologies, though confined in the South are fast gaining popularity. The Nigerian government's current fish self-sufficiency drive is supporting farmers to produce more fish per unit volume. However, national and regional collaborative efforts among local universities and research institutes with organization and funding from international organizations are suggested to generate concerted biotechnological innovations in improving the genetic quality of Clarias and tilapia broodstock, their health and feed conversion efficiency.

Application of biotechnology in forest tree breeding: A case study of breeding Melia volkensii for drought tolerance in Kenya

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About 40% of global landmass is dryland and the proportion is projected to increase due to climate change. Furthermore, forest genetic resources in these ecosystems are threatened by overexploitation and degradation. Our goal was to develop drought tolerant *Melia volkensii* varieties for commercial and reforestation programmes in the drylands of Kenya. The species is multipurpose and native to the drylands of East Africa. We use microsatellite markers to assess genetic diversity of the species across the range, delineate populations, select and grade elite trees from the populations based on aridity index. We used the elite trees to establish first generation seed orchards and progeny trials. The elite tree were genotyped for traceability. We developed an *in-vitro* propagation protocol for mass production of the elite germplasm. We found high levels of genetic diversity and genetic differentiation among populations and used this information in selection of the elite germplasm. One hundred elite trees were selected and used in establishment of two clonal seed orchards. Our study established significant relationship between drought tolerance index and genotypes, which will be used in future selections. The *in-vitro* propagation protocol developed during this study will be used for mass propagation of the elite germplasm.

Parallel session 4: Food safety, post-harvest and agro-processing: The role of biotechnologies

The Aflasafe Initiative, developing biocontrol products to reduce aflatoxin contamination in maize and groundnuts across Sub-Saharan Africa

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Maize and groundnut contamination with aflatoxins is frequent across sub-Saharan Africa (SSA). Aflatoxins pose major challenges to health, food security, and trade, and affect farmers, traders, markets, and finally consumers. Several *Aspergillus* species produce aflatoxins. However, within *Aspergillus* communities, there are atoxigenic genotypes (i.e., do not produce aflatoxins) that can be used as biocontrol agents to reduce crop contamination. This safe, environmentally friendly, and effective technology was initiated in the US, where >million acres of susceptible crops are treated annually. Since 2003, the technology has been adapted and improved for use in SSA. Biocontrol products based on atoxigenic A. *flavus* genotypes have been developed for 11 SSA nations under the tradename Aflasafe; more products are underway. Leading-edge technology has been developed for large-scale manufacturing of Aflasafe. Treated crops contain >80% less aflatoxins compared to untreated crops, in both field and storage conditions. Using Aflasafe, along with other aflatoxin-minimizing tools, is improving human and animal health, increasing food safety, and linking farmers to premium markets. The International Institute of Tropical Agriculture (IITA) is identifying key partners for production, commercialization, and use of Aflasafe at scale as a part of the Aflasafe Technology Transfer and Commercialization project, funded by USAID and the Bill & Melinda Gates Foundation.

The use of biotechnologies in post-harvest handling and management in the fishery sector

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Fish consumption patterns in many developing countries are based on locally and seasonally available products with supply driving the chain. Processing and preservation of fish minimizes waste whilst storing up the much needed protein for more profitable trade during the low fish catch periods. Common preservation methods employed are smoking, frying, freezing, salting, drying and fermentation. Fermentation is the second most widely used form of preservation after smoking in Ghana. It is one of the oldest low-cost biotechnology fish preservation tools in these countries and it is usually used by woman with basic or no formal education. It adds value and variety to fish which otherwise could have been discarded due to poor quality. Fermented fish is consumed as a main protein source in a meal or is added as a condiment for aroma and taste. The presentation is a review of the process of fish fermentation in the West Africa and its value addition to otherwise fish of poor quality.

