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Impact Report
on the Food and Agriculture Cooperation Initiatives of RDA
(Social and Economic Impacts of Asian and African Countries)

Rural Development Administration

Contents

I. Brief Introduction of AFACI and KAFACI

Asian Food & Agriculture Cooperation Initiative

Cooperation initiative for agricultural technology that enhances agricultural productivity through resolving common issues conducted by research programs in agriculture in Asia

※ Inauguration: Signed MOU by minister or deputy minister with 13 countries (2009. 11)

13 AFACI Member Countries and 6 Partner Organizations

■ Member Countries

BANGLADESH BHUTAN CAMBODIA INDONESIA KYRGYZSTAN Lao PDR MONGOLIA MYANMAR NEPAL PHILIPPINES SRI LANKA THAILAND VIETNAM

■ Partner Organizations

APIRAS (Asia-Pacific Islands Rural Advisory Services Network) · Bioversity International · FFTC · ILRI International Livestock Research Institute · IRRI · World Vegetable Center

Key Achievements

- Establishment of information system for migratory disease and insect occurrence (13 countries)
- Establishment of integrated management system for plant genetic resources (13 countries)

Developing the AMIVS system

Input of migratory disease and insect data → Graph → Information Sharing → Prevention

Conducting evaluation workshop for projects

Enhancing capacity building for researchers and farmers

Korea-Africa Food & Agriculture Cooperation Initiative

Cooperation initiative for agricultural technology that increases agricultural production through resolving common issues conducted by research programs in agriculture in Africa

※ Inauguration: Signed MOU by minister or deputy minister with 20 countries (2010. 7)

20 KAFACI Member Countries and 6 Partner Organizations

Member Countries

Angola, Cameroon, Cote d'Ivoire, Comoros, DR Congo, Ethiopia, Gabon, Ghana, Kenya, Malawi, Morocco, Nigeria, Rwanda, Senegal, Sudan, Tunisia, Tanzania, Uganda, Zimbabwe, Zambia

Partner Organizations

CONFLICT AND DEVELOPMENT TEXAS A&M UNIVERSITY, AFAAS, AfricaRice, AGRA Growing Africa's Agriculture, ILRI, International Trade Centre

Key Achievements

- Development and dissemination of high-yielding rice variety adaptable to Africa : 1,094 lines in 19 countries
- Variety registration : 2 varieties registered in Senegal (Miryang23, Taebaeg)
- Capacity enhancement of rice breeders : 78 breeders from 19 countries

Reducing the period of rice breeding by anther culture technique

Developing elite variety adaptable to Africa

Enhancing the capacity for rice breeders

Ⅱ. Infographics of Achievements of AFACI and KAFACI

BANGLADESH

Project Results

ANSOFT — Asian Network for Sustainable Organic Farming Technology

Model organic villages

- 210 demo farms
- 330 training participants
- 400 books Organic vegetable production
- 500 manuals Participatory Guarantee System (PGS)

POST HARVEST — Improved Postharvest Handling Technology

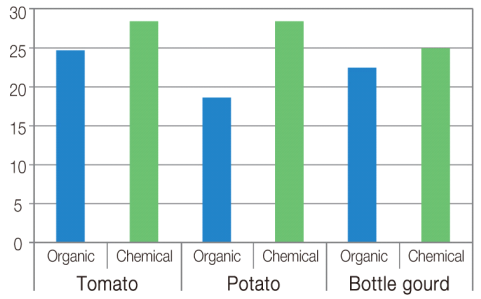
- 3 Crop manual (cabbage, tomato, mango)
- 3,000 copies
- 3,000 copies
- 5,000 copies

ATIN — Agricultural Technology Information Network

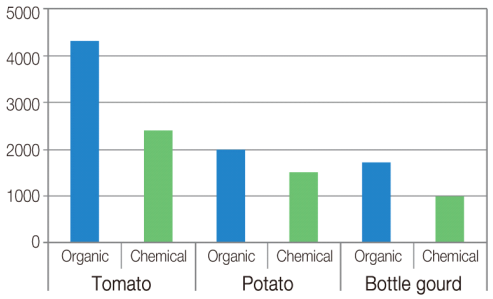
Socio-Economic Impacts

Application of organic farming technology

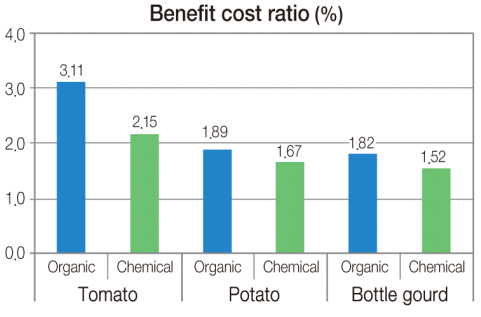
Crop yield (ton/ha)



Net return (USD) of each crop

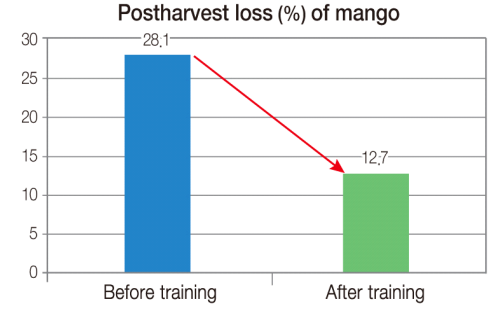


Benefit cost ratio (%)



Application of postharvest technology

Postharvest loss (%) of mango



BHUTAN

Project Results

AnGR — Animal Genetic Resource Value and Productive Performance

Phenotypic and genetic characterization

1,546 DNA samples

5 species
(horse, yaks, chicken, pig, cattle)

ATIN — Agricultural Technology Information Network

645 farmers
70 extension officials
Training program of postharvest management for apple and orange

12 core cluster
62 household covered
Training program of organic management

GAP — GAP programs and Agricultural Produce Safety Information System

4 GAP manual
(apple, mandarin, potato, hazel nut)

GAP Certification body
(ISO/IEC 170 65:2012)

Sharing GAP information with AFACI member countries and SAARC countries

IPM — Epidemiology Information System for Migratory Disease and Insect Pests

Virus in tomato & chilli
(cucumber mosaic, veinal mottel, pepper mild mottle, tobacco curly shoot virus)

Using pheromone trap
250 farmers

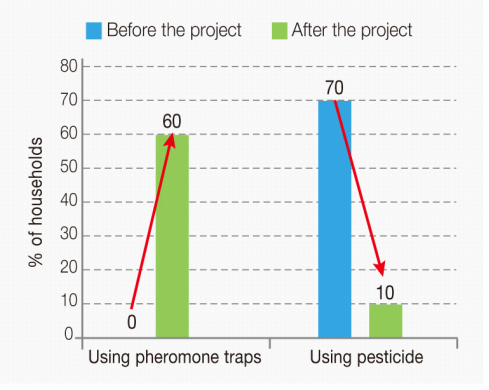
Seed-potato — Virus-free Seed Potato ProductionTechnology

community seed growers established

195 wheat
maize
potato
320 been

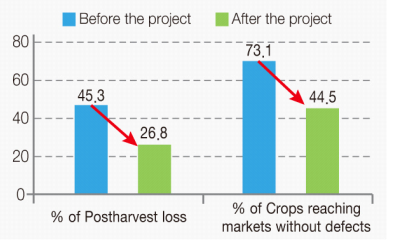
Socio-Economic Impacts

Application of organic farming technology

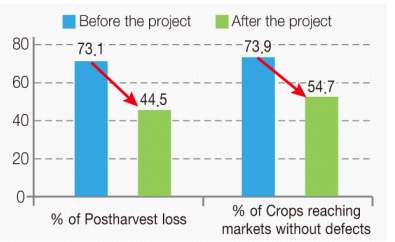


Application of postharvest technolgy

〈Orange〉



〈Apple〉



CAMBODIA

Project Results

AnGR
Animal Genetic Resource Value and Productive Performance

Phenotypic characterization
2 species (cattle, chicken)

2 handbooks
(native cattle, buffalo)

ANSOFT
Asian Network for Sustainable Organic Farming Technology

Cambodia organic agriculture standard

Training program
2 programs, 3 topics

Demonstration on organic vegetables cultivation

ATIN
Agricultural Technology Information Network

156 information materials
(durian, crop cultivation, etc.)

4 crop calendars
2,000 booklets

POST HARVEST
Improved Postharvest Handling Technology

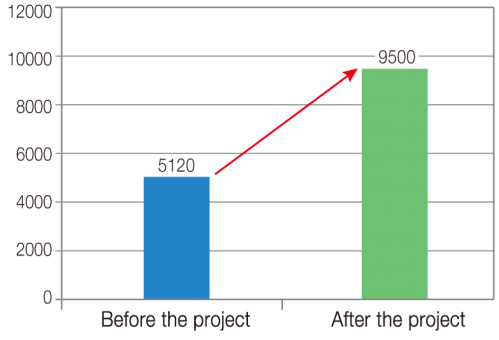
Chili, tomato, mango
900 copies of manuals
3,000 posters

11% reduction of postharvest losses

Socio-Economic Impacts

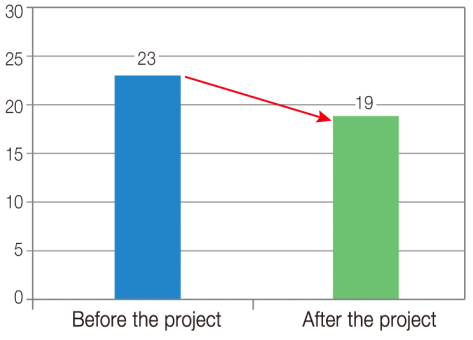
Application of GAP technology

Farmers' GAP awareness



Application of postharvest technology

Postharvest losses (%) of tomato



INDONESIA

Project Results

AnGR — Animal Genetic Resource Value and Productive Performance

- 2 handbooks (native cattle, buffalo)
- Genetic characterization for breeding resource - Kosta goat

ANSOFT — Asian Network for Sustainable Organic Farming Technology

- Training system: 3 programs, 8 topics; 70 farmers, 10 specialist
- Organic Certification Indonesian regulation

ATIN — Agricultural Technology Information Network

- 9 information materials (potato, chili, horticulture, etc.)
- Training porgrams for children, extension works, etc.

GAP — GAP programs and Agricultural Produce Safety Information System

- Indonesian GAP standard
- 1,000 farmers of certified
- 3 GAP manuals (chili, mango, salak)

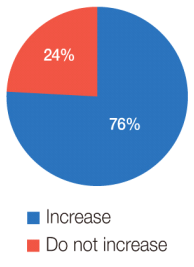
POST HARVEST — Improved Postharvest Handling Technology

- 3 manuals (cabbage, tomato, banana)
- 58.3% reduction of postharvest losses

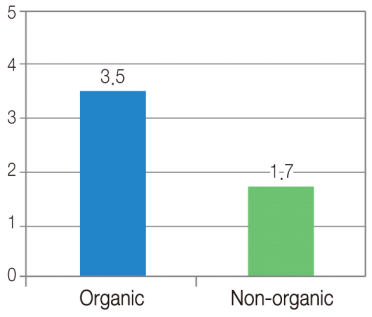
Socio-Economic Impacts

Application of organic farming technology

Farmer's snake fruit production

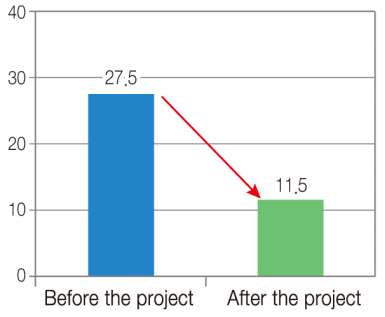


Revenue cost ratio (%)



Application of postharvest technology

Postharvest losses (%) of shallot



PHILIPPINES

Project Results

ANSOFT — Asian Network for Sustainable Organic Farming Technology

- 17 modules of education
- 10 farmer groups applied organic farming technology

ATIN — Agricultural Technology Information Network

- 16 information materials
- 19 news articles
- 5
- 573,862 copies
- 20 regional seminars
- 10 commodity calendars
- 23 regional in-house seminars
- 15,450 copies
- 3,090 attendees

CASSAVA — Agricultural Mechanization Technology for Cassava

- 100% reduction of labor requirement/ faster harvesting
- 88% reduction of drudgery
- 81% reduction of harvesting losses

GAP — GAP programs and Agricultural Produce Safety Information System

- 3 manuals (cabbage, tomato, banana)

IMPGR — Integrated Management System of Plant Genetic Resources

Germplasm collection

- 130 accessions of legumes
- 7 pigeon pea conserved in national gene bank

Germplasm characterization

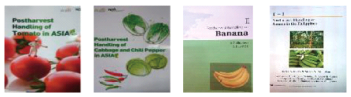
- 228 mungbean
- 85 cowpea
- 53 pigeon pea

IPM — Epidemiology Information System for Migratory Disease and Insect Pests

- 120 vials of planthopper
- 12 biocubes of virus
- internet platform for AMIVS

POST HARVEST — Improved Postharvest Handling Technology

- 3 manuals (cabbage, tomato, banana)
- 23.8% reduction of postharvest losses



GHANA

Project Results

AGRICULTURAL EXTENSION

Enhancement of National Agricultural Extension System

1.9 tons seeds of 3 promising upland rice seeds distributed to 55 farmers covering 22 hectares

7 1 1

BASIC AGRICULTURAL SCIENCES

Development and Improvement of Technology on Conservation of Genetic Resources

3,240 accessions of orthodox germplasm

228 image databases regenerated

FOOD CROP

Rice Breeding Project

20 crosses between KAFACI lines and popular aromatic rice varieties in Ghana

- Screening of KAFACI lines for resistance to rice yellow mottle virus (RYMV) disease

12 KAFACI lines with resistance to RYMV disease

100% increase in rice germplasm

55 received seeds

HORTICULTURE

Development and Application of Postharvest Management Technology Model for Horticultural Crops

Manuals translated into 3 local languages and developed into audio-visual training materials

30% reduction of postharvest losses in tomato

Disseminated information through published manuals:

- utilizing improved/pure seeds, healthy seedlings
- managing temperature through effective cooling shade covers
- utilizing plastic crates for packaging

LIVESTOCK

Promotion of Good Management for Increased Productivity of Market Oriented chicken producers

55 farmers supported

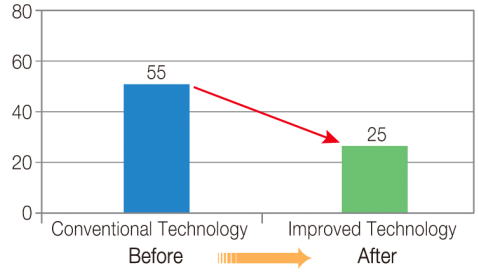
75% egg-laying rate

Know how using:

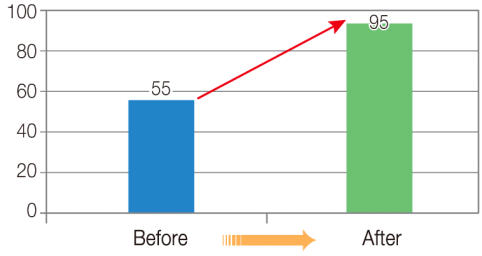
- sea-water and Limbux (limestone)
- light to increase day length to enhance laying performance
- cheap and efficient laying nest
- phase feeding in laying hen performance

Socio-Economic Impacts

Reduction of postharvest losses (%) in tomato production



Increase of seed viability (%) after completing germplasm inventory



KENYA

Project Results

FOOD CROP

Rice Breeding Project

- development of promising lines KAFAGR-54, KAFAGR-8, and K2-9
- have been applying NPT (national performance trials)
- increased local knowledge capacity in double haploid

HORTICULTURE

Development and Application of Postharvest Management Technology Model for Horticultural Crops

documentation of postharvest practices, losses and causes

14,826 kgs tomato saved from being waste

40-50% to 10-25%
reduced tomato loss using manual and attending to trainings

LIVESTOCK

Promotion of Good Management for Increased Productivity of Market Oriented chicken producers

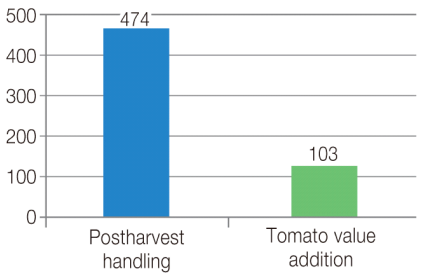
- supply food and nutrition to people

USD 333 income from 300 birds

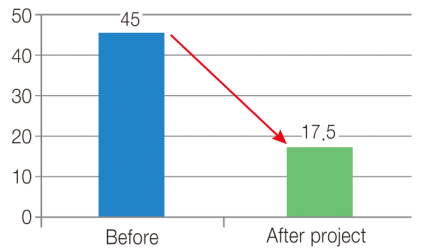
Socio-Economic Impacts

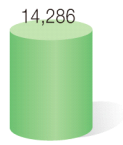
Effect of Capacity Building to Reduce Postharvest Loss

No. of trainees on postharvest management



Reduction of postharvest losses on tomato(%)





Additional yield of tomato through postharvest technology (kg)

MOROCCO

Project Results

BASIC AGRICULTURAL SCIENCES

Development and Improvement of Technology on Conservation of Genetic Resources

Genetic Resources

- Moroccan tetraploid oat species screened for drought tolerance
- MS and PhD degree students trained in Plant Cytogenetics Laboratory
- A mixture of 80 % and 20% oat cv. Alfaouz for good tasty bread

FOOD CROP

Rice Breeding Project

identified
- high-yielding germplasm
- suitable genotypes

19 promising lines selected (9 DH, 8 Elite, 2 salinity tolerance)

HORTICULTURE

Development and Application of Postharvest Management Technology Model for Horticultural Crops

Manuals in English

1,000 farmers received citrus manual translated to Arabic

2 Master Degree students were trained

LIVESTOCK

Promotion of Good Management for Increased Productivity of Market Oriented chicken producers

- publication of management guide
- training of farmers and increase interest in adoption
- increase in income

NETWORK

Young Scientist Project

3 weeks training on bioinformatics

- DNA data analysis
- Program operation and problem solving of Linux system

NIGERIA

Project Results

FOOD CROP

Rice Breeding Project

3 superior rice genetic resources distributed to 100 farmers

6.3~7.1ton/ha of transgressive lines

200% profit return

- improvement in grain quality
- discovery of new donor lines tolerant to aphids
- enhancement of high-yielding rice germplasm and breeding capacity

HORTICULTURE

Development and Application of Postharvest Management Technology Model for Horticultural Crops

postharvest manuals

LIVESTOCK

Promotion of Good Management for Increased Productivity of Market Oriented chicken producers

- producers have been empowered
- trained to improve their production

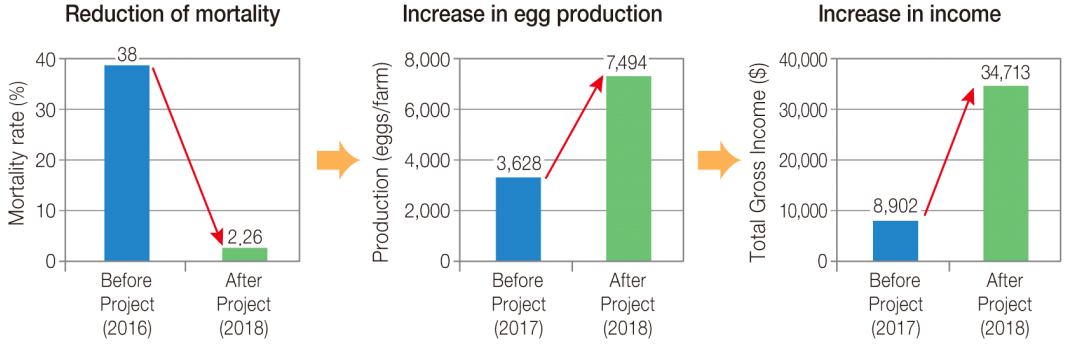
Management Guide for Increased Productivity of Small-Scale Chicken Farmers

Farmers, Extension workers, scientists — Training on good management practices in small-medium scale egg laying

3,500 pullets distributed to 430 farmers

Socio-Economic Impacts

Changes in Farmer's production and income through Poultry project



ZIMBABWE

Project Results

AGRICULTURAL EXTENSION

Enhancement of National Agricultural Extension System

0.2 tons/ha in 2013 increased to 2-3 tons/ha in 2016

100 tons are being sold to Grain Marketing Board(GMB) Hwedza depot every season

BASIC AGRICULTURAL SCIENCES

Development and Improvement of Technology on Conservation of Genetic Resources

- crafted national policies to protect national biodiversity
- developed reverse engineer and planters
- reduced labor and cost in grain production and processing

HORTICULTURE

Development and Application of Postharvest Management Technology Model for Horticultural Crops

- developed zero-energy cooling storage unit
- translated postharvest manuals in local languages

LIVESTOCK

Promotion of Good Management for Increased Productivity of Market Oriented chicken producers

- increase household income levels
- improve nutrition within the household and community

generated US$100 monthly income

Additional accumulated savings of farmers in the Cooperative account

US$4076.43

NETWORK

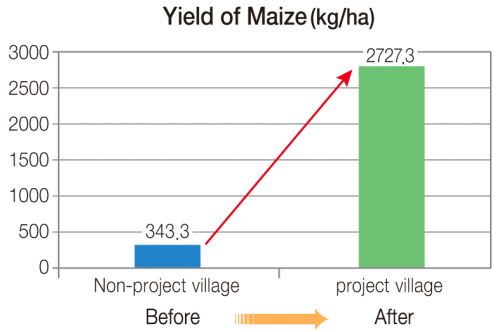
Young Scientist Project

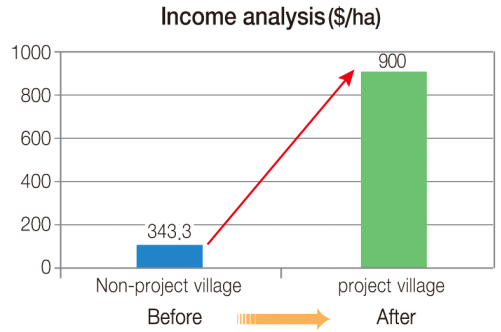
Trained on :

- design method of research for animal feed and nutritional composition
- normal air environment management to improve vegetable storage

Socio-Economic Impacts by Enaes Project

Changes in maize production and farmer's income through Extension project





Ⅲ. Impact Report of the AFACI Projects in

Bangladesh

Impact of the AFACI Projects in Bangladesh

1. Introduction

Since 2010, under the funding of the Government of Korea, 13 projects have been/are being implemented in Bangladesh through Asian Food and Agriculture Cooperation Initiative (AFACI). Out of 13 projects, seven have already been implemented and the remaining six (6) will be completed by June 2019. It may also be noted that two new AFACI projects on rice salinity tolerant variety dissemination and on agro-product processing have begun in 2018. The list of the projects implemented/being implemented with brief information is given below:

Brief information of AFACI funded projects in Bangladesh

Sl. No.	Project Title	Principal Investigator	Implementing organization (s)	Duration & Budget	Status
1.	Construction of Epidemiology Information Interchange System for Migratory Disease and Insect Pests in Asia Region (Regional)	Dr. Md. Mofazzel Hossain, Principal Scientific Officer, Entomology Division, BRRI	BRRI	October 2012 to September 2013 October 2013 to September 2016 & October 2016 to June 2019 (120,000 USD)	On-going
2.	Establishment of network and model manual on post-harvest technology of horticultural crops in Bangladesh (Pan Asian)	Dr. Khorshed Alam, Director (Training & Manpower) BARC	BARC & BARI	September 2012 to August 2015 (30,000 USD) January 2016 to December 2018 (72,000 USD)	Completed
3.	Development of locally appropriate GAP programs and produce safety information system of selected crops in Bangladesh (Pan Asian)	Dr. Mian Sayeed Hassan, CSO (Crops), BARC	BARC & BARI	September 2012 to August 2015 (30,000 USD) January to December 2018 (60,000 USD)	Completed

Sl. No.	Project Title	Principal Investigator	Implementing organization (s)	Duration & Budget	Status
4.	Establishment of agricultural technology Information network in Asia (Pan Asian)	Hasan Md. Hamidur Rahman Director (Computer and GIS), BARC	BARC	August 2013 to July 2016 July 2016 to June 2019 (60.000 USD)	On-going
5.	Construction of the Asian network for sustainable organic farming technology (Pan Asian)	Dr. Muhummad Nazim Uddin, Scientific Officer, HRC, BARI	BARI	July2014 to June 2016 (30,000 USD) July to 2016 to June 2019 (30,000 USD)	On-going
6.	Collection, characterization and promotion of rice, chili, cucumber and melon in Bangladesh (Pan Asian)	Dr. Md. Aziz Zilani Chowdhury, MD (Crops), BARC	BARC, BARI & BRRI	January 2012 to December 2015 (75,000 USD) January to December 2017 (75,000 USD)	Completed
7	Improving animal genetic resources values and productive performance in Asia (Pan Asian)	Dr.Talukder Nurun Naher, Director General, BLRI	BLRI	April 2013 to April 2019 (180,000 USD)	On-going
8	Demonstration project to distribute national superior seeds of food crops and transfer agricultural technology (seed extension)	Dr. Shaikh Md. Bokhtiar Director (TTMU), BARC	BARC	July 2016 to June, 2019 (42,000 USD)	On-going
9	Technology dissemination of virus free seed potato producing using hydroponic systems (seed potato)	Dr. Bimol Chandra Kundu, Principal Scientific Officer, TCRC, BARI	BARI	July 2016 to June, 2019 (42,000 USD)	On-going

Sl. No.	Project Title	Principal Investigator	Implementing organization (s)	Duration & Budget	Status
10	Development of rice production techniques for increase of self-sufficiency of staple food in Bangladesh (Pan Asian)	Dr. Md. Abdul Jalil Mridha, Chief Scientific Officer, Agronomy Division, BRRI	BRRI	September 2012 to August 2015 (30,000 USD)	Completed
11	Production and service of agro-meteorological information for the adaptation to climate change (Pan Asian)	Dr. Sultan Ahmmed, Member Director (NRM), BARC	BARC & BUET	September 2012 to August 2015 (30,000 USD)	Completed
12	Agricultural land management for improving soil fertility and irrigation efficiency	Dr. M. Bakhtear Hossain Principal Scientific Officer (Soil), BARC	BARC	September 2012 to August 2015 (30,000 USD)	Completed
13	Development of variety, cropping system research and technology transfer of major cereals for sustainable food security in Bangladesh	Dr. M.Khalequzzaman Akanda Former Member-Director (Crops), BARC	BARC, BARI, BRRI, DAE & BADC	October 2010 to December 2013	Completed

The AFACI projects focus on the emerging and demanding issues of agriculture. Though the projects are with small funding, benefits and impacts are high. The GAP and ANSOFT projects have generated awareness about the importance of food safety, certification, and production of safe and healthy food. The projects on pest management, soil fertility management, postharvest management, agricultural technology information network, technology transfer, plant and animal genetic resource collection, conservation and characterization will surely benefit the farmers a lot. AFACI also provides opportunity for training/workshop on different issues agriculture and also for knowledge sharing in agriculture of other AFACI member countries through participation in AFACI workshop and other events.

2. Development and Project Impact

2.1. Impacts of two AFACI projects - ANSOFT and Postharvest are given below as per the prescribed format sent from AFACI.

I. Introduction

Bangladesh is an agro based country lying between 20.340 and 26.380 North latitude and between 88.010 and 92.410 East longitudes. It is bounded by India in the North and West, south by Bay of Bengal and East by India and Myanmar. The country has a total area of 147,570 ㎢ with a population of about 167.5 million (www.worldometers.info). The country is located as an interface of two different environment; Bay of Bengal in the south and the Himalayas in the north. It is the world largest deltaic country and is formed by the three great rivers of Brahmaputra, the Meghna and the Ganges. It is the low-lying riverine country and roughly 80% of the landmass is made up of fertile alluvial lowland called the Bangladesh Plain.

FAO/UNDP (1988) classified the Bangladesh soil into three broad types, which are floodplain (79.0%), hill (12.7%), and terrace (8.35%). The country is small but has diverse ecosystems like hills, plains, coastal, and wetlands. Bangladesh has a tropical monsoon climate characterized by wide seasonal variations in rainfall, high temperatures, and high humidity. Regional climatic differences in this flat country are minor. Three seasons are generally recognized: a hot, muggy summer from March to June; a hot, humid and rainy monsoon season from June to November; and a warm-hot, dry winter from December to February. In general, maximum summer temperatures range between 38 and 41°C. April is the hottest month in most parts of the country. January is the coolest month, when the average temperature for most of the country is 16-20°C during the day and around 10°C at night. Average daily humidity ranged from March lows of between 55 and 81% to July highs of between 94 and 100%. Agriculture is predominant with a cropped area of 8.51 million hectare and 190% cropping intensity (MOA, 2018). Agro-ecology of the country is divided in to 30 AEZs. Lands are categories into high, medium high, medium low land, low land and extremely low land. There are 14.9 million farm household having wide range of biodiversity of fruits and vegetables spices, tuber crops and medicinal plants and poultry and livestock traditionally. Three cropping seasons are recognized, rabi (cool and dry months: October-March) and kharif I (hot: April–June and Kharif II (hot and humid months: July-September). Average landholding

of a farm household is less than 1,000 ㎡, and more than 10% had no farmland (Ministry of Agriculture, 2010). The total cultivated land under conventional practices is 8.51 million hectare (MOA, 2018).

Food productions system of Bangladesh are mostly based on synthetic chemical fertilizers and pesticides. The concepts of productions are followed high input and received high output without considering the economic benefit and environmental consequences. To attain the food security more than 500 kg and 5 kg synthetic fertilizers and pesticides are being applied per ha of land, respectively. This is five times incremental dose over the last 30 years in Bangladesh. As a result, Bangladesh soil lost its organic matter (OM) (70% land possess <1% OM) and enriched biological properties. Excessive use of petroleum-based synthetic product to the crop built the food safety questionable. The shift to monoculture cropping system meant transformation to consumer society. This change was accelerated by the increase of off-farm job opportunities, infrastructure development that facilitates population transfer, and admiration for urban lifestyle amplified by mass media.

Organic agriculture is known as a method of rebuilding environmental degradation, sustained agriculture, and improving food safety and quality. In addition, the farming system is appropriate for small farmers in the developing countries especially in South and South East Asia. Bangladesh has long tradition of organic practice in the homestead and commercial basis. However, it is the time to cope with this and therefore, organic farming is an appropriate approach to address the issue. To bring more stakeholders under the umbrella of organic farming, an organized model farm is required. At present, there is an organized production system of organic produce in Bangladesh but no marketing channel to sale the organic food. Therefore, this project will give the experience to small-scale growers in the field of production, processing, and marketing of organic food. Bangladesh Agricultural Research Institute (BARI) has formed local network, named, Bangladesh Organic Agricultural Network (BOAN) who are involved in organic farming to facilitate the promotion of organic practices. Moreover, Bangladesh is less experience in organic farming, therefore, collaboration and cooperation with the other developed and developing countries in the field of technology and knowledge sharing are essential.

The objectives of the project were the reinforcement of the model organic agricultural village including operation of organic demo-farms, dissemination of the packaged knowledge and information from the model organic village to organic

farmers, and internalization of organic farming technologies considered domestic conditions of each member countries.

II. Development

Working team of the project

1. M Nazim Uddin PhD, Principal Investigator, Senior Scientific Officer, Olericulture Division, Horticulture Research Center, BARI, Gazipur, Bangladesh
2. G M A Halim PhD, Co-Principal Investigator, Director Horticulture Research Center, BARI, Gazipur, Bangladesh
3. M Kamrul Hasan PhD, Socioeconomist, Chief Scientific Officer, ICT, Division, BARI, Gazipur, Bangladesh
4. Ferdouse Islam PhD, Gender Specialist, Principal Scientific Officer, Olericulture Division, Horticulture Research Center, BARI, Gazipur, Bangladesh
5. M Sahadath Hossain PhD, Entomologist, Principal Scientific Officer, Entomology Section, Horticulture Research Center, BARI, Gazipur, Bangladesh
6. M Alamgir Siddhiky PhD, Soil Scientists, Senior Scientific Officer, Soil and water Section, Horticulture Research Center, BARI, Gazipur, Bangladesh
7. M Golam Kibria PhD, Pathologist, Principal Scientific Officer, RARS, BARI, Rahmatpur, Bangladesh

Area: Gazipur, Dhamrai, Jhinaidah, Mymensing and Netrokona, Budget : USD 10,000 each year

III. Main activities include: Construction of model organic villages in Bangladesh to share successful experiences, including modelling of resource recycling and energy saving organic farming system. Three MS student will receive facility for collecting data on organic farming technologies and its adaption; active communication and data input by using ANSOFT website, workshop and working group or farmer's group meeting; publication of technical reports, workshop proceedings, etc. and construction of database for organic farming technology, alternative techniques for pest and soil management, traditional knowledge, and natural resources, especially organic seeds.

