ASARECA
Transforming Agriculture for Improved Livelihoods

@25

Celebrating Decades

of Coordinating Collaborative Agricultural Research for Development

1994 - 2019

ASARECA Development Partners

USAID FROM THE AMERICAN PEOPLE

IFAD Investing in rural people

European Union

WORLD BANK GROUP

Sida

DFID Department for International Development

IDRC CRDI International Development Research Centre Centre de recherches pour le développement international

Canadian International Development Agency

Australian Government Australian Centre for International Agricultural Research

USDA United States Department of Agriculture

As ASARECA celebrates 25 years of coordinating and convening AR4D in Eastern and Central Africa, we recognize our Development Partners for their contribution towards the fulfillment of ASARECA mandate. On behalf of the Governments of our 12 member countries and all our constituents, we say—**Thank You!**

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List of Acronyms

ACIAR	Australian Centre for International Agricultural Research
AFAAS	African Forum for Agricultural Advisory Services
AfDB	African Development Bank
ARC	Agricultural Research Corporation
AR4D	Agricultural Research for Development
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
A-SRF	ASARECA Strategy and Results Framework
ASTI	Agricultural Science and Technology and Innovation
AU	African Union
BXW	Banana Xanthomonas Wilt
CAADP-XP4	Comprehensive Africa Agricultural Development Programme Ex Pillar 4 Institutions
CBSD	Cassava Brown Streak Disease
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIDA	The Canadian International Development Agency
CIMMYT	Centre for Improvement of Maize and Wheat
CIP	Institute for Potato Research
CMD	Cassava Mosaic Disease
COMESA	Common Market for Eastern and Southern Africa
CORAF	West and Central African Council for Agricultural Research and Development
CSIRO	Commonwealth Scientific and Industrial Research Organization
CURAD	Consortium for Enhancing University Responsiveness to Agribusiness Development
DeSIRA	Development Smart Innovation through Research in Agriculture
DDPSC	Donald Danforth Plant Science Centre
DFID	Department for International Development
DONATA	Dissemination of New Agricultural Technologies in Africa
EAAPP	Eastern Africa Agricultural Productivity Project
EAC	East African Community
EAPGREN	East African Plant Genetic Resources Network
EASCOM	Eastern Africa Seed Committee
EC	European Commission
ECA	Eastern and Central Africa
ECAPAPA	Eastern and Central Africa Programme for Agricultural Policy Analysis
EU	European Union
FAO	Food and Agricultural Organisation

FARA	Forum for Agricultural Research in Africa
FFA	Framework for Action for Agricultural Research in Eastern and Central Africa
GDP	Gross Domestic Product
ICER	Internally Commissioned External Review
ICRISAT	International Centre for Agricultural Research in Arid and Semi Arid Tropics
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
IGAD	Intergovernmental Authority on Development
IITA	International Institute for Tropical Agriculture
IPTAS	Innovation Platforms for Technology Adoption
ISABU	Institut des Sciences Agronomiques du Burundi
ISAR	Institut des Sciences Agronomiques du Rwanda
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MDTF	Multi Donor Trust Fund
MTOP	Medium Term Operational Plan
NaCRRI	National Crop Resources Research Institute
NAKIS	National Agricultural Knowledge and Innovation Systems
NARI	National Agricultural Research Institutes
NARO	National Agricultural Research Organization
NARS	National Agricultural Research Systems
NEPAD	New Partnership for Africa's Development
OFSP	Orange-Fleshed Sweet Potato
OPVs	Open Pollinated Varieties
PGRFA	Plant Genetic Resources for Food and Agriculture
QPM	Quality Protein Maize
RABESA	Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa
RECs	Regional Economic Communities (RECs)
RCoE	Regional Centres of Excellence
SCARDA	Strengthening Capacity for Agricultural Research and Development
SIDA	Swedish International Development Cooperation Agency
SPAAR	Special Programme for Africa Agricultural Research (SPAAR)
SVCDC	Sorghum Value Chain Development Consortium
TCBN	Tissue Culture Business Network
TIMPS	Technologies Innovations and Management Practices
UNBS	Uganda National Bureau of Standards
UniBRAIN	Universities in Business and Research in Agricultural Innovation Initiative
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

ASARECA General Assembly Presidents

The General Assembly Presidents preside over all the meetings of ASARECA stakeholders constituting the Plenary of the General Assembly

Prof. Elly Sabiiti
President of the 1st ASARECA General Assembly
(2011 - 2013)

Prof. Jospeh Bigirimana
President of the 2nd ASARECA General Assembly
(2013 - To date)






ASARECA Executive Directors Since 1994

Prof. J.S Mugerwa (RIP)
1994 - 1995

Prof. Geoffrey Christopher Mrema
1995 - Dec 2001

Dr. Seyfu Ketema
Jan 2002 - Feb 2013

Dr. Fina Opio
March 2013 - June 2015

Prof. Francis Wachira
June 2015 - Dec 2016

Dr. Cyprian Ebong
Jan 2017 - Sept 2018

Prof. Jean Jacques Mbonigaba Muhinda
Sept 2018 - To date






1994 - 2019
25th ANNIVERSARY
ASARECA
Transforming Agriculture for Improved Livelihoods

In 2019, ASARECA marked a Silver Jubilee. Activities to mark the Anniversary were launched during the ASARECA Council of Patron Ministers Summit in Kampala, Uganda and graced by the Patron Ministers, the General Assembly, the Board of Directors and National Focal Persons. The ceremony was presided over by Uganda's Second Deputy Prime Minister and Minister for East African Community Affairs, Rt. Hon. Alhaj Ali Kirunda Kivejinja.

25 Years of Adding Value to National Agricultural Research Systems

Executive Statement

In 2019, ASARECA celebrated its Silver Jubilee since the Association was created in 1994. For 25 years now, projects supported and coordinated by ASARECA have made a substantial contribution to the livelihoods of many of the over 350 million people in Eastern and Central Africa.

Prof. Jean Jacques Mbonigaba Muhinda
ASARECA Executive Director

ASARECA work has led to the development of noble agricultural technologies, innovations and management practices (TIMPs) such as improved crop and livestock varieties; integrated soil fertility and water management; agronomic packages; storage; value addition and marketing; regional agriculture and trade policy harmonization; and institutional capacity development.

ASARECA has evolved through three major phases:

PHASE 01

1994- 2007

The period of birth (1994) and development of the ASARECA Long Term Strategic Plan (1997). This period characterized the creation of Research Networks which drove ASARECA Agricultural Research for Development (AR4D) agenda at the time.

PHASE 02

2008- 2018

The period of change and development of the Second ASARECA Strategic Plan. This period, saw ASARECA negate the Research Networks approach and adopt the Programmatic approach. This was implemented through ASARECA Operational Plan One (2008-2013) and Operational Plan Two – (2014-2018).

PHASE 03

2019 going forward

The period of review and realignment, which ASARECA embarked on after revisiting and refreshing its approach to AR4D through the development of the new ASARECA Strategy and Results Framework 2019-2028; the Medium Term Operational Plan 1 (2019-2023); and revisiting its niche to focus where stakeholders demand it to concentrate.

Looking into the Future

Refreshed Mandate

ASARECA has just launched a ten-year ASARECA Strategy and Results Framework (A-SRF) for the period 2019-2028. The 10-year Strategy is operationalized through two Medium Term Operational Plans each covering a period of five years. Given this arrangement, therefore, ASARECA has developed its first Medium Term Operational Plan (MTOP I) covering the period 2019- 2023.

The development of the MTOP I was done through extensive consultations involving key stakeholders and partners within and outside the ECA sub region. It also included information gathered through consultations carried out during the preceding Internally Commissioned External Review (ICER) of ASARECA Programmes and Management over the past 20 years.

To date, ASARECA has cut out a sharp prestigious niche, rebranded and strategically repositioned to perform a higher level facilitative, supportive, coordination and advocacy role to enhance sustainable agricultural transformation, sustained economic growth and inclusive development in the ECA sub-region. To deliver on this role, ASARECA is now repositioned as the regional "Go to Service Provider of Choice for AR4D coordination, convening, partnership brokerage, process facilitation, and communication products and services." These services are designed to deliver targeted high priority inclusive and sustainable agricultural transformation and development outcomes and impact in the ECA sub region.

The new ASARECA therefore supports the improvement of the **relevance, effectiveness and efficiency** of the sub-regional AR4D, leading to significant improvement in **value for money** in the delivery of inclusive and sustainable agricultural transformation and development. ASARECA will achieve this by supporting the attainment of **economies of scale** in the conduct of priority regional research and by significantly reducing **duplication and misalignment of efforts and resources**.

In this regard, therefore, the mandate of the repositioned ASARECA shall be to:

01 Identify regional research priorities and opportunities through credible, authentic and participatory ongoing strategic visioning processes.

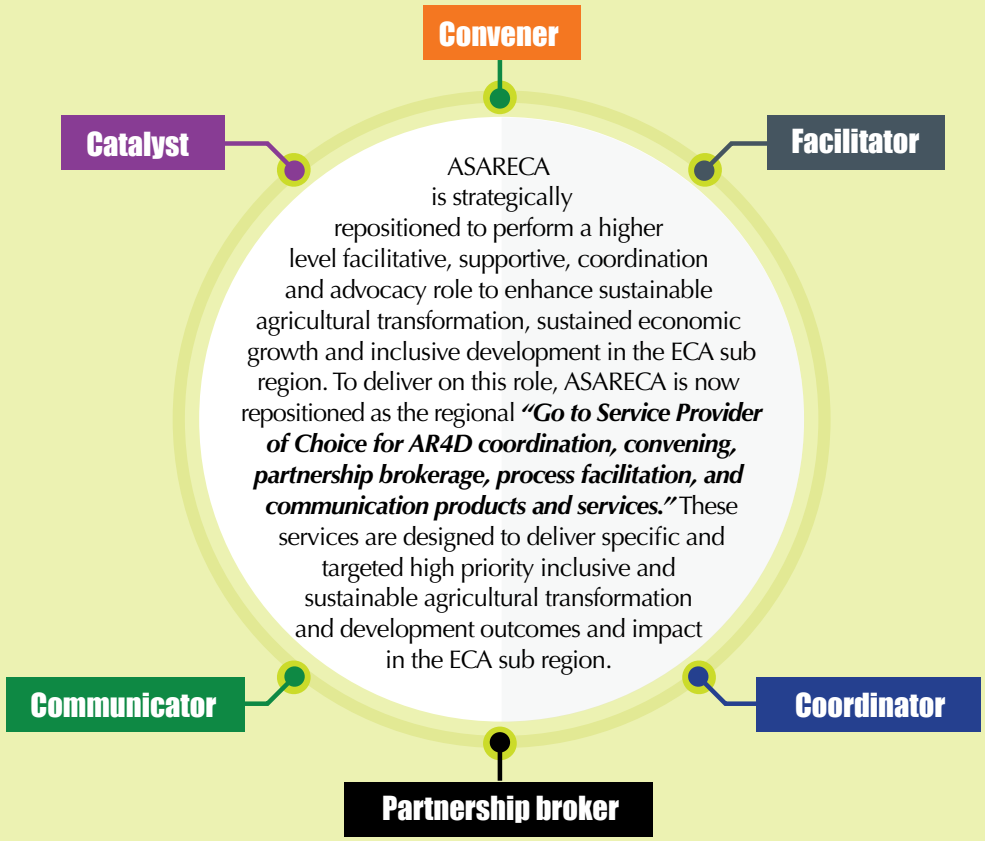
02 Commission, broker and manage strategic research partnerships to address identified regional priorities in the most effective, efficient and synergetic ways.

03 Nurture pathways for on-time delivery, spill over and scaling up of regional agricultural research results to deliver agricultural outcomes and impact.

04 Mobilize, allocate and manage regional AR4D investments to support generation of regional agricultural research public goods and services.

05 Monitor and evaluate returns on AR4D investment and repackage lessons and best practices to inform decision-making processes and actions.

Highlights of ASARECA Mandate



This driving Value Proposition has been designed to enable ASARECA add value and contribute significantly to accelerated sustainable agricultural transformation and growth for shared prosperity and improved food and nutrition security of the ECA people.

To undertake this mandate, ASARECA has identified four thematic areas through rationalization of critical AR4D issues. The themes include: Transformative Capacity Strengthening and Integration; Agricultural Transformation Technologies and Innovations; Enabling Policy Environment, Functional Markets and Transformative Institutions; Knowledge and Information Management.

This publication is an attempt to put together a statement of the Promise of ASARECA to its constituents. It is a comprehensive account of efforts and resources that ASARECA has put forth to its stakeholders in fulfillment of its value proposition.

I welcome you and appreciate your contribution.

Prof. Jean Jacques Mbonigaba Muhinda
ASARECA Executive Director

Context and Justification for ASARECA Work

The ultimate beneficiaries of ASARECA interventions are predominantly smallholder farmers pursuing agriculture-based livelihoods and using one-third of the total land area in the sub-region (about 300 million hectares).

These communities experience poor returns from agriculture and face similar challenges including variable climate; declining natural resource base; lack of access to input and output markets; limiting agriculture and trade policies; use of poor quality inputs; and attack by menacing pests and diseases. Young men and women born in these communities have abandoned farming in search of money-making ventures in urban areas, leaving agriculture to the elderly.

Low investment in agriculture and agribusiness has led to sluggish productivity growth in the sector, which through the years deepened the level of poverty, slowed overall economic growth and per capita income levels. Ironically, the agriculture sector heavily features in the national economies, accounting for about 43% of their Gross Domestic Product (GDP).

> ASARECA supports the NARS through regionally coordinated interventions to boost their capacities and leverage global resources to harness opportunities to transform agriculture

Things could get worse if not checked. Alternatively, things could get better if the apparent challenges are quickly harnessed into opportunities. Recent studies show that the Sub-Saharan Africa region will experience the largest growth in demand for food in the next decades (about 155% between 2015 and 2050), compared to an average global increase of 40%. This growing demand for food is driven by increasing incomes and population with most of the incremental demand expected to come from urban areas where the retail value of urban food markets is expected to increase by 400% between 2010 and 2030. There will be increased demand for both fresh and processed foods. However, the demand for processed foods will increase relatively faster, presenting an opportunity for linking primary agriculture (farming) with the food industry and unlocking the contribution of agriculture to industrialization. Based on the foregoing, the contribution of the sector to growth, attainment of food and nutrition security and increased prosperity for the people is still lagging behind expectations.

The value of ASARECA

In a bid to address the challenges and pace ahead of global trends, ASARECA has supported the National Agricultural Research Systems in the member countries through regionally coordinated and convened interventions to boost their capacities and leverage global resources to harness opportunities to transform Agriculture.

ASARECA was established in 1994 by ten member States represented by their National Agricultural Research Institutes (NARIs) following the approval of the Framework For Action (FFA) for agricultural research in Eastern and Central Africa by the Special Programme for Africa Agricultural Research (SPAAR). The original ten member States included Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda. The membership has since grown to 12 following the admission of South Sudan and Republic of the Congo in 2011 and 2019 respectively.

Why ASARECA was Established by the NARS

The founders established ASARECA to complement national efforts through sub-regional level collective action and cost-effective utilization of resources to improve the delivery and impact of scientific knowledge, policy options and technologies to drive the sub-region towards meeting the Comprehensive African Agricultural Development Program (CAADP).

Core functions of ASARECA

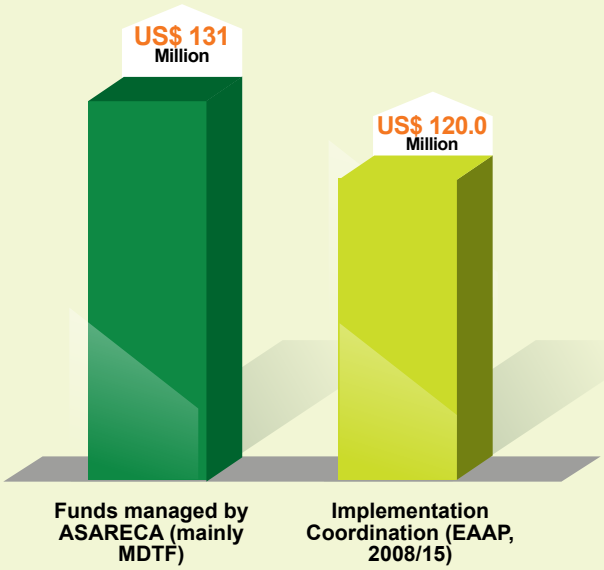
- Promote and facilitate regional collaboration for cost-effective utilization of available resources to produce technologies, knowledge and innovations (regional public goods) to be shared by member countries.
- Mobilize resources globally for implementing collective action on agricultural research, training, extension and education services.
- Develop policies and programs aimed at deepening co-operation in agricultural research among member countries and facilitate the adoption of such policies including agricultural commodity arrangements.
- Complement the activities of the national, pan-African and international research institutions guided by the Principle of subsidiary, by focusing on activities for which the sub-region has a comparative advantage over national or international actions in delivering more responsive services to stakeholders.
- Empower end-users to meaningfully participate in developing priorities for AR4D.
- Contribute to the development and transfer of appropriate knowledge, methodologies, information and technologies and benefits among the NARS.
- Strengthen the capacity of national AR4D institutions to fulfill their national mandates.
- Promote the conservation of natural resources and the adoption of improved methods of agricultural production.

Dr. Enock Warinda
ASARECA Deputy Executive Director

ASARECA Stakeholders

- National Agricultural Research Institutes
- Farmer's associations
- National and sub-regional associations that coordinate agricultural research, extension, training and education
- Associations of processors of agricultural products and service providers
- Associations of agricultural businesses and related marketing agents
- Consumer associations
- Organized women and youth groups working in agriculture
- Non-governmental associations working in agricultural research and development
- International agricultural research centres;
- Universities and advanced research institutes
- Investors and development partners.

ASARECA AR4D investments (1994-2018) vs Total R&D spending in member countries



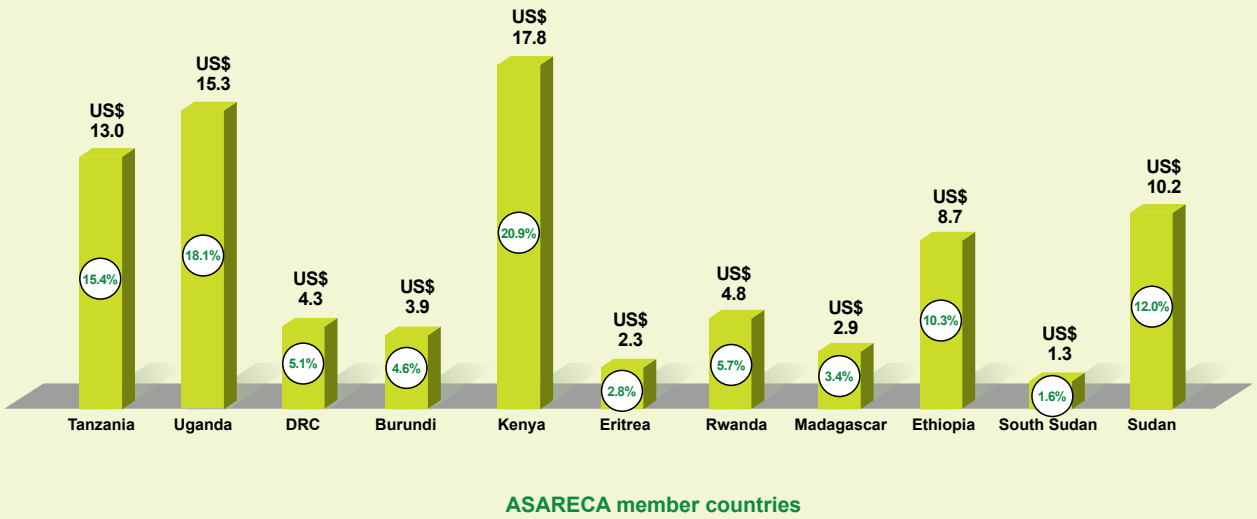
- *US$ 10 million per year to support regional research*

Country	Total agricultural Research Spending as a share of Ag-GDP (%)	Total agricultural R&D spending, excluding private-for-prifit sector (US$ Million)
Burundi	0.39	10.9
DRC	0.24	27.7
Eritrea	0.30	2.9
Ethiopia	0.29	162.1
Kenya	0.48	222.4
Madagascar	0.14	10.4
RoC	0.26	6.3
Rwanda	0.44	27.3
South Sudan	-	-
Sudan	0.14	57.3
Tanzania	0.17	68.5
Uganda	0.62	99.04

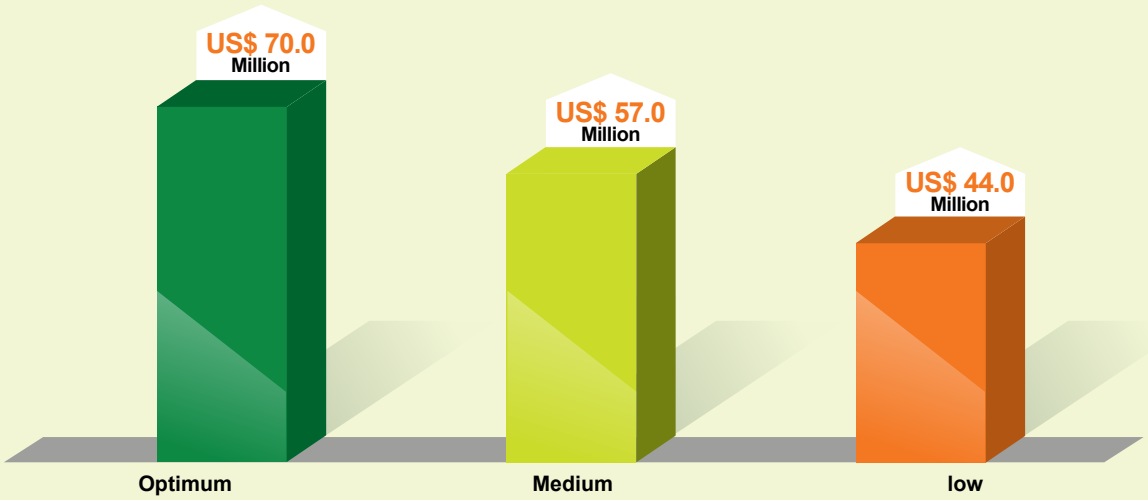
- *None of ASARECA countries met the target to allocate 1% Ag-GDP to research spending*

Source: www.asti.cgiar.org (2016 data)

ASARECA investment in member countries from 1994 to 2018 (US$ million)



Financing scenarios for the 5 year MTOP-I (US$ Million)



- *US$ 8.8 million per year under the low-level funding scenario*
- *ASARECA anticipates funding from it's member states' contributions in cash and kind; Development partners; Private sector actors and other stakeholders*

ASARECA Coverage

European Union

IFAD
Investing in rural people

ASARECA
Transforming Agriculture for Improved Livelihoods

CAADP-XP4 implementing partners during a workshop at FARA headquarters in Accra, Ghana in February 2020

CAADP XP4: Flagship Project (2019- 2023)

Comprehensive Africa Agriculture Development Programme (CAADP ex-Pillar 4) Africa Regional and Sub-regional Organizations for Agricultural Research and Innovation

The "CAADP XP4 project funded by the EU, is the lifeline for the CAADP Pillar 4 Institutions to build their capacities to support African Governments to deliver on the Malabo promise," Dr. Irene Frempong, Director Research and Innovation, FARA recently told experts from implementing institutions.

No statement could be as correct as this in regard to the generous contribution that the EU has offered to support the sub-regional organisations to boost their capacity to deliver AR4D priorities. The five institutions are: The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA), West and Central African Council for Agricultural Research and Development (CORAF); and the continental apex institutions: The Forum for Agricultural Research in Africa (FARA), and the African Forum for Agricultural Advisory Services (AFAAS).

The Project is funded under the initiative "Development Smart Innovation through Research in Agriculture" (DeSIRA). The total project funding is EUR 30 million. ASARECA has been allocated EUR 5,370,000.

The goal of the project is to contribute to the implementation of Agenda 2030. It will contribute

to the progressive achievement of Sustainable Development Goal 2 (SDG 2 - zero hunger) and to the action to combat climate change and its impacts (SDG 13). It promotes progress towards ending poverty (SDG 1), gender equality (SDG 5), decent work and economic growth (SDG 8), and responsible consumption and production (SDG 12). The project will additionally contribute to Agenda 2063 and the Malabo Declaration of the African Union (AU).

The objective is: To enable agricultural research and innovation, including extension services, to contribute effectively to food and nutrition security; economic development and climate mitigation in Africa. This will be achieved by improving the capacity, effectiveness and positioning of the Regional and Sub regional Agriculture research and extension organizations as well as National Agriculture Research Systems (NARS), and by promoting collaboration and knowledge sharing among the organizations.

Target countries

The Project will target the Eastern and Central African countries: Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Republic of Congo, Rwanda, South Sudan, Sudan, Tanzania, and Uganda.

Direct target group: The direct target group comprises the national agricultural knowledge and innovation systems (NAKIS), the private sector, farmer organizations, extension and advisory services, universities, as well as the Regional Economic Communities (RECs).

Indirect target group: These comprise the rural poor consisting of smallholder farmers, women and youth agripreneurs and pastoralists, as well as other marginalized communities.

Key thematic areas of intervention

The key interventions are aligned with ASARECA's new thematic areas of focus. They include:

Capacity Strengthening: Activities related to this output are intended to strengthen the institutional capacities of regional and sub-regional agricultural research organisations to enhance their support to the countries, and to address previous poor performance in AR4D and emerging cross-border challenges.

Multi-stakeholder Partnerships' Development: This output is designed to facilitate and support equitable multi-stakeholder partnerships for climate relevant innovation, including uptake and scaling-up of technologies, innovations and management practices to achieve program targets.

Policy, cross country market access and improved investment: Under this output, ASARECA will focus on policy advocacy and harmonization in support of climate relevant agriculture transformation leading to food security and economic growth as well as target market linkages and strengthening of regional institutional arrangements to enable regional trade, markets and trans-boundary commodity movement and improved investment in agriculture transformation.

Knowledge Management: ASARECA will enhance knowledge management and communication for decision support, sharing innovations and advocacy related to climate-relevant agriculture within the sub-region. It will include sharing innovation and advocacy related to climate-relevant agricultural transformation.

FARA Forum for Agricultural Research in Africa
CCARDESA Centre for Coordination of Agricultural Research and Development for Southern Africa
AFAAS Africa Forum for Agricultural Advisory Services
CORAF

Taking Stock: Celebrating Impacts of US$ 131 Million Investments

Since establishment, ASARECA has harnessed critical partnerships and mobilized over **US$ 131 million** to implement its mandate. The investments were channeled to projects in member countries through two main arrangements: **ASARECA Networks, Programmes and Projects (NPPs)** (1994-2017) and through ASARECA **Research Programmes** (2008-2018). Besides, ASARECA coordinated the implementation of the Eastern Africa Agricultural Productivity Programme (EAAPP) worth **US$ 120 million** in member countries. Below are highlights of achievements over the last 25 years.