Metagenomics in food safety: what's the added value? Case studies from the livestock sector in Tanzania and Uganda

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In most countries, food safety monitoring relies on costly and time demanding laboratory processes. Metagenomics – the study of microorganisms by direct extraction and sequencing of DNA from environmental samples - could offer a faster alternative to the comprehensive assessment of microbial presence in food. We investigated the comparative advantages of metagenomics versus conventional microbiology to evaluate the safety of food products in two African countries: milk in Tanzania and pork in Kampala, Uganda.

DNA was extracted from the milk and pork samples, for 16S Metagenomics and DNA-Metagenomics analysis, respectively. At the same time, conventional laboratory methods for count and identification of selected pathogens were applied to both products. The data generated with the former gave a comprehensive overview of microbial diversity in the food and of relative importance of various microbial genera. While the method allows for identification and discovery of microorganisms not previously reported or expected in such food products, it does not inform on the presence of health hazards per se, as unable to discern viable from death microbial cells. Although not a substitute for conventional microbiology, the method has potential when used in combination with conventional methods or as screening procedure and for blue-sky research on food safety.

Parallel session 5: Biotechnologies to enable smallholders to adapt to climate change

Perspectives from a farmer organization on climate change and the role that biotechnologies can play in enabling smallholders to adapt

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As farmers we are ready to embrace technology that is helpful towards improving our productivity and optimizing our returns. We are now living in the era of climate change where historical weather data can no longer be relied upon to predict the future weather.
Biotechnology is an area that is not well understood by farmers as many mistake it to be synonymous with GMOs. In 2011 the Eastern Africa Farmers Federation (EAFF) commissioned a study on Biotechnology and GMOs with a view of advising our members on the way forward, and we developed a position on the same. In both documents it was very clear that some of the following should be addressed:

- Fundamentals of production & markets –Currently the conventional challenges farmers face are access to markets (& financial services) and climate change which then informs the level of investments in agronomy (certified inputs and labour) and risk mitigation/management. Therefore there is need to address the entire value chain from a business and small holder perspective when developing biotechnologies.

- Communication/awareness – the current approaches are skewed towards research(ers) as seen in many forums. There is need for a deliberate effort to involve the civil society, consumers as well as farmers (all levels). There are many myths that need to be debunked in terms of health concerns, environmental concerns and seed systems.

There are many opportunities for biotechnology to address from droughts, floods, pests, post harvest, salinity, crop nutrition, productivity and marketability of products. Biotech should enhance certainty and predictability to ease decisions on planning, policy and investment with all value chain actors (public and private); it should also embrace use of business models that will be attractive to the market, investors and the farmers.

Development and deployment of climate resilient maize in sub-Saharan Africa through integration of novel tools and technologies

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With more than 35 million ha harvested each year, maize is the most important staple food crop in sub-Saharan Africa (SSA). Integrated use of novel tools and technologies is key for improving genetic gains in the stress-prone environments of SSA. In the last two years, CIMMYT team has developed more than 92,000 doubled haploid (DH) lines from diverse Africa-adapted maize genetic backgrounds. Improved CIMMYT-derived maize hybrids using DH lines as parents have been developed, and now being commercialized in SSA. Breeder-ready markers are being used for improving resistance to Maize Streak Virus (MSV), and for provitamin A enrichment in maize. CIMMYT has also undertaken the largest MARS and GS program in SSA, demonstrating 2-3-fold higher grain yield using marker-assisted recurrent selection (MARS) and genomic selection (GS) compared to conventional pedigree-based selection. Marker-assisted backcrossing (MABC) has been successfully implemented for conversion of 23 elite but maize lethal necrosis (MLN)-susceptible parental lines of widely-used commercial hybrids in SSA. Molecular marker-based quality assurance/quality control (QA/QC) has been optimized to ensure genetic purity and genetic identity of important breeding materials and early generation seed stocks. Under the Water Efficient Maize for Africa (WEMA) project, confined field trials of transgenic drought tolerant (DT MON87460), transgenic insect resistant (MON810 and MON89034) and stacked (DT and Bt) have been conducted with promising results.