IV. Output of the project

1. Publication (manual, book including success story, book, poster, etc.)

Print materials (e.g. Manual, book, poster, etc.)	Title	Language	Number of publications/ copies	Date published
Book	Organic vegetables production	Bangla	400	May 2018
Manual	BARI introduced participatory guarantee system (PGS) to certify organic farming and organic products	Bangla	500	January 2018
Poster	Organic farming and production of safe and nutritious vegetables by organic practices	Bangla	2	December 2017

2. Implementation of organic model village

Organic model village(OMV)	No. of demo-farms	Organic farming technologies used in OMV	Remarks
Muktagacha, Mymensingh	65	Cabbage 5, Cauliflower 5, Bitter gourd 5, Brinjal 5, Bottle gourd 5, Bean - 5 , Tomato 10, Home gardening 5, Vermicompost 10	Supervised by BARI, DAE and LSP
Sholokopa, Jhenaidah,	120	Cabbage 10, Cauliflower 10, Bitter gourd 10, Brinjal 10, Bottle gourd 10, Bean - 10 , Tomato 10, Home Gardening 20, Vermicompost 20, Magic compost 10	Supervised by Unnayan Dhara a local NGO. PGS Boan BARI making data base
Atpara, Netrokona	25	Brinjal 2, Indigenous Potato 2, Bottle Gourd 5, Home Gardening 16	Initiated by BARI, DAE and LSP on 2018

3. Development of organic farmers' training programs and modules

Title of training program	Training modules for Farmers capacity building (main contents)	Remarks/ No. of participants
Organic farming standards and successful vegetables production	Standard, soil amendment method, vermin-compost, compost production	Motivation program (60)
Vermi compost production and preservation	Use of devise, preparation of vermin media, warm raring and hatching, food ingredients and their ratio, compost separation and preservation	Women farmers (30)
Preparation of IMO and application	Ingredients of IMO, mixture methods, anerobic and aerobic methods, preservation and application	3 batch (90)
Organic vegetables production methods	Seedling raising, land preparation, planting method, organic fertilizer application method, inter-culture operation, harvesting maturity	3 batch (30)
Orientation training on PGS implementation to the LSP	What is PGS, PGS organic standards, motivation of farmers, how to form farmers group, preparation of inventory, function of regional committee, formation of local PGS team, monitoring and field visit, reporting	3 batch (60)

4. Dissemination of organic farming technologies from OMV to other villages or farmers

* OMV: Organic Model Village

Additional OMV (in other village)	Organic farming technologies used	Remarks (Ripple effect, etc.)
No. of farms / ha.	*What kind of crop*	*Economic impact*
5 (2 ha)	Cabbage, tomato, brinjal and bottle gourd	Cabbage (3.36), tomato (2.46) brinjal (2.31), bottle gourd (2.21)

5. PR performance (extension, training, technical support, etc.)

Media (TV, radio, newspapers, magazine)	Contents	Date published/aired (dd-mm-yy)	Remarks
TV	Organic fair and seminars	17 Feb 2018	An organic fair have been organized from this project on 16-17 February 2018.
Radio	PGS organic products and seminar talk	9 May 2018	Participated in eco-festival and showcased the organic products and talk as keynote speaker
Newspaper	Organic is the ultimate solution in Bangla	12 Dec 2017	Special issue of Popular Bangla Newspaper
Magazine	Organic farming status, safe food		Supplementary of popular English Daily

6. Internal and external cooperation for the improvement of organic farming technologies

Cooperation activities	Contents	Date of activity (dd-mm-yy)	Remarks
Symposium	Organic farming, safe food and eco-friendly products fair 2018	16-17 Feb 2018	Seminar, poster presentation, Secretary Ministry of Agriculture opened the fair and Director General DAE presented in the losing session
Workshop	Organic farming, safe food and role of civil society	9 April 2018	Keynote presentation in the eco-fest jointly organized by ANSOFT and sustainable alliance
Seminar	Prospects and challenges of organic production, quality and marketing in Bangladesh	17 Feb 2018	Side seminar during Fair

Cooperation activities	Contents	Date of activity (dd-mm-yy)	Remarks
Technical meeting	PGS, organic vegetables production, organic moringa production and certification, microbial fertilizer preparation plant	**12 Sep 2017, 9 Jan 2018, 25 Jun 2018**	ANANDA, Taranga, Parmida,
MOU	Land improvement through organic amendment by using neel in the Jhum cultivation area	21 Nov 2017	Creative Conservation Alliance (CCA) a conservation group work with indigenous population

V. Potential socio-economic returns / impacts

Yield performance: The study revealed that on an average organic farming produced tomato, potato and bottle gourd were 24.8, 18.7, and 22.5 tons fresh yield per hectare against semi-organic farming produced 30.0, 25.9, and 27.5 tons per hectare and chemical fertilizer farming produced 28.4, 28.4, and 24.9 tons per hectare, respectively (Fig 1). In all study districts, semi-organic and chemical fertilizer farming produced the highest yield compared to other two systems. But the organic fertilizer farming received the highest price for their products. In the case of tomato production using organic fertilizer, the highest yield was recorded in Jhenaidha district (26.2 ton/ha) and for potato and bottle gourd, the highest yield was found in Mymensigh (19.2 ton/ha) and Gazipur districts (23.7 ton/ha) respectively. The lowest fresh yield of organic farming was obtained from Mymensigh (23.7 ton/ha) for tomato, Gazipur (17.6 ton/ha) for potato and Mymensigh (19.7 ton/ha) for bottle gourd.

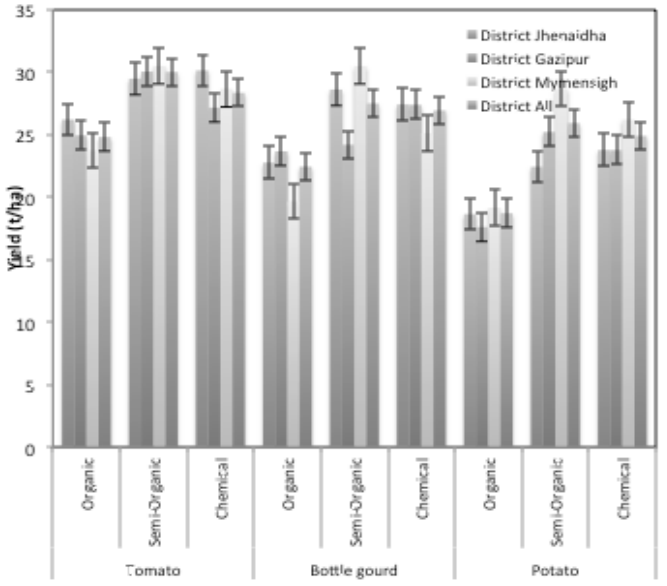


Fig. 1. Yield of tomato, potato and bottle gourd under organic, semi-organic and chemical fertilizer farming

Variable cost (USD) of tomato, bottle gourd and potato production: The variable cost of production included the costs of human labour, mechanical power, seed /seedling, manure, fertilizers, irrigation, pesticides and support cos. Both cash expenses and computed value of family supplied inputs were included in the variable cost.

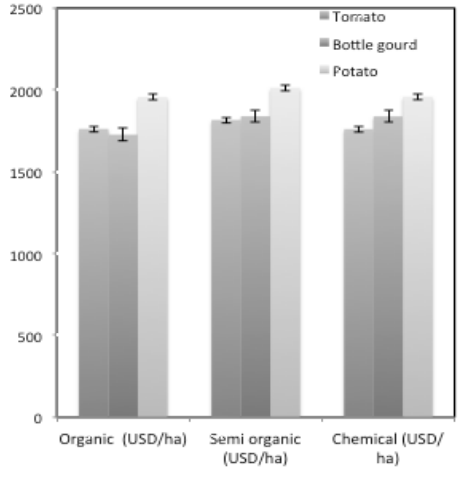


Fig. 2. Variable cost (USD) of organic, semi- organic and chemical farming tomato, bottle gourd and potato production (n=20 of each)

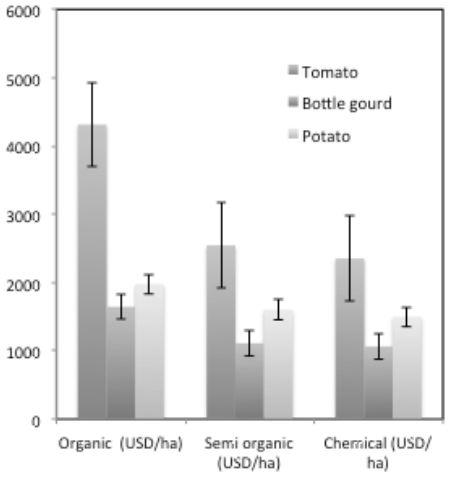


Fig. 3. Net return (USD) of organic, semi-organic and chemical farming tomato, bottle gourd and potato production (n=20 of each)

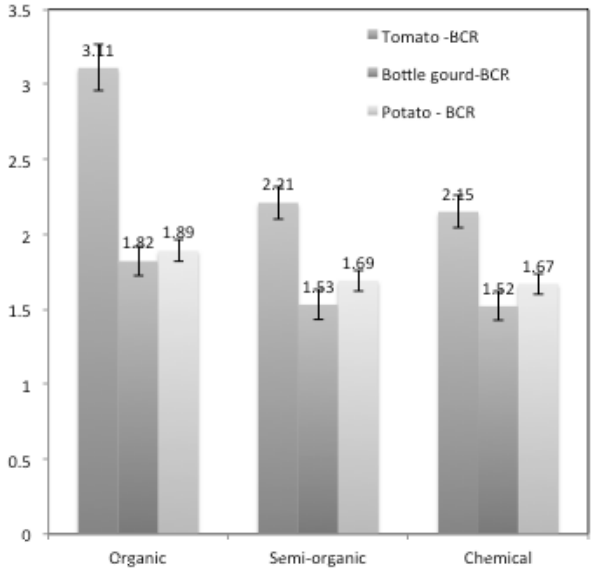


Fig. 4. Benefit Cost Ratio of Selected Vegetables

Impact of different farming on soil properties: Nine (9) samples from organic farmers, semi-organic farmers and chemical fertilizer farming collected from three locations (Gazipur, Jhenaidah and Mymensigh) and analyzed in the laboratory as to find the impact of organic fertilizer. The results are presented in the table 7 and it was revealed that the organic farmers soil contain more amount of available nutrient compared to the semi-organic and chemical farming. Organic matter is the storehouse nutrient and it was revealed that all the organic farms (F1, F4 and F7) contained more amounts OM compared to other counterpart. The chemical farming soils (F3, F6 and F9) is containing the lowest amount of organic matter. Nitrogen is the key element for maintaining growth of crops and it was revealed from the test results that nitrogen level below the critical level in the chemical farming (F3, F6 and F9) and the organic and semi-organic soil holding nitrogen near to CL or CL, it might be due to use of excessive chemical inhibited the biological properties of the soils (Table 5).

7. Status of the soil samples collected from organic, semi-organic and conventional farming field (15 cm depth) located at Gazipur, Jhenaidah and Mymensingh

Soil Characters	CL	Gazipur			Jhenaidah			Mymensingh		
		F1	F2	F3	F4	F5	F6	F7	F8	F9
pH	-	7.00± 0.51	6.22± 0.67	6.86± 0.49	6.43± 0.62	6.75± 0.58	6.40± 0.55	6.30± 0.51	6.01± 0.53	6.61± 0.45
OM (%)	-	2.17± 0.11	1.86± 0.12	0.60± 0.09	1.88± 0.22	1.72± 0.13	0.34± 0.11	1.82± 0.22	1.60± 0.18	1.24± 0.10
N (%)	0.12	0.12± 0.003	0.10± 0.004	0.04± 0.001	0.10± 0.002	0.10± 0.001	0.02± 0.003	0.10± 0.002	0.09± 0.001	0.07± 0.001
P μg/g	7.0	72.29± 9.52	29.49± 5.51	64.54± 6.56	11.40± 2.33	16.51± 4.32	34.04± 8.59	31.07± 8.52	7.00± 1.56	32.09± 9.41
K meq /100g	0.12	0.27± 0.03	0.13± 0.02	0.41± 0.06	0.08± 0.01	0.13± 0.03	0.17± 0.0	0.08± 0.51	0.09± 0.51	0.08± 0.51
S μg /g	10.0	37.69± 6.51	18.49± 2.51	37.92± 5.58	24.03± 4.55	23.77± 3.53	29.00± 6.46	27.03± 5.16	27.81± 4.55	21.23± 3.36

F_1= Organic farmer soil converted the land 2010 at Jhenaidah, F_2= Semi-organic farmer soil at Jhenaidah, F_3 = Conventional farmers soil at Jhenaidah F_4 = Organic farmer soil converted the land 2013 at Gazipur, F_5 = Semi-organic farmer soil at Gazipur F_6 = Conventional farmers soil at Gazipur F_7 = Organic farmer soil converted the land 2014 at Mymensingh F_8= Semi organic farmer soil Mymensingh , F_9= Conventional farmers soil Mymensingh, CL= Critical limit (BARC 2012).

Impact of organic production on soil microbial properties: Organic production is required not only for the health of the consumers but also for the improvement of the soil health. In our study, organic soil observed more amount of beneficial microbes (Fig 5). Although the sample is very limited but it still have indication of improvement of soil.

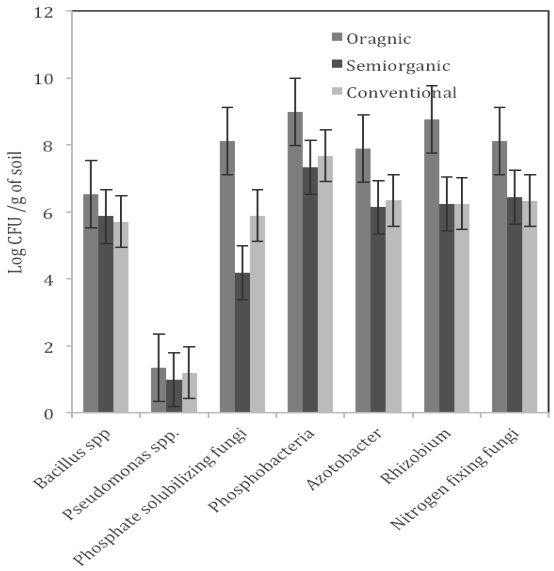


Fig. 5. Beneficial Microbes status of the soil samples collected from organic farming field (15 cm depth) located at Gazipur, Jhenaidah and Mymensingh

Presence of higher number of *Pseudomonas spp.* is required for inhibiting some plant pathogens, and plant growth factor. However, all soil samples tested contain significantly lower number of Pseudomonas spp and hence supplementation of these bacteria is necessary in these fields to ensure that the bacteria reduce pathogens around the seed and root of the crop.

VI. Conclusion

An organic standard including PGS system, has been developed through this project. Organic production of vegetables in the country got positive direction during the last couple of years. BARI introduced PGS certification system ensures the organic product to consumer as organic. Every year new grower groups are coming and growing vegetables under organic farming system. This year, there have been a total 30 ton of different types of organic vegetables sales in the niche market, while in 2015 it was 5 tons only. Farmers' income has substantially increased as they are getting more price than before. The project has left a positive impact on the working villages. It is expected that the extension of this project would promote and spread the organic movement throughout the country.

2.2 Establishment of Network and Model Manual on Postharvest Technology of Horticultural Crops in Bangladesh

I. Introduction

Bangladesh produces a variety of fruits on a seasonal basis. Mango is one of the important fruits in Bangladesh in terms of area and production. Bangladesh produces 116,200 MT of mango in an area of 93,000 acres of land (Yearbook of Agricultural Statistics, 2016). The fruit is very popular to the people due to its taste and nutritional value. This important fruit is grown well in Chapai Nawabganj district of Bangladesh. Mango now has been recognized as one of the important commercial fruits in that area. It is not only the nutritious and tasty fruit, but also it has huge business potential in the country and abroad. Many people are dependent on mango for their livelihood. Postharvest management of fruits in Bangladesh is far from satisfactory level as in the most developing countries of the region. Due to inadequate knowledge on postharvest handling of this important fruit, a bulk portion is spoiled every year leading to huge economic losses for the farming community.

Postharvest losses of fresh fruits and vegetables are estimated to be 30% and even reach up to 50% for some products due to lack of postharvest technology in developing Asian countries. In Bangladesh postharvest losses of fresh fruits and vegetables were estimated at 23.6-43.5% (Hassan, 2010). Minimizing postharvest losses of fruits is more sustainable and environment friendly in terms of production than increasing the area of cultivation in order to compensate for these losses.

Therefore, quality maintenance is important to farmers, traders and consumers, and it becomes a key factor for consumers in evaluating the horticultural products. Around USD 441.28 million are lost every year due to post harvest spoilage of some selected fruits and vegetables in Bangladesh. The postharvest losses of mango must be reduced for sustainable production and better availability in the market, better nutrition for the people, higher income for farmers and stakeholders in the market chain. Very recently, mango is being exported from Bangladesh to many European countries including Middle East. However, there are many problems in mango industry of Bangladesh due to traditional methods of harvesting, transportation, distribution and so on. Therefore AFACI project has included mango in the project to improve the overall postharvest management activities in Bangladesh. With this end in view, AFACI-Bangladesh postharvest project has undertaken a program to train the producers, traders and other stakeholders on the application of improved technology

of postharvest handling of mango in Chapai Nawabganj district with a view to reduce postharvest losses, thus, increase the income of farmers and traders. To feed more people in Asia, postharvest losses must be reduced to an acceptable level. Project First Phase was from September 2012 to August 2015 (USD 30,000) and Second Phase was from January 2016 to December, 2018 (USD 72,000).

The project aimed at building a cooperative system and to integrate practical knowledge targeted at postharvest quality maintenance and food safety of horticultural crops among participating Asian countries; developing concrete actions aimed at resolving the existing problems of the postharvest industry with practical model manual on postharvest handling of tomato, cabbage and mango, and also enhancing food safety and quality of tomato, cabbage and mango by utilizing more efficient postharvest technologies and applicable advanced food safety policies. Implementing Institute: Bangladesh Agricultural Research Council, Dhaka-1215

II. Development / Progress

The major achievements of this project include:

A postharvest network has been developed with 50 professionals in Bangladesh. Two manuals on cabbage and tomato have been developed and published both in Bangla and English for 3,000 copies. Each manual on mango has been developed and published in April 2016 from AFACI-Korea. Awareness and capacity building on postharvest management of horticultural crops have been developed through the project activities. Manuals published on tomato and cabbage would help to minimize postharvest loss in Bangladesh through improved postharvest handling technologies being applied in the postharvest industry.

Most of the trained professionals involved in the production to retailer's levels of horticultural crops are adopting improved postharvest handling technologies. Farmers' / Peoples' perception: Farmers and public peoples are very much interested to adopt the improved postharvest technologies as their knowledge increased as a result of AFACI-postharvest project activities. Postharvest manuals on three horticultural crops have been published in Bangla and English languages.

- A Manual on Postharvest Handling of Cabbage (3,000 copies).
- A Manual on Postharvest Handling of Tomato (3,000 copies).
- Manual on Postharvest Handling of Mango (5,000 copies).
- Awareness and capacity building among participating stakeholders have been

increased to a great extend through training, workshops, coordination meetings, seminar, etc.

- The PI of the project participated in AFACI annual workshops and gained knowledge and experiences, which he could contribute in their own situation to improve the postharvest management system of the country.

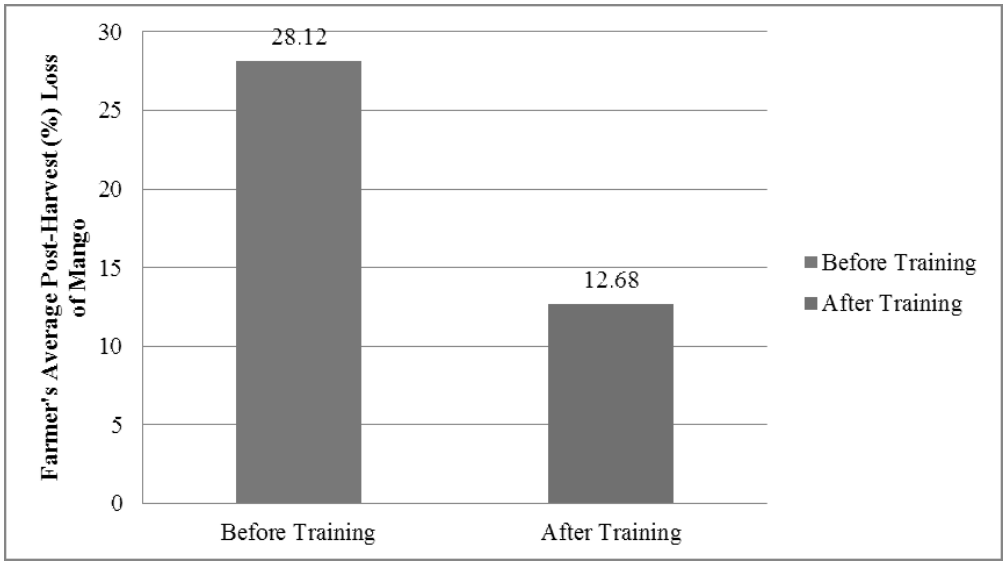
The constraints are that most of the stakeholders at different levels do not know about the improved postharvest technologies. Market prices are not stable for fresh horticultural crops. There is no adequate number of postharvest processing industries in the country. There is lack of infrastructures for postharvest activities in Bangladesh. There is no monitoring system of the AFACI projects in Bangladesh. There is no enough packing house and cold storage for fruits and vegetables in Bangladesh. There is no honorarium for PI and Co-PI of the project.

III. Socio-Economic Returns

Postharvest losses of mango at farmer's level (before and after training):

An attempt was made to assess the postharvest losses of mango at farm level. The following figure shows the comparison of postharvest losses in mango at farmers level between two period (before and after training). Before participating in the training, postharvest losses of mango at farm level was estimated 28.1% in the study areas. Hossain (2017) also found in their study that postharvest losses of mango accounted for 24% in the hilly region. After participating in the training, the postharvest losses came down to 12.7%. The change in reduction of postharvest losses was observed to be 54.9% implying that the training had positive impact on reduction of postharvest losses.

Postharvest losses of mango at farmers level (Before and after training)



The postharvest losses in mango have decreased. But whether this decrease is significant or not, this was further examined by 't' test, since the distribution was normal (See appendix table). We can see the result of 't' test in the following table.

Descriptive statistics of postharvest losses at farm level
Paired Sample Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PHL Before training(%)	28.1	25	11.8	2.36
	PHL After training (%)	12.7	25	5.13	1.03

Significance test of postharvest losses at farm level
Paired Sample Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std.. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PHLBef.train (%) –PHLAftr.train(%)	15.4	8.07	1.61	12.1	18.8	9.57	24	0.00

The result of the paired 't' test showed that at 5% level of significance we have enough evidence to conclude that there is a significant effect of training in reducing Post Harvest Losses of mango at farm level. The difference in postharvest losses of mango (before training and after training) was observed significant.

3. Conclusion

Through the study, it was found that before training, the postharvest losses at farmers' level accounted at 28.1% and after training the loss reduced to 12.68%, which was significant at 5% level. Before training, the postharvest losses of mango at trader level were observed to be 21.80% and after training, the loss reduced to 8.52% which was significant at 5% level. The study also revealed that after obtaining training, average income of farmers and traders had increased by 25% and 16%, respectively which was significant at 5% level. The study showed that respondents faced some problems in adopting the technology such as paucity of institutional credit, unavailability of BARI mango harvester and hot water treatment plant in the study areas. If the constraints could be eliminated and more farmers, traders and laborers involved in mango business would have been trained on improved postharvest technology, postharvest losses in mango could be reduced substantially thus ensure increased sustainable income for the farmers and traders in mango business. This kind of further project is needed for postharvest technology dissemination, training and awareness generation on postharvest loss especially for fruits and vegetables.

Bhutan

Impact of the AFACI Projects in Bhutan

1. Introduction

Bhutan is a landlocked country with a population that is largely agrarian and rural based (62.2% of total 735,553 persons in 2017), agriculture sector in Bhutan has a potential to expand its role as a key driver of food security, economic diversification and growth, wealth creation, employment generation, and poverty alleviation. Today, the agriculture sector continues to be a predominant player in improving the country's economy, livelihood, and environment contributing 17.4% to national GDP (2018) and employing 49.1% (2017) of the total population, of which 59.3% are female. More than 71% of country's total geographical area is maintained under forest cover with abundant biodiversity resources.

Bhutan formally became a member of Asian Food and Agriculture Cooperation Initiatives (AFACI) in May 2016 together with Myanmar, expanding the AFACI member countries to 14. The overall goal of the AFACI projects are:

ⅰ. Promoting sustainable agriculture development;
ⅱ. Establishing a network of researchers for development and dissemination of agricultural technologies; and
ⅲ. Collaborating in the research and development for capacity building.

The Ministry of Agriculture and Forests (MoAF) is the executing agency for all AFACI funded projects in Bhutan. As of today, Bhutan has implemented nine different projects funded by AFACI and major activities included: (i) Dissemination of Renewable Natural Resources (RNR) information and agricultural technologies; (ii) Development and improvement of organic model farming to share successful experiences, modeling of resource recycling and pest management in organic farming system; (iii) Characterization and documentation of traditional animal genetic resources; (iv) Development of locally-appropriate GAP programs and agriculture products safety information; (v) Conservation, sustainable utilization, and improvement of gene bank protocol for animal and plants genetic resources; (vi) Conducting comprehensive surveys of important pests and diseases of rice and vegetable virus; (vii) Establishment of aeroponic structures and production of potato mini-tubers seed potato free from virus; and (viii) Distribution and transfer of national superior seeds of food crops.

2. Development

A. **Strengthening of institution:** The AFACI-GAP project has been most instrumental in development of required documents of GAP. Besides, preparation of GAP manuals for four crops, namely; apple, mandarin, potato and hazelnut and the Bhutan Agriculture and Food Regulatory Authority (BAFRA) accreditation to ISO/IEC 170 65:2012 Conformity Assessment - Requirements for Bodies Certifying Products, Processes and Services as GAP Certification Body (CB) are a major capacity building and step towards Bhutan's participation in international agriculture trade. Further, project played pivotal role in establishing linkages of safety information system among AFACI member countries and neighboring SAARC countries for exchange of safety information.

B. **Transfer of technologies and identification of new virus:** Rice pests are one of the common factors that reduce production of the rice in Bhutan. With the support of the AFACI project, around 250 farmers were trained and introduced to Pheromone traps to manage rice pests in the project area. This technology is now widely used in many rice growing areas. The researchers in collaboration with the scientist from Korea, identified and recorded four new (Cucumber mosaic, veinal mottel, pepper mild mottle and tobacco curly shoot virus) viruses in chilli and tomato in Bhutan for the first time. Such a finding helped to better control the pests and disease in chilli and tomato.

C. **Training of farmers and extension Officials:** With the support from the project, training and awareness on the postharvest management and value addition of apple and orange were conducted (645 farmers and 70 extension officials) and extension materials on proper post-harvest handing of apple were published and distributed. Training of farmers on basic organic management, soil fertility, and pest management (12 core cluster households and 62 household covered) covered 60 acres of land under cultivation. Further, training also covered protected vegetable cultivation, orchard management, rainwater harvesting, zero energy cold storage, etc.

D. **Establishment of community-based seed growers:** 195 wheat seed growers, 320 maize, potato, and beans seed growers were instituted with the support of the project. These helped to supply and distribute national superior seeds and transfer of technologies. Thus, it is expected to increase the yield of the crops.

E. Capacity development of officials: The officials were benefited from the collaboration and exchange program. As of today, over 45 officials have availed the various training programs and other ex-country visits. It has greatly enhanced their knowledge and experiences, which can be seen in the demonstration of their expertise while delivering their services.

F. Phenotypic and genetic characterization of AnGR: The mitochondrial DNA D-loop sequences of traditional horses were published. Further, the DNA banking of traditional AnGR at the National Animal Gene Bank was completed. Currently the gene-bank holds 1,546 DNA samples from five species, namely, horse, yaks, chicken, pig, and cattle. It is expected to enable researcher across the globe to compare and reference Bhutanese AnGR. In addition, it also contributed in the conservation of AnGR in Bhutan. The detail as in table 1 below.

Table 1. Phenotypic and Genetic Characterization of AnGR

Activities	Completion (Year)
Morphological characterization of chicken	2016
Genetic characterization of horse	2017
Genetic characterization of cattle (Nublang)	2017
Molecular genetic studies of yak	2018
Morphological characterization of sheep	2019 (to be completed)

G. Cooperation: With the implementation of the AFACI projects, there has been an increased cooperation between Republic of Korea and Bhutan. It has also seen an increased visit of delegations. Hosting of “2018 AFACI Workshop on Horticulture” in Bhutan and bestowing of 5th AFACI Chair to National Representative (NR) of Bhutan have further strengthened cooperation with AFACI Secretariat, AFACI member countries, and Ministry of Agriculture and Forests, Bhutan.

3. Socio-economic Returns and Impacts

a. **Reduced exposure to pesticides:** Use of pesticides in the project sites to control rice pests were reduced to 10%, which has reduced exposure of farmers to health hazards and also contributed to reducing environmental pollution in the community. Further, it has also contributed to Bhutan's policy of shifting towards organic farming.

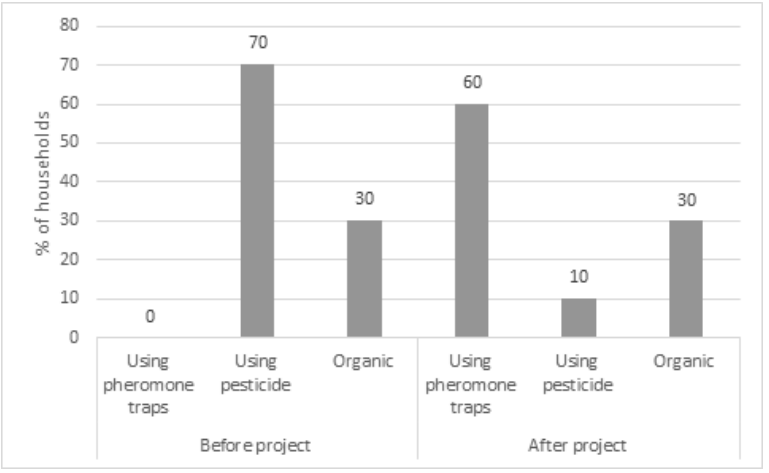


Figure 1. Percentage of households using pheromone traps

b. **Significant reduction in the postharvest losses of apple and orange:** Before implementing the project, the postharvest loss of apple was 73.1% and orange was 45.3%, which has been identified as the major factor in production loss in the country. With the support of the AFACI projects, there has been a significant reduction in the postharvest losses in these two commodities. In 2017, only 54.7% of the Bhutanese orange reached the market without any defects or damages. This figure has increased to 73.2% in 2018 which correlates to better earnings and income for the growers in the same year. The detail is shown in the figure 2 below.

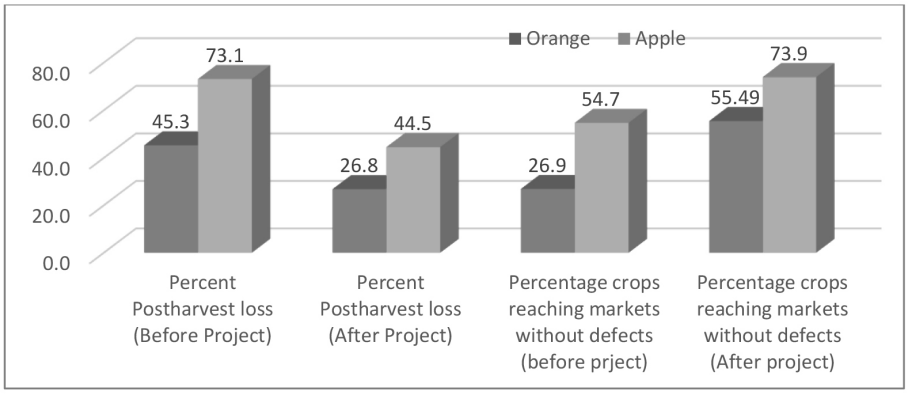


Figure 2. Reduction in the Postharvest losess (%)

c. **Significant increase in the vegetable cultivation:** Before implementing the project, there was no or very limited vegetable production. The most significant shift was been observed in organic vegetable production. It has contributed to nutritional requirement of the communities and also generated income from the sales of organic vegetables. This organic model village has also been replicated in other districts. The production of vegetables is shown in the table 2 below.

Table 2. Approximate vegetable production (2017)

Sl.No.	Vegetable	Estimate area (Ac)	Production (MT)
1	Cabbage	3.00	7.5
2	Sag	1.00	0.4
3	Pea	3.50	3.5
4	Radish	2.00	6.0
6	Tomato	0.60	1.5
7	Cucumber	NA	0.5
8	Coriander	NA	0.02
9	Chili	0.60	1.2
10	Cauliflower	0.20	0.6
Total		10.9	21.2

d. **Effects on policies and programs in agriculture sector:** With the support of the AFACI project, Bhutan is able to institutionalize the GAP certification program for the selected crops; strengthen the implementation of GAP activities for improving quality and safety of agricultural produce. Most importantly, it has served a pivotal point in major policy shift and changes towards the development of

agriculture sector in Bhutan gearing towards GAP system. Therefore, it highly contributes to the Bhutan's vision of achieving 100% organic. Recently, the Royal Government of Bhutan has approved one of the mega projects (about USD 15 million) to support organic farming and Good Agricultural practices in Bhutan as a special government program.

4. Conclusion

Within the short period of time, AFACI projects have made a significant impact in the lives of rural people in Bhutan. Moreover, the implementation of AFACI projects was very instrumental in supporting our national programs such as: improving food and nutrition security situations; improving rural livelihood and reducing poverty; enhancing cash income for subsistence farmers and most importantly, the capacity development of researchers and extension officials. Continuity of the AFACI's presence in Bhutan can greatly contribute to reach national goal of achieving national self-sufficiency in food production and technology transfer and dissemination.

Therefore, it is highly recommended that AFACI should continue to support member countries. Increasing frequency of dispatching visiting scientist from AFACI can contribute in better dissemination of knowledge and technology as well as exchange of expertise. At times, PI meetings consume lots of project budgets, and limit budget for actual implementation of activities. Therefore, a separate fund allocation by AFACI secretariat for such meetings may need to be considered.

Cambodia

Impact of the AFACI Projects in Cambodia

1. Introduction

The Asian Food and Agriculture Cooperation Initiative (AFACI) is an inter-governmental and multi-lateral cooperation body aiming to improve food production, realize sustainable agriculture and enhance extension service of Asian countries by sharing knowledge and information on agricultural technology.

AFACI, which was officially inaugurated in Seoul, Korea back in November 2009, is composed of 14 member countries, namely: Bangladesh, Cambodia, Lao PDR, Indonesia, Kyrgyzstan, Mongolia, Nepal, Philippines, Sri Lanka, Thailand, Vietnam, Korea, Bhutan and Myanmar.

