

### **Annual Report 2017**

# Delivering Technologies to Farmers through Public-Private Partnerships

Better tools, better harvests, better lives

Northern Tanzania, Kerimasi. A Maasai elder in traditional attire. Red has always been the preferred Maasai colour. Photo credit: Alamy Stock Photo 

## Delivering Technologies to Farmers through Public-Private Partnerships

**Annual Report 2017** 



Nairobi, Kenya

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*Cover:* A Datoga woman in traditional attire relaxes outside her thatched house in Manyara, Tanzania. Photo credit: John Warburton-Lee Photography / Alamy Stock Photo

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### Achievements at a glance



### Who we are

AATF was founded in 2003 with the mandate of tackling poverty and food insecurity through technological interventions. The organisation empowers farmers to transform livelihoods by equipping them with better tools and inputs that would, without the organisation's intervention, take a longer time to reach and/or cost a lot more. AATF is a central figure in facilitating capacity building in regulatory compliance, intellectual property management, biotechnology development, agribusiness and stewardship in the region.

Working with 80 partners through 10 projects, AATF seeks to address various challenges bedevilling various staple crops in 13 countries in Sub-Saharan Africa. These crops include maize, rice, cassava, cowpeas, bananas and potatoes – depended on by over 160 million households. Towards this end, AATF has facilitated transfer of over \$400 million worth of technologies, comprising seed and non-seed-based products.

### Key priority areas

- Climate change mitigating impact of climate change on agriculture.
- Pest management developing technologies for pest management that are affordable, safe, effective and environmentally friendly.
- Mechanisation adopting efficient tools for better yields.



## Message from the Board Chair



Ousmane Badiane, AATF Board Chair

For decades, Africa did not reach its potential to ensure an adequate standard of living for its citizens. Since the beginning of the new millennium, Africa has shown a remarkable recovery, bringing stronger economic growth, faster poverty reduction, and an expanding middle class. The economic recovery was bolstered by the upturn in Africa's agriculture, which emerged from a long period of stagnation and decline to provide increased incomes and improved food security.

However, the prior decades of crisis left Africa with the highest poverty rates, and the largest number of poor people, of any world region. Many African farmers still work with little or no access to modern inputs and other technology, extension, financing, and markets, leaving them unable to achieve the productivity gains seen elsewhere. Growth in demand is outstripping agricultural production increases, resulting in a widening agricultural trade deficit. The remaining challenges make it vital to sustain and deepen the agricultural and economic recovery to expand the achievements of recent years.

African leaders have committed to harnessing the potential of agriculture to contribute to the continent's well-being. The African Union's Agenda 2063, launched in 2013, outlined Africa's aspirations for the future, including to increase agricultural productivity in support of Africa's prosperity and food security. The following year, African leaders adopted the 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared

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Prosperity and Improved Livelihoods. They pledged to double agricultural productivity by improving access to inputs, knowledge and other resources, as part of their commitment to end hunger in Africa by 2025.

Other regions that have successfully translated higher agricultural productivity into overall economic growth offer several lessons for Africa. Central among these is that broad access to and use of improved technologies on the farm and along the value chain is key to agricultural transformation. Moving new technologies from research into farmers' hands takes more than a good product, it also requires an enabling environment that supports transactions right across the food value chain – a key part of that being policy and regulations.

This is where the work of AATF is making a difference. We are making real impact in negotiating for those technologies that will make a difference to the poor. We are working with the private owners of technology and are making considerable success in debunking the theory that profit motive means private industry lacks real interest in the world's poor farmers.

We are contributing towards realisation of supportive public polices, adequate regulation and public appreciation and uptake of new technologies such as biotechnologies. We are using social marketing approaches to create demand and deliver new products to farmers, and many are giving testimony of the change they are seeing, on their farms and in their lives, some merely as a result of switching to modern crop varieties.

I am reminded of Eunice Anyango from Kenya's Nyakach in Kisumu County, who changed from planting her 'farmers choice' maize seed variety to StrigAway maize and was able to transform her family's fortunes from '... a small farmer packing maize in small tins to take to the local retail market...' to one who supplies maize to the local boarding school, receiving payment in cheque as opposed to coins at the market. You can read her story on *https://aatfnews. aatf-africa.org/?p=804* or on page 29 of this report.

We can also report considerable traction with the switch to mechanisation for greater productivity and to eliminate the physical toil associated with farming in Africa. Making agriculture less strenuous will attract the youth to agriculture, a resource that abounds in Africa but which the continent has up to now not fully utilised.

We are grateful for the goodwill from partners and donors, who have demonstrated concurrence with our mission of eradicating hunger and poverty among smallholder farmers in the continent through agricultural technology.

With their support, we are confident that even in the coming year, we will continue to achieve more, to deliver the promise of better livelihoods to Africa's farmers.

**Ousmane Badiane**, AATF Board Chair

## 'It is not ideology that feeds people, it is science'

- World Food Prize winner and AfDB president Dr Akinuumi Adesina (https://www.youtube.com/watch?v=NcF1Iy4CV60&t=132s)



- Soil management improving crop adaption for resource use efficiency.
- Enabling environment addressing obstacles that hinder end-user access to technologies.
- Improving breeding methods – using new breeding tools for improved breeding selection and accuracy.
- Improving food safety and quality – developing food safety systems for health and trade.

### **Partners**

- African governments
- Regional and sub-regional organisations and economic communities in Africa
- Farmers and farmer groups
- International agricultural research institutes (ARIs) and research centers affiliated with the Consultative Group on International Agricultural Research (CGIAR)
- Local and international notfor-profit organisations
- Leading industry technology developers (Monsanto, Arcadia Biosciences, Academia Sinica, BASF, DowAgro, Pioneer/DuPont, Syngenta)
- African seed traders and agribusiness organisations

# Message from the Executive Director



Denis T Kyetere, AATF Executive Director

Developing Africa's agriculture is an exciting undertaking that also includes dealing with a multitude of challenges, including a reliance on rain-fed systems that have recently been disrupted by climate change, low soil fertility, low access to finance, a poor market infrastructure, and emerging pests and diseases. It is also about the challenges expected while introducing relatively new concepts and creating legal, regulatory and policy pathways for them.

In 2017 we recorded exciting developments that supported our quest for getting innovative technologies that impact lives into farmers' hands. We also experienced some challenges but these are normal and we are working with partners in addressing them.

A key development was the launch of the QualiBasic Seed Company (QBS) at the end of January 2017, made possible largely by a five-year grant of US\$8.4 million from the Bill and Melinda Gates Foundation. QBS is a unique business venture that seeks to fill the gap between the release of high yielding crop varieties by breeders and efforts by small- and medium-size seed companies to produce sufficient certified seed. With headquarters in Nairobi and offices in Zambia and South Africa and run by staff who have vast experience in seed production and merchandising, QBS will focus on timely production of quality foundation (basic) seed on behalf of the seed companies. AATF is nurturing the company through its first five years. We also recorded some firsts such as Mozambique's first planting of transgenic confined field trial under the Water Efficient Maize for Africa (WEMA) Project. With this trial of the WEMA stacked DT + Bt, Mozambique joins the other WEMA countries – Kenya, South Africa, Tanzania and Uganda – in assessing the drought tolerant (DT) and insect protected (Bt) maize varieties.

Another first was release of the first set of maize hybrids with tolerance to Maize Lethal Necrosis (MLN) disease through the WEMA Project. This disease is impacting performance of some of the best maize hybrids causing havoc not only to farmers' fields but to food security in affected countries such as Kenya.

The performance of our *Bt* maize against the Fall Armyworm (FAW) attack on maize in parts of Sub-Saharan Africa (SSA) was another key development that brings hope to our farmers. While Bt maize was intended for the control of stem borers, the unexpected invasion of FAW increased its significance and worth for SSA. The FAW is more damaging than stem borers and can destroy whole maize fields in a few days. Observations in all Bt maize trials in Kenya, Mozambique, South Africa and Uganda indicated significant reduction of damage by FAW infestations. Preliminary results showed that under natural infestation of both stem borer and FAW in Uganda and Mozambique, the stacked DT + *Bt* (TELA<sup>®</sup>) varieties yielded more than the nontransgenic (isogenic) varieties, with some showing yield advantage of 9%-98% better than isogenic varieties. Similarly, under natural infestation of FAW and artificial infestation of stem borer in Kenya, some

stacked TELA<sup>®</sup> varieties yielded 15%–27% higher than non-transgenic versions of the same varieties. This is an exciting development and we look forward to regulatory approvals for *Bt* maize to enable release to farmers.

A major occurrence during 2017 was initiation of a new partnership project with the International Potato Center (CIP) and Academia Sinica, Taiwan, for controlling bacterial wilt in potatoes. Potato is an ideal food security crop due to its year-round production but its production is hampered by bacterial wilt (BW) disease. The goal of this project is to develop transgenic potatoes of the farmer-preferred variety 'Shangi' with resistance to bacterial wilt.

Further contribution towards climate smart technologies was the successful installation of rainout shelters in Ghana, Nigeria and Uganda to support the wateruse efficient trials of the triple-stacked Nitrogen-Use Efficient Water-Use Efficient and Salt Tolerant (NEWEST) rice events. The shelters will prevent rain water from interfering with the water-use efficiency trials during the imposed water stress periods of the NEWEST rice and facilitate evaluation of events.

We continued our work towards addressing the spread of MLN through our drive towards maize chlorotic mottle virus (MCMV)-free commercial maize seed production in MLN-endemic countries. So far, 404 outgrowers and 56 seed companies were trained in Ethiopia, Rwanda, Tanzania and Uganda. This outreach also included farmer education on the importance of certified seed to prevent MLN virus reinfection on the farms.

The friends of our friends are our friends - Congolese proverb

For food quality management, our partnership with the Common Market for Eastern and Southern Africa (COMESA) and the United States Department of Agriculture Foreign Agricultural Service (USDA-FAS) contributed equipment worth over US\$36,000 to the Kenya Bureau of Standards and Uganda Bureau of Standards to be used for testing for aflatoxin in maize and peanuts. This followed concerns of critical levels of aflatoxin contamination in foods in East Africa.

The Hybrid Rice Project completed the second national performance trials (NPTs) for 15 hybrids in Kenya, from which 8 early maturing and high yielding varieties were selected and are undergoing distinctness, uniformity and stability (DUS) observations. The yields from these varieties are very encouraging at 7–10 tonnes per hectare compared to 3 tonnes per hectare for the commercially available varieties. A number of seed companies are waiting to take up these hybrids.

Two projects are preparing to enter the deregulation (environmental release) phase between 2018 and 2019. The NEWEST Rice Project selected lead and back-up events – NUE12 and NUE9 respectively – for regulatory trials towards environmental release. The *Maruca* Pod-Borer Resistant Cowpea Project carried out confined farmer-managed trials, insecticide reduction trials and efficacy tests of the Metarhizium-based bio-pesticide. These activities will strengthen the integrated pest management strategy for the effective control of *Maruca* and other cowpea pod-sucking pests.

Interest in agricultural technology by youth continues to grow. Through our Cassava Mechanisation and Agro-Processing Project (CAMAP), 75 youth in Nigeria established mechanised cassava farms covering 90ha through the project's youth agri-business empowerment initiative. In addition, we have seen youth stand up for biotechnology in various countries in recognition of its potential for job opportunities in addition to food security issues.

The Seeds2B Project that focuses on getting better performing seed to boost farmer productivity received US\$1,225,000 from USAID and the Syngenta Foundation for Sustainable Agriculture (SFSA) under the Partnership for Africa Seed Technology Transfer Activity (PASTTA) to support its work for the next three years. The project engaged 12 private technology owners in 2017 from Brazil, France, Holland, India and Switzerland to assess high performing adaptable and market appropriate cultivars for Africa.

The environment for technology access and delivery continues to be a matter of concern even as we celebrate positive developments that indicate better things to come. Inefficiencies in input and output markets and the policy environment hamper efforts and goals of getting value adding technologies into the hands of farmers. We continue to fully engage ourselves in efforts towards building an enabling environment not just for better understanding of the science of agricultural biotechnology, but also for changes in legislative frameworks to advance research.

We wish to recognise and appreciate efforts by governments, institutions and individuals who dedicate themselves to helping shape the legal, policy and regulatory environments for agricultural and economic development on our continent. It takes great commitment, patience and high tolerance for pain that often comes with unrealised hopes and promises.

During 2017, we saw good developments towards enhancing use of science and technology in agriculture that point to a better future. New countries, such as Mozambique, commenced confined field trial (CFT) activities. We witnessed increased interest in *Bt* cotton in three countries – Ethiopia, Kenya and Nigeria. The Uganda parliament finally passed the Biosafety Bill that now awaits presidential assent. We continue to contribute towards attainment of a more conducive environment for scientific innovations for agricultural development through various engagements with policy, decision makers and farmers.

We continued to benefit from the support of our main investors and are grateful for their belief in AATF as they enable realisation of our mandate. We also reached out to new donors who received our proposals well and we look forward to further engagement.

The past year was therefore productive and the few challenges that we came across – some of which continue to 2018 – are being addressed as part of our mandate. We are grateful to all our partners, investors, staff, Board of Trustees, researchers, and other professionals we engage with during the performance of our work. An exciting 2018 awaits us!

#### Denis T Kyetere,

AATF Executive Director



## **Highlights**

#### January

On 30 January, AATF announced the establishment of Qualibasic Seed Company (QBS), for effective and efficient supply of high quality foundation seed to small and medium enterprise (SME) companies in Africa.

#### **February**

- The Agricultural Research Institute (IIAM) in Mozambique, planted the 1<sup>st</sup> GM maize in a confined field trial (CFT) at the Chokwe Experimental Field Station in Chokwe District, Gaza Province on 18 February.
- The 9<sup>th</sup> WEMA Annual Review and Planning Meeting was held in East London, South Africa on 5–10 February. It was attended by 79 people from the partner organisations, and a representative from the Bill and Melinda Gates Foundation.
- The WEMA Project held a product introduction launch for *Bt* maize in East London, South Africa during the 9<sup>th</sup> WEMA Annual Review and Planning Meeting.
- The Open Forum on Agricultural Biotechnology in Africa (OFAB) and MAIZEALL (an international maize alliance uniting corn farmers across America) organised a high-level 'seeing-is-believing'



Workers plant Bt maize at the Chokwe CFT site. The Bt maize was harvested in August 2018



Dr Alois Kullaya with Dr Hussein Mansoor, the Director of Research and Development, Ministry of Agriculture, Tanzania, launching the harvesting of MON87460 at the Makutupora CFT site on 15 February 2017

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Prof Teng Yung Feng (right) stresses a point during the meeting at AATF offices. With him are (left) Moussa Elhadj Adam, Director Finance and Administration, and Alhaji Tejan-Cole, Director Legal Affairs



Dr John Mann updates the AATF Board members on the performance of the Hybrid rice compared to local varieties when they visited the Rice NPT site in Kisumu in March 2017



A journalist takes footage of farmers during the AATF-One Acre Fund soybean field day at the Namikango Experiment Station in Malawi in April 2017

tour to Brazil for Ugandan policy makers and journalists from 20–26 February, where they gained a better understanding of the concept of GMO and its management.

- The first confined field trial of droughttolerant trait (MON87460) in Tanzania was harvested at Makutupora.
- Prof Teng Yung Feng of Academia Sinica, Taiwan, a technology provider and member of the Project Advisory Committee of the Bacterial Wilt Resistant Banana and Potato Project, held a meeting at AATF on how to work together with regard to management of bacterial wilt affecting potato productivity in the country. Prof Feng gave a talk at the International Livestock Research Institute (ILRI) titled 'Technology for cropping under global warming: transgenic and microbiomics' during the visit.

### March

- Members of the AATF Board of Trustees visited the Hybrid Rice: Breeding by Design national performance trial (NPT) site in Kisumu, Kenya to assess the progress of the project.
- The WEMA project conducted a twoday training on intellectual property for Mozambican Agricultural Research Institute (IIAM) scientists in Maputo during which the Director General, Dr Olga Faftine, announced establishment of legal frameworks on intellectual property (IP) for use by scientists.
- Uganda President calls for passing of Biosafety Bill, while on a tour of a demonstration farm at Kawumu State Lodge in Luweero district.. https://geneticliteracyproject. org/2017/04/03/ugandas-presidentsupports-bill-allowing-countrysfarmers-grow-gmo-crops/

#### **April**

- The Seeds2B Project in collaboration with the One Acre Fund, Malawi, organised a soybean field day at the Namikango Experiment Station in Zomba on 3 April that brought together over 250 participants from the seed sector, local government, community leadership and farmer groups.
- AATF organised six 'March for Science' rallies on 22 April in Kenya, Nigeria and Ghana as part of the global effort to create awareness and garner support for scientific research and evidence-based policies.