NATIONAL AGRICULTURAL OUTPUT

20.6%

The average growth in value of total agricultural output for all ASARECA countries (2008-2013). Three countries in the region achieved CAADP agricultural growth targets of 6 percent per annum: These include Rwanda (12.4%), Kenya (7.8%) and Tanzania (7.8%). Ethiopia and Eritrea recorded 5.8 percent and 5 percent pa respectively.

RESEARCH & DEVELOPMENT

11.6%

Average regional yields for maize (@ a rate of 3 percent per year), with increases of **8.6 percent** for rice, **8.4 percent** for sweet potato and **4.5 percent** for beans.

HOUSEHOLDS

422,176

Rural households thas directly benefited from ASARECA-related support initiatives. Overall. 2.5 million individuals benefited directly from an assortment of ASARECA support initiatives.

TIMPS

364

Agricultural Technologies, Innovations and Management practices (TIMPs) that have been either generated or improved to suit farmers' demands.

435

TIMPs that were availed for uptake. So far, 270,000 farmers and other stakeholders have adopted new TIMPs leading to an increase in net crop production value of US$73.4 million at the peak of ASARECA interventions by 2014.

LAND

4,600 ha

Land that has was dedicated to improved TIMPs. As a result of this, over 800 metric tons of quality seed was produced and sold or distributed to farmers for further multiplication.

FOOD SECURITY

Food security improved for beneficiary households from **74% to 81%** compared to an increase from **78% to 79%** for non-beneficiaries.

SPILLOVER RATE

Highly positive spillover effects were noted, with an average pass-on rate to non-project farmers of 7 for each beneficiary household.

POLICY

ASARECA contributed to enabling policy environment through review of existing policies, laws, regulations and management practices. A total of 100 policies, laws, regulations and procedures were analyzed, 46 were presented for legislation and dialogue, while 17 were approved by various legislative bodies, EAC and COMESA parliaments.

LAND DEGRADATION

Over **5,000 ha** of highly degraded lands and watersheds was reclaimed, thereby providing targeted households with steady water supply for domestic and farm use.

CAPACITY STRENGTHENING

81,751

Stakeholders that received short-term training in integrated water management, value addition, integrated soil fertility management, value chain development, project management, monitoring and evaluation, environment and social safeguards, basic agronomic and management practices, among others.

Taking Stock: Celebrating Impacts of US$ 131 Million Investments

CAPACITY STRENGTHENING

150

Number of students that benefited from ASARECA long-term training at different levels. These include: 15 PhD [9 male, 6 female); 112 MSc (73 male, 39 female); 4 BSc (2 male, 2 female); and 19 diploma/certificate (12 male, 7 female)

INFORMATION MATERIALS

10,000

Information packages produced with support from ASARECA. They include peer-reviewed journal articles and book chapters, electronic newsletters, conference proceedings and manuals. These products were made available to partners through over 260 different delivery pathways such as websites, flyers, TV, radio, SMS, dissemination events, media events, farm trials, multimedia (YouTube) among others, benefiting over 1 million targeted stakeholders.

PARTNERSHIPS

400

Number of partnerships formed by ASARECA in implementing its AR4D strategies.

BENEFITS TO STAKEHOLDERS

ASARECA supported projects have led to significant generation of benefits to stakeholders, including provision of additional income for farmers, processors, small-scale traders, and increased productivity of selected commodities. For example, average total crop revenue has increased by 63% from US$272 to US$442 between 2008 and 2012 for beneficiaries (compared to only 5% for non-beneficiaries). Total livestock revenues also increased by 139% from US$157 to US$375, compared to a fall of 21% for non-beneficiaries.

Current ASARECA Board of Directors (2019)

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Director General,
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(Programmes) - COMESA

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Director of the Pan Africa Bean
Research Alliance - CIAT

Bol Andrew Wieu Riak
Assistant Professor, Upper
Nile University - South Sudan

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Director General,
TARI - Tanzania

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ISABU - Burundi

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Membership and Marketing
Manager, Chamber of
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Officer, National Extension
Service - DRC

Mr. Eric Hermann Raparison
National Coordinator, Civil
Society Platform in the land
sector - Madagascar

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NARO - Uganda

Dr. Dennis Kyetere
Director General,
NARO - Uganda

Dr. Emily Kabushenga Twinamasiko (RIP)
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NARO - Uganda

Dr. Ambrose Agona
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Director General,
KALRO - Kenya

Dr. Joseph Mureithi
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Dr. Victor S. Bennet
Director General,
Directorate of Agric Research, Min. Agric & Food Security - S. Sudan

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Dr. Marie-Goretti Mirerekano
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ISABU - Burundi

Mr. Richard Sahinguvu,
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Dr. Eltahir Sidding Ali (RIP)
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ARC - Sudan

Mr. Zubeir Ibrahim Mohammed
Private Sector Representative - Sudan

Dr. Cris Muyunda
COMESA

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EIAR, Ethiopia

Dr. Mandefro Nigussie
Director General,
EIAR - Ethiopia

Dr. Iyassu Ghebretatios,
Director General,
NARI, Eritrea

Dr. Tsegay Berhane
Director General
NARI - Eritrea

Dr. Getachew Belay
COMESA

Dr. Daphrose Gahakwa
Director General, ISAR, now RAB, Rwanda

Dr. Mark Bagabe
Director General, RAB - Rwanda

Dr. Patrick Karangwa
Director General, RAB - Rwanda

Dr. Theogene Rutagwenda
Director General, Rwanda Animal Resources Development Authority

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Director General, IRA - Republic of the Congo

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Director General, INERA - DRC

Dr. Jimmy Wilson Smith
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Dr. Carlos Sere
Director General, ILRI

Dr. Yemi Akinbamijo
Executive Director - FARA

Mr Phillip Kiriro,
President Eastern Africa Farmers' Federation

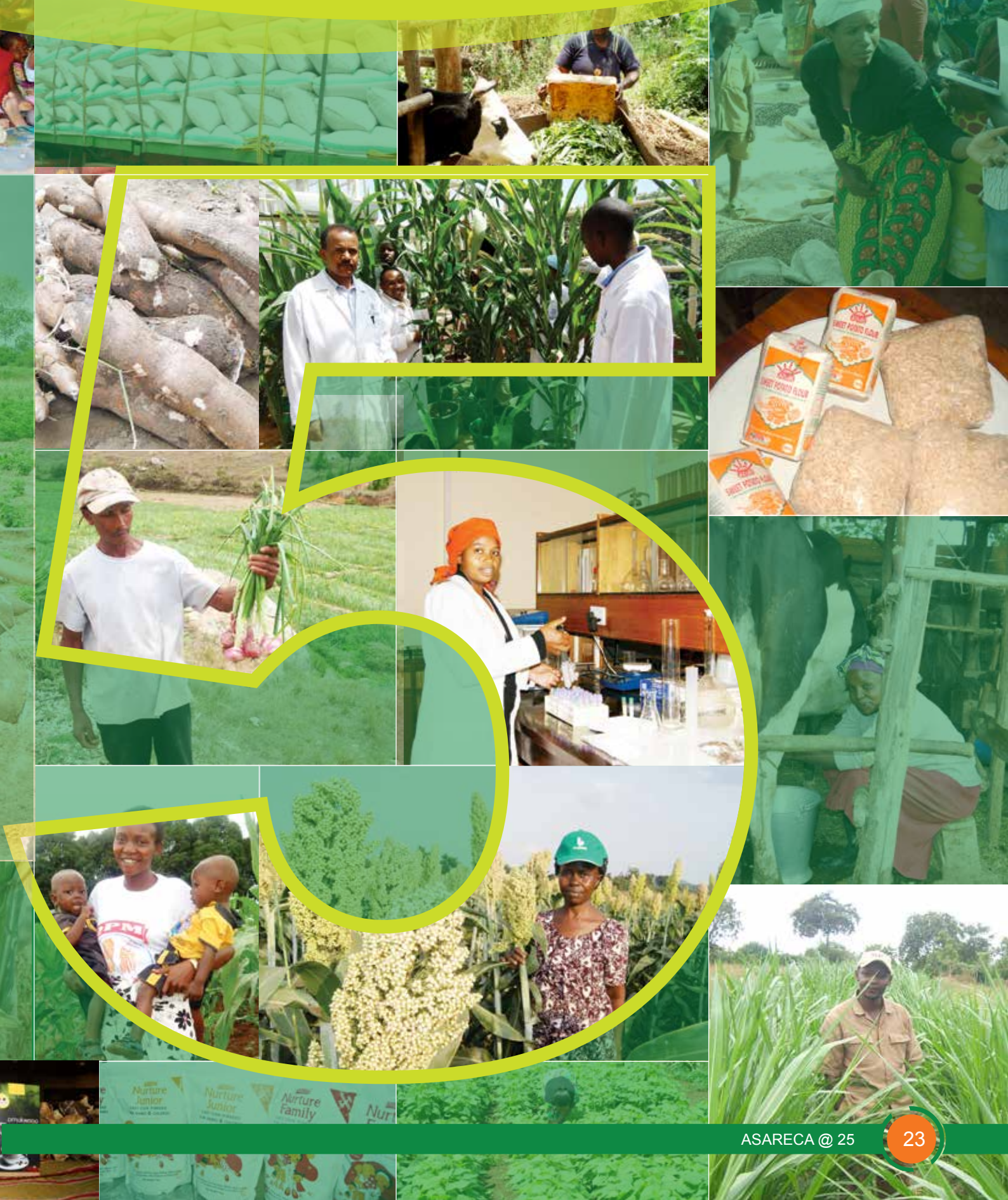
Mr. Stephen V. Muchiri
CEO, Eastern Africa Farmers Federation

Mrs Lucy Muchoki,
Private Sector, Nairobi - Kenya

ASARECA National Focal Persons (NFPs) at a meeting in Entebbe, Uganda. The NFPs are senior managers of at the NARIs appointed by the Director Generals as foot soldiers for coordination of ASARECA supported initiatives in the member countries.

Highlights of Achievements

Through the ASARECA **Networks, Programmes and Projects** (NPPs, 1994-2017); ASARECA **Research Programmes** (2008-2018) and the **Eastern Africa Agricultural Productivity Programme** (EAAPP), ASARECA has coordinated implementation of over 180 AR4D projects in Eastern and Central Africa. This section presents highlights of achievments in a few selected projects.


SWEET POTATO FLOUR
Nurture Junior
Nurture Family

Elite dairy breeds produced during EAAPP interventions in the region

Eastern Africa Agricultural Productivity Project (EAAPP)

Introduction

ASARECA successfully coordinated the five-year Eastern Africa Agricultural Productivity Project (EAAPP) and won admiration from the Governments of member countries and the World Bank. Started in 2009, EAAPP promoted collaborative AR4D and sharing of research outcomes among participating countries and spill-over countries.

Ethiopia
Kenya
Tanzania
Uganda

The Project was guided by 3 objectives: (i) Enhance regional specialization in agricultural research; (ii) Increase regional collaboration in agricultural training and dissemination; and (iii) Facilitate increased sharing of agricultural knowledge and technologies across national boundaries. Under the arrangement, the member countries of Ethiopia, Kenya, Tanzania and Uganda provided leadership to others as Regional Centres of Excellence in chosen commodities.

The Centres ensured that outcomes from their work benefit the others. Kenya is the Centre of Excellence for dairy, Uganda for cassava, Ethiopia for wheat and Tanzania for rice. EAAPP was one of the major initiatives in Africa contributing to the attainment of the Millennium Development Goals (MDGs) of halving hunger and poverty by 2015 through sustained economic growth of about 6 percent annually.

The goal of EAAPP was to increase agricultural productivity and competitiveness, farm incomes, reduce poverty and improve food security in Eastern Africa.

Over the five years, EAAPP implemented initiatives to achieve its goal by increasing adoption of new varieties, breeds and management practices; increasing adoption of improved processing and handling methods by processors; increasing access to disseminated new technologies; increasing land area with seeds of improved cultivars, and increasing the number of improved livestock breeds.

Summary of EAAPP Impacts

EAAPP recorded significant successes summarized below:

Over 156 new TIMPs were developed by the Regional Centres of Excellence (RCoE), comprising new varieties of cassava, rice, wheat and forage crops.

This farmer in Kenya adopted best practices and innovations disseminated through EAAPP to increase dairy production

156

TIMPs developed by the Regional Centres of Excellence under EAAPP. These comprised new varieties of cassava, rice, wheat and forage crops

Out of the 156, 64 new TIMPs were disseminated across national boundaries. For example:

(i) Uganda shared: cassava germplasm with Ethiopia, Kenya, South Sudan, Rwanda, DRC, Burundi and Malawi.

(ii) Kenya shared: 4 clones of Napier Grass that are high yielding and disease tolerant with Uganda and Rwanda; an assortment of assisted reproductive technologies with Uganda, Tanzania, Ethiopia and Burundi; cassava germplasm with Uganda, Tanzania, Mozambique and Malawi; wheat varieties resistant to UG99 wheat virus with Ethiopia, Tanzania and Uganda; and rice germplasm with South Sudan, Ghana and Senegal.

(iii) Tanzania shared: rice germplasm with Kenya, Uganda, Ethiopia, Zanzibar and Malawi.

Besides the above achievements in exchange of technologies, EAAPP facilitated the following:

- Implementation of 33 regional research sub-projects.
- Enhanced capacity for undertaking research for 232 researchers attached to the Regional Centres of Excellence (2010) contributed to almost three-fold increase of researchers to 661 (2014).
- Commendable progress in acquisition of infrastructure, including commissioning of laboratories and associated equipment.
- Rate of change in adoption of new varieties, breeds, and selected management practices by farmers increased from 35% to 53% (2010-2014) in project areas.
- The land planted with improved cultivars increased from 2,755 ha in 2010 to 12,807 ha in 2014, all attributed to the substantial increase in production of planting materials and farmer awareness in EAAPP project areas.
- EAAPP contributed to significant increase in productivity at farm-level over control technology for all disseminated new technologies, with productivity increases ranging from zero to 8% between 2010 and 2014. For example, the average yields for beneficiaries in 2014 were 15 t/ha for cassava, 7 for wheat and 9 for rice – exceeding the regional productivity figures for rice and wheat.
- Farmer satisfaction with the new TIMPs increased from 23% to 69% of households in targeted project areas. The greatest increases were in cassava and wheat.
- Over 5,559,229 beneficiaries (799,891 direct; 4,759,338 indirect) were reached – an indication that 1 direct beneficiary reached 12 indirect beneficiaries with information and TIMPs.

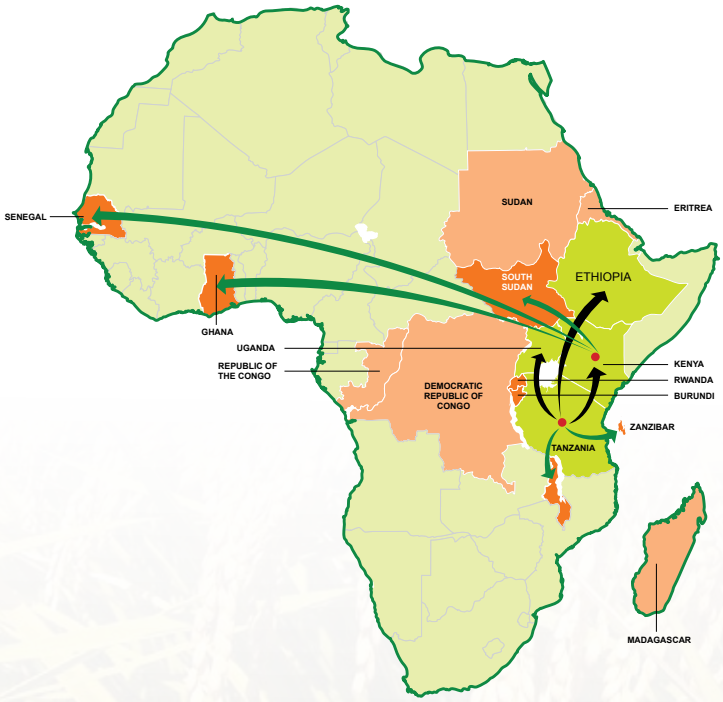
Exchange of Cassava TIMPS under EAAPP

- **Botanical Cassava seed with enhanced β-carotene and NASE 14 high yielding cassava variety from Uganda were shared with Kenya, Tanzania and Ethiopia. Spillover countries included; DRC, Rwanda, South Sudan, Burundi and Malawi.**
- **Cassava germplasm exchanged from Kenya exchanged with Tanzania and Uganda. Spillover countries included; Mozambique and Malawi.**
- **Three of the germplasm from Kenya have been evaluated.**

Movement within EAAPP countries

Movement to spillover countries

Exchange of Rice TIMPS under EAAPP



- **8 new Rice varieties from Tanzania shared with Kenya, Uganda and Ethiopia. Spillover countries were; Malawi and Zanzibar.**
- **2 Rice varieties from Kenya shared with the following Spillover countries; South Sudan, Ghana and Senegal.**

Movement within EAAPP countries

Movement to spillover countries

Exchange of Wheat TIMPS under EAAPP

- **1 Wheat variety King Bird resistant to UG99 from Kenya shared with Uganda, Tanzania and Ethiopia.**
- **1 Wheat variety from Tanzania shared with Kenya.**

Movement within EAAPP countries

Movement to spillover countries

Capacity Building Exchange Initiative under EAAPP

- Cassava RCoE in Uganda provided Capacity building and training to scientists, students and staff from Kenya, Tanzania and Ethiopia. Spillover countries were Ivory Coast, Rwanda and Nigeria

Movement within EAAPP countries

Movement to spillover countries

Exchange of Dairy TIMPS under EAAPP

- 4 clones of Napier grass from Kenya shared with Uganda. Spillover country was Rwanda.
- 1 Tube silage making technology from Kenya shared with Uganda and Tanzania.
- Bulls/semen from Kenya shared with Uganda, Tanzania and Ethiopia. Spillover countries included Burundi and Zanzibar.
- Assisted Reproductive Technologies (ART) from Kenya shared with Uganda, Tanzania, Ethiopia and Malawi.
- Over 470 bulls for semen production were reared in Kenya for sharing to other countries.

Movement within EAAPP countries

Movement to spillover countries

Value-added products including OFSP flour made it to the supermarkets in Kenya

Harmonization of Cassava and Potato Standards in East Africa

Burundi
Kenya
Rwanda
Tanzania
Uganda

Introduction

Cassava and potato have been identified as crops with the potential to spur poverty reduction and growth in ECA. The New Partnership for Africa's Development (NEPAD) in the early 2000s launched the Pan-African Cassava Initiative that sought to tap the enormous potential of the crop for food security and income generation.

Cassava is considered as a crop with high potential for industrial processing

Consequently, the Comprehensive Africa Agriculture Development Programme (CAADP) prioritized cassava as a strategic commodity to increase food supply, reduce hunger and improve responses to emergency food crises.

However, market failures had for long constrained the realization of the potential of root crops such as cassava and potato. Most countries in ECA lacked the standards necessary for the commercial use of cassava and potato. In addition, value-addition technologies were underutilized due to lack of clear guidelines on standards and supportive policies.

ASARECA work

To address these challenges, ASARECA coordinated efforts towards harmonizing quality standards for cassava and potato to facilitate cross border trade. ASARECA played the critical networking, coordination and convening roles hence enabling private and state actors in Burundi, Kenya, Rwanda, Tanzania and Uganda to work together towards agreed standards for the two commodities. As a result, 11 rationalized and harmonized standards for cassava and sweet potato were approved by the East African Community (EAC).

11

Harmonized standards approved by East African Community Council and recommended for adoption by the EAC Council of Ministers

Cassava and potato products that meet the standards can now be traded in the five countries, hence getting the opportunity to earn better prices and to diversify product offerings.

The process towards the approval started in 2006, when ASARECA initiated a process of rationalizing and harmonizing standards for cassava and sweet potato to enhance their value, open a window for their inclusion in the production of industrial products, and promote trade in their products. ASARECA worked with the Uganda National Bureau of Standards (UNBS), which compiled a list of 14 proposed standards for the two commodities. The UNBS formally sent the list to the other four East African Community countries as zero drafts for consideration and adoption as regional standards. This proposal was tabled before the EAC Standards technical sub-committee and approved in a meeting held in November 2009 in Arusha, Tanzania.

Facilitating dialogue

Using its vantage position as the AR4D coordinating entity of the Governments, ASARECA supported the technical departments of the standards bureaus of Burundi, Kenya, Rwanda, Tanzania and Uganda to convene national consultative workshops to discuss the zero drafts in 2009.

ASARECA then convened and facilitated discussions among the Bureaus and other stakeholders such as the International Institute for Tropical Agriculture (IITA), the International Institute for Potato Research (CIP), cassava and potato researchers, and members of the respective national Parliaments

11 harmonised standards approved

In early 2010, ASARECA, working with UNBS collated the comments and prepared them for discussion at a regional forum from March 22 -24, 2010, in Kigali, Rwanda. The participants included representatives from the national standards technical committees, the International Institute for Tropical Agriculture (IITA), the International Institute for Potato Research (CIP), cassava and potato researchers, and representatives of Uganda's Parliamentary committees on agriculture and environment. Eleven (11) draft standards were presented to the Eastern Africa Standards technical sub-committee at a meeting in Arusha in May 2010.

Cassava chips done to standard

After concerted efforts to help member states to come on board, the East African Community Council approved the 11 harmonized standards and recommended their adoption by the EAC Council of Ministers. The standards were published in *the EAC Gazette. 2010. Declaration of East African Standards. Legal Notice no. 22. Vol. AT – 1. No. 007. Arusha 16th July 2010.*

The 11 harmonized standards are:

- EAS 738: Fresh sweet cassava
- EAS 739: Dried cassava chips
- EAS 740: Cassava flour
- EAS 741: Cassava wheat composite flour
- EAS 742: Food grade cassava
- EAS 743: Cassava crisps
- EAS 744: Cassava
- EAS 745: Potato crisps
- EAS 746: Frozen potato chips
- EAS 747: Fried potato chips
- EAS 748: Fresh (ware) potato

Policy harmonization directly boosts regional trade and benefits all parties.

Promoting Regional Seed Trade Through Seed Policies Harmonization

Introduction

Seed markets in the Eastern and Central Africa region are small and highly fragmented. Many released varieties have not been widely disseminated due to closed national markets dominated by a few transnational companies. Transactions costs within and across national boundaries are high because of varying rules and regulations across countries.

Kenya
Rwanda
Tanzania
Uganda

In 1999, ASARECA through its Eastern and Central Africa Programme for Agricultural Policy Analysis (ECAPAPA) Network with financial assistance from USAID-REDSO embarked on a strategy to achieve a unified seed policy.

The ultimate aim of rationalization and harmonization was to increase the flow of seed across national boundaries to increase the choices of quality seeds available to farmers, leading to increased productivity, increased incomes and food security. Most of the costs took the form of non-tariff barriers, regulations, procedures, administrative and technical requirements imposed by the governments of member countries, and discriminatory demands on importers, exporters, domestic producers and traders.

Achievements

- Facilitation of seed technical working groups, joint seed certification exercises and review of seed policies and regulations resulted into revision of certification procedures, harmonization of variety release and registration, harmonization of import/export procedures in Kenya, Rwanda, Tanzania and Uganda.

- Initially, only Kenya had a plant variety protection (PVP) system, but the focus on harmonization resulted in a PVP Act of 2003 in Tanzania and a draft PVP Bill for Uganda. In Kenya, there were several high-level consultations to discuss a bill to rationalize three existing acts into one.

- Tanzania and Rwanda enacted the Seed Acts in 2003 and 2004 respectively.

- In 2005, a review of the project was undertaken and a report was presented at Eastern Africa Seed Committee's (EASCOM) Annual General Meeting. The review lauded the projects efforts in bringing the public and private sector to work together through the national seed traders' associations. It also pointed out areas requiring further attention such as improving efficiency of variety testing systems, support to national seed quality control and implementation of agreements and policies.

- In 2006, EASCOM published varietal lists and standards handbooks and shared them with Permanent Secretaries in the Ministries of Agriculture of Kenya, Rwanda, Tanzania and Uganda.

- In Sudan, the seed law was revised and plans for establishment of seed traders association were undertaken.

- Draft quarantine pests lists and seed certification standards for Kenya, Rwanda, Tanzania and Uganda were produced.

- Business plans for establishment of seed traders associations in Sudan, Rwanda and Tanzania were developed.

- Burundi reviewed existing seed Act guidelines for implementation of Seeds Act of 2003 and Plant Breeders Act of 2002.

- Implementation of the Acts in Tanzania became operational with the establishment of the Tanzanian Official Seed Certification Institute (TOSCI) to follow seed testing and quality control. 21 varieties have so far been released.

- The project also invested resources in local capacity building, which was valuable for future EASCOM work.

In 2006, EASCOM published varietal lists and standards handbooks and shared them with Permanent Secretaries in the Ministries of Agriculture of Kenya, Rwanda, Tanzania and Uganda

Containing escalating food prices requires providing evidence-based information to policy leaders

Burundi
Ethiopia
Eritrea
DRC
Kenya
Madagascar
Republic of Congo
Rwanda
Tanzania
Uganda
Sudan
South Sudan

Containing Food Prices Through Trends Analysis

Introduction

ASARECA has in the past mobilised partners towards concerted efforts to keep the issue of food prices, markets and barriers to commodity trade high on the policy agenda of the governments in the region.

This started after world food prices reached historic high levels in 2011, hence aggravating food security. Part of the advocacy to curb food prices has been to keep policy-makers well informed of the food trends and their implications so that they do not make ad-hoc policy actions, which could worsen the situation. In collaboration with the CGIAR Alliance, ASARECA generated data on food trends, analysed it and made it available to guide policy-makers to make evidence-based decisions.

The analysis generated six main recommendations:

- Although rising food prices were contributing to food price inflation in Eastern and Southern Africa, the changes in global food prices were not completely transmitted to domestic markets.
- A regionally coordinated response offers a more effective alternative in responding to food price crisis than individual country responses.
- The crisis provided an opportunity to promote agricultural led development through increased domestic production, regional trade and integration in ECA. However, this required commensurate support from governments in major areas that include research, infrastructure, and market development.
- Addressing the harmful effects of the food price surge and volatility requires actions by various stakeholders along the food chain. The welfare of the vulnerable population must be protected by ensuring access to affordable food supplies.
- High food prices provide positive incentives for farmers to increase domestic food production and regional trade.
- Favourable commodity prices foster innovation that enhances competition along food value chains.

> A regionally coordinated response offers an alternative that is potentially more effective in responding to the food price crisis than individual country responses

Recommendations have been presented in several regional and international fora.

A regionally coordinated response to food prices is more effective than individualized measures.

Selection of OFSP root tubers for value addition at a project site in Tanzania

Upscaling Adoption of Orange-Fleshed Sweet Potato (OFSP) Technologies

Ethiopia
Kenya
Rwanda
Tanzania
Uganda

Introduction

Malnutrition and vitamin A deficiency has been a common problem especially among children in many parts of Africa. Vitamin A deficiency reduces disease resistance, impairs growth, can lead to blindness and increases mortality.