Among one of the 12 first country members of the AFACI, Cambodia is an agricultural country that consists of about 85% of population live in rural areas, and more than 70% are doing farming that depend on crop, livestock, fisheries, and forestry. The Royal Government of the Kingdom of Cambodia sets out policies and promotes the implementation of “The Rectangular Strategy, phase III and national strategic development plan 2014-2018” that continues to consider agriculture as a priority sector to support national economic growth, ensure equity, food security and to promote rural economic development. The Agriculture Strategic Development Plan 2014-2018 is an important medium terms policy and strategic document. It serves as a road-map that clearly identifies agriculture development goals with expected result indicators and clusters of activities of the Ministry of Agriculture Forestry and Fisheries for its five-year implementation from 2014 to 2018.

Following the missions of AFACI to promote the sustainable agricultural growth in the Asian region; and to contribute to consistent economic development of member countries through the technological cooperation in agricultural and food sectors, Cambodia had implemented seven projects on Technology Information Network; Animal Genetic Resources; Postharvest Technology of Horticultural Crops; GAP and Safety Information System; Organic Farming; Pest Management and Seed Extension Seed.

AFACI Projects that are being implemented by different technical departments under the Ministry of Agriculture, forestry and Fisheries are small, but they are so

practical and contribute a lot to improve food production, realize sustainable agriculture and enhance extension service of the member countries by sharing knowledge and information on agro-technologies. The support by AFACI has greatly contributed to the development of agricultural sector and to alleviation of the people's poverty. The project Principal Investigators (PIs) and many relevant scientists and technician have learned and shared many new lessons and experiences.

2. Development

With the financial support from the AFACI, we have developed and implemented projects related to the application of improved postharvest handling of tomato in postharvest industry. With this regard, the reduction of postharvest losses of tomato has been conducted by analyzing the problems and determining the present status of postharvest technology. The postharvest loss rate has reduced from 23% to 20.5% and the farmers' income has increased approximately 5% through loss reduction and quality improvement. Through this project, we have published 900 manual books and 3000 posters on practical postharvest handling of tomato in Khmer language and shared knowledge to approximately 700 participants of students, farmers, collectors, private sectors, government officials through various methods.

AFACI also support the Establishment of the Asian Network for Sustainable Organic Farming Technology (ANSOFT). The whole results show that organic and chemical- free farming is feasible and helps to employ more people in the countryside and generate additional income.

The acheivement of the ANSOFT project support by AFACI such as:

- Farmers consume a good quality of the free-chemical products and made them healthier than before.
- Farmers could produce their organic fertilizer (i.e. compost) by using the resource available in the farms, especially, the manures from their small livestock such as cattle, pig, chicken, instead of chemical fertilizer.
- The cost of input has been reduced by less or no cost for organic fertilizer, thus, farmers will get higher net income.
- The soil quality has been improved and become better for the environment. Because farmers has stopped using chemical fertilizers and replaced it by organic fertilizers.

- With growing public concern for food quality and safety and nature resources, organic farming has become more accepted by government, farmers and consumers worldwide. This trend and market demand directly influence the rapid growth of organic farming in Cambodia.
- It linked organic farmer groups to markets and diversified organic products into higher value-added products.
- It has conducted training, meeting and discussion programs on organic farming among the farmers and stakeholders.
- It has demonstrated on cultivating organic vegetables by using greenhouse.
- It has organized planting schedule of farmer group.
- It has continued to develop Cambodian organic agriculture standard.

AFACI projects have also included Animal Genetic Resource (AnGR) project. This project plays a significant role in providing the insights of animal genetic resources in Cambodia in the purpose of improving genetic cattle, buffaloes, and genetic chicken breeds, and sharing information among AFACI member countries. This project has achieved two handbooks, phenotypic cattle survey in Cambodia 2015 and phenotypic buffalo survey in Cambodia 2016, and two types of leaflets, characteristically unique native cattle in Cambodia 2015 and characteristically unique buffalo cattle in Cambodia 2016. It was solidly strong support from AFACI through the two trainings held in Republic of Korea: 2017 AFACI Training Program on Molecular Genetic Characterization of Domesticated Animals and 2018 AFACI International Training Program on Molecular Genetic Characterization of Domesticated Animals. Through this support, Cambodian livestock researchers have started taking into consideration about the improvement of animal breeds in Cambodia.

The importance of GAP in agricultural production has been well recognized by AFACI to promote the sustainable agriculture and green growth in the Cambodia and contribute to consistent economic development through technological cooperation and networking. The key issue is an urgent need to assist farmers in improving their knowledge, skills and practices to better manage the local ecosystems on which their food supply depends.

In this context, the key problems to be addressed in the target areas are as follows:

- Lack of farmers' knowledge and skills related to food safety and post-harvest quality of vegetables, as well as the abilities to manage these crops and inputs in an efficient and sustainable manner; and
- Inadequate opportunities for farmers to systematically share, discuss, analyze and resolve the problems they are facing.

The possible solution on the above issues is to promote food safety and product quality in Cambodia by enhancing the sustainability of intensified crop production systems. This is possible through the promotion of managing food safety and post-harvest quality of fruit and vegetables production at the farm level. To achieve this target, the project needs to publish manuals on good agricultural practices for training and experiments.

During the implication of the projects, AFACI had proved its strong and crucial support in overcoming challenges that can be generally viewed as:

- Increased capacity to conduct training activities, field experiments and follow-up activities
- Enhanced technical and facilitation skills in guiding farmers and community organizations
- Improved food safety and post-harvest quality management skills
- Diversified and increased production
- Increased family food safety and income
- Improved environment, health and gender equality
- Disseminated technical knowledge on managing food safety and post-harvest quality of vegetables from participating farmers
- Direct observation of proven, applied examples
- Strategic plan in line with policy of donors and government formulated
- Successful activities documented and disseminated

With regard to the seed extension project, the AFACI project provides effective outreach through strengthening seed distribution managing system of community in order to stabilize seed production in Cambodia. This project helps farmers to gain skill and knowledge of high-quality seed production technology and to extend the knowledge to their neighbors.

3. Potential socio-economic returns impacts

The AFACI projects in Cambodia have helped to strengthen government policy, especially in agriculture sector. Ever since it is officially launched, AFACI projects have played important role in contribution to Cambodian's agricultural development.

In terms of environment protection, the proposed project is designed to have a direct, positive impact on the environment through the reduction of pesticide application in general, and the use of the most toxic agrochemical in particular.

Through the projects, we have closely communicated and cooperated with other Asian counties including Sri Lanka, Bangladesh, Philippine, Bhutan, and Kyrgyz Republic.

There were approximately 2,000 leaflets of manual, extension materials, posters and training materials published in Khmer language. There were also 20 field demonstrations that cover 16,000 m^2 of total land on cucumber, yard-long bean, tomato and eggplant, and 20 proliferation farms of superior seeds.

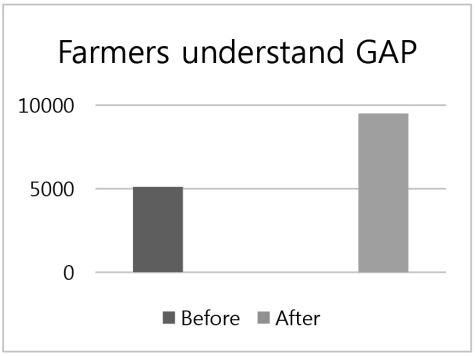
The AFACI project on Establishment of Agricultural Technology Information Network in Asia (ATIN) has helped the publication of educational books (crop calendars) which are:

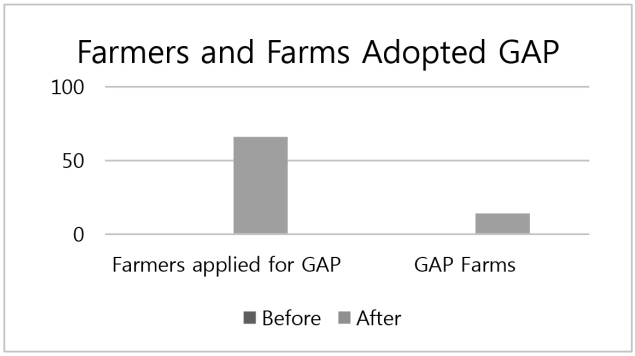
- Booklets on desertification – A visual synthesis, 500 pcs
- Booklets on durian production, 500 pcs
- Books on some concepts and terminologies related to UNCCD, 500 pcs
- Books on text of UNCCD, 300 pcs
- Crop calendar, 2,400 pcs
- Rice seed quality, 1,000 pcs
- Laboratory equipment for testing grain quality, 400 pcs
- National action program to combat land degradation 2018-2027, 1,000 pcs.

We have observed differences in farmers' understanding and implementing Good Agriculture Practice with the help of the AFACI project (indicated in the graphs below):

- Before the project, until 2015, there were:
  - 5,120 farmers understand GAP
  - 0 farmer applied for GAP
  - 0 GAP farm

- After the project, there were:
  - 9,500 farmers understand GAP
  - 66 farmers applied for GAP
  - 14 GAP farms

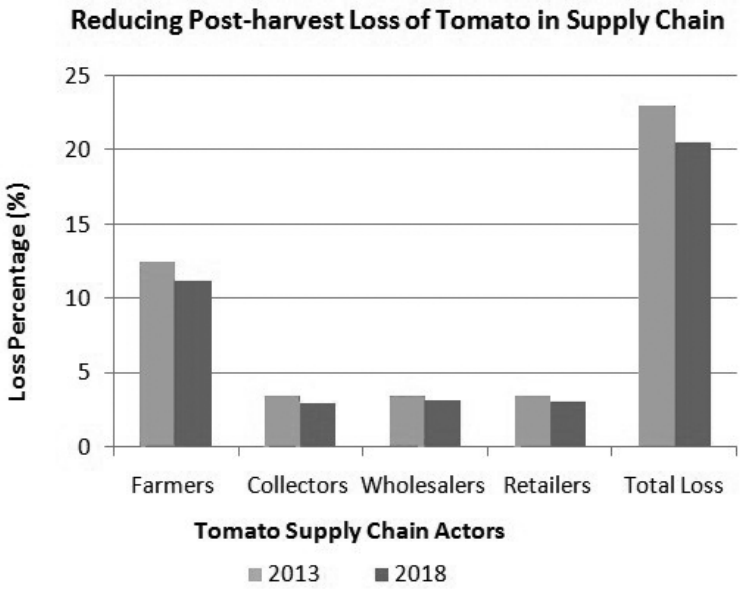




900 manuals and 3,000 posters of postharvest handling of tomato written in Khmer language have been distributed to farmers and vegetable collectors in target area.

Reduction of postharvest losses of tomato has been conducted by analyzing the problems and determining present status of postharvest technology. The loss rate reduced from 23.0% to 20.5% and the farmers' income increased approximately by 5% through loss reduction and quality improvement by applying the manual.

During the application of this manual, about 80% of the farmers and collectors understood the new techniques and will continue to apply the manual to reduce the loss of their produce.



The graph shows the reduction of post-harvest loss of tomato in supply chain before (2013) and after (2018) applying the tomato postharvest handling technical manual published by the AFACI project at the project target area in Kandal province. The loss was reduced from 12.5 to 11.2% at the farmer level, from 3.5 to 3.0% at the collector level, from 3.5 to 3.2% at the wholesale level and from 3.5 to 3.1% at the retailer level. The total loss through the whole supply chain was reduced from 23 to 20.5%.

4. Conclusion

Finally, the AFACI projects have made significant contributions to the poverty reduction in Cambodia. These projects are the solutions to the issues that Cambodia is currently facing. To promote food safety and product quality in Cambodia by enhancing the sustainability of intensified crop production systems, it is made through the promotion of managing food safety and postharvest quality at the farm level. The projects help to identify problems occurring in agricultural production and to find appropriate solution.

In order to achieve the sustainable agricultural development in Cambodia, I sincerely request RDA and AFACI Secretariat to provide continued supports through collaborative projects.

Indonesia

Impact of the AFACI Projects in Indonesia

1. Introduction

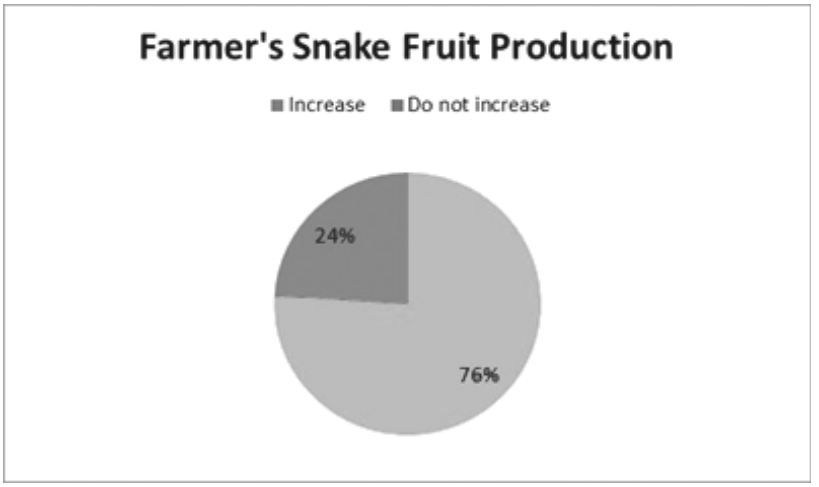
Agriculture is one of the key sectors within the Indonesian economy. Currently, around 30% of Indonesia's land area is used for agriculture. Supporting the livelihood of millions of Indonesians, it needs to be a key component of the Government's poverty alleviation strategy. The Indonesian agriculture sector is supervised and regulated by the Indonesian Ministry of Agriculture. The technology is necessary to developagriculturefor effective, efficient, healthy, and safety agricultural production. Indonesian Agency for Agricultural Research and Development is responsible for technology development through conducting agricultural research.

The Asian Food and Agriculture Cooperative Initiative (AFACI) was officially inaugurated in Seoul, Korea, and since holding its first General Assembly meeting in April 2010, it has carried out various projects with Asian partners. Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, has collaborated with AFACI to conduct agricultural research and development activities in various areas, such as livestock, crops, land management, mechanization, genetic resources, and postharvest technology and to strengthen the internet and education sectorfor information sharing opportunities among member countries.

After the Letter of Agreement (LOA) signed in 2014 by IAARD and AFACI, IAARD has self-funded its research activities and has not received fund from AFACI to implement the technical projects in Indonesia. As the compensation of the contribution, AFACI funds Indonesia's scientists to attend AFACI workshops held outside Indonesia to present the results of cooperation activities and facilitate scientific training for 3-5 researchers at research centers in the Republic of Korea annually. In 2018, Indonesia and AFACI renewed the LoA, and reallocated Indonesian research projects. Indonesia has participated in nine projects with different amount of project budget. Indonesia through IAARD participate in the AFACI is the implementation of its tagline: *Science, Innovation, Network.*

2. Development

For 18 years of collaboration, Indonesia has been implementing 15 AFACI's projects. The overall goal of implementing AFACI projects is to develop technology, promote agricultural research and development in member countries. AFACI has provided many benefits for researchers in Indonesia. For example, the project allowed to develop Good Agricultural Practices (GAP) for snake fruit farmer in Sleman Regency. The collaboration brings benefit to improve GAP application on horticulture cultivation. Horticulture farming needs intensive treatment such as land management, giving organic fertilizer, watering routinely, pest and disease controlling, pruning, and post-harvest management. Impact of GAP implementation increases farmer's production. About 76% of farmers said that their production increased because of the GAP implementation, while about 24% of farmers said that their production did not increase as they did not implement the GAP. Average increase in production was about 24% within two (2) years after the GAP implementation.



Beside the improvement of the agricultural technology, AFACI projects have helped farmers to increase their ability in developing organic vegetable farming or converting from inorganic to organic farming (ANSOFT Project). There were 10 farmers' groups which were involved in the project with a varied status on organic vegetable farming. During the project activities, farmers were trained to apply organic vegetable farming that efficiently using local resources. Training materials included the following: (a) integration of plants and animals on organic vegetable farming; (b) pest and diseases management on organic vegetable farming; (c) institution and association of organic vegetable farmers; (d) composting techniques, local microorganism,

and biopesticides; (e) submission of organic certification; (f) organic marketing channel; and (g) socialization of national regulation on organic farming.

The application of organic vegetable farming has increased farmers' income. The revenue of its farming was about USD 9,836/ha/3 months over the cost of farming of USD 2,807/ha/3 months. As a comparison, the revenue of non-organic vegetable farming was USD 4,775/ha/3 months over its cost of USD 2,846/ha/3 months. It means the revenue-cost ratio of organic farming was 3.5, while the same ratio of non-organic farming was only 1.68.

The AFACI project has improved and strengthened networking and science both at the international and national level with stakeholders such as farmers, extension workers, researchers, entrepreneurs, policy makers, and other practitioners. In addition, Indonesian researchers had the opportunity to participate in training and workshop conducted by AFACI to improve their capacity. AFACI project in Indonesia has helped increase the capacity of extension agents through training, technical guidance, and publications. Through training and technical guidance, extension agents were introduced to information on agricultural technology from the IAARD. Information on agricultural technology plays an important role in the process of agricultural development. The availability of various information sources that will disseminate or convey information on agricultural technology can accelerate the progress of the agricultural business.

3. Potential Socio-Economic Returns Impacts

Most of the AFACI projects give the potential return impacts of socio-economics in the projects locations. One of the projects which has impacts is the project on postharvest. The AFACI project was quite helpful in overcoming the problem of postharvest losses in shallots in Indonesia. Through the project funded by AFACI, postharvest losses of shallot could be identified, so that the necessary technology was more directly applied. In improving the quality and reducing the postharvest losses of shallot, IAARD has recommended the use of in-store drying for the process of curing, drying, and storage of shallots.

The application of in-store drying can reduce postharvest losses of shallot from 27.5% to 11.5%. Solok regency with shallots population has near 5,000 ha

of land and its productivity is 12 ton/ha. Then, the shallots production should be 120,000 ton/year. If losses can reduce about 16%, then 19,200 ton of shallots can be saved or can increase farmer's income of Rp. 192 million or USD 13,715,000 a year at Solok. At present, the Instore dryer has been implemented in Alahan Panjang, Solok Regency, West Sumatra, Brebes Regency, and Central Java. In addition, handling and processing technology of shallots was disseminated more widely so that the use of technology by the community has highly increased.Some GAP project activities were done through AFACI project. For instance, Standard Operational Procedure (SOP) for chili was produced in Lembang and Ciamis, SOP mango in Cirebon; GAP demo plot for chili, mango, and snake fruit was built. Another outstanding activity was the dissemination of GAP product (snake fruit) in the national event in horticulture which was held in October 2018. The objectives were to disseminate and socialize the safety and quality of fruit (snake fruit), in order to increase awareness of society to consume GAP product. It is suggested that same activities should be applied to other commodities. The potential social impact is increasing knowledge and awareness among consumers on GAP products.

ATIN Project brought a significant impact in adopting information system at the farm level. The ATIN project activities were training for extension officers, producing media materials for dissemination, providing relevant documents, monitoring and evaluating projects. This project has contributed to the improvement of dissemination system in the IAARD and brought a positive impact on increasing adoption of technolgy at the farm level.

Another potential social impact is networking among national and international actors, such as farmers, extension agents, government, private companies, and NGO through web site. The website is consist of AFACI projects, national projects regulation, and Indonesian AFACI project progress.

4. Conclusion

The ANSOFT project has an influence on local government policy as follows; : a) the village of Batur is one of the villages in the sub-district of Getasan in Central Java Province launched as a center of organic vegetables in Semarang District, Central Java Province; b) the local government provided nine units of greenhouse (plastic house) for the farmer group of Bangkit Merbabu and one unit for Tranggulasi farmer group. Both farmer groups have organic farming certificates. In addition, the local government also provided 12 units of a motor tricycle with van cargo to transport vegetable for Batur village; c) the local government improved the farm road to be passed by motor tricycle van cargo; d) the capacity of farmers related to the implementation of organic farming has improved.

The collaboration gives so many positive impacts for Indonesia. We hope the collaboration with AFACI could continue to: (1) add the other commodities, (2) make a market, and (3) disseminate the technology to the larger area.

Philippines

Impact of the AFACI Projects in the Philippines

1. Introduction

The Philippines is an agricultural country. The agriculture sector is made up of four sub-sectors, namely: farming, fishing, livestock, and forestry.

The main agricultural crops are rice, corn, coconut, sugarcane, bananas, pineapple, coffee, mangoes, tobacco, and abaca. Secondary crops include peanut, cassava, camote, garlic, onion, cabbage, eggplant, rubber, cotton, among others.

Since its involvement as one of the member countries in 2010, a total of 14 projects have been coordinated within the DA's bureaus and attached-agencies, and selected State Universities and Colleges (SUCs). As of this reporting date, out of the 14 projects, 10 have already been completed and the remaining four are nearing their project completion.

2. Development and Project Impact

The AFACI-funded projects can be summed up into the following categories as follows: organic agriculture, rice, genetic resources, soil fertility, fruits and vegetable post-harvests, climate change adaptation measure, rice pest management, cassava farm mechanization, rice production, good agricultural practices, biotech, biofertilizer, good agricultural practices (GAP), and information network.

Descriptions about the projects and their potential socio-economic impacts are presented as follows:

Construction of the Asian Network for Sustainable Organic Farming Technology

The project on farming technology resulted to the adoption of an organic farming community village in Camiguin Island. A network of subsistence upland farmers has devoted themselves to practice organic agriculture.

Since the farmers are already organized and part of the "network of networks" under the Philippine AFACI-ANSOFT, the interventions of the project resulted to an

enhanced ecological, economic, socio-cultural, and technological capital.

Because of the project, the provincial government of Camiguin embarked on a province-wide organic program involving all the four municipalities through a provincial council resolution and an organic agriculture master plan.

Collection, Characterization, and Distribution of Vigna sp. and Pigeon Pea Germplasm to Promote use in the Philippines, Phase 2 and Integrated Management System of Plant Genetic Resources, IMPGR

The PGR project has strengthened the national PGR network and conserved Solanaceous vegetables like tomato, eggplant, and pepper. This is a high impact project as there is now a collective effort on conserving the genetic identity of our traditional Solanaceous crops.

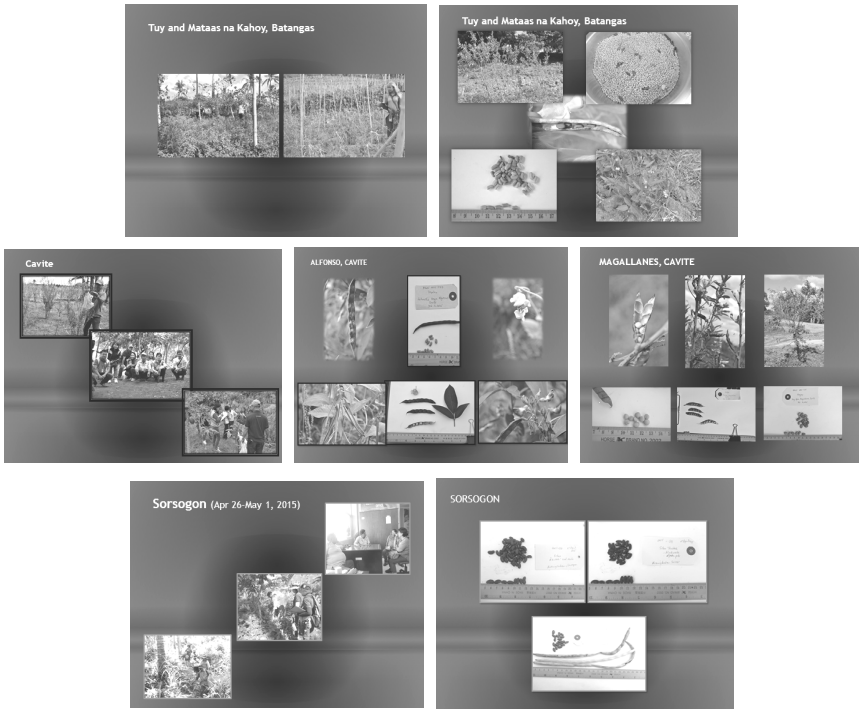
In the Philippines, the national gene bank or National Plant Genetic Resources Laboratory (NPGRL) of the Institute of Plant Breeding holds significant germplasm collections of legumes that include seven (7) Vigna species and pigeon pea.

The first activity was able to achieve the aim by identifying stakeholders with germplasm collections of Vigna species and pigeon pea. A national survey was performed on the status of the germplasm holding of agencies or institutions with legumes germplasm collections. Nine PGR stakeholders for Vigna crop species and pigeon pea were identified.

One hundred thirty accessions of legumes were collected from 12 provinces of the country. Pigeon pea had the greatest number of collection with 48 accessions, followed by cowpea with 34 accessions, yardlong bean with 27 accessions, 13 accessions for mungbean, ricebean had seven (7) accessions and one (1) accession of ricebean. These were collected from backyard garden, market, and home storage.

Collections were placed in the drying room to remove initial moisture and will be further dried using silica gel.

The status of characterization of the germplasm of identified legumes and pigeon pea from 2016 to 2017, have 228 mungbean, 86 cowpea and 53 accessions of pigeon pea characterized.

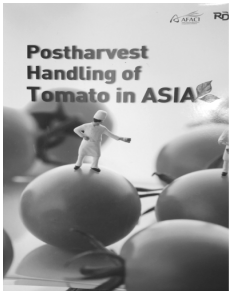


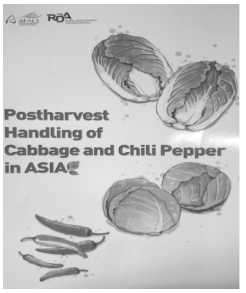
Exploration, collecting and conservation of Vigna and pigeon pea germplasm and summary of legume collections from the three provinces

Establishment of Network and Model Manual on Postharvest Technology of Horticultural crops in ASIA and Application of Improved Postharvest Handling Techniques of Crops Grown by Farmers in the Philippines

Publications on postharvest handling of tomato, cabbage, and banana were some of the direct outputs under the postharvest project. These materials were produced independently and have been in circulation within the AFACI member countries and partners.

The outputs of this project are books and manuals, like the ones seen below.

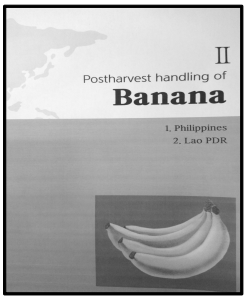


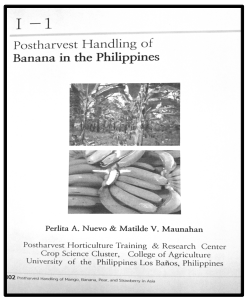


The first book published was on tomatoes, which was done by all the participating countries namely, Bangladesh, Cambodia, Indonesia, Korea, Lao PDR, Mongolia, Nepal, Philippines, Sri Lanka, Thailand, Vietnam and recent inclusion of Kyrgyztan.

The second book was on pepper and cabbage and the third book was on fruits including banana, mango, strawberry and Asian pear.

Philippines and Lao PDR focused on banana. The banana postharvest handling system from the farm to the packinghouse and market was discussed in the project. It also shows that the use of liners during hauling could very well improve the quality by minimizing mechanical damage.





Other information, education and communication (IEC) materials have also been produced: (1) an enlarged tomato fan for a second reproduction, (2) expandable wombok fan, and (3) mobile poster indicating postharvest tips for vegetables including tomato and written in Filipino. A pictorial guide on Postharvest Handling of Bungulan Banana is in the pipeline.

Development of Locally-Appropriate GAP Programs and Agricultural Produce Safety Information Systems in the Philippines

The GAP project includes supply chain analysis in the form of a survey questionnaire specific for stakeholders along the food supply chain. A traceability tool and training modules have also been developed.

The AFACI GAP Philippines project is aimed to focus on other areas of intervention such as market linkages, implementation and controlling structure and monitoring and learning platform. Also included were value or supply chain analysis in the form of a survey questionnaire specific for stakeholders of the target commodity along the food supply chain.

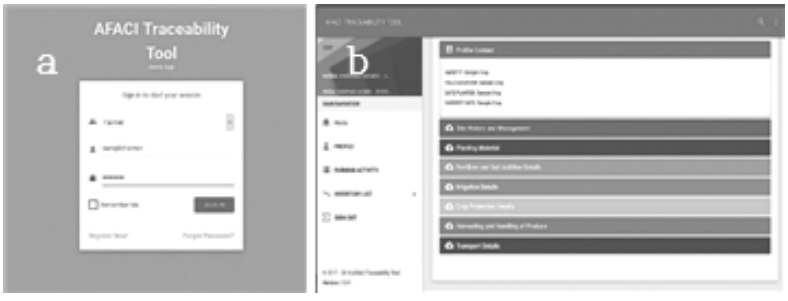
Traceability is a tool that helps in mapping the movement of a fresh farm produce along the supply chain.

Major activities (1st (2016), 2nd (2017), and 3rd (2018) year)

- Developed the PNS on the Code of Hygienic Practices (COHP) for Gabi Leaves
- Conducted Value-or supply chain analysis for a specific agri-commodity.
- Developed the traceability tool (electronic-based or paper-based) for Gabi Leaves and its training module

Instrumental to the success of the PhilGAP program prior to its transfer is the assistance provided by the AFACI-GAP Project, which enabled its timely assessment.

The screenshots below show the user-interface of the draft version of the traceability tool.



Screenshots of the Traceability Tool (desktop version) – a) log-in page, and b) dashboard

The other activities in the AFACI GAP Project Phase I also included value chain analysis of a specific subsector, baseline and impact monitoring survey. The validation activities gave a snapshot of the current farmers' practices and the quality of gabi leaves produced using current practices.

The results of the microbiological and chemical analyses were used as basis for the development of national standards. From the results of the validation of farmers' practices, a farmer-group specific GAP manual for gabi leaves was developed – an approved Philippine National Standard (PNS) Code of Hygienic Practice for Gabi Leaves.

GAP manuals on target crop

The brochures aim to harmonize the understanding and interpretation of the developed standards. This may also help in increasing the compliance of farms with standards towards GAP certification.

The team also aims for the traceability system tool to be institutionalized as part of the GAP certification program. This tool will not only benefit the stakeholders (farmers, traders, processors, market and consumers) in tracking the product flow but it will also help the regulators (BPI) and extension workers (RGTs) in monitoring the compliance of farms.

Assessment of Brown Planthopper, Whitebacked Planthopper Populations and Virus Diseases in Rice and Selected Solanaceous Crops

The importance of Integrated Pest Management (IPM) to combat rice pest and its application are given attention in the pursuit of increased rice production.

The monitoring of rice planthopper (RPH) using light trap was established in PhilRice Central Experiment Station (CES), Maligaya, Science City of Muñoz, Nueva Ecija.

High populations of RPH monitored using sticky trap coincided with the reproductive to ripening phases of rice plants in the field. It was further observed that planthopper adults invaded rice at reproductive phase and seems that they invade rice earlier during wet season. For both dry and wet seasons, monitoring showed that white-backed planthopper was usually recorded earlier to colonize rice plants than brown planthopper.

During the field samplings, spiders, coccinelids, mirids, and tiger beetles were commonly observed in the field.

The proponent plans to continue monitoring RPH to establish population patterns of the insect pests. Likewise, we would like to sustain the strong regional collaboration that is very essential for the generation of information to improve management of RPH in our country.

Through this collaboration network, the outbreak of RPH and associated viruses will be intensively monitored in-countries or inter-countries. The outbreak information will be shared through the Internet Platform for Asian Migratory Insects and Viruses Surveillance (AMIVS) system.

Enhancing Agricultural Mechanization Technologies for Crop Production and Postharvest Processing of Cassava in the Philippines

Cassava is one of the major agricultural crops in the Philippines. In terms of product utilization, direct food use constitutes only 10 percent of total production. Large portion is used in processing. About 64 percent of cassava for processing is used for food related products.

In collaboration with project counterpart from Thailand, Dr. Anuchit Chansing, a tractor drawn digging implement which he originally designed was adopted. Detailed AutoCAD drawings were made and ACT Machineries was commissioned to fabricate the first prototype (Figure 2). Using 90 HP tractor initial results showed that the prototype performed with great potential. In addition to AFACI project funds, the

Philippine government provided more funds to locally develop the digger.

The prototype digger underwent series of pre-tests under different field conditions in the provinces of Isabela and Quirino. Using 90 HP tractor, replicated short runs of 100 m showed that the theoretical field capacity was 0.24 to 0.37 hectare/hour. Depth of cut was 20 to 28 cm, while average tractor speed was 3.8 to 6.1 km/hour.

Figure 2. Locally fabricated cassava digger prototype.

The cassava digger was subjected to more intensive field tests in the provinces of Isabela, Pampanga and Bataan. Half hectare areas were harvested. Results showed that the field capacity was 0.15 to 0.42 ha/hr. Depth of cut was 22 to 25 cm, while average tractor speed was 4.8 to 7.0 km/hr. Harvesting losses (end portion of tubes that were cut out left in the soil) were estimated at 1.9 to 2.2%.

Feedbacks were gathered from farmers and other observers. They pointed out several advantages of using cassava digger, namely, reduction of drudgery (88%), reduction of labor requirement (100%), faster harvesting (100%) and reduction of harvesting losses (81%). Most of the observers (94%) expressed interest to use the digger.

Figure 4. Cassava digger prototype with sturdier frame.

The AFACI project played a key role in introducing mechanized harvesting of cassava in the Philippines. In collaboration with project counterpart from Thailand, a tractor drawn digging implement was localized, evaluated and further developed. The cassava digger was eventually promoted, adopted by farmers and commercially manufactured. The project demonstrated the importance of inter-country collaboration for rapid introduction and adoption of appropriate technologies.