#### May

- AATF in partnership with the Common Market for Eastern and Southern Africa (COMESA) handed over aflatoxin sampling and testing equipment worth US\$30,000 to the Kenya and Uganda Bureaus of Standards to support uniformity in measurement of Aflatoxin within the two countries. The equipment was handed over by Dr Francis Nangayo, Senior Manager, Regulatory Affairs.
- The Hybrid Rice (Breeding by Design) harvested its second National Performance Trial (NPT) in Kisumu, Kenya, overseen by the Kenya



March4Science Campaign in Nairobi in April. Similar events were organised simultaneously in Embu, Nyahururu and Kakamega towns in Kenya through OFAB Project's support



From Right: Dr Francis Nang'ayo, Senior Manager, Regulatory affairs at AATF, and Francis Mangeni, Director, Food Technology in COMESA, handover Aflatoxin measuring equipment to Ben Manyindo, Executive Director of Uganda National Bureau of Standards (UNBS) and Charles Ongwae, Managing Director, Kenya Bureau of Standards (KEBS)



Workers harvest rice following the second NPT rice trials in Kisumu



Journalists who participated in the West Africa Regional Media Training held 3–5 May 2017 visited the University of Ghana – Legon, Biotechnology Centre to witness DNA extraction process



From left: Dr Marco Ferroni and Moussa Elhadj Adam signing the Seeds2B Project agreement for additional funding in July. Looking on is Donald Mavindidze

Plant Health Inspectorate Services (KEPHIS). The hybrid rice is expected to be released in 2018.

Two regional media trainings on science reporting were organised for West and East African journalists by OFAB, PBR Cowpea and WEMA projects to impart quality and facts in reporting science. The first, was held in Accra, Ghana from 3-5 May and was attended by 30 journalists from Ghana, Nigeria and Burkina Faso. The Chief Guest was Ahmed Yakubu Alhassan, Former Deputy Minister, Ministry of Food and Agriculture, Ghana. The second training was held in Mwanza, Tanzania, from 29–31 May and was attended by 35 journalists.

#### June

- The QualiBasic Seed Company (QBS) held its inaugural Board meeting on 12–13 June in Nairobi, Kenya, following constitution of the board and successful recruitment of the company's Managing Director, Mr Andy Watt.
- AATF held a meeting with Africa Rice on 30 June in Abidjan to discuss collaboration opportunities. The AATF team was led by the Executive Director, Dr Denis Kyetere, while the Africa Rice team was led by the Director General, Dr Harold Roy-Macauley.

### July

- An end-of-project review workshop for the *Striga* Control in Maize Project was held in Nairobi on 19-20 July where progress in commercialisation of StrigAway<sup>TM</sup> (IR) maize technology in Kenya, Uganda and Tanzania was reviewed.
- AATF and the Syngenta Foundation for Sustainable Agriculture signed an agreement extending the Seeds2B

Project's funding with US\$450,000. Dr Marco Ferroni, Executive Director, signed for Syngenta while Mr Moussa Elhadj Adam, Director Finance and Administration, signed for AATF.

OFAB, the Kenya Agricultural Livestock Research Organization (KALRO) and partners organised a study visit on July 22 to the WEMA *Bt/*Dt stacked trial at Kitale, Trans-Nzoia County, Western Kenya for regulators from National Biosafety Authority Board (NBA) and National Biosafety Appeals Board (NBAB).

### August

- The Hybrid Rice Project harvested its second NPT on 25 August at Alupe, Busia, Kenya. The rice outperformed the local checks for all the desired traits such as early maturity, higher yields, and disease resistance.
- Ghana and Nigeria received import permits for a set of new PBR cowpea lines carrying the Cry2Ab transgene developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

#### September

 AATF in partnership with the Ugandan Ministry of Science, Technology and Innovation hosted



*Elorence Akumu winnows rice during the harvest of the second NPT trials of hybrid rice in Alupe, Busia* 



Participants to the StrigAway commercialisation conference held 19-20 July in Nairobi, Kenya



Rt. Hon. Ruhakana Rugunda (second right), Uganda's Prime Minister, and Dr Elioda Tumwesigye (left), Uganda's Minister for Science, Technology and Innovation, among other diginitaries, arrive at Speke Hotel, Entebbe for the opening of the High-Level Conference on Science Technology and Information on 27 September 2017



(From left) Jimmy Lamo, Principal Investigator for NEWEST Rice Project Uganda, James Ogwang, Chair, Institutional Biosafety Committee (IBC), Charles Mugoya, Chair of National Biosafety Committee (NBC), Byaurgaba Beatrice, Director Extension, Ministry of Agriculture, and Denis Kyetere, Executive Director, AATF, commission the rainout shelter at Namulonge, Uganda in September 2017

the first conference on Application of Science, Technology and Innovation in Harnessing African Agricultural Transformation from 27–29 September at the Speke Hotel, Munyonyo to mark OFAB's tenth anniversary. OFAB published a book on its achievements over the ten years and launched the Journalist of the Year Award that recognises and rewards excellence and effectiveness in biotechnology reporting in OFAB countries.

- A Rain out shelter was commissioned in Uganda, Namulonge, on 26 September by the NEWEST Project to strengthen capacity in climate smart agriculture research. This paved way for commencement of evaluation of the triple stacked NEWEST rice events.
- ThefiveTELA<sup>TM</sup> (MON89034*Bt*) hybrids submitted for Variety Registration (listing) in South Africa in 2016 were approved for commercialisation.
- The WEMA Tanzania team received approval to carry out stacked *Bt*/Dt Maize trials and are also granted a plant import permit to facilitate seed importation.
- The PBR Cowpea Project was granted in Burkina Faso an import permit for a set of new PBR cowpea lines carrying the Cry2Ab transgene developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

#### October

The United States Agency for International Development (USAID) Administrator, Mark Green announced partnership with the Syngenta Foundation for Sustainable Agriculture (SFSA), in collaboration with AATF to help smallholder farmers in Senegal, Mali, Kenya, and Malawi gain access to affordable, high-yielding seeds through the Seeds2B project. The announcement was made during the World Food Prize in Des Moines, Iowa.

- AATF paid a courtesy call on HE Chief Olusegun Obasanjo, former president of Nigeria, at his residence in Abeokuta, on 16 October.
- The PBR Cowpea Project held a press conference and field visit in Kano State to address misconceptions by the public that PBR cowpea causes health challenges. The press conference was organised in collaboration with the Agricultural Research Council of Nigeria (ARCN) and the Institute for Agricultural Research (IAR), Ahmadu Bello University (ABU), Zaria. It was attended by 25 journalists from local, national and international media.
- The Ugandan Parliament debated and passed the Biosafety Bill 2012 into an Act on 3–4 October 2017.

#### November

- AATF participated in the annual Seed Traders Association in Kenya (STAK) Expo and Mazao Forum held at the Nairobi School of Government on 23-24 November.
- Hon David Obongo, Permanent Secretary, Ministry of Science and Technology, Uganda, and his team visited Namulonge CFT site for Bt maize trials under the WEMA project on 23 November.



Hon Tom Vilsack (second right), 30th United States Secretary of Agriculture, with Dr Stanford Blade (left), Dr Jeremy Ouedraogo, AATF Board Members and Dr Denis Kyetere, AATF Executive Director, at the World Food Prize Event 2017



Participants to the 'High-Level Conference on Application of Science, Technology and Innovation in Harnessing African Agricultural Transformation' to mark OFAB's 10th Anniversary held at Speke Resort Munyonyo in Uganda, from 27–29 September 2017

# Priority Area 1: Mitigating Impact of Climate Change on Agriculture

### Fortifying agricultural systems

While some years back the issue of climate change or global warming was a topic with considerably conflicting theories, it has now been acknowledged unequivocally as the most disruptive influence on agriculture with significant impacts on food systems.

Climate change is triggered by human activities that exacerbate the increased emission of carbon dioxide and other greenhouse gases into the air. These gases trap heat within the atmosphere, leading to a range of observable effects on water resource, floods, drought, increase in average temperatures, heat-waves, altered precipitation patterns, heightened atmospheric CO<sub>2</sub> concentrations, etc. As a consequence of climate change, the recurrence or persistence of drought and high temperatures have been very devastating on agriculture, with weather data indicating that the last three decades have been successively warmer than all previous decades. The first decade in 21st century has been the warmest on record.

With climate change, crops are exposed to environmental conditions that are outside of their physiological limits and beyond the range to which they are adapted (Ward and Kelly 2004, Shaw and Etterson 2012). They have to deal with increased pressures and combinations of biotic and abiotic stresses which severely affect crop growth and yield.

The abiotic stresses induced by climate change further alter plant-pest interactions leading to increased crop susceptibility to pathogens and insects while also reducing the crop's competitive ability with weeds for resources (Coakley et al. 1999, Scherm and Coakley 2003, McDonald et al. 2009, Ziska et al. 2010, Peters et al. 2014).

# **75–250 million**

Estimated number of people in Africa who may be exposed to increased water stress due to climate change by 2020



Agricultural Research Council (ARC) officials training farmers how to plant refugia during a farmers' information day in South Africa

The brunt of the climate-change related pain is most borne by people living in Sub-Saharan Africa, because the continent's economy and growth is highly dependent on agriculture which is mainly rainfed based for 95% of the production system. The success of the continent's agricultural production system therefore is sensitive to climate variability. When considered against the backdrop of low productivity and high poverty levels, the continent's people are considered the most vulnerable to climate change as they possess minimum financial and technical resources to cope. It is estimated that between 75 and 250 million people in Africa may be exposed to increased water stress due to climate change by 2020 with yield decreasing by up to 50%. Therefore, threats associated with climate change undermine global food security and puts aspirations such as the United Nations Sustainable Development Goal of ending poverty in all its forms in serious jeopardy.

As the most vulnerable continent where agriculture is dominated by small-scale farmers, Africa will need to essentially embrace resilient production systems that

The man who has bread to eat does not appreciate the severity of a famine – Yoruba Proverb



Dr Murenga Mwimali (left), the WEMA Country Coordinator from the Kenya Agricultural and Livestock Research Organization (KALRO), discusses WEMA hybrids with Dr Pindi Chana from the Tanzanian High Commission in Nairobi and Caleb Obunyali from AATF at the CIMMYT research station in Kiboko

support climate-smart agriculture. Resilient production systems explore practices/ technology that strengthen the adaptive capacity of crops to perform under pressure of diverse stresses induced by climate change. Adaptive capacity is defined as 'the ability or capacity of a system to modify or change its characteristics or behaviour so as to cope with existing or anticipated external stress (Smit et al 2000, Adger et al. 2004). It has been recognised that adaptation measures can reduce negative impacts of climate change. Without extensive adaptation, the effects of climate change on agriculture are expected to exacerbate Africa's deepening food crisis, and slow down efforts to expand food productivity. Reports (Ochieng et al 2016, Adhikari et al 2015) indicate that climate change will result in an increase in hunger in Africa over the next few decades. This point highlights the importance of developing climate smart crops that can provide high yields even in drought conditions. The development and use of drought tolerant seed varieties among other interventions is an effective approach to addressing this challenge.

# 50%

Estimated decrease in crop yields in Africa due to climate change by 2020

AATF has thus taken initiative towards improving resilience of key staples through the development of drought tolerant maize and rice with good water use efficiency. If nothing is done, yields of rainfed maize, for example, are projected to decline by as much as 25 percent or more by 2050.

# 25%

Projected decline in yields of rainfed maize by 2050

AATF is also improving crops for pest resistance (e.g. stem borer resistance in drought tolerant maize) to address the issue of minor pests suddenly becoming potential threats due to temperature changes and drought.

*Striga* parasitic weed (*Striga hermonthica*) is a major cause of cereal yield reduction in Sub-

Saharan Africa. Changes in temperature, rainfall and seasonality are contributing to creating more suitable habitats for this weed (Niang et al. 2014, Cotter and Sauerborn 2012). AATF in consequence is also strengthening the development of *Striga* tolerant varieties of maize to address the increased negative impact of this pest on maize.

Considering that climate change factors are influencing crop physiology, it has implications for the physiological efficiency (PE) of nutrient use and availability of nutrients in soil and their transport through soil and across root membranes. AATF is improving rice for nutrient (nitrogen) use efficiency in response to climate change.

A Turkana woman wears all the finery of her tribe – brass lip plug, beaded collar decorated with bleached shells of the African land snail, leaf-like ear ornaments and metal earrings from which hang tiny rings of goat horn. Photo credit: Alamy Stock Photo

# Developing drought tolerant and insect resistant maize



## Hedging maize farmers from climate change scourge – alleviating farmer distress

Maize is the most widely cultivated staple crop in Sub-Saharan Africa (SSA), with almost three quarters of it being consumed as food. As with other crops, the negative impacts of climate change are being felt among maize farmers, with smallholder farmers set to suffer the most.

As part of the response to the climate change threat, the Water Efficient Maize for Africa (WEMA) Project is developing maize hybrids that are well adapted to moderate drought conditions and insect protected against the stem borer. The adoption and cultivation of WEMA products are expected to benefit at least 12 million people with a projected total value of yield increase estimated at over US\$280 million by 2025. The project is using classical breeding, molecular breeding, and double haploid technology to fast track the development of drought tolerant and insect protected maize hybrids (both conventional and transgenic) for deployment to smallholder farmers through the seed companies and other partners.

From 2015, whenever I plant TEGO, I harvest good yields and the money I used to spend on buying maize I am now able to save for other uses - Farmer Jane Sabula, Kenya

### Water Efficient Maize for Africa (WEMA) Project Opening new frontiers for smallholder farmers – providing choice and hope

With the successful introduction of its first transgenic TELA<sup>®</sup> maize product to smallholder farmers in South Africa towards the end of 2016, the WEMA Project hit a milestone that heralded new pathways for Africa's fight against hunger and poverty – providing farmers with a choice that will make a difference in their quest to increase maize productivity. Together with conventionally bred DroughtTEGO<sup>®</sup> (TEGO), TELA<sup>®</sup> is an additional weapon for farmers as they battle the evil twins of drought and insect pests.

During 2017, the project built on its product commercialisation process, signing licensing agreements with six companies in South Africa to produce TELA<sup>®</sup> maize

38

Number of seed companies producing WEMA products

seed for smallholder farmers. During the year, the project widened its horizons with 16 TEGO hybrids allocated for testing to a seed company in Burkina Faso.

In total, 38 seed companies have been licensed to test and/or commercialise WEMA products beyond the project life.

In 2017, a total of 2,371 tonnes of DroughtTEGO<sup>®</sup> and 13 tonnes of TELA<sup>TM</sup> hybrid seeds were sold to farmers. This is enough to plant an estimated 95,360 hectares of farmland to benefit at least

238,400 farm households (FHHs) assuming each household plants 10kg per acre.

For the four years that WEMA products have been commercialised (October 2013– September 2017), a total of 5,349 tonnes of certified seeds were produced, with 3,959 tonnes sold to farmers for cultivation, conservatively reaching an average of 396,000 FHHs and benefitting about 2.4 million people assuming each household has six members. This achievement represents 72% of the 5-year target of 550,000 FHHs.

The commercialisation of transgenic products is a significant achievement and accomplishment of one of the major objectives of WEMA as the project strives to get this compelling technology into the hands of more farmers. It is anticipated that in the next five years, the remaining five countries in the WEMA partnership will have the transgenic insect-resistant and drought-tolerant (TELA®) hybrids in their markets.

### Breeding and testing of hybrids and parental lines – fresh pipeline

The project continues to maintain a healthy pipeline of hybrids and parental lines. Currently, WEMA has over 4,000 hybrids and over 5,000 parental lines under various

**5,349** Tonnes of certified seed produced by WEMA in 5 years stages of development and testing in its breeding pipeline, making it one of the largest R&D projects in the public sector.

Since 2013, the WEMA project has continued to build on its contribution to the seed market with highly impactful maize hybrids. It has, to date, released 106 climate smart maize hybrids. Of these, 101 are conventional DroughtTEGO® hybrids, four of which have resistance to Maize Lethal Necrosis (MLN), while five others are transgenic TELA® hybrids. There are also 36 parental lines available for licensing to seed companies in Africa to make their own hybrids.

