Synthesis of RUFORUM Technologies, Innovations and Management Practice (TIMPs)

DRAFT

Introduction

The major outcome of RUFORUM supported research is knowledge and technologies generated that are passed on to the national agricultural research and extension systems for scaling up. Research initiated through graduate training has resulted into the generation of several technologies including elite varieties of drought tolerant indigenous crops and contributed to approaches for sustainable use of natural resources for enhanced livelihoods in the region. Adoption of new crop varieties and commodity production practices from the research has contributed to improving livelihoods of smallholder farmers. RUFORUM estimates that the assortment of technologies generated have reached over one million beneficiaries through extension, seed systems and supportive policies. Adoption of new crop varieties and commodity production practices from the research has contributed to improving livelihoods of smallholder farmers and solving real community problems. This document aims at sharing knowledge and innovations to solve cross-cutting problems in agriculture in the African Continent and globally and contribute to productivity and growth of the agricultural and related sectors.

Definition of terms

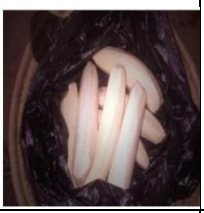
Technology: Refers to outputs of a research process beneficial to the target clientele, can be commercialized and can be patented under intellectual property rights arrangements.

Innovation: Is a modification of an existing technology for an entirely different use from the original intended use.

Management practice: Refers to recommendations/practices that are considered necessary for a technology to achieve its optimum output. This includes different agronomic and practices, protection methods, for crops; and feed rations, management systems, disease control methods, etc. for livestock. This information accompanies the parent technology before it is finally released to users and the technology would be incomplete without this information

The technologies, innovations and management practices have been summarized according to the major thematic areas including; crop improvement; livestock management; agribusiness/marketing; climate change & environment; extension and rural innovations; soil health & fertility; ICTS in agriculture; agroforestry & crop protection; and, gender in agriculture

Agribusiness/Marketing

TIMP Name	Contamination risks associated with wrapping indigenous foods in polyethylene bags during cooking
University of development	Makerere University
Country	Uganda
Year of development	2014
Principal Investigator	Prof. Noble Banadda
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Wrapping food in banana leaves for the purposes of keeping it hot/warm has been practiced for centuries across communities in Uganda. However, the use of plastic bags especially polyethylene bags as opposed to banana leaves is on the steady increase especially in urban and peri-urban areas. Identifying hazards and risks associated with wrapping and packaging local food stuffs in colored low density polyethylene bags during and/or after cooking is a little-studied topic in Uganda whereas experiences from elsewhere point to the fact that such a practice is potentially devastating.
What is it? (TIMP description)  	Polyethylene bags have extremely high contaminant concentration (above USFDA limit) of Lead, Cadmium, Chromium and Cobalt respectively confirming the potential health risk to individuals if continuously eat food thermally prepared in polyethylene bags.
Benefits of the TIMPs to smallholder farmers and communities	Communities reconsidering using natural materials as leaves as opposed to synthetics.
Lessons learnt during implementation	Apart from polyethene bags, alternative food handling materials need to be developed. This requires understanding the microscopic interactions between food components and contaminants
Online links to TIMPs	
Comparative study of two modeling approaches for predicting heavy metals contaminant migration from polyethylene bags	

Crop Improvement

TIMP Name	Management of organic residues to improve Carbon sequestration, reduce Nitrogen losses and improve crop yields
University of development	Kenyatta University
Country	Kenya
Year of development	2012
Principal Investigator	Dr. Benjamin Oginga Danga
Category (i.e. technology, innovation or management practice)	Management practice
A: Description of the technology, innovation or management practice	

Problem to be addressed	Few quantitative relationships between decomposition rates of organic manures & wastes and controlling edaphic, climatic and biotic variables have been determined.
What is it? (TIMP description) Process oriented computer simulation models of Nitrogen and Carbon transformations in a soil-organic waste-plant system (NCSOIL)	Soil incorporation of 10 ton/ha compost and 5 ton/ha maize stover in farms improves soil productivity and yields
Benefits of the TIMPs to smallholder farmers and communities	Sustainable management of organic resources helped to improve Carbon sequestration in soil, crop yields, water and air quality
Lessons learnt during implementation	Adequate funding is indispensable in enabling students work with communities for a long period of time as extension agents to transfer technologies
Online links to TIMPs	
Effects of different organic residues on carbon sequestration, nutrient availability in soil and maize yields at Katumani, Machakos county Kenya (1library.net)	