The introduction of mechanized harvesting technology revealed several weaknesses in the current crop production of cassava. For example, most cassava farms are not planted uniformly, limiting the effectiveness of mechanized harvesting and implying the need for proper planting or even mechanized planting. Likewise, the severe presence of weeds hinders efficient digger performance, implying the need for better weed control.

The AFACI project provided funding support to initiate activities to introduce and promote cassava mechanization and postharvest technologies.

Five units were acquired from ACT Machineries for the nationwide field testing and demonstration activities. Cooperators have been identified and the diggers were shipped to the cooperators by April 2015. The field testing and demonstration cooperation between the project and the cooperators were covered by a Memorandum of Agreement (MOA) stipulating the roles and responsibilities of respective parties.

The cassava digger reduces the drudgery of manual digging or uprooting of cassava tubers. It decreases the harvest losses down to two percent and reduces labor costs up to 80 percent.

Establishment of Agricultural Technology Information Network

The Agricultural Technology Information Network presentation materials and reports are consolidated and uploaded in the website of AFACI-ATIN. The standardized information platform allows easy inter-country access to agricultural technology and information and its database to its users. Also featured in the ATIN database are crop calendars of selected commodities.

2017 was a great year for the ATIN project in the Philippines as it was the first time in eight years that the project was recognized and bestowed with Most Outstanding Project/Principal Investigator.

Discussed below are the highlights of accomplishments of the project from July 2017-June 2018 that are contributory in this achievement.

A total of 16 information materials and 19 news articles were maintained in the database of agricultural information.

- Produced the BAR Digest Magazine (July-September 2017) dedicated to AFACI-funded projects being implemented in the Philippines
- Produced five (5) Video documentation of AFACI projects in the Philippines
- Produced and published 10 Commodities for the Crop Calendars. 15,450 calendars were distributed.
- Distributed agri-educational books in various events
- Produced and distributed a total of 573,862 copies of various IEC materials
- Conducted 20 regional seminars from July 2017-June 2018 and 23 regular in-house seminars. Both seminars accumulated 3,090 attendees

As such, people from outside of the country like Saudi Arabia, Dubai, Hong Kong, Qatar, USA, etc. were able to view the seminar in their respective places. Exchange of information and inquiries were made possible through FB messages.

Realizing the importance of the ATIN initiative in contributing to agricultural information dissemination and knowledge exchange, the ATIN-Philippines, through DA-BAR, further strengthened the content build-up of the database. This was evident in the increase of the uploaded information materials from merely 10 crop calendars in October 2013 to more than 60 information materials on various agricultural commodities including repackaged crop calendars, technology flyers and brochures, and success stories – uploading of which started from February 2017 up to the present.

On Video documentation

Episode aired on national TV featuring an AFACI project on rice

Episode aired on national TV featuring an AFACI project on postharvest

Distribution of crop calendars/IEC materials

Sample of IEC materials produced/distributed

Social Media

Annual review

BAR Director Nicomedes Eleazar gives his opening message during the annual project review

Group photo of AFACI PIs in the Philippines together with BAR Director Nicomedes Eleazar and staff

The AFACI-funded and implemented projects in the Philippines are being coordinated by the Department of Agriculture (DA), through the Bureau of Agricultural Research (BAR).

The coordination, management, and documentation of the projects are being done through the Applied Communication Division (ACD) in my capacity as the head of the division and as the newly designated AFACI National Coordinator. I have a special section within the division devoted to the AFACI.

Since the projects are implemented across the country, one of the challenges experienced, so far, are the gathering of the Principal Investigators (PI) or project implementers for the regular progress update meetings and the erratic schedules of PIs for project audio-video production.

There may be perceived challenges, but the cooperation among the project implementers are/were always assured. In the implementation and monitoring of the projects, seldom did we experience issues and concerns relative to their implementation.

Asked if there are critical support or help to overcome challenges by AFACI? None so far. The coordination of the bureau with the various project proponents are working well.

3. Conclusion

At the top of any international cooperation and partnership is the promotion of the common good, resonating towards to the good of humanity.

Promoting sustainable agriculture, enhancing technological innovation, establishing network for joint research and development (R&D) initiatives, intensifying technology, and sharing knowledge are important components and deliverables in attaining a progressive agriculture. These (deliverables) are also being intensified between the Philippine's Department of Agriculture, through the Bureau of Agricultural Research, and the Korea's Rural Development Administration (RDA) through the Asian Food and Agriculture Cooperation Initiative.

Transformational driven activities and technological innovations are just some of the initiatives undertaken by BAR and partner-agencies, which resulted into high-impact project outcomes. Since AFACI's establishment and our continuing partnership, we, at BAR would like to say, further, that without your support and trust this would not have been possible at all.

Ⅳ. Impact Report of the KAFACI Projects in

Ghana

Impact of the KAFACI Projects in Ghana

Executive Summary

Support from the Korea-Africa Food & Agriculture Cooperation Initiative (KAFACI) to the Council for Scientific and Industrial Research (CSIR) to carry research towards reducing poverty, ending hunger by improving food security, and promoting sustainable economic growth. These directly contributed to meeting Sustainable Development Goals (SDGs) 1, 2, and 8, respectively.

The programme sought to improve food production, attain sustainable agriculture and enhance extension services through knowledge and information sharing on agricultural technologies in Ghana. The programme was effectively implemented by three research institutes of CSIR, namely: Plant Genetic Resources Research Institute, Crop Research Institute and Animal Research Institute. The specific projects under this programme are: ***Germplasm management, Agricultural mechanization, Horticulture postharvest project, Enhancement of national agricultural extension systems phase II, Rice breeding project, and Livestock project phase II.***

Through the Germplasm Management project, the following were achieved:

- A review of information on 3,240 accessions of orthodox germplasm;
- Regeneration of 1,084 orthodox germplasm; Characterization of 228 orthodox germplasm;
- Disease evaluation of 228 orthodox germplasm; Development of image database for 228 orthodox germplasm; and
- Baseline survey conducted on eggplant germplasm utilization and disease challenges in 11 communities of 2 Districts in the Volta region of Ghana.

Comprehensive inventory of orthodox plant genetic resources completed during the project period will be instrumental for planning future collecting expeditions, promotion of lesser used germplasm, enhance species reintegration into agro-based systems, and assist coordination of *in situ* conservation, among others. Germplasm regenerated to acceptable exchange seed viability standards will also promote seed distribution, exchange and efficient conservation. Provision of physical location for germplasm will enhance speedy seed distribution, reduce labour and resource constraints and consequently reduce cost of operation. Characterization, evaluation

and image databases produced during the project will promote utilization of germplasm for breeding programmes. Duplicate germplasm will be easily identified and managed. Distribution based on plant traits due to available database will reduce the number of plant accessions given out at a time to ensure longer regeneration regimes and hence reduce cost of germplasm maintenance.

The Agricultural Mechanization Project on "***Baseline survey on the status of agricultural mechanization in Ghana***" is in its second year of implementation. The project, which has a broad objective to understand the status of agricultural mechanization in KAFACI member countries in Africa, had the following specific objectives: Identify constraints and opportunities to the adoption of improved agricultural mechanization technologies and innovations in Ghana to establish the current status of agricultural mechanization in Ghana; Share a strategy and research agenda for KAFACI member countries; and Make technical and policy recommendations for enhanced adoption of agricultural mechanization practices. Results obtained from the baseline survey will be instrumental in generating information that will help to understand the existing agricultural mechanization practices, constraints and opportunities in Ghana. This will also help in guiding the research agenda for agricultural mechanization, improvement of existing technologies and recommendations for technical and policy development in the country. The implementation of such recommended technical and policy interventions will lead to the realization of measurable qualitative and quantitative outcomes through the improvement of productivity among the selected value chains ensuring improved farm production systems, incomes, food and nutrition security.

The model manual developed under Phase 1 is currently being used to build capacity of stakeholders on proper postharvest handling and improving quality and value of fresh tomatoes along the supply chain. Information provided being disseminated through the manual/model is focused on: The importance of using improved/pure seeds, healthy seedlings and best production and management practices to produce superior quality tomatoes; Avoiding the heat of the sun during harvest and transportation, and how to manage temperatures by using effective cooling shade covers; The use of plastic crates as packaging to replace large wooden boxes and plastic bowls at the point of harvest and throughout the supply chain. To facilitate usage of the manual by stakeholders who cannot read, it was translated into three (3) local languages and developed into an audio-visual training material. This electronic manual is currently in DVD format and is also available in

other simple and less expensive formats which can be easily copied directly on mobile phones and uploaded onto social media platforms (YouTube, Facebook, WhatsApp, etc.).

Noteworthy impacts of the ***Development and Application of Postharvest project are***: Reduction in losses; Integration of the supply chain; Improvement in quality and safety of harvested produce; Availability of new upland rice lines in seven districts: Knowledge transfer; Market linkages; Credit access; Dissemination of seed; Increased demand for seeds; and Equipment.

The project also distributed seeds to 55 farmers in seven districts within the Volta Region of Ghana. It has sensitized and built capacity of the public on Good rice production techniques through accompanying radio and television educational programmes. The high yielding, disease resistant and consumer-preferred rice varieties are tolerant to the major diseases. Fewer insecticides will therefore be used in its cultivation, and this indirectly protects the farmer and the environment from being exposed to high levels of dangerous chemicals. A good foundation has been laid for release and further dissemination of the new lines with financial assistance from the Korea Program on International Agriculture, thus giving impetus to the government's Planting for Food and Jobs programme.

The livestock project under the programme also showed better performance of birds of farmers who bought their feed from the Animal Research Institute's research station and was diligent in following the prescribed husbandry practices and management. Below are some key findings identified from the livestock project: Farmers now have the technical know-how on raising layers for maximum profitability through modern husbandry practices; Farmers are now using sea water and Limbux (limestone) as a cleaning disinfecting agent; Farmers are now using light to increase day length to enhance laying performance; Farmers are now using cheap and efficient laying nest; and lastly, The researchers on the project have affirmed the importance of phase feeding in laying hen performance.

The outcomes attained so-far from the KAFACI-support to Ghana is showing positive impact on agricultural production and livelihoods of farmers. The detailed report below will further highlight on key developments, impacts, and potential benefits of all the six projects under this programme.

Project 1: Germplasm Management Project in Ghana

1. Introduction

Ghana has made efforts in the conservation of plant genetic resources, with the establishment of Plant Genetic Resources Research Institute (PGRRI) under the Council for Scientific and Industrial Research (CSIR) mandated to collect conserve and coordinated plant genetic resources activities. The PGRRI has collected, characterized, evaluated, documented, distributed, conserved and promoted utilization of plant genetic resources of Ghana and abroad. About ten thousand accessions of cereals, legumes, vegetables, root and tubers, fruit trees, medicinal plants and spices have collected and conserved in the ex–situ genebank of the PGRRI.

Ghana has several in situ conservation activities going on at several locations throughout the country. The PGRRI manage 16.5 hectares arboretum of timber species, medicinal plants and local spices at Bunso, the Centre for Scientific Research in to Plant Medicine (CSRPM) at Mampong-Akwapim have arboreta which contains mostly, medicinal plants and the Forestry Commission (FC) maintains 276 Forest Reserves which contain timber species and other forest resources.

The Act 307 of 1965 regulates exchange of Plant Genetic Resources in Ghana. Ghana has signed conventions on biological diversity such as: Convention on Biological Diversity, Rio de Janeiro, 1992; International Tropical Timber Agreement, Geneva, 1983; Convention on International Trade in Endangered Species of Wild Flora and Fauna, Washington, 1973; Convention concerning the Protection of the World Cultural and Natural Heritage, 1972 and the African Convention on the Conservation of Nature and Natural Resources, Algiers, 1968.

There have been collaborations with several institutions within the Consultative Group on International Agricultural Research (CGIAR) and other agencies that provide funds for PGR activities in Ghana such as: the International Institute of Tropical Agriculture (IITA), the International Rice Research Institute (IRRI), the International Crop Research Institute for Semi-Arid Tropics (ICRISAT), EMBRAPA, Biodiversity International, Global Crop Diversity Trust, and others. The continuous discard of landraces for improved cultivar by farmer and habitat modification due to human activities and climate change endanger existence of many plant species.

Challenges in data generation and documentation of plant genetic resource information plagued coordination of plant genetic resource activities for effective conservation and management in Ghana. The Korea Africa Food and Agricultural Cooperation Initiative (KAFACI) Germplasm Management Project which aimed at understanding the status of genetic resources conservation and management of Ghana and to enhance capacity for adoption of standardized genetic resources management system was appropriate in addressing some challenges with germplasm conservation Ghana.

2. Development

In Ghana the project priority was on conservation of orthodox germplasm and evaluation of landraces of eggplant, tomato and pepper. These crops were selected based on their immense genetic resources available, the potential of the crops for income generation by small holder farmers and challenges with cultivation.

The project activities were undertaken in the Eastern and Volta Regions of Ghana by a team of scientist in the expertise of crop breeding, agronomy and crop protection. There were collaborations with farmers in the country and scientist from within and outside Ghana. The project budget was $60,000 for four years.

The KAFACI Germplasm Management Project came at the time when seed viability of many orthodox plant genetic resources at the CSIR-Plant Genetic Resources Research Institute had dropped below recommended levels due to power outages and hence needed regeneration. A review of the seed inventory was necessary due to germplasm loss. Many of the crop landraces especially the Solanum species had limited information on characterization and disease evaluation. It was important to generate more characterization and disease evaluation information on available landraces of eggplant, tomato and pepper to enhance their utilization for breeding programs and cultivation.

Capacity was built through training in the best practices of plant genetic resource (PGR) conservation, management and evaluation methods at the National Agrobiodiversity center in Jeonju, Korea during the project period. Techniques learnt during the training and funds received were instrumental in improving PGR conservation and management practices at the CSIR-PGRRI.

Through the KAFACI project the following was achieved:

1. A review of information on 3,240 accessions of orthodox germplasm
2. Regeneration of 1,084 orthodox germplasm
3. Characterization of 228 orthodox germplasm
4. Disease evaluation of 228 orthodox germplasm
5. Development of image database for 228 orthodox germplasm
6. Baseline survey was conducted on eggplant germplasm utilization and disease challenges in 11 communities of 2 Districts in the Volta region of Ghana

	Areas of achievement	Before	After
1	**Inventory**	Incomplete	Completed for 3,240 plant accessions
2	**Regeneration**	Average seed viability was 55%	1,084 (33%) orthodox germplasm regenerated to 95% seed viability
3	**Characterization database**	Needed addition	Created for 100 eggplant accession, 28 pepper accessions and 86 tomato accessions
4	**Evaluation database**	Needed addition	Created for eggplant, pepper
5	**Image Database**	Not available	Created for 100 eggplant accessions, 28 pepper, accessions tomato, and 100 maize accessions
6	**Germplasm Physical location**	Not available	Created to ease orthodox germplasm conservation and management

3. Socio-economic Returns and Impacts

Comprehensive inventory of orthodox plant genetic resources completed during the project period will be instrumental for planning future collecting expeditions, promotion lesser used germplasm, enhance species re-integration into agro-based systems, assist coordination of in-situ conservation, among others.

Germplasm regenerated to acceptable exchange seed viability standards will promote seed distribution, exchange and efficient conservation. Provision of physical location for germplasm will enhance speedy seed distribution, reduce labour and some resources constraints and consequently reduce cost of operation.

Characterization, evaluation and image databases produced during the project will promote utilization of germplasm for breeding programs. Duplicate germplasm will be easily identified and managed. Distribution based on plant traits due to available database will reduce the number of plant accessions given out at a time to ensure longer regeneration regimes and hence reduce cost of germplasm maintenance.

Capacity building through the project has enhanced adoption of standard germplasm management practice. This will promote efficient management and coordination of germplasm activities in Ghana.

The KAFACI Germplasm Management Project coordinated Plant Genetic Resources Management activities of 12 African countries from West, North, East, and Southern Africa. The project provided platform for comprehensive overview of PGR potential of Africa. Major PGR of the project member countries was identified. Joint training and discussions of member countries were organized by the project. The improved agricultural output of Korea through development of expertise and facilities for effective management and utilization of PGR was demonstrated. Through the project implementation it was established that PGR conservation and management was a shared responsibility. Individual country effort and global collaboration is important to safeguard PGR for future crop improvement and utilization.

4. Conclusion

The KAFACI Germplasm Management Project was a timely intervention and the aim was useful for promoting efficient conservation and utilization of PGR in Ghana and abroad. Database necessary for effective management of PGR were generated through project implementation. Capacities have been built through training and exposure for adoption of standard PGR management practices. Windows for regional and global collaboration on PGR activities have been opened. These achievements will enhance effective PGR conservation utilization for improve agricultural output in Ghana.

Germplasm collection, conservation facility upgrade and expansion should be considered in future projects. The rapid depletion of PGR requires more efficient facilities to complement human expertise for effective conservation and management. Long term training on PGR management is also suggested.

Project 2: Potential Impacts of the KAFACI Agricultural Mechanization Project

Potential impacts of the KAFACI Agricultural Mechanization project

The KAFACI Agricultural Mechanization Project on “Baseline survey on the status of agricultural mechanization in Ghana” is in its second year of implementation. The project which has a broad objective to understand the status of agricultural mechanization in KAFACI member countries in Africa has the following specific objectives:

1. Identify constraints and opportunities to the adoption of improved agricultural mechanisation technologies and innovations in Ghana to establish the current status of agricultural mechanization in Ghana
2. Share a strategy and research agenda for KAFACI member countries
3. Make technical and policy recommendations for enhanced adoption of agricultural mechanization practices

Results obtained from the baseline survey will be instrumental in generating information that will help to understand the existing agricultural mechanization practices, constraints and opportunities in Ghana. This will also help in guiding the research agenda for agricultural mechanization, improvement of existing technologies and make recommendations for technical and policy development in the country. The implementation of such recommended technical and policy interventions will lead to the realization of measurable qualitative and quantitative outcomes through the improvement of productivity among the selected value chains ensuring improved farm production systems, incomes, food and nutrition security.

Project 3: Impact of KAFACI Horticulture Postharvest Project

1. Introduction

Postharvest losses in fresh fruits and vegetables are estimated at 30–50% due to lack of adequate postharvest technology in most developing countries. Minimizing postharvest losses of horticultural crops is a more environmentally sustainable approach merely than increasing cultivation to compensate for these losses. Quality maintenance through improved postharvest technology is therefore important for farmers, retailers and consumers, and is a key factor in increasing the value of horticultural produce. In advanced countries, improved postharvest technologies are practically applied for maintaining high quality and food safety using handling manuals or guides for each commodity; however, such manuals using advanced technologies are often not suitable for developing countries due to differences in climate, infrastructural access and production systems. There is an urgent need for development of such manuals for appropriate handling of key fruits and vegetables by relevant stakeholders in the industry, to enhance agricultural development in developing countries. The goal of this Project is therefore to reduce postharvest losses in selected crops (especially tomato) and improve commercial value, through the implementation of a postharvest handling model.

2. Development

a. Information on projects

STAFF: Project Team, CSIR-Crops Research Institute Fumesua-Kumasi
COLLABORATORS: Extension Officers, Ministry of Food and Agriculture (MOFA)
PARTICIPANTS: Tomato Farmers and Traders' Association, Agogo

PHASE 1: Summary by Year

	YEAR 1	YEAR 2	YEAR 3
Inputs	US$12,000	US$12,000	US$12,000
Activities	1. Participatory Rural Appraisals (PRAs) conducted in selected Districts of Three (3) Regions in Ghana 2. Analysis of data and writing of reports	1. Development and testing of improved technologies 2. Analysis of data and writing of reports 3. Development of handling manuals for three (3) crops	1. Development of simple and practical tomato manual for application 2. Workshop for Capacity-building and networking 3. Participation in AsiaPostharvest conference

PHASE 2: February 2018 – Feb 2021

	YEAR 1.	YEAR 2	YEAR 3
Inputs	US$17,000	--	--
Activities	1. Development of electronic model manual for tomato in English and three (3) local Ghanaian languages 2. Construction of Basic Packing house demonstration Unit at CRI Fumesua Station	--	--

b. Technical challenges needed to solve during the project implementation

In Project Phase 1, the main objectives were to:

- Find out the current status of postharvest handling of three (3) selected horticultural crops in Ghana (Tomato, Pepper and Orange)
- Develop improved handling technologies for each selected crop, capable of reducing postharvest losses
- Document these technologies into manuals to be published for each of the three (3) crops, to be implemented for one selected crop (Tomato) in Phase 2 of the project

c. Critical support or help to overcome challenges (problems) by KAFACI

KAFACI Postharvest Coordinator and his team have helped by

- Presenting guidelines and recommended format for developing the model manual
- Advising on our proposed technologies and execution of the pilot application of the model
- Facilitating the sharing of results between fifteen (15) African countries for better learning experiences

d. Agricultural development and achievements (up to now) through the project

The model manual developed under Phase 1 is currently being used to build capacity of stakeholders on proper postharvest handling and improve quality and value of fresh tomatoes along the supply chain. Information provided being disseminated through the manual/model is focused on:

i) The importance of using improved/pure seeds, healthy seedlings and best production and management practices to produce superior quality tomatoes

ii) Avoiding the heat of the sun during harvest and transportation, and how to manage temperatures by using effective cooling shade covers

iii) The use of plastic crates as packaging to replace large wooden boxes and plastic bowls at the point of harvest and throughout the supply chain

Target users of the manual (Fig. 1) are Farmers & harvesters, Agricultural Extension staff, Traders & middle men, Transporters & loading boys, Market queens and District Assembly representatives (Local Government).

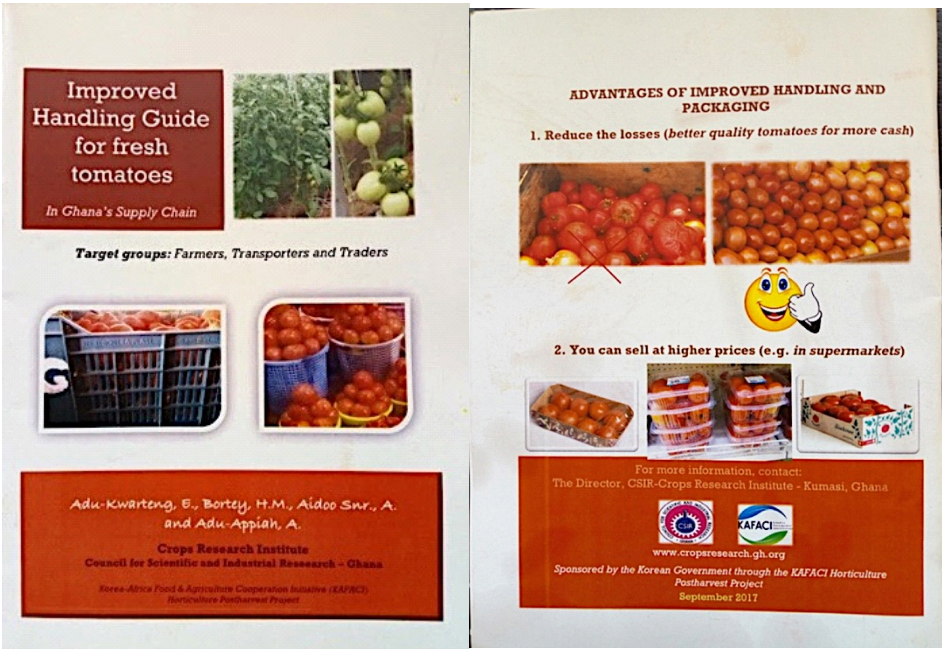


Figure 1. Manual printed out as a simple picture book

To facilitate usage of the manual by stakeholders who cannot read, it was translated into three (3) local languages and developed into an audio-visual training material. This electronic manual is currently in DVD format (Fig. 2) and is also available in other simple and less expensive formats which can be easily copied directly on mobile phones and uploaded onto social media platforms (YouTube, Facebook, WhatsApp, etc.)

Figure 2. DVD format of audio-visual training material produced in different languages

(English, *Twi, Hausa and Ewe*)

The CSIR-KAFACI tomato postharvest model in Ghana is therefore currently available in four (4) languages (English, Twi, Hausa and Ewe) and it will be disseminated as a Training Guide which will be widely used widely by Extension Agents in their regular interactions with the stakeholders. In its current form, the manual is being used to disseminate information on:

i) The importance of using improved/pure seeds, healthy seedlings and best production and management practices to produce superior quality tomatoes

ii) Avoiding the heat of the sun during harvest and transportation, and how to manage temperatures by using effective cooling shade covers

iii) The use of plastic crates as packaging to replace large wooden boxes and plastic bowls at the point of harvest and throughout the supply chain

A very basic Pack house point is also under construction at CSIR-CRI Fumesua Station (Fig. 3). It will serve as a training/ demonstration facility for key actors in the tomato supply system in the selected area and other areas.

Figure 3. Demonstration Pack house unit under construction at Fumesua Station

Improved technologies capable of reducing losses were applied as interventions at critical points identified in Ghana's fresh tomato supply chain, as shown in Table 1.

Table 1 : Critical points identified for intervention in postharvest loss reduction in Ghana's tomato sector

Postharvest losses (%)	Conventional technology	Improved technology
Field losses (disease, damage)	22	5
Packaging & Transportation (mechanical & heat damage)	16	8
Marketing (accumulated stresses, both physical and biological)	17	12
Total	**55**	**25**

The model will be under continuous refinement throughout Phase 2, and the final version of the manual will be one of the main outputs of the project.

3. Potential returns socio-economic impacts

a. Successful and outstanding effects

i) Reduction in losses

Tomato production in 2013 345,000 Mt (MOFA SRID, 2014). Production costs average $40 per ton (IFPRI 2010). Postharvest losses up to 50% of production (i.e. >150,000 Mt); estimated value of losses is therefore >$6 million/year in terms of production costs. Current Pilot application of KAFACI Horticulture Postharvest Model indicates up to 30% reduction in postharvest losses within the Project area (Table 1). The results expected in a less controlled application in the tomato sector is targeted to achieve at least 10% or more reduction in losses. Achieving just 10% reduction in postharvest losses by application of the KAFACI Horticulture Postharvest model translates into >$600,000 increase in national income from tomato.

4. Conclusion

a. Improvements, impacts, changes

i) *Reduction in losses*: Pilot application of KAFACI Horticulture Postharvest Model resulted in up to 30% reduction in postharvest losses within the Project area (Fig. 4).

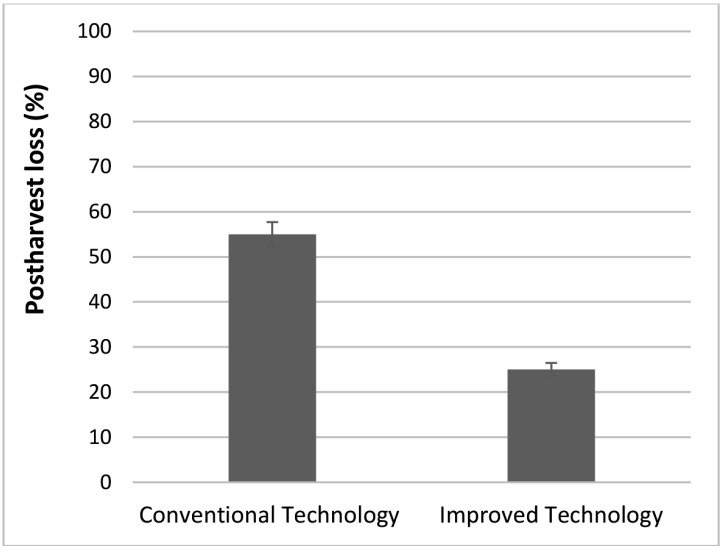


Figure 4. Comparison of postharvest losses (%) under different management practices

ii) *Integration of the supply chain*: Through the Project, various actors within the supply chain are being brought together on the same platform to recognize their inter-dependency, and the fact that the way each activity is managed (production, transportation and marketing) has an impact on the overall strength of the tomato business.

iii) *Improvement in quality and safety of harvested produce*: Application of improved production practices presented by the model being implemented through KAFACI Horticulture Postharvest Project is targeted to reduce the hazards of chemical misuse.

Project 4: Impact of KAFACI Enhancement of National Agricultural Extension Systems Phase II in Ghana

1. Introduction

Agriculture employs over half of Ghana's labour force (FAO, 2015). It is the mainstay for about 51% of people who live in rural areas, of which women who are household heads are among the poorest 20% (IFAD, 2009). Ghana's domestic economy revolves around subsistence farming which accounted for 20.2% of GDP in 2015 (MoFA, 2016). Agriculture is also the main source of raw material inputs for the industrial sector. Its contribution to GDP keeps declining due to little investment. "Despite efforts towards achieving food security, hunger and malnutrition is still prevalent in Ghana. The Government's poverty reduction strategy paper identifies low productivity and poorly functioning markets as the major cause of rural poverty" (IFAD, 2009; cited by PCD and HGSF, 2011). As an agriculturally based economy, smallholder farmers face a number of pertinent challenges in relation to constraints, perceived risks and uncertainties, and lack of incentives (Eenhoorn and Becx, 2009).

The World Bank believes the sector has potential to be one of the leading sectors for a more diversified economy with the right reforms, although growth in 2018 was low (2.8% compared to 8.4% in 2017 (World Bank, 2018a). Hardwick Tchale (World Bank's Senior Agricultural Economist) recommended, "There is need to channel public resources into research to increase the use of technology, invest in irrigation infrastructure to increase productivity and mitigate the potential adverse effects of climate change, and leverage increased private sector investment in agriculture" (World Bank, 2018b). This proposition made by the economist support the objective of the KAFACI ENAES Phase II project.

The Agriculture sector is constrained by low productivity resulting from low use of production inputs (certified seeds and fertilizers) and lack of access to quality extension service, lack of irrigation facilities, lack of mechanization, lack of credit access and poor markets. In 2009, Ghana showed remarkable achievement with the production of most of its major staples except rice (Refer to Table 1 by Ministry of Food and Agriculture (MoFA) in Appendix 1). There were surpluses as total production for human consumption exceeded national demand. Rice showed a deficit of 372,200 Mt (MoFA, 2009; cited by PCD and HGSF, 2011).

Every household in Ghana consumes rice. Demand keeps increasing due to changes in consumer behaviour, population growth and urbanization. The rice import bill reached $1.2 billion in 2015 (an 800 percent increase since 2007). During the same period, the volume of rice imports rose from 441,000 metric tonnes to 638,000 metric tonnes (Business and Financial Times, 2017). Currently, the country is only 34 percent self-sufficient in rice production. MoFA's report on agricultural sector progress in 2017 indicated that, Ghana is self-sufficient in all major staples except rice and millet (MoFA, 2018). Rice drains Ghana's foreign earnings; this requires investment in the sector.

One factor that has retarded the uptake of improved technologies is poor extension delivery due to the low extension to farmer ratio. The extension farmer ratio in 2016 was one extension officer to 2,500 farmers. This accounts for many inefficiencies in the delivery services (GNA, 2018). The KAFACI ENAES Project Phase II was therefore timely when its focus was to enhance the national agricultural extension services to increase food sufficiency, reduce poverty, the rice import bill, and safeguard the country's foreign earnings.

2. Development

In 2017, KAFACI supported Ghana to enhance our national agricultural extension services through the project 'Dissemination of market quality rice varieties to reduce rice importation in Ghana'. CSIR-Crops Research Institute coordinated the project from 2017 to 2019. The goal was to "improve food security and incomes of farmers through the use of adapted, high yielding, market quality rice varieties" The budget was US$ 100,000. The vision of success was a minimum yield of 4 t/ha obtained on at least 40 farmers' fields over 2 years from the use of new varieties and recommended agronomic practices and at least 10% increase in revenue of the farmers. The project also sought to link farmers to credit (which is a limiting factor to successful technology adoption/adaption for increased productivity). The project involved a multi-disciplinary team consisting of breeder, food scientist, agricultural economist and staff of extension and other rice interest groups. Since its inception, it has worked with cross section of rice stakeholders from policy, research, extension, private sector, farmers, consumers and the media.

First year

- The project successfully collected and documented baseline information on cultivation of upland rice varieties and the agronomic practices employed in twelve (12) communities within the Kadjebi district.
- Field demonstrations of three new upland rice lines with Nerica 1 (best aromatic upland rice variety in Africa) as check were set up in Dzamlome (Kadjebi district), Worawora (Biakoye district) and Hohoe (Hohoe district).
- The Dzidefo farmers' group also tested the three elite lines on 10 acres but had insignificant yields due to climatic variations and poor group work.
- Two field days organized in Dzamlome and Hohoe involved the District Chief Executive, Department of Agriculture Director, Extension agents, farmers and the NGO ProLink.
- Through Particiatory evaluation of the demonstrations, participants selected their preferred rice lines supported with reasons of their choices. As expected, the new lines yielded similar to Nerica 1 but had better visual acceptance of paddy and milled rice.
- Two tons seed was produced to be supplied to farmers in the projects second year.
- The Dzidefo farmers' group successfully opened an account with North Volta Rural Bank.
- The project used both the print and electronic media in its sensitization and education programs - six (6) radio, one (1) television broadcast and one (1) newspaper report.

Second year

The following activities were undertaken:

- Three demonstrations - in Teteman (Jasikan district), BowiriKyirahi (Biakoye district) and AkpafuMempeasem (Hohoe district).
- One field day at Teteman, with DCEs and Agriculture Directors of Kadjebi and Jasikan districts in attendance.
- Milling and sensory tests of the three new lines and Nerica 1 by CSIR-Food

Research Institute. Results showed consumers better preferred the three lines (appearance and taste).

- Distribution of 1.9 tons seed to 55 farmers in seven (7) districts in Volta region.
- The project continued its public sensitization and educational broadcasting program and was able to hold twenty-nine (29) radio, one (1) television broadcast, and one (1) newspaper print.
- The project began cataloguing spread of the new lines from farmer to farmer (Fig.1).
- Supply of 1.5 kg seed of same lines for demonstration (at their own cost) by Center for No Till Agriculture - CNTA at Amanchia near Nkawie.