# Opening new battle line against MLN

Another major accomplishment for the year was the release of four DroughtTEGO<sup>™</sup> hybrids that are tolerant to MLN disease for commercialisation in Kenya. The four conventionally bred hybrids (WE6101, WE610, WE6109, and WE6110) were approved after successful national performance trials conducted by the Kenya Plant Health Inspectorate Service (KEPHIS), the agency responsible for seed certification in the country. The four hybrids had grain yield advantage of 12%–43% over commercial checks, with satisfactory MLN tolerance scores recorded.

The four hybrids were selected from 3,000 hybrids and inbred lines which were screened for MLN tolerance over two evaluation trials carried out under artificial inoculation at Naivasha in Kenya. Results showed that the best 10 single-cross hybrids gave 422%–633% greater yield than the best commercial check (WE1101 – DroughtTEGO®). The best inbred lines and single-crosses will be distributed to WEMA partners for their use as new breeding starts for the development of new MLN tolerant hybrids in the project countries.

# Western Kenya farmer reaps big from climate smart seed



Jane Sabula, a DroughtTEGO<sup>®</sup> farmer, at her farm in Eliang'oma village, Luanda Sub County, Vihiga County

Looking at the failed crops around her neighbours' farms in Eliang'oma village in Vihiga County, 50-year old Jane Sabula is grateful for the decision she took two years ago to start planting DroughtTEGO® hybrid maize on her farm.

At her local church, most of the stories from her fellow women are about crop failure, and the difficult choices their families have to make between buying maize flour and sending their children to school.

'Many people here have had to survive on one meal in a day, but I have been fortunate because I was able to harvest enough maize to at least feed my family well. I only heard over the radio that people are buying maize flour at Sh. 150, but I never went to the shop to buy maize flour because I had enough,' says Jane.

She points out that she has previously tried several other hybrid seeds, but with little improvement in her yield. 'I am not sure if it's this soil that has favoured your seed over other maize varieties, because there is no time I ever harvested more than two bags of maize from my farm. I thank God that as soon as I planted your maize seed I have not suffered hunger, even when my neighbours complained of maize shortage,' she says.

Jane first heard about DroughtTEGO<sup>®</sup> maize at a seminar held by a local non-governmental organisation in 2015. As she had tried other hybrids with little change, she was skeptical at first, but after visiting a couple of demonstration fields, she decided to give it a try.

'From 2015, whenever I plant TEGO<sup>®</sup>, I harvest good yields and the money I used to spend on buying maize I am now able to save for other uses,' she says, beaming proudly.

]ane is now encouraging her neighbours to replace their traditional seeds with TEGO<sup>®</sup> as one way to raise productivity on their farms towards better food security.

**3,959** Tonnes of seed taken up by farmers in 5 years

In Tanzania 17 MLN-tolerant lines were evaluated under natural MLN infection at Kiru-Babati (a hot spot location for the disease). Results indicate the materials showed good tolerance to MLN. Based on these results, the best eight MLN-tolerant hybrids have been selected for submission in 2018 for product certification process and release for eventual commercialisation in the country.

# Good news as project seeks the fall of the Fall Armyworm

In a pleasant turn of events, confined field trials to evaluate the efficacy of hybrids with combined *Bt* MON810 and MON87460 (drought-tolerant – DT) traits against stem borers have shown that the *Bt* gene is capable of cushioning farmers against infestation by the Fall Armyworm.

## 396,000

Tarm households benefited from WEMA products in 5 years



Alinasibu Mwenda (center), Village Extension Officer in Soya, Chemba District in Tanzania, with two WEMA scientists during a field-day hosted on 6 July 2017

## **2.4 million**

Number of people estimated to have benefited from WEMA products by 2017

The top performing TELA<sup>\*</sup>hybrids containing both *Bt* and DT transgenes have yielded on average 30% more than the same hybrids without the transgenes (isogenic hybrids). But under severe pest pressure, TELA<sup>\*</sup>hybrids had even more impressive yield advantage of up to 98% compared with its isogenic hybrids as reported in Mozambique from their first ever confined field trial on GM crop.

## 106

Number of climate smart maize hybrids released through WEMA Project

### WEMA welcomes Ethiopia, seeks rapid release of TELA maize

The new kid on the WEMA block, Ethiopia, literally hit the ground running, with the selection of top performing WEMA hybrids and parental lines, for field trials which were planted at six sites. The plantings were expedited to take advantage of the full maize cropping season in Ethiopia. Ethiopia joined WEMA in June 2017 through a partnership between AATF and the Ethiopian Institute of Agricultural Research (EIAR). An application dossier to conduct confined field trial on GM containing drought-tolerant and insect-resistant traits was submitted in December 2017 to the regulatory authority for approval.

### Looking ahead

The WEMA Project is transitioning into TELA® Maize Project in early 2018 focusing on supporting the deregulation and deployment of promising transgenic TELA<sup>™</sup> hybrids that combine tolerance to drought and resistance to insects including the FAW in the remaining five WEMA partner countries, and possibly expanding into other African countries by 2023. This will be an exciting phase that we all look forward to.

Sylvester Oikeh, WEMA Project Manager



# Priority Area 2: Pest Management

## Technology solutions ramp-up onslaught on plant pests

The recent attack by the crop-eating Fall Armyworm may have made all the headlines recently, but pests have for ages persisted as some of the African farmer's biggest enemies.

A significant part of the factors that cause low productivity of yield in the developing world can be attributed to the activities or effects of pests either on the field (preharvest) or in storage (post-harvest). Pests by broad definition encompass all organisms that interfere with crop production and include insects, disease-causing pathogens, weeds, arthropods other than insects and vertebrates.

Pests, which are biotic stressors, reduce crop productivity through various ways such as feeding damage on plants (by insects causing holes and notches, leaf defoliation, leaf skeletonising), leaf senescence, diseases and reduced photosynthesis (by pathogens), resource use competition (weeds), and assimilate sapping (arthropods, necrotrophic pathogens, etc.).

Crop losses due to pests are a major threat to food and nutrition security in Africa with severe consequences on the income of rural families on the continent. The yield losses, both in quantity and quality, could be estimated at 40%–50%, with the monetary value being worth billions of US dollars annually depending on the severity of the pest pressure. For example, a new report released by the Centre for Agriculture and Biosciences International (CABI) shows that improper management of Fall Armyworm could cost 10 of the continent's major maize producing economies between \$2.2 billion and \$5.5 billion per year in lost maize harvests (*The EastAfrican*, 21 September 2017).

A wide range of pests continues to devour crops and render farming a nightmare across the continent for smallholder farmers especially with the increasing emergence of new pest threats such as the Fall Armyworm which was first observed in West Africa in 2016. Shortly before this was the emergence of a new maize disease (maize lethal necrosis - MLN) that devastated farm fields of this crop in East and Southern Africa. These developments attest and justify the strong demand for robust pest management approaches to tackling biotic stresses and safeguarding the food and nutrition needs of the increasing population of Africa.

## 40%-50%

Estimated percentage of crop losses to insect pests in Africa (Parag Chitnis, 2015)



Maruca vitrata pod borer feeding on cowpea

For a long time, these pests have been controlled mainly with chemical pesticides, but control using chemicals is expensive, unsustainable and hazardous to the environment (disruption of the natural ecosystem and pollution) while also a health threat to smallholder farmers who are not adequately informed of the side effects of such chemicals. Due to the increasing pest impact on food security considering the effect of climate change in driving up pest populations and pressures, great investments have been made towards finding effective control measures to this challenge.

The smallholder farmers in Africa on whose shoulders the continent's agricultural growth and development rests are the core interest of AATF and its partners. AATF has activated great initiatives on pest management to control key devastating crop pests (and associated diseases) especially for those where conventional approaches have not offered effective control. AATF and partners have explored novel approaches to address *Maruca* sp. in cowpea, stem borer and FAW in maize, Xanthomonas sp. in banana, cassava and enset (in the absence of good natural genetic variation in the germplasm of these crops. In addition to facilitating breeding initiatives for pest control, AATF is exploring the use of biopesticides and diverse cropping systems towards an integrated pest management approach that combines cultural, physical, biological and chemical applications.

The key focus is on developing technologies for pest management that are affordable, safe, effective and environmentally friendly. So far, these technologies have been seen to not only control the pests but also contribute to better health for people and environment through reduction of chemical spraying. It is expected that these technologies will be easily accessible to farmers through AATF's deployment and commercialisation platforms.

### **The locust lives only a little while but does great damage** - African proverb

Man of a northern tribe, Nigeria. His tatoo is custom in this tribe as it is considered beautiful and decorative. Photo credit: Ton Koene / Alamy Stock Photo

### Controlling Striga weed in maize farms



#### Taming a 'witch' – giving maize farmers hope against Striga

The most agonising damage caused by pests is felt by maize farmers, given the central place the crop holds on the continent. By robbing its host of water and nutrients, Striga has in some cases caused losses of up to 80%, with 100% loss not being uncommon.

With its large number of seeds that remain dormant but viable for years, *Striga*, a parasitic plant that attaches to maize roots and causes major crop losses, has continued to resist many control methods. In despair, some small-scale farmers have abandoned maize planting.

The goal of the *Striga* Control Project is to increase on-farm maize grain yields by significantly reducing *Striga* weed infestation on smallholder farms in Kenya, Tanzania and Uganda. To accomplish this, the project is facilitating access to and delivery of Imazapyr Resistant (IR) maize technology, which is also referred to by its trade name, StrigAway<sup>®</sup> maize.

StrigAway<sup>®</sup> is the first herbicide-tolerant maize seed commercialised in Africa which prevents or reduces maize field infestation by *Striga*, which is also known as 'witchweed'.

So powerful is the yield effect of StrigAway on his fields that Richard Amolo, a farmer in Siaya District in Kenya, said:

'Striga is gone. The witch has left!'

- World Food Prize winner and AfDB President Dr Akinwumi Adesina

### Striga Control in Maize Project

# Growing partnerships with seed sector – driving seed access for farmers

Widespread adoption of IR maize technology by farmers depends on a transition from product introduction to full commercialisation though private seed companies.

In 2017, activities in the project focused on sustaining the IR maize seed supply chain and demand creation among farmers with seed companies and agro-dealers as key partners in Kenya, Tanzania and Uganda.

Proactive engagement with local seed producers and marketers, involving introduction of the product and its technical attributes, market fit, and capacity enhancement package for quality seed multiplication, stimulated significant interest by seed companies and their agencies that generated wider access to and adoption of StrigAway technology by smallholder maize producers in Kenya, Tanzania and Uganda.

# 160%

Growth in annual sales between 2014 and 2017

Between 2014 and 2017, there was significant improvement in participation of private seed companies in the project as the number increased from three to seven companies. The project supported these companies to acquire seed processing and handling equipment, necessary to ensure quality seeds reach the market. In addition, annual seed sales increased from below 130 tonnes per year in 2014 to 338 tonnes in 2017, representing a 160% growth.

Within four years, 693 tonnes of maize seed worth over US\$1.4 million reached farmers through the private sector. The IR maize seed purchased by farmers has enabled the cultivation of over 28,000ha of farmland (equivalent to about 69,300 farm households at 0.4ha per household) across Kenya, Tanzania and Uganda.

#### The witch meets its match – private sector accelerates production to meet demand

Leveraging on the marketing and distribution networks of commercial seed companies, AATF was able to get the products into the hands of over 3,000 farmers and further supported the safe and proper use of the technology through stewardship activities.

During 2017, 380 tonnes of seed were produced by the project and, of this amount, 338 tonnes were sold to farmers for planting. At the usual planting rate of 25kg/ha, the project provided good quantity IR maize seeds sufficient to cultivate 13,520ha. The seed production improved significantly over the four years of the project with the cumulative total production coming to about 1,000 tonnes.

# Capacity strengthening for seed companies, agro-dealers and farmers

Awareness and uptake has been largely driven by testimonies of farmers and field demonstrations. Those who have planted IR maize have attested to a dramatic difference 28,000

Hectares planted with StrigAway by end of 2017

in their crop relative to their neighbours who are not using IR maize seeds. On farms where StrigAway is used, maize is able to reach maturity well before *Striga* can establish itself, thus ensuring a healthy crop of maize with minimal or no *Striga* damage. The project's focus on sustaining the StrigAway seed supply chain was intensified during 2017.

# 69,300

Number of farm households planting StrigAway by end of 2017

AATF continued to build the capacity of seed companies on best agronomic practices for IR maize production through the demonstration plots it co-jointly established and managed with the companies. The plots were used to educate farmers on the StrigAway seed technology while equally affording the project the opportunity to conduct research on the effect of the technology on field *Striga* load and IR maize response and agronomic performance.

# 380

Tonnes of StrigAway seed produced during 2017

# From petty trader to major supplier, thanks to StrigAway



Eunice Anyango addresses journalists at her farm in Nyakach -Kisumu County, Kenya

Before Eunice Anyango decided to switch to StrigAway maize, the yield from her five-acre farm could barely feed her family. Any little surplus she got she sold in tiny 2kg tin containers known as *gorogoro* in the local market.

'I am now supplying maize to the local boarding school and I cannot forget the first time I held a cheque worth Sh. 100,000 in my hands,' says a beaming Eunice Anyango, looking back to the days when all she managed was a few 2-kg containers (*gorogoros*) which she took to the local retail market.

'We would faithfully plant the variety known locally as "farmer's choice" and wait for the little harvest. Whatever was not 'eaten' by *kayongo (Striga)* would come out stunted but we had no option but to hope for a better harvest the following season,' says Eunice.

Like many other farmers here in Nyakach, Kisumu County, Eunice was for long at the mercy of the devastation caused by *Striga* weed on her farm. Despite her faithful use of fertiliser, weeding and spraying, the most she would harvest from the five acres was three 90kg bags.

It was while attending a field demonstration held by AATF, that Eunice first heard of StrigAway. She saw how the demonstration farm had thrived after using the herbicide-coated maize seed that was being sold locally under the name *Ua Kayongo*.

Four years later, Eunice has enough harvest to not only feed her family but to also store and wait for demand to rise and the market price to improve. Her family is comfortably paying fees for their son's university education, and they have even started constructing a permanent house.

Working with AATF, Eunice is now keen on spreading the good news to neighbouring farmers. As we take a walk through her 5-acre farm, she points out a *Striga*-infested section which she says she has been using to demonstrate to other farmers the difference between StrigAway maize seeds and the local variety.

https://aatfnews.aatf-africa.org/?p=804



Jovita Joachim, AATF Field Officer, in a StrigAway maize plantation in Tanzania

Over 4,000 on-farm demonstrations have so far been done to improve technology awareness, market development, and capacity building of farmers and agrodealers on handling and use of the StrigAway technology.

By the end of the year, over 670 agro-dealers had received training both on seed handling

and on point-of-sale extension. This agrodealer network has spread through 10 counties of Kenya, 10 districts of Tanzania and 5 districts of Uganda, representing areas where 60% of farmers are affected by *Striga* in the project countries. Consultant surveys have indicated that 93% of the farmers reached had a high likelihood of purchasing the IR maize regularly for each production season.

# 338

Tonnes of StrigAway seed sold to farmers in 2017

## **1,000 tonnes**

Tonnes of StrigAway seed produced in four years
### Looking ahead

The project has made accelerated traction in the last four years leading to increased IR maize seed production, uptake and commercialisation in the project countries. The next steps are to out-scale the IR technology to reach more farmers for increased adoption in *Striga* endemic areas in more countries for high impact through improved maize productivity in Africa.

**Gospel Omanya**, Senior Manager Deployment









CIMMYT.



Close-up portrait of a Samburu Maasai woman wearing traditional attire, Samburu Village, Samburu, Kenya, East Africa. Photo credit: Alamy Stock Photo

# Managing the Maruca pod borer in cowpea



#### Improving farmers' wealth and health

Cowpea, a protein-rich cereal that is consumed by almost 200 million people in Africa, has for years faced many biotic and abiotic stress factors that have continued to reduce harvests. Principal among these constraints is the pod borer, Maruca vitrata, which damages cowpea pods in the fields.

*Maruca vitrata* inflicts severe damage to the cowpea plant, with severe infestations causing yield losses of up to 80%. Control through insecticide sprays involves a cost that is prohibitive to many smallholder farmers. Moreover, farmers who have adopted insecticidal control are exposed to serious health hazards as most of them often use hazardous chemicals without proper protection.

Over the years the pod borer has developed resistance to most common pesticides, and farmers are responding to this by increasing the frequency of pesticide application, further exacerbating the health risk.

I can hardly wait for the time that I will not only be getting higher yields, but also taking care of the environment because I have heard that I will only spray my crop twice a year, spending almost five times less on chemical sprays.