Research carried out by the International Potato Centre (CIP) in collaboration with scientists from National Agricultural Research Systems (NARS) in ASARECA countries generated Orange-Fleshed Sweet Potato varieties (OFSP) which were proved to provide the daily recommended allowance of vitamin A for children and mothers. OFSP also contributes to energy requirements as the crop generates superior levels of food compared to other major staples.

From 2008 to 2012, with support from the African Development Bank (AfDB) and FARA under the Dissemination of New Agricultural Technologies in Africa (DONATA) programme, ASARECA promoted OFSP technologies through Innovation Platforms for Technology adoption (IPTAS).

The objective of the project was to improve livelihoods for resource-poor farmers by increasing the production and consumption of OFSP fresh roots, processed products and marketing of vines. OFSP and QPM technologies include improved varieties, crop management practices and post-harvest management and processing to produce value-added food products.

Achievements

- Twelve (12) high yielding, nutritious OFSP varieties were adopted in the five countries. In Bungoma district in Kenya for example, by June 2010, an estimated 204 smallholders were growing OFSP varieties on an estimated 50 acres. It is estimated that in 2009, over 1,000 farmers were applying OFSP varieties in target countries.
- OFSP greatly improved the food security and income of vulnerable communities. In Western Kenya, about 30 groups of people taking care of orphans depended on OFSP as their major food item.
- The project implemented an effective vine multiplication and distribution system, with primary multiplication sites managed by researchers, secondary multiplication sites managed by individual farmers and farmer groups, and tertiary multiplication sites managed by individual farmers.
- 3.3 million OFSP cuttings and 9,936 OFSP tissue culture plantlets were produced and distributed to the farmers
- The tissue culture technique was successfully applied to clean OFSP vines of the sweet potato virus and for transferring improved varieties from Kenya and Uganda to Rwanda and Ethiopia. In Rwanda, a total of 10,874 plantlets were planted in nursery for hardening.
- Over 1,300 farmers (663 female/ 682 male) were trained on quality root production. Training manuals on vine multiplication were developed and made available for use by farmers and extension staff.
- A total of 102.1 hectares were put under the multiplication of OFSP varieties in D.R. Congo, Kenya, Rwanda and Tanzania.
- The (IPTAs) approach, where a network of partners use research knowledge to generate goods and services was employed to greater success and widely popularized in the ASARECA region. Like never before, farmer groups; NGOs; extension; local governments, researchers; traders and processors etc., were pooled to work together to address critical issues along the commodity value chains.

OFSP vine multiplication site in Kenya

Children at a feeding centre in Tanzania, who were given QPM porridge rapidly recovered from malnutrition

Transfer and Dissemination of Proven and Emerging Agricultural Technologies in Quality Protein Maize

DR Congo
Kenya
Tanzania
Uganda

Introduction

Maize is a major staple in many ECA countries. However, its nutritional quality is poor (FAO, 1992). Protein in conventional maize has a biological value of 40% that of milk; has limited amounts of essential amino acids like lysine, tryptophan and threonine and therefore needs supplementation from other sources such as meat, fish, bean and milk.

Quality Protein Maize (QPM), however, has nearly twice the amount of lysine and tryptophan and offers 90% of the nutritional value of skim milk, the standard for adequate nutrition value. Therefore, consumption of QPM supplies the essential proteins and results in improved rates of growth among malnourished children.

At the onset of the project, a survey conducted in DRC by the government, WFP and UNICEF revealed many areas suffered global acute malnutrition (rates above the 10 per cent threshold for intervention) while some areas suffered malnutrition rates above 15 per cent (the emergency threshold). Fifty-two out of the 90 territories surveyed revealed global acute malnutrition rates above 10 per cent.

The project was implemented under the Dissemination of New Agricultural Technologies in Africa (DONATA) arrangement led by the Forum for Agricultural Research in Africa (FARA), supported by African Development Bank (AfDB) and managed by ASARECA.

40,000

Over 40,000 people in Democretic Republic of Congo got involved in planting QPM to sell both as grain and as seed.

This mother and babies at a feeding centre in DR Congo are a testimony of the health benefits of QPM

The project activities were implemented by the NARIS namely: INERA in Democratic Republic of Congo, KARI in Kenya, MAFC in Tanzania, and NARO in Uganda, with technical backstopping from the International Centre for Improvement of Maize and Wheat (CIMMYT). The objective was to rapidly scale-up and out, proven agricultural technologies for food and nutritional security and economic growth through enhanced utilization of Quality Protein Maize (QPM)

Achievements

- QPM was adopted as a major ingredient in regular diets and as a food for malnourished children, expectant and lactating mothers as well as adults in health units and orphanages. Farmers who used QPM reported improvement in well-being.

- In DRC where observation trials on malnutrition were done in two hospitals with three nutrition centres, children fed to diets containing QPM gained weight within two weeks. Similar observations were made in an orphanage in Tanzania. As a result, some Community Based Organizations operating orphanages opened large hectares of QPM fields to produce food for the children.

- Farmers were able to produce quality seeds that were bought and processed by seed companies. In Kenya for instance, QPM villages committed to maintaining the quality of QPM through seed production and information transfer were established.

- Breeder seed for all varieties that were promoted by the project were produced. These include LONGE 5 in DR Congo, and Uganda, LISHE K1, LISHE H1 and LISHE H2 in Tanzania. IPTAs in Tanzania and in Northern Uganda established seed plots to train stakeholders on improved QPM seed production.

- In DR Congo, the project was implemented in 3 districts in Kasai province by Institut National Pour l'Etude et la Recherche Agronomiques (INERA), the agricultural research institute in DR. Congo. INERA partnered with a nutritional center in Gandajika where malnourished children and lactating mothers could access QPM flour. The results were impressive. Malnourished babies began to recover within two weeks of feeding on QPM. The news about the 'maize-milk' spread across Kasai province and beyond, and the demand for the Quality Protein Maize became overwhelming.

- Over 40,000 people in DRC got involved in planting QPM to sell both as grain and as seed. President Joseph Kabila got drawn into the QPM action in 2012 after watching television coverage on a QPM. As a result, the government allocated 500 hectares of land to INERA for scientists to produce QPM seeds for distribution across the country, and for grain production and processing.

- The following year, the State House agricultural department ordered for 1,000 kg of QPM seed for their farm. In addition, the Ministry of Environment and Nature Preservation bought 250 kg of seed for QPM production. The government then availed small competitive grants to INERA to fund research for development for 3 years.

QPM value-added products in Morogoro, Tanzania

- A total of 11 IPTAS were established, leading to an unprecedented participation along the maize value chains.

- A booklet with a collection of 40 proven best-bet agricultural technologies and innovations that are available for up-scaling in the ASARECA sub-region was produced and disseminated.

A water dam in an intervention site in Kenya constructed under the water productivity projects

Water Against Climate Change

- **Management of water for productivity and livelihood security under variable and changing climatic conditions in ECA (2009-2013)**
- **Sustainable agricultural water productivity enhancement for improved food and nutrition security in ECA (2014-2016).**

Burundi
Ethiopia
Eritrea
Kenya
Madagascar
Rwanda
Uganda
South Sudan

Introduction

All the Eastern and Central African (ECA) countries depend largely on rain-fed agriculture for livelihoods. Much of the rainfall comes in few high-intensity events with long dry spells in-between. This results in high frequency of droughts that reduce yields, and often, total crop failure.

Year-round cultivation of vegetables using drip irrigation in Machakos, Kenya

The risk-averse and impoverished small holder farmers are unwilling to make investments in agriculture without assurances of favourable rates of return to their investment. Against this background, ASARECA working with a pool of scientists from the National Agricultural Research Systems (NARS), launched two successive projects; **"Integrated management of water for productivity and livelihood security under variable and changing climatic conditions in ECA"**, implemented from 2009 to 2013; and **"Sustainable agricultural water productivity enhancement for improved food and nutrition security in ECA" (2014-2016).**

The projects used water as an entry point to stimulate demand for other productivity-enhancing technologies to boost agricultural productivity and sustainability in Kenya, Ethiopia, Eritrea, Rwanda and Madagascar, Burundi, Uganda and South Sudan.

How the water projects operate

During the first project, two small agricultural watersheds of 5-10 km^2 area involving about 150-200 households were identified within each country and used to conduct project activities.

Mwania and Kalie watersheds in Machakos and Makindu districts, respectively, were selected for Kenya; Karama and Muse-Bivumu in Nyamagabe and Bugesera districts, respectively, in Rwanda; Adulala and Ketchema in Ethiopia; Amadir and Molqi in Eritrea; and Ankazomiriotra and Avaratrambolo in Mandoto and Manjakandriana districts, respectively, in Madagascar.

Several technologies were selected, evaluated and availed to farmers to enhance productivity and income in all the participating countries.

Achievements

- Over 1,500 households in Eritrea, Ethiopia, Kenya, Madagascar and Rwanda adopted technologies to use water efficiently and became food secure.
- Up to 5,000 hectares of severely degraded land was rehabilitated through the use of efficient water conservation and management practices in selected watersheds.
- The amount of water available to support agriculture, increased.

Overall impact

Kenya

Out of 198 farmers trained on terracing to conserve soil and water, 252 constructed them on their farms and realized excellent maize yields. Similarly, 146 farmers trained on pitting to harvest run-off and grow fodder, dug over 20,000 pits on their farms and planted Napier grass for their livestock.

By embracing these and other technologies such as forecast-based farming, tied-ridging, seed priming, improved agronomic practices, improved crop varieties, and micro-dosing, farmers posted good yields throughout the project period despite the harsh climate. Maize yields ranged from 1.2 t/ha to 3.2 t/ha compared to baseline yield of less than 500 kg/ha.

Hence, for most households in the two watersheds, over 70 %, are now food- secure.

This farmer in Makindu in Kenya deployed water productivity innovations to beat off food insecurity

Madagascar

Adoption of improved rice varieties increased rice yields from 2 to 4 t/ha while onion yields increased from 10 to 25 t/ha due to prudent management of water and other inputs.

As a result, communities in Ankazomiriotra and Avaratrambolo watersheds became 60% food-secure and earned additional income of about US$ 2500 per ha per year from the sale of onions and potatoes during the off-season.

The farmers adopted CSA innovations to diversify water management benefits to stop the over 20% harvest losses associated with dry spells and land

degradation. In Ambohitrakely and Ampahitrizina Fokontany demonstration sites, which were established by farmer groups, project technical teams facilitated the farmers to dig canals and swales to improve water retention and avoid soil erosion.

Healthy onions harvested in Madagascar using water use efficiency innovations

Rwanda

Farmers were able to construct twelve 120-m^3 capacity water pans and rehabilitate another four (4) to harvest run-off to grow tomatoes on 0.5 acre plots during off-season when the demand is at peak.

Farmers in Rwanda modify agricultural land using runoff-reducing techniques

Ethiopia

Farmers in Buso and Zata watersheds received training and used the skills to construct deep trenches with soil bunds in the upper and middle levels of their catchments. Using such skills, they created percolation ponds to recharge underground water and reduce runoff to downstream areas. They established check-dams and planted trees and grass to balance the eco-system.

Land reclamation for agriculture in Ethiopia

Uganda

Farmers were trained in nursery tree management. This kicked off excitement to grow trees in Ongino, Bunghoko and Kwapa watersheds. Up to 19,000 trees were planted. Following training in soil and water conservation technologies such as contour bunds, trenches, tied ridging, a total 780 trenches; eight water reservoirs complete with pumps and horse pipes; and three micro-catchment reservoirs of 240,000 liters each were established for supplementary irrigation. Over 75 plots for maize, onions, cabbages and groundnuts were established to demonstrate integrated activities.

A water dam in Ongino in Uganda

A bumper harvest of cabbages in Tororo in Uganda

Burundi

Soil management and water conservation activities were carried out at landscape level while terracing, value chain arrangements, organic manure composition, bean and vegetable farming was done at farm level. The farmers established vegetable nurseries for cabbage, amaranthus, African eggplant, tomato and sweet pepper, which they shared among themselves. They diversified to poultry.

Farmers diversify income sources through poultry in Burundi

Eritrea

By the end of the project in 2013, adoption rates were low but encouraging. About 66 out of 450 households adopted agroforestry after training. They planted 1,130 Rhamnus prinoides, 218 Psidium guajava, and 198 Papaya seedlings and were able to earn about US$ 450 each in just six months from the sale of Rhamnus leaves and vegetables. Most of them used this money to buy sheep and poultry to diversify sources of income. Similarly, out of the 153 households trained on soil and water conservation measures, six constructed tied ridges and terraces and realized high sorghum yields ranging from 1.5 to 2t/ha compared to baseline yields of 600kg/ha.

Reforestation initiatives in Eritrea to recover land for farming

A farmer in Masaka in Uganda offers evenly chopped feeds to her dairy cow

Climate-Smart Crop-Livestock Innovations

- **Crop-livestock integration for sustainable management of natural resources in ECA (2009-2011)**
- **Harnessing crop-livestock integration to build resilience of smallholder crop-livestock production systems in ECA (2012-2013).**

Burundi
Kenya
Rwanda
Tanzania
Uganda

Introduction

Dairy production is a major source of nutrition, employment and income for smallholder farmers who account for about 80% of farming communities in Eastern and Central Africa (ECA).

On the other hand, vegetables play a significant role in food security, nutrition and income generation. While livestock products like urine and cow-dung are some of the best organic fertilizers, crop residues are a source of livestock feed.

However, the sustainability of these production systems is threatened by the adverse effects of climate change. Efforts to implement productivity -enhancing technologies are often futile when the component of water is not adequately factored in. Climate variability affects the production and nutritive value of vegetables, crop residues, and forages and directly affect livestock health and production.

> Forage interventions increased fodder availability by 76 percent, milk yield by 78 per cent and cash incomes by 52 percent.

Against this background, ASARECA commissioned two successive projects, ***"Crop-livestock integration for sustainable management of natural resources in ECA",*** which ended in 2011 and ***"Harnessing crop-livestock integration to build resilience of smallholder crop-livestock production systems in ECA*** *(2012-2014)",* to improve the resilience and sustainability of smallholder dairy and vegetable systems by boosting the adaptive capacity of smallholder farmers.

A locally fabricated forage chopper in Masaka, Uganda

The projects were implemented in Uganda; Kenya; Tanzania; and Burundi. The first project scored achievements including:

- Identification, generation and dissemination of innovations in dairy feed packages and feed conservation.
- Improvement in soil fertility management.
- Improvement in water harvesting and water use efficiency through small scale irrigation systems.
- Improved value addition for milk.
- Introduction of labour-saving innovations.
- These achievements led to increases in fodder yield by 2%, milk yield (65%), vegetable yield (500%) and household income (66%).

The second project was built on these achievements and as a result, a total of over 26,000 people benefited through direct participation, by learning from their colleagues, workshops, agricultural shows and field days. **Table 1 below shows the number of direct and indirect beneficiaries.**

Table 1: Number of direct and indirect beneficiaries (2011-2013)

Country	Male	Female	Total
Uganda	4,754	8,891	13,645
Kenya	3,421	4,532	7,953
Tanzania	1345	1,754	3099
Burundi	543	879	1422
Total	10,063	16,056	26,119

Highlights of interventions and achievements

Baseline surveys on smallholder crop-livestock farm households were carried out prior to the start of the first project. The surveys identified inadequate feed supply, frequent dry spells leading to insufficient water, poor soils, and lack of basic information on best practices as the major problems affecting productivity. ASARECA and partners provided farmers with a range of facilities and technical support to promote integrated Climate-smart Agriculture (CSA) practices to improve production and ultimately increase profitability. These included a mix of technologies for cattle feed, water harvesting and vegetable growing, soil and water management, exploitation of market opportunities and institutional and policy innovations to address farmers needs. Below are some highlights of interventions and achievements:

Rain water harvesting for vegetable and dairy production

Through farmers' initiatives, over 200 roof catchments and surface-runoff water harvesting reservoirs with a capacity of 10,000-30,000 litres and 133 drip kits were installed in homesteads in Masaka in Uganda and Kenya. Micro catchment holes (*tumbukiza*) and shallow wells were dug in fodder fields to demonstrate simple water harvesting and conservation techniques. These were integrated with drip irrigation techniques and cattle manure application. The project supplied drip irrigation kits to facilitate year-round vegetable production in Kenya, Uganda and Tanzania, to produce cabbages, tomatoes and leafy vegetables. Vegetable trials were established in 220 households in Kenya; 132 in Songa in Burundi; 326 in Uganda and 112 in Tanzania. As a result, farmers reported a 500percent cabbage yield increase following the application of goat, cattle and poultry manure with drip irrigation. Manure application on tomato fields improved the number of fruits per plant from 15 to 23. Overall yields increased from 22 to 44.t/ha.

Forage interventions

About 40 ha of various forage seed multiplication fields were established. Forage interventions increased fodder availability by 76 percent, milk yield by 78 per cent and cash incomes by 52 percent. Average Napier yield under *tumbukiza* micro-catchment pits was 230% higher (6.9 t/ha) than in conventional planting. Besides, Napier grass in *tumbukiza* persisted the dry season and the foliage remained green and healthy. Farmers producing Brachiaria hybrid cv. Mulato for fodder and seed in

A simple drip irrigation kit in a project site in Uganda

Uganda made a net profit of about US$1,360 per acre/year. Milk yield significantly increased by 10-20% when lactating dairy animals were given feeds supplemented with multi-nutrient feed blocks in Tanzania, Kenya, Uganda and Burundi.

Trials conducted in Tanzania indicated an increase in income from US$1,040 to US$1,525 when cows were supplemented with the blocks. In particular, a feeding ration produced in Tanzania, composed of maize bran, cotton seed cake and minerals containing 75% energy, 20% protein and 5% mineral produced significantly higher milk yield per animal per day. The package was up-scaled to non-project countries.

Multi-purpose fodder trees

Fodder trees namely; Gliricidia sepium (Gliricidia), Calliandra (Calliandra calothyrsus) and Sesbania (Sesbania sesban) were introduced on farm. These were specifically meant to supplement feeds for dairy cattle while fixing nitrogen in the soil and controlling soil erosion. In Kenya and Burundi, the multipurpose tree Leucaena was established. On-farm case studies showed that supplementing 2 kg dry matter of Calliandra leaf hay with 1 kg of maize bran to dairy cattle previously fed on low-quality forages and crop residues improved daily milk production by over 30% during the dry season.

Intercroping Napier grass with Centrosema pubescens

The farmers received technical advice on intercropping Napier grass with Centrosema pubescens, a tropical forage legume. As a result, Napier grass fodder dry matter yield increased from 10 to 12 tonnes per hectare per year. The forage legumes contributed about 26% of total fodder yield and in addition, improved the crude protein available to the dairy cattle. In Tanzania and Kenya, the tropical legume Clitoria ternatea was used instead of Centrosema pubescens.

Intercroping maize with Lablab

Fodder and grain yield increased by 26% and 6% respectively when maize was intercropped with the forage legume, Lablab purpureus. Lablab notably controls the weeds that often compete with maize for nutrients and moisture.

Fixed-knife forage choppers, hay and silage technologies

The project introduced fixed-knife forage choppers to reduce the labour burden. Fixed knife forage choppers, treadle pumps and hay balers were produced and distributed to stakeholders. Over 10,000 stakeholders were trained on forage production, conservation and utilization. The manual method of forage chopping using *a panga* or machete is tedious, time consuming and risky. Farmers often chopped off their fingers in the process of cutting fodder. In addition, the chopped pieces turn out irregular in length, which contributes to reduced feed intake by the cattle. The fixed knife forage choppers reduced forage wastage by 20%. Farmers reported reduction of chopping time by about 30%.

10,000

Stakeholders trained on forage production, conservation and utilization

Onions grown using organic manure in Masaka, Uganda

A family in Bukoba, Tanzania, celebrates a good harvest after defeating BXW

Out Scaling Banana Xanthomonas Wilt (BXW) Control in ECA

Burundi,
Kenya,
Rwanda
Tanzania,
Uganda

Introduction

Banana and plantain are major sources of food and income for about 30 million people in Eastern and Central Africa. When BXW ravaged the region in the 2005 through to 2010, immediate action was needed. BXW is characterised by premature ripening and rotting of banana, leading to massive reduction in yield and severe loss in income for the farmers.

BXW causes immature ripening of banana, hence totally compromising its quality

ASARECA's mobilised the National Agricultural Research Institutes (NARIS) to deal with the disease as a trans-boundary problem. The scientists working with local communities in the hotspots promoted proven and cost-effective measures to control the disease through the project, **"Outscaling BXW control in Eastern and Central Africa".** They created awareness on the spread and control of the disease. The control measures included, disinfecting farming tools, destroying sick plants, cutting affected corms from the banana mat, and using forked sticks to remove the 'male' bud of infected plants, and planting only clean materials.

8,000

Clean banana planting materials that can be produced in one macro-propagation unit

Training of trainers

Extension staff and farmers were trained to produce clean banana seed using macro-propagation and decapitation techniques. Uprooting old corms up to the meristem to allow secondary plants to sprout turned out to be very effective. Up to 30 plants could be obtained from each corm. As a result, there was rapid multiplication of clean planting materials, leading to the revival of banana fields. The project worked closely with community leaders and extension staff to enforce agreed measures and standards to keep BXW away sustainably. Elite farmers were facilitated to establish macro-propagation units for rapid production of clean planting materials.

Achievements

- In Tanzania, over 6,000 clean banana planting materials were produced from two mother gardens and supplied to farmers. Besides, the project trained 90 newly recruited extension staff on BXW management.

- In DR Congo, two macro-propagation units with a capacity of producing over 8,000 clean banana planting materials were established and managed by the local platforms.

- In Rwanda, two mother gardens each of 1 ha were established in the intervention areas to produce improved varieties.

- In Kenya, three mother gardens or demonstration plots and six functional hardening nurseries were established.

- In Burundi, two mother gardens of 1.4 ha and 0.6 ha were set up with tissue culture and plantlets to produce healthy suckers.
- In Uganda, 8 mother gardens of various sizes (total area of 4.5 ha) were established in 8 BXW hotspots.
- Up to 100 functional platforms comprising farmers, local administrative leaders, extension service providers and banana traders were formed in Uganda, Tanzania, Rwanda, Kenya and Burundi.

100

Platforms comprising farmers, local administrative leaders, extension service providers and banana traders formed in intervention countries

- Realizing that BXW could re-occur if farmers relaxed on control measures, the project facilitated the formation of BXW control platforms with by-laws approved by the local governments for the control of the disease.

Impact

Within the first six months of intervention, the proportion of farmers who controlled the disease increased from less than 5% to over 60%. Within 15 months, banana production recovered, shooting up to over 80% in some areas.

Measures undertaken to control the spread of BXW and recover production in project sites

A bumper cassava harvest after measures were taken to control CBSD

Controlling CBSD, the Deadly Enemy of Cassava

Kenya
Tanzania
Uganda

Spill over countries:
Burundi
Ethiopia
Malawi
Rwanda
Sudan

Introduction

Cassava is the second most important staple crop in Africa after maize and is a major staple for more than 200 million people (over 70% of the population in the ECA region). The crop has a huge role for food security in ECA where over 30 million metric tonnes are produced annually (which is more than any other staple crop).

The Food and Agricultural Organisation (FAO) estimates that Africa harvested over 108 million metric tonnes of cassava in 2005. However, the crop came under attack by Cassava Brown Streak Disease (CSBD), a devastating disease that affected the Eastern and Central African Sub-region in the early 2000s through to 2011. The disease spread like bush fire destroying the cassava crop in ECA, hence, becoming the most important constraint affecting cassava production.

Food security threatened

CBDS caused serious reduction of cassava harvest and in some cases, total crop loss through reduced root production and quality. This threatened food security causing crop losses of between 50%-100% in Kenya, up to 100% in Uganda, and 20-80% in Mwanza and Mara in Tanzania.

In the Tanzanian hotspots with over 1.6 million people relying on cassava, CBSD caused an annual monetary loss of about US$50 million. The disease also affected Rwanda, Burundi, Sudan, Malawi and Mozambique. The consultative group in International Agricultural Research estimated that losses due to CBSD were above US$ 100 million in 2003.

What ASARECA did

Realizing that the disease was transboundary, ASARECA convened researchers from International Institute for Tropical Agriculture (IITA) and the International Centre for Tropical Agriculture (CIAT) to work with the NARIs to: Research and promote the use of cassava varieties that are resistant to CBSD; study the spread of the disease with the aim of generating information to control its spread; and study why the disease spread from the cost to areas of high altitude.

Achievements

Through this coordination, researchers agreed that the use of resistant varieties was the long term and main strategy for controlling the disease. In the short term, however, urgent action was mobilized

Cassava roots totally damaged by CBSD

from governments and donors to provide financial support and policy frame works to catalyze efforts to achieve the following:

- Producing and distributing cassava planting materials free from the disease.
- Distributing the existing relatively tolerant varieties to farmers.
- Limiting movement of planting materials from CBSD infested areas/countries.
- Ensuring that only virus-tested tissue culture materials were used for inter-country cassava germplasm movements.
- Developing and reinforcing standards for certification of cassava planting materials.
- Creating awareness on the dangers of CBSD, its symptoms and potential control methods.
- Understanding the disease, its causes, how it spreads, developing disease control measures and CBSD resistant varieties.
- Developing policies and standards to enable exploitation of the full potential of cassava.

CBDS was subdued, and lots of efforts continue at the national systems to breed for varieties that are resistant. During the implementation of the Eastern Africa Agricultural Productivity Project (EAAPP), which ended in 2015, the cassava centre of Excellence hosted by Uganda, reported advanced progress in finding CBSD resistant varieties.

Improved Napier grass clones developed through regionally coordinated efforts

Napier Grass Smut and Stunt Disease Resistance Project

Burundi
Eritria
Ethiopia
Kenya
Tanzania
Rwanda
Uganda

Introduction

Also called elephant grass, Napier grass *(Pennisetum purpureum)* is a major livestock feed, especially for dairy cows constituting between 40 to 80% of forage used by smallholder farmers. When fresh, it contains 77.8g water, 1.0g protein, 0.5g fat, 17.6g total carbohydrate, 3.1g ash, 0.12% calcium and 0.07% phosphorus and can yield 50-100 tonnes green matter per hectare.

Healthy calf feeds on Napier grass in Tanzania

In Kenya, about half a million smallholder dairy producers rely on Napier grass as a major source of feed.

In Uganda, 90% of the farmers rely entirely on Napier grass as a source of fodder for improved dairy cattle. Napier grass is also used for the management of stem borers as a trap crop, conservation of natural enemies of other potential crop pests and prevention of soil erosion.

However, the emergence of two major diseases; Napier grass head smut, a fungal disease caused by *Ustilago kame*runesis, and Napier grass stunt disease, caused by *phytoplasma*, became a serious threat to Napier grass with the potential of causing significant reduction in yields and threatening an industry with most varieties susceptible to the diseases.

The objective of the project was to promote adoption of superior (resistant) clones and crop management practices to mitigate the spread of Napier smut and stunt.