TIMP Name	Use of Crotalaria species in sustainable management of plant-parasitic nematodes of vegetable crops in western Kenya
University of development	University of Eldoret
Country	Kenya
Year of development	2014
Principal Investigator	Dr. Elizabeth Omami
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem to be addressed	Root knot nematodes are a serious biotic production constraint affecting vegetable production in Kenya. The adoption of sustainable management strategies including the use of antagonistic plants is important in reducing the amount of losses attributed to this soil pest.
What is it? (TIMP description)	The host suitability of different Crotalaria species against root knot nematodes, different Crotalaria application methods (preplant, aqueous extract and soil amendment) and quantifying nematode infestation at different nematode inoculum threshold levels.
Benefits of the TIMPs to smallholder farmers and communities	Increased vegetable production and improved nutrition; increased incomes due to marketing of surplus vegetables; and, low production costs: through the use of sustainable nematode management strategies that reduces use of expensive chemicals which at times are ineffective
Lessons learnt during implementation	while it was thought that only few, at most five species of nematodes were present, several species were identified. The efficacy of the different Crotalaria species needs to be established before embarking on the assessment of the efficiency of different application modes.
Online links to TIMPs	
Omami.pmd (ruforum.org) Hillary Theses pdf-Biological Management of Root Knot Nemato.pdf	

TIMP Name	Technical guideline for top cleft and side veneer grafting of African baobab tree (*Adansonia digitata L.*)
University of development	University of Abomey Calavi
Country	Benin
Year of development	2020

Principal Investigator	Prof. Achille Assogbadjo
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	The cultivation of baobab for its pulp and leaves are possible to meet consumers' needs. However, when the species is propagated by seeds, the first flowering takes place at 10 – 15 years old; which is considered too delayed and hence a major constraint for its domestication. Grafting, a vegetative propagation technique that joins a rootstock and a scion is an alternative to the problem of the relatively long time needed for reproduction to start. Grafting can shorten the reproduction time to less than 5 years.
What is it? (TIMP description)  Top cleft grafting  Side veneer grafting	Grafting is a vegetative propagation technique that joins a rootstock and a scion. It is an alternative to the problem of the relatively long time needed for reproduction to start. Grafting can shorten the reproduction time to less than 5 years. Grafting also ensures complete transfer of the characters of mother plants to new individuals from grafting, allowing to fix interesting traits. This technique can therefore offer quite interesting alternatives for baobab plantation and its early fruiting.
Benefits of the TIMPs to smallholder farmers and communities	-
Lessons learnt during implementation	Developing technical solutions to support baobab plantations and baobab-based horticultural systems will go a long way in enhancing faster propagation of baobab
Online links to TIMPs	
Technical guideline for top cleft grafting of African Baobab Tree Technical guideline for side veneer grafting of African Baobab Tree	

TIMP Name	Technical data sheet on Baobab (*Adansonia digitata L.*) leaves production
University of development	University of Abomey Calavi
Country	Benin
Year of development	2018
Principal Investigator	Prof. Achille Ephrem Assogbadjo
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem addressed	Pulp and leaves of African baobab (*Adansonia digitata L.*) are the two most harvested products which highly contribute to farmers especially women's income and households food security reach in sub-Saharan Africa. Over exploitation of those plant parts added to low natural regeneration of the species put at risk the remaining populations of the species. Among sustainable alternative for conservation is the domestication / cultivation of the species for its leaves and fruits.
What is it? (TIMP description) 	Fresh leaves of Baobab are widely used as vegetable in sauce preparation. They are used either as Spinach or spice and dried powder. Baobab leaf is an excellent source of calcium, iron, potassium, magnesium, manganese, molybdenum, phosphorus, and zinc, provitamins A and C and vitamin B2. It contains 13-15% protein, 60-70% carbohydrate, 4-10% fat and around 11% fibre. Energy value varies from 1180 to 1900kJ/100g of which 80% is metabolized energy. The Leaf is used as a panacea, that is to treat almost all diseases and specific documented uses including the treatment of malaria, tuberculosis, fever, microbial infections, diarrhoea, anaemia, dysentery and toothache