- Farmer Sylanus, Nigeria

## Pod Borer Resistant Cowpea Project

#### Gaining momentum towards farmers' fields

One sustainable approach to addressing this pest is to develop cowpea varieties with host plant resistance (plants having their own 'built-in' protection). Partners in the Pod Borer Resistant (PBR) Cowpea Project have been developing and testing cowpea varieties with a gene for resistance to the pest.

Significant progress has been made toward incorporating one or more *Bt* genes into cowpeas to provide a long-term plan for robust protection.

By reducing insect infestation and damage, the improved cowpea varieties will boost farmer harvests by at least 20%, in addition to improving their health and saving them costs through reduced insecticidal sprays. The increase in harvests will in turn impact household, national and global food security and economic status.

By the end of 2017, most of the regulatory science work required to support the deregulation of the PBR cowpea had either been carried out or nearing completion. The project is thus at an advanced stage towards release of PBR cowpea into farmers' hands.

Multi-location confined field trials continued in Burkina Faso, Ghana and Nigeria. The trials compared the agronomic performance

## 200 million

Number of people consuming cowpea in Africa

of farmer varieties with the newly developed pod borer resistant varieties under natural infestation conditions in different agroecological zones. The pod borer resistant varieties out-yielded the farmer varieties. In Nigeria at least 60% of the farmers ranked PBR cowpea as their most preferred variety. In Burkina Faso all farmers ranked PBR cowpea as their most preferred variety. Similarly, in Ghana at two locations farmers ranked PBR cowpea as their most preferred variety.

Prior to conducting the multi-location trials, the project implementation teams were taken through a regulatory compliance and trial management training to enhance their skills in generation of data in accordance with national and international regulatory standards, protocols for the various studies, requirements for biosafety compliance and other relevant issues on regulatory science.

## Protecting human health and sustaining the environment

To control insect pests of cowpea, farmers usually spray their crop with insecticides five to ten times in a cropping season to secure adequate grain yield. While spraying is in itself an expensive process, reduction in application of insecticides to crops is also key to reducing adverse impacts on the environment and human exposure to hazards.

Earlier trials in the project confirmed that with PBR cowpea it is possible to reduce the frequency of spraying from ten to only two. This drastic reduction in the number of pesticide sprayings represents a substantial gain in time, money and human and environmental health. During 2017, a second trial on insecticide reduction was carried out using a revised protocol to generate more robust data. The insecticide trials were conducted in Nigeria and Malawi. Preliminary results from Malawi indicate that there was linear response in yield increase with the number of sprays for a maximum of two sprays. However, there was a decline in yield increase for the PBR cowpea beyond two sprays, implying there was no economic advantage with additional sprays. This indicates farmers can save on number of sprays as there is no need to spray more than twice with PBR cowpea. Results show that pod borer resistant cowpeas (Event 709A and IT97KT) were generally yielding higher than the local varieties.

In an effort to further minimise or completely eliminate the use of chemical insecticides for pest management of *Maruca* for cowpea, trials are being conducted to identify environmentally friendly bio-pesticides that could be effectively applied to control other pod-sucking insect groups of cowpea. The results from this study are anticipated to contribute to efforts at developing an effective and environmentally friendly integrated pest management plan for cowpea.

**80%** Estimated cowpea yield loss to

Maruca vitrata

## All set for first transgenic in Nigeria market

Nigeria is in the lead on the implementation of the CFTs and are well placed to introduce PBR cowpea as the first transgenic in the Nigerian market. The trials compared the

### Nigeria farmer waits expectantly for release of *Maruca*-resistant cowpea



Farmer Sylvanus Ahiaba in his cowpea farm

Sylvanus Ahiaba has almost two decades of experience in the growing of cowpea, a popular source of food and feed in Nigeria. In all that time, the most exciting experience has been witnessing the experiments with PBR cowpea, and seeing the possibility of relief after years of frustration by *Maruca*, the pod-devouring insect pest that has many times wiped off his entire season's harvest.

Partners in the Pod Borer Resistant (PBR) Cowpea Project have been developing and testing cowpea varieties with a genetic trait that would make the plant resistant to the borer and provide farmers with an alternative to costly and hazardous insecticide spraying.

Sylvanus has just attended a presentation by scientists conducting multi-location confined field trials in Nigeria, and expects that positive results will eventually lead to release of *Maruca*-resistant varieties.

'I can hardly wait for the time that I will not only be getting higher yields, but also taking care of the environment because I have heard that I will only spray my crop twice a year, spending almost five times less on chemical sprays,' says Sylanus.

He adds that early germinating of the PBR cowpea variety gives it an edge over the old variety because farmers will be able to harvest twice in a year.



Bt Cowpea (foreground), at the CFT in Kano, Nigeria, ready for harvest with many pods and few leaves while the farmer variety (background) has little or no pods with lots of leaves

agronomic performance of the farmers' varieties with the newly developed pod borer resistant variety under natural infestation conditions in different agroecological zones and this information is being synthesised for inclusion in the dossier which will be submitted soon to regulators for deregulation approval.

**20%** Estimated percentage boost to farmer harvests using PBR cowpea

### Looking ahead

The next immediate steps on the project are to deregulate PBR cowpea and ramp-up seeds in partnership with seed companies towards a commercialisation process that will facilitate farmers' access to the product. In another dimension the project has initiated activities towards developing a second generation of PBR cowpea combining two Bt genes to improve durability of resistance to Maruca and reduce the risk of the pest developing resistance. The second gene (Cry2Ab) has been accessed and activities have commenced to test the efficacy of the new gene with work on-going for the stacked gene constructs (combining both Cry1Ab and Cry2Ab).

**Issoufou Kollo Abdourhamane**, Project Manager, PBR Cowpea



# Improving banana, Ensete, potato and cassava against bacterial diseases



## Securing resistance for bacterial diseases where none exists conventionally

A major threat to the attainment of Sustainable Development Goals related to agriculture is the onslaught of bacterial diseases on staple crops that provide main sources of food, nutrition and income security for the poor in Africa.

Banana, Ensete, potato and cassava are some of the key staple crops that serve as food for millions of people in Africa and command high volumes of the domestic trade in several countries on the continent. However, these are regularly and severely devastated by bacterial diseases. Cassava is negatively impacted by the bacterial blight disease under heavy infection while bacterial wilt disease is a major hindrance to improved productivity of banana, Ensete and potato in Africa. Yield losses in these crops could be as high as 20%–100% under high incidence and severity of disease.

### We cannot feed our population if we do not embrace scientific and technological advancements in food production. We need to feed these people and help them progress,'

- Ugandan Minister of Science, Technology and Innovation, Dr Elioda Tumwesigye (https://www.newvision.co.ug/new\_vision/news/1462555/debate-gmo-foods-resumes)

### **Developing transgenic banana, Ensete, cassava and potato**

#### Working towards host resistance

There is no good genetic variation for resistance to bacterial diseases in the germplasm of banana, Ensete, cassava and potato. Transgenic host plant resistance could offer a more lasting solution to these bacterial diseases. AATF and partners are using the Pflp, Espflp, and Hrap genes for genetic transformation of banana, Ensete, potato and cassava for the control of these bacterial diseases. The genes were accessed by AATF from Academia Sinica and sublicensed to project partners for product research and development. AATF is also undertaking biosafety and intellectual property compliance management for the transgenic research.

The banana project is being implemented in Uganda and Kenya, Ensete in Ethiopia, potato in Kenya and cassava transformation activities are presently being carried out in Kenya.

The banana project is the most advanced of these initiatives having already reached the confined field trial stage. The year started on a positive note in Kenya with approval by the National Biosafety Authority for the conduct of confined field trials for 30 transgenic events by the Kenya Agriculture and Livestock Research Organization (KALRO) at the CFT site in Alupe. The banana initiative also continued

## 20%-100%

Yield losses in banana, cassava and potato under high incidence of bacterial diseases with additional genetic transformation, exploring new gene constructs, to improve disease resistance expression against *Xanthomonas wilt.* 

For Ensete and cassava, genetic transformation is still at the proof of concept stage to assess the efficacy of the transgenes being tested for resistance to bacterial wilt and bacterial blight respectively. A total of 16 transgenic events of Ensete, having either *Hrap* or *Pflp*, have been tested through inoculation and three were found to be partly resistant.

The work on cassava genetic transformation resulted in 50 transgenic events which have undergone molecular characterisation.

The potato project started in November 2016 with the goal of developing transgenic potatoes of farmer-preferred varieties for resistance to bacterial wilt. The initial activities for potato are primarily targeted at demonstrating proof of concept of the efficacy of two genes, plant ferredoxin-like protein (*Pflp*) and EFR transgenes in the control of bacterial wilt in potato. The two genes have demonstrated resistance against bacterial pathogens affecting tomato and banana crops.

During the reporting period, plantlets for two farmer-preferred varieties (Shangi and Jalena) were obtained from partners and used for genetic transformation. This initiative has resulted in the identification of 15 transgenic events confirmed for the *Plfp* gene.

AATF is working with the International Institute of Tropical Agriculture (IITA) the National Agriculture Research Organization



AATF's Abed Mathagu (right) with KALRO staff during an IP and biosafety licensing compliance monitoring visit at the CFT site in Alupe, Busia, Kenya

(NARO), Uganda, KALRO, Kenya, the Ethiopian Institute of Agricultural Research (EIAR), Ethiopia, the International Potato Center (CIP), and Academia Sinica.

#### Looking ahead

In the absence of good conventional genetic resistance for bacterial wilt in banana, Ensete and potato, and blight in cassava, the current progress being made to develop host plant resistance in these staple crops offers good hope of optimism for a foodsecure Africa. The banana project is at final stages of identifying candidate events for progression into putative products for deregulation. For the newer initiatives (on Ensete, cassava and banana), establishing positive confirmatory results of the proof of concept will be a major milestone and a new vista to managing the target diseases. This anticipatedly will lead to expanded product development for these three crops soon.

**Emmanuel Okogbenin**, Director Technical Operations



Fulani nomads of the of the Bel'ah group of the Sahel, Burkina Faso. Photo credit: Novarc Images / Alamy Stock Photo

## Managing the Maize Lethal Necrosis disease



#### Focusing on clean seed production

Maize Lethal Necrosis (MLN) disease has continued to wreak havoc on maize production in East Africa since it was first reported in Kenya in 2011. Since then it has been reported in other eastern Africa countries.

The disease, caused by the combination of the Maize Chlorotic Mottle Virus (MCMV) and Sugarcane Mosaic Virus (SCMV), causes irreversible damage that kills maize plants leading to yield losses. MLN pathogens can be transmitted not only by insect vectors but also through contaminated seed.

Some developed countries have managed the disease through strategies that include combining tolerant varieties, crop rotation, and having maize free seasons to reduce the insect vector pressure that transmits the disease. However, in eastern Africa, the epidemic is aggravated by lack of MLNresistant maize varieties and year-round cultivation of maize, allowing transmission via insect vectors, among others.

The disease can result in yield loses of up to 100%, thus exacerbating food insecurity and affecting grain trade.

### **Tomorrow belongs to the people who prepare for it today** -African Proverb

### Maize Lethal Necrosis Disease Diagnostics and Management Project

#### **Overcoming seed production challenges**

MLN disease has been registered as a threat to food security in Kenya and Uganda. The MLN Diagnostics and Management Project is supporting the production of MCMVfree commercial seed and promoting the use of clean hybrid seed by farmers in a bid to contain the spread of the disease to nonendemic countries in Sub-Saharan Africa.

Project partners also share MLN diagnostic and surveillance protocols, as well as best management practices for MLN control in Africa. With the trans-boundary nature of infection, it is crucial that countries adhere to a common management approach, including quality control in production of seeds. AATF activities have therefore focused on

**100%** Yield loss that MLN disease can cause



A farmer making contributions during MLN training held at Masindi, Uganda

supporting the production of MCMV-free seed in Ethiopia, Kenya, Rwanda, Tanzania and Uganda.

During 2017, key activities included monitoring the implementation of MCMVfree seed production checklists that were produced in 2016. The project also carried out follow-up activities to assist breeders, seed companies and seed out-growers to implement the checklists. This involved on-farm visits to 66 seed companies across Ethiopia, Kenya, Rwanda, Tanzania, and Uganda to document feedback on the implementation of the checklists, best agronomic practices for MLN management and control, MLN status in seed production fields as well as MLN disease history within the seed production fields.

The visits also included training for the seed companies on the use of rapid MLN diagnostic techniques for early detection of suspect crops.

### Reaching farmers and outgrowers to fortify MLN response chain

With most seed companies depending on contracted out-growers, the project trained 437 maize seed out-growers

## 66

Number of seed companies trained on production of MLN free seed in 2017 on MLN management. The interactive trainings discussed the usefulness of each standard operating procedure and best implementation methods as well as practical sessions on use of rapid diagnostic kits for MLN.

Over 1,300 farmers from the project countries were educated on the importance of certified seed, especially for prevention of MLN virus re-infection on the farm. This was a crucial activity given that smallscale farmers in SSA obtain more than 90% of their seed from informal seed systems which largely include farmer-saved seeds.

## 437

Maize seed outgrowers trained on production of MLN free seed in 2017

During the trainings and individual onfarm seed company visits, discussions revolved around the practicability and cost implications of the standard operating procedures (SOPs) in the harmonised checklists. Several revisions were made to ensure that the SOPs could be easily understood and were practical even to the basic farmer.

Scientists from National Agricultural Research Systems (NARS) from target countries were trained on the use of an open data kit (ODK) so they could monitor how their countries were implementing the standard operating procedures. The kit is also being used to collect information on the status and impact of MLN disease in seed production fields.

**1,300** Farmers educated on the importance of using certified seed

### Looking ahead

The out-grower training sessions brought out several issues that will need to be addressed in future MLN management strategies. Being emerging threats, MLN and Fall Armyworm (FAW) call for the enactment of appropriate seed policies and regulations. Activities that will foster access to tolerant varieties by farmers through seed companies are also planned.

Most plant health and regulatory departments face human and infrastructural capacity challenges for tackling emerging threats. In mitigation, third party inspectorate services appointed by the regulator may be used to address the inadequate number of technical officers. Indeed, this model is currently being implemented by the Kenya Plant Health Inspectorate Service (KEPHIS) and, in line with this strategy, AATF availed six staff members to undergo the private seed inspectorate service training offered by KEPHIS to third-party officers to supplement the KEPHIS team.

Gospel Omanya, Senior Manager Deployment







# Priority Area 3: Mechanisation

### **Removing drudgery from African farms**

For many smallholder famers in Africa, a typical field day mostly involves toiling under hot tropical weather conditions, usually with the most basic rudimentary implements such as hoes and cutlasses which do not confer timeliness or efficiency to operations. Where exigencies require that the farmer contemplates exploring some extra labour to accomplish tasks quickly, the drudgery that is involved with the use of these implements often attracts high labour fees by hired hands. The smallholder farmers therefore have no choice but to continue working at their inefficient small pace, negatively impacting on productivity in Africa. Agricultural productivity in Africa has therefore remained behind the rest of the world because of low investment in agricultural machinery.

Transformation of African agriculture from subsistence farming under low implement use to modern/commercial farming under best bet production practices powered by use of advanced tools or machinery is critical to improving farmer livelihoods and economic growth in Sub-Saharan Africa. It is increasingly clear that African farmers will need to apply appropriate tools and machines because mechanisation can increase production efficiency, timeliness of operations and facilitate increased output of higher value products at a lower cost of operations while eliminating the drudgery associated with human muscle-powered cropping.

Apart from obvious advantages which mechanisation offers such as the potential to expand the area under cultivation and timely completion of critical farming operations and, in many cases, the quality of work leading to increased crop yields (land productivity), African demographic trends support the case for mechanisation.

Africa, with the fastest growing population in the world, has 60% of her people below the age of 25, making it a continent of youth. In contrast, the average farming population age has over the period increased to 60 years. The future of African agriculture therefore lies with African youth. Mechanisation holds strong potential to generate strong attraction for youth engagement in agriculture as it circumvents the drudgery associated with the use of low input implements under subsistence farming. It also encourages efficiency in production and the net benefits to the farmer are higher.

There is also a growing feminisation of smallholder agriculture, especially as women are increasingly left in charge of the family farm with less time for tending these farms as more men engage in search of jobs

60%

60% Percentage of populace below 25 years old in Africa today – making it a continent of youth

with higher and sustainable incomes. The feminisation of agriculture further imposes the need to empower women with accessible mechanisation to efficiently maximise their limited time during farming operations for enhanced and sustainable productivity.