Achievements

- Morphological and molecular characterization, scoring for disease susceptibility and measuring biomass and nutritional quality were completed in replicated trials for 120 clones in Kenya, 30 in Tanzania and 56 in Uganda. As a result, productive clones with good agronomic and nutritional traits were identified for promotion in the region.
- Molecular diagnostic tools to identify Napier smut and stunt were developed, validated and disseminated to national partners for testing of clones for disease before multiplication and dissemination.
- Best management practices to mitigate the impact of the diseases were promoted. This led to keenness by farmers to: inspect crops regularly and remove diseased plants, keep Napier healthy, use disease-free planting materials, monitor and report diseases.

Molecular diagnostic tools to identify Napier smut and stunt were developed, validated and disseminated to national partners for testing of clones for disease to ensure materials are disease-free

- Milk production increased exponentially in the three countries.
- Twenty clones of high yielding Napier grass from Kenya were identified as resistant to Napier stunt disease.
- The project developed policy options for Eastern and Central Africa on: protection of vegetative propagated genetic materials, management practices for effective control of Napier stunt, and mechanisms for cross border movement of materials.

ASARECA supported partners to capture 140,000 accessions of crop resources

East African Plant Genetic Resources Network

Burundi
Eritrea
Ethiopia
Madagascar
Kenya
Sudan
Uganda

Introduction

Plant genetic resources for food and agriculture are vital in feeding the world's population. They serve as a reservoir for desirable traits for yield improvement, disease resistance and other qualities. Despite this, plant genetic resources suffer from genetic erosion both from man-made and natural factors.

Ex-situ genetic resources Gene Bank

Yet policy-makers in most countries of Eastern and Central Africa have limited awareness of the social, economic and ecological values of Plant Genetic Resources for Food and Agriculture (PGRFA).

Recognizing this, ASARECA undertook two major initiatives to ensure the sub-region does not lag behind in plant genetic resources conservation. The initiatives were:

- Promoting the effective implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in harmony with national and sub-regional priorities and capacities.
- Formation and implementation of the East African Plant Genetic Resources Network (EAPGREN)

Implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)

The ITPGRFA was signed at the global level to make the parties duty-bound to put in place policies, legislation and action plans to implement commitments under the Treaty.

The objective of the Treaty is the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of benefits derived from their use for sustainable agriculture and food security.

At the Eastern Africa level, nine countries deposited instruments of ratification, acceptance or approval with the Director General of FAO. Among the

African countries, six countries: DRC, Eritrea, Ethiopia, Kenya, Sudan and Uganda ratified the Treaty hitherto.

Achievement

- Working with the Advocates Coalition for Development and Environment (ACODE), ASARECA organized training courses for lawyers and policy-makers on the ITPGRFA.
- ASARECA also convened a regional conference on the implementation of ITPGRFA and a regional policy dialogue for Members of Parliament.
- In addition, ASARECA organized a preparatory workshop for the African Group of delegates to the ITPGRFA. As a result, a preliminary plan of action for the implementation of the ITPGRFA in Eastern and Central Africa was drawn with recommendations for coordinated national implementation with a strong constituency of legislators ready to champion the implementation of the IPGRFA.

15,720

Accessions of crop plant and wild relatives of cultivated species captured for conservation and utilization in ASARECA countries.

Samples of seeds conserved at the Genetic Resources Bank in NARO, Uganda

- Following the adoption of the Global Plan of Action (GPA) on IPGRFA and the State of the World's Plant Genetic Resources Report, several consultations catalyzed by IPGRI/(now Bioversity International), FAO and the Nordic Gene Bank, (now NordGen) were held. These efforts culminated to the preparatory meeting held in Kampala, Uganda from 3-5 November 1997 to establish the Eastern Africa Plant Genetic Resources Network (EAPGREN). This marked the birth of the EAPGREN.

East African Plant Genetic Resources Network (EAPGREN)

Funded by the Swedish International Development Cooperation Agency (SIDA). Its objective was to develop capacity for effective conservation and sustainable utilization of plant genetic resources for agricultural development and for food security.

The first meeting of the Eastern Africa Plant Genetic Resources Network (EAPGREN) was held in Kampala, Uganda. It was organized by the International Plant Genetic Resources Institute (IPGRI, now Bioversity International) in collaboration with the National Agricultural Research Organization of Uganda (NARO). It was attended by International Agricultural Research Centers, Regional organizations, crop networks, UN agencies, NGOs and delegates from the National Agricultural Research Systems of Burundi, Eritrea, Ethiopia, Madagascar, Kenya, Sudan and Uganda.

EAPGREN was established to promote regional collaboration in the conservation and use of genetic resources in the member countries by sharing information, using institutional comparative advantages, pooling resources and avoiding duplication of efforts.

Achievements

- ASARECA, in collaboration with national partners, have captured over 15,720 (an increase of 13%) accessions of crop plant and wild relatives of cultivated species for conservation and utilization in eight Eastern African countries.
- A total of 140,000 accessions of crop plants were collected and conserved in the various national gene-banks in the sub-region. Some of the accessions were adequately characterized (about 27,000) and evaluated (1,416) for various agronomic traits, nutritional qualities, yield potential and drought tolerance.
- Three PhD candidates from the NARS were supported in various national universities.
- A total of 12 plant genetic resources scientists were supported to do MSc degrees in and outside the region. 10 of the graduates did MSc degrees in Biodiversity Management at the Uppsala, Agricultural University of Sweden. After completing their courses, they returned to their respective institutions.

- Twelve staff members from the national plant genetic resources programmes were supported to attend specialized training including information and documentation training in the Nordic gene-bank in Sweden.
- Hands-on training was provided for nine technicians on principles and practices of conservation and management in gene-banks. Furthermore, short term training courses were provided on *in situ* conservation for relevant staff. Community-level training was also provided on plant genetic resources conservation for communities in all EAPGREN countries.

- EAPGREN participated in organizing awareness and sensitization workshops for policy-makers and the public on the importance of plant genetic policies and legislation. In some countries, relevant actions were undertaken to reinforce efforts to address gaps in plant genetic resources policies and legislations. Some countries have responded positively by enacting laws governing plant genetic resources access and exchange in line with global instruments.

Conservation equipment for genetic resources in NARO, Uganda

140,000

Accessions of crop plants collected and conserved in the various national gene-banks in the sub-region.

- The project acquired hardware and software for developing the regional plant genetic resources information and documentation hub at Entebbe, Uganda. Similar facilities were installed at the national gene-banks of Burundi, Eritrea and Sudan. A temporary information portal was established and maintained by NordGen awaiting the establishment of a fully operational system in Entebbe, Uganda.
- ASARECA continued to support the national PGR initiatives by providing them relevant gene-banking facilities and equipment, including deep freezers, drying rooms, conservation facilities, computers and vehicles.

Young researchers showing off maize plants that they transformed at Kenyatta University

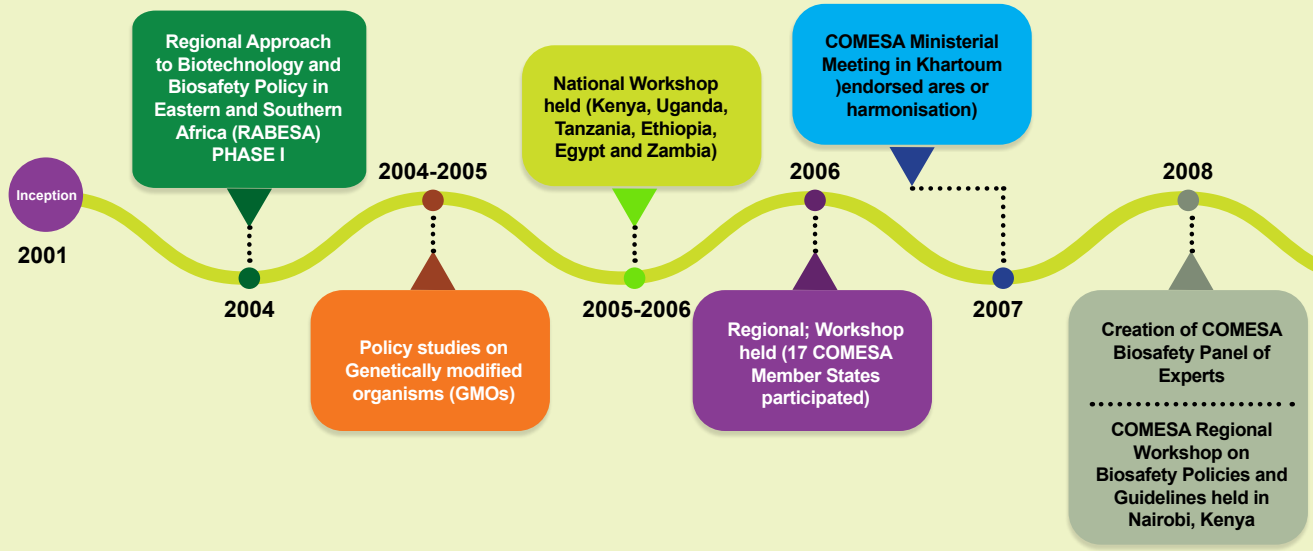
Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa project

Introduction

The Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa (RABESA) initiative was endorsed by the Common Market for Eastern and Southern Africa (COMESA) in 2003.

COMESA countries

RABESA Project Progress: 2001- 2011



It was designed to examine the potential ramifications of GMOs on trade, food security and access to emergency food aid in COMESA and ASARECA countries.

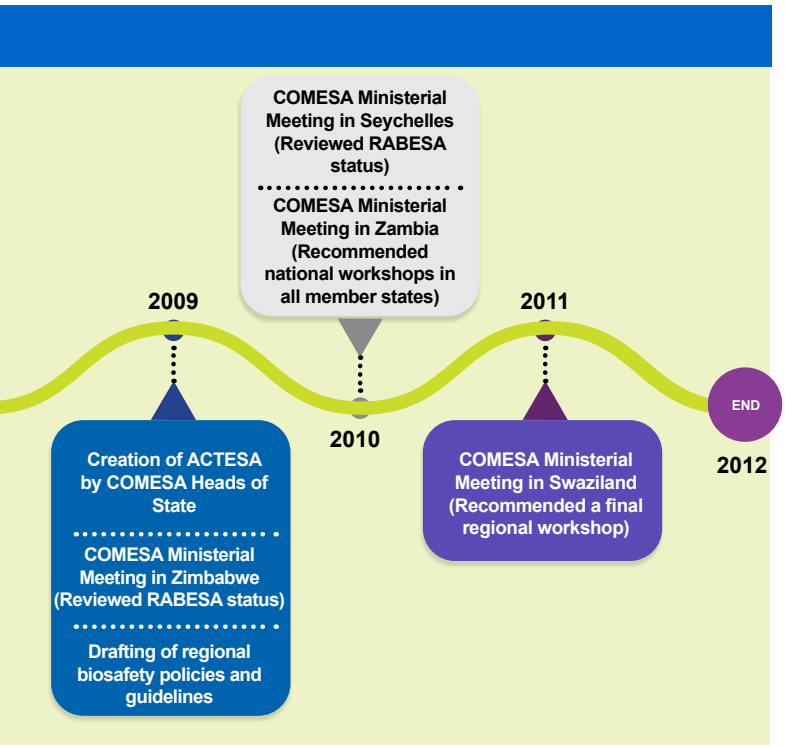
The overall objective of the initiative was to generate and analyze technical information required to inform COMESA and ASARECA countries on regional biotechnology and biosafety policy options.

The specific objectives were to: (i) Undertake stakeholder analysis in the COMESA countries highlighting opportunities, challenges, views and positions related to their engagements in trade, GMOs and food security; (ii) Estimate impacts of GMO crops on farm income in the COMESA region; (iii) Analyze commercial risks that COMESA countries would face in the destination export markets if permission to plant GMO crops was granted; (iv) Estimate the impact of precautionary GMO policies on access to emergency food aid and food security in the COMESA region; and (v) Identify a range of regional biosafety policy options for decision-making on issues of GMOs and trade in COMESA countries.

2013

COMESA Biosafety policy was approved by the 5th COMESA Meeting of Ministers of Agriculture, Environment and Natural Resources in Addis Ababa, Ethiopia.

ASARECA's Eastern and Central Africa Programme for Agricultural Policy Analysis (ECAPAPA) which would later become the Policy Analysis and Advocacy Programme (PAAP), in conjunction with the Program for Biosafety Systems (PBS) and the African Centre for Technology Studies (ACTS) provided technical support to COMESA in the implementation of the RABESA initiative.



The Journey of RABESA

- Implementation of RABESA phase I commenced in 2004 and ended in 2006 with a regional workshop that brought together key stakeholders from COMESA member states. Recommendations of the regional workshop were presented at the 4th meeting of the COMESA Ministers of Agriculture held in Khartoum, Sudan, in March 2007. The Ministers endorsed recommendations reached by stakeholders. This mainly focused on three priority areas of: Commercial planting of GMOs and trade policy in GM products; policy on access to emergency food aid with GM content; and policy harmonization.
- Regional Biosafety policies and guidelines addressing the three thematic areas were drafted in line with the Ministerial recommendations.
- At the request of the COMESA Ministers of Agriculture, the RABESA initiative, which had been in progress since 2003, completed the preparation of three regional biosafety policies and guidelines in March 2010. These policies and guidelines were presented and discussed in a regional workshop held in Nairobi, Kenya, in April 2010. During the workshop, stakeholder comments and feedback were obtained and incorporated.
- The Third Joint Meeting of the COMESA Ministers of Agriculture, Environment and Natural Resources, in July 2010, in Lusaka, Zambia, decided that the documents be subjected to further national consultative process for wider ownership before consideration by the COMESA policy organs.
- National consultative workshops were successfully held in 15 of the 19 COMESA member countries by September 2011. The workshops involved key stakeholders drawn from a diversity of institutions including ministries of agriculture, trade, environment, national biosafety focal points, biosafety competent authorities, farmers and farmers' representatives, seed traders, millers, media, food relief agencies, consumer groups, civil society, and politicians. The countries which participated included: Burundi, DR Congo, Djibouti, Eritrea, Ethiopia, Egypt, Kenya, Madagascar, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia, and Zimbabwe.

Milestones and achievements of RABESA Implementation

- Formation of the COMESA Panel of Experts.
- Development of the COMESA Biosafety policy on commercial planting of GMOs, trade in GM products and access to emergency food aid with GM content, which was approved in the 5th Joint COMESA Meeting of Ministers of Agriculture, Environment and Natural Resources, 16-20 September 2013 in Addis Ababa, Ethiopia.
- Development of a communication strategy to create awareness about the COMESA harmonization agenda.
- Development of a biosafety roadmap to support countries to establish and implement functional biosafety systems.

Rasha Adam, one of the researchers during the maize transformation process at Kenyatta University

Genetic Engineering of Local Maize for Drought Tolerance

Ethiopia
Kenya
Tanzania
Sudan
Uganda

Introduction

ASARECA implemented the Genetic Engineering of Maize for Drought Tolerance in Eastern and Central Africa project from 2008 to 2013. The Objective of the project was to develop and avail drought-tolerant maize genotypes adapted to the region.

This was done using genetic engineering approaches including gene up-regulation, under-regulation (silencing) and drought inducible expression of candidate genes. The project was supported by the Multi-donor Trust Fund (MDTF) comprising the European Commission and USAID to the tune of US$ 4,350,980.

Justification of the project

At the onset, it had been established that maize is the most widely cultivated cereal covering over 147 million hectares in the world. It is the third most important food crop for humans after wheat and rice, and is a staple food crop in East and Central Africa that is grown on more than 5.5million hectares mostly by small and medium-scale farmers. Maize provides well over 50% dietary calories with a per capita consumption of about 100kg/year. However, maize productivity has been declining over years due to a number of biotic and abiotic factors.

US$ 4.3m

Fund provided for the Genetic Engineering of Maize for Drought Tolerance in Eastern and Central Africa project by the EU and USAID

Drought is the single most important abiotic stress responsible for reduced maize productivity in arid and semi-arid areas, leading up to 70% crop loss. These, coupled with lack of suitable varieties that perform well under insufficient and erratic distribution of rainfall significantly reduce productivity of maize, with grain yield of 1.3tons/ha, compared to the potential of over 10tons/ha. Conventional breeding methods aimed at producing varieties resistant to drought fell below expectations.

The project set out to introgress drought resistance genes through genetic transformation into farmer preferred varieties sourced from Sudan, Kenya, Tanzania and Ethiopia. To enhance capacity in genetic maize research, ASARECA offered opportunities to scientists from the National Agricultural Research Institutes; Mikocheni Agricultural Research Institute (MARI), Tanzania;

Maize crop under drip irrigation

Leta Tulu Bedada, from EIAR is one of the researchers who transformed maize for drought tolerance

Ethiopia Institute of Agriculture Research (EIAR), Ethiopia; Sudan Agricultural Research Co-operation (ARC), Sudan; together with Biotechnology students at Kenyatta University to undertake PhD studies in genetic engineering of maize. The students constituted part of the core research team. Fifty-seven (57) ECA maize varieties including 15 open pollinated varieties (OPVs) and 42 inbred lines adapted to ECA were tested to establish their transformability and regenerability. Transformation efficiency of up to 46.7% was achieved.

Achievements

- A total of nine (9) tropical maize genotypes were successfully transformed with drought conferring genes in 2010. They include two Ethiopian lines, three Kenyan lines, two Sudanese lines, and two Tanzanian lines. They were transformed with amiRNA1 gene, amiRNA3 gene, NHX1, PMI genes, XvPrx2 gene and CBF1 gene.
- The transformed lines were advanced and evaluated in the screen house at Kenyatta University and bulked in preparation for drought stress experiments and field trials.

9

Tropical maize genotypes that were transformed with drought conferring genes

Potential areas for further interventions

Due to operational interruptions at ASARECA Secretariat, some of the previously planned interventions were not accomplished. ASARECA was due to commence follow up initiatives to ensure than the technologies were transferred to national systems for confined field trials.

Some of the next steps included: Carrying out an impact assessment of the GMO before campaigning for confined field trials; coordinating preparation of member countries for multi-location trials including mobilizing resources for the development of physical infrastructure and human resources for Biotechnology adoption.

Four lines of striga resistant sorghum varieties were released by the Government of Sudan

The Three Successive Striga Projects

- **Fighting striga: resistance genes deployed to boost sorghum productivity**
- **Enhancing sorghum adaptability to climate change, striga resistance, and drought tolerance traits pyramiding through biotechnological approaches**
- **Evaluation of striga resistant farmer preferred sorghum varieties**

Eritrea
Kenya
Madgascar
Rwanda
Sudan
Uganda

Introduction

From 2008 to 2013, ASARECA implemented three successor projects, which brought together a team of scientists from the National Agricultural Research Systems including:

Striga resistant sorghum varieties in Singida, Tanzania

Agricultural Research Corporation of Sudan (ARC); the National Agricultural Research Institute of Eritrea; the Rwanda Agricultural Board; the University of Nairobi; and the International Centre for Agricultural Research in Arid and Semi Arid Tropics (ICRISAT) to implement three initiatives, popularly referred to as the Striga projects. The three projects were: (i) Fighting striga: resistance genes deployed to boost sorghum productivity project; (ii) Enhancing sorghum adaptability to climate change, striga resistance and drought tolerance traits pyramiding through biotechnological approaches project; and (iii) Evaluation of striga resistant farmer preferred sorghum varieties.

The objective of the first project (2009-2011) was to develop Striga resistant marker selected sorghum lines into the Striga prone cropping systems of Eastern and Central Africa to enhance sorghum productivity, while the objective of the second project (2011-2013) was to advance gains from the first project by developing resistant crop cultivars using molecular biological tools, marker assisted selection and transformation. The third project was a one-year bridging initiative (2011) meant to evaluate available Striga resistant lines to open the way for their dissemination in the region. The three projects were supported by the Multi-donor Trust Fund Financed mainly comprising the European Union and USAID and managed by the World Bank.

Justification of the projects

Sorghum is ranked second after maize as the most important cereal staple crop in the ASARECA region. However, its production has over the years been constrained by Striga, a parasitic weed that causes yield losses as high as 100%. At the onset of the project in 2009, over 17,000 ha of sorghum had been infested by the weed, leading to yield losses of up to 2.3 million metric tons annually.

Against this background, ASARECA led the efforts to develop Striga-resistant sorghum lines using a marker assisted selection, which is reputed for its precision and effectiveness inbreeding for Striga resistance. The technology involved backcrossing using a donor Striga-resistant sorghum line N13 and three farmer preferred sorghum cultivars—Tabat, Wad Ahmed and AG-8—that were susceptible to Striga.

A sorghum field in Uganda devastated by Striga, the witch weed

Achievements

- A total of 51 lines of striga-resistant sorghum varieties were generated using the molecular marker breeding technology. Out of these, four lines code named ASARS1, ASARS2, ASARS3, ASARS4, were in 2012 released by the Government of Sudan.

- Thirty-six lines were put under advanced evaluation in at least six countries including Eritrea, Kenya, Rwanda, Tanzania, Uganda and Sudan for agronomic performance and striga resistance with the aim of releasing them for commercial use. In Uganda, the 36 lines were successfully put under adaptation trials at National Semi Arid Research Institute (NaSARRI) for striga resistance, farmer acceptance and colour and bulking.

- Through the project, one PhD student and two (MSc) students from Sudan and Kenya respectively were funded as part of the efforts to build capacity for marker-assisted breeding for striga resistance. They used facilities at ILRI-BecA in Nairobi and ICRISAT headquarters in India for DNA extraction and genotyping of the BC3 progenies.

51

Striga-resistant sorghum varieties generated using molecular marker breeding technology.

- The project facilitated the training of 14 scientists and technicians from National Agricultural Research Institutes and universities from Eritrea, Kenya, Tanzania, Uganda and Sudan in application of molecular markers in diversity studies and marker assisted breeding at BecA.

- To scale out the new varieties, a GIS map of the study sites was generated for promoting Striga-resistant and drought-tolerant sorghum varieties in the region.

Cassava and potato germplasm was collected for screening for viruses

Applying Tissue Culture to Improve Access to Clean Cassava and Sweet Potato Planting Materials for Farmers in the ECA Region

Burundi
DR Congo
Ethiopia
Kenya
Madagascar
Tanzania

In partnership with

Biosciences East and Central Africa Region

Introduction

Cassava and sweet potato are major staple crops for millions of people in the region.

Despite their crucial importance, the two crops face low productivity due to inadequate quality planting materials, pests and diseases, inefficient multiplication and distribution systems, poor market access and lack of a conducive policy and regulatory environment. ASARECA implemented this project from 2008 to 2011.

The objectives of the project were: To make available clean cassava and sweet potato tissue culture materials to national breeding programmes and other users for rapid multiplication; Strengthen NARS capacity to apply tissue culture in cassava and sweet potato improvement programmes; and to disseminate information to stakeholders. The project was supported by the Multi-donor Trust Fund (MDTF) comprising mainly the EU and USAID. It was implemented in Burundi, DR Congo, Kenya, and Ethiopia. The Biosciences East and Central Africa Region (BecA) was commissioned to develop, validate and standardize virus indexing tools and a plant material certification system.

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Technicians and scientists trained in the basic techniques of tissue culture, virus indexing and seed systems of the vegetative crops.

Achievements

- A baseline on the status of Tissue Culture applications in Eastern and Central Africa was conducted in Burundi, DR Congo, Ethiopia, Kenya, Madagascar, Rwanda, Tanzania and Uganda to determine the existing capacity in terms of human resources and physical infrastructure.

- All the available virus sequences for cassava and sweet potato virus were collected for major viruses of cassava and sweet potatoes. Over 200 sequences of virus for Cassava Brown Streak Virus (CBSV), Sweet Potato Feathery Mottle Virus (SPFMV), sweet potato chlorotic stunt virus (SPCSV), Sweet Potato Chlorotic Fleck Virus (SPCFV), and Sweet Potato Mild Mottle Virus (SPMMV) were collected for virus indexing.

- Using DNA sequences obtained, PCR primers can now be used to test for the presence of cassava and sweet potato diseases. A set of potential epitope from the virus sequences has been selected. Using the selected epitopes, a total of 12 peptides for cassava/ sweet potato virus coat proteins were selected for epitope candidates, and the synthesized peptides were injected to rabbit for polyclonal antibody production. These antibodies will be used to detect viruses in the diagnostic kits to be developed.

- A total of 22 technicians and scientists from Uganda, Kenya, Madagascar, Tanzania, Burundi, Ethiopia, DRC, and Rwanda were trained in the basic techniques of tissue culture, virus indexing and seed systems for vegetatively propagated crops.

Clean cassava planting materials under development

Scientist from Tanzania explain efforts to produce clean cassava planting materials to Tanzania's Head of State during an agricultural show

Establishment of a Genetic Transformation Platform for Cassava in the ECA Region

Kenya
Tanzania
Uganda

Introduction

Cassava is a major food security crop in Eastern and Central Africa. However, it is constrained by pests and diseases, which are responsible for the dramatic reduction of harvest, hence cutting down yield to less than half the potential.

Production of clean cassava and potato planting materials in NaCRRI, Uganda and MARI, Tanzania

Cassava Mosaic Disease (CMD) and cassava brown streak disease (CBSD) have over time been the most important constraints affecting cassava. With funding from USAID, ASARECA coordinated efforts by researchers from the region in partnership with researchers at the Donald Danforth Plant Science Centre, USA and the International Institute for Tropical Agriculture (IITA) to improve cassava varieties through genetic engineering.

The project was implemented from (2008-2011). It brought together scientists from Kenya, Tanzania and Uganda. The objective of the project was to improve farmer preferred, but highly susceptible local cassava cultivars by introducing CMD and CBSD resistance genes into cassava while retaining the superior storage root traits.

Resources were provided to refurbish laboratories, purchase modest equipment for transformation and adapting technologies that were developed elsewhere in preparation for confined field trials.

Achievements

- Resources were provided to refurbish laboratories, purchase modest equipment for transformation and adapting technologies that were developed elsewhere in preparation for confined field trials.

- In Uganda and Tanzania, new laboratories were constructed and refurbished. Laboratory technicians were recruited and trained on genetic transformation. Several students were attached to these laboratories to enhance their skills in biotechnology applications.

- In Kenyatta University, a biotechnology laboratory and a state of the art screen house were upgraded to match the regulatory requirements for biosafety.

- Cassava molecular constructs and embryogenic cultures for cassava transformation were developed using facilities of the National Crop Resources Research Institute (NaCRRI) in Uganda and Mikocheni Agricultural Research Institute (MARI) in Tanzania.

- Cassava landraces in Uganda, Tanzania and Kenya were screened for somatic embryogenesis using these platforms.

- Building on initial facilitation from this project, other donors supported a number of activities to enhance cassava transformation in the member countries, including training of scientists and technicians in cassava transformation and refurbishment of transformation facilities.