Challenges

The poor performance of the Dzidefo group farm in Year 1 is partly due to working in a group instead of individual farms. This retarded the spread of the new lines. Working with individual farmers and giving only seed enabled the project to reach seven districts instead of one.

Timeliness of seed supply is essential to widen the window for planting. Seed should get to farmers at least one month (June) before the season starts. Farmers should plant early to reduce risks of terminal drought.

Using mechanized small equipment (power tiller and combine harvesters) will increase pace of manual planting that is very slow.

3. Potential returns - socio-economic impacts

The project has made some milestones; both direct and indirect through its 2-year life cycle. The project reached out to policy makers, farmers, consumers, NGO, the private sector, the media and the public. Remarkable impacts are:

- **Availability of new upland rice lines in 7 districts**: No upland rice was in existence at the start of the project, but now the project has three promising lines that could be released to farmers.

- **Knowledge transfer**: The project in the 2-year period, organized thirty-five (35) radio broadcast, two (2) television broadcast and two (2) newspaper articles which sensitized and educated the general public. Twenty outdoor billboards on steps to rice production were constructed.
- **Market linkages**: Farmers were linked to Worawora Rice Mills Ltd for subsequent milling and sale of produce
- **Credit access**: Dzidefo Farmers Group opened an account with North Volta Rural Bank
- **Dissemination of seed**: The project distributed 1.9 Mt of seed to 55 farmers during the second year that covered approximately 22 hectares in seven districts.
- **Increased demand for seeds**: Participating farmers now have seeds for their subsequent crop, and at least two farmers have sold seed to other farmers for 2019 planting, creating a multiplier effect.
- **Equipment**: Two motorbikes, one power tiller, one rice thresher and one push-type planter acquired have outlived the project.

We envisage greater future impact as farmers multiply, sell or exchange their seeds. The project also created the foundation for the release and further promotion of the new lines by a follow up project kindly funded by the Korea Program on International Agriculture (KOPIA). Faso Kaba Seed Company in Mali has requested for same lines; thanks to the project, they will be given small quantities of seed.

4. Conclusion

Ghana's economy is agrarian and agriculture is the lifeblood for many people living in rural areas and the country at large. However, the sector is bedeviled with several challenges that slows down its growth and contribution to GDP. The country depends so much on imports to meet the needs of the growing population of about 30 million, though it has natural resources and suitable weather and environment for the production of food. One commodity that raises the country's import bill is rice. Demand for this commodity is on the rise due to change in consumer preferences, urbanization and population growth. Most of the local rice less meet consumer and market

preferences due to poor grain characteristics and poor post-harvest processes.

The Korea - Africa Food and Agriculture Cooperation Initiative (KAFACI) of the Rural Development Administration of South Korea supported Ghana to enhance its national agricultural extension services through the project 'Dissemination of market quality rice varieties to reduce rice importation in Ghana' for a period of 2 years. The project through participatory approaches has been able to demonstrate three promising upland lines that yield similar to released NERICA 1 but have market preferred traits. The project distributed seeds to 55 farmers (excluding members of the Dzidefo farmers' group) in seven (7) districts within the Volta Region of Ghana. It has sensitized and built capacity of the public on Good rice production techniques through accompanying radio and television educational programs. The project facilitated the opening of account by the Dzidefo farmer group and linked farmers to Worawora Rice Mills Ltd for future purchase of paddy. A measure of success has been the cropping of introduced lines in 2018 by individuals in the Dzidefo farmers' group who were only supplied seed in 2017, and such farmers selling seed to colleague farmers. This KAFACI project has laid the foundation for release and further dissemination of the new lines with financial assistance from the Korea Program on International Agriculture.

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Appendix 1

Table 1: Domestic food supply and demand of key staples

Commodity	Total Domestic Production MT		Production available for human consumption ('000MT)		Estimated National demand (' 000MT)		Deficit/ Surplus (' 000 MT)	
	2008	2009	2008	2009	2008	2009	2008	2009
Maize	1,470.1	1,619.6	1,090.1	1,197.7	1,024.5	1,052.1	65.6	145.6
Rice Milled	**181.2**	**234.9**	**157.6**	**204.3**	**561.4**	**576.5**	**-403.8**	**-372.2**
Millet	193.8	245.5	168.6	213.6	23.4	24.0	145.2	189.6
Sorghum	350.5	331.0	288.0	304.9	11.7	12.0	276.3	292.9
Cassava	11,351.1	12,230.6	7,945.8	8,561.4	3,576.3	3,672.9	4369.5	4888.6
Yam	4,894.8	5,777.8	3,915.8	4,622.2	980.0	1,006.5	2935.8	3615.7
Cocoyam	1,688.3	1,504.0	1,603.9	1,428.8	935.6	960.9	668.3	467.9
Plantain	3,337.7	3,562.5	2,837.0	3,028.1	1,983.4	2,037.0	853.6	991.1
Groundnut	470.1	526.1	423.1	473.5	280.7	288.3	142.4	185.2
Cowpea	179.7	204.9	152.7	174.2	116.9	120.1	35.8	54.1

Source: PCD and HGSF, 2011

Fig.1. AtsuYibor is a member of the Dzidefo farmers' group who had negligible yields in 2017. In 2018, he replanted without further project intervention. He has sold seed to Kpogo Newton (from Dzamlome), Worze Wilson (Dzamlome), NestineDzator (Dodi-Papase), Peter Lekpo (NkonyaBumbula), Joseph Denutsui (Koando) and GadogoKobla (Badu, Republic of Togo).

The Project recently purchased approximately 300 kg seed from him and gave to Kind David Norgbey of Ho whose four ha land is prepared and awaiting rains.

Fig.2. Farm of King David Norgbey (Tel = 0546869390) in March 2019

Project 5: Impact of KAFACI Rice Breeding Project in Ghana

1. Introduction

Rice is a major staple in Ghana. Production has doubled in the last decade increasing from 300,000 MT in 2008 to approximately 700,000 MT of paddy in 2017. However, per capita consumption within the period also increased from about 15 to 40 kg/person/annum making it is the fastest growing food in Ghana. Consequently, the country imports about 60% percent of its requirements using millions of foreign currencies which could been invested in the local agricultural economy. The development and dissemination of higher yielding varieties will contribute immensely to bridge this gap. Current varieties are mainly Jasmine-styled with similar genetic backgrounds. There is the need to introduce diverse germplasm into the programme in Ghana to increase the probability of developing varieties that are higher yielding than current varieties, have similar or better grain quality and superior stress tolerance.

2. Development

Since 2014, many anther culture derived rice lines have been received from KAFACI. The lines include Tongil-type varieties (intermediate between indica and japonica) and japonicas. Some of the Tongil-type lines were derived from crosses between japonica and O. glaberimma/ O. longistaminata. The diverse backgrounds of these lines make them very useful for developing superior rice varieties for Ghana.

The following activities have been done:

1. Observational yield trials on over 500 lines received from the KAFACI project
2. Screening of KAFACI lines for resistance to rice yellow mottle virus (RYMV) disease
3. Over 20 crosses were made between selected KAFACI lines and popular aromatic rice varieties in Ghana
4. Preliminary yield trials on selected KAFACI lines and lines derived from crosses between Ghanaian varieties and KAFACI lines

5. Advanced (Replicated) yield trials on lines derived from crosses between Ghanaian varieties and KAFACI lines

Other Project Activities and Benefits

1. Training of two rice breeders from Ghana on another culture and other aspects of breeding
2. Opportunity to network with Korean breeders and breeders from other African countries
3. Three Masters students have used KAFACI lines for theses work

Outputs

1. Rice germplasm at the CSIR-Crops Research Institute increased by over 100% due to the introduction of lines from the KAFACI breeding program
2. KAFACI lines with superior yield and yield component traits were identified for use in our breeding program
3. Over 12 KAFACI lines with resistance to RYMV disease were identified
4. Many lines were derived from crosses between KAFACI and local aromatic varieties
5. Six lines from the crosses are undergoing national performance trials. Two of the lines have been found to be very promising.

3. Potential returns - socio-economic impacts

EXPECTED BENEFITS/IMPACTS: The new varieties derived from KAFACI lines will help increase yields of small holder farmers and hence their livelihoods. Many farmers could come out of poverty through the cultivation of superior rice varieties because rice is basically a cash crop in Ghana and the returns on investment are very high. Besides, up to three crops per year could be produced in the rain fed lowland and irrigated ecologies. Farmers will thus get regular incomes to pay school fees of their kids, build houses, buy cars and invest in other business. This could be a very good poverty alleviation intervention for poor Ghanaian farm families

especially women and children. Also, the marketing of rice either in raw (milled) or cooked form is mainly done by women and increased production and patronage of domestic rice expected from these new varieties will benefit them immensely. Many young university graduates have also started bagging and branding milled domestic rice for sale and these varieties will enhance their business and help reduce unemployment in Ghana.

There are many new seed companies and seed growers in Ghana. These seed entrepreneurs will benefit greatly from the superior characteristics of these new varieties because it will result in high demand of seed by famers and thus more sales for them.

These varieties will give great impetus to the governments planting for food and jobs programme. The new varieties provide farmers at the various parts of the country with increased options of selecting varieties that best works for them. The new varieties have varied genetic backgrounds and better resistance to environmental stresses and thus more likely to express their potential on farmers' fields and result in better yields and increased production envisaged under the planting for food and jobs programme. An increase in rice production will help to cut down imports and save the millions US dollars used on rice imports every year. This money could be invested on other pressing needs in the local economy.

ENVIRONMENTAL IMPACT (DIRECT/INDIRECT): These high yielding, disease resistant and consumer-preferred rice varieties can be cultivated intensively on paddy fields and thus limit the clearing of new land for rice cultivation. Because the varieties are tolerant to the major diseases, fewer pesticides will be used by farmers who cultivate them. This will help protect the farmers and the environment from being exposed to high levels of dangerous chemicals.

Project 6: Impact of KAFACI Livestock Project Phase II in Ghana

1. Introduction

Agriculture's contribution to total employment is estimated to be 44.7%, with the Service and Industry sectors accounting for 40.9% and 14.4% respectively in Ghana (GLSS6, 2014). Agriculture is predominantly on a smallholder basis in Ghana. The livestock sector, including poultry, is an important component of agriculture in Ghana and plays a key role in providing livelihood support to many Ghanaians especially the rural population. Livestock rearing is an important subsidiary occupation that supplements the income of smallholder farm families and rural households in most developing countries. Livestock production in Ghana mainly consists of large ruminants (cattle), small ruminants (sheep and goats), swine and poultry production. Among livestock-based vocations, poultry production has assumed an important role as a commercial activity with enormous potential for rapid economic growth (Ekunwe et al., 2006; as cited by Anang et al., 2013).

The poultry industry in Ghana is important for employment generation, source of income and regular supply of protein for human consumption. It has a huge potential for growth and has been identified as a key sector with the potential to create jobs and help address the short fall in the supply of animal protein. Poultry also possess greater efficiency in converting feed into egg and meat compared to other livestock enterprises. Commercial layer farms also play an important role in meeting national protein supply through the supply of eggs in addition to poultry meat. Commercial broiler production on the other hand, provides mainly poultry meat as birds are raised solely for meat.

Rising domestic incomes have created increased in demand for animal protein, thus opening investment opportunities in both poultry meat and eggs. In Ghana, domestic consumption of poultry is increasing rapidly at roughly 13.9% per year. While local production is growing at a comparable rate of 14.1%, this poultry is dominated by "layers" rather than "broilers." On a regional and global level, consumption rates have also shown steady growth at 6.9% per year and 4.1% per year, respectively. (AgricInGhana Media 2019). In the year 2013 Global Alliance for Improved Nutrition (GAIN) estimates the 2012 domestic market share of broiler meat at 10 percent of national consumption. As a result of this from 2000, onwards, many poultry producing farmers are focusing on egg production, with production increasing steadily(FAO).

It is now clear that poultry production in commercialized form is an indispensable tool for alleviating poverty among farmers. Successive governments have tried to support both the livestock sector and poultry, to enable them to impact meaningfully on economic development, but this is yet to be achieved. This is due to the fact that, small holder farmers face challenges; chiefly among these are, high cost of feed, weak technical know–how (example, poor feeding practices, poor use of day length, poor / no record keeping) and frequent out-break of diseases. The effect of these factors have resulted in low profitability in the industry which has caused the exit of many farmers and preventing others from entering. Therefore any studies that will help farmers solve these challenges is a step in the right direction which will help keep and bring in more farmers (women, unemployed graduates, Youth) into the poultry value chain industry. Layer production is becoming more prominent in Ghana because there is less competition with eggs produced domestically as compared to broiler.

2. Development

In 2017, KAFACI supported Ghana to establishment a Small Scale layer model Complex for some selected farmers by supplying the farmers with 20 weeks old pullets that were raised on CSIR –Animal Research Institute (CSIR-ARI) farm. CSIR-ARI coordinated this project which started in 2017 and will be ending this year 2019. The objectives of this project were to build self-reliance capacity of the farmers through their retained earnings and to build capacity of experts in member countries through cooperation with Korean experts. The budget was US$ 45,000.00. The project seeks to increase the project margins of farmers by introducing them to better management and husbandry practices. The project sought to link farmers together in order for them to share ideas and experiences among themselves as well as other farmers in knowledge sharing and technical backstopping.

The project involved a multi-disciplinary team consisting of Animal breeders, Animal nutritionists, accountant, veterinary technician, administrative staff and Ministry of Agriculture staff. Since the inception of the project we have been dealing with our selected farmers and other farmers as well.

First year

Rearing / raising of Pullets

1200 layer day old chicks (DOCs) purchased from Reiss & CO Ghana Limited were used in this project. Some renovation works was done on the already existing poultry house at the CSIR-ARI where the birds were to be kept for first 17-20 weeks. The following activities were undertaken prior to the arrival of the day old chicks to the ARI farm at Katamanso:

- Proper cleaning, scrubbing and disinfecting of the brooding house
- The brooder house was well prepared 24 hours before the arrival of the chicks following standard protocol.
- Feed and water were made available

There were enough feeders and drinkers so that at any time about 80-90% of the birds could have easy access to the feed or water during the entire production cycle (chicks to pullets' stage). Water as well as feed was given ad libitum. Vaccines and drugs were given at appropriate time according to the prevailing environmental conditions as well as the health status of the birds.

Distributions of birds

The birds were transferred to the farmers' farms after they have all been given the 3rd Newcastle vaccination. Table 1 below shows the date, time, location as well as quantities of pullets supplied to farmers. Before the birds were transferred to the various farms, training was organized for the farmers on modern husbandry practices.

Table 1: Distribution of pullets to farmer's farms

Farmer Name	Date of Transfer	Quantities Received	Time of Transfer
Alice Domozoro	11/07/2017	200	Morning
Margaret Nyameke	11/07/2017	150	Evening
Mad. Vida Addobea	14/07/2017	150	Morning
Mad. Doris Darkwa	24/07/2017	150	Evening
Mad. Cecilia Yankey	19/072017	150	Morning
Mr. Daniel Borquaye	14/07/2017	150	Evening

Performance of Pullets supplied

Table 2 shows the financial performance of the farmers from December 2017 to September 2018. The profit margins are monies realized from eggs sales after feed, water and medications expenses have been paid. From the table it clear that all the farmers were able to make some profit from the birds supplied though not much. Because in Ghana the minimum number of birds a farmer needs to make meaningful profit is 500 birds (small scale farming).

Table 2 : Performance of farmers from 2017 to September 2018 from egg sales

Name of farm	Profit margins (GHs)	Profit margins (USD$)	Number of birds alive
Magi Farms	5,027.01	1005.40	141
Magsan Farms	4,802.88	960.58	128
Tac Farm	4,507.90	901.58	107
Addobea Farms	5,808.53	1161.71	133
Doris Farms	4,348.99	869.80	104
Swinton Farms	5,629.75	1125.95	130

Second year

This year three thousand, nine hundred (3,900) Lohmann brown and white layers were purchased, raised and supplied to farmers. Though there was a Gumboro outbreak the team still with the cooperation from the farmers managed to supply some birds to the selected farmers. The table 3 below shows the pullet distribution status.The birds are currently on the farmers farm with a laying rate of 70 - 75%.

Table 3: Status, location and quantities of birds given to selected farmers

Farmer Name	Date of Transfer	Quantities Received	Community
Madam Vida Adobea	28/09/2018	200	Otinyibi
Mr. Daniel Borquaye	28/09/2018	200	Danfa
Madam Alice Domozoro	1/10/2018	200	Katamanso
Madam Margaret Nyameke	02/10/2018	200	Pantang
Madam Doris Darkwa	02/10/2018	200	Oduman
Madam Cecilia Yankey	02/10/2018	200	Madina
Madam Gladys Omaboe	26/10/2018	200	Haatso

Activities yet to be done:

- We are planning of sharing the current knowledge and information of raising layers to other farmers through their various association
- Currently, we are investigating the nutritional requirement of the layers during the laying phase, this we hope to share with our farmers and publish it as well.
- Baseline survey will be conducted (value chain analysis)
- Training of farmers (book keeping, accounting, early detection of ill health)
- Monitoring and evaluation of selected farmers farm

Challenges

Like every other project this project has some few challenges, chiefly among them are:

- Low numbers of birds to farmers to maximize their profit earnings
- Gumboro outbreak during the second year caused us to lose more than 70% of the stock (this we are hoping to receive funds to investigate properly)
- In adequate funds for regular monitoring of farmers farms
- Limited number of farmers selected due to inadequate funding

3. Potential returns - socio-economic impacts

The farmers were all given performance record sheets which were later collected for analysis of their performance. The performance records from the various farms shows that those who bought the feed from ARI research station performed slightly better than those who prepared their own feed. It was also evident from the performance records that the commercial feed on the market is not promoting optimal performance of these birds. It was obvious from the findings that though the birds were subjected to similar treatments until they were transferred to the selected the farmers farm, their performance were different.The difference in their performance could be attributed to the different routine husbandry practice.Hence the optimal performance of these birds is not only due to their genetic constituents but also the environmental conditions (i.e. husbandry practices and management).

These are some key findings that have been identified from the implementation of this project:

- Farmers now have the technical know-how on raising layers for maximum profitability through modern husbandry practices
- Farmers are now using sea water and Limbux (limestone) as a cleaning disinfecting agent
- Farmers are now using light to increase day length to enhance laying performance
- Farmers are now using cheap and efficient laying nest
- The researchers on the project have affirmed the importance of phase feeding in laying hen performance

4. Conclusion

Agriculture is the backbone of Ghana's economy especially for many people living both in and peri-urban areas in the country. The livestock sector especially poultry industry has been identified as the sector with a high growth potential to turn the fortunes of not only small scale farmers but both medium and large scale farmers as well. However these farmers face challenges; chiefly among these are, High feeding cost, Weak technical know–how (eg. Poor feeding practices, poor use of day length, poor /no record keeping) and Frequent Out-break of diseases. These challenges have resulted in low profitability in the industry which has caused the exit of many farmers and preventing others from entering

The Korea - Africa Food and Agriculture Cooperation Initiative (KAFACI) of the Rural Development Administration of South Korea supported Ghana to help retain the earning of small scale farmers to increase their profit margins by supplying these farmers with 20 weeks old pullets. In the first year all the selected farmers were given one hundred and fifty birds (150 birds) with the exception of one farmer who received two hundred birds (200 birds). This particular year all the farmers are receiving two hundred birds each with a new entry farmer receiving two hundred birds (200). This has been possible because all the farmers were able to pay their

40% which was ploughed back into the project when the birds on the Institute were severely hit by Gumboro disease.

The knowledge of using sea water as a disinfectant was discovered and it's helping a lot. Before this project, most of the selected farmers were not able to make maximum use of day length but through the training the farmers received they are able to make good use of that now. Some of these farmers were getting results they have not had before since they started layer production as a form of livelihood. Currently there is project (Challenge feeding and phase feeding) which is on-going and the results of this research will be made known soon to farmers to help them maximise their profit margins. The current project has enlighten us more on the need to have a brooding centre to raise birds to sell to farmers as pullets. This will help take care of loses due to disease out-break which in turn will make the poultry industry more attractive to already existing and new farmers (unemployed graduates. Youth and women).

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Kenya

Impact of the KAFACI Projects in Kenya

1. Introduction

a. Agricultural and social background (policy and R&D) related to the KAFACI projects

Kenya's population stood at 49.7 million in 2017 and the country has an area of about 582,644 square kilometres out of which agricultural land is about 48.55% or 282,873.66 km^2.

Agriculture is the backbone of Kenya's economy employing 80% of the population, contributing 25% to the country's GDP annually and another 25% indirectly while accounting for 65% of the total exports and a source of most raw materials for industry. The government has developed the Agricultural Sector Transformation and Growth Strategy (ASTGS 2019-2029) and National Agriculture Investment Plan (NAIP 2018-2028) where R&D and policy issues have been addressed.

KAFACI projects which have been implemented in Kenya include rice research, determining horticulture post-harvest losses and their mitigation, agricultural mechanization studies and indigenous poultry research.

Rice is a key commodity and food security crop in the country and production areas include the Coast, Central, Rift valley, Western and Nyanza. Irrigated rice comprises about 80% while rainfed rice comprises 20%. Mwea irrigation scheme accounts for more than 60% of the 150,000mt of rice produced in the country against a consumption of 650,000 mt, which is met through imports that cost the government more than KES 9 billion annually. Among the three main staple crops, rice has the highest growth rate in consumption at 12% compared to wheat at 4% and the main staple crop maize at only 1%. This is attributed to change of lifestyles, better incomes, urbanization, ease of recipe preparation and use of less cooking fuel compared to other food items like maize, beans, wheat etc.

There is huge potential to increase the area under production for irrigated, rainfed lowland and rainfed upland ecologies as well as yield per unit area. The current on farm yield is about 3.5 and 1.5 t ha^{-1} for irrigated and rain-fed conditions

respectively. The low on-farm production can be attributed to low yielding varieties that have been in cultivation for many years, poor crop husbandry, poor and degraded soils, pest and diseases, limited agribusiness opportunities etc .

High postharvest losses characterise the horticultural produce value chains in Kenya and losses of up to 50% have been recorded. This is mainly due to lack and/or inadequate postharvest infrastructure, proper skills in Good agricultural practices, postharvest handling methods, knowledge on maturity indices of the crops, harvesting methods, proper containers to reduce bruising, proper sheds/shades, lack of cold chain among others. Horticultural produce is highly perishable in nature and hence the need to grow, harvest, sort, grade, store and transport within the shortest time possible to end users. The tomato (*Solanun lycopersicum* L.) was ranked first in the prioritization of vegetable crops value chains in Kenya. In 2013, the area under tomato production nationally was estimated at 23.82 thousand hectares producing 494.04 thousand metric tons valued at KES 14.1 billion. The crop is grown in almost all the counties of Kenya and performs best in mid altitude areas at 1150-1800 meters above sea level.

The KAFACI project chose Kirinyaga County in Central Kenya to host the training on tomato postharvest handling and value addition. Tomato production currently in the county is estimated at 59,149 metric tons/year and is leading in Kenya. High postharvest losses of upto 55% characterise tomato production in this county.

Low level of agricultural mechanization in Kenya's agriculture has led to drudgery, lowered agricultural productivity and making agriculture unattractive to the youth. About 50% of agricultural activities utilize manual labour which is mostly provided by women, elderly and the youth, 30% uses power provided by draught animals and only 20% rely on agricultural machinery.

The National Agricultural Mechanization strategy NAMS (1995) and Strategy for Revitalizing Agriculture (2004-2014) identified low level of mechanization as one of the main causes of low agricultural productivity in the country and further stated that the three main causes of low utilization of mechanization were;

- Inadequate access to mechanization technologies
- Inadequate mechanization extension services and

- Poor development in agricultural mechanization due to lack of mechanization research institutions, personnel to conduct research and funding mechanization research.

The estimated poultry population in Kenya is 44.6 million birds (MoA, 2016) of which indigenous chicken are 82%, broilers and layers are 16% with 1% commercial breeding flocks. Other types of poultry reared in smaller numbers but gaining importance include ducks, quails, turkeys, ostriches, and guinea fowls making up 2% of the total poultry population. Annually, the country produces around 20 metric tons of poultry meat valued at Kenya shillings (KES) 3.5b and 1.3b eggs valued at KES 9.7B. Poultry products supply more than 30% of all animal protein consumed in the country.

Poultry statistics in Kenya (KNBS, 2017)

Year	Indigenous Chicken	Layers	Broilers	Ostrich	Others*
2015	34,698,794	3,660,727	3,112,915	5,639	705,552
2016	36,578,441	4,161,289	3,056,747	5,795	822,181

Poultry meat consumption in Kenya is projected to triple from 54.8 thousand MT in 2000 to 164.6 thousand MT by 2030. Increased urbanization, population and economic growth will drive this demand for poultry products. This calls for increased productivity across the poultry value chain using innovative technologies in production, health management, breeding and marketing of products among others.

b. Key aims and priority through the KAFACI projects

The KAFACI projects main aims were:

- Enhancement of high-yielding rice germplasm and breeding capacity of rice producing countries in Africa aims to boost on-farm productivity through development of high yielding varieties from Korean and Kenyan bred varieties with end user desirable traits.
- Reduction the postharvest loss and improve commercial value of fruits and vegetables hence economically empowering small scale farmers and other

stakeholders among them traders and transporters. The selected crops for Kenya were tomato, banana and potato.

- To contribute to the understanding of the status of agricultural mechanization in Kenya and the generation of information to assist in recommending research and policy interventions. These would enhance the adoption of agricultural mechanization technologies and hence increase agricultural productivity and competitiveness in Kenya.
- To increase poultry productivity through use of good poultry practices and also to establish small-scale layer model production units

2. Development

a. Information on projects (staff, area, budget, main activities, etc.)

The rice project being implemented in central, western and coastal areas has a team of 10 persons who are specialized in various fields that include breeding, plant physiology, agronomy, crop health, post-harvest and socio-economics. The main activities include crossing of elite by elite lines as per the product profile to develop superior lines. The evaluations for both crossed and acquired elite materials from KAFACI regional office at St. Louise Senegal were conducted for stress tolerance and agronomic performance, morphological traits and other adaptability and acceptability parameters. Evaluations involved OYT, PYT, RYT and AYT in order to select National Performance Trial materials and finally release varieties for commercialization. The budget plan was USD 22,000 per year with possibility of funding for some of the important activities such as NPT, DUS and special procurement for project advancement.

The horticultural postharvest project involved both technical and administration staff. The technical officers were engaged in training small scale farmers, extension staff and other stakeholders along the selected crops value chains. They have also been writing reports and manuals while the administration staff have provided logistical support such as financial, procurement, transport and typing services to the project.

The project so far has covered Kirinyaga County for the tomatoes and bananas and Nyandarua County for irish potatoes. For Banana and potato crops, the main

activity was a baseline survey that was carried out to document the postharvest practices of the crops, postharvest losses and causes. A report was prepared and later a manual on postharvest handling of fruits in Africa was published by KAFACI and one of the chapters is on the findings of the survey on postharvest handling of bananas in Kenya. The budget for the first phase of the project was 36,000 USD while that of the second phase was 17,000 USD.

Regarding agricultural mechanization, the first activity dealt with the status of agricultural mechanization in Kenya and had five objectives including appraising the status of information on agricultural mechanization in Kenya, establishing the levels of agricultural mechanization among selected agricultural value chains, identifying constraints and proposing interventions for the adoption of the improved agricultural mechanization technologies and innovations, recommending strategy and research agenda and making technical and policy recommendations to enhance agricultural mechanization in the respective value chains in Kenya. This project came to an end in 2016 and a technical report was generated.

The second activity was a study to determine agricultural mechanization indices and evaluation of agricultural productivity for major value chains in Kenya. The objective of the study was to contribute to the understanding of the agricultural mechanization indices, productivity and profitability on major value chains for purposes of recommending research and policy interventions in Kenya.

The KAFACI livestock project was based at KALRO Poultry Research Unit. Main activities included, a poultry value chain needs assessment in Bungoma County. The budget released totaled 4,000 USD used to finance data collection, analysis and reporting. A farmers management manual was reviewed, redesigned and printed as a major output.

b. Technical challenges needed to solve during the project implementation

Limited capacity in terms of knowledge and few technologies with desirable qualities. The project will build the knowledge capacity through trainings and demonstration to ensure both theory and practical aspects are well covered for smooth project implementation. There are limited technologies available with various challenges such as low yielding, and lack of various stress-adapted varieties that possess market demand or requirements as per developed product profiles. The

project is geared towards developing appropriate technologies that meet the client demands in terms of morphological, quality and consumer traits. The project will also acquire necessary facilities like vacuum emasculators, rice cookers, necessary chemicals for undertaking necessary tests, etc to ensure it achieves its objectives.

Technical challenges during the project implementation of the horticulture activities were mainly those related to postharvest handling of the produce including lack of knowledge on varieties, maturity indices of the crops, harvesting methods, postharvest handling structures such as sheds, harvesting containers and also sorting and grading areas. Others were lack of knowledge on simple value addition processes, lack of records thus making it hard to determine whether the farmers and other stakeholders were making profit in their enterprises. Other challenges included lack of knowledge on time of day and how to transport the produce to the market to reduce postharvest losses since the cold chain infrastructure is lacking.

Regarding mechanization, the number of value chains against the resources available is challenging and available resources may only be adequate to address two value chains instead of the originally planned four.

Main technical challenges in the poultry project included a lack of clear objectives, outputs and expertise in livestock/poultry from KAFACI.

c. Critical support or help to overcome challenges (problems) by KAFACI

KAFACI has a critical role to play in terms of support such as providing various personnel with expertise in given technological or information areas and more importantly availing developed elite germplasm for gene mining. The KAFACI will also provide required equipments and funding. This support is important in supporting the country objective of achieving food and nutrition security. The activities in rice breeding, horticulture post-harvest loss reduction and agricultural mechanization require additional support to ensure objectives, which are well aligned with national priorities are met. It is thus important to continue, and if possible, increase the budgets to bring activities/interventions to scale for greater impact.

Regarding livestock projects, KAFACI should engage technical livestock experts to mentor beneficiaries. Also joint M&E will assist with mutual learning and funding levels could be enhanced and also agreed beforehand on SMART objectives.

d. Agricultural development and achievements (up to now) through the project

※ *Favorable to demonstrate the outstanding and remarkable results and performance with graph and data table comparing before and after implementation on each project*

The rice project has contributed significantly in both capacity and technological development since its inception. Besides improved research capacity, the development of promising rice lines, KAFAGR-54, KAFAGR-8 and K2-9 were developed and presented for season one of National Performance trials (NPT). Thereafter, they will be entered into season 2 NPTs. The project has 10 elite materials at various stages of development and it is hoped there will be continuous entry of materials to NPT leading to release and finally development of seed system for commercialization. This will ultimately have major impact on rice productivity.

For the horticulture project, stakeholders (ToTs) trained during the workshop on proper postharvest handling of tomatoes in Kirinyaga County were 30. Those who were trained later by the ToTs were 64, while those trained by the extension staff ToTs were 380 totaling to 474 (Table 1).

Table 1: Stakeholders trained by extension staff (ToTs) on proper postharvest handling of tomatoes

No. Trained by KALRO	No. Trained by ToT stakeholders	No. Trained by ToT extension staff	Total
30	64	380	474

Thirty-three stakeholders were trained as ToTs during the second workshop that was on tomato value addition (Plate 2). However, the ToTs have not yet trained other stakeholders on value addition although they are planning to carry out training soon. One hundred and three stakeholders have been trained on tomato value addition by the extension staff ToTs (Table 2). These will in turn train members of their groups, neighbours and family members and hence the impact of the training will be great in the region and beyond.

Table 2: Stakeholders trained by extension staff (ToTs) on tomato value addition

No	Name of farmer group	Males (numbers)	Females (numbers)	Total
1	Muungano Self Help Group	14	18	32
2	Furaha Women Group	0	20	20
3	Umoja Self Help Group	3	17	20
4	Giting'a Self Help Group	11	20	31
Total		28	75	103

The above two interventions on proper postharvest handling and value addition of tomatoes are estimated to have so far saved about KShs 500,000. The estimated price of a kilogram of tomatoes is KShs 35, which indicates that about 14,286 Kg of the produce has been saved from going to waste. This is expected to improve as more stakeholders internalise the new technologies they have acquired during the training and as more stakeholders are trained.

Mr. Joseph Mutugi Mugo, a ToT farmer who attended both workshops had the following to say about the effect of the knowledge acquired during the trainings "Transporting tomatoes in small quantities and in standard crates, has reduced postharvest losses resulting in more income compared to the way I transported the tomatoes in huge containers that caused squashing of the produce and hence high postharvest losses and very low income."

Another ToT farmer Mr. James Kariuki Eston noted that "Taking care during transportation and keeping tomatoes in a cool place after harvesting, has greatly reduced postharvest losses leading to increased income. I also make tomato juice for home consumption and hope to expand this to commercial production in the near future."

ⅰ) The findings of the studies on postharvest practices, postharvest losses and causes conducted on tomato, banana and potato are very important and may be used as a basis for policy formulation on reduction of postharvest losses in the counties/country and beyond.

ii) The manuals have been distributed to various stakeholders and some agriculture colleges are using them for training students.

Plate 1: A group photo of the team after the meeting with Korean Delegates

Plate 2: A group photo of the team posing with tomato value added products

For agricultural mechanization, the baseline survey report has been used by researchers and national planners for reference purposes in agricultural mechanization research and promotion activities.

Regarding the livestock project, the poultry value chain mapping and needs analysis was completed and reported on. Five hundred (500) poultry farming manuals were printed and six (6) commercial small-scale layer units were established.

Chicken are the most abundant livestock and an important tool in fighting poverty. Small scale commercial poultry units are a source of revenue generation for farmers through sale of eggs as demonstrated in Table 1. A small scale layer unit of 300 birds will generate over 333 USD for the farmer on a monthly basis. Thus poultry production can contribute towards the attainment of food and nutrition security among low income as well as landless and vulnerable members of the population. Chicken have short production cycles a factor, that makes them attractive for most households and are commonly used as part of a mixed/intergrated farming system which allows farmers to utilize resources efficiently, spread risks and protect against shocks. The low input nature of extensive and semi-intensive production systems makes chicken accessible to the vulnerable and marginalized groups especially women.