Despite the obvious need and recognition for mechanisation, several constraints face the continent in harnessing the benefits of mechanisation. Smallholder farmers are resource poor and often have difficulty investing in physical assets in general and in agricultural machinery in particular. In many countries, agricultural machinery suppliers are only found in the larger towns and cities, as the perceived low demand in rural areas for equipment does not justify the establishment of distribution networks. More so, farmers are not well organised in clusters to effectively and efficiently access mechanisation service by providers. In addition, there is the lack of financial portfolio to serve the purposes of smallscale farm mechanisation because lending institutions are reluctant to extend credit to poor farmers with little collateral and because they view agricultural production as a high-risk business.

The African Agricultural Technology Foundation identifies this key mechanisation gap as a major bottleneck to African agricultural transformation; and through its public private partnership model initiated a project in this priority intervention area exploring novel business models to address the dearth and demands of specific mechanisation needs of African staples. The major goal is to increase smallholder farmer access and affordability to mechanisation in SSA.

AATF initiated the Cassava Mechanisation and Agro-processing Project (CAMAP) in 2012 as a pilot initiative for the transformation of African agriculture



Application of pre-emergence herbicide on cassava field in Ayetoro, Ogun State, Nigeria

through mechanisation. The selection of cassava as a choice case crop that has a long growth cycle is also strategic, given its highly challenging biology of being vegetatively propagated, and having its most important economic part (the root) underground, as well as other key considerations regarding its role in food security and rural economic development in Africa.

The project addresses the specific mechanisation needs of cassava using well adapted and customised machinery from Brazil and Asia for planting, weeding, harvesting, and stem preparation (planting materials).

Under the project, smallholder farmers have been organised and clustered to facilitate access to mechanisation tools for production with links to expanded markets and marketing platforms for the uptake and trade of high volume of cassava roots resulting from increased productivity (300% increase in yield over average cassava yield in Africa).

Over 18,000 hectares have been mechanised and credit facilities and government support to mechanisation have been enabled through the project.

### Work done in the right way rewards both the employer and the employee – Ethiopian proverb

Zulu woman making pottery dishes, KwaZulu Natal, South Africa. Photo credit: Alamy Stock Photo

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### Promoting agricultural mechanisation for efficiency and better productivity



#### Modernising production practices

Just over half of the world's cassava production comes from Africa, but unfortunately farmers on the continent get the lowest yields per unit area averaging 7 to 9 tonnes per hectare, which is about a third of what their counterparts in other areas like Brazil, Thailand and Indonesia get. The main factors behind this low production in Africa include limited use of improved varieties, poor agronomy, and manual farming processes.

The Cassava Mechanisation and Agroprocessing Project (CAMAP) aims to improve cassava productivity, increase efficiency in operations, reduce drudgery as well as create market linkages for small holder farmers in the three countries of Nigeria, Uganda and Zambia. The project also addresses agronomy issues within the cassava sector, encouraging farmers to use improved stem varieties, fertiliser and herbicides, and ensure timely farm operations.

Farming, is not just a way of life; it is an economic activity, a money generating business that produces food, feeds people, creates jobs and employment, brings wealth, empowers and transforms people. It is the pathway to sustainable development.

- Kanayo F. Nwanze, FAO Special Goodwill Ambassador on Zero Hunger for the Africa Region

### Cassava Mechanisation and Agro-processing Project (CAMAP)

Adopting efficient tools for better yields

Nigeria continued to record impressive progress in mechanisation implementation during the year. By the end of 2017, farmers in five of the targeted eight states had requested and utilised 7,178 mechanisation operations, each operation being equivalent to work on one hectare be it ploughing, harrowing, spraying, planting or harvesting. The number and choice of operations mechanised depended on specific requests from farmers.

## 8,528

Hectares of mechanisation operations done through CAMAP in Nigeria (7,178), Zambia (820) and Uganda (530) in 2017 The most encouraging factor with the project is that even though it is run on a full cost recovery model, farmers continue to seek mechanisation services due to the programme's flexibility that enables farmers to select operations that fit their financial capabilities and that they consider critical to their respective production needs.

In Zambia, a total of 820 hectares of mechanisation operations were done, whilst in Uganda, a total of 530 hectares of mechanisation operations were carried out. Farmers requested for ploughing more than the other services while herbicide spraying was sought the least.

## Betting on youth for agricultural transformation

One of the major objectives of CAMAP is reduction of the drudgery that discourages



CAMAP youth farmers in Iseyin, Oyo State, Nigeria

youth from considering agriculture as a viable business option. With this in mind, CAMAP continued building the capacity of youth in agri-business through training in farm machine maintenance and service provision.

75

Number of youth in Nigeria running mechanised cassava farms through CAMAP

Youth training in all the three countries involved attaching them to CAMAP machine operators for skill acquisition in mechanised field operations. On completion of the training, youth that were certified as competent were engaged to offer services to farmers under the project's mechanisation services platform. The youth are then paid using funds generated from these services. This engagement has helped to provide job opportunities to youth, and it is envisaged that this model will be replicated by entrepreneurs emerging in mechanisation service provision to farmers. A formal training was also held for 100 farmers in Zambia on how to effectively and efficiently mechanise cassava production and the best agronomic practices for cassava production.

By close of 2017, 75 youth in Ogun and Oyo states in Nigeria had established mechanised cassava farms covering 90ha through CAMAP. The youth had established two fully mechanised demonstration sites of 40ha each. Similar demonstration sites as those in Nigeria have also been set up on 40ha in Uganda, with plans for the same in Zambia. Youth are being encouraged to take lead roles.

### Youth find new joy in formerly tedious cassava farming



*Abdul Waheed (left) with some of the members of the youth group he leads* 

Abdul Waheed recalls the excitement among members of Path-P Agricultural Enterprise when they first used the planter to plant cassava on their 40ha farm.

'Suddenly everyone wanted to do the work, while before that it was difficult to get the members to turn up to work in the field,' says Waheed, who is the leader of the youth group whose main activity is growing of cocoa, cashew and cowpea in Ondo State, Nigeria.

It is only recently that they undertook growing cassava, after they were referred to the Cassava Mechanisation and Agroprocessing (CAMAP) Project.

'The planter makes cassava planting fun, and a farmer can plant a hectare of cassava in about an hour while with manual planting it would take four people about a week,' says Waheed.

He says that he has noticed an interest in more young people in Ondo State making enquiries about joining the group, most of them attracted by the possibility of less arduous processes under the CAMAP project.

On satisfying the recruitment process by CAMAP, Waheed's group was provided with the inputs, including quality stem cuttings, fertiliser and herbicide. The new project has become the group's primary focus. The members plan to incorporate their wives to help with processing and selling cassava products, with the hope that they will soon increase the land under cultivation from 40ha to 150ha.

CAMAP is also training some of the members to operate and repair a variety of tractors, and they hope these ones will provide the same services to other farmers in the state.



CAMAP youth farmers in Igboho, Oyo State, Nigeria

## Pooling resources for maximum gains

CAMAP assisted the Value Chain Development Programme (VCDP) funded by the International Fund for Agricultural Development (IFAD) to procure 6 planters and 6 harvesters. The project facilitated the procurement of these machines from Brazil for delivery to farmers in six IFAD Project participating partner states in Nigeria – Niger, Benue, Taraba, Anambra, Ebonyi and Ogun.

This collaboration demonstrated the rising profile of and interest in mechanisation as a strategy for improving cassava production.

## 83%

Increase in revenue generated under CAMAP revolving fund in 2017

## Assuring growth through capacity building

In Nigeria, on-farm training of farmers and service providers towards efficient and economic provision of mechanisation services for cassava to build sustainability continued. This training included showcasing the benefits of cassava mechanisation in terms of increased yields, increased efficiency, increased timeliness of operations, reduced drudgery and market linkages.

## Revolving fund points to success in sustainability

The revolving fund was established in 2016 as an institutional mechanism to ensure the functionality of CAMAP on a full-cost recovery basis with smallholder farmers as well as on profit basis engagement with large commercial farms.

The fund continued to register success and, by the beginning of the third quarter of 2017, it had recorded a



AATF team with Chinese machine distributors during a cassava harvesting demonstration.

revenue increase of 83% from \$135,000 in 2016 to \$247,000 in 2017. Under the fund, farmers pay 70% of the operation cost before commencement of work and the remaining 30% upon completion of work. The amount collected was reploughed in-country into the project for continued implementation of the project such as procuring additional machines and reaching out to more farmers.

#### Looking ahead

More lives have been transformed through mechanisation, more farmers are paying for provision of mechanisation service after realising the benefits of mechanisation. The Project plans to expand to new areas within the current countries and to include many more entrepreneurs providing mechanisation services as a business, thus creating wealth for people.

**George Marechera –** Business Development Manager, AATF



## Priority Area 4: Soil Management Improving crop adaption for resource

### use efficiency

The effects of soil degradation are most devastating in Sub-Saharan (SSA) countries where large proportions of the population reap their livelihoods directly from agriculture which is the mainstay of Africa's economies Rapid soil degradation and poor soil productivity are due to erosion, desertification, decline in organic matter, soil contamination, decline in soil biodiversity, deforestation, and soil nutrient mining without replenishment. A consequent implication of soil degradation is that population pressure is forcing farmers to cultivate increasingly in marginal land or ecologies that are not optimal for agriculture for various reasons. Degraded soils are a major contributory factor to stagnating yields or low crop productivity which leads to hunger and poverty. An estimated 180 million people are living on land that is in some way or another degraded (ref). Soil degradation is costing African farmers an estimated US\$42 billion in income through reduction in crop productivity (Bationo et al. 2012).

As per capita area of land dedicated to food production continues to decrease and as population increases and urbanisation grows, crop production intensification under best soil management practices becomes critical for sustainable food production from limited land.

Among the 17 sustainable development goals, four contain targets related to soils and sustainable soil management. Inappropriate agricultural practices in most parts of SSA and the low use of fertilisers are just a few of the reasons that African soils are weakening progressively. Agricultural yields are sustainable when soil management practices are integrated into production systems in Africa. These practices include maintenance of soil fertility levels; protection of soil structure; reduction of erosion and runoff; and promotion of soil biological functions. Soil-management technologies required for agricultural intensification involve interventions that enhance soil structure; increase nutrient use efficiency; and support increased cropping intensity.

In Sub-Saharan Africa, a great part of land suffers from geologically induced and inherently low soil fertility with smallholder farms accounting for over 80% of all the farms. Unfortunately, most of the smallholder farmers on the continent can hardly afford the high cost of fertilisers which is further complicated by the inefficient input market systems that do not guarantee timely supplies for fertilisers. This, among other factors such as lack of financial incentives and weak fertiliser policies, accounts for why Africa has lower

## **180 million**

Estimated number of people living on degraded land in Africa



National Crops Resources Research Institute (NaCRRI) scientists collecting data at the NUE CFT site at Namulonge, Uganda

## **US\$42** billion

Estimate of what soil degradation is costing African farmers

fertiliser consumption when compared to other regions of the world.

Improving crop adaption for resource-use efficiency is a key approach to boosting productivity under limited soil fertility condition as this could help reduce rapid nutrient depletion. Given the need to reduce cost of production to increase competitiveness in the global agricultural trade, nutrient use efficient crops can reduce the amount and cost of fertilisers required for crop intensification.

Nitrogen is an essential nutrient in rice production and is often the most yieldlimiting nutrient, with the cost of nitrogen fertiliser comprising an important fraction of total production. Rice is one of the major staples in Africa, and due to rapid urbanisation and improved income of middle class families, consumption has equally increased with net import of US\$5 billion.

**US\$5 billion** Net import of rice to Africa due to increased consumption

In recognition of the above highlighted major challenges in rice cropping systems and with a view to improving productivity levels of the crop, AATF initiated a project to improve nitrogen use efficiency and salt tolerance as a soil management strategy to boost rice production. This approach, which aims to adapt rice varieties to adverse soil conditions, is more sustainable as small holder farmers prefer effective low-cost soil management technologies that are compatible to and reflect positively their socio-economic status. The development of nitrogen-use efficient rice by AATF is expected to contribute to other efforts in creating an efficient integrated soil fertility management (ISFM) to improve productivity.

### We do not inherit the earth from our ancestors we borrow it from our children - Haida Proverb

A young tribeswoman with beauty scarring. The Mursi tribe is a nomadic cattle herder ethnic group located near the Omom River Valley, Ethiopia. Photo credit: Alamy Stock Photo

## Improving rice productivity in Sub-Saharan Africa



## Reducing fertiliser use and soil nutrient depletion, protecting water quality, increasing yields

Rice plays a critical role in food security for more than half of the world's population. In Africa, rice is one of the most cultivated and important food crops. The United States Department of Agriculture (USDA) projects that Sub-Saharan Africa (SSA) will be the leader in global rice imports.

With production of about 16 million tonnes of rice, Africa still depends on imports to satisfy its demand estimated at 30 million tonnes annually. In 2016 the continent imported 12 million tonnes and the USDA estimates imports will grow to 15.4 million tonnes by 2026, making SSA the leading destination in the global rice trade.

Most of the rice in SSA is produced and consumed by small-scale farmers who are

often constrained by the cost and availability of new technologies that could help them increase food output.

Globally, rice production accounts for nearly 16 percent of total fertiliser use. Improved nitrogen use efficiency within rice production systems will increase crop yields, lower the continent's fertiliser nitrogen deficit, reduce its soil nutrient depletion, and protect water quality.

### "This project definitely marks a major scientific milestone" -

Michael Gomez Selvaraj, International Centre for Tropical Agriculture (CIAT)

### Nitrogen-Use Efficient, Water-Use Efficient and Salt Tolerant Rice Project

#### Setting the stage for product definition – selecting best events

With better water use efficiency, the rice will offer an appreciable coping mechanism against drought, and it is estimated that it would also increase yields by up to 30% with 50% less nitrogen fertiliser than conventional rice.

Soil salinity is the accumulation of watersoluble salts in the soil to a level that negatively impacts on crop production. This condition could be imposed by prolonged drought periods due to less availability of water to leach salts already present in soil, excessive use of irrigation water with improper drainage, coupled with the use of poor-quality irrigation water which can lead to an abundance of concentrated salt. Salinity limits the germination of seed and survival of seedlings, giving rise to a scanty uneconomical crop stand that could result in yield loss of about 30%-50%. High salinity is increasingly becoming a major problem in rice growing areas of the coastal lowlands and mangrove swamps of Africa.

The Nitrogen-Use Efficient, Water-Use Efficient and Salt Tolerant (NEWEST) Rice Project seeks to harness Nitrogen Use Efficiency (NUE), Water Use Efficiency (WUE) and Salt Tolerance (ST) technologies for the production of rice by smallholder farmers in Africa to improve the livelihoods of an estimated 14.3 million people in Africa.

## 15%-20%

Level of yield increase expected through NEWEST rice

The project is being implemented in Ghana, Nigeria and Uganda with two pipelines of products: Nitrogen Use Efficient (known as NUE) and the triple gene product combining NUE, WUE and ST (called NEWEST). The current focus is on the development of new varieties with a trait for increased nitrogen use efficiency, which helps the plant to take better advantage of the insufficient nitrogen found in African soils.

The genetically-engineered varieties will also have resilience against abiotic stresses such as salinity and drought.

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### **16%** Amount of fertiliser used in global rice production

Activities for 2017 focused on confined field trials (CFTs) for identification of the best events for regulatory trials and subsequent deregulation for release as varieties.

Important milestones were realised during the year for NUE and NEWEST for the next set of trials in the project.

The first milestone was the selection of NUE12 and 9 as the lead event and backup event, respectively, for regulatory trials towards environmental release. The selection was made after carrying out four CFTs and based on the combined results of the agronomic performance trials and the molecular characterisation. NUE12 ranked the best with its high yield potential and yield stability.

These top two events were also the best performers at both low and high nitrogen levels which showed that on top of their ability to optimise the use of nitrogen at low level, they also have good potential to

## **50%**

Expected reduction in nitrogen fertiliser use by NEWEST rice compared to conventional rice respond to high fertiliser input for better yield. This means that both smallholder farmers and large-scale farmers can adopt the events.

The trials indicated that the events can increase rice yield by between 15% and 20% under low to high nitrogen fertiliser application. The two will be advanced for regulatory trials.

# Rainout shelters to assure quality water use efficiency research

The second significant development for the project was the successful installation of rainout shelters in the three project countries – Ghana, Nigeria and Uganda – thus signifying the readiness of the project to commence the water use efficient component trials of the triple-stacked NEWEST rice events.

### **30 million tonnes**

Amount of rice consumed in SSA

The shelters are a crucial part of experimental trials for the NEWEST Rice Project. The shelters are fitted with a movable roof to enable partners conduct controlled evaluation of events for water use efficiency without interference by rain water when plants are subjected to drought stress. The shelters will also strengthen capacity of participating countries in climate smart agriculture research.