Africa in a changing global climate: The need for rapid diagnostic tests to deal with emerging fish disease challenges

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Floodplains support Africa's most productive inland fisheries. The nutritional needs of large populations of rural people who have little access to other sources of animal protein depend on this resource. During the 10 years since Epizootic Ulcerative Syndrome (EUS) was first reported from Africa, the disease has had its greatest impact on floodplain fish where EUS outbreaks have been linked to drought-flood cycles. These are anticipated to increase in frequency and severity in Sub-Saharan Africa in response to global climate change. The extent of the negative impact of EUS on species composition and productivity of Africa's flood plain fisheries is not yet known but is likely to increase. This may have potentially grave consequences for people dependent on this natural resource. Rapid means of diagnosis will greatly enhance essential surveillance activities.

The commercial production of Nile tilapia is increasingly replacing the declining production of natural inland fisheries in a number of African countries. The two major tilapia producing water bodies, Lake Volta and Lake Kariba, have come under increasing environmental pressure associated with periodic low inflows into these lakes. Whether these reflect natural climate variability or a consequence of global climate change is not clear. A dramatic increase in disease outbreaks on Nile tilapia farms has

been associated with these low flow periods. Environmental stress under such conditions may have been compounded by introduction of an exotic virus pathogen and emergence of increasingly virulent bacterial pathogens. Climate variability associated with global climate change is likely to drive the severity of disease outbreaks in these farms. As in the case for EUS, rapid diagnostic tests will be needed to deal with the challenges of implementing control measures against outbreaks of infection with pathogens such as Tilapia lake virus, *Streptococcus agalactiae* and *Lactococcus garvieae*.

Analysis of genetic diversity of the African Locust Bean (Parkia biglobosa) to improve its strategy of conservation and breeding in the face of climate change

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Parkia biglobosa is a food and medicinal tree widespread in agroforestry parklands in West African savannahs. Seeds and sweet pulp are the most marketed products, culturally valued, contributing to income generation and improvement of diets. The species is not threatened but the extension of the range has declined and some populations are under strong pressure from overexploitation and climate change. Understanding the contemporary genetic variation is crucial for the conservation and sustainable utilization of its genetic resources. Therefore, we used microsatellites to investigate molecular diversity of 84 populations from 12 countries in West and Central Africa. In addition, we used bioclimatic data and more than 2,000 occurrence records of P. *biglobosa* from across its natural range to investigate the modelled distribution of the species under present and past climate conditions. Combining the findings from the genetic analyses and the distribution modelling, we derived important insight on how to improve conservation and breeding for this valuable tree species.

Use of biotechnology tools to combat Rift Valley fever (RVF) in Africa

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RVF is a major animal and public health problem in Africa and part of the Arabic Peninsula, caused by a mosquito borne virus. Outbreaks occur in interval of several years. The disease has a considerable impact on livestock producers including smallholder farmers and the whole livestock industry, while constituting a serious public health challenge with human infection and mortalities. The costs of an outbreak can be considerable; examples include the East African outbreaks of 1997-1998, estimated at over USD 250 million, the 2006-2007, with 237 human deaths, livestock losses estimated at USD 30 million in Kenya and the 2010 outbreak in South Africa, with 26 human fatalities, livestock losses estimated around USD 20 million. RVF virus is also considered to be a potential bioterrorist threat.

The control of RVF relies on a range of measures, with detection and vaccination being very critical. Detection or diagnosis of the RVF virus or antibodies in human or animals has relied on several tools that have considerably been improved over the past few years and are also aiming at early detection for early responses.

Although RVF has been occurring in all parts of the African continent, South Africa, Kenya and Egypt have been the main producers and users of the different RVF vaccines. Through collaboration between African and foreign institutions, research into improved RVF vaccine has been focusing on several characteristics, including improved safety, combination vaccines for improved uptake and marker vaccines to differentiate infection from vaccination.