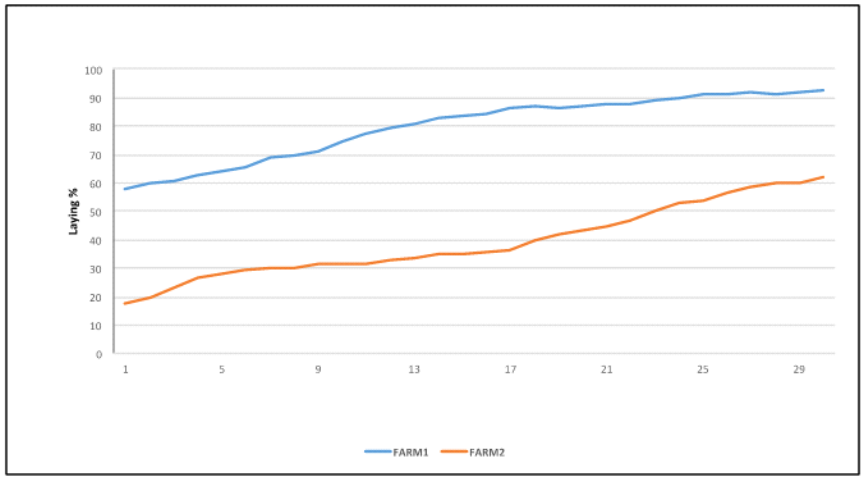


Table 1. Profitability of a small-scale layer unit after KAFACI project intervention

PROFITABILITY FOR 300 LAYERS

	UNITS	COST KSH
Feed cost	Kg	40.00
Daily feed consumption per bird	g	120
Egg production	%	85
Sale per 30 eggs	Tray	300
Feed cost per bird per day		4.80
Revenue per bird per day		8.50
Gross profit per bird per day		3.70
Monthly Gross profit per bird		111.00
Egg Feed Price Ration (min 1.4)		1.77
Gross monthly revenue for 300 layers Forex Ksh.100=1USD		33,300

e. Regional and continental integration through the project implementation

The rice project is being implemented in 20 Countries and there is practical exchange of experiences and technologies for faster implementation continental wise. This will spur mass sharing of both technological knowhow and products for wider rice-sector growth and productivity.

The horticulture project is implemented in 14 African countries and Korea. This has made it possible to visit various countries and learn their postharvest practices with a view to adopting/adapting them. The PIs have become a very solid team that even engage in other technical issues once the need arises. During the KAFACI workshops held every year, the PIs attend social events and this has made them aware of their very rich diversity in culture. This has contributed significantly to regional, continental and international integration.

A visit by the KAFACI secretariat to Kirinyaga County Project site was very successful and all those present were very grateful to the visiting team for the initiative from the Korean government. This too has helped cement the relationship between Kenya and Korea.

The agricultural mechanization information on baseline survey done in Kenya is currently assisting other KAFACI member countries to carry out their survey with

reference to the methodologies used as well being a reference material when identifying priority areas in agricultural mechanization interventions and research.

Agriculture remains the main source of livelihood for many African countries, hence, increasing productivity and efficiency of agricultural value chains is the key to stimulating economic growth. In Kenya as well as in sub-saharan, over 70% of the land is classified as arid or semi arid. This is where livestock production is practiced. With population pressure and climate change, more efficient production innovations to meet consumer demand for animal products in both quantity and quality are needed. The shortfall to meet demand for poultry meat in sub-Saharan Africa increased by 99% since 2004 while production increased by 57%. This shows a gap in supply of 44% which is met through imports, which increased by 209% between 2004 and 2014. Major constraints in poultry production are inadequate feeds, diseases, poor genetics, and lack of commercial orientation. Collaborative regional efforts such as the KAFACI projects are needed to mitigate these issues and ensure food and nutritional security.

f. Summary of each project on positive part (if anything to be improved, you can mention it)

The rice project has increased local knowledge capacity in double haploid rice improvement that is faster than convectional method with very impressive results. It has transformed the knowledge from theory to practice and it is a friendly technological tool for rice variety improvement with desirable results..

The KAFACI Horticultural project has greatly benefitted the small scale farmers and other stakeholders in reducing postharvest losses of the produce and hence enhancing their incomes and also availing food to the consumers

The horticulture project made the following achievements:

ⅰ. Documentation of postharvest practices, losses and causes for tomato, banana and potato along the value chain in Kenya

ⅱ. Publishing of 2 manuals on postharvest handling of tomatoes and fruits in Africa. These have been distributed to various stakeholders and are being used for capacity building farmers, students and transporters. Agriculture Extension staff are always trained alongside the stakeholders so that once

the project period is over, there will be sustainability as these are able to continue backstopping the farmers and other stakeholders.

iii. Reduced postharvest losses have been recorded by some tomato farmers and traders from about 40-50% to 10-25% attributable to adoption of the recommended postharvest and value addition practices.

iv. Revenue of about KES 500,000 (USD 5000) in the pilot area of Kagio in Kirinyaga County due to the small scale farmers and other stakeholders applying the recommended postharvest practices.

v. Visit by the KAFACI secretariat to the project site in Kirinyaga was very encouraging to the small scale farmers, extension staff and other stakeholders. They felt valued and promised to work hard to achieve the goals of the project (Plate 1).

The positive agricultural mechanization milestones include:

i. Baseline agricultural mechanization survey report 2016 – The report is used for formulating research agenda and identifying the areas for mechanization interventions.

ii. Mechanization index report – identify areas of mechanization interventions (on going). In order for this activity to achieve its objectives of using 4 value chains in mechanization, it may be necessary to increase funds or reduce the number of value chains to be addressed.

KAFACI livestock project is mainly targeting small scale poultry farmers who constitute 75% of all households in Kenya. Increased funding will ensure wider project coverage with improved poultry technologies. This will enhance productivity as well as food and nutrition security regionally.

3. Socio-economic Returns and Impacts

a. Successful and outstanding effects

The rice project ensured the project staff and related stakeholders had their capacity improved for sustainable rice production. The new elite lines developed have huge potential to contribute to food security through increased productivity.

The horticulture project has enabled KALRO to capacity build the small scale farmers and other relevant stakeholders in the selected crops value chains. The trained farmers and other stakeholders have benefitted as they now record low postharvest losses and hence better returns and improved food availability. Indeed, the farmers have confessed of how they have been able to put more money in their pockets after the training. They indicated that they have been able to reduce postharvest losses, some from as high as 40 to 10%. Others said they have even accessed better markets after preparing the tomatoes for market as trained. They indicated that the postharvest losses have now reduced for some from as high as 40 to 10%-25%. Others said they have accessed better paying markets after preparing the tomatoes for market as trained. The stakeholders have indicated that the trainings are of great importance to them as they are helping them to maximize on returns to their investment.

The mechanization activity produced important information regarding information on level of mechanization for nine value chains (Maize, wheat, Rice, Sugarcane, Tea, coffee, Tomatoes, Mangoes and livestock). This document will greatly assist in setting up the research agenda for mechanization in the country as well as in policy formulation. The development of mechanization indices for given value chains such as maize will assist with determining productivity and profitability in farming.

b. Suggestion for improvement

Increased funding will enable the team to undertake an additional study of an additional two value chains as originally planned by the Project.

The livestock project suggests a planning format as below for better outcomes.

Improvements	Impacts	Changes
Increased funding-livestock work is expensive and time bound	Increased coverage for more impacts	Increase funding and promote visibility/branding for the project
Participatory planning that include R&D agenda	Regional planning meetings to set impact indicators	Include livestock/poultry experts in KAFACI projects (bring on board multidisciplinary teams)
Focused SMART objectives and clear outputs	Exposure to successful projects	Plan to include public private partnerships for training and dissemination
Participatory monitoring and evaluation	Capacity building for PIs on advances in livestock production	
Feedback on projects		

4. Conclusion

a. Improvements, impacts, changes

The project on rice has impacted positive improvements that are desirable in our rice-sub sector and this change from convectional to double haploid technique will spur faster development in line with our Country vision on food and nutrition security.

The horticulture project has made significant impact even in the short run and is expected to make a bigger impact after the trained farmers and other stakeholders apply the knowledge fully.

Due to budgetary constraints, it was not possible to reach a large number of farmers/stakeholders and hence would recommend an increase in the funding levels to bring capacity building for farmers to scale.

The information on baseline survey done in our country is currently assisting other KAFACI member countries to carry out their survey with reference to the methodologies used as well being a reference material when identifying priority areas in agricultural mechanization interventions and research.

Documentation of the baseline report as a reference material for agricultural mechanization researchers has led to increased availability of information on agricultural mechanization information in Kenya including indices that can predict productivity and profitability for given value chains. There has been increased request for mechanization information by farmers, machinery dealers and other stakeholders.

There has been increased interest in funding agricultural mechanization and general interest in mechanization.

b. Proposal, suggestion or recommendation, or comments for future projects

The current proposed strategy is quite innovative and will spur the project contribution in rice productivity is it fits well in our national agenda. The period planned for is unique and the developed milestones and product profiles will help monitor and evaluate the progression.

There is urgent need to align funding to project framework to ensure timeliness that will spur positive impact and help project achieve its objectives. Otherwise, funds delay have affected negatively the project out puts.

We hereby propose an improvement on the funding level and also provision of simple postharvest tools from Korea that can be prefabricated in our country. More funds will help reach more small scale farmers and other stakeholders and hence alleviate the postharvest losses, enhance incomes and food availability.

The simple tools will help the trainers and the farmers adopt/adapt superior but simple technologies that will help reduce postharvest losses.

We suggest that future projects should focus on:

ⅰ. Capacity building for agricultural mechanization researchers and officers
ⅱ. Acquisition and testing of improved agricultural innovation as identified by the baseline survey on the priority major value chains in Kenya.

Harmonization of KAFACI livestock project proposals across participating countries and building the capacity of Principal Investigators/experts in modern poultry production and marketing will create greater impact. Also, baseline indicators should be established for effective M&E.

Morocco

Impact of the KAFACI Projects in Morocco

1. Introduction

a. Agricultural and social background (policy and R&D) related to the KAFACI projects

Agriculture, in Morocco, is a strategic sector, economically and socially. It plays major roles in terms of food security and nutrition, supply for agro-industry, employment, integration into the international markets, stabilization of populations in rural areas, and sustainable development. Food supply in Morocco, which is a major component of food security, depends mainly on rainfall. Agricultural production is challenged by extreme large inter-annual variation in rainfall. Irrigation is provided only for 16 percent of croplands, leading to little flexibility for weather risk mitigation and crop improvement. Long term average rainfall in Morocco is around 365 mm, varying from a minimum of 198 mm recorded in 1994-1995, to a maximum of 610 mm recorded in the 2009-2010 season. In addition, rainfall distribution between seasons is skewed, since most of the seasons display under average precipitation. Most of the rainfall in Morocco is received between the months of October and April, which is a short period for crop growth and development. As in most of the Mediterranean countries, the cereal production system (cereals/food legumes) is predominant. Olive tree plantations cover an area of about 980,000 ha, or nearly 65 percent of the national tree orchard. Agriculture is covering an area of almost 8.7 million hectares with agro-climatic systems that allows producing a wide range of agricultural products (Table 1 &Fig. 1). The agricultural sector contributes with 19% to the national GDP, divided between agriculture (15%) and agro-industry (4%).This sector employs over 4 million people including about 100,000 in agro-industry. The new Moroccan agricultural strategy, Green Morocco Plan (Plan Maroc Vert) launched in 2008, is designed to promote the development of the entire agricultural and territorial potential. It will contribute to GDP with 174 billion Dirhams, creating 1.15 million jobs by 2020 and triple the income of nearly 3 million people in rural areas. The Green Morocco Plan relies on two pillars supported by structural reforms: Pillar I: The invigoration of high value-adding, highly productive farming systems and agro-industry through an aggregated model. Pillar II: The development of small-scale agriculture built on solidarity in unfavorable areas. Structural reforms in the Plan target the land tenure policy, the water policy and the development of regional agro-tech platforms. They also focus on institutions

and governance, especially through the creation of the Agricultural Development Agency, which is in charge of: (1) monitoring the implementation of the new agricultural strategy; (2) linking with private or social investors; and (3) promoting and managing the implementation of the aggregated model, providing linkages between the different partners.

b. Key aims and priority through the KAFACI projects

[Postharvest]

Reducing Food and postharvest losses is a top priority. Morocco has launched a *Food waste project with the* FAO. The aim of this project is to develop a national strategy and action plan to reduce food losses and waste (PAG) in Morocco. It was launched in Rabat, in partnership with the United Nations for Food and Agriculture. INRA is responsible for conducting and coordinating this study. The expected results consist of conducting a study on the PAG in Morocco for key food sub-sectors selected as a priority for the government as part of the Green Morocco Plan, identifying the main causes, analysis of measures to PAG reduce and the assessment of their economic feasibility, acceptability regarding social dynamics and gender as well as their environmental impact. The goal of this project is to reduce postharvest losses and improve quality of horticultural crops through application of Good Postharvest Handling Practices (GPHP).

[Genetic resources]

Oat is a Mediterranean crop: the centre of diversity for genus Avena has in fact been identified in Morocco, counting the presence of 29 species belonging to this genus. In all Mediterranean countries oats are important multi-purpose cereal crop cultivated for grain, feed, green fodder, hay and silage. In the Maghreb oat it is the most important sown forage, cultivated on about half a million hectares and it is mainly used as hay to feed livestock when green forage is not available (summer and early autumn). In addition, in southern areas, winter sowing allows oats avoiding in part the harsh late summer, however drought stress together with disease incidence are still main causes of yield instability. Despite these limits, oats have several characteristics that make them a crop which deserve special attention in the frame of facing climate change, of increasing the richness of cultivated species and of the growing demand for safe and healthy food and sustainable feed. Legumes pastures such as *Trifoliumsp.* and *Bituminaria sp*. are also important forage crop

species, which attract more attention due to their forage quality. According to the latest collecting data, these taxa are also undergoing genetic resources due to many factors mainly climatic changes. Therefore, their collecting, characterisation and evaluation become a priority for further use and conservation. The objective of the "Improvement of Technology on Conservation of Genetic Resources" Morocco is to mine the Moroccan collections of tetraploid oats *A. magna* and *A. murphyi*, *Trifolium* sp. and *Bituminaria bituminosa*, for interesting traits such as technological parameters and abiotic stresses tolerance.

[Livestock]

Poultry production in Morocco has two production systems. The first one is grouped under modern poultry farming which is called intensive and the second one is called the local poultry, which is traditional system and concerns mostly the backyard's farming in rural and suburban areas. Evolution of poultry's productions sectors indicates that the local poultry farming was the pillar until the 1960s, from which development strategies accorded more importance to the modern poultry farming. Since 2000, a strategy of upgrading the intensive sector was established. It was based essentially on a health management. At 2006, this strategy was reinforced by the publication of many laws that governed various activities of intensive poultry production (from the farm to the consumer). The law n°49-99 is related a health protection, control and marketing of poultry products. This strategy is based on the establishment of sanitary barriers, a monitoring and effective supervision of a health and control of infectious diseases. Currently, all poultry activities within herd more than 500 subjects are conditioned by obtaining a license to practice from ONSSA (National Agency for Sanitary Safety of Food Products). This project aimed to apply an appropriate management to improve the productivity of small scale Chicken farmers, enable small and mid-size farmers to essentially disseminate applicable rearing technologies to other farms and finally to share with Korea and African countries knowledge and information of agriculture technologies.

[Mechanization]

The Government of Morocco has been actively promoting farm mechanization since the independence in 1956, first by implementing "Operation labour" a tillage program that aimed to generalize the use of tractor power in all farms. Then, by granting tax relief for all the agricultural sector after the three years drought early Eighties and direct subsidies on farm equipments. Agricultural mechanization is still one of the main interests within the GMP and the objective is to improve the rate

and quality of mechanization and the accessibility to the technologies. However, the quality of mechanization and access to mechanization services is still problematical. The main objective of this project is to understand and improve agricultural mechanization and promote sustainable agricultural mechanization for the climatic changes that hits Morocco and mainly the semi-arid regions that are facing more aridity constrains. The survey will try to approach technical and policy problems in the mechanization field and benchmark the success stories to the cereals production system.

[Rice]

Rice cultivation was introduced in Morocco in 1948 to upgrade the heavy and flat soils of the Gharb region (north-west). Recently, rice cultivation became a significant socio-economic sector. It is cultivated generally in two regions: the Gharb region that sets a record in terms of yield for rice and the Lokkos region. On a potential of 25,000 ha, the harvested area varies from 5,000 ha to 9,000 ha depending on climatic conditions. On 2017, Rice cultivation covers 7,500 ha and produces 53,400 tons (7.12 T/ha). The annual rice consumption in Morocco is 1,5 to 2 kg/ha (52,000 tons). Quantities exported fluctuate from year to year and reach 2,000 tons in 2017. Imports are of the order of 4,500 tons. Sale price in Morocco by producers is 7 DH/kg. The most used varieties are hybrids imported from Italy: Centauro, Arpa, KrystallinoSfera and Gladio. Yields reached 11 to 12 tons per ha in some localities. The average productivity is around 8 to 9 tons/ha. In order to better develop this culture and to reinforce the variety profile, Morocco is integrated into the Africa Rice network in collaboration with the KAFACI project funded by the Republic of South Korea. This collaboration aims to strengthen innovative selection techniques at INRA level and to benefit from the experience of South Korea in the development of genetic material and high yield breeding technologies.

[Young Scientist Training]

Agricultural biotechnology offers the potential for increasing and improving food production capacity and promoting sustainability. Biotechnological tools, such as bioinformatics, start to make a significant impact on our knowledge development. Due to the fast development in biotechnological tools, capacity building remain one of the major need to agricultural biotechnology improvement in developing countries. In the genomics era, a huge amount of data is produced each day taking advantage of the decreased coast of sequencing duo the development of several sequencing technologies. When data generation is no longer a bottleneck, the storage, speed of analysis, and

interpretation of DNA sequence data are becoming the major challenges. the development of a streamlined, highly automated pipeline to facilitate analysis and interpretation of data is the key to overcome these challenges. The objectives of this training were to learn how to install and to practice such tools then run them in Linux system. Gained skills and experience through this training will be transferred to the bioinformatics platform in our institute and that will help us to advance the running project in the field of plant genomics especially in date palm genomics.

2. Development

a. Information on projects (staff, area, budget, main activities, etc.)

[Postharvest]

The Principal Investigator is Dr. El Guilli mohammed and Collaborators are Dr. Hamza Abdelhak, Samdi Ali, Zelmat Lamia and Zakaria Baiz. The Budget for Phase I (2015-2017) was $45,000 and for Phase II (2018) was $17,000. The Main activities for the First Year (2015) were:

- Investigating the current status of postharvest handling and losses in staple horticultural crops
- Review of existing postharvest technology in Tomatoes, onion, Citrus
- Analysis of the steps in the working process from production to distribution.
- Investigation on the degree and the cause of loss in each step of the distribution process.
- Survey on success cases for the postharvest management

The Main activities for the Second Year (2016) were:

- Development of postharvest management technology manual for loss reduction of Tomatoes, onion and citrus.
- Assessment of postharvest losses of the onion, tomatoes and Citrus
- Preparation of technology manual on postharvest management for Tomatoe, Onion and Citrus.

For the Third Year (2017) activities were:

- Publishing the Tomato manual in English

- Translation of the Citrus manual into arabic and publication of posters,
- Dissemination of the Citrus through workshops for farmers

For the Phase II (2018) activities were

- Translation of the Citrus manual into arabic second edition (Fig. 1)
- Dissemination of the Citrus through workshops for farmers and fields pilot tests

We have a lot of emphasis on good harvesting practices (Fig. 2 & Fig. 3). Then, through pilot field applications, we try to show the improvement they could have when the good practices are applied. For that Citrus manual has been translated to Arabic and disseminated through workshops to more than 1000 farmers and this was mainly supported by INRA and others national partners.

Fig 1: Second edition of the Citrus manual

Fig 2: Losses during harvesting Citrus fruit

Fig 3: Field school on citrus harvesting

[Genetic resources]

For this project entitled "Characterization and evaluation of a Moroccan wild collection", the Principal investigator is Dr. Nezha SAIDI and collaborators are Dr. R. Kallida and Dr. N. Shaimi. The project duration was 2 years (2016–2018) and the project budget is 30,000 USD. The Main activities:

- Seed increase of the wild material in the field for targeted taxa
- Screening of plant material under severe and moderate drought conditions under greenhouse conditions and in the field
- Collect of more wild material of tetraploid oat species, red clovers and albo tedera
- Pre-breeding

[Livestock]

For this project, the actual principal investigator is Dr. El Haj El Maadoudi and collaborators are El Housni Abdellah, Lakhssassi Kenza, Samira El Otmani and Saadi Abdenbi. The Main actions are:

- Use of performed strain
- Develop more suitable shelters with local materials ensuring protection of animals against weather and predators
- Make available livestock's equipment necessary for organizing and improving the efficiency of farms as perches, nest boxes, feeders, and drinkers.
- Disseminate good cleaning practices and local disinfection
- Reasoning complementation food so that they are sufficient and balanced
- Develop a control program and adapting the packaging of medicines to the actual animal
- Develop the organic label for these types of livestock farming: analyze the products of these farms and popularize their nutritional values to consumers.
- Organize sales and minimize intermediaries.

[Mechanization]

For this project, the Principal investigator is Dr. Oussama EL GHARRAS and collaborators are Mohamed BOUGHLALA, Najib EL HANTAOUI, Mohamed EL AZHARI and El Hassan BOURRARACH. The project area will focus on Casablanca – Settat region which represents rainfed as well as irrigated agriculture sites and is known as one of the most important areas of cereals production in Morocco. The total budget allocated to this study is 30,000 US$ for two years. The main objective is to understand and improve agricultural mechanization and promote sustainable agricultural mechanization for the climatic changes that hits Morocco and mainly the semi-arid regions that are facing more aridity constrains. The survey will try to approach technical and policy problems in the mechanization field and benchmark the success stories to the cereals production system. Sugar beet yields in Casablanca-Settat region exceeded in average 85 tons per ha with a production of about 14 tons of sugar per hectare. This case study will allow us to identify the keys to the success of this model and adjust it to cereal based system.

[Rice]

The main objective of the project 'Enhancement of high-yielding rice germplasm and breeding capacity of rice producing countries in Africa' is to strengthen and diversify rice germplasm in Morocco through the introduction of new varieties of

agronomic and socio-economic interest selected from double-haploid rice lines developed by KAFACI. The Principal investigator is Mohamed SEDKI (PhD), Abdelaziz CHETTO, Hassan BENAOUDA, Rachid MENTAG, and Mohammed EJRHOM. The budget for the project is $ 66,000 over three years, from January 1, 2019 to October 31, 2021. The Main activities.

- Provide the genetic material needed to evaluate it in Morocco
- Identify high-yielding germplasm through evaluation of KAFACI breeding materials in Morocco
- identify suitable genotypes adapted to climate change and containing the desired genes among existing varieties
- Development of varieties by the DH technique of promising lines identified under Moroccan conditions.

[Young Scientist Training]

The project is aiming to support training within 3 weeks of a junior scientist (Dr Slimlane KHAYI together with Korean specialist in the field of bioinformatics. In this training, trainer learned how to install and run 3 main pipelines related to the filed of bioinformatics: i) the annotation pipeline *funannotate* ii) Phylogenomics pipeline and iii) SNPhylo SNP-based phylogenetic pipeline.

b. Technical challenges needed to solve during the project implementation &

c. Critical support or help to overcome challenges (problems) by KAFACI

[Postharvest]

The main challenge was to reduce the postharvest losses through the implementation of adequate postharvest handling practices. This is being achieved by presenting data to farmers and all stakeholders on the high levels of losses we have noticed during our surveys and their main causes. For citrus Fruits, the harvesting operation is very important to reduce post-harvest losses. Our surveys on onion have shown that post-harvest losses are linked to the traditional storage system in use in Morocco. To reduce losses the establishment of an appropriate storage facility, especially for small farmers, is required.

The technical assistance provided by the Coordinator of the project Dr. Kim and Dr. Lee in organizing the workshop for the partners from the packinghouses and from the ministry of agriculture was useful.

Fig 4: Workshop on Good Post harvesting Practices

[Genetic resources]

Kafaci Project aims the conservation of plant genetic resources and the improvement of its technology hence, it will be highly recommended that the budget will be increased to cover also collecting of wild genetic resources, to evaluate the material and proceed to its conservation. For Morocco, the achievement of all project activities depended upon the availability of daily workers and local travel fees to cover more regions where the material characterization should be undertaken. Hence, it would be worth that daily workers and local travel allocated budgets should be increased since it demands more financing that will help executing to the whole action plan. Furthermore, the duration of the project worth to be of 3 years to give the chance to breeder to achieve a good characterization of the genetic resources material and therefore proceed to the publication of the results.

[Livestock]

The absence of brooder, bedding, laying nests in all households implies low productivity of livestock due to loss of animals by pests and mortality and loss of egg. The hens have the distinction of laying scattered in several places, stables, fields. Economically, eggs success rate is 69%, lower than standards. Reasons are conditions of incubation. Also, mortalities are important. The rate is 25.29% in chicks and 7.5% among adults.

[Mechanization]

The main challenges for this project are data availability. The financial support of KAFACI to conduct this survey will help to achieve the objective and collect the needed data to suggest alternative approaches to policy makers and all stakeholders of mechanization.

[Rice]

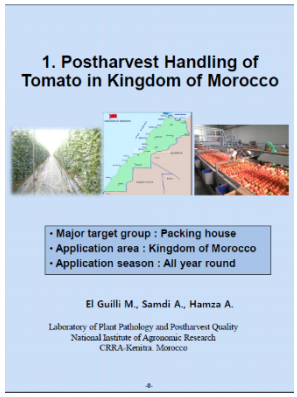
Develop varieties adapted to climate change was the main challenges for this project.

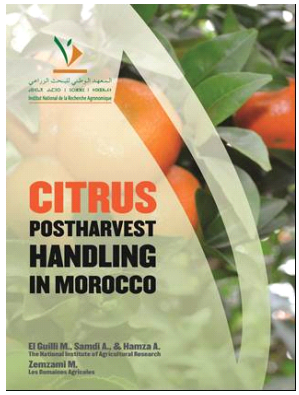
The critical support or help to overcome challenges are: Training and Supply of efficient plant material.

d. Agricultural development and achievements(up to now) through the project

[Postharvest]

Based on the result that we obtained from the surveys on the three crop (Tomatoes, Onion, and Citrus), a postharvest management manual were established in collaboration with KAFACI and other partners. The manuals contain issues mainly related to management from the field, harvesting, paking houses and cold storage rooms.





- Results of the preliminary surveys were detailed in the first document elaborated and presented in the first workshop
- Results were Presented and discussed in the workshop in Kenya
- Publications presented at IV *Asia* Symposium on Quality Management in *Postharvest* Systems, 12/09/*2017*, Jeonju,
  - Poster : Main causes of onion post-harvest losses in Morocco
  - Oral presentation : Citrus postharvest diseases in Morocco and the challenges of a biological control
- 3 manual books in English
- Master dissertation in French
- 3 Manuals in English and the first draft of the Arabic version of the Citrus manual

- Second Master dissertation in French
- Publication in Arabic of some part from the manual (Harvesting)
- ZELMAT. L, IBRIZ. M, HAMZA. A, SAMDI. A, EL GUILLI. M. (2019). Contribution à l'identification des causes de pertes en post-récolte de la tomate (*Lycopersicon esculentum* Mill.) au Maroc. Communication orale au 11ème Congrès de l'AMPP, la protection des plantes: face aux défis actuels et en perspectives, Maroc

[Genetic resources]

- Moroccan tetraploid oat species collections screened for drought tolerance
- Drought tolerant lines available for genetic improvement of forage production in Morocco
- Oat lines with good groat nutritive value (β-glucan & protein contents) selectedfor human consumption
- Trained student on plant physiology and interspecific crossing & cytogenetic technologies
- Results dissemination to local farmers and their involvement to participatory plant selection

[Livestock]

- Publication of the management guide with practical and applicable technologies suitable for the Moroccan country conditions,
- Rehabilitation of chicken locals within selected farms,
- Purchasing of necessary equipment,
- Training of farmers to the use of hatchers.

[Mechanization]

The project is still under going through the second year and the data collection is in progress. It is early to appraise the achievements or the adoption of the recommendations that will be produced.

[Rice]

- Acquire expertise on variety evaluation and crossbreeding during the two workshops in 2017 and 2018
- Selection of 19 promising lines (9 DH, 8 Elite, 2 salinity tolerance) selected from OYT test trial conducted in 2017 in the experimental station of SidiAllal Tazi.

[Young Scientist Training]

This training helped trainer to develop and upgrade his bioinformatic skills, with thesepipelines and software, in which we are sequencing and analyzing big data issued from agricultural genomics, genome assembly of mandated cultivated plant species.

3. Socio-economic Returns and Impacts

[Postharvest]

- The project has provided manuals for Good post harvesting practices
- Through our surveys we have provided data on postharvest losses for onion and Citrus.
- The project has provided a platform for exchange of experience between fifteen African countries.
- Through the application of the manual, we are convinced that post-harvest losses will be reduced.

[Genetic resources]

KAFACI project was a real assistance to help transferring technologies and results to beneficiaries through field days and training courses, promoting INRA new oat varieties and inIvove farmers in selection participatory approach. I should recognize that due to KAFACI financial support, we managed, for the first time, to go further in our study and promote new oat based products and organize a tasting day:

- **Field day**

A field day was organized at INRA-Marchouch experimental station for local farmers and students to promote INRA oat varieties and make them aware about the importance of wild genetic resources in breeding programmes. Some presentations were done by INRA expertise on plant selection, crop management, and plant pathology and seed post harvest conservation. Participatory plant selection was realized involving both famers and students to involve them in breeding process and teach them the best selection criteria to take into account for varieties selection.


Farmers field day at INRA's experimental station of Marchouch, Morocco

- **Student training course**

Training was organized for Master and PhD students at the INRA's Regional Centre for Agricultural Research - Plant Cytogenetic Laboratory. The training aimed to introduce them to plant ploidy analysis using both flux cytometer and the conventional methods. The students have undertaken some experiments to count chromosome number in root tips of oat hybrid seeds.


Training on ploidy analysis using flux cytometer at INRA plant cytogenetic laboratory, CRRA-Rabat Morocco

- **Tasting oat products' day**

Due to oat high nutritive value and health benefits, there is an increase demand for oat products. In Morocco, the cereals are mostly consumed as bread and people started incorporating this cereal in their daily food. Bread is an important food present in the Moroccan diet. Hence, different types of bread were prepared from Moroccan cultivars of bread wheat (CV. Kenz) and two oat Moroccan cultivars flours *A. sativa* cv. Alfaouz and *A. nuda* cv. Bounejmate. Mixtures were made by

incorporating oat flour into bread wheat flour in proportions of 10%, 15%, 20%, 25% and 30%. From the appreciation of bread testers, bread made from 80 % bread wheat cv. Kenz and 20% oat cv. Alfaouz flours was the most appreciated due to the best testing and high nutritive value. The results confirm that the oat cultivar Alfaouz, issued from crosses aiming the improvement of the groat nutritive value using wild genetic resources, is a proof regarding the necessity to involve wild relative species in plant breeding programs.

Testing day for oat products at INRA–CRRA-Rabat, Morocco

[Livestock]

- Publication of the management guide with practical and applicable technologies suitable for the Moroccan country conditions,
- Rehabilitation of chicken locals within selected farms,
- Purchasing of necessary equipment,
- Training of farmers to the use of hatchers
- Increase of income,
- Create of jobs,
- Increase the interest of other farms neighbors to do the same,
- Make available of treasury within farm,
- Diversify the sources of incomes.

[Mechanization]

This study may have an important impact on agricultural mechanization in Morocco since 85% of arable lands in Morocco are under rainfed and are facing similar problems. The government is investing through subsidies and taxes relief but economic fallout

does not follow. The expected results may be useful to most North Africa countries that are at the same level of technologies and are facing similar problems.

[Rice]

- Selection of 19 promising lines (9 DH, 8 Elite, 2 salinity tolerance) selected from OYT test trial conducted in 2017 in the experimental station of SidiAllal Tazi.
- Acquire expertise on variety evaluation and crossbreeding during the two workshops in 2017 and 2018.

[Young Scientist Training]

After returning to home country, gained skills were applied to assist research programs in the field of genomics and genome assembly. During these 3 weeks of training I leaned many things regarding these tree pipelines. The installation process of theses pipeline encounters several errors related to Linux system such as compatibility and missing of packages and modules. After installation, I have performed trials with these pipelines using real data to assess the installation of the softwares implemented in the pipelines. Main skills gained during the training:

- Investigating and solving errors during installation process
- Installation of specific python and perl packages
- Usage of conda
- Writing of simple scripts in bash
- File processing with sed, awk and grep command.

4. Conclusion

[Postharvest]

The objective of the project is to reduce post-harvest losses, in line with country priorities. As part of this project, we identified and reported the causes of these losses for tomato onions and citrus fruits.

In the case of the onion, we have shown that the cause of the high losses is related to the storage system used in the country. We suggested creating storage rooms for all farmers.

For citrus, we have prepared a simple manual in Arabic that has been disseminated and workshops and schools in the field have been organized

[Genetic resources]

As for most of the countries worldwide, Morocco is in the hot spot of climatic changes threat. This will have a negative impact on wild genetic resources sustainability which is the raw material for breeding program. Knowing that Morocco is a centre of diversity for many species, it is highly important to preserve the remaining biodiversity for further use to release promising varieties tolerant to drought and / or salinity. Within the framework of this project, we managed to prospect some genetic material in different regions of Morocco and gather some wild genetic resources. The characterization of this material has revealed that there is potential ecotypes which can be used in breeding programs and generate very promising varieties. Due to the support of KAFACI-ITCGR Project, we managed to select some ecotypes to start new breeding programs. However, it was worth that more financial support would be allocated for collecting since no budget is allocated by the institute to undertake prospections. In addition project period would be worth to be of 3 years in order to give more time to characterize the genetic material, confirm the results and be able of publishing them through journals and / or thesis defense.