### **14 million tonnes**

Amount of rice imported into SSA to cater for the deficit

### Early food safety evaluation

Early Food Safety Evaluation (EFSE) of the water use efficiency protein was successfully completed. The dossier was submitted to the Food and Drug Administration (FDA) of the United States late March 2017 and was accepted with no further comments in June 2017. The gene is part of the triple gene stack in NEWEST rice.

### Looking ahead

The project is now set to commence the regulatory trials for the selected lead and back-up NUE rice events. Also, the stage is set for transfer of the gene from the lead events to some farmer-preferred rice varieties in each project country. Following completion of the rainout shelters, evaluation of triple-stacked NEWEST rice events will commence.

Kayode Sanni, Project Manager, Rice



# Priority Area 5: Enabling Environment

### Addressing obstacles that hinder enduser access to technologies

Uplifting Sub-Saharan Africa's agriculture and making meaningful difference to the lives of smallholder farmers entail the institutionalisation of a supportive and enabling environment that will stimulate innovation, technology uptake and agribusiness. Such a conducive environment contributes to efficient and effective country and continent-wide economic growth. Indeed, countries that create conducive business climates employ sound policies, institutions and services to promote investment, attract capital and engender economic growth.

According to Christy et al. (2009), enabling environment refers to sets of policies, institutions, support services and other conditions that collectively improve or create a general business setting where enterprises including agribusiness activities can start, develop and thrive. Because agriculture has a direct link to food security, it is generally regarded as strategically important for countries in the developing world.

AATF was principally established to address some of the obstacles to technology access and delivery across the food value chain from research, production, processing, through to market linkages. This was born of the belief that science and technology can positively impact agricultural development, but only if the technologies get into the hands of farmers in a systematic and sustainable way. AATF, therefore, collaborates with various public and private sector partners across Sub-Saharan Africa to address obstacles to smooth flow of agricultural technologies from developers to end users. This includes advocating for better policy environments, functional institutional arrangements and political support for agricultural innovations.

To contribute effectively towards attaining the desired enabling environment, AATF has mainstreamed into its research and development projects complementary enabling functions that include intellectual property rights management, regulatory support, technology stewardship, communications and issue management, policy advocacy, product deployment and seed systems development.

**The best way to eat an elephant in your path is to cut him up into little pieces** - African proverb

The Peul, Fulani women from Burkina Faso decorate their faces and bodies with colorful tattoos. Photo credit: Alamy Stock Photo

## Intellectual property (IP) management and licensing



Alhaji Tejan-Cole (left), Director of Legal Affairs at AATF, shows Dr Ian Barker, Head of Agricultural Partnerships at the Syngenta Foundation for Sustainable Agriculture (SFSA), where to sign on the funding agreement for the Seeds2B Project

#### Managing IP landscapes for the good of smallholder farmers

Different countries face different intellectual property landscapes that create challenges in translating research products to applications, especially in today's dynamic agricultural biotechnology IP landscape.

The establishment of the African Agricultural Technology Foundation (AATF) was in response to the growing significance and complexity of IP and regulatory regimes in agricultural research, and the need to manage them as part of the process of bringing innovations to feed the growing Sub-Saharan Africa populations.

Scouting and identification, negotiation for access, IP licensing and compliance form the key pillars of AATF's approach to IP management. The AATF Legal and IP team also provides legal regulatory advice for the projects, specifically those with potential for/or attracting legal action.

#### Scouting and identification

With an eye on the major food and cash crops preferred by small-scale farmers in Sub-Saharan Africa (SSA), AATF works with partners to identify appropriate technologies – whether proprietary or not – that can benefit a majority of smallholder farmers. The identification is not restricted to innovations within any region, and they could be from private or public IP or technology owners.

Before you buy shoes, measure your feet - African Proverb

#### **Negotiation for access**

The negotiation for access to technologies is a process ridden by legal intricacies. It involves reaching consensus on a range of issues such as the intellectual property rights under which the license is awarded, right to grant sub-licenses and rights of the licensor and licensee.

In 2017, a total of 12 sub-licenses were entered into with various partners. Nine sublicenses were granted for commercialisation of seed and three for research purposes to project partners – the International Institute of Tropical Agriculture (IITA), the Ethiopian Institute of Agricultural Research (EIAR) and the National Agricultural Research Organisation (NARO).

Three agreements were negotiated with various project partners to facilitate access to technologies and funding. These included a research collaboration agreement with EIAR to join the WEMA project that covers research collaboration, licenses for product development and commercialisation, and project governance.

Two trademarks were filed during the year. The TELA<sup>™</sup> trademark was filed in Tanzania, Uganda, Nigeria, Zanzibar and South Africa including another 26 designated countries under the Madrid Protocol trademark application system.

Full registration was achieved in Uganda. The OFAB trademark was filed in Uganda, Tanzania, Zanzibar and Ethiopia.

### **IP** compliance

Flouting of IP agreements can result in crippling legal consequences even for humanitarian use licenses that AATF manages. Apart from constant monitoring, AATF carries out IP training to ensure compliance with IP agreements for sublicensees, including NARS, seed companies and their agents, the agro-dealers. AATF also seeks statutory IP protection from national and international IP registration offices for applications, including patents, plant breeders' rights, copyrights and trademarks for innovations generated or arising from project activities.

A total of three IP trainings were held during 2017, one each for KALRO, NARO and IIAM on patents, copyright and confidentiality. The IIAM training was the maiden one for Mozambique and it was well received by the IIAM scientists and management. One of the major accomplishments was a resolution for the formation of a committee to spearhead the development and adoption of the IIAM Intellectual Property Policy and Confidentiality Policy. Outreach materials in Portuguese were prepared for distribution during the training amongst IIAM scientists.

### **Regulatory and policy engagement**

Some of the participants to the national stakeholder's consultation meeting for the review of bio-pesticides registration guidance document in Malawi

#### Navigating the fluid regulatory terrain in Africa

The agricultural biotechnology landscape in Africa is a labyrinth of evolving policies, laws and regulations that requires specialised capacity to navigate. AATF applies a two-step process towards securing regulatory approval. Firstly, for product testing and subsequently for permit authorisation during release and deployment.

The entire process is preceded by an assessment of applicable regulatory systems in the target countries for each project, a fundamental consideration that is embedded in project formulation.

This preliminary assessment of the regulatory terrain helps to anticipate and forestall regulatory challenges so as to save time and resources during project implementation.

## Regulatory support during product testing

Close regulatory oversight is necessary as the product moves through the development phase, comprising laboratory and field testing stages. Different countries have their specific regulations governing trials, and with a diverse portfolio of products cutting across several countries, AATF must provide customised regulatory support for project activities in each target country.

### **He who refuses to obey cannot command** -Kenyan proverb

In 2017, AATF sought and secured permit approvals for testing GM maize in Mozambique, Tanzania and Uganda. A key development during the year was that Mozambique managed to conduct their first ever field trials of GM crops, joining a dozen other Africa countries in this innovative endeavor (see map below).

# Regulatory support during product release and deployment

Moving regulated products from the trial phase to what is usually termed environmental release or deregulation is a complicated process that requires a coordinated approach in managing technical issues as well as non-technical public acceptance considerations. This is the only sure way for ensuring that this essential stage of getting the technologies into the hands of farmers is achieved. By end of 2017, AATF had advanced four products to the threshold of environmental release. The products included two WEMA TELA products (Bt and Bt/DT), PBR cowpea and NEWEST rice.

Therefore, after successive years of securing approvals for testing efficacy and performance, AATF has in recent times turned focus on exploring prospects for obtaining approvals for general release.

In 2017, the general release dossier for maize with event MON87460 by MON810 stack TELA was completed for submission to authorities in South Africa. However, the dossier was not submitted due to on-going



African countries with project activities on GM crops

consultations with some key stakeholders. Stacked TELA is one of the two transgenic products to come out of the WEMA project. This product combines two traits (transgenic insect resistance with transgenic drought tolerance) while the other (*Bt* maize) combines only transgenic insect resistance and conventional drought tolerance.

Subject to emergence of a conducive regulatory environment for GM crops in other African countries, a projection has been made for considering submission of general release dossiers for the stack event in some of the WEMA project countries.

Multi-locational trials for GM cowpea continued in Burkina Faso, Ghana and Nigeria focusing on agronomic performance. Encouraging results were recorded that will set the stage for planned deregulation of PBR Cowpea in Nigeria in the coming years.

To ensure that innovative technologies are used in a safe and responsible manner, AATF commits to upholding compliance with all country regulations where field trials are conducted. This is achieved through regulatory compliance and trial management trainings. Training is all-inclusive and is held for scientists, technicians and non-technical personnel involved in field trials. In the process, data is collected in accordance with national and international regulatory standards. Periodically, audits are carried out to verify adherence to compliance protocols and standards.

### **Stewardship**



#### Responsibly and ethically managing the technology pipeline

With controversy courting new technology introduction, technology and product stewardship is critical to enhancing understanding and uptake.

Stewardship is the responsible and ethical management of the technology development, release and utilisation process, and, at AATF, this is a crosscutting function accomplished through accountable and responsible individuals. Key elements that make up stewardship include quality standards; insect resistance management (IRM) plan and compliance monitoring; procedural guidelines; and issues management.

#### **Quality standards**

AATF complies with globally-recognised and established standards, policies,

guidelines and processes to perform safety, environmental and market impact assessments. These may vary from country to country, and from product to product, which therefore behoves AATF to build the capacity and raise awareness of the various participating partners at all product development stages.

In the reporting year, South Africa's University of Free State (UFS) was identified and its GMO lab assessed as a certified facility to carry out trait purity tests for the Water Efficient Maize for Africa (WEMA) Project TELA certified seed. This followed

If you close your eyes to facts you will learn through accidents - African proverb
confirmation that they had the requisite infrastructure and human capacity to do so. The standard of the trait purity in certified seed has been set at 96%. Upon meeting this standard, licensed seed companies could treat, bag and sell TELA maize seed to smallholder farmers.

To support seed companies achieve the required national quality and trait purity standards, AATF and the Agricultural Research Council (ARC) embarked on a series of trainings for licensed seed companies covering the seed production and processing stages.

# IRM plan and compliance monitoring

As part of technology stewardship, an insect resistance management (IRM) plan was put in place to lengthen the duration in which farmers can use the WEMA *Bt* products.

A training on effective implementation of the IRM plan, compliance with regulatory permit conditions and quality assurance/ control (QA/QC) issues was carried out for 16 WEMA partners.

An IRM compliance monitoring plan for MON89034 was developed and farmer compliance audits initiated in the 2017/18 season.

To support surveillance on field-evolved insect resistance, a critical component of IRM plan, surveys and insect collection missions were carried out in eight provinces of South Africa where TELA maize hybrids are deployed to generate baseline susceptibility data.

#### **Procedural guidelines**

With evolving regulatory landscapes in project countries, stewardship processes should be kept up to date and customised according to prevailing circumstances. In addition, stewardship must provide stakeholders (seed companies, extension agents and farmers) with technical guidelines on stewardship considerations necessary for handling products at different stages of the life cycle.

Since 2013, AATF has trained 300 individuals on stewardship and IRM implementation. During the year, training materials on IRM plan implementation, seed production and quality assurance were developed and used during various trainings for representatives of seed companies, extension service personnel and farmers. Compliance and IRM 'training of trainers' for WEMA project partners was also carried out.

#### Issues management and incident handling processes

Despite the best intentions and careful project design, unforeseen incidents and circumstances often confront projects and products at the most unexpected moments. Effective stewardship entails establishing systems to anticipate and manage such crises promptly whenever they occur, and also documenting lessons from the same to avoid recurrence where possible.

Seed companies are critical in this process and a complaints or incidence handling structure to support engagement with the companies, including data on the products licensed and key events in product cycles, was developed and is in use.

## Communications



# Driving public support for technology and creating demand for products

Building understanding and appreciation of technologies that will encourage actions such as uptake by farmers or desirable decision making by policy makers is a key component of the technology research and development process. Knowledge, attitudes and perceptions are, at the end of the day, key influencers of technology progression. Providing clarity and building confidence and trust is only achievable through sustained awareness and engagement efforts that build meaningful relationships.

AATF uses various communication strategies and means to inform, educate, and share knowledge from our work; facilitate dialogue and interactions among stakeholders on issues of mutual interest such as biotechnology; and to build interest and demand for products of technology, especially those that have advanced to commercialisation.

## **To be without a friend is to be poor indeed** – Tanzanian proverb

#### **Communication support for project objectives**

Strategic interventions guided by project annual objectives were developed for all projects. The strategies were supported by a mix of approaches such as media (including social media), events and meetings, supplemented by easy-to-comprehend publications such as pamphlets to achieve the set objectives.

The media continues to be a trusted source of information and a cost-effective avenue for reaching the masses. Media was engaged both as a target as well as a channel to pass information and knowledge. In that regard, three science reporting seminars for journalists from Burkina Faso, Ghana, Kenya, Nigeria, Tanzania and Uganda were held attracting 65 participants. The journalists witnessed a DNA extraction process during one of the trainings. The result of these engagements is increased and balanced science reporting that was evident during the year.

Events and meetings provided avenues for engagement with various stakeholders and sharing of information materials. These included project field days that allowed for interaction with the technology; various national, regional and international events including exhibitions and agricultural shows; and specially arranged meetings with groups or individuals that sought to address issues of interest.

Specific community outreach meetings were organised to encourage deeper discussions on the products especially for the Water Efficient Maize for Africa (WEMA) and the Pod Borer Resistant (PBR) Cowpea projects. The interactions facilitated identification of issues of concern to stakeholders and information gaps that need to be addressed. During 2017, 15 such interactions were carried out with farmers, agro-dealers and extension service providers for the two projects. Key issues raised included seed access and requests for further information on transgenics.

Policy outreach continued during 2017. The projects worked with OFAB and other actors to enhance interactions that also included seeing is believing tours to local, regional or international sites that can help clarify matters of conflict and contribute to decision-making processes. Over 40 such engagements were carried out through the projects.

Woman with face scarification. Pastoral tribe of Kotido, Karimojong, Uganda. Photo credit: Alamy Stock Photo

## Moving forward the biotech agenda in Sub-Saharan Africa



# Seeking conducive environment for GM products – demystifying biotechnology

Biotechnology advances, such as genetic engineering, are reshaping agriculture and improving food security, economies, the environment and public health. However, agricultural biotechnology is a relatively misunderstood science, especially in Africa. As with most new ideas, cutting through the myths and misinformation is a daunting but necessary task, which if not handled well can roll back any advantages inherent in the technology.

For various reasons, special interest groups strive to block biotechnology advances on the continent. This creates confusion among decision makers who are critical in development of conducive legislative policies making it necessary to engage and share information to build understanding on the science and potential gains of biotechnology.

"The Biotechnology Bill will help us resolve some of the problems we have in the agriculture sector. The NRM caucus will soon convene to finalise on this matter. We should not be held back on this matter,' - President Yoweri Museveni, Uganda

http://allafrica.com/stories/201703210439.html

# Open Forum on Agricultural Biotechnology in Africa (OFAB) Project

# Campaigning for legislative and public support for biotechnology

Effective engagement of all stakeholders including product developers, product users, and government officials is central to ensuring a healthy public involvement in this process.

Now in its tenth year of operations, the Open Forum on Agricultural Biotechnology in Africa (OFAB) was established with the mission of enabling understanding and support for modern biotechnologies by providing accurate information to stakeholders on the benefits of the technology. The project promotes biotechnology through various advocacy channels, especially stakeholder engagement with media and policy influencers, to enable legislative environments for biotechnology.

Effective advocacy entails gaining champions to work with towards achieving behavior change and policy promulgation, review or implementation. Due to effective messaging, various stakeholders are voicing their support and calling for various legislative bottlenecks to be removed in their respective countries.

The year 2017 saw the sprouting of the fruits of engagements, with decision-makers moving to put in place legislations that will smooth the way for biotechnology research and use in the countries.

After more than a decade, Uganda finally passed the Uganda Biosafety Bill into an Act of Parliament in October 2017. The passage of the Bill followed several years of working with the Uganda Government and communities to create awareness on the benefits and safety of transgenic crops and build the case for a functional biosafety law to govern research, deployment and cultivation.

In Kenya, various farmer groups petitioned the government to lift the ban on GMO imports and fast-track release of transgenic crops to help them fight diseases and pests, such as the Fall Armyworm. Through collaboration with OFAB, the Kenya Agricultural and Livestock Research Organization (KALRO) appointed biotech champions from among its scientists across the 52 centers to help drive community outreach and effective issues management.