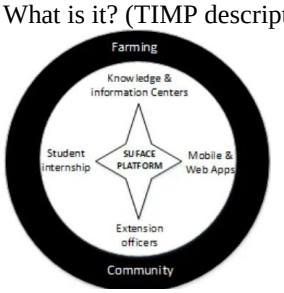
Benefits of the TIMPs to smallholder farmers and communities	-
Lessons learnt during implementation	-
Online links to TIMPs	
Technical data sheet on baobab leaves production	

Climate change & environment

TIMP Name	Optimum rain water harvesting technique for crop production in semi-arid Botswana
University of development	Botswana College of Agriculture/Faculty of Agriculture
Country	Botswana
Year of development	2014
Principal Investigator	Prof B. Kayombo
Category (i.e. technology, innovation or management practice)	Technology and Management practice
A: Description of the technology, innovation or management practice	
Problem addressed	In the semi-arid areas of Botswana, agriculture and the livelihoods that depend upon it are greatly affected by the unreliable and highly variable rainfall regime and endemic droughts. Agricultural technologies that tackle the moisture constraint through optimization of rain water use, such as Rain Water Harvesting (RWH), are therefore required to improve crop-water storage and increase agricultural productivity
What is it? (TIMP description)	In-situ rain water harvesting feasible in semiarid areas of Botswana. This is a 5 x 5 m catchment area whose runoff is directed to a ploughed cropped area
Benefits of the TIMPs to smallholder farmers and communities	Harvested rainwater for crop production aroused interest of 50 farmers in Kgatleng District near Gaborone to rehabilitate abandoned domestic water supply rain water harvesting structures in order to use the harvested rainwater for cropping. The Agricultural Extension Service in Bobirwa Sub-district adopted a "new" method of extending knowledge and technology to farmers through participation by farmers in farmer-managed field testing.
Lessons learnt during implementation	In semiarid regions where rainfall is low and unreliable, farmers need not to wait for the rain - rather the rain finds them fully prepared.
Online links to TIMPs	
Baipusi 643.pmd (ruforum.org)	

ICTs in Agriculture

TIMP Name	Outreach Framework for Strengthening University-Farming Community Engagement for Improved and Sustainable Livelihoods (SUFACE)
University of development	Makerere University
Country	Uganda
Year of development	2014
Principal Investigator	Dr. Peter Ebanyat
Category (i.e. technology, innovation or management practice)	Innovation
A: Description of the technology, innovation or management practice	
Problem to be addressed	Lack of a long-term, engagement framework between the University and rural communities to enhance productivity and competitiveness of

	smallholder farmers as well as responsiveness and impact of university in agricultural development.
What is it? (TIMP description)  	The SUFACE model developed by Makerere University and NGO partners is an outreach framework for strengthening university-farming community engagement. Under the SUFACE Model, a number of ICT tools have been developed and deployed, moving knowledge from the university to empower smallholder farmers to improve their productivity, access markets and enhance dissemination of farming practices. This includes a multi-channel ICT platform for information sharing (the SUFACE App) 
Benefits of the TIMPs to smallholder farmers and communities	i. Increased access to agricultural information through the multi-channel ICT framework. ii. Stronger farmers groups as a result of capacity building initiatives by the project. iii. Increased access to high quality seeds of improved crop varieties.
Lessons learnt during implementation	i. Establishing an ICT platform is very demanding, time consuming and costly. ii. Through students and innovative use of ICT, universities can indeed have strong and sustainable engagements with farming communities for improved livelihoods.
Summary of uptake of the research outputs (technology packages)	i. Use of improved varieties, MAKSOY 2N and MAKOY 3N, inoculation and application of 15kg per hectare of phosphorus fertilizer increases yields from 500 kg/ha to 1300 kg/ha. ii. The SUFACE ICT platform can be scaled up to include other value chains. Initially developed for soybean and groundnuts value chains, cassava has now been added.
Online links to TIMPs	
View of Developing and piloting a multi-channel ICT-Enabled Model to enhance University engagement with smallholder farming communities in Uganda (afjrd.org)	