Some of the 15 cassava clones selected by farmers for multiplication and use in the face of CBSD and CMD

Cassava Production Restoration in Kenya

Introduction

Cassava is an important staple food crop in Western, Central, Eastern and coastal regions of Kenya, which are the leading producers (60%) and consumers. The most important biotic stresses to production are cassava green mites (CGM), mealybugs (CMB), cassava mosaic disease (CMD) and cassava bacterial blight (CBB).

Kenya

302,000

The number of households who adopted improved varieties with yield above 15Mt/ha

Between 1994 and 1997, the most severe form of CMD attacked cassava and devastated all traditional varieties in Kenya. As a result, households suffered serious food shortages.

ASARECA Interventions

With ASARECA coordination and facilitation, the Kenya Agricultural Research Institute (KARI), now KALRO, in collaboration with EARRNET in 1997 teamed up scientists with farmers, public and private sectors, to mitigate the pandemic.

Strategies to tackle the pandemic included the introduction and evaluation of germplasm, multiplication and distribution of cassava mosaic resistant planting materials to farmers in the region; training of stakeholders in disease identification; rapid multiplication techniques; and processing and utilization of cassava products. Diagnostic surveys were also conducted to establish the extent of the spread of the disease and determine the strains of the virus with the aim of developing and disseminating control measures.

Achievements

- Within six years of intervention, over 1,400 cassava clones were introduced and evaluated for the disease and other important agronomic characteristics.
- Through the evaluation of the introduced clones, genotypes with desirable characteristics were selected and tested on-farm.
- Fifteen clones selected by farmers were distributed for multiplication. This was followed with the creation of awareness on CMD control measures.
- There was wide adoption of improved varieties with yield above 15MT/ha and area of about 21,000 ha. Over 302,000 households started to grow the improved varieties.
- An impact study conducted at the time indicated that 38% of the farmers adopted the improved varieties with a net return to investment of up to 200%.

Healthy cassava roots

ASARECA supported initiatives for enhancing access and exchange of cassava and potato germplasm

Conservation for Sustainable Availability of Cassava and Sweet potato Germplasm Through the Application of Biotechnology in the ECA Region

Burundi
Ethiopia
Rwanda
Uganda

In partnership with

International Istitute of Tropical Agriculture

Background

The project sought to optimise the application of tools of modern biotechnology to conserve germplasm for cassava and sweetpotato.

1,400

Cassava clones introduced and evaluated for the disease and other important agronomic characteristics within six years of intervention

ASARECA implemented the project in Uganda, Ethiopia, Burundi and Rwanda in partnership with the International Institute of Tropical Agriculture (IITA).

Objectives

- **To strengthen the capacity for cassava and sweet potato conservation in the national agricultural research systems (NARS).**
- **To develop protocols for enhancing access and exchange of cassava and sweet potato germplasm and information.**
- **To generate information on useful attributes to** support improvement efforts for disease-free cassava and sweet potato germplasm.

Achievements

- Breeders in Kenya have made collections of cassava and sweet potato germplasm.
- A field genebank was built at Muguga centre. A regional biotechnology laboratory (including a gene-bank office and laboratory, tissue culture laboratory, office block with three rooms, two glass houses (each 6x4m) was constructed.
- Additionally, two stores were renovated. Modest laboratory equipment and materials were also procured.
- Parents of the mapping populations were screened for 400 SSR markers. 56 SSR markers were identified and will be used for future development of a genetic linkage map. The development of a genetic linkage map forms the basis for understanding the genetic basis of CBSD tolerance in cassava cultivars in order to rapidly and efficiently breed improved varieties.
- Training was conducted for 14 regional scientists and technicians in conservation biotechnology.

Tissue culture banana materials developed with partners in Kenya

Transfer of Banana Tissue Culture Technology to Small Scale Farmers

Burundi
Kenya
Rwanda
Uganda

Background

Banana especially, cooking banana is a major source of food and income for smallholder farmers in ECA. In Uganda, Burundi and Rwanda, per capita consumption has been estimated at 450 kg per year, the highest in the world. In the past, banana was a highly sustainable crop with a long plantation life and stable yields.

However, with the arrival of the black sigatoka fungus and banana wilt, banana production in ECA fell by over 40%.

Objective

To produce and provide quality and pest and disease-free banana germplasm using tissue culture and training farmers in modern agricultural practices.

Achievements

- With support from the International Institute of Tropical Agriculture (IITA), disease resistant cultivars such as the FHIA-17 were developed and made available in intervention countries.
- The project facilitated mass production of tissue culture banana. Demonstration gardens for training farming communities and nursery operators to advance mass production were also established.
- The Tissue Culture Business Network (TCBN) was formed to multiply and make available appropriate tissue culture technologies; build the capacity of its network members and increase information production and dissemination.

Tissue culture laboratory in Nairobi, Kenya

Researchers explain the seed plot technology for boosting potato production

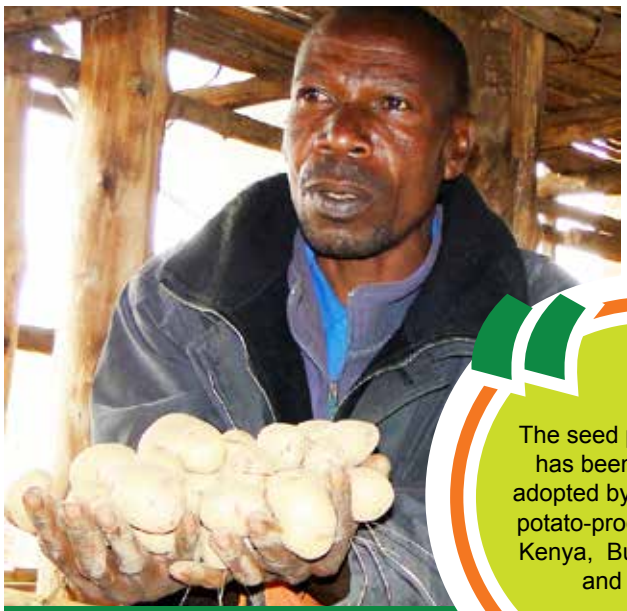
A Seed-plot Technology for On-farm Improvement of Seed Potato Quality

Burundi
Kenya
Rwanda
Uganda

Background

Potato farmers in Eastern and Central African (ECA) countries experience yields way below 10 tonnes/ha compared to 40-60 tonnes/ha achievable under enhanced production circumstances. The average yields in Burundi, Uganda and Kenya are 2.6, 7.0 and 7.5 tonnes/ha, respectively.

ASARECA staff interact with farmers who adopted the seed plot technology



A bumper potato harvest as a result of the innovations

Lack of healthy, high-yielding planting materials is a leading cause of low yields. In more than 95% cases, farmers plant own-saved tubers from previous harvests or sourced from markets or neighbours. Such tubers are often of poor health due to infections by *Ralstonia solanacearum* (the bacterial wilt causal agent), viruses and other tuber-borne pathogens.

A regional team drawn from KARI (lead institution), NARO, ISABU, ISAR and CIP implemented the project in collaboration with farmer groups and agricultural extension institutions.

Objective

The project was designed to enhance the adaptation and utilization of appropriate practices, tools and technologies for production and delivery of high-quality seed potato through informal systems.

The seed-plot technology maximises tuber production per unit area of limited, disease-free land through high-density planting. Tubers are planted at a spacing of 30cm by 30 cm and the healthy tubers obtained from a clean seed-plot are planted at the usual spacing in the production (ware) field. Land for propagating seed for the next season is identified early and left to fallow.

Achievements

- Farmers and agricultural extension staff in project areas received season-long training in positive seed selection, improved crop rotation, and field sanitation to improve the quality of seed potato.

- There was increased availability of bacterial wilt-free seed potato, three times higher land productivity for seed; and a 50 percent reduction in land required to meet on-farm seed tuber needs.

- The technology has been successfully adopted by farmers in four potato-producing areas in Kenya (Kianthumbi, Muchicha, Mutethia Buyene and Kibaranyaki), three areas of Burundi (Buyengero, Mugongomanga and Muruta), three districts in Uganda (Kabale, Kisoro and Kanungu), and target areas in Rwanda.

The seed plot technology has been successfully adopted by farmers in four potato-producing areas in Kenya, Burundi, Uganda and Rwanda.

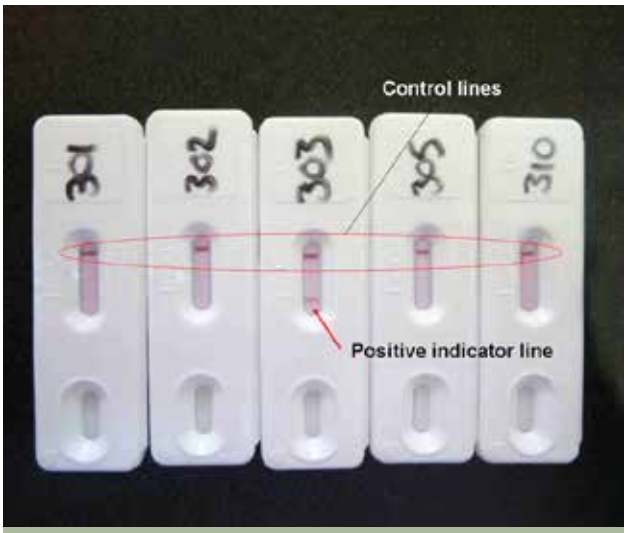
Piggery was threatened by *Teania solium*, which affected pork consumption

Burundi
DR Congo
Ethiopia
Eritrea
Kenya
Tanzania
Uganda

Diagnostic and Control Tools and Strategies for *Teania Solium Cysticercosis* Implementation

Introduction

Pig rearing and pork consumption increased significantly in ECA during the past two decades primarily due to the lack of grazing land for ruminant livestock. Besides, the farmers realized that piggery offers quicker returns on investment.



Teania Solium diagnostic kit

However, there was an increase in the prevalence of epilepsy and cases of porcine *cysticercosis* in humans in Eastern and Southern Africa (ESA) without a clear etiology. *Cysticercosis* is caused by a zoonotic tapeworm *Teania solium* found in pigs. Humans acquire *taeniosis* (tapeworm infection) when they eat raw or undercooked pork contaminated with *cysticerci*, the larval form of *Teania solium*.

When ingested, the *cysticerci* establishes in the intestine of humans, become adult tapeworms and shed eggs in human feces that can infect other humans and pigs. *Teania solium cysticercosis* is present throughout the region and it is increasing as an important constraint to the nutritional and economic well-being of small holder farming communities and as a serious public health risk.

Community-based studies on *porcine cysticercosis* in Tanzania indicated a prevalence of up to 18%. The project was implemented from 2009 and 2010.

The main participating countries were: Burundi, DR Congo, Kenya, Ethiopia, Tanzania, Eritrea and Uganda. The main objectives were to determine the risk factors for *Taenia solium cysticercosis/taeniosis*; developing and evaluating a pen-side diagnostic test for *Teania solium cysticercosis* in pigs; and strengthening the national capacity for surveillance, prevention and control of *Teania solium cysticercosis* in pigs. The project was funded by the Multi-donor Trust Fund (MDTF) comprising mainly of the EU and USAID

Achievements

- An epidemiological study was conducted in the five countries of Uganda, Kenya, Tanzania, D R Congo and Burundi on the impact of *Teania solium cysticercosis* in pigs and humans. It revealed that 23.5% of humans were positive for *Teania solium cysticercosis*. In Tanzania, 30 – 50% of epilepsy cases were found to be positive for *Teania solium cysticercosis*. In Kenya, About two hundred pigs in Homa bay district were examined for cysts of *Taenia solium* and about 10% were found positive.

- Data collected on pig production and management systems and the risk factor for porcine *cysticercosis* in the selected areas was used for clinical evaluations and testing of serum samples from pigs and humans. This formed the basis for the acquisition of immunodiagnostic kits and vaccines for field tests.

- Using the data, national action plans were developed for surveillance, prevention and control of *Teania solium cysticercosis* in Uganda, Kenya, Tanzania, Burundi and DR Congo and a policy brief was prepared for awareness and sensitization.

- An MSc student was trained at Sokoine University in Tanzania to use biotechnological tools for diagnosis and control of *Teania solium cysticercosis*.

Farmers in Malawi explain how the Chameleon Sensor, one of the VIA tools works

Virtual Irrigation Academy

Celebrating a model irrigation project in Africa

Introduction

Launched in 2015, the implementation of the Virtual Irrigation Academy (VIA) is coordinated by ASARECA. The four-year project is a brainchild of the Commonwealth Scientific and Industrial Research Organization (CSIRO) in partnership with the Australian Centre of International Agricultural Research (ACIAR).

Malawi
Tanzania

In Africa, the project is being undertaken in Malawi and Tanzania. In Tanzania, it is implemented by the National Irrigation Commission in collaboration with Sokoine University and Arusha Technical College. The Tanzania, project is implemented in eight irrigation schemes and 3,968 farmers are benefiting from the Project. In Malawi the Department of Agricultural Research Services (DARS) in collaboration with the Department of Irrigation (DoI) are the lead implementers.

Farmer-friendly tools

The VIA refines and deploys farmer-friendly monitoring tools that measure amount of moisture, nutrients and salts in the soils; develops a "Virtual Irrigation Academy"(VIA) through on-line visualization of data from the monitoring tools linked to a virtual discussion, learning and teaching space with skilled facilitators; determines how the VIA promotes social and institutional learning that improves irrigated farm productivity; and develops partnerships for sustainable out-scaling of VIA and monitoring tools.

Onions in Tanzania grown using the VIA decision support tools

It combines new irrigation monitoring tools with an on-line communication and learning system. The academy tools include physical data capture from the schemes on a daily basis. Country leaders use the data to study the situation to inform the process of mentoring extension workers; capture of the dialogue between farmers, extension workers and scientists for analysis of how learning occurs.

> The project provided farmers in Malawi and Tanzania monitoring tools that have provided them with information on amount of water, salts and fertilizer needed for the good health of their crops.

The VIA monitoring tools have been designed to fit the mental model of farmers and to give an output that is linked to action.

The project provided farmers in Malawi and Tanzania monitoring tools that have over the last five years provided them with information on amount of water, salts and fertilizer needed for the good health of their crops. These include: the Chameleon readers, sensors, and Wetting Front Detectors.

Wetting Front Detectors show amount of nitrate in the soil, while Chameleon sensors display the amount of soil moisture at different soil depths using blue, green and red lights. The lights provide visual interpretations of the moisture levels. The farmers were trained to interpret the data, which in turn informs the decisions they make on water use and agronomic options. As a result of using these tools, farmers have reported that they are able to use the available scarce water efficiently, which has reduced conflicts for water; saved time for other activities; improved household incomes; increased yields; created new jobs and improved food security.

The project has posted important achievements. The following case studies are meant to shade light on some of the achievements.

Story 1

Data rules: Technology Intelligent Farmers Influencing Decisions and Policies in Tanzania

Farmers in four regions of Tanzania have become a critical part and parcel of the generation and relaying of information that technical and policy leaders need to make key decisions in the agriculture and irrigation sectors.

The farmers under the Virtual Irrigation Academy (VIA), use data signals to irrigate their farms in some of the most water and nutrient efficient ways. At least twice every week, a total of eight (8) data collectors, all of them principally agricultural extension officers, descend to the eight (8) irrigation schemes in the four regions of Dodoma, Iringa and Morogoro to collect data.

Lead farmers work with technical staff

Onsite, they are joined by two lead farmers who work with them to read the (VIA) monitoring tools and upload the data into the VIA online platform. The tools are uniquely designed to fit farmers' mental model, giving a colour signal that matches an implication. Information on soil water suction, nitrate concentration and salinity levels are illustrated by colour signals that represent action thresholds instead of complicated numerical units.

The system has since been advanced after the innovation of Wi-Fi (chip) enabled readers to relay information directly to the online platform. Initially, two farmers per scheme were deliberately trained to interpret data from the tools. Currently, four lead famers are being trained to take over all the roles from data collectors as the project comes to an end.

These farmers will sooner than later, take full custody of the Wi-Fi readers and assume all the roles of data collection and transmission.

How the data travels

Currently, the farmers together with the data collectors connect Wi-Fi readers to the field tools, hence relaying it instantly to the VIA platform. Besides relaying, the farmers explain to the data collectors (scheme extension workers) their latest experience with the tools. This is proceded by a discussion and onsite analysis to enhance learning. The relayed data is accessed by the National Project Manager and the Research facilitator based in

Potato vegetables in Dodoma, Tanzania grown through supplemental irrigation using VIA tools

Leafy vegetables grown through irrigation and using monitoring tools in one of the harshest months of the year

Arusha; and the National Project Coordinator (in the Capacity of the Director General, the National Irrigation Commission; and the project facilitators at Commonwealth Scientific and Industrial Research Organization (CSIRO) based in Canberra, Australia.

"Through the tools, information is made available not only to the farmers, but also to other decision makers at a higher level, who are given access at their various levels," says Stanley Awaki, the VIA Country Manager. "All the officials in the chain use the information analytically to make management and investment decisions, "says Mr. Awaki.

"As a result of this, the Tanzanian Government is fully aware of strategic challenges such as massive silting which has reduced the capacity of Buigiri Dam by up to 80%, and of the breakdown of the irrigation system at Chinangali Irrigation Scheme. These challenges are now prominent at the policy domain."

NIC is considering various options and has welcomed development partnerships to explore opportunities such as raising the embankment of the dam, establishing a new dam altogether or de-silting it.

This project, exemplifies the central place of the use of noble innovations, data collection, transmission and analysis in AR4D. Grounded on social learning, the project has focused on developing a people-centred learning system based on the concept of the Virtual Irrigation Academy.

Story 2

Simple Irrigation Tools with Huge Impact in Malawi

"My family is healthy and happy because we have adequate food to eat," says Joseph Mkaka from Mlongola village in Chikwawa district in Malawi. "During the last season, I registered a big harvest of beans, which earned me MK 144,000 (about US$ 195).Yields from my garden (0.12 ha) increased from 75 kg to 360 kg," says Mkaka.

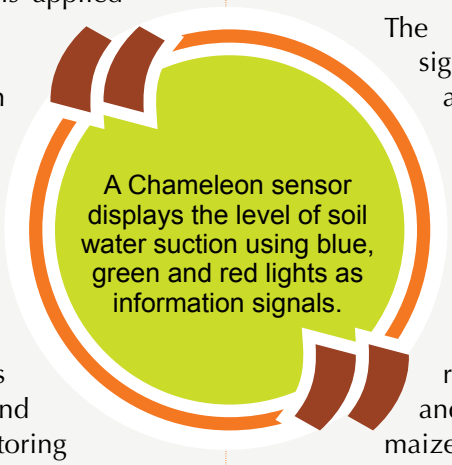
In real terms, the yields increased by 373%, while his income rose by MK 114,000 (about US$ 155) from MK 30,000 (US$ 40.8) the previous years. Besides, securing food for the family, Mkaka also added two goats to his stock.

Another farmer, Fanny Makwinja from Matabwa village registered a yield growth of 164% from 25kg to 66kgs from 0.075ha; earning MK 26,400 (US$ 35.9). This, Fanny attributes to her ardent application of irrigation monitoring tools, soil and crop management, practices. "I am not the only one benefiting, two other farmers who did not receive irrigation monitoring tools are using information derived from the tools to make irrigation decisions," she explains.

A couple in Malawi celebrates a rare good maize harvest, thanks to the VIA monitoring tools

Mkaka and Fanny are just only two among the 132—plus—farmers in Malawi who are being supported under the Virtual Irrigation Academy to Improve Water Productivity in Malawi and Tanzania. Among other things, the farmers have been trained to use the tools to make decisions on when and when not to irrigate, when to regulate amounts of salts in the soil and how to ensure fertilizer is applied efficiently.

A total of six irrigation schemes in the two districts of Chikwawa and Dedza were selected to pilot the innovations.



Farmers in these locations now see a reason to look to the future since they were provided with simple monitoring tools such as chameleon readers, sensors and wetting front detectors for monitoring moisture levels and nutrient content in the soil.

A wetting front detector shows the depth that water has infiltrated into the soil and captures a water sample for in-field testing of nutrients using colour strips, while a Chameleon sensor displays the level of soil water suction using blue, green and red lights as information signals. It is these colours, which the farmers use to determine when and when not to irrigate.

Because of the project, farmers note that the intervals of irrigation have reduced five times a month to once or twice a month, signifying a 50% water saving. "This implies that water has been saved and made available to increase area under irrigation," says Dr. Isaac Fandika, Research Scientist, Department of Agricultural Research Services, Kasinthula Agricultural Research Station, Irrigation and Drainage Commodity Team in Malawi.

In Tadala scheme for example, the area under irrigation has increased from 6 ha to 11 ha, signifying 83 percent expansion. Farmers in Matabwa irrigation scheme say whenever the tools show that they don't need to irrigate, they often advise the village headman, who controls water release, to channel it to farms with water deficiency.

The VIA project has resulted in significant changes in productivity among participating farmers. The benefits from using the chameleon moisture detector and the wetting front detectors are multiple and create knock-on effects.

On average, farmers used to get a range of 0.5 to 0.8 ton/ha of beans and between 1.4 to 1.8 ton/ha of maize, but currently yield for beans and maize has improved to 1 to 1.5 ton/ha and 2 to 2.3 ton/ha respectively. This represents a 34.4 percent increase in maize yields and 92.3 per cent increase in bean yields.

Over irrigation often led to saturation of the soil, which caused rotting of pods and accumulation of salts, which is dangerous for plant life. Excess water leached nutrients beyond the root zone, which rendered it unavailable to the crops. Frustrated, some farmers thought the fertilizers were fake. After the introduction of the tools, they reduced the frequency to twice monthly.

Farmers now have more time to undertake secondary income generation streams. Before the VIA, the incidence of water sharing conflicts was becoming a social problem with security repercussions. The village leader had to resolve four to six cases a week. However, today weeks pass without cases related to water sharing.

Youthful beneficiaries of agribusiness incubation in Uganda

Supporting Business Incubation for Youth Empowerment

Introduction

ASARECA and partners implemented the Business and Research in Agricultural Innovation initiative (UniBRAIN) project in 2013 to 2016.

Kenya
Uganda

In partnership with

FARA

UniBRAIN was a joint effort to use human resources, technical skills, financial support and institutional facilities from universities, the private sector and the National Agricultural Research Institutes to make agricultural innovations profitable and attractive to the youth.

It was a continental programme coordinated by the Forum for Agricultural Research in Africa (FARA) in which the sub-regional organisations played the critical role of ensuring that the national research community was fully engaged by contributing new technologies and refining and using applied research to address bottlenecks along various value chains.

ASARECA role

In Eastern and Central Africa, ASARECA leveraged its network of national agricultural research and extension systems (NARES) to facilitate the establishment of innovation incubator consortia including: Consortium for enhancing University Responsiveness to Agribusiness Development (CURAD), Sorghum Value Chain Development Consortium (SVCDC), and Afribanana products. Using this network, ASARECA supported the business incubation programme by identifying research products ready for commercialisation and enhancing capacities of researchers and incubators on intellectual property rights and technology evaluation.

200

Researchers were sensitized on the UniBRAIN initiative and concept of incubation

What are incubation centres?

The incubation centres are focal areas for exchanging experiences and sharing resources and knowledge. The centres were designed to guide incubatees from conceptualization to implementation, scaling up technologies, and creating competitive agribusiness enterprises. They help entrepreneurs get off the ground through mentoring, funding, facilities, and providing critical business networks.

Achievements

- Over 91 business startups were supported (incubated) to overcome challenges that often 'kill-off' small and medium enterprises before they can realize their potential.
- 200 Researchers were sensitized on the UniBRAIN initiative and concept of incubation.
- An inventory of Technologies, Innovations and Management Practices (TIMPs) under the sorghum and banana value chains which have potential for commercialization was developed.

Coffee

CURAD, which was constituted by Makerere University, NUCAFE and the National Agricultural Research Organisation, supported nine business start-ups, two existing SME's and successfully commercialized one technology. As a result of these pilot initiatives, over 100 jobs were created and 105 farming households were positively affected by incubation programmes.

Ready-to-cook fresh vacuum sealed matoke (banana)

The incubator brought agro processing equipment nearer to farmers, enabling them to add value to coffee and attract premium prices. Fifty four (54) students were supported to develop ideas and build business plans. Of these, 35 were recruited into various coffee businesses along the value chain.

The incubator covers enterprises like coffee shops, agro processing, coffee nurseries, transportation and managing collection and bulking centres. CURAD provided 180 off-site contact support to incubatees. As a result of these efforts, 140 new jobs were created. The consortium also helped to establish two biotech commercial labs with average production capacity of of 200,000 disease-free coffee seedlings annually.

Adding value to bananas

Afribanana Products (ABP) Ltd, a banana value chain incubator in Uganda is nurturing innovative enterprises with a high growth potential to become competitive through training on business development, marketing and financial management. Afribanana has also supported enterprises to make biodegradable bags, banana fabrics, banana juice, banana wine, charcoal briquettes, and tissue culture planting materials.

Making clean planting materials available

Over 20,000 high-yielding and disease resistant tissue culture seedlings were distributed to small and medium enterprises in Uganda and Kenya. The incubator has also reduced waste production by converting banana peelings into high-value products such as banana briquettes and biogas. Several incubatees have acquired skills in these areas. They are conversant with these innovations and can put them into use.

Besides, Afribanana has diversified into new products such as banana syrup, ready to eat snacks, banana fibre tissue, banana-okracaffeine free beverage etc. Seeking a global presence, Afribanana acquired US food and drug administration certification. To date, they are exporting ready-to-cook fresh vacuum sealed *matoke* (banana) to various markets in the UK and US.

Coffee packaged by an Umukwano, an incubatee in Uganda

Value-added sorghum packaged by the sorghum value chain in Kenya

Making the best out of sorghum

SVCDC, an autonomous public-private partnership hosted by Jomo Kenyatta University of Agriculture and Technology, was positioned to be a one-stop advisory and service centre for commercial firms seeking short-term services and specialized facilities.

The consortium is promoting maximum use of sorghum through the 4F approach (Food, Feed, Fuel, Fibre). The consortium is constituted by Jomo Kenyatta University of Agriculture and Technology, Kenya Agricultural Research Institute, Agritrace and Farm Support International Limited. It is supporting seven food ventures, three fuel ventures, four feeds ventures, 14 seed ventures and one education venture.

L-R: Dr. Leah Ndungu, Regional Manager for Africa, ACIAR; Prof. Jean Jacques Mbonigaba Muhinda, Executive Director, ASARECA; Dr. Peter Horne, Global Manager, Country Programmes, ACIAR; Mr. Moses Odeke, Technical Officer - Monitoring, Evaluation and Learning, ASARECA; and Dr. Enock Warinda, Deputy Executive Director, ASARECA, during the May 2019 ASARECA Council of Patron Ministers Summit.

The Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) Project

Botswana
Ethiopia
Kenya
Malawi
Mozambique
Rwanda
Tanzania
Uganda

The Sustainable Intensification of Maize-Legume Cropping Systems for food Security in Eastern and Southern Africa (SIMLESA) project was a multi-stakeholder collaborative research program implemented in five ASARECA countries (Kenya, Tanzania, Ethiopia, Rwanda and Uganda) and three Southern Africa countries (Malawi, Mozambique and Botswana).