Ghana, Kenya and Nigeria participated in the annual Global March for Science held in April where about 650 people, mainly scientists, farmers and university students, were involved. The event aims to draw attention to various challenges facing adoption and use of science, technology and innovations to solve global problems such as poverty and food insecurity.

#### Setting the record straight: OFAB steps up onslaught on misinformation

OFAB continued to counter the unrelenting anti-biotech campaigns in various countries.

In Nigeria, OFAB sought to address public concerns through radio call-in programs, TV jingles, seeing-is-believing tours, news commentaries and video documentaries to provide credible information on the benefits and safety of modern biotechnology products for policy makers and the public. In Tanzania, OFAB conducted regular in-depth community focused advocacy and communication campaigns aimed at awareness creation and mobilising support for biotech from local farmers, politicians, clerics, teachers, and students, among others. Over 500 champions were mobilised and leveraged in outreach efforts aimed at causing removal of policy huddles that might impede product release.

In Burkina Faso, important steps were taken towards lifting the moratorium on Bt cotton growing. This followed results of surveys conducted on the impact of conventional cotton cultivation showed the cost of producing cotton had gone up due to increased pest pressure and environmental damage occasioned by overuse of deadly pesticides. Farmers also complained about high costs, the health risks and hard labour involved in producing conventional cotton using toxic chemicals. To address the growing concerns, tthe Directorate of Research at the Ministry of Education, Science and Technology partnered with OFAB to educate the farmers and to work towards resumption of GM cotton farming. As a result, the National Council for Research and Innovation organised a highlevel consultative meeting to brief policy makers on the need to revert to transgenic cotton.

In Kenya, Parliament ordered the National Biosafety Authority (NBA) to facilitate WEMA *Bt* Maize NPTs to proceed. However, this has not been implemented as expected due to dynamics at play in the various regulatory agencies. The government's interest in commercialising *Bt* cotton grew stronger with the Ministries of Industrialisation and Agriculture leading the process towards deregulation. At the year's end, there were close consultations among the various government departments on how to fast-track planting of *Bt* cotton NPTs.



Hon Dr Elioda Tumwesigye (holding book), Minister of Science, Technology and Innovation, launches the ten year OFAB book during the forum's ten years' celebration in Uganda

Ethiopia moved closer to commercialising *Bt* cotton with the Ethiopian Institute for Agricultural Research (EIAR) applying for product deregulation and variety registration following two successful multilocation trials conducted since June 2016. To facilitate fast-tracking of *Bt* cotton trade, OFAB partnered with the cotton industry stakeholders, including farmers, ginners and textile makers, to convene a meeting of policymakers and stakeholders for further discussions on taking the product to farmers safely and effectively.

#### Leveraging on power of media

Media stories have strong influence on opinions of audiences. It is, therefore, imperative that biotechnology coverage by the media is balanced and factual. To this end, OFAB continued meaningful engagements with the media to strengthen their capacities for effective coverage of biotechnology.



Omolora Afolayan (left), a Nigerian TVC news journalist, receives the OFAB Africa Journalist of the Year Award winner from Denis Kyetere, AATF Executive Director

In May, 65 journalists from West and Eastern Africa were trained in effective biotech reporting during two regional media workshops held in Ghana and Tanzania. The journalists were then linked with biotechnology experts, including project leads at AATF. The linkage and access to expert sources facilitated continued exchange of credible information.

As part of its tenth anniversary celebrations, OFAB launched the OFAB Africa Journalist of the Year Award in Kampala in September 2017. The Award recognises and rewards excellence and effectiveness in biotechnology reporting by journalists in OFAB countries. The need to promote solution journalism in Africa also informed the decision to establish the annual award system, which starts at the national level. Nigerian TVC news journalist, Omolora Afolayan, scooped the top prize to become the first OFAB Africa Journalist of the Year Award winner.

#### Looking ahead

The project will intensify advocacy and communication campaigns to help create and maintain conducive environment to derestrict commercial release of transgenic crops in Africa. Use of locally generated credible data on benefits and safety of biotechnology for policy engagements will be mainstreamed.

#### Daniel Otunge, OFAB Project Manager



## Deployment



# Harnessing all factors and players to sustainably deliver agricultural products to farmers

Getting products to farmers is central to realising the desired impact. Responsible and sustainable delivery of products to farmers covers various activities that include commercial release of products coming from the research and development pipeline; product allocation, licensing and seed production; and promotion and marketing of new products. Key partners for successful deployment include both public and private sector, farmer groups and individual farmers.

#### Commercial release of products coming from the research and development (R&D) pipeline

Depending on the country, the process of evaluation and selection of varieties for release could take between two and three years. This includes matching and testing of products for suitability and adaptability in target agro-ecologies.

In 2017, four DroughtTEGO<sup>™</sup> hybrids that are tolerant to Maize Lethal Necrosis (MLN) disease were released in Kenya. This brings the total number of new maize seed released to date through AATF efforts to 117 (106

## **When one begs for water, it does not quench the thirst** – Soga people, Uganda

through the Water Efficient Maize for Africa (WEMA) Project and 11 through the *Striga* Weed Control Project).

Another 141 promising hybrids were entered into National Performance Trials (NPTs) – 15 from Hybrid rice, 99 through WEMA and 27 under the Seeds2B Project.

# Product allocation, licensing and production

AATF takes great care in allocating products to seed companies, using an allocation strategy that emphasises production, quality and distribution capacities. This is critical because quality seed production is a key component of the value chain, and hitches in production can have serious

# 117

Number of new seed varieties produced with support of partners (101 DroughTEGO; 5 TELA; 11 StrigAway).



A farmer with maize seed bought during a roadshow in Kenya.

repercussions, especially because planting seasons have little room for manipulation.

During 2017 seven companies from Burkina Faso, Kenya, Malawi, and South Africa were allocated products for testing and production.

The total seed production for 2017 stood at 1,453 tonnes from three products – DroughtTEGO, TELA and StrigAway – bringing total produced in five years to 6,350 tonnes.

For DroughtTEGO, 946 tonnes were produced from 9 hybrids in Kenya, South Africa, Tanzania and Uganda bringing total TEGO maize seed produced since 2013 to 5,222 tonnes. For TELA maize seed a total of 127 tonnes were produced for the year, and 380 tonnes of StrigAway maize seed was produced for 2017, giving a cumulative total of 1,000 tonnes of StrigAway maize seed since 2014.

# 6,350

Tonnes of maize seed produced through WEMA and Striga Control in Maize projects over five years

#### **Promotion and marketing**

Innovative promotion and marketing strategies are critical to the successful deployment of new and innovative products. This is especially so recognising that small scale farmers have limited resources which makes them risk averse when it comes to new technologies. AATF applies a mixed approach that provides education, awareness, experience and familiarity with the product, and efforts that encourage farmers to take up the technologies. AATF works with various partners to address the needs of the players along the seed value chain. Media and experiential marketing approaches such as road shows and field days support efforts to drive uptake among farmers.

## 130

Number of seed companies working with AATF to get products to farmers

Seed companies are critical to getting seed to farmers and, to date, AATF has engaged 131 seed companies in various stages of commercialisation from testing, production and sale of various products. Of these, 56 are involved in actual seed production and sale.

# 2,700

Tonnes of maize seed purchased by farmers in 2017

During 2017, over 2,700 tonnes were sold to farmers (DroughtTEGO® 2,371 tonnes; TELA<sup>™</sup> 13 tonnes; StrigAway 338 tonnes). This brings total seed sold to farmers to date to 4,652 tonnes (DroughtTEGO 3,946 tonnes, TELA 13 tonnes and StrigAway 693 tonnes). This would be sufficient to benefit 465,200 households assuming a household uses 10kg of seed per acre.

# 4,652

Tonnes of maize seed purchased by farmers during the last five years

To support marketing and promotion of products, capacity strengthening was carried out for the various actors. Seed production trainings for seed companies and seed growers were carried out for more than 130 seed companies. In addition, 677 agrodealers were trained in product handling, seed quality and product characteristics that helped them understand and stock new products. This training also prepared agrodealers in advising farmers on product types as their first point of call. Extension service providers, farmers and farmer groups were invited to demonstration sites to enable them to experience the product and engage developers on any unclear issues.

Demonstration plots are critical in showcasing new products and reaching and educating end users including farmers and extension service providers. During 2017, a total of 2,235 demos were set up that reached about 9,688 farmers through 82 field days showcasing a total of 97 elite varieties.

**465,200** Number of households reached by new varieties

Bushman dressed in animal skin in the Kalahari desert near Ghanzi, Botswana, Africa. Photo credit: Alamy Stock Photo

# Building 'seed bridges' to improve small-holder access to quality seed



#### Improving linkages between seed companies and farmers

Farming in most of Sub-Saharan Africa faces myriad challenges, not least being the availability of quality, affordable seed of modern crop varieties. The effect of this challenge is magnified in 'orphan' crops, which are characterised by low investment in their improvement resulting in lack of diversity within local breeding populations, continued dominance of old varieties in the market and a dearth of products that are responsive to the region's changing climate and market needs. This is further compounded by the fact that many farmers depend on informal seed systems, with the commercial seed market making up about a tenth of total seed planted by farmers. The result is declining productivity in the region attributed to farmers planting retained seed of varieties that are more susceptible to emerging biotic and abiotic stresses.

To increase access to quality seeds of a range of new varieties for smallholder farmers, the Seeds2B Project applies a systematic, market-led methodology to transfer betterperforming, locally adapted and marketappropriate improved crop varieties from research programmes to seed enterprises in Sub-Saharan Africa. The initiative works with public and private breeders to reduce risks related to market entry as well as seed enterprises to expand their product portfolios. Through these two key interventions, Seed2B contributes towards enabling smallholder farmers serve existing and emerging markets with quality locallygrown produce. The project targets several in-demand non-core crops as well as high value vegetables.

## **It is from a small seed that the giant iroko tree has its origin** -African proverb

#### The Seeds2B Project Progress as testing of new crop varieties enters second year

A second season of small scale soybean evaluations was finalised in Malawi. From the data collected over the two seasons, two varieties, SOY3 and SOY4, were identified as promising based on yield advantages ranging from 17% to 20% compared to the commercial checks. Farmers surveyed during the trials preferred several attributes related to these two products, including early maturity, plant architecture and pod size. The varieties also displayed good tolerance to soybean rust disease.

By close of the year, the commercial leads for tomato, sorghum and pearl millet hybrids had been identified for Malawi and Zimbabwe. Commercial profiles for the high performing hybrids were developed to facilitate engagement with seed enterprises in the two countries. All the leads – 11 sorghum, 8 pearl millet and 10 tomato hybrids – demonstrated better performance compared to commercial checks. The sorghum and pearl millet yields ranged from 8% to 63% in Zimbabwe. The tomato yields ranged between 4% to 111% in Zimbabwe and 16% to 203% in Malawi.

Nine seed companies in Malawi and Zimbabwe had taken up some of the high performing sorghum, pearl millet and tomato hybrids for further evaluation and selection. The capacity of these seed companies in technology licensing was also enhanced to facilitate negotiation and uptake of the hybrids under testing.

The first season of small scale trials for groundnuts, with three test entries and four controls, and new soybean varieties were established in Malawi and Zimbabwe. Data on parameters such as plant architecture, response to pests and diseases and yield and yield attributes is now being analysed.



Farmers score attributes of soybean varieties based on their preferences during the Seeds2B Project field day held at the Namikango Experiment Station in Zomba, Malawi

During the year, 12 new private technology owners from Brazil, France, Holland, India and Switzerland were engaged for access to high performing, adaptable and market appropriate crop cultivars of sorghum, pearl millet, tomato, soybean, sweet pepper, cabbage, carrot, onion and groundnuts for evaluation trials in subsequent seasons.

These engagements are aimed at facilitating product commercialisation and developing a robust evaluation trial pipeline which will offer a range of differentiated commercially viable products. To facilitate the trials, regulators in Malawi and Zimbabwe issued permits for the importation of over 116 varieties/hybrids for research purposes.

By the end of the year successful access had been negotiated for 100 improved crop varieties including tomato (38), sorghum (13), pearl millet (14), groundnut (3) and soybean (32). The sorghum, pearl millet and tomato hybrids were developed by breeders in Australia, Brazil, China, France, Hong Kong and India. The groundnut and soybean varieties were developed by breeders in China, Ghana, Malawi, Uganda, Zambia and Zimbabwe.

The project received a three-year sub-grant funding of US\$1,225,000 from the Syngenta Foundation for Sustainable Agriculture following an award from USAID under the Partnership for Africa Seed Technology Transfer Activity (PASTTA). To scale the Seeds2B model, the PASTTA initiative will develop a replicable and scalable variety technology transfer model to build equitable partnerships for technology transfer between public and private organisations for the benefit of smallholders in Malawi and Uganda. Furthermore, a grant of US\$225,000 over three years was awarded to AATF by the Syngenta Foundation for Sustainable Agriculture to advance both pre-commercial and commercial project activities in Zimbabwe.

#### Looking ahead

Building on the progress made and lessons learned during Phase I, the project will focus on deployment of commercially viable tomato, sorghum and pearl millet cultivars in Malawi and Zimbabwe while sustaining an active cultivar evaluation pipeline. Project activities will be initiated in Uganda during 2018. Collaborations with public breeding institutions to access appropriate improved crop varieties for evaluation and commercialisation in the project's target countries will be a focus during Phase II.

Edgar Wavomba, Seeds2B Project Coodinator









African bedik woman with headscarf, Iwol village, Bassari, Senegal, Africa. Photo credit: Alamy Stock Photo

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## **Building quality seed for Africa**



# Addressing the lacuna between breeder seed and commercial seed

The poor supply of foundation seed has been a major bottleneck to the sustainable production of improved seed of various crops for the benefit of smallholder farmers in Sub-Saharan Africa.

The deployment and commercialisation of newer better performing seed products has been severely hampered by systemic failures especially the acute technical, infrastructural and financial challenges that independent (small and medium enterprises – SME) seed companies in Sub-Saharan Africa (SSA) face in the maintenance and timely multiplication and supply of quality foundation seed. Seed companies require a steady supply of quality foundation seed which is critical to improving farm productivity by small holder farmers. A failure in foundation seed production processes would result in low quality certified seed reaching farmers. In some cases, this may result in the nonavailability of the latest varieties thus affecting productivity.

When a needle falls into a deep well, many people will look into the well, but few will be ready to go down after it –

African Proverb

### QualiBasic Seed Company Growing into the quality foundation seed supplier for Africa

There have been substantial investments that have been made towards crop improvement and the development of new varieties for Africa over the years. These breeding programmes have released high yielding and very adaptable crop varieties, such as maize hybrids, that offer high productivity opportunities. However, the benefits of these products are yet to be fully realised by smallholder farmers due to delayed seed production in some cases and low-quality seed in others.

The main cause of the unrealised benefits is poor integrity and quality of foundation seed availed and/or produced by seed companies for production of certified seed. This has affected technology uptake, with the adoption rate of maize hybrid seed remaining at around 30%, yet more than 75% of the hybrids have been on the market for more than 18 years.

To mitigate this problem, AATF established and is incubating QualiBasic Seed Company (QBS) to produce and supply quality foundation seed to seed companies. To ensure sustainability of this novel business to business (B2B) model, QBS operates on a commercial basis.



QualiBasic Seed Company Board of Directors

The company is the result of extensive consultations with a variety of stakeholders. It was established with support from the Bill and Melinda Gates Foundation, and it is expected that, in five years, the company will achieve standalone status.

QBS will address the challenge of availability of quality foundation seed by stepping into the gap that exists between the release of high yielding and adaptable crop varieties by breeders that offer high productivity opportunities on the one hand and efforts to produce sufficient certified seed for commercial sale to the farmers by the independent (SME) seed companies. Often the disconnect between the two results in loss of/or delayed benefits of these products for smallholder farmers.

The three specific challenges to address are low quantity and poor quality of foundation seed; limited use of newer and betteryielding improved varieties by farmers; and low achievements of farm-level genetic gain.

QBS was launched in January 2017 as a commercial entity. AATF has set up the company that is now operational with country office hubs established. The company has been registered in the three countries – Kenya, Uganda and Zambia. The board has been fully constituted, comprising individuals with wide business experience from different sectors and functions – public and private – including the seed industry.