Parallel session 6: Resourcing for agriculture and agricultural biotechnologies

Parallel session 7: Public-private partnerships and south-south cooperation involving biotechnologies

African Orphan Crops Consortium (AOCC): A public-private partnership for enablement of African plant scientists through development of open source genomics resources for promoting food and nutritional security in Africa through orphan crops

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The growing African population needs substantial increase in food production along with nutritious food options to address hunger, malnutrition and stunting. The indigenous or naturalized African food crops are inherently nutritious, fortified with minerals, vitamins and antioxidants with the potential to improve resilience of African food systems. To make them sustainably productive and commercially viable there is a need to produce high yielding and climate resilient good quality seed material. The African Orphan Crops Consortium (AOCC, http://africanorphancrops.org), a public-private international partnership seeks to address this gap. Through stakeholder consultations, AOCC selected 101 crops including ~ 50 trees, to generate genomics resources i.e. reference genome, transcriptome, re-sequencing of 100 accessions from each of them and developing single-nucleotide polymorphism (SNP) panels. At present, genome sequences of ten species are ready for release and other 19 are in the process. To enable deployment of these resources in field breeding programs, concurrently, African plant breeding academy (AfPBA) is training 120 African breeders over a period of five years with ~80 already been trained. All these efforts are expected to improve food and nutritional security of Africans, strengthen and develop markets hence raise incomes and make farming landscapes more resilient with diverse tree-crop system.

Public-private partnerships for effective and efficient agricultural technology transfer to smallholders in SSA: The AATF experience

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The absence of robust public private partnerships (PPPs) in Africa is constraining access to good infrastructure and innovative technologies for farmers. PPP mechanisms are crucial to support access and transfer of technologies. African Agricultural Technology Foundation (AATF) in over 10 years has facilitated access, availability and affordability of modern technologies to farmers in Africa through PPPs, bringing along additional investments and leveraging on public funding. AATF has accessed several technologies (including biotech related) for traits associated with climate change, pest and soil management, productivity, food safety/quality, and nutrition. AATF-facilitated PPPs have been built not only to ensure relevant product development but to support deployment and commercialization toward transitioning farmers from subsistence farming into agri-business for poverty alleviation. AATF has brokered royalty-free genes for farmers' use in maize, cowpea, and rice. AATF has over 80 organizations under its PPP platform. In the platform, technologies which otherwise would have been inaccessible are now being deployed in Africa. For example, in the AATF managed Water Efficient Maize for Africa project, over 104 maize hybrids have been released for commercialization. PPPs are indispensable to transforming agriculture in Africa if African farmers are to rapidly modernize production and have links to processing zones, good market and distribution networks.

A case study of cooperation between Brazil and Ghana in the development of bio-fertilizers for grain legumes in northern Ghana

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Savanna Agricultural Research Institute (SARI), located at Nyankpala, 16 km west of Tamale, Northern Region, Ghana, is one of thirteen institutes constituting the Council for Scientific and Industrial Research (CSIR) of Ghana. CSIR-SARI's mandate is to conduct research into food and fibre crop farming in northern Ghana to introduce improved technologies that will enhance agricultural productivity among smallholder farmers. This positions the institute to contribute to UN's SDG goals 1, 2 and 3. CSIR-SARI collaborates with other public- and private-sector organizations/institutions to achieve this mandate. Key among these are agricultural input dealers, international and regional research institutions and one notable south-south co-operation is CSIR-SARI-EMBRAPA collaborative research partnership. Transfer of

biotechnologies and technical skills/knowledge from EMBRAPA to CSIR-SARI during the joint implementation of three projects financed by Africa-Brazil Agricultural Innovation Marketplace and one by Alliance for a Green Revolution in Africa (AGRA) has resulted in the establishment of a novel rhizobium inoculants (bio-fertilizers) production and quality control laboratory at CSIR-SARI. With CSIR-SARI's partnership with a private entrepreneur in a public-private partnership (PPP), this laboratory currently produces quality rhizobium inoculants for enhanced grain legume production which will result in increased protein nutrition and reduced food insecurity among farming communities in northern Ghana.