ASARECA key stakeholders including the Council of Patron Ministers, General Assembly, Board of Directors, and National Focal Persons join the Guest of Honour, Rt. Hon. Ali Kirunda Kivejinja, Uganda's Second Deputy Prime Minister in a group photo. The Ministers received evidence of SIMLESA work during the Summit.

The project commenced in 2010 and ended in 2018. It was aimed at improving farm-level food security in the context of climate change and variability through the development of resilient, profitable and sustainable farming systems. The project's approach was to leverage science and technology to develop and deliver technological and institutional innovations in the maize-legume production systems. It was funded by the Australian Centre for International Agriculture Research (ACIAR) and managed by the International Maize and Wheat Improvement Centre (CIMMYT). Other partners included: University of Queensland and Murdoch University in Australia; International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); and Agricultural Research Council (ARC), South Africa.

ASARECA's role in the Project

ASARECA coordinated the Project's implementation in Kenya, Tanzania, Ethiopia, Rwanda and Uganda through the National Agricultural Research Systems (NARS). ASARECA's technical backstopping focused on: monitoring and evaluation (M&E); gender mainstreaming; and technology and knowledge transfer and spillovers.

Among the ASARECA's deliverables included: (i) coordinating a study to establish strategies to effectively transfer information and knowledge to end-users; (ii) facilitating scaling out and spillovers of SIMLESA technologies, thus leading to the development of an inventory of available maize and legume technologies and conservation agriculture practices that could be scaled out in participating countries; (iii) using the study to identify extension approaches and knowledge products that were used in the SIMLESA project; (iv) coordinating policy harmonization; (v) coordinating gender mainstreaming in the National Agricultural Research Institutes; and (vi) establishing M&E framework that was adopted by all the implementing partners in tracking the Project progress.

Overall, SIMLESA aimed at reaching 750,000 households by 2023, to increase maize and legumes yields by 30%, while reducing downside yield risk by 30% through the implementation of selected activities. These activities were based on five main principles, namely: (i) Adaptive agronomy—which included the identification, testing and recommendation of conservation agriculture-based sustainable intensification (CASI) farming practices suitable for smallholder farmers; (ii) Socio-economics

and gender—which focused on the identification of the institutional, market and policy enablers of CASI; (iii) Seed systems—involving the strengthening of seed systems to deliver drought-tolerant maize varieties compatible with Climate Smart Agriculture (CSA) systems; (iv) Scaling modalities—which includes identifying scaling modalities to support the diffusion of CSA methods for true impact; and (v) Capacity building for skilling of early-career scientists, and cementing of Africa-Australia scientific collaboration.

> SIMLESA directly benefited 484,000 households who adopted at least two recommended CASI practices within 20-30 km of demonstration sites by 2018

SIMLESA Impacts

Among the key impacts from SIMLESA include: (i) Higher yields in maize and legume farming systems; (ii) Direct benefits to 484,000 households who adopted at least two recommended CASI practices within 20-30 km of demonstration sites by 2018; (iii) At least 52 percent increase in net maize-legume income, and 26% reduction in the use of pesticides (by 0.4-0.6 liters per acre) when farmers combined legume-maize intercropping and legume-maize rotations in Malawi; (iv) Increased farmers' net income by more than 66-92% through combinations of crop diversification practices, intercropping, rotations and minimum tillage in Ethiopia; (v) Over 30% increase in maize and legume productivity due to adoption of permanent planting basins and rip-lines for renovation of degraded landscapes in Uganda; (vi) Up to 20% increase in maize yields using planting basins compared with conventional tilled seed beds in Mozambique; (vii) An increase of maize yields by 2.5 – 3 tons/ha in the drier areas of Tanzania.

Other notable impacts of the Project include: (i) Time saving among the farmers by adopting two-wheel tractors. In Tanzania, this technology reduced the amount of time spent on planting one hectare of maize field from 160 person-hours of intensive tillage using a hand hoe to only 3 machine-hours, while in Kenya, the cost of labour reduced by 56%; (ii) Increased soil stability and fertility through shifting from conventional tillage-based cropping systems to conservation agriculture, thereby reducing runoff and soil loss. In Malawi, 30% soil organic carbon increase was noted compared to soils under conventional tillage, alongside a 30% increase in water retention and 60-90% increase in water infiltration rates relative to the conventional systems. Sites in Tanzania recorded an average increase in soil organic carbon by 65%.

It is noteworthy that the use of crop residue as a permanent soil cover and intercropping reduced soil loss by 34-65% in the Central Rift Valley of Ethiopia. As regards the scaling of CASI technologies and practices using multi-stakeholder agricultural innovation platforms (AIPs), the Project facilitated information exchange, collective action and market participation. In Ethiopia, the project reached 375,557 farmers, while up to 90% (up from 20%) of the farmers

who had no access to extension services benefited from AIPs in Uganda. Within one year, the number of farmers who adopted CASI increased from 2 to 35% in Malawi. The Project contributed to knowledge base on CASI by generating at least 60 briefs and synthesis documents to inform policy actions, besides journal articles, how-to-do manuals, videos and other documentation. The project proved that smallholder-appropriate mechanization is an important driver of the adoption of CASI technologies and practices.

Pitching SIMLESA to the highest policy level

As part of enhancing policy advocacy, ASARECA in collaboration with CIMMYT, ACIAR and member countries organized two High-Level Policy Fora. These fora – in October 2015 and May 2019 were held to present the SIMLESA evidence to Agriculture Ministers, and to ease sustainable integration into national systems. Some of the evidence include: (i) the use of sustained application of resource conservation practices, crop diversification and livestock integration to increase productivity; (ii) enhanced ability of farmers belonging to groups to diversify cropping patterns and build their resilience; (iii) the ability of farmers who are close to markets having better access to farm inputs and readily selling their farm produce; (iv) the fact that removing barriers to regional food trade and facilitating access to key inputs such as seeds and fertilizers provide farmers with incentives to supply the growing demand for food in the region; (v) the fact that development of resistant varieties is still the most sustainable approach to fighting maize lethal necrosis (MLN).

October 2015 High-Level Policy Forum

During the 2015 High-Level Policy Forum, the ministers agreed that enhancing access to extension services, agricultural inputs and markets, are part of the critical package of policy actions that must be fast-tracked to maximize benefits from agriculture. In a joint a Communiqué, the ministers agreed to: commit their Governments to increase the number of frontline extension workers to at least 33 staff per 10,000 farmers; facilitate farm level access to investment capital through innovative rural financing; improve the logistics of fertilizer distribution; simplify documentation and approval procedures for importation and marketing of fertilizer, herbicides and seed in the region, removing barriers to cross border trade among others.

May 2019 Council of Ministers Summit

During the May 2019 ASARECA Council of Patron Ministers Summit, ministers deliberated among other things on: options of mainstreaming sustainable farming practices to increase the productivity of smallholder systems; practical approaches that support collective action; practical ways of enhancing sustainable access to inputs; and ways of delivering integrated regional markets for agricultural products and inputs. To concretize their deliberations, they signed a joint Communiqué, thus committing their Governments among other things to: implement sound policies that are backed by evidence from agricultural researchers, socio-economists and development workers; implement CASI practices, including practicing minimum tillage, maintaining permanent soil cover and mulches, and implementing crop diversification practices; mainstream CASI through institutionalization efforts that support scaling and networking; integrate agricultural research and extension systems and foster value chains development; support appropriate mechanization to reduce drudgery; and provide political and material support at both national and regional levels to build strong partnerships in regional AR4D flagship programs for scaling of agricultural technologies and innovations.

> ASARECA Council of Patron Ministers Summit deliberated on options for mainstreaming sustainable farming practices to increase productivity of smallholder systems

Mathilde inspecting crops in Rwanda. She was appointed as Head of the National Soybean Programme in Rwanda after her Master's studies.

Building the Capacity of Weaker NARS to Drive Agricultural Research

Burundi
Kenya
Rwanda
Sudan
Uganda

Introduction

A total of 34 young scientists from the national agricultural research institutes of Burundi, Rwanda and Sudan whom ASARECA sponsored in 2008 to undertake Masters degrees in universities in East Africa completed their studies in Plant Breeding, Soil Science, Agricultural Information and Communication Management, Research Methods, Range Management, Agricultural Extension, and Breeding.

The young scientists were well received in their countries. In Rwanda, Burundi and Sudan, for example, the scientists were deployed in strategic positions to help realise the food security visions of the countries.

Through the project, Strengthening Capacity for Agricultural Research and Development in Eastern and Central Africa (SCARDA-ECA), ASARECA teamed up with the Forum for Agricultural Research in Africa (FARA) and the Regional Universities Forum (RUFORUM) to place the students in acclaimed universities in the region.

The students were selected from the Agricultural Research Corporation (ARC) in Sudan, Institut des Sciences Agronomiques du Burundi (ISABU), and Institut des Sciences Agronomiques du Rwanda (ISAR), now Rwanda Agricultural Board.

These countries were chosen following an institutional assessment of the national agricultural research systems conducted through country scoping studies, spear headed by FARA and ASARECA.

The SCARDA scoping study indicated that lack of adequate human resource capacity was a major weakness in delivering research outputs to meet the needs of the poor. In addition, the study outlined priority research areas for the three institutions, which provided the basis for selecting the relevant courses for the MSc students.

Experienced supervisors from Universities and NARIs were identified and attached to the students for continuous technical and professional support.

Additional support provided to the SCARDA students included pre-entry English courses for Francophone students from ISAR and ISABU, which enabled the students to acclimatize to the new environment at the Universities.

The students also received training on proposal writing, scientific writing and publication. They were supported to publish their research work at the end of the studies and establish a network of researchers in the region and beyond with whom they would collaborate.

ASARECA supported the institutionalizing of mentorship in ISAR, ISABU and ARC. SCARDA trained a pool of researchers on the approaches of mentoring, leadership and management, which consequently led to adoption of the mentoring approach in the three institutions.

Similarly, several workshops aimed at integrating the students back into their home institutions were conducted.

The scientists successfully completed their courses in 2010 and returned to their respective countries early 2011. Two years later, ASARECA tracked them to see what contribution they were making to their countries. The following are highlights of their work.

RWANDA

Leonidas Dusengemungu

Leonidas did an MSc in Agricultural Extension and Education at Makerere University, where he was introduced to the innovation platforms of FARA, considered a model for participatory research. When he completed studies in 2010, he was appointed head of outreach in Rwanda Agricultural Board. This placed him at the helm of taking all agricultural and associated technologies to farmers. He was later to be appointed the National Head for the Innovation Platforms.

Gafishi Kanyamasoro

Gafishi did MSc studies in Plant Breeding at Makerere University. After studies, he was appointed as the scientist in charge of maize breeding in Rwanda. His task was to develop inbred lines of maize for all high-altitude areas in Rwanda. Rwanda at the time had an acute shortage of maize breeders.

Cyamweshi Rasangama

He did MSc in Soil Science at Makerere University after which he was appointed a researcher in soil conservation in RAB. He was later appointed the Director of Natural Resources Management and tasked with initiating research in soil conservation and formulating fertilizer use recommendations for priority crops: maize, wheat, rice, potato and beans.

Uwizerwa Mathilde

After her Masters studies, Mathilde was appointed as Head of the National Soybean Programme in Rwanda. This put her at the helm of efforts to produce quality soybean, promote soybean inoculated through farmer field schools and link farmer cooperatives to soybean oil processors.

Maximillan Manzi

After completing an MSc in Range Management at the University of Nairobi in Kenya, Maximillan was appointed Director of Livestock Research and Extension in the Eastern zone.

Wilson Dufitumukiza

After attaining an MSc in Soil Science at Egerton University, Wilson was appointed as Head of the National Tea Research and Extension Programme for Rwanda. This put him at the helm of promoting public–private partnerships to improve tea production and conservation.

BURUNDI

Nepomusecene Ntukamazina

After earning his MSc in Research Methods at Jomo Kenyatta University of Science and Technology, he was appointed in-country representative for Bean Innovations. Over time, he became the Assistant to ISABU Director General in managing a five-year programme funded by the Belgian and Burundian governments worth euro 5 million euros.

Fulgence Niyongabo

Upon return from Makerere University where he attained an MSc in plant Breeding and Seed Systems, Fulgence was appointed team leader for rice research in ISABU. At the time, he said: "I consider myself the most experienced rice scientist in ISABU because I lead a team of the only three researchers and seven technicians."

Michelin Inamahoro

On completing her MSc degree in Plant Breeding and Seed Systems at Makerere University, she was appointed head of the National Biotechnology Laboratories and Screen Houses. Under a project funded by the Belgian Technical Corporation, she was also allocated funds to collect samples of potato countrywide and to characterize samples of taro (colocase) countrywide for diseases and other stress factors.

Cyrille Mbokihankuye

Cyrille was appointed as the Head of the Climate Change Programme in ISABU after attaining an MSc at Sokoine University of Science and Technology in Tanzania.

Gloriose Habonayo

Gloriose did her MSc in Crop Science, specializing in agronomy, at Sokoine University of Science and Technology. She is involved in fruit and legume research and crop–livestock integration in ISABU.

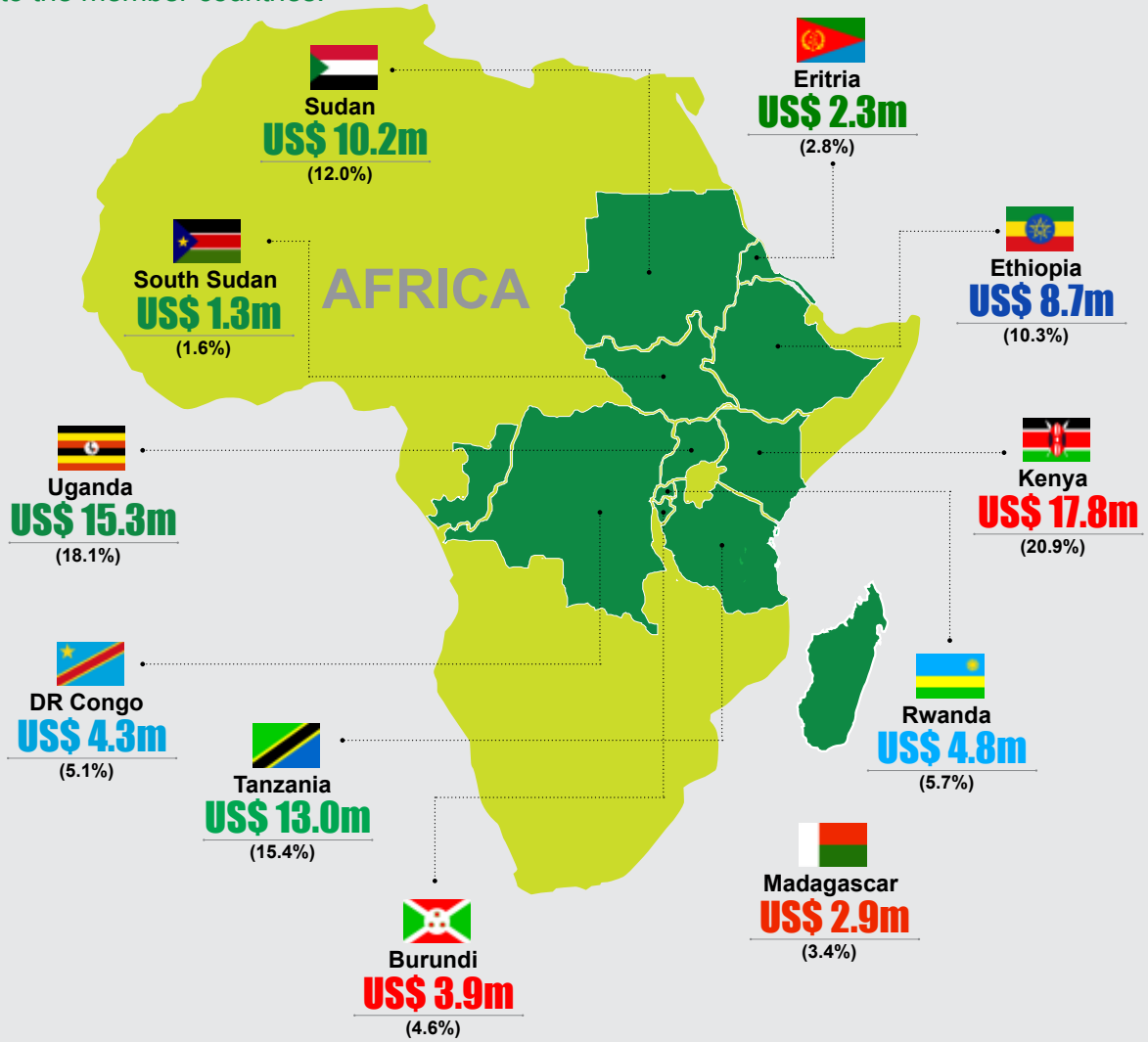
SUDAN

Mayada M. Beshir

Upon completion of her Msc in **Plant Breeding and Seed Systems at Makerere University**, **Uganda,** Mayada noted: "The National Crop Resources Research Institute (NACRRI), where I undertook field research, is probably one of the best research centre in Africa. I gathered lots of knowledge and I met colleagues with whom I am collaborating with in breeding efforts." She returned to the Agricultural Research Corporation (ARC) in Sudan a confident scientist. "I know how to release seeds in all the fields that I studied because of my interaction with the Phd Students."

Contribution to Member Countries

Since inception in 1994, ASARECA has worked with National Agricultural Research Systems (NARS) of its twelve member countries: Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Republic of the Congo, Rwanda, South Sudan, Sudan, Tanzania and Uganda. Between 1994 and 2018, ASARECA mobilized **US$ 131 million** to implement Agricultural Research for Development (AR4D) initiatives in the countries. In addition, ASARECA coordinated the EAAPP programme in five member countries. Below are snapshots of ASARECA contribution to the member countries.



Burundi

Since inception, ASARECA has worked mainly with Institut des Sciences Agronomiques du Burundi (ISABU) and the Ministry of Agriculture to implement AR4D projects. Between 1994 and 2018 ASARECA invested US$ 3.9 million to catalyze agricultural transformation in Burundi through key beneficiary projects highlighted below:

Controlling the spread of Banana Xanthomonas Wilt (BXW): ASARECA supported ISABU to promote proven and cost-effective measures to control the deadly BXW epidemic that caused up to 92% crop loss and affected 72% of the banana farmers in Burundi. Farmers in Cibitoke were trained on how to control the spread of BXW and regain banana production. Within six months of adoption, BXW prevalence reduced from over 90% to less than 5%, while the proportion of farmers who controlled the disease increased from less than 5% to over 60%. After 15 months, banana production recovered from zero percent in some places to over 80%.

Building capacity of scientists to deliver AR4D: As part of enhancing capacity and regional collaboration among scientists, ASARECA sponsored 34 young, mid-level scientists from Rwanda, Burundi and Sudan to undertake leadership and mentorship training, and master's degree studies in various disciplines through the Strengthening Capacity for Agricultural Research and Development in Eastern and Central Africa (SCARDA) project. A total of five scientists in Burundi received Master's degrees, and returned to take up various leadership positions in the ISABU research structure.

Fighting the Maize Lethal Necrosis Virus: ASARECA coordinated seven countries (Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania and Uganda) to fight MLN. In collaboration with CIMMYT, ASARECA supported the countries to adopt integrated and multi-pronged control strategies, including development and use of appropriate management practices, breeding and germplasm development. In Burundi, MLN surveillance was conducted in Ngozi, Kirundo, Ruyigi, Cankuzo, Rutana, Makamba and Cibitoke provinces that border countries with high MLN prevalence. The main virus (MCMV) that causes MLN was detected for the first time in samples from farmers' fields in Cibitoke, leading to testing and validation of seven (7) management practices by ISABU. Majority of the affected farmers have adopted the availed technologies and innovations.

The main virus (MCMV) that causes MLN was detected for the first time in samples from farmers' fields in Cibitoke, leading to testing and validation of seven (7) management practices by ISABU.

Mitigating effects of climate change: Working with researchers from Kenya, Ethiopia, Eritrea, Burundi, Uganda, South Sudan, Madagascar and Rwanda, ASARECA implemented two projects to increase the availability and productivity of water in rain-fed and irrigated farms. The projects built capacity to harness water resources from rain, runoff surface, and ground water at farm, and at the watershed level. In Burundi, the project

was implemented in Muhembuzi (Kirundo) and Kibimba (Gitega) watersheds. Following the transformation of one of the hilly landscapes in the watersheds into agricultural land, the participating farmer groups generated US$ 17,358 from sale of cabbages, onions, amaranths, tomatoes, beans, chicken and fish, besides 592 households reporting improved nutrition levels.

Promoting clean potato planting materials: Research in the early 2000s established that 95 percent of farmers in Eastern and Central Africa were using poor quality tubers riddled with bacterial wilt and viruses, leading to low yields. In response to the challenge, ASARECA in collaboration with the International Potato Center (CIP), supported scientists from ISABU to increase the productivity of Irish Potato through the seed plot technology. The technology involved maximizing the production of disease-free seed tubers using best practices. Farmers who adopted the technology in Bunyengero, Mugongomanga and Muruta, witnessed a production increase from 10 to 30 tons per/ha.

Promoting climbing bean innovations: Following decline in yields and quality of most bean varieties in Rwanda, Burundi and DRC, ASARECA supported researchers from these countries to identify and test the best bean cropping systems. Two systems, namely: intercropping beans with maize stalks (as stakes) and mono-cropping beans using sisal and banana fibre/strings were selected. Extension workers and farmers were trained on best agronomic practices. As a result, beneficiary farmers registered yield increases from 780 to 3,500 kg/ha, while those who intercropped climbing beans with maize realized yield increases from 367 to 2,100 kg/ha compared to farmers who did not use these technologies.

Improving wheat productivity: Despite being a major staple food crop, wheat productivity is marginal in Burundi. To reduce increasing importation of the commodity, ASARECA partnered with International Maize and Wheat Improvement Center (CIMMYT) to support ISABU to pilot productivity measures in Mugongomanga and Muruta communes. Using two new varieties, ISWSN 64 and HRWYT12, six proven wheat management practices and innovations were tested for techniques in sowing, fertilizer application, weeding, harvesting, threshing, and post harvest. As a result, the mean yield at project sites increased from 0.8 to 2.5 t/ha.

Establishing cassava and potato standards for EAC states: Aware of the dual roles of cassava and potato as food security crops and as commodities with high industrial potential, ASARECA in partnership with National Bureaus of Standards of East African Community (EAC) states jointly formulated the East African standards for cassava, seed potato, potato and related products. Eleven (11) rationalized and harmonized standards for cassava and sweet potato were approved by EAC, hence opening up space for structured trade and industrialization of the commodities.

Increasing productivity of pigs: Following reports of the outbreak of Porcine cysticerosis in human beings as a result of consuming pork infected with Teania solium, ASARECA coordinated researchers from International Livestock Research Institute (ILRI), Uganda, Kenya, Tanzania, Burundi and DRC to develop national capacities for surveillance, prevention and control of Teania solium. National Action Plans were developed for control of the disease in the five countries, leading to remarkable control, and increased productivity in the piggery sector.

Support to Policy reform processes: ASARECA supported Burundi institutions to develop a seeds and varieties roadmap leading to the national review to draft changes to the Ministerial Orders, which were then forwarded to the Ministry of Justice for endorsement. Besides, as part of the process towards implementation of the COMESA Biosafety Policy Implementation Plan (COMBIP), ASARECA in 2016 provided technical support to Burundi to review the national seed acts, aligning them with COMESA seed regulations under the Seeds Regulations Implementation Plan (COMSHIP).

Democratic Republic of Congo

The Democratic Republic of Congo is a founding member and one of the 12 constituents of ASARECA. Since inception, ASARECA has worked mainly with Institut National Pour l'Etude et la Recherche Agronomiques (INERA) and the Ministry of Agriculture and Livestock to implement AR4D projects. Between 1994 and 2018, ASARECA invested US$ 4.3 million to catalyze Agricultural transformation in DRC through key beneficiary projects highlighted below:

Controlling the spread of Banana Xanthomonas Wilt (BXW): ASARECA supported INERA to promote proven and cost-effective measures to control the deadly BXW epidemic that threatened to wipe out the banana crop in Rwanda, Burundi, Kenya, Tanzania, Uganda and DRC. Working with INERA, the project established eight macro-propagation units in four sites in DRC, in addition to mother gardens and demonstration plots established in Kayonza and Gisagara districts. The units initially produced over 10,000 clean banana plantlets for distribution to farmers. Within six months of adoption, BXW prevalence reduced from over 90% to less than 5%, while the proportion of farmers who controlled the disease increased from less than 5% to over 60%. After 15 months, banana production recovered from zero percent in some places to over 80%.

Promoting climbing bean innovations: Following decline in yields and quality of most bean varieties in Rwanda, Burundi and DRC, ASARECA supported researchers from these countries to identify and test the best bean cropping systems. Two systems: intercropping beans with maize stalks (as stakes) and monocropping beans using sisal and banana fibre/strings were selected. Extension workers and farmers were trained on best agronomic practices, with the beneficiary farmers registering yield increases from 780 to 3,500 kg/ha, while those who intercropped climbing beans with maize realized yield increases from 367 to 2,100 kg/ha above the farmers who did not use these technologies.

1,000 kg

President Joseph Kabila ordered 1,000 kg of QPM seed for planting on the State Farm, while the Ministry of Environment and Nature Preservation bought 250 kg of seed for QPM multiplication.

Fighting Cassava Brown Streak Disease (CBSD): As part of ensuring regional collaboration, ASARECA supported scientists from Uganda, Kenya, DRC, Madagascar, Rwanda and Burundi to fight CBSD that had wrecked havoc in the region between 2000 and 2011. The losses were estimated at above US$ 100 million. ASARECA led the development of Information Resource Kit used in awareness creation campaigns, and in training of farmers and extension workers on detection of affected materials. Researchers have since developed varieties that are tolerant to CBSD as efforts continue to find varieties that are totally resistant to CBSD.

Increasing productivity of pigs: Following reports of the outbreak of *Porcine cysticerosis* in human beings as a result of consuming pork infected with *Teania solium,* ASARECA coordinated researchers from International Livestock Research Institute (ILRI), Uganda, Kenya, Tanzania, Burundi and DRC to develop national capacities for surveillance, prevention and control of *Teania solium*. National Action Plans were developed for control of the disease in the five countries, leading to remarkable control and increased productivity in the pig sector.

Promoting Quality Protein Maize (QPM)

Following the high incidence of acute child malnutrition, massive illiteracy and high levels of poverty, ASARECA has supported INERA in rapid scaling-up of QPM. This improved variety of maize contains 70-100% more building blocks of proteins than normal maize varieties. Out-scaling initiatives were implemented in the Southern and Central Provinces, with over 40,000 farmers planting QPM for sale as grain and quality seed. In Gandajika, where malnutrition was highest, lactating mothers and malnourished children were exposed to feeding regimes of QPM at organized feeding centres. Within two weeks of feeding, the malnourished babies began to recover, with majority of the breast-feeding mothers reporting increase in breast milk. This led to rapid awareness of QPM within the country.