The company has also recruited more than 90% of its required staff strength to place it firmly for effective commencement of its business operations. QBS has already set up systems and structures and embarked on its first foundation seed production on more than 30 hectares. The company has identified



The QBS HQ team from left: Rashid, Elizabeth, Andy, Wycliffe, Wanjiru and Joyce

more than 80 potential customers and has engaged 52 of these customers. From the customers engaged, QBS is currently in the process of processing and delivering orders for 18 companies.

QBS is focusing on the production and supply of maize foundation seed. It will diversify into other crops such as cereals and legumes at a later stage.

#### Looking ahead

During the coming year, efforts will go towards setting up state of the art fit for purpose processing facilities in all the hubs. The company will also strengthen its quality management systems to support delivery of its promise to seed companies and continue engagement with its key customers, the seed companies.

# Priority Area 6: Improving Breeding Methods

# Using new breeding tools for improved breeding selection and accuracy

Africa's ever-growing population is posing a major threat to its food security. The need to rapidly develop well adapted and high yielding varieties could not be more compelling and apt than now given the increasing biotic and abiotic stresses that are bedevilling agriculture in Africa. Improved crop productivity would have to be achieved under increasing challenges including limited arable land and difficult physical conditions imposed by changing climate if sustainable food and nutrition security of Africa is to be guaranteed and enhanced.

Plant breeding, which has been in use for several hundred years, has been pivotal in creating desirable gene combinations for key traits of economic importance such as faster growth/early maturity, vigour, higher yields, pest and disease resistance, larger seeds and better nutritional value.

Conventional or traditional plant breeding was principally driven for a long time on pedigree-based methods. This has resulted in release of improved varieties – open pollinated varieties and hybrids – that have sustained Africa and the world for a long time. Under traditional breeding, activities are mainly done through crossing and selection resulting in the release of better varieties. With advanced knowledge of the science of genetics, it became glaringly clear that most of the economic traits of importance were controlled by several genes making their utilisation in breeding more complicated and difficult to manipulate effectively without tools or decision support systems.

Yield thresholds are principally set by the genetics of a crop variety whose potential is maximised on farmers' fields through improved farm management practices. It therefore means that the attainment of crop super yields will have to rely heavily on improved plant breeding. While traditional plant breeding has been considerably successful, it has not been very efficient and effective in delivery of best results. It takes no less than 8–10 years to release a variety and another 2–3 years to ramp-up large quantities of seed for dissemination to reach huge numbers of farmers. The

### Tomorrow belongs to the people who prepare for it today -

African Proverb



A worker harvesting hybrid rice at the Busia trial site.

need for more improved varieties makes this timeframe less efficient. The high number of years involved also means high added cost to breeding initiatives. Perhaps the most challenging part is the aspect of understanding and dissecting the genetics of complex traits and exploring the knowledge to build good haplotype combinations for desirable phenotypes.

The challenge with traditional breeding is further exacerbated by the need to address nutritional traits (especially for those lacking sufficient genetic variation in breeding populations) and breeding for high crop value traits linked to agro-industrial development and new market niches. These are crucial traits to alleviating poverty in Africa and they require the adoption of new breeding strategies.

Following advancement in science in the 20<sup>th</sup> century, new breeding strategies and tools have rapidly facilitated improved crop breeding methods. Advances in biotechnology have resulted in a new era of modern breeding that is exploring double haploid technology, molecular markers,

genomics and genetic engineering, Nextgen sequencing, improved phenotyping power (e.g. proteomics, metabolomics) to enhance crop improvement capacities. These have resulted in the development of molecular breeding strategies such as marker assisted selection, marker assisted recurrent selection, genomic selection, transgenic breeding, etc., which have improved breeding selection and accuracy for desirable genotypes or superior varieties and increased genetic gain. The improved accuracy that modern breeding strategies offer have helped to reduce the number of phenotyping trials conducted in a breeding scheme.

AATF has facilitated application of new breeding tools (including brokering access to proprietary genes) and crop improvement strategies for African staples (rice, maize and cowpea). For example, AATF has used a combination of these strategies to develop hybrid maize in WEMA. Transgenic breeding has been used to develop rice and cowpea products. AATF has also promoted classical breeding for hybrid rice development with varieties released and commercialised.

Young woman of Watatulu tribe with her baby. Shinyanga District, Tanzania. Photograph by Sean Sprague. Photo credit: Alamy Stock Photo

# Developing hybrid rice with yield advantage



# Increasing productivity and competitiveness of African rice varieties

Rice demand on the continent exceeds production and Africa has been forced to rely heavily on importing large quantities of rice to meet demand at a very huge cost. Only a few countries in Africa have attained self-sufficiency in rice production and as many as 21 of the 39 rice-producing countries import between 50% and 99% of their rice requirements. Sub-Saharan Africa (SSA) produces 16 million tonnes of milled rice per year; but consumes nearly double that amount at 30 million tonnes of milled rice per year.

Africa's inability to reach self-sufficiency in rice is the result of a combination of several factors in the rice industry. The continent suffers low rice productivity averaging 2.2 t/ ha against the global average of 3.4 t/ha. This

is largely caused by lack of high performing varieties, poor seed systems that make it difficult for farmers to access certified and high-quality seeds, as well as the vagaries in weather brought about by climate change.

### "The hybrid is of good quality. It also has characteristics of Pishori which is loved by Kenyans, and has a more translucent and stronger grain"

- Dr Raphael Wanjogu, Chief Research Officer at the National Irrigation Board

### Hybrid Rice: Breeding by Design Project Inching closer to the first indigenous rice hybrids

Low productivity leads to high production costs that limit African rice farmers by making their products costlier and less competitive in the global market, thereby favouring importation over local production.

# 200,000

Amount in tonnes of rice produced in Kenya per year against a demand of 450,000 tonnes

Despite being one of the country's key staple foods, Kenya produces less than 200,000 tonnes of rice, far below the national demand of over 450,000 tonnes per year as reported by the National Irrigation Board. The gap is bridged by huge imports mostly from countries in Asia.

The Hybrid Rice Project aims to develop 2-line rice hybrids and parental lines in selected African countries and to facilitate expedited farmer access to this product through private companies and public institutions in Africa, for increased yields and improved income streams for farmers.

As the project approached the end of its first phase, activities primarily shifted to national performance trials of candidate best lines

# 50%-99%

Quantity of rice imports by 21 African countries developed in the project – an important step towards the release of the first set of rice hybrids for use by seed companies and eventual availability to farmers in Kenya.

During the year, the second season national performance trial (NPT) of 15 hybrids were completed, marking a significant milestone towards delivering the first indigenous rice hybrids in Kenya.

In the trials, the candidate hybrids outperformed the local checks for key traits such as date-to-maturity, yields and disease resistance. The hybrids take only 90–120 days to mature compared to 135–150 days for local varieties. Under best bet production practices, yields for the new hybrids ranged from 7–10 tonnes per hectare compared to 3 tonnes per hectare obtained for commercial varieties.

The NPTs, carried out by Hybrids East Africa Ltd (HEAL) under the supervision of the Kenya Plant Health Inspectorate Service (KEPHIS), were conducted at Hola and Malindi in the coastal region, Mwea in central Kenya, and Bondo and Kisumu in western Kenya.

The new rice hybrids will not only improve yields of rice but they will also be as competitive as imported rice in terms of grain quality and affordability. It is estimated that farmers stand to gain an average of US\$350 to US\$1,000 per hectare more than with the commercially available varieties.

# Seeking sustainability of rice value chains

As part of its activities, the project has trained rice value chain personnel on: evaluation and selection of rice hybrids, production of quality seeds, breeding and development of 2-line rice hybrids, and establishment of hybrid rice demos. Most of these activities targeted the key aspects of the 2-line hybrid rice development and production system.

In addition, the project is already partnering with ten seed companies in East Africa to enhance the sustainability of the hybrid rice system in Kenya and Tanzania.

## US\$350 to US\$1,000

Estimated financial gain to farmers per hectare of hybrid rice

In recognition of the agribusiness potential of the rice value chain, four seed companies have already acquired parental lines and are conducting yield trials in Ghana, Kenya, Nigeria, Tanzania and Zimbabwe.

# 7-10

Yield in tonnes per hectare with hybrid rice compared to 3 tonnes per hectare for commercially available varieties

#### Looking ahead

The project has started working on development of the next generation of more market-oriented products. The next generation demand-driven products include aromatic parental lines and hybrids which would require more time to develop. Such premium products will enhance profit margins for the stakeholders along the rice value chain in Africa. During phase two, efforts will focus on technical backstopping, sustainable capacity strengthening for private seed companies, stewardship of the technology, and best-bet agronomic practices.

Kayode Sanni, Project Manager, Rice









# Priority Area 7: Improving Food Safety and Quality

## Developing Africa's food safety systems for health and global trade

At least three Sustainable Development Goals – reducing poverty, achieving food security, and improving health – have a direct relationship and will be affected by the issue of food safety.

The World Health Organization estimates that globally 420,000 people die and 600 million fall ill annually from foodborne hazards, with the highest incidence per capita being in Africa.

The continent is affected by various types of food contamination arising from veterinary drugs, pesticide residues and a range of pathogenic microorganisms all linked to factors such as weak production and storage practices, environments and climatic conditions.

Other factors exacerbating contamination include unethical practices such as use of illegal additives to accelerate the ripening of crops or corruption in licensing of food business operators.

In addition, global climate change may result in altered conditions for food production, which could lead to emergence of new pathogens and even altered mechanisms through which contaminants move from the environment into food.

All this is taking place at a time when consumer demands and globalisation of the food system are requiring harmonised food safety standards and modern practices to assure compliance.

For African farmers to access more formal and regional markets, they will need to have systems in place for assurance of food safety. Unfortunately, efficient food control systems are still an issue within the region.

In many African countries, key constraints to food safety comprise the lack of such fundamentals as effective public policies, legislation and institutions to provide regulatory oversight, insufficient extension services, few trained personnel to carry out food safety activities, lack of cold chain

## 420,000

number of people who die annually due to foodborne hazards

facilities and unaccredited food testing laboratories.

A leading cause for concern in Sub-Saharan Africa is contamination of food grains by aflatoxins. Case in point is maize, one of the most important agricultural commodities in terms of amounts produced, traded and consumed worldwide.

While many countries may have regulations on aflatoxin control among their statutes, many individuals consume food, especially maize, that has not undergone regulatory inspection, especially in Africa where subsistence farming is widespread.

# Aflatoxin control, health and trade

In recognition of the varying processes for testing and registration of biological control products, AATF, through collaboration with the United States Department of Agriculture Foreign Agricultural Service (USDA-FAS), is facilitating regional consensus building on registration frameworks for biopesticides in selected African countries including Nigeria and Kenya, where control of aflatoxin contamination in food grain has been a national priority in recent years. In this respect, a 'Guidance Document' for registration of bio-pesticides has been tabled for stakeholder review and input. In addition, sampling and testing equipment for aflatoxin control regulatory laboratories in Kenya and Uganda were handed over to Kenya and Uganda during 2017 signifying mutual agreement on the use of a common aflatoxin sampling, testing and protocol between the two countries.



A farmer applies Aflasafe in a maize farm in Siakago, Kenya, during trials for the control of aflatoxin

### **600 million** Number of people who fall ill annually from foodborne hazards

Through further collaboration with other U.S. government agencies including the U.S. Food and Drug Administration (FDA), USAID East Africa Trade and Investment Hub (EATIH), USAID/USDA Food Safety Network (FSN), and the Food Safety Preventive Controls Alliance (FSPCA), AATF convened a training for government ministries and private sector entities on the importance of practical food safety measures, compliance with international trade standards, and their impact on trade especially with the U.S. market and opportunities under the African Growth and Opportunity Act (AGOA).

## He who doesn't clean his mouth before breakfast always complains that the food is sour - African Proverb

## **Financial Report 2017**

These audited financial statements cover the period from January 2017 through December 2017 and provide comparative data for 2016 – the previous accounting period.

#### **Funding overview**

AATF investors for the year 2017 were Bill & Melinda Gates Foundation; The Howard G. Buffett Foundation; United Kingdom's Department for International Development (DFID); United States Agency for International Development (USAID); Syngenta Foundation for Sustainable Agriculture (SFSA); and Fintrac.

AATF is grateful to all its investors for their continued support that ensures that its commitment towards assisting resource-constrained farmers in accessing affordable agricultural technology to improve their lives is achieved.

	2017	2016
ASSETS		
Non-current assets		
Equipment and motor vehicles	27,529	50,230
Intangible assets	1,040	3,120
	28,569	53,350
Current assets		
Contributions receivable	2,264,472	4,166,654
Other receivables	867,108	974,027
Bank and cash balances	8,001,806	5,993,533
	11,133,386	11,134,214
Total assets	11,161,955	11,187,564
Fund balances and liabilities		
Current liabilities		
Unexpended grant payable	4,619,035	3,191,576
Deferred income	24,483	31,171
Payables and accruals	1,283,186	2,824,366
	5,926,704	6,047,113
Fund balances	5,235,251	5,140,451
Total liabilities and fund balances	11 161 955	11 187 564

#### Statement of financial position as at 31 December 2017 (US\$)

	2017	2016
Income		
Grant income	21,335,873	20,456,945
Other income	1,038,158	1,434,462
Deferred income	6,688	(80,192)
Total Income	22,380,719	21,811,215
Expenditure		
Project related expenses	19,934,801	20,289,215
Management and general expenses	2,351,118	2,152,484
Total expenditure	22,285,919	22,441,699
Surplus for the period	94,800	-630,484
Percentage of management and general expenses to the total operating expenses	10.55%	9.59%
Percentage of project related expenses to the total operating expenses	89.45%	90.41%
	100%	100%

#### Statement of comprehensive income (abridged version in US\$) For the year ended 31 December 2017

### **Financial status**

During the period under review, the funding status was relatively stable as the expected major funding for that period came through.

The funding received during 2017 was adequate for the Foundation's needs for the year as all expenditures were fully catered for. The Foundation received an unqualified audit opinion from external auditors. The independent auditors' opinion for the year was that the financial statements presented fairly, in all material aspects, the financial position of the Foundation as at 31 December 2017 and its financial performance and cash flows for the year then ended in accordance with International Financial Reporting Standards and the requirements of Kenya's Companies Act of 2008.

The Foundation Trustees and Management are not aware of any material uncertainties related to events or conditions that may cast doubt upon the Foundation's ability to continue as a going concern.

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57.	Fredah Nyaga	Accountant
58.	Simeon Eze	Driver, Abuja Office

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## Acronyms

AATF	African Agricultural Technology Foundation
ABU	Ahmadu Bello University
AGOA	African Growth and Opportunity Act
ARC	Agricultural Research Council
ARCN	Agricultural Research Council of Nigeria
CAMAP	Cassava Mechanisation and Agro-processing Project
CFT	Confined field trial
CIAT	International Centre for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
COMESA	Common Market for Eastern and Southern Africa
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EFSE	Early Food Safety Evaluation
EIA	Environment Impact Assessment
EIAR	Ethiopian Institute of Agricultural Research
FAW	Fall Armyworm
FDA	Food and Drug Administration
HEAL	Hybrids East Africa Ltd
IAR	Institute for Agricultural Research
IAR	Institute of Agricultural Research
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
INERA	l'institut de l'Environnement et de Recherches Agricoles
IRM	Insect resistance management
KALRO	Kenya Agriculture and Livestock Research Organization
KEPHIS	Kenya Plant Health Inspectorate Service
MCMV	Maize Chlorotic Mottle Virus
MLN	Maize Lethal Necrosis
NARO	National Agricultural Research Organisation
NARS	National Agricultural Research Systems

Acronyms

NBA	Kenya National Biosafety Authority
NBAB	National Biosafety Appeals Board
NEMA	National Environment Management Authority
NEWEST	Nitrogen-Use Efficient, Water-Use Efficient and Salt Tolerant Rice Project
NPT	National performance trial
ODK	Open data kit
OFAB	Open Forum on Agricultural Biotechnology in Africa
PASTTA	Partnership for Africa Seed Technology Transfer Activity
PBR	Pod Borer Resistant (Cowpea Project)
PIPRA	Public Intellectual Property Resource for Agriculture
QBS	Qualibasic Seed Company
SCMV	Sugarcane Mosaic Virus
SFSA	Syngenta Foundation for Sustainable Agriculture
SME	small and medium enterprises
SOPs	Standard operating procedures
SSA	Sub-Saharan Africa
STAK	Seed Traders Association in Kenya
TSBF-CIAT	Tropical Soil Biology and Fertility Program of the International Centre for Tropical Agriculture
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USDA-FAS	USDA Foreign Agricultural Service
VCDP	Value Chain Development Programme
WEMA	Water Efficient Maize for Africa (Project)


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