[Livestock]

The KAFACI project is an opportunity to transfer the technology developed in these target farmers to other neighboring farmers and other remote areas.

[Mechanization]

The project is still undergoing and it is early to jeopardize on any conclusions.

[Rice]

Through this project, we increased our staff expertise on rice variety evaluation techniques and crosses and also we Identified 19 promising KAFACI lines under Moroccan conditions. Strengthening partnership with AfricaRice and KAFACI will speed up the production of double haploid lines and will also Strengthen rice breeding program in Morocco.

[Young Scientist Training]

This kind of training need more time period over then 3 weeks in order to let the trainee gain more skills in the filed of interest. It is recommended to make the

participants and the PIs of the project in contact before the implementation of the proposal of trainings. That will help to implement the proposals based on the real needs of the participants. Also, it will be more efficient to send Korean scientists or postdocs to Morocco to help more moroccan Scientists and technicians on developing their skills on Bioinformatics or other biotechnological technics. A short stay of Korean Scientists or postdocs (1 to 2 months) will be for great help.

Nigeria

Impact of the KAFACI Projects in Nigeria

1. Introduction

Nigeria is situated in West Africa; the nation is divided into six (6) geopolitical zones with 36 states and the Federal Capital Territory. It has an estimated land area of about 923,768 km^2 (92.4 million hectares), 84 million hectares of which is arable; about only 40 percent of this arable land is being cultivated. In addition, Nigeria possesses different distinct climates and agro-ecological belts (mangrove, rainforest, guinea savannah, Sudan savannah and Sahel Savanna) for the production of wide range of agricultural products (Othman, 2017). The topography, climate and vegetation distribution of Nigeria is equable and favourable for a variety of agricultural production activities. Nigeria has tropical rain forest vegetation in the south and savannahs in the north. Temperatures range between 20^oC and 30^oC throughout the year, although sometimes, it could be as high as 40^oC and as low as 12^oC. It also has great irrigation potential with surface water volume of about 267.7 billion cubic meters from 171 dams of various sizes with a total storage capacity of 36.7 billion cubic meters and the remaining balance of water volume from rivers located across the nation (Chauvin et al., 2012; Lipton, 2012 and Othman, 2017).

Although, the Nigerian economy largely depends on oil, agriculture still remains a key component and it accounts for over 75% of all non-oil foreign exchange earnings, Agriculture is therefore an important sector of the Nigerian economy. Over 70% of the Nigeria's population depend directly or indirectly on agriculture for livelihood. Nigerian agriculture is characterized by subsistence farming, use of crude and simple implements and techniques; resulting to low productivity and making it unattractive to young generations. Rain fed agriculture is generally practiced while irrigation is carried out along the large river valleys, 'Fadama' lands, dams and the inland valley ecologies. Successive governments have tried to introduce various policies to boost the sector but the impact is not mostly felt due to lack of adequate support from private sectors, development partners etc. in the areas of funding, training, provision of infrastructures, etc.

The Korean government through KAFACI is currently implementing and funding a number of developmental projects geared towards improving agricultural production in Nigeria. The projects are in consonance with the Nigeria's Agricultural Promotion

Policy (APP) currently implemented by the Nigerian Government. The KAFACI projects in Nigeria provide support for agricultural extension, mechanization, development and conservation of Nigeria's crop diversity, increased food and agricultural production, etc. The support of KAFACI is a welcome development as it has strengthened the food self-sufficiency drive of the Nigerian government.

Currently, KAFACI is supporting Nigeria in the following areas:

i. **Improving livestock production**: Selected poultry producers have been empowered and trained to improve their production.

ii. **Reduction of Postharvest loss of fruits and vegetables:** Appropriate and applicable postharvest manuals were developed for tomato, orange and banana. Farmers and traders are also being trained to reduce postharvest loss

iii. **Conduct of baseline survey to ascertain the present status of agricultural mechanization in the country**. This is to establish the present status and level of agricultural mechanization in Nigeria and identify challenges and opportunities of agricultural mechanization in Nigeria among others.

iv. **Development of a good conservation strategy for Nigerian genetic resources** and distribution to farmers.

v. **Implementation of the Young Scientists Pilot Research Project (YSPRP)** This is targeted at improving agricultural networking and enhancing information among farmers through innovative ICT methods in order to improve food production, food security to alleviate poverty and solve other agricultural production problems.

vi. **Support to research and development in rice breeding**: This has led to the development of improved, high yielding rice variety resistant to some persistent edaphic and biotic influences in Nigeria

2. Development

● **KAFACI Livestock Project**

The Institute of Agricultural Research and Training (IAR&T) obtained funding support of a total sum of $59,000 from the Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI) in four tranches, $15,000 in 2015, $15,000 in 2016, $17,000 in 2017 and $12,000 in 2018. The project commenced with a baseline survey conducted by scientists comprising 4 Animal Scientists and 2 socio-economists in 2015, after the submission of the report on the “Current status of Industry, Research and Development for Livestock in Nigeria” using secondary data. The survey was conducted in the six states of south western Nigeria, with the support of extension staff of the Agricultural Development Programmes (Agricultural Extension Organisation) in each of the six states.

a. Main activities of the project

The baseline survey identified the attributes of chicken production systems in the region with emphasis on the constraints and potentials of the enterprise among small-medium scale farmers. There were inadequate capital for management of chicken farms, knowledge gap in feed formulation and low level of compliance with recommended practices on hygiene and biosecurity, hence, mortality rate was high among the stock on the farms. Following findings from the survey, a management guide titled “Management Guide for Increased Productivity of Small-Scale Chicken Farmers” was developed and produced as resource material for poultry farmers with the fund and training support of KAFACI. Two training workshops were conducted on the 6th December 2017 and 22nd May 2018, using the manual as training guide. Distribution of the manual was also extended to relevant sister Research Institutes and Higher Institutions for knowledge sharing.

Thirty (30) farmers were selected from the six states among the participants at the training workshops for empowerment under the pilot project on Establishment of Small Scale Layers Model Complex in 2017 and 2018. The farmers, extension agents and scientists were trained on good management practices in small-medium scale egg laying chicken production. The farmers were supported with pullets, feed and medications, while there was technical backstopping from the scientists in the Coordinating Institute and the extension agents in each of the six states. The project

distributed 3,500 pullets to participating farmers. These comprised 1,400 Pullets distributed to the 13 farmers who participated in the first pilot phase and a total of 2,100 birds distributed as additional stock to the existing farmers (400) and 17 new set of farmers selected in 2018 (1,700).

b. Technical challenges needed to solve during project implementation:

c. Critical support or help to overcome challenges (problems) by KAFACI

d. Agricultural development and achievements (up to now) through the KAFACI Livestock Project

The project has been able to reduce the mortality rate on farms from the baseline of 38% in 2016 and 39.8% among project farms in 2017 to 2.26% in 2018. Similarly, mean egg production increased from 3,628 eggs/farm in 2017 to 7,494 eggs/farm in 2018. Same pattern was recorded for egg production/bird (Table 1). Total egg production was 293,099, while total stock of birds in farms at present was 3,170. The economic analysis of the project showed that gross income realized from sale of eggs in the life of the project was ₦7,913,673, while estimated value of spent layers was ₦5,389,000, for a total Gross Income potential of ₦13,302,673 in the life span of the project. There was an increase in Total Gross Income from ₦2,715,136 ($8,902) in 2017 to ₦10,587, 537 ($34,713) in 2018 at N305/$.

In the same vein, average Total Gross Income/farm was ₦314,933.88, while the average total variable cost/farm was ₦358,883.70, thereby resulting in an average net loss of ₦56,550.23 (-3.93%). The bulk of the loss could be attributable to the high mortality rate recorded in 2017 that resulted in loss of potential revenue from egg production and spent layers. The average net loss/farm in 2017 was - ₦198,194.38, while a net benefit of ₦2,848.93 was realized in 2018. Consequently, the rate of return on investment increased from -48.7% to 0.84% in 2018.

The net loss was, however, attributable to the high mortality rate recorded in 2017 while the increase in cost of feed limited the profitability potential in 2018. In addition, the new stock of birds supplied in 2018 which formed the largest percentage of stock of birds at hand are midway into the peak of their egg laying potential, as they are 29 weeks in lay and 48 weeks old. With the current trend, the birds are bound to improve for the better as the birds progress in the period of active laying. The cost of feed and pullet accounted for 54.8% and 33.6% of the

total variable cost respectively (Table 2). This pointed to the critical area of support for boosting the income potential of the farmers. Provision of feed and pullets to farmers at subsidized rate as provided for under the Growth Enhancement Support (GES) Scheme of the Federal Government of Nigeria could be explored. Similarly, farmers need training on cost-effective feed formulation using readily available materials as partial replacement for the expensive grains (maize and soybean) in poultry feed.

It was however obvious that the farmers have been able to apply the knowledge gained in management for ensuring low incidence of diseases and mortality through biosecurity. This reflected in the performance of the birds in 2018 compared to 2017 and the baseline survey result in 2016.

Table 1: Trend in Stock Size and Egg Production by Years

Stock Structure	2017	2018	Total	F-statistics
Initial Stock size	107.69 (9.71)	81.06 (25.21)	89.30 (24.83)	13.45 ***
Present Stock Size	65.23 (25.35)	78.62 (25.02)	74.47 (25.59)	2.55
Mortality rate (%)	39.81 (21.64)	3.22 (4.29)	14.55 (21.04)	78.32***
Mean Egg Production	3628.31 (2287.03)	7494.13 (2222.45)	6058.25 (2913.51)	24.21***
Egg Production per Bird	49.07 (26.29)	130.82 (88.11)	105.52 (83.47)	10.63**

Table 2: Cost and Returns Analysis.

Stock Structure	2017	2018	Total	F-statistics
Benefit from Eggs	97,964.30 (61,749.93)	228,830.59 (72,321.20)	188,324.36 (91,855.23)	31.99***
Benefit from Spent layer	110,892.31 (43,108.51)	133,655.17 (42,530.13)	126609.52 (43504.38)	2.55
Total Benefit	208856.62 (101430.04)	362485.76 (67262.66)	341533.88 (106151.22)	33.88***
Pullet Cost	145,384.62 (13104.79)	109,443.1 (34032.18)	120567.86 (33526.66)	13.45***
Feed Cost	210099.08 (46,334.10)	190618.21 (98282.87)	196,648.00 (85487.88)	0.46***

Stock Structure	2017	2018	Total	F-statistics
Drugs and Medication Cost	19461.54 (1754.23)	13949.742 (5176.46)	15578.22 (5101.42)	13.90***
Total Variable Cost	407051.00 (54502.58)	338684.52 (125149.86)	358883.70 (112924.17	3.56
Net Benefit	-198194.38 (100789.36)	2848.93 (133266.58)	-56550.23 (154385.3)	
RRI (%)	-48.70	0.84	-15.75	12.13***

- **AGRICULTURAL MECHANIZATION PROJECT**

a. Information on Project

The Agricultural Mechanization Project is implemented by the National Centre for Agricultural Mechanization, NCAM, Ilorin in conjunction with the Federal Ministry of Agriculture and Rural Development. The project area covers 6 states of Nigeria, one state in each geo-political zone of the country. The project budget is $30,000 (Thirty thousand United States Dollars).

The KAFACI Agricultural mechanization project is for a period of 2 years commencing in August 2017. The project staff are as follows:

S/N	Name	Experience (Years)	Qualification	Discipline	Role in Project
1.	Engr. Dr. M.Y. Kasali	26	Ph.D.	Agricultural Engineer	Soil and water specialist
2.	Engr. Dr. I.C. Ozumba	24	Ph.D.	Agricultural and Biosystem Engr	Principal Investigator
3.	Engr. Dr. O.A. Ogunjirin	22	Ph.D.	Agricultural Engineer	Farm Power and Machinery specialist
4.	Dr. A. O. Adejumo	22	Ph.D.	Statistician	Statistical Data Analyst
5.	Mr. B.T. Mohammed	12	M.Sc.	Agric Economist and Extension	Survey Project Economist
6.	Mr. F. A. Mohammed	26	HND	Statistician	Statistical Data Analyst

S/N	Name	Experience (Years)	Qualification	Discipline	Role in Project
7.	Mr. K.O. Eneh	16	MBA	Human Resources Management	Data collation and processing
8.	Engr. T. Iorpev	8	B.Eng.	Agricultural Engineer	Survey Field coord/Supervisor
9.	Engr. O.O. Opadotun	8	B.Tech	Agricultural Engineer	,,
10	Mrs. Eze	8	HND	Agricultural Economist	Survey Project Economist
11	Mrs. Boni-Ude	15	HND	Secretariat Administration	Data processing

The main activities of the Agricultural mechanization projects include:

1. Planning, budgeting and development of survey template
2. Comprehensive literature review for stakeholders analysis
3. Composition and meeting of the research team
4. Design and production of questionnaires
5. Creation of Database and training of enumerators
6. Preliminary survey and stakeholders workshop
7. Baseline Survey, collation and analysis of data
8. Report writing and presentation
9. Evaluation Meeting and Policy Drafting

b. Technical challenges needed to solve during project implementation

ⅰ. Inadequate budget proposal for gadgets such GPS device and consequent inavailability of the device for specific use to ascertain the actual location of survey;

ⅱ. Constraints of limitation of project sites to only six states out of a total of 36 states of the country

ⅲ. Some necessary activities were not captured in the budget proposal such as cost of questionnaire production, data collation and analysis, etc.

c. Critical support to overcome challenges

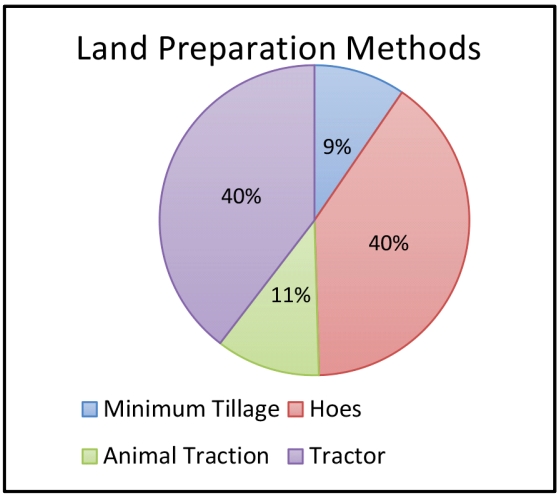
Adequate funding to overcome the aforementioned challenges.

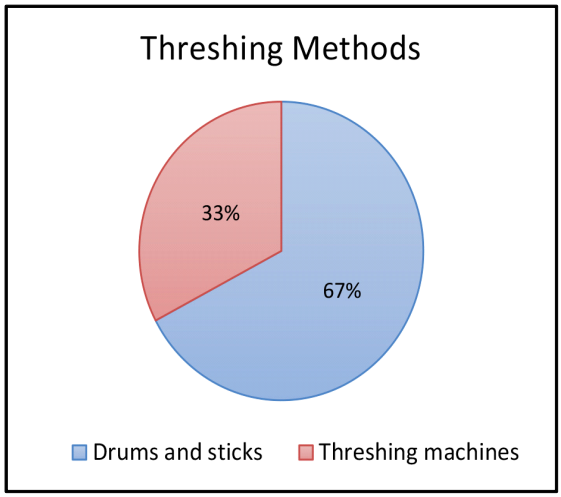
d. KAFACI baseline achievement so far

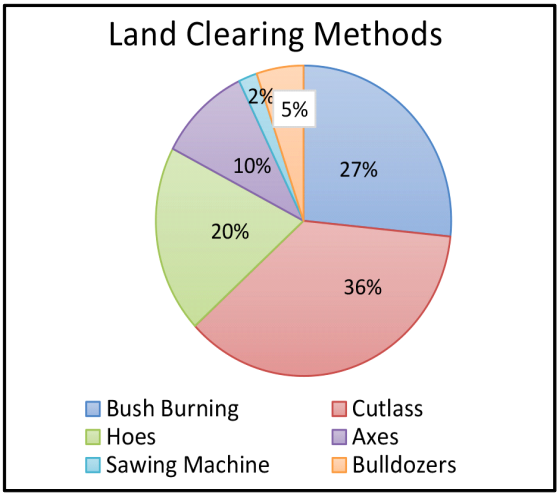
Since the commencement of the project in 2018, we have been able to amongst other things designed and produced questionnaires, create database, train enumerators, carried out preliminary survey and commenced the full baseline survey.

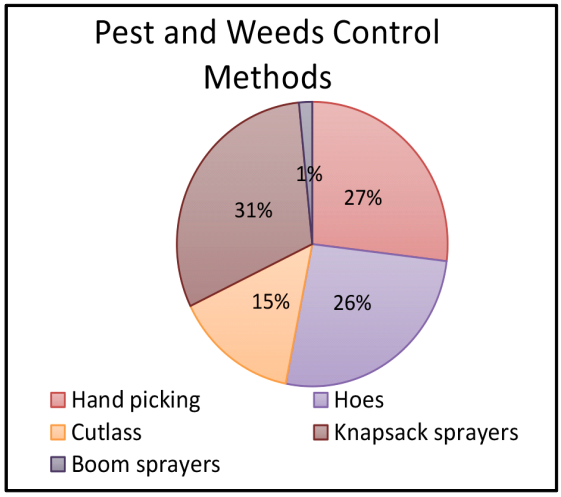
The results of the preliminary survey are concisely presented in the following chart:

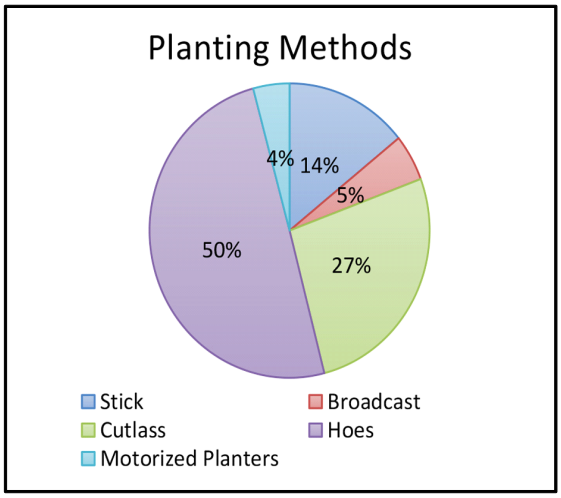
i. Existing levels of agricultural mechanization technologies practiced in Nigeria

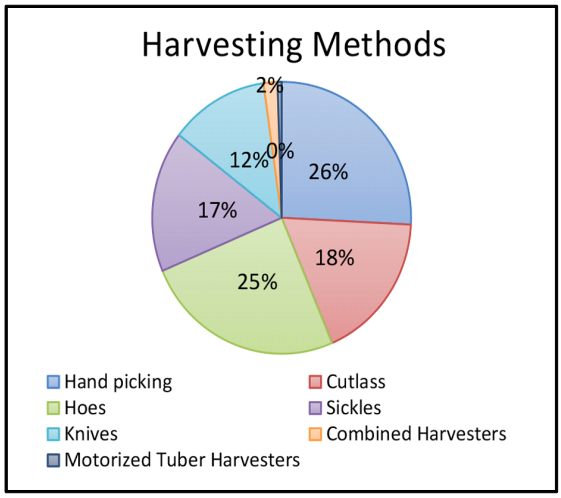


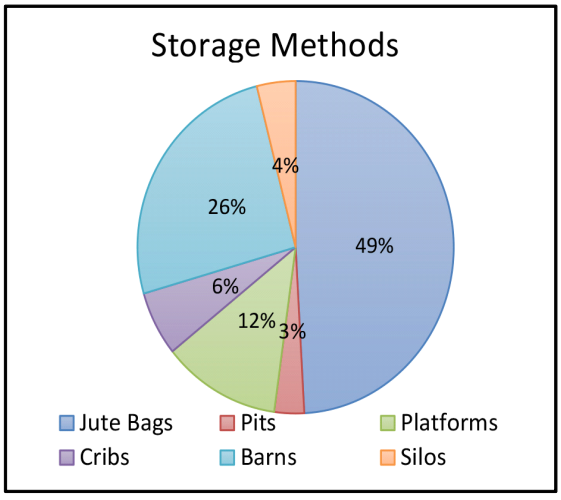




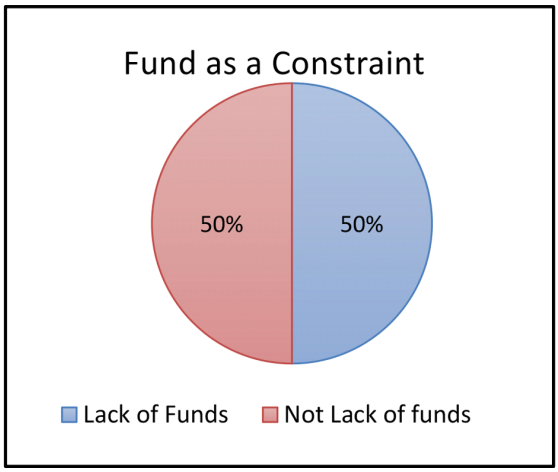


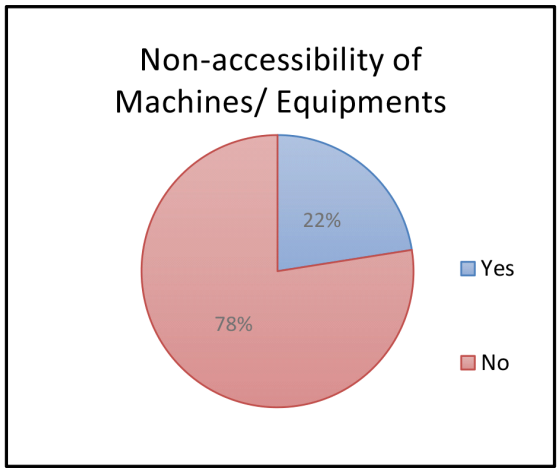

Planting Methods
14%
5%
27%
50%
4%
Stick
Broadcast
Cutlass
Hoes
Motorized Planters

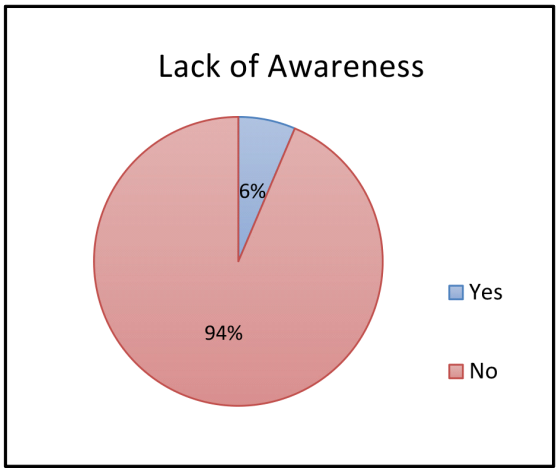

Harvesting Methods
26%
18%
25%
17%
12%
2%
0%
Hand picking
Cutlass
Hoes
Sickles
Knives
Combined Harvesters
Motorized Tuber Harvesters

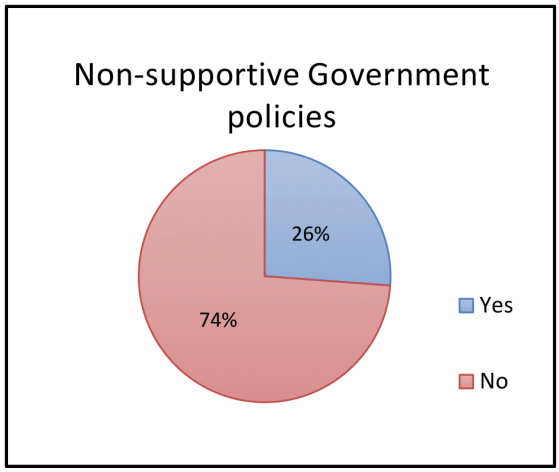

Storage Methods
49%
3%
12%
6%
26%
4%
Jute Bags
Pits
Platforms
Cribs
Barns
Silos

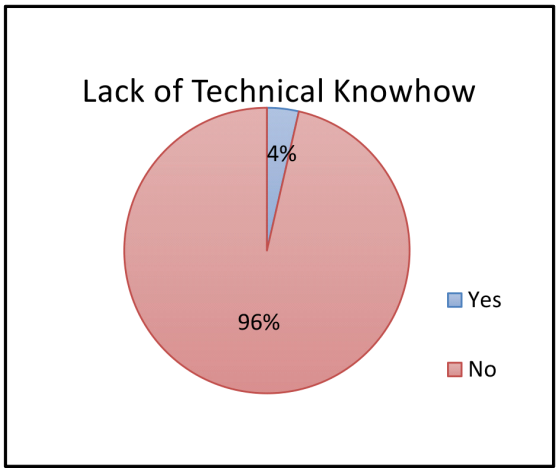
ii. **Constraints and opportunities to the adoption of the improved agricultural mechanization technologies and innovations in Nigeria.**

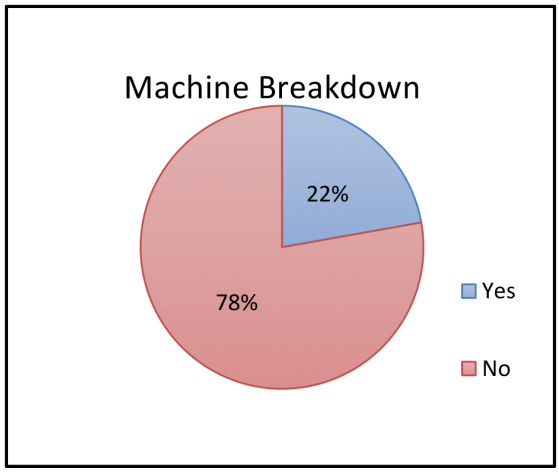


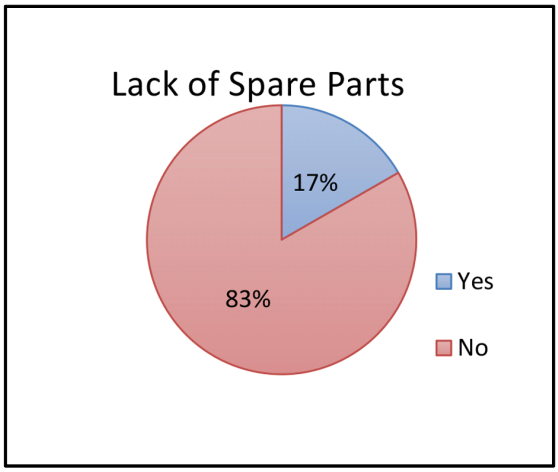


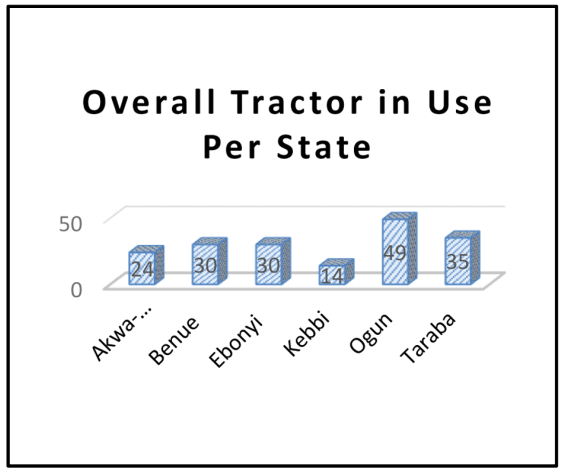












- **KAFACI RICE BREEDING PROJECT**

a. Information on projects (staff, area, budget, main activities, etc.)

Project staff	Main activities	Location	Time allocation (%)
Andrew A. Efisue (PhD)	Principal Investigator(PI), Rice Breeder	University of Port Harcourt	50
Azeez Shittu Olaniyan (M.Sc)	Rice breeder/seed technologist	IIT/AfricaRice	20
Joseph Orluchuku (PhD)	Agronomist	University of Port Harcourt	30
Emmanuel Ikiriko (M.Sc.)	Soil scientist	University of Port Harcourt	20
Augustine Uche (OND)	Field technician	IITA	100

b. Technical challenges needed to solve during the project implementation
Major constraints in Rice production

Lack of fund to conduct effective rice research, in Nigeria and Africa in general funding research is a big problem. Without fund, there will not be an effective research to compete with other advance research institutions were there are modern and cut-edge research equipment. Fund is necessary and essential to purchase minimal equipment and establishment of field trials.

i. Lack of high yielding varieties with desirable grain qualities, average yield in farmers' field is about 2.0 t/ha as compared to Korea that ranges from 8.0-15.0 t/ha. A high yielding variety will generate income to better the livelihood of the Nigerians' rice farmer.

ii. Lack of remediation of poor farm soil fertility, due to population pressure especially in the lowland, the fertility of the soil is declining yearly due to intensive cultivation and some part of the country crude oil spillage. There are no effective remediation materials to mitigate this trend in Nigeria soils

iii. Lack of nutrient use efficient varieties, some of the released varieties are not nutrient responsive due to some genetic factors, thus lead to waste of valuable nutrients such as fertilizers

iv. Poor acceptable agronomic characteristics, breeders developed rice varieties without considering the perception farmers and their traits preferences, which ought to be incorporated into the varieties during the developmental stages for easy adoptions and acceptance by consumers.

v. Poor agronomic management of rice crop, Nigeria rice farmers still lack modern good agricultural practice (GAP). They require more training in these areas.

vi. Low mechanization for land preparation, planting, weeding and post-harvest activities still very poor. This is partly due to poor resources to finance this equipment.

vii. Lack of fertilizers are not readily available and it does not come as at when due, probably after the stage of fertilizer application.

c. Critical support or help to overcome challenges (problems) by KAFACI

i. Provision of fund for effective rice research, as stated in section 1.2, research fund from KAFACI will assist in conducting an effective and adaptive research by releasing high quality rice varieties that will generate income for the poor resource farmers and better their livelihood.

ii. Provision of high yielding varieties with end user traits, some of the target traits being consider under KAFACI breeding programme are farmers driven and consumers' preferred traits, which very easy for adoption and acceptance by the rice stakeholders

iii. Improvement on agronomic management as stated in section 1.2 will help in boosting productivity

iv. Provision of certified quality seeds, after the release of rice varieties, these need to get into farmers' field through certified seeds. Most often, breeder do not have enough resource after the production of breeders and again produced certified seeds for farmers, at times, seeds companies may not be willing to produce the certified seeds for farmers for fordable price, which will stem the commercialization of the releases varieties.

v. Provision of breeding equipment such leave area meter as stated in section 1.2.

d. Agricultural development and achievements (up to now) through the project

The Table below showed introgression of Korean anther culture lines into Nigerian improved rice varieties. A total of 529 crosses were made during the reporting period using Korean anther culture lines both as male and female in the crosses for rice population development and improvement for upland, lowland and irrigated rice ecologies.

Table 1: Introgression of Korean genes into popular Nigerian rice

Male	UPIA 1	UPIA 2	UPIA 3	IWA 4	IWA 6	NERICA 1	NERICA 2	NERICA 7	NERICA 8	FARO 52	FARO 57	FARO 44
Female												
323804		7	46			9			14			
323806		26	29						54			9
323807			90	27					69			18
323817			35			16				22	21	19
323826		12					23			53	50	24
323829		24	48	14		30	16		7			8
323830			26			4			39	28		18
323836		4		55						70		91
323837		15				42			26			120
323839		12	14	60	23	9			81		43	7
323840			30	27						22		47
323841		17	22							39	17	17

Male	UPIA 1	UPIA 2	UPIA 3	IWA 4	IWA 6	NERICA 1	NERICA 2	NERICA 7	NERICA 8	FARO 52	FARO 57	FARO 44
323842		20	32					17		50	67	66
323843		19								90	41	60
323844		14	25	30		33						29
323846	24	80	16			31			24			
323847	7	39			45						15	61
323851	7	15	34							20	34	
323852	52	38	94				20	94				
323853		26	25	10	20	10	80	40	30		42	
323855	7		90		8	36	80				20	
323859	50		80			94	15					
323860	20						70	54				
323862	50	36		72	40	28	54		64	50	60	
323865	36	48	30		52	20	114	72		5	86	
323867		40			56	3	24		20			
323872				40						30		28
323879		10	52	46		48		40		11		54
323884		28	80	11					84	15	10	
323891	3		26			80	16	80			40	40
323892			2				70		100	34	64	30
323898	50		40			80	24	4		5		20
323900	62					80		40		50		42
	368	530	966	392	244	653	606	441	612	594	610	808

Total 396 crosses made in 2018 for various agronomic traits

The following crosses were made:

Year = No. of crosses

2015 = 115

2017 = 18

2018 = 396

Total = 529

The Table below showed the promising Korean lines for yield and phenotypic acceptability (PACP) as compared with the adapted Nigerian popular rice varieties. Therefore, some promising Korean lines have been identified undergoing the nomination processes for release into the Nigerian rice economy.

Top 15 Korean anther culture lines of 122 in OYT evaluated in 2018

Envelope No.	YLD t/ha	50% DFLW	Plant height (cm)	Tiller No.	No. Effective Panicle	PACP
336	6.77	81	80.0	15	11	2
216	5.65	78	105.0	15	11	1
Sahel 134	5.61	78	77.5	9	7	2
440	5.53	73	97.5	12	9	1
409	5.50	82	97.5	9	6	1
528	5.27	81	97.5	17	13	2
377	5.03	81	92.5	9	8	2
508	4.96	55	107.5	14	11	1
148	4.85	80	95.0	13	9	2
471	4.73	69	105.0	7	6	3
541	4.59	87	105.0	11	10	1
UPIA 1	4.55	101	115.0	13	12	1
402	4.43	85	90.0	12	9	2
454	4.33	92	100.0	9	8	1
105	4.32	80	92.5	16	11	1
488	4.31	81	87.5	19	13	2
129	4.29	81	95.0	11	8	1
UPIA 3	3.73	80	90.0	12	7	2
F44	3.45	85	85.0	18	15	2
UPIA 2	3.40	79	102.5	13	11	1
Mean	3.4	77.1	93.3	10.9	9.2	2.6
LSD	1.978***	23.555**	14.225***	7.618*	6.327***	1.997***

The Table below showed some of the transgressive segregants lines obatained from the crosses between Korean anther culture lines and some Nigeria rice varieties. To fast tract the breeding process, the F1 seeds of the materials have been sent to KAFACI for anther culture.