In May 2012, President Joseph Kabila learnt of the nutritional and income benefits of QPM, and joined researchers in promoting it by allocating 500 hectares of land to INERA to multiply QPM seeds for distribution across the country. Subsequently, the President's office ordered 1,000 kg of QPM seed for planting on the State Farm, while the Ministry of Environment and Nature Preservation bought 250 kg of seed for QPM multiplication.

Children at a feeding centre in Tanzania enjoy QPM porridge

Eritria

Eritrea is a founding member and one of the 12 constituents of ASARECA. Since inception, ASARECA has worked mainly with National Agricultural Research Institute (NARI) and the Ministry of Agriculture to jointly address AR4D challenges in the country. Between 1994 and 2018, ASARECA invested US$ 2.3 million to catalyze agricultural transformation in Eritrea through key beneficiary projects highlighted below:

Sorghum-legume intercrop for food security: ASARECA supported researchers from Eritrea, Uganda and Sudan to increase the productivity of sorghum, legumes and livestock. The project focused on boosting efficient farm production, post harvest handling, value addition and diversification and marketing.

In Eritrea, this project was implemented through NARI, which was supplied with high yielding and striga resistant sorghum varieties and legumes (green gram (Filsan)) from ICRISAT for on-farm evaluation. Farmers, extension staff and scientists were sensitized and their capacity built on best agronomic practices, soil and water conservation practices, techniques for sorghum legume intercrop, seed production, and value addition.

The farmers now enjoy continuous supply of clean water. Using the skills learnt, farmers on their own constructed over 60 check dams and dug about 6,000 *tumbukiza* pits to harvest water and establish woodlots.

As a result, all the 160 farmers who participated in the project activities adopted the variety, which they intercropped with green gram, alongside other practices such as tie-ridges; application of fertilizer; and use of quality seed. Consequently, yields of both green gram and sorghum increased by over 100 percent. Households in the intervention areas reported improved nutritional benefits associated with feeding on green gram, which is rich in protein, magnesium and iron

Promoting pearl millet: ASARECA supported scientists from Eritrea, Sudan, Kenya and Tanzania to develop a profitable cropping system and value-chain for Pearl Millet to enhance its production in the arid and semi arid lands of the sub-region. ASARECA investments boosted the capacity of Eritrea to enhance its genetic resources and address post harvest, utilization, input delivery and marketing constraints.

Following successful implementation of the project, researchers in ASARECA countries in June 2010 endorsed pearl millet as the crop that is most suitable for the semi arid areas.

Response farming to address effects climate change: Due to increasingly unpredictable and erratic onset, quantity, distribution and cessation of rainfall in the sub-region, it has been challenging for farmers to make decisions on when to start land preparation, planting and estimating quantities of seed for planting.

This has affected agricultural productivity, leading to food insecurity. Informed by these trends, ASARECA coordinated Scientists from Eritrea and other member countries to enhance the capacity of smallholders to adapt to variability through response farming innovations. Relevant historical climatic and crop production data was collected and analyzed to map out trends that researchers could use to prepare the farmers to respond to variability.

The project developed and promoted options for tactical decision-making and trained farmers on farm-level water management. The project also built the capacity of researchers to generate and disseminate timely weather advisories and promoted communication systems to disseminate the advisories.

Mitigating effects of climate change

Working with researchers from Kenya, Ethiopia, Eritrea, Burundi, Uganda, South Sudan, Madagascar and Rwanda, ASARECA implemented projects to increase the availability and productivity of water in rain-fed and irrigated farms.

The projects built capacity to harness water resources from the rain, runoff, surface, and ground water at farm, and at the watershed level. In Eritrea, the project was implemented in Amadir and Molqi watersheds in the Sahelian rainfall zone.

Through ASARECA facilitation, researchers from NARI provided technical support to farmers to establish two check dams of (190 m3 and 334 m3) and two terraces (5.4 kms and 9.5m3) to control soil erosion and prevent siltation of Amadir and Molqi dams.

As a result, the farmers now enjoy continuous supply of clean water. Using the skills learnt, farmers on their own constructed over 60 check dams and dug about 6,000 *tumbukiza* pits to harvest water and establish woodlots.

With a reliable source of water established, over 300 farmers planted 1,200 trees to conserve the environment, and adopted *Rhamunus prinoides* and high yielding varieties of sorghum and malt barley. Because of these improvements, farmers in the intervention areas reported improved food security status.

The farmers also reported better income from sales of sorghum, malt barley and Rhamunus prinoides. Realizing the potential of improving livelihoods countrywide through this initiative, the Eritrean government allocated about US$ 68,000 to NARI to scale up project activities.

Other ASARECA supported projects implemented in Eritrea

- Characterization of Production Traits and Establishment of Genetic Potential for Improved Indigenous Sheep and Goats in Eastern and Central Africa.
- Strengthening Regional Germplasm Collection and Forage Seed Production in Eastern and Central Africa.
- Evaluation of Striga Resistant and Drought-tolerant Farmer Preferred Sorghum Varieties.
- Developing Gender Responsive Community Based Low-Cost Tissue Culture for Improved Food Security.
- Fighting Striga: Resistance Genes Deployed to Boost Sorghum Productivity.

Ethiopia

Ethiopia is a founding member and one of the 12 constituents of ASARECA. Since inception, ASARECA has worked mainly with the Ethiopian Institute of Agricultural Research (EIAR) and the Ministry of Agriculture to jointly address AR4D challenges in the country. Over the last 25 years, ASARECA has invested US$ 8.7 million to catalyze Agricultural transformation in Ethiopia through key beneficiary projects highlighted below:

Fighting the Maize Lethal Necrosis (MLN) Virus: ASARECA coordinated the fight against MLN in seven countries (Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania and Uganda). In collaboration with CIMMYT, ASARECA supported these countries to adopt integrated and multi-pronged control strategies, including development and use of appropriate management practices, breeding and germplasm development. The practices included the use of clean and certified seed as well as crop rotation and control of different vectors using different chemical products.

Key activities undertaken in Ethiopia included: generation of information on population dynamics, incidence, survival and migration characteristics; conducting efficacy trials on new and locally available insecticides; studies on insecticide resistance to Fall Army Worm (FAW); and development and popularization of guidelines on insecticide resistance management. Out of the 71 commercial seed samples sent for screening at CIMMYT in Naivasha, Kenya, MLND was detected in 4 out of 26,400 seeds, thus setting the stage for management of MLN in Ethiopia.

High yielding maize varieties: ASARECA supported Ethiopian scientists to introduce high yielding highland maize varieties with grain yields of 9 t/ha (compared to 2.3 t/ha of predominant lowland varieties). Three hybrids (AMH800, AMH850 and AMH851) were released, including one open-pollinated variety (Hora) for the highland zones. Some of the new varieties, including the four hybrids, have a potential yield of 12 t/ha, which is at par with global standards.

Ethiopian scientists introduced high yielding highland maize varieties with grain yields of 9 t/ha (compared to 2.3 t/ha of predominant lowland varieties). Three hybrids (AMH800, AMH850 and AMH851) were released

Ethiopia seed policy harmonization: ASARECA worked with the national partners in Ethiopia to review national seed laws and regulations and to align them to the COMESA seed regulations. ASARECA also provided technical support in the review of national seed acts, aligning them with COMESA seed regulations under the Seeds Regulations Implementation Plan (COMSHIP), as well as in implementation of the COMESA Biosafety Policy Implementation Plan (COMBIP).

Assessing human capacity needs for AR4D: ASARECA has just completed studies in Rwanda, Uganda,

Kenya and Ethiopia to derive credible evidence for human capital and institutional investments to deliver national strategic plans for agricultural transformation. In Ethiopia, three studies were undertaken including: Assessing and forecasting qualitative human capital requirements for agriculture in Ethiopia; interpreting the existing global yield gap atlas data to determine capacity gaps in Ethiopia; and review of NaFSIPs and implementation gaps in Ethiopia. ASARECA intends to use these findings to mobilize resources for capacity strengthening efforts in Ethiopia.

Mitigating effects of climate change

Working with researchers from Kenya, Ethiopia, Eritrea, Burundi, Uganda, South Sudan, Madagascar and Rwanda, ASARECA implemented projects to increase the availability and productivity of water in rain-fed and irrigated farms. The projects built capacity to harness water resources from the rain, runoff, surface, and ground water at farm, and at the watershed level. In Ethiopia, ASARECA worked with EIAR to rehabilitate hills in Adulala and Kechema watersheds, which had long been degraded by human activities leading to accelerated soil erosion and consequently decline in the yields of crops such as teff, wheat, barley, field pea, field bean, haricot bean and maize. The communities were mobilized and sensitized on the benefits of reclaiming the hills through re-vegetation. Over 1,000 farmers benefited from integrated natural resources management techniques, including digging benches to curb runoff and planting 120,000 seedlings of different tree species along fragile hillsides.

Three varieties including the fast maturing and high yielding CR-37 with a capacity of 25kg per hectare were promoted. As a result, over 500 households adopted the water-efficient technologies, leading to the rehabilitation of 1,000 hectares of severely degraded land. Over 500 households have adopted various crop technologies ranging from improved wheat varieties (danfi, kursht-drought resistant variety), malt barley and high value crops (apples) leading to increase in wheat yields by over 80% (from less than 5 quintal/ha before the intervention to 20 to 30 quintal/ha after the intervention). More than 1,200 households previously dependent on relief food are now food secure.

Eastern Africa Agricultural Productivity Project (EAAPP): ASARECA coordinated this regional initiative of the Governments of Ethiopia, Kenya, Tanzania and Uganda. In as much as Ethiopia provided leadership as the Centre of Excellence for Wheat, it still sold over 63,500 doses of livestock semen within the collaborating countries. On the other hand, it received four rice varieties (TXD306, Tai, Komboka and Ziada) from Tanzania (with TXD306 being released); 159 Cassava accessions and botanical seed sprouting technique from Uganda; and elite wheat variety (Kingbird) from Kenya for multiplication and wider dissemination.

A degraded lanscape in Ethiopia

Kenya

Since inception, ASARECA has worked mainly with the Ministry of Agriculture, Kenya Agriculture and Livestock Research Organisation (KALRO), formerly Kenya Agricultural Research Institute (KARI), and universities (Kenyatta, Egerton, and Nairobi). Over the last 25 years, ASARECA has invested US$ 17.8 million to catalyze agricultural transformation in Kenya through key beneficiary projects highlighted below:

Mitigating effects of climate change: Working with researchers from KALRO, ASARECA implemented projects to increase availability and productivity of water in rain-fed and irrigated farms. The projects built capacity to harness water resources from the rain, run-off, surface, and ground water at farm and watershed levels. In Machakos and Makueni, over 1,500 households adopted water-efficient technologies, leading to the rehabilitation of over 5,000 hectares of severely degraded land as well as increased maize yields from 0.5t/ha to 3 t/ha. Over 1,000 households previously dependent on relief food are now food secure. To ensure sustainability, Machakos and Makueni County governments mainstreamed agricultural extension and advisory services, and allocated US$ 40,000 to out-scale availed technologies, respectively.

Out-scaling OFSP (the darling potato): ASARECA supported KALRO to out-scale Orange-fleshed Sweet Potato (OFSP) as a cheaper source of vitamin A for children and breast-feeding mothers (as alternatives to fish, liver, milk and eggs). Three varieties (*Ejumula*, *Kabode* and *Vita*) were promoted on 27 hectares dedicated to multiplication of planting materials. Over 474,000 vines were produced and distributed to farmers in Western Kenya, with over 30 orphanages using OFSP as a nutritional diet. In Busia and Bungoma Counties, farmers earned US$ 20,000 and 17, 000 respectively from sales of vines.

Over 474,000 potato vines were produced and distributed to farmers in Western Kenya, with over 30 orphanages using OFSP as a nutritional diet. In Busia and Bungoma Counties, farmers earned US$ 20,000 and 17, 000 respectively from sales of vines

Controlling the spread of Banana Xanthomonas Wilt (BXW): ASARECA supported KALRO to promote proven and cost-effective measures to control the deadly BXW epidemic that threatened to wipe out the banana crop in Rwanda, Burundi, Tanzania, DRC, Uganda and Kenya between 2005 to 2010. Six hardening nurseries, 10 demonstration plots and 10 macro-propagation units were installed at the BXW hotspots. Within six months of adoption, BXW prevalence reduced from over 90% to less than 5%, while the proportion of farmers who controlled the disease increased from less than 5% to over 60%. After 15 months, banana production recovered from zero percent in some places to over 80%.

Genetic modification of maize for drought tolerance: ASARECA in collaboration with Kenyatta University supported a team of young scientists from Sudan, Ethiopia, Tanzania and Kenya to undertake PhD research that focused on inserting drought tolerance genes into local maize varieties (sourced from Ethiopia (2), Kenya (3), Sudan (2), and Tanzania (2). The scientists successfully transformed nine transgenic maize lines with drought resistant genes that were bulked awaiting confined field trials in participating countries.

Fighting Cassava Brown Streak Disease (CBSD): ASARECA supported scientists from Uganda, Kenya, DRC, Madagascar, Rwanda and Burundi to fight CBSD that had wrecked havoc in the region, with losses estimated at above US$ 100 million. This led to the development of Information Resource Kit used in awareness creation campaigns, and in training of farmers and extension workers on detecting affected materials. Breeders in Kenya developed CBSD tolerant varieties that have been availed to farmers.

Introducing mixed crop livestock innovations: ASARECA supported KALRO to improve efficiency and quality of production for crops and livestock in semi-arid lands of Wote, Machakos and Wamunyu. Increased fodder availability by 50%, and crude protein content by 20% was recorded through inter-cropping Napier grass with forage legume *(Centrosema pubescens)*. Similarly, feeding livestock with new fodder mixture increased feeding efficiency by 30% and milk yield by 65%. Vegetable yields and household income grew by 500% and 66% respectively. Overall, 8,000 farmers benefited from the project.

Establishing cassava and potato standards for EAC states: Aware of the dual roles of cassava and potato as food security crops, and as commodities with high industrial potential, ASARECA in partnership with National Bureaus of Standards of East African Community (EAC) states jointly formulated the East African standards for cassava, seed potato, potato and related products. Eleven (11) rationalized and harmonized standards for cassava and sweet potato were approved by EAC, hence opening up space for structured trade and industrialization of the commodities. Motivated, KIWAFA and Uwezo Mashambani farmer groups initiated procedures towards acquiring the Kenya Bureau of Standards quality mark and bar code for potato crisp export.

Eastern Africa Agricultural Productivity Project (EAAPP): ASARECA coordinated this regional initiative of the Governments of Ethiopia, Kenya, Tanzania and Uganda. Kenya provided leadership as the Centre of Excellence for Dairy. Through ASARECA's collaboration, Kenya sold over 3 million doses of livestock semen, and received the following technologies from collaborating countries: Descriptions of livestock cross-breeding practices from Uganda; four rice varieties (TXD306, Tai, Komboka and Ziada) from Tanzania (and officially released Komboka and TXD306); improved cassava varieties including elite materials tolerant to CBSD from Tanzania; quality management protocols for multiplying clean cassava materials from Uganda; virus diagnostic procedures from Uganda; 951 lines of bread-wheat from Ethiopia (72 elite lines are in advanced trials for release).

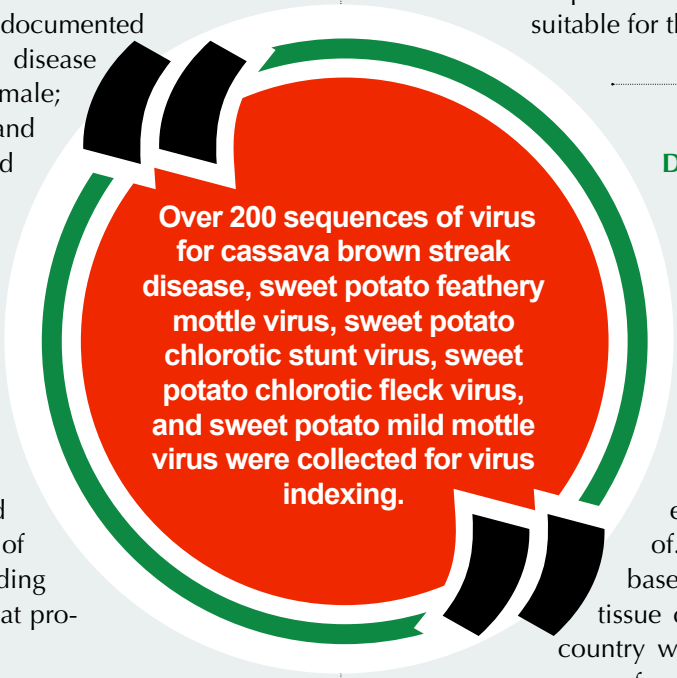
Promoting Napier grass as key livestock feed: Through the Napier grass smut and stunt disease resistance project, ASARECA coordinated researchers from Uganda, Kenya and Tanzania to help farmers adopt superior resistant clones alongside management practices to mitigate the spread of the diseases. Tolerant clones, management practices and molecular diagnostic tools were developed, validated and disseminated for regular testing. This led to reduction to disease incidence and milk production in the countries

Madagascar

Since inception, ASARECA has worked mainly with Canter National de Recherche Appliquee au Developpement Rural (FOFIFA) and the Ministry of Agriculture, Livestock and Fisheries to jointly address AR4D challenges in the country. Between 1994 and 2018, ASARECA invested US$ 2.9 million to catalyze agricultural transformation in Madagascar through key beneficiary projects highlighted below:

Controlling tick-borne diseases: ASARECA supported experts on tick-borne diseases from six countries (Uganda, Kenya, Tanzania, Burundi, Sudan and Madagascar) to develop, validate and promote appropriate technologies to control tick and tick-borne diseases in pastoral and agro-pastoral farming systems. The experts conducted epidemiological studies; identified management options for different livestock production systems; and documented best-bet practices for the disease control. Thirty-five (30 male; 5 female) veterinarians and technicians were trained in tick ecology, data collection, sample preservation, and proper use of acaricides, among others. In addition, 120 farmers were trained in disease diagnosis and the use of acaricides. As a result, farmers in the intervention areas registered unprecedented reduction of tick-borne infestation, leading to increased dairy and meat production.

Promoting pearl millet: ASARECA supported scientists from Eritrea, Sudan, Kenya and Tanzania to develop a cropping system and value-chain to enhance the production of pearl millet in the arid and semi arid lands of the sub-region. This investment boosted the capacity of the Institution to enhance its genetic resources and address post harvest losses, input delivery and marketing constraints. Following successful implementation of the project, researchers in ASARECA countries endorsed pearl millet as the crop that is most suitable for the semi arid areas.



Delivery of clean planting materials: In an effort to reduce disease infestation of cassava, sweet potatoes and banana, ASARECA supported researchers in Madagascar to apply tissue culture interventions for mass production of disease-free planting materials of. Through this initiative, a baseline study of the status of tissue culture applications in the country was conducted, while virus sequences for cassava and sweet potato virus were collected. Over 200 sequences of virus for cassava brown streak disease, sweet potato feathery mottle virus, sweet potato chlorotic stunt virus, sweet potato chlorotic fleck virus, and sweet potato mild

Researchers in ASARECA countries endorsed pearl millet as the crop that is most suitable for the semi arid areas.

mottle virus were collected for virus indexing. As a result, FOFIFA produced clean cassava and sweet potato tissue culture materials for national breeding, rapid multiplication and dissemination to farmers. These efforts helped to keep the major diseases at bay, thus increasing productivity for cassava, potato and banana.

Mitigating effects of climate change

Working with researchers from Kenya, Ethiopia, Eritrea, Burundi, Uganda, South Sudan, Rwanda and Madagascar, ASARECA implemented projects to increase the availability and productivity of water in rain-fed and irrigated farms. The projects built capacity to harness water resources from rain, runoff, surface, and ground water at farm for drip and supplemental irrigation, and at the watershed level. In Madagascar, the project was implemented in Avaratrambolo, Manjakandriana, Ankazomiriotra, and Betafo–Antsirabe districts, which are characterized by high growth of population, expansion of agriculture into fragile lands, high levels of land degradation and poor harnessing of available water. The project promoted the use of: improved rice varieties; harrowing in land preparation; seedlings instead of direct sowing; and recommended quantities of fertilisers.

As a result of the adoption of improved rice varieties (such as x265), yields increased from 0.5t/ha to 4 t/ha, while onion yields increased from 10 to 25 t/ha due to prudent management of water and other inputs. Farmers adopted CSA innovations to stop the over 20% harvest losses associated with dry spells and land degradation. As a result, communities in the watersheds are now 60% food-secure and are able to earn about US$ 2,500 per ha per year from the sale of onions and potatoes the during off-season. As a means of sustaining the project, the Water, Sanitation and Hygiene Ministry provided funding to further improve water access in Avaratrambolo watershed, which is anticipated to serve over 600 people.

Rwanda

Since inception, ASARECA has worked mainly with Rwanda Agricultural Board (RAB), formerly Institut des Sciences Agronomiques du Rwanda (ISAR), University of Rwanda and Kigali Institute of Science and Technology to jointly address AR4D challenges in the country. Between 1994 and 2018, ASARECA invested US$ 4.8 million to catalyze agricultural transformation in Rwanda through key flagship projects highlighted below:

Building capacity of Rwanda scientists to deliver AR4D: ASARECA in 2008 sponsored 34 young, mid-level scientists from Rwanda, Burundi and Sudan to undertake leadership and mentorship training, and master's degree studies in various disciplines through the Strengthening Capacity for Agricultural Research and Development in Eastern and Central Africa (SCARDA) project. A total of six scientists in Rwanda received Master's degrees, and returned to take up various leadership positions in the ISAR/RAB research structure.

Promoting banana productivity and value addition: Working with RAB and the Kigali Institute of Science and Technology, ASARECA facilitated efforts to increase productivity and profitability in the banana value chain by promoting use of clean planting materials and improvements in banana processing by Rwandan cooperatives. Specifically, COPROVIBA, a farmer cooperative, benefited from this project and improved its capacity to handle up to 4 tons of banana weekly.

Within six months of adoption, BXW prevalence reduced from over 90% to less than 5%, while the proportion of farmers who controlled the disease increased from less than 5% to over 60%.

Controlling the spread of Banana Xanthomonas Wilt (BXW): ASARECA supported RAB to promote proven and cost-effective measures to control the deadly BXW epidemic that threatened to wipe out the banana crop in Rwanda, Burundi, Kenya, Tanzania, DRC and Uganda. Through RAB, ASARECA mobilized and supported Rwandan communities from 26 BXW hotspots in Gisagara and Kayonza to establish sources of clean planting materials. Within six months of adoption, BXW prevalence reduced from over 90% to less than 5%, while the proportion of farmers who controlled the disease increased from less than 5% to over 60%. After 15 months, banana production recovered from zero percent in some places to over 80%.

Mitigating effects of climate change: Working with researchers from Kenya, Ethiopia, Eritrea, Burundi, Uganda, South Sudan, Madagascar and Rwanda, ASARECA implemented projects to increase the availability and productivity of water in rain-fed and irrigated farms. The

projects built capacity to harness water resources from rain, runoff, surface, and ground water at farm, and at the watershed level. As a result, over 500 households adopted water-efficient technologies, leading to a rehabilitation of over 5,000 hectares of severely degraded land. Over 1,000 households previously dependent on relief food are now food secure.

Promoting clean potato planting materials: Research in the early 2000s established that 95 percent of farmers in Eastern and Central Africa were using poor quality tubers riddled with bacterial wilt and viruses leading to low yields. In response to the challenge, ASARECA in collaboration with International Potato Center (CIP), supported scientists from RAB to increase the productivity of Irish Potato through the seed plot technology. The technology involved maximizing production of disease-free seed tubers using best practices. Farmers who adopted the technology witnessed a production increase from 10 to 30 tons per/ha.

Promoting climbing bean innovations: Following decline in yields and quality of most bean varieties in Rwanda, Burundi and DRC, ASARECA supported researchers from Rwanda, Burundi and DRC to identify and test the best bean cropping systems. Two systems, namely intercropping beans with maize stalks (as stakes), and monocropping beans using sisal and banana fibre/strings were selected. Extension workers and farmers were trained on best agronomic practices, with the beneficiary farmers registering yield increases from 780 to 3,500 kg/ha, while those who intercropped climbing beans with maize realized yield increases from 367 to 2,100 kg/ha.

Improving wheat productivity: Despite being a major staple food crop in Rwanda, the productivity of wheat is marginal, leaving the demand gap to be met through imports. To close the gap, ASARECA in partnership with the International Maize and Wheat Improvement Center (CIMMYT) supported RAB to assess technology adaptability in Kinigi, Rwerere and Nyamagabe Research Stations. Subsequently, fields of improved varieties (*Njoro BW2, Chozi,Simba, EN161* and *EN48*) were established, while demonstration plots were established in Butaro and Mukura to evaluate promising technologies. The smallholder wheat farmers who adopted these varieties registered increased productivity from 2 to 2.8 tons/ha.

Establishing cassava and potato standards for EAC states: Aware of the dual roles of cassava and potato as food security crops and as commodities with high industrial potential, ASARECA in partnership with National Bureaus of Standards of East African Community (EAC) states jointly formulated the East African standards for cassava, seed potato, potato and related products. Eleven (11) rationalized and harmonized standards for cassava and sweet potato were approved by EAC, hence opening up space for structured trade and industrialization of the commodities. Rwanda realized the potential of cassava and established the Kinazi Cassava Plant, which has promoted the "Made in Rwanda" high quality cassava flour footprint on the global market.

Policy reforms in the seed sector: ASARECA incorporated Rwanda into the Seed Regional Working Group (SRWG), which championed the analysis of the entire sector and recommended actions to ensure a vibrant and transformative seed industry. This led to the formation of Eastern Africa Seed Committee (EASCOM), and subsequently to the harmonisation of Certification Standards and Procedures, Q-List, Variety Catalogue, harmonisation of Import and Export Procedures. These efforts informed the evolution of Rwanda's Seed Policy, its alignment with COMESA Seed regulations and subsequently becoming law in 2016. ASARECA also spearheaded efforts to establish and strengthen national seed trade associations in Rwanda, leading to the birth of the Seed Trade Association of Rwanda (STAR).

South Sudan

South Sudan was enjoined to the ASARECA family in 2011 by the First ASARECA General Assembly. Since then, ASARECA has worked mainly with the Ministry of Agriculture, Forestry, Cooperatives and Rural Development to jointly address AR4D challenges in the country. Between 2011 and 2018, ASARECA invested US$ 1.3 million to catalyze agricultural transformation in South Sudan through key beneficiary projects highlighted below:

Up scaling adoption of NERICA rice: ASARECA supported researchers from South Sudan and Uganda to enhance productivity, value addition, and competitiveness of smallholder NERICA rice production systems in the post conflict areas of Northern Uganda and South Sudan. In South Sudan, it was promoted in Morobo and Yei counties. The project established innovation platforms for upscaling NERICA innovations through participation.

