TECHNOLOGY NEEDS ASSESSMENT

The Republic of Uganda

TECHNOLOGY NEEDS ASSESSMENT REPORT FOR CLIMATE CHANGE ADAPTATION

Technology Action Plan for Adaptation

June, 2021

WATER, AGRICULTURE, AND FORESTRY SECTORS

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TECHNOLOGY ACTION PLAN FOR ADAPTATION [JUNE, 2021]

WATER, AGRICULTURE, AND FORESTRY SECTORS

REPORT 3: TNA REPORT FOR CLIMATE CHANGE ADAPTATION IN THE WATER AGRICULTURE, AND FORESTRY SECTORS OF UGANDA

This publication is an output of the Technology Needs Assessment project, funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) and the UNEP DTU Partnership (UDP) in collaboration with Energy Research Centre, University of Cape Town The views expressed in this publication are those of the authors and do not necessarily reflect the views of UNEP DTU Partnership, UN Environment or Energy Research Centre, University of Cape Town. We regret any errors or omissions that may have been unwittingly made.

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List of acronyms

AEATREC	Agricultural Engineering &Appropriate Technology
AEZ	Agro Ecological Zones
BMAU	Budget Monitoring and Accountability Unit
CAADP	Comprehensive Africa Agriculture Development Programme-Au
CAES	College of Agricultural and Environmental Science
CBI	Community Based Irrigation
CDC	Centre for Disease Control
CDO	Chief District Officer
CDO	Community Development Officer
CIF	Climate Investment Fund
CMF	Collaborative Forest Management
COP	Conference of the Parties
COVID 19	Coronavirus Disease 2019
CSOs	Civil Society Organizations
DAES	Directorate of Agricultural Extension Services
DCO	District Commercial Officer
DFO	District Forestry Officer
DWD	Directorate of Water Development
DWWE	Deep Well Water Extraction
ENR	Environment and Natural Resources
FAO	Food and Agricultural Organization of The United Nations
FBE	Forest Based Enterprise
FIEFOC	Farm Income and Enhancement and Forestry Conservation
FIP	Forest Investment Program
FLR	Forestry Landscape Restoration
FMNR	Farmer Managed Natural Regeneration
FO	Forestry Officer
FSC	Forest Stewardship Council
FSSD	Forest Sector Support Department
FY	Financial Year
GDP	Gross Domestic Product
GEF	Global Environment Facility

GHG	Green House Gas
GIS	Geographic Information System
GOU	Government of Uganda
ICRAF	International Council for Research in Agroforestry
ICT /IT	Information and Communications Technology
IDRC	Infectious Diseases Research Collaboration
IEC	Information, Education and Communication
INDC	Intended Nationally Determined Contribution
IPM	Integrated Pest Management
ISSD Plus	Integrated Seed Sector Development Plus
JICA	Japan International Cooperation Agency
JWESSP	Joint Water and Environment Sector Support Program
LDC	Least Developed Countries
LG	Local Government
LU/LC	Land Use /Land Cover
M&E	Monitoring and Evaluation
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MCM	Million Cubic Meters
MLHUD	Ministry of Land Housing and Urban Development
MoFPED	Ministry of Finance, Planning and Economic Development
MOU	Memorandum of Understanding
MPS	Ministerial Policy Statement
MWE	Ministry of Water and Environment
MWLE	Minister of Water Lands and Environment
N/A	Not Applicable
NAEP	National Agricultural Extension Policy
NAES	National Agricultural Extension Strategy
NAP	National Planning Authority
NAPA	National Adaptation Plan for Action
NAP-Ag	National Adaptation Plan for Agriculture sector
NARI	National Agricultural Research Institute
NARO	National Agricultural Research Organization