Livestock Management

TIMP Name	Improving smallholder milk production of dairy goats and their crosses in Botswana
University of development	Botswana College of Agriculture/Faculty of Agriculture
Country	Botswana
Year of development	2014
Principal Investigator	Dr. Gaolebale Mpapho
Category (i.e. technology, innovation or management practice)	Technology and management practice
A: Description of the technology, innovation or management practice	
Problem addressed	The demand for milk and milk products in urban areas of Botswana has shown a large increase in the last decade leading to milk deficit that calls for imports in excess of 80% of milk products. Such a deficit makes milk products expensive and not available to vulnerable groups that include children, people of low income and sick people especially since Botswana is one of the African countries hardest hit by HIV/AIDS.
What is it? (TIMP description)	Dairy goat management and technological interventions including improved genetic material of Saanen dairy bucks and female tswana goats to increase productivity of dairy goats, alleviate poverty,

 Dr Goolekale Mpapho demonstrates how the goats' milk is tested for mastitis at the College. Masters student Kelaeboga Dipheko gained hands-on experience looking after the College's herd of Saanen goats.	increase food security and provide an economic stability in the household and country as a whole
Benefits of the TIMPs to smallholder farmers and communities	Smallholder farmers have been able to produce hygienic milk at the lowest level without the same emphasis on industrial processes and equipment that accompanies large-scale production.
Lessons learnt during implementation	-
Online links to TIMPs	
Ruforum Case Study - Botswana Story_2014_email.pdf http://dx.doi.org/10.17582/journal.pjz/2018.50.3.809.815	

Soil Health & Fertility

TIMP Name	Managing Uranium in Tanzanian agricultural soils and its transfer in food chains
University of development	Sokoine University of Agriculture
Country	Tanzania
Year of development	2014
Principal Investigator	Dr. Ernest M.M. Marwa
Category (i.e. technology, innovation or management practice)	Management Practice
A: Description of the technology, innovation or management practice	
Problem to be addressed	Radiation levels and spatial distribution of Uranium in agricultural soils in selected areas where Uranium deposits have been confirmed in Central Tanzania is currently not known
What is it? (TIMP description)	Soda ash, surface and well waters in Bahi. District, Tanzania are highly contaminated with Uranium up to levels exceeding the recommended limit by a factor of more than 41. Finger millet grains, catfish and flamingo meat also contain relatively high levels of Uranium above the recommended values. Continuous ingestion of foodstuffs containing such high levels of Uranium exposes the local community and livestock to Uranium risk. Awareness creation amongst the public should be undertaken so that safety measures can be taken to minimize such risks.
Benefits of the TIMPs to smallholder farmers and communities	Communities attained new knowledge that exposures to Uranium in their area are through drinking surface and underground water, using soda ash and eating fish and flamingo meat. They resolved to avoid these meats. The district authorities rely on the project findings to increase awareness on Uranium effects to the communities.
Lessons learnt during implementation	The RUFORUM Biennial Conferences prepared students in their professional carrier as researchers in Agriculture.
Online links to TIMPs	
i. Uranium contamination in drinking water and foodstuffs in Bahi District%2c Tanzania.pdf (ruforum.org) ii. Sokoine Brochure.pdf (ruforum.org)	

TIMP Name	Enhancing phosphorus release from rock phosphate using whitelupin (*Lupinus albus L. cv. Amiga*) and chickpekpeap (*Cicer arietinum L.*)

University of development	Egerton University
Country	Kenya
Year of development	2014
Principal Investigator	Dr. Joyce J. Lelei
Category (i.e. technology, innovation or management practice)	Technology
A: Description of the technology, innovation or management practice	
Problem addressed	Smallholder farming systems are characterized by application of suboptimal rates or non-utilization of inorganic fertilizers due to their exorbitant prices vis-à-vis low financial return from crops. Minjingu rock phosphate would be a viable option to the expensive inorganic phosphorus (P) fertilizers but is insoluble.
What is it? (TIMP description)	Whitelupin and Chickpekpeap, through the production of exudates hasten solubilization of rock phosphate to the benefit of companion crops or subsequent crops.
Benefits of the TIMPs to smallholder farmers and communities	Smallholders obtained new knowledge on an affordable and sustainable way to improve soil fertility and increase maize yield
Lessons learnt during implementation	Team work is important in project implementation as it enables students to combine field work and course work
Online links to TIMPs	
https://ageconsearch.umn.edu/record/230513/	