NERICA rice was promoted in Northern Uganda and South Sudan in Morobo and Yei counties.

The multi-stakeholder platforms comprised members from the Ministry of Agriculture, Forestry, Cooperatives and Rural Development; Agricultural extension Department; Millers; NGOs; Farmers; Traders; Community leaders; Commissioners for Agriculture; Seed companies and Japan International Corporation Agency among others. The project established commercial supply and distribution systems in which farmers were contracted to produce the seeds. An analysis of both seed and grain production and supply chains was conducted and priority constraints identified and addressed.

A total of 1,200 value chain actors were trained on production, processing and marketing of the new technologies. Demonstration sites were established in Yei and Morobo for training potential seed growers and rice farmers on best agronomic practices.

On-station upland rice trials of twenty (20) varieties including NERICA 1, 4 and 10 alongside preferred local varieties showed that NERICA flowers much earlier and yields higher than the local varieties. By the end of the project, NERICA varieties were due to be released into the national seed system.

Farmers in Morobo produced a total of 7.6 MT of Quality Declared Seed (QDS); while those in Yei produced 3 MT. As a result of the interventions, the farmers reported increased incomes with which they paid school fees for their children; bought livestock (cows and goats), motor cycles, cars, quality seed and rice threshers among others.

Farmers in Morobo produced a total of 7.6 MT of Quality Declared Seed; while those in Yei produced 3 MT. As a result of the interventions, the farmers reported increased incomes with which they paid school fees for their children, bought livestock, motor cycles, quality seed and rice threshers.

Confronting maize Lethal Necrosis Disease (MLN): Following the outbreak of the Maize Lethal Necrosis (MLN) disease in the region, ASARECA supported South Sudan researchers to control the spread of the disease in the country. As part of this support, surveys were conducted in the major maize-growing areas of Magwi and Torit Counties in the Eastern Equatoria State; and Ikotos and Juba Counties in the Central Equatoria State, which confirmed the presence of the disease. The surveys also established disease distribution, and information on indigenous knowledge and other coping strategies that farmers were using to manage the disease. As a result, South Sudan research teams assembled and sent 12 types of maize germplasm for screening at the CIMMYT MLN facility in Naivasha, Kenya. The teams are in the process of increasing seed of selected hybrids and of open pollinated varieties with tolerance to MLN.

Sudan

Sudan is a founding member and one of the 12 constituents of ASARECA. Since inception, ASARECA has worked mainly with Agricultural Research Corporation (ARC) and the Ministry of Science and Technology to jointly address AR4D challenges in the country. Between 1994 and 2018, ASARECA invested US$ 10.2 million to catalyze agricultural transformation in Sudan through key beneficiary projects highlighted below:

Building capacity of scientists to deliver AR4D: ASARECA in 2008 sponsored 34 young, mid-level scientists from Rwanda, Burundi and Sudan to undertake leadership and mentorship training, and master's degree studies in various disciplines through the Strengthening Capacity for Agricultural Research and Development in Eastern and Central Africa (SCARDA) project.

Two (2) scientists from ARC were supported through this project and received Master's degrees in Plant Breeding and Seed Systems from Makerere University.

The students carried out research in areas that were deemed relevant for their country.

Such areas included development of molecular markers for introgression of resistance to turcicum leaf blight in sorghum and mapping of genes associated with striga resistance in sorghum. Both students were mentored and had an opportunity to use advanced laboratory facilities for their research.

In 2012, Sudan released four out of the 51 lines of striga-resistant sorghum varieties (ASARS1, ASARS2, ASARS3, and ASARS4), with yield potential of up to 3.6t/ha. These new varieties with barriers to striga, have been widely disseminated to farmers in Sudan and are performing well.

Controlling tick-borne diseases: In 2009, ASARECA implemented a project to support tick-borne disease experts from Uganda, Kenya, Tanzania, Burundi, Madagascar, Sudan and Madagascar to develop, validate and promote appropriate technologies for the control of tick-borne diseases in pastoral and agro-pastoral farming systems. Experts from Sudan, conducted epidemiological studies; identified management options for different livestock production systems; and documented best-bet practices for ticks and tick-borne disease control.

Thirty male and five female veterinarians and technicians were trained in tick ecology, survey, collection, preservation, identification, diagnosis, prevention, control, and proper use of acaricides. Over 150 farmers benefited from training in tick-borne disease diagnosis and the use of acaricides. As a result, farmers in the intervention areas registered unprecedented reduction of tick-borne infestation, leading to increased dairy and meat production.

Promoting pearl millet: ASARECA supported scientists from Eritrea, Sudan, Kenya and Tanzania to develop a profitable cropping system and value-chain for pearl millet in order to enhance its production in the arid and semiarid lands of the sub-region. ASARECA invested in boosting the capacity of Sudan to enhance its genetic resources as well as addressing post harvest handling, utilization, input delivery and marketing constraints. As a result, pearl millet production was boosted through use of improved varieties, best bet agronomic practices including water and soil conservation. Following successful implementation of the project, researchers in the sub region endorsed pearl millet as the crop that is most suitable for the semi arid areas in June 2010.

Mitigating effects of climate change: Working with researchers from Sudan, ASARECA implemented projects to increase the availability and productivity of water in rain-fed and irrigated farms. The projects built capacity to harness water resources from the rain, runoff, surface, and ground water at farm and watershed levels. The project was able to improve the productive performance of sheep significantly in one of the project sites in the Western Sudan Sandy Plains, through strategic feeding, thereby improving livelihoods of the target families. Up to 300 farmers in the target sites adopted the agricultural water productivity innovations.

Fighting Striga (witch weed) for improved food security

Sorghum is the second most important staple crop in Eastern and Central Africa. Prior to ASARECA's intervention in 2008, which focused research efforts to controlling the spread of Striga, over 17,000 ha of sorghum had been infested by the weed, leading to yield losses of up to 2.3 million metric tons annually. ASARECA supported and coordinated scientists from Agricultural Research Corporation of Sudan (ARC), University of Nairobi, the National Agricultural Research Institute of Eritrea, the Rwanda Agricultural Board, and the International Centre for Agricultural Research in Arid and Semi Arid Tropics (ICRISAT) to develop striga-resistant sorghum lines. Led by ARC, the researchers used biotechnology, reputed for its precision and effectiveness in breeding. The process involved backcrossing a donor striga-resistant sorghum line N13 and three farmer-preferred sorghum cultivars—Tabat, Wad Ahmed and AG-8, that were susceptible to striga.

As a result, the government of Sudan in 2012 released four out of the 51 lines of striga-resistant sorghum varieties (ASARS1, ASARS2, ASARS3, and ASARS4, with yield potential of up to 3.6 tonnes per hectare). These new varieties with barriers to striga, have been widely disseminated to farmers in Sudan and are performing well. Besides, ASARECA facilitated movement of the striga resistant varieties to Uganda, Kenya, Tanzania and Rwanda where adaptability trials were carried out. The adoption of the varieties in Sudan and the entire ASARECA region is a major milestone towards restoring the productivity of sorghum and getting 300 million people in Eastern and Central Africa (ECA) out of hunger.

Tanzania

Tanzania is a founding member and one of the 12 constituents of ASARECA. Since inception, ASARECA has worked mainly with the Division of Research and Development, constituent NARIs and the Ministry of Agriculture, among others, to jointly address AR4D challenges in the country. Between 1994 and 2018, ASARECA invested US$ 13.0 million to catalyze agricultural transformation in Tanzania through key beneficiary projects highlighted below:

Controlling the spread of Banana Xanthomonas Wilt (BXW): ASARECA supported researchers from Tanzania to promote proven and cost-effective measures to control the deadly BXW epidemic that threatened to wipe out the banana crop in the country. In Muleba district, researchers deployed disease eradication approaches, including propagation of clean planting materials and trained farmers on how to detect and control the disease. Since then, the committees monitor the compliance of households to control measures. Within six months of adoption, BXW prevalence reduced from over 90% to less than 5%, while the proportion of farmers who controlled the disease increased from less than 5% to over 60%. After 15 months, banana production recovered from zero percent in some places to over 80%.

Within six months of adoption of innovations promoted through ASARECA, BXW prevalence reduced from over 90% to less than 5%, while the proportion of farmers who controlled the disease increased from less than 5% to over 60%.

Introducing mixed crop livestock innovations: ASARECA supported scientists in National Livestock Research Institute (NLRI) in Tanzania to work with farmers to improve efficiency and quality of crops and livestock production. In Ilemela and Nyagagana, a feeding ration comprising maize bran and cotton seed cake with 75% energy, 20% protein and 5% mineral content was produced. The ration led to significantly higher milk yield per animal per day than any other ration tested in the project and was therefore quickly promoted to 3,100 beneficiaries. As a result, farmers reported an increase in income from US$1,00 to 1,600 when cows were supplemented with the blocks. In addition, farmers realized increased fodder availability by 50%, and crude protein content by 20% through inter-cropping Napier grass with forage legume (Centrosema pubescens). Feeding livestock with the new fodder mixture increased feeding efficiency by 30%. The fodder yields increased by 22%, milk yield (65%), vegetable yield (500%) and household income (66%).

Establishing cassava and potato standards for EAC states: ASARECA in partnership with the National Bureaus of Standards of the East African Community (EAC) states coordinated the formulation of the East African standards for cassava, seed potato, potato and related products. As a result,

11 rationalized and harmonized standards for cassava and sweet potato were approved by the EAC in 2010, hence opening up space for structured trade and industrialization of the commodities. The Standards are anticipated to stimulate the emergence of value addition and processing initiatives for both the local and export markets.

Clean planting materials: In an effort to reduce disease infestation of potato, cassava and other staple crops, ASARECA supported researchers in Tanzania to apply tissue culture interventions for mass production of disease-free planting materials of cassava, sweet potatoes and banana. New laboratories, mainly for tissue culture were built and old ones were refurbished, technicians were recruited and trained, thus reducing the cost of production of tissue culture plantlets by 40%. Over 200 farmers benefitted from this initiative.

Controlling Napier smut and Napier stunt diseases: Following the outbreak of Napier smut and Napier stunt diseases, ASARECA coordinated researchers from Uganda, Kenya and Tanzania to quantify the incidence of the diseases in the region. Consequently, scientists developed tolerant clones and molecular diagnostic tools to identify the diseases. In Tanzania, ASARECA provided additional support to researchers to scale up adoption superior Napier clones by farmers using recommended management practices. As a result, there was a reduction of disease incidence by up to 35%, and increase in milk production by over 40%.

Eastern Africa Agricultural Productivity Project (EAAPP): ASARECA coordinated this regional initiative of the Governments of Ethiopia, Kenya, Tanzania and Uganda. Tanzania provided leadership as the Regional Centre of Excellence for rice, thus bringing together 128 researchers to work on 33 regional projects. Through ASARECA's coordination, Tanzania sold over 676,436 doses of livestock semen within EAAPP countries. On the other hand, Tanzania received: A livestock breed survey tool and Nine Napier grass collections from Kenya; and protocols for quality management, virus diagnostic procedures and cassava-processing equipment.

Promoting Quality Protein Maize (QPM): ASARECA supported Tanzania in rapid scaling-up of QPM. This improved variety of maize containing 70-100% more building blocks of proteins than normal maize varieties. Two varieties (Lishe K1 and TAN H611) were promoted, alongside crop management and post harvest handling practices. Over 80% of the farmers adopted these varieties, leading to improved nutrition and income. Value addition has been promoted, including use of QPM recipes in cakes, samosas, biscuits and salads.

Delivering high yields through irrigation innovations: ASARECA is supporting the National Irrigation Commission, Sokoine University and Arusha Technical Institute to facilitate 1,200 households in Buigiri, Kiwere and Msolwa-Ujamaa Irrigation Schemes to promote the use of soil moisture and nutrient measuring tools. The farmers use these tools to make decisions on when to irrigate and add nutrients to the soil. The project has so far supplied about 4 Wi-Fi readers, installed 80 chameleon sensor arrays and 55 Wetting Front Detectors to farmers' fields. This has reduced the frequency of irrigation from six times a week before the intervention to only two times. This in turn has reduced conflicts over water, which is attributed to increased availability of water; improved household incomes; increased yields; new jobs and improved food security. As a result of applying the new knowledge, farmers are now able to save time for other activities such as grazing livestock or work in factories.

Uganda

Since inception, ASARECA has worked with the National Agricultural Research Organisation (NARO) and a number of Ugandan institutions, including Universities (Makerere, Mbarara, and Gulu); and the Ministry of Agriculture, Animal Industry and Fisheries. Between 1994 and 2018, ASARECA has invested US$ 15.3 million to catalyze agricultural transformation in Uganda through key flagship projects highlighted below:

Fighting Cassava Brown Streak Disease (CBSD): ASARECA supported scientists from Uganda to fight CBSD that had wrecked havoc in the region between 2000 and 2011. The losses were estimated at above US$ 100 million. Up to 25 districts in Uganda were affected, with Luweero, Busia, Pallisa, Wakiso, Mukono, and Kaberamaido being the hotspots. ASARECA led the development of Information Resource Kit used in awareness creation campaigns, and in training of farmers and extension workers on detection of affected materials. Researchers have since developed varieties that are tolerant to CBSD as efforts continue to find varieties that are totally resistant to the disease.

Establishing cassava and potato standards for EAC states: ASARECA in partnership with the National Bureaus of Standards of the East African Community (EAC) states coordinated the formulation of the East African standards for cassava, seed potato, potato and related products. As a result, 11 rationalized and harmonized standards for cassava and sweet potato were approved by the EAC in 2010, hence opening up space for structured trade and industrialization of the commodities. As a result of this breakthrough, Popular Kumi Women Initiative (PKWI) cooperative (with 2,500 farmers) collaborated with Cassava Adding Value for Africa (CAVA-Uganda) and started producing high quality cassava flour that was sold to confectionaries in Kampala, while Makerere University's Department of Food Science and Technology currently makes cassava chips for local and export markets.

ASARECA supported Ugandan scientists to introduce high yielding highland maize varieties with grain yields of about 9 t/ha. Some of the new varieties, including four hybrids, have a potential yield of 12 t/ha, which is at par with global standards.

Introducing mixed crop livestock innovations: ASARECA supported scientists from NARO to work with farmers in improving efficiency and quality of production for crops and livestock. As a result, farmers in Masaka and Kumi districts realized increased fodder availability by 50%, and crude protein content by 20% through inter-cropping Napier grass with forage legume (*Centrosema pubescens*). Feeding livestock with the new fodder mixture increased feeding efficiency by 30%. Following the provision of 35,000-litre water-harvesting tanks to each of selected 24 farmers, water availability increased by 46%; the area under

forage production increased by 134%; and fodder quantity increased by 76%. Consequently, milk yields increased by 80%, leading to a 52.4% increase in household income.

High yielding maize varieties: ASARECA supported Ugandan scientists to introduce high yielding highland maize varieties with grain yields of about 9 t/ha (representing an exponential growth compared to 2.3 t/ha of lowland varieties that are predominant in the country). Some of the new varieties, including four hybrids, have a potential yield of 12 t/ha, which is at par with global standards.

Controlling Banana Xanthomonas Wilt (BXW): ASARECA supported Uganda in the promotion of proven and cost-effective measures against BXW that threatened to wipe out banana crop in the country. Deployment of disease eradication approaches, including propagation of clean planting materials led to increased production from less than 5% at the start of the epidemic to over 60%. Farmers from the affected districts of Bushenyi, Ntungamo and Mbarara recovered production from zero to over 60%, and currently earn at least US$ 450 per month, up from only US$ 30 during infestation.

Promoting Quality Protein Maize (QPM): ASARECA supported NARO in rapid scaling-up of QPM. Two varieties (Longe 5 and Salongo) were promoted, alongside crop management and post harvest handling practices in Lira and Gulu districts where acute malnutrition was predominant following the over two decades of the Lord's Resistance Army war. Over 80% of the farmers adopted these varieties, leading to improved nutrition and income.

Fighting Striga (witch weed): ASARECA supported and coordinated a team of scientists from Sudan, Kenya, Eritrea, Rwanda and Uganda to develop striga-resistant sorghum lines using biotechnology. The joint research efforts led to the release of four out of the 51 lines of striga-resistant sorghum varieties with mechanical barriers to striga in Sudan. Given that the released lines are capable of yielding up to 3.6 tons/ha, ASARECA facilitated the movement of these released varieties to Uganda, Kenya, Tanzania and Rwanda where adaptability trials were carried out. In Uganda, the 36 lines were tested at the National Semi-Arid Research Institute (NaSARRI) for striga resistance, farmer acceptance and colour. The farmers have already adopted the selected varieties.

Mitigating effects of climate change: ASARECA facilitated and coordinated water-efficient projects in rain-fed and irrigated farming systems. The projects built capacity to harness the use of water resources, including rainwater, runoff, surface and ground water at farm, and at watershed levels in Kumi (Ongino), Mbale (Bunghoko), and Tororo (Kwapa) districts. Over 5,000 hectares of severely degraded land was rehabilitated, thus increasing water availability for agriculture. Farmers in Ongino, Bunghoko and Kwapa districts planted 18,600 trees, and established 780 water trenches on farmers' plots.

Eastern Africa Agricultural Productivity Project (EAAPP): ASARECA coordinated this regional initiative of the Governments of Ethiopia, Kenya, Tanzania and Uganda. Uganda provided leadership as the Centre of Excellence for cassava, thus bringing together 128 researchers to work on 33 regional projects. Through ASARECA's collaboration, Uganda sold over 40,000 doses of livestock semen within EAAPP countries. On the other hand, ASARECA facilitated the transfer of the following technologies from other countries to Uganda: 300 straws of high quality Ayrshire breed semen from Kenya; nine Napier grass collections from Kenya; four rice varieties (TXD306, Tai, Komboka and Ziada) from Tanzania; elite cassava materials tolerant to CBSD from Tanzania; 951 lines of bread-wheat from Ethiopia; and nine improved cassava varieties from Tanzania (already released in Uganda).

ASARECA work with the RECs (COMESA & EAC)

ASARECA's relationship with the Regional Economic Communities (RECs) dates back to 1999 when ASARECA started joint initiatives with the RECs to rationalize and harmonize policies, laws, regulations and procedures for key agricultural sectors mainly in COMESA and the EAC. Initiatives on seed policy started in 1999; engagements on dairy policy and biosafety work was initiated in 2004; while work on commodity standards started in 2006 and continued through to 2013. Some of the key flagship projects are highlighted below:

Rationalization and Harmonization of Policies, Laws, Regulations and Procedures for Key Agricultural Sectors in ECA Project

Under the policy Rationalization and Harmonization initiative, ASARECA established several platforms including the Eastern Africa Seed Committee (EASCOM) and the Eastern Africa Dairy Regulatory Authorities Council (EADRAC) to work with the East African Community to rationalize and harmonize policies, laws and regulations in the dairy, seed and root crops sectors in the Eastern and Central Africa region (ECA). By 2002, the technical agreement spearheaded by EASCOM on seed trade policy had been approved at EAC level between Kenya, Tanzania and Uganda.

Through ASARECA support, EASCOM developed the first edition of the regional variety catalogue in April 2004. The list covers regional varieties for common bean, climbing bean, maize, pigeon pea, sorghum, sunflower and wheat released in at least two EAC countries.

Other ASARECA member countries later acceded to the agreement in principle. The agreement specified policy reforms, which included changes in law, procedures or institutions in the areas of variety evaluation and release, plant variety protection, phytosanitary measures, export and import procedures and documentation, and seed certification. The agreement has informed revision of national seed laws and regulation in the region, which has improved the flow of seed to farmers within and between countries. As part of this initiative, national seed trade associations were established and/or strengthened as a mechanism for enhancing the role of private seed companies in shaping seed policy and trade.

COMESA Seed Trade Harmonization Regulations

Milestones achieved under EASCOM were presented to the COMESA Ministers of Agriculture in Victoria Mahe, Seychelles in 2009. The meeting resolved that "*COMESA member countries commit to harmonise seed policy within two years*". As a result, COMESA formed the Alliance for Commodity Trade in Eastern and Southern Africa (ACTESA) in 2009

to lead the process of enacting a harmonised seed policy regulation for COMESA.

ASARECA provided technical backstopping in development of analytical papers on the position of its member countries to the stakeholder consultative processes. The regulation, which takes into cognizance the provisions of the ASARECA seed policy agreement, was approved in September 2013 during the Joint Meeting of the COMESA Ministers of Agriculture, Natural Resources and the Environment.

Regional Variety Catalogue

Through ASARECA support, EASCOM developed the first edition of the regional variety catalogue in April 2004. The list covers regional varieties for common bean, climbing bean, maize, pigeon pea, sorghum, sunflower and wheat released in at least two EAC countries. Since 2004, EAC and other ASARECA member countries have updated their national variety lists, providing the rationale for updating the current regional variety list. The updated regional variety list with approved varieties for commercial production and trade in more than one EASCOM country covers Burundi, Ethiopia, Kenya, South Sudan, Sudan, Tanzania and Uganda. The list also provides sources and suitable agro-ecological zones.

As a result of this effort, several varieties have been released in additional ECA countries following only one season testing. The harmonisation agreement on seed provides for a shortened release and registration period for foreign varieties onto national catalogues. Uganda evoked this provision in 2008 to release two hybrid maize varieties (Yara 41 and Yara 42) from Kenya onto the Uganda market after only one season of tests. On 29th March 2012, Kenya released 3 potato varieties (Asante, Sherekea, Tigoni) from Tanzania and the Victoria variety from Uganda. The varieties are now under commercial production, signifying improved farmer access to high yielding varieties and heightened space for trade in the region.

Regional Seed Potato Standards

ASARECA partnered with the bureaux of standards in EAC partner states to initiate the process of mainstreaming the regionally approved seed standards into the EAC with the development of the East African standards for cassava, seed potato, potato and related products. As a result, 23 rationalized and harmonized standards for cassava, potato and sweet potato were approved by the EAC in 2010, hence opening up space for structured trade and industrialization of the commodities.

In 2013, ASARECA embarked on a follow on project to facilitate awareness of and implementation of the EAC standards and to enhance regulatory capacities for monitoring compliance to standards among value chain actors in the region. This pilot phase focused on implementation of 13 of the 23 standards. Three sentinel sites were chosen in each country (Tanzania and Uganda for cassava; Kenya and Rwanda for potato) and five "value chain champions" selected per site. The standards were re-written as training manuals and have formed the basis for training of the value chain champions in standards implementation. These are expected to act as the springboard for a critical mass of value chain actors who are not only aware but also have the requisite skills for standards implementation.

Roadmap for Dairy Policy Harmonisation Finalised for Ethiopia, Kenya, Tanzania and Uganda

As part of the Eastern Africa Agricultural Productivity Program (EAAPP), ASARECA undertook analysis to identify key policy reforms needed to enhance performance and improve productivity in the sector. A technical agreement on options for dairy policy reform was generated in five key areas including animal feeds and forages; animal registration and breed performance evaluation; delivery of Artificial Insemination services; procedures for movement of heifers and germplasm; standards for and; regulations for inspection of dairy premises; and standards for dairy processing.

Draft policies in response to the agreement were developed including: the Kenya animal breeding policy; Kenya animal breeding rules, Tanzania Regulations for compounded animal feeds and forages and over 35 dairy standards were formulated and approved in Ethiopia.

The Regional Approach to Biotechnology and Biosafety in Eastern and Southern Africa (RABESA)

Cognizant of the lack of biosafety capacity in COMESA member countries, the porosity of trade borders and the lack of a unified position among member countries on how to treat GMOs in relation to trade, transit and commercial planting, COMESA commissioned ASARECA to undertake analysis to inform policy action. The analysis focused on the: opportunities and challenges related to biotechnology and biosafety; the likely impacts of GMO crops on farm incomes in the COMESA region; the potential commercial export risks associated with planting GMO crops in the COMESA region; the impact of restrictive GMO policies on access to emergency food aid in the COMESA region.

The evidence led into the development of the COMESA Biosafety policy on commercial planting of GMOs, trade in GM products and access to emergency food

aid with GM content, which was approved in the 5th Joint COMESA Meeting of Ministers of Agriculture, Environment and Natural Resources, 16-20 September 2013 in Addis Ababa, Ethiopia. Besides the policy, ASARECA also developed a Communication Strategy to create awareness about the COMESA biosafety harmonization agenda; a biosafety capacity building roadmap to support countries establish and implement functional biosafety systems.

Facilitating Generation and Adoption of Appropriate Policy Options for a Regional Response to the Food Crisis

The 2007 food crisis awakened the need to periodically monitor food price movement across markets within the region to promote trade between surplus and deficit areas. In 2008 ASARECA in collaboration with the Regional Strategic Analysis and Knowledge Support Systems (ReSAKSS) and the Alliance of the Consultative Group on International Agricultural Research (CG Alliance) produced a report on the regional food price crisis.

Evidence from the report for the Head of States urged the need to embrace regional trade, provide safety nets for the most food insecure and vulnerable, and foster agricultural supply response. This was inline within the Common Framework for East African Food Security Strategy, which was ratified by the member states leading to a project in 2010 to develop a framework for forecasting future price changes in Ethiopia, Kenya, Rwanda, Tanzania and Uganda.

Impact of Non-Tariff Barriers on Cross-Border Trade in Eastern Africa

On March 2, 2004, the member states of the East African Community signed a protocol for the establishment of the East African Community Customs Union and committed to eliminate non-tariff barriers (NTBs). In 2005, a study by the East African Business Council on trade impediments in the region ranked NTBs in decreasing levels of severity as: (i) administration of duties/taxes, (ii) corruption, (iii) customs administration, (iv) transiting checks, (v) police checks, (vi) immigration procedures, and (vii) licensing procedures. While the EABC study was very useful in highlighting these trade impediments in the EAC, the quantitative effects of the NTBs on regional trade were largely unknown.

ASARECA in collaboration with ReSAKSS, undertook research to quantify the effects of the NTBs on regional trade for two key tradable commodities in the region: maize and beef. This work helped inform the reduction in the number of road blocks in Kenya and the strengthening of the EAC NTB monitoring mechanism.

Dairy Policy Harmonisation

Aware that informal milk trade accounts for over 85% of total milk trade in the region and contributes significantly to employment and livelihoods, ASARECA supported the development of training manuals to enhance the quality of milk traded informally. Over 100 business development service providers in Arusha and Mwanza were trained to assist the Tanzania Dairy Board to train and certify informal milk traders.

Besides, ASARECA established the East Africa Dairy Regulatory Authorities Council (EADRAC) in 2004 to provide a platform for leaders of dairy regulatory authorities to share lessons on ways to rationalize and harmonize policies and standards in the region. As part of these efforts, the Kenya dairy policy, which recognizes the role of the informal dairy sector, and supports its integration into the formal value chain, was approved by the cabinet. Rwanda became an active participant in the Eastern Africa Dairy Regulatory Council (EADRAC) and a private sector led platform for dairy industry policy regulation was established.

Current ASARECA Secretariat staff. The Secretariat is maintaining a lean technical, fiduciary and operations team

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