Crosses	Yield (t/ha)	Days to 50% flowering	Plant height (cm)	Tiller number/ plant	Phenotypic Acceptability
323867/UPIA 2	7.1	86	93.3	13	1
323879/UPIA 3	7.0	84	98.3	13	1
323859/UPIA 3	6.6	84	11.7	17	3
323874/UPIA 2	6.5	86	108.3	20	1
323841/UPIA 3	6.3	98	113.3	15	1
UPIA 2	6.0	84	110.0	17	1
UPIA 1	5.6	77	105.0	18	3
UPIA 3	5.0	70	95.0	19	3
323826	4.8	100	93.3	16	1
323861	4.6	88	88.3	16	1
FARO 52	4.5	84	113.4	17	3
323879	4.5	88	85.0	23	3
323874	4.4	88	95.0	19	1
323818	4.3	99	91.7	14	3
FARO 44	4.2	74	90.6	15	1
STD	1.06	8.53	24.26	2.73	1.01

Hybridization in the screen house

Nursery bed stage


Vegetative stage



Reproductive stage

● **KAFACI ITCGR PROJECT**

The KAFACI project on ITCGR is being coordinated by National Centre for Genetic Resources and Biotechnology (NACGRAB), the national focal point on matters relating to genetic resources conservation and utilization. The first phase of the project was from December 2014 – November 2016 and the second phase was from Dec., 2016 - November 2018. Altogether, KAFACI has committed a total of 60,000 USD to the project. The main activities embarked upon in the execution of the project in the second phase are:

ⅰ. Evaluation of Nigerian rice varieties for yield
ⅱ. Distribution of superior rice genetic resources to over 100 Nigerian farmers.
ⅲ. Screening of cowpea wild relatives for resistance to aphids attack
ⅳ. Recommendation of resistant lines to breeders for further improvement
ⅴ. International trainings on Germplasm Management System
ⅵ. Training of over 20 internship students on characterization of rice using Bioversity International descriptor.

The Principal Investigator received training at RDA genebank on how to use of molecular techniques to manage plant genetic resources. The fund received from KAFACI was used to distribute superior rice genetic resources to Nigerian farmers. Before this, the seed distribution system in the country is weak such that farmers (most especially poor farmers) do not have access to quality seeds. But with the assistance of KAFACI fund on ITCGR project, three superior rice genetic resources were distributed to over 100 farmers freely in four locations.

Table showing the distribution of superior rice seeds to farmers

No.	Locality	GPS	Varieties distributed	No of farmers
1	Ilora farm settlement, Oyo State.	N 07o 34 19.6” E 003o 54 52.9” Elevation 260m	FARO 44	29 Male = 23 Female = 6
2	Onilaru village, Orire local govt, Oyo State.	N 08o 14 23.7” E 004o 09 13.2” Elevation 410m	FARO 44	25 Male = 21 Female = 4
3	Iboko, Izzi local govt, Ebonyi State.	N 06o 24.677” E 008o 13.524” Elevation 82m	FARO 44 FARO 66	31 Male = 28 Female = 3
4	Lafiagi, Kwara State	N 08o 52 10.81” E 005o 24 51.02” Elevation 200m	FARO 44 FARO 66	30 Male = 25 Female = 5

- **KAFACI YOUNG SCIENTIST PILOT RESEACH PROJECT**

a. Information on projects (staff, area, budget, main activities, etc.)

The research is in progress and is being conducted all over Nigeria (covering all the geo-ecological and administrative zones of the country) using online/offline tools. 10 States were selected for the administration of questionnaire to the farmers manually while the rest of the states were contacted through phone calls and other channels of communication. But the final outcomes/result of the research are expected to be used over the entire KAFACI member countries. The project is of two years’ time with total budget of Twenty Thousand U.S. Dollars (US $20,000), in which Seven Thousand and Five Hundred U.S. Dollars ($7,500) is use for the implementation of the project every year. While Five Thousand ($5,000) U.S. Dollars were used by the PI in attending the 30 days mandatory International Training at Korea (2018) covering Air-Tickets, Visa, Accommodation and Feeding. Apart from Training attended at Korea, among the other activities of this project includes:

ⅰ. Interview with agricultural extension Agents in order to obtain the current status and issues of ICT/Networking in Agriculture at Nigeria (already completed)

ii. Organization of field visits for face-to-face interview and administration of questionnaire to small and medium scale farmers of different regions, in order to find out the current status, constrains and solutions to Agricultural ICT (completed)

iii. Supplement research on ICT books and published papers related to agriculture and agribusiness (on-going)

iv. Analysis of the acquired data (on going)

v. Building and designing of the sample layout and functions of KAFACI-Mobile-App for Android and Windows Phones, for effective information sharing among the KAFACI member Countries (on going)

vi. Finding solutions to the issues/problems discovered and enhancement of the capacity of KAFACI member countries networking/information sharing (on going)

vii. Research paper publication on Agricultural ICT & Effective Information sharing at Science Citation Index (SCI) Open Access Journal, so that the research will be made freely available online to the general public of KAFACI participating countries (not yet done)

viii. Write-up, compiling, communication and presentation of the research result and final report (not yet done)

b. Technical challenges needed to solve during the project implementation

Currently, there is no any technical challenge needed to be addressed for the YSPR project in Nigeria.

c. Critical support or help to overcome challenges (problems) by kafaci

None

d. Agricultural development and achievements (up to now) through the project

The research is not yet complete but Federal Ministry of Agriculture and Rural Development Nigeria discovered some important aspect learnt through Young Scientist Training at Korea, and now ready to implement them in order to achieve maximum level of production in the country. Among the discoveries include Social

Networking Service (SNS) in Agriculture, which is ready to be initiated and implemented by the Department of Agricultural Extension Services. SNS in Agriculture describes an online platform used to build social networks or social relations with others with similar personal or career interests, activities, backgrounds or real-life connections. Agriculture being knowledge intensive industry, creation and application of SNS in Agricultural Extension services has the potential to improve service delivery effectively.

- **Development and Application of Postharvest Handling Model for Horticultural Crops**

a. Information on projects (staff, area, budget, main activities, etc.)

S/N	Name	Qualification	Discipline	Experience
1	Engr. M. O. Ogunbiyi	MSc. PhD (In view)	Crop Processing Storage	26 years
2	Okon, Victor Daniel	HND	Agric Engineering	23 years
3.	Isah Mohammed	HND	Agro Processing	22 years
4.	Etolue Ikechukwu	BSc	Agric Engineering	10 years
5	Ndugba, O, D	B.Sc	Crop Production	4 years

The project is being implemented in 2 phases. The first phase commenced in 2015 and ended in 2018 with a total budget of USD45,000. The second phase commenced in August 2018 and will run for 3 years with a total budget of USD55,000.00.

The first phase essentially focused on the assessment of postharvest losses in the horticultural crop production sector and the development of model manuals on postharvest handling of tomato, orange and banana. The second phase is targeted at the application of the model manual of tomato in Nigeria's Postharvest industry. The main activities for the project are:

ⅰ. Conduct Baseline survey and follow up survey among the stakeholders. Conduct market survey

ⅱ. Conduct training and provide technical support on postharvest handling model

ⅲ. Participate in KAFACI workshops where delegates will include experts on postharvest management from participating countries attend to share

information on the status of postharvest industry and discuss possible ways to adapt developed postharvest technology.

iv. Produce country reports on postharvest loss, example of industrial postharvest handling, postharvest infrastructure, regular monitoring and evaluation etc.

v. Assessment of postharvest handling procedure in the tomato industry of Nigeria

vi. Development and dissemination of manual on postharvest handling of tomato

b. Technical challenges needed to solve during the project implementation

i. Delay in acquiring the facility for the fruit handling and postharvest training centre. This has delayed the establishment of the centre and also the commencement of the training activities.

c. Critical support or help to overcome challenges (problems) by KAFACI

None, the challenges enumerated above is being handled with the concerned government agencies in Nigeria.

d. Agricultural development and achievements (up to now) through the project

i. Postharvest handling manuals for tomato, orange and banana were published in English and Hausa languages.

ii. A poster on **"Postharvest handling of tomato for domestic markets in Nigeria"** was also produced and exhibited at the 4th ISHS Asia Symposium on Quality Management in Postharvest Systems held in Jeonju, South Korea in September, 2017.

iii. A paper was also presented on "Strengthening Postharvest Food Loss Prevention in Africa: The Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI) Project" at the African Session of the Symposium.

3. Socio-economic Returns and Impacts

Implementation of the KAFACI projects provided for both direct and indirect beneficiaries. For the rice projects and the ITCGR projects, the direct beneficiaries are the seed companies in Nigeria, seed producers and rice farmers. The seed companies and seed growers will multiply the high-quality foundation seeds received from this project to generate high quality certified seeds, which will be available to rice farmers for paddy production. This indirectly translates to high yield and high income to take care of the social needs. The development of improved rice varieties from the rice project and the distribution of improved rice genetic resources from the ITCGR project is expected to give about 200% profit return to farmers. Rice farmers in Nigeria will thus have improved livelihood.

The KAFACI projects implementation in Nigeria is expected to have the following returns/socio-economic impact on the country:

i. **Food security**: Nigeria can become self-sufficient in food production if agricultural mechanization is fully embraced.

ii. **Industrial Revolution:** Optimizing the agricultural potential of Nigeria through mechanization has the potential of stimulating industrial revolution as raw materials would be readily available for manufacturing industries.

iii. **Job Creation**: With the use of modern methods and machineries, more youths would be engaged in agriculture; as mechanization would bring dignity to farming.

iv. **Increase Gross Domestic Product (GDP):** This would be increase through exports and non-oil earnings from agriculture.

v. **Reduction of Post-Harvest Losses**: This is mostly caused by poor handling methods, poor infrastructural facilities, lack of modern storage facilities, etc. KAFACI is addressing these issues and thus Post harvest losses would be reduced

vi. **Enhanced livelihood of farmers**: It would also enhance the standard of living of the farmers as well as increase their income.

vii. **Improved market access**: The projects especially the YSPRP in Nigeria is expected to improve market access for producers, marketers and processors through enhanced information sharing.

a. Regional and Continental Integration through Project Implementation

In the course of the execution the Agric Mechanization project, there has been great regional integration within the country through interactions between sampled states. Some States now know they can solve problems of other states in other regions. This has improved inter-state and regional collaborations.

The KAFACI rice project has collaborated with regional states like Ghana, Mali and Uganda in the exchange of germplasm. The project also contributes some of the genetic materials from this project to AfricaRice Breeding Task that will be distributed to all member countries in Africa. It has also linked up with IRRI INGER programme for germplasm exchange of which some of the outstanding project rice varieties will nominated to this platform that will be distributed to IRRI affiliated countries all over the world.

The KAFACI ITCGR project has greatly improved network and cooperation among genebank managers in the member countries.

The implementation of the KAFACI postharvest project has encouraged inter regional interaction on the appropriate ways to reduce postharvest losses in most horticultural crops. The project has developed a social media platform where all the 18 Principal investigator engage in DAILY interactions on postharvest and other agricultural sector issues.

b. Summary of each project on positive part

The baseline survey of the level of agricultural mechanization in Nigeria has shown a low level of mechanization and the need to close the gaps through public-private and international collaborations in funding and training; as government alone cannot meet the demands of the sector for Nigeria to become a mechanized Nation

The KAFACI rice project has contributed immensely to rice breeding programme in Nigeria, particularly in germplasm exchange. Some of the genetic materials received from Korea (the anther culture) have accelerated the breeding cycle of rice varieties. Some of the anther culture varieties were used as donor for rice population improvement in Nigeria. These are promising rice varieties derived from this project that are very outstanding in terms of high yield, good grain quality and with aroma

good for the rice consumers in Nigeria.

The ITCGR project has made an impact in capacity building, meeting the needs of resources-limited farmers by making available superior quality rice seeds and identification of wild cowpea relatives resistant to aphids attack which will be used for further improvement and will in turn increase farmers yield.

The Postharvest project titled **"Development and application of postharvest management technology model for horticultural crops"** is targeted at reducing postharvest losses and improves quality of horticultural crops in Nigeria through implementation of postharvest handling model. The project has recorded great achievement ranging from the development and publication of practicable postharvest manuals and the enlightenment of farmers and traders on the need to employ safe and good postharvest methods and infrastructure that allow for preservation of quality and quantity after harvest.

4. Conclusion

a. Conclusion

The KAFACI Livestock project has so far demonstrated the potential of chicken egg production as an enterprise with potential for small-scale investment. The small space requirements and adaptation to backyard farming points to its attractiveness to resource-poor women and youth. The enthusiasm displayed by participants and other potential beneficiaries not accommodated indicates the need to extend the project to cover more locations and more farmers.

The high cost of feed has undoubtedly limited the profit potential of the enterprise thereby underscoring the need for subsequent intervention to put more emphasis on cost-effective feed formulation by farmers. In a larger perspective, this observation suggests that growing the industry will require supporting farmers through subsidized feed for keeping with recommended practices especially at start-off.

The AM project has achieved the following:

ⅰ. The level agricultural mechanization in Nigeria has been ascertained to be low but has great potential for improvements;

ii. The causes of low agricultural mechanization in the country has been identified to high level of reliance on government to meet the needs of the sector;

iii. The need areas of collaborations are identified as funding for Research and Development, infrastructure, training, etc.;

iv. The tractorization index of the country for each geo-political zone has been identified to low and that of the nation is 0.2446 ha/hp which is lower FOA recommended 0.4ha/hp, hence there is need for improvement;

v. Crops with dominant mechanization potential in each geo-political region of the country has been identified.

From the Rice Project, the transgressive lines obtained based on grain yield of 6.3-7.1 t/ha as compared to Nigeria rice mega variety FARO 44 of 4.2 t/ha is already being promoted through participatory varietal selection (PVS), On-farm trails and demonstration s in the major rice growing areas of the country. The breeding programme has also intensify efforts to improve the grain quality for aromatic scented rice, which is now on high demand by the consumers.

The RDA standard in genebank management has been adopted in some of the ITCGR project implementation operations in Nigeria. The research work on rice has greatly impacted on Nigerian farmers by having access to superior quality. Also, the discovery of new donor lines tolerant to aphids attack will improve farmer's productivity when the breeding is completed.

The Young Scientists Pilot Research Project explores the issues and constraints to effective agricultural information sharing among farmers in the country such as inadequate accessibility of ICT services to rural farmers, lack of basic skills of using ICT facilities in agriculture by farmers, lack of electricity especially at rural areas, high level of poverty among the small scale farmers.

b. Recommendations

To further promote the activities of KAFACI Livestock project in Nigeria beyond the level in which it is currently operating, the following possible options are suggested:

i. Extension to more farmers with greater participation of women and youth.

ii. Advocacy and Lobby visits to policy makers and government (at local, State and Federal levels).

iii. Enlistment and subsequent empowerment of more farmers, thereby expanding project base by addition of more benefiting farmers and sustenance of existing ones.

iv. Continuous conduct of training workshops for farmers, extension agents and other stakeholders.

v. Regular monitoring and backstopping.

vi. Addition of more birds to existing farmers thereby increasing the stock size.

vii. Establishment of pilot mini-hatcheries.

viii. Provision of low cost feed formulation packages to new farmers

ix. Improvement of laying chicken production facilities of benefiting farmers, such as provision of battery cage to accommodate chickens, remodelling and repairs of some chicken houses etc.

To enhance high level of agricultural mechanization in Nigeria, it is recommended that there should be more collaborations between government, private and international donors (e.g. KAFACI, etc.) in the areas of funding, training, research and development (R&D), marketing, input supply, farm and rural infrastructural development for this important sector of the economy.

It is also recommended that the KAFACI Rice Project should continue as it has strengthened the rice breeding programme by fast racking the breeding cycle through anther culture lines of which some will soon be register and release to rice farmers in Nigeria. The project has led to the enhancement of high-yielding rice germplasm and breeding capacity of rice production in particular Nigeria, through selection and hybridization to identify high-yielding germplasm for yield and biotic and abiotic stresses.

The YSPRP will like to recommend that both the KAFACI projects and training in Africa need to be continued in order to help the continent out of the issues/problems in Agriculture.

Based on the experience acquired on KAFACI-Genetic Resources project, it is recommended that the project should be sustained and taken to another level of germplasm exchange and evaluation among KAFACI member countries and the Republic of Korea.

Zimbabwe

Impact of the KAFACI Projects in Zimbabwe

1. Introduction

The Korea Africa Food and Agriculture Cooperation Initiative was launched in July 2010 in Seoul, Republic of Korea. Fifteen (15) African countries signed a Memorandum of Understanding (MOU) with the Republic Korea represented by its Rural Development Administration (RDA). Zimbabwe was represented by the Scientific and Industrial Research and Development Centre (SIRDC), at the signing ceremony which was graced by the then Prime Minister of the Republic of Korea, Mr Kim Hwang-sik. Since then Zimbabwe has been an active and pivotal member country of KAFACI through the implementation of successful agricultural projects in collaboration with other member states. KAFACI is a multilateral organization. Currently KAFACI comprises 20 member countries namely: Angola, Cameroon, Comoros, Cote d'Ivoire, Democratic Republic of Congo (DRC), Ethiopia, Gabon, Ghana, Kenya, Malawi, Morocco, Nigeria, Rwanda, Senegal, Sudan, Tunisia, Uganda, Zambia, Zimbabwe and Republic of Korea. Zimbabwe is the immediate past Chair of KAFACI.

The overall goal of KAFACI is to promote agricultural research and development in member countries. The initiative aspires to enhance agriculture and food production in Africa through sharing of experiences with the Republic of Korea. The Republic of Korea is a country that experienced rapid development from the 1960s when it was a donor recipient country and moved to being an aid-giving country. The Republic of Korea has achieved food security through rapid development of excellent agronomic practices. There are numerous lessons to be learnt from Korea before and after independence and analogies can be made between Korea and the African members of KAFACI that motivate the African members to look up to Korea for inspiration to develop.

It is against this background that as one of the founding members and immediate past Chairman of KAFACI, I write to express deep gratitude and appreciation to the government of The Republic of Korea on behalf of the African member states in general and Zimbabwe in particular for the immense contribution and impact KAFACI has noted in less than ten years of its existence. The success of KAFACI interventions has been largely due to:

2. Development

a. Problems Identification

KAFACI, unlike other funding agencies, has developed a unique way of working together with member countries in identifying problems peculiar to specific member countries. These challenges are funneled into the network where solutions are then crafted through tailor-made national programs targeting specified communities.

This approach has led to generally positive outcomes in programs funded by KAFACI in Zimbabwe in particular and Africa at large. With specific reference to Zimbabwe, the Hwedza Enhancement of National Agricultural Extension System (ENAES) project is a case in point, where farmer maize yields averaged a mere 280kg/Ha before the program started in 2013 to the current yield of between 2-3t per hectare. The dramatic increase in output is credited to the use of good agronomic practices adopted through the KAFACI ENAES project. This has had a positive downstream multiplier effect whereby communities outside the project areas are implementing agricultural practices learnt through the KAFACI project members. Food security and income have tremendously improved at household level as a result. The project has seen participating villages increasing from one to the current 18 villages and a 6-fold membership increase from the initial 100 farmers at project commencement (2013) to the current 561 farmers. Close to 3000 family members are therefore benefitting directly from the KAFACI ENAES project.

Due to the increased maize output, KAFACI introduced the layer chicken project as an incentive where those farmers who produced more and thus had excess maize, were eligible to join hence introducing the value chain concept to local farmers. Farmers with excess produce from the KAFACI ENAES project now rear layer chickens and use the excess maize as supplementary feed to produce eggs. The eggs are sold within the community thus addressing two issues at the same time, increase household income levels as well as improvement of nutrition within the household and community at large.

The Grain Marketing Board (GMB) which buys grain from farmers has been receiving regular maize grain deliveries from the KAFACI project farmers. KAFACI farmers deliver an average 100t of maize to the GMB Hwedza depot every season since the start of the ENAES project. Deliveries of maize to GMB by communal

farmers had become non-existent due to poor agricultural extension and advisory services.

b. Introduction of and exposure to agricultural mechanization of small holder farmers to increase productivity.

Zimbabwe is one of the countries that benefitted immensely through the high level delegation and Scientists' exposure to Korean technologies in agricultural mechanization. As a result, the country proposed and undertook to reverse engineer Korean agricultural machinery to suit Zimbabwean local conditions. The need to have access to smallholder agricultural equipment is largely driven by two factors in Africa; low productivity and wastage of many man-hours in doing some simple but necessary tasks especially during land preparation, harvesting and processing of small grains. SIRDC has therefore embarked on a program to reverse engineer planters and threshers to reduce the amount of labor and cost associated with small grains production and processing in Zimbabwe. Although funding is limited, SIRDC has made this one of its major projects that can change Zimbabwean agriculture in the smallholder sector significantly. The reverse-engineered prototypes have attracted serious attention and interest by small holder farmers at the Harare Agricultural Show and Zimbabwe International Trade Fair (ZITF) in Bulawayo, respectively.

c. Conservation of National Germplasm and Biodiversity

One of the significant positive outcomes of the KAFACI projects in Zimbabwe and Africa in general has been the need for creating awareness and the crafting of national policies to protect national biodiversity. The preservation of Zimbabwe's national biodiversity is an integral part of protecting its heritage. The project on Conservation of national genetic resources managed to bring two things to the fore in African countries namely:

The need to preserve national germplasm which serves as the resource pool for national adaptive breeding programs particularly now given the driving need to develop national climate resilient seed & systems and the creation of networks that allow formal sharing and exchange of such genetic resources leading to a wider network for preservation and access of gene banks amongst Korea and African members of KAFACI.

d. Training of Scientists

Zimbabwe has benefitted from the collaboration and staff exchange programs funded by KAFACI. Working and training visits were conducted between Korean Centers of excellence and KAFACI member countries for mutual benefit. Such visits were not only beneficial but managed to a create national drive for young Scientists to innovate within the context of their home countries national needs and resources yet benchmarking on international best practices as seen through the eyes of Korea. The trained Scientists have demonstrated a high degree of competence and confidence when disseminating collaborative work over radio and television broadcasts within Zimbabwe. The training of Scientists in Korea complements government effort in elevating Zimbabwe's Human Capital (HC) development index. The HC dimension is undoubtedly crucial in the development of a Knowledge Society (KS). Through KAFACI, Zimbabwean Scientists in particular as well as Scientists from other African member states, have been empowered with all the knowledge and skills needed to survive in a society that continuously changes.

e. Unique project Funding Model

The Korean funding model approach has been unique, practical and inclusive. It is channeled at specific activities directed at benefitting communities and not specific individuals. This approach has found home in Zimbabwe particularly at SIRDC where the same ethos form part of our core values and drive SIRDC's research and development initiatives.

The Korean funding model while providing small project grants demands that recipient countries also contribute to the project to ensure buy-in by the host country and sustainability in the long term. This therefore allows recipient member countries to assess, evaluate and adapt the project nationally to local needs and then it is up to member countries to adopt and scale up the project should it be so required and by then KAFACI would have demonstrated the impact of such a project in the given community. This serves African governments a lot of money in that resources are not put to waste and the impact or likely impact would have been proved through the KAFACI funding model which targets specific and systematic technical interventions in the identified project sites.

f. Birth of KOPIA Zimbabwe Centre & Establishment of Bilateral Ties

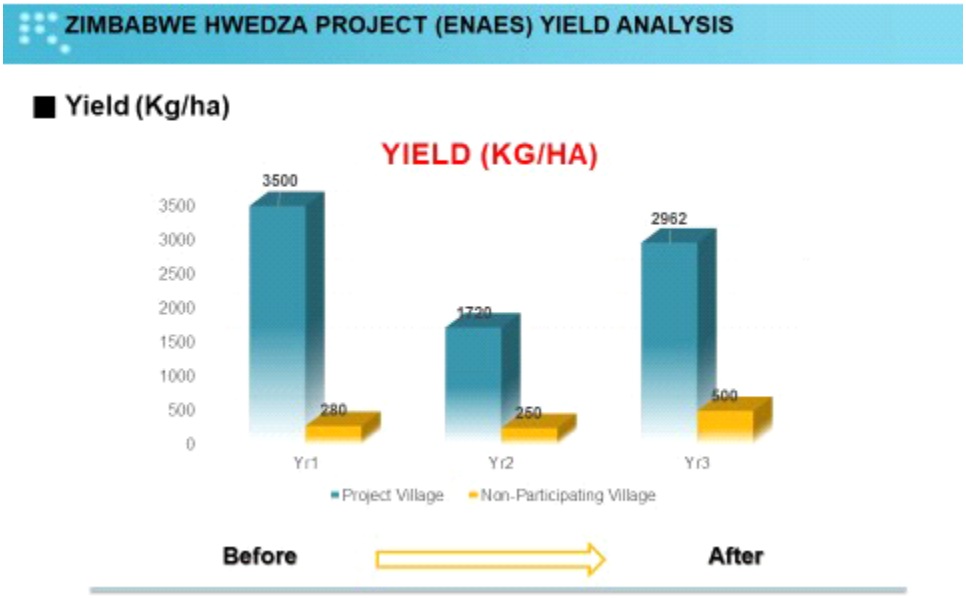
Through KAFACI, the Zimbabwe-Korea relations were further strengthened through the establishment of the Zimbabwe Korea Program on International Agriculture (KOPIA) Centre, a bilateral arrangement between the governments of Zimbabwe and the Republic of Korea. This has seen the solidifying of economic and cultural relations between the people of Zimbabwe and Korea. KAFACI thus presented a diplomatic conduit that gave birth to the bilateral Korea Program on International Agriculture(KOPIA) in Zimbabwe.

Through KOPIA, scientific, agricultural and economic ties between Zimbabwe and Korea have blossomed and are growing in leaps and bounds. It is our hope to see the same happening in other African countries so we develop together as a continent.

3. Socio-economic Returns and Impacts

The KAFACI projects in Zimbabwe have helped to strengthen government policy especially in the building of resilience in poor and less privileged communities. KAFACI funding has been catalytic in resilience building in protecting communities against future unforeseeable shocks particularly in view of climate change dynamics. To promote effective utilization and value-addition of the maize produced by farmers under the ENAES project in Hwedza, the poultry project complemented the maize project to bring a balance in terms of nutrition where farmers will get protein from the eggs and also to increase and diversify their income streams. The 30 best farmers who produced the highest yields of maize in the 2016 agricultural season were selected for the layer chickens project baseline survey and 10 eventually benefitted. The capacitation of farmers follows the Saemaul Undong model which seeks to promote diligence, hard work and self-reliance.

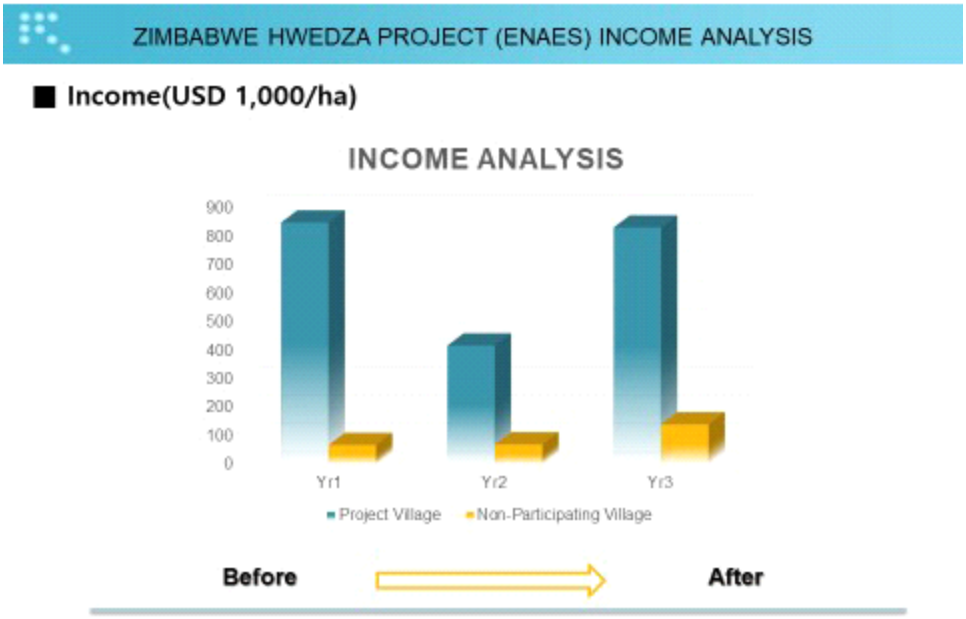
Table 1. Yield Analysis for Hwedza KAFACI (ENAES) Project



The yield analysis table indicates an improved yield per hectare of maize for farmers in the project compared to non-participating farmers over a three-year period. This is despite the drought experienced in year 2 of project implementation. There was therefore a significant yield advantage from a baseline survey of 280 kg/ha before the project and 3,500 kg/ha/yr of project implementation. The positive impact is also seen over the three-year period.

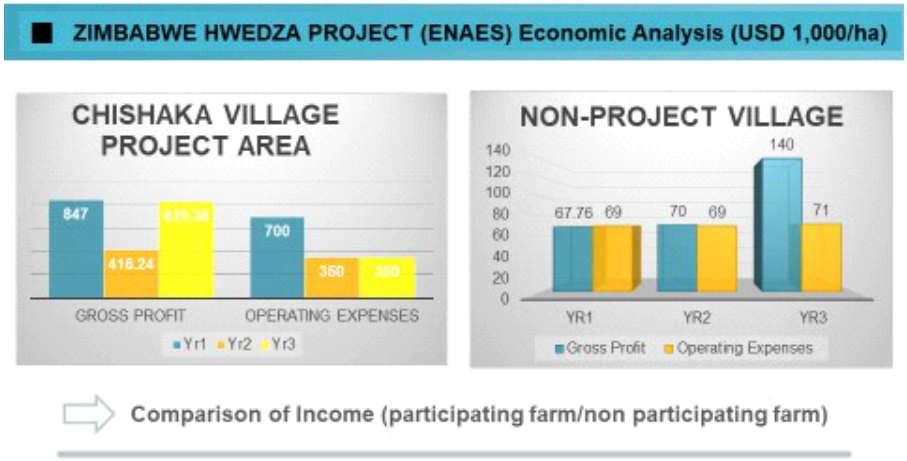
The increase in yield also translated into improved income for the farmers as indicated in the Table 2 and 3.

Table 2. Income Analysis Table for Hwedza KAFACI (ENAES) Project



The improvement in income flow is meteoric for rural farmers who used to generate less than US$100 from their maize farming activities per hectare to approximately US$900/ha under the KAFACI ENAES project.

Table 3. Economic Analysis of the Hwedza KAFACI (ENAES) Project



An economic analysis in which income was compared against operating expenses still left farmers under the KAFACI project with a net disposable income

that could be channeled towards paying school fees and buying uniform for children still going to school as well as meet low cost family health needs such as medication and tablets.

The Zimbabwe ENAES project followed the Korean Saemaul Undong model when it selected farmers for the poultry project. Ten (10) best performing farmers in the ENAES project were selected and a Summary Table of the financial analysis is given in Table 4 below.

Table 4: Summary of financial analysis for poultry project farmers (All figures are denominated in US$)

Date	Sales/month	Deposits1 [30%]	Cumulative Savings	Expenditure	Sharing	Farmer Income
Baseline	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Sep-17	2,625.00	357.62	357.62	1,267.38	1,000.00	100.00
Oct-17	2,400.00	273.00	630.62	1,377.00	750.00	75.00
Nov-17	3,000.00	202.62	833.24	1,797.38	1,000.00	100.00
Dec-17	2,598.00	441.61	1,274.85	1,125.96	1,030.43	103.04
Jan-18	2,893.00	490.62	1,765.47	1,257.60	1,144.78	114.48
Feb-18	2,642.43	430.68	2,196.15	1,206.83	1,004.92	100.49
Mar-18	2,455.00	135.42	2,331.57	1,139.54	1,180.04	118.00
Apr-18	2,445.00	391.61	2,723.18	1,139.62	913.77	91.38
May-18	2,800.00	496.95	3,220.13	1,143.50	1,159.55	115.96
Jun-18	2,545.00	419.31	3,639.44	1,147.30	978.39	97.84
Jul-18	2,600.00	436.64	4,076.08	1,144.52	1,018.86	101.89
Total	**29,003.43**	**4,076.08**		**13,746.63**	**11,180.74**	**101.64**

The poultry project has seen farmers supported by KAFACI now having a reliable monthly income of US100 that did not previously exist and additional accumulated savings of US$4076.43 which is a compulsory 30% farmers put into their cooperative account which can then be used to expand the project by the farmers to ensure project sustainability.

4. Conclusion

a. Regional and Continental Integration

Although Africa is a single continent, most African countries do not very often experience the opportunity of working together at a practical level as was demonstrated by the KAFACI initiative. This is largely due to limited financial resources as well as geographical location and language barriers. KAFACI ably facilitated regional and continental integration through the creation of sector networks through the 5 program areas that encouraged South-South cooperation among African member states while at the same time promoting North-South cooperation between Korea and the African member states of KAFACI.

b. Conclusion

Finally, in view of the role KAFACI projects have made in the development of a poverty-reduction model in Africa. I recommend that the Government of the Republic of Korea continue to expand and fund KAFACI programs in Africa to consolidate the gains made to date and also to identify leading African countries through which the Korean development model can be further promoted and disseminated throughout the continent.

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