List of acronyms

NCST	National Council for Science and Technology
NDC	Nationally Determined Contribution
NDP	National Development Plan
NELSAP	Nile Equatorial Lakes Subsidiary Action Plan
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NFSS	National Forest Stewardship Standard
NaFORRI	National Forestry Resources Research Institute
NGO	Non-Government Organization
NSCS	National Seed Certification Service
NSS	National Seed Strategy
NWDR	National Water Development Report
OECD	Organization for Economic Co-Operation and Development
OPM	Office of the Prime Minister
PM&E	Planning Monitoring and Evaluation
PPP	Public Private Partnership
PPPP	Public Private People Partnership
QC	Quality Control
RAE	Responsive Agricultural Extension
REDD	Reducing Emissions from Deforestation and forest Degradation
RWH	Rooftop rainwater Harvesting
SDG	Sustainable Development Goals
SDP	Sector Development Plan
SIP	Sector Investment Plan
SME	Small and Medium Enterprises
SNC	Second National Communication
SPR	Sector Performance Report
SRWH	Surface Runoff Water Harvesting
SSIP	Sector Strategic Investment Plan
TNA	Technology Needs Assessment
UDHS	Uganda Demographic and Health Survey

UGX	Uganda Shillings
UMC	Uganda Media Conference
UNBS	Uganda National Bureau of Statistics
UNCST	Uganda National Council of Science and Technology
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nation Framework to Combat Climate Change
UNMA	Uganda National Meteorological Authority
URA	Uganda Revenue Authority
URWA	Uganda Rainwater Association
USAID	The United States Agency for International Development
USD	United States Dollar
UTGA	Uganda Timber Growers Association
UWA	Uganda Wildlife Authority
VAT	Value Added Tax
WASH	Water Sanitation and Hygiene
WMZ	Water Management Zones
WP	Water for Production
WUC	Water User Committees
ZARDI	Zonal Agricultural Research and Development Institute

Report III Technology Action Plan

Executive Summary

This report consists of actions to overcome barriers to the transfer and diffusion of technologies prioritised for climate change adaptation in the Water, Agriculture and Forestry Sectors of Uganda.

Priority technologies for climate change adaption are rooftop rainwater harvesting, deep-well water extraction and surface runoff water harvesting in the Water Sector; crop breeding, community-based irrigation and responsive agricultural extension for the Agriculture Sector; and Farmer Managed Natural Regeneration for forest landscape restoration, Integrated pest management (IPM) in natural forests and forest plantations, and Promoting Forest based enterprises in the Forestry sector. These three sectors play key roles in the country's development yet they are majorly vulnerable to climate change and technologies to enable adaptation will potentially benefit a large proportion of the population. Actions for overcoming barriers to technology transfer are aligned with existing policies and measures contributing to climate change adaptation and were selected based on their potential to:

- Catalyse these actions by expanding the scale to reach where interventions are most needed
- Increase efficiency including forging new partnerships,
- Address major gaps along the value chain from installation to ensuring sustained functionality.

Action plan for technology transfer in the Water Sector

The water sector ensures supply of water of adequate quality and quantity to key economic sectors including agriculture, energy, housing, health, services and industry for enhancing livelihoods, progress and development. Climate change is predicted to cause temperature rise and alter rainfall seasonality and intensity. The increase in temperature is predicted to accelerate evaporation from water and soil surfaces and evapotranspiration in vegetation causing lowering of surface water levels and driving increased abstraction of ground water sources. Rainfall will reduce and drought incidences will increase in the cattle corridor, north-eastern, south-western parts of Uganda. In the Northern and West Nile sub-regions, rainfall intensity is predicted to increase with increased incidences of flooding, contamination of water sources, water-borne diseases, soil erosion, land degradation and landslides in mountainous areas. Under the existing policies and measures for reducing climatic impacts in the water sector, the status of the prioritized technologies is outlined in **Table 1.**

Table 1 . Targets for Prioritized Technologies

Technology	Current level of uptake	Future targets
Rooftop rainwater harvesting	11.3% of rural water supply	Establishing 50 rooftop rainwater harvesting units for