A regional research and training platform for innovative plant breeding in West Africa[1]

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Harnessing biotechnology and its applications was identified by FAO as a way to increase food supply, quality and nutrition in order to reach some Sustainable Development Goals (SDGs). However, their uses in developing countries need substantial capital and human investments, and technology platforms to generate new discoveries and cutting-edge products. To overcome these challenges, a new research and training partnership model was set up in recent years between two French research institutes (IRD and CIRAD), and national agricultural research systems (NARS) in Senegal, Mali, Niger, and Burkina Faso: the international joint laboratory on plants and microorganisms adaptation to environmental stresses (LAPSE) established in Senegal, and the IAVAO (Innovation and plant breeding in West Africa) regional partnership platform. This North-South and South-south partnership model is aligned with the ISRA/CERAAS Regional Center of Excellence on dryland cereals and associated crops, recently endorsed by CORAF/WECARD, that generates and disseminates agricultural innovations and technologies for West and Central Africa. How this partnership is organized to benefit from complementary assets of each party towards contributing to nutritional and agricultural productivity enhancement through new generation of plant breeding will be discussed.

Parallel session 8: Governance, policy and regulatory processes regarding agricultural biotechnologies

Overview of the work and achievements of the NEPAD-ABNE

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The African Biosafety Network of Expertise (ABNE) is a project of AU/ NEPAD Agency established in 2009 to support the building of functional biosafety regulatory systems for the safe and informed use of modern biotechnology for spearheading agricultural and economic development in African Union member states. ABNE works with national regulatory bodies, regional economic communities such as Common Market for Eastern and Southern Africa (COMESA), Economic Community of West African States **(**ECOWAS) and Southern African Development Community (SADC) and international partners, to create optimal biotechnology regulatory environment that ensures safety to the environment and human health while promoting development. ABNE's services include national biosafety training workshops, regulatory consultancy services, facilitation of networking, biosafety internships, study tours, and information sharing among regulators and policy makers. As a result of the concerted efforts ABNE

[1] Abbreviations: CERAAS [Centre régional pour l'amélioration de l'adaptation à la sécheresse, www.ceraas.org]
CIRAD [Centre de coopération Internationale en Recherche Agronomique pour le Développement, www.cirad.fr]
CORAF/WECARD [Conseil Ouest et Centre africain pour la recherche et le développement agricoles/West and Central Africa Council for Agricultural Research and Development, www.coraf.org]
IRD [Institut de Recherche pour le Développement, www.ird.fr]
ISRA [Institut Sénégalais de Recherches Agricoles, www.isra.sn]

has made in AU member states, countries have been able to develop new or revise existing biosafety legislations to make them broadly workable (e.g. Ethiopia, Mozambique, Nigeria, Tanzania, Uganda). A number of countries that included Ethiopia, Mozambique, Swaziland and Tanzania have started confined field trials of genetically modified (GM) crops. Moreover, countries like Kenya, Malawi and Nigeria have given approvals for environmental release of GM crops. Although ABNE has mandates for providing biosafety services for all AU member states, its current activities mainly focus on 15 AU member states all located in Sub-Saharan Africa which have requested the support of NEPAD Agency. These countries have expressed needs felt in building functional biosafety systems for the safe modern biotechnology in agriculture (e.g. interest in developing functional legislations or revising existing legal instruments to make them workable and /or progress in technology introduction and testing). As more AU member states start to realize the critical role this technology plays towards enhancing food security and agricultural development in Africa, there is an apparent need to enhance biosafety services for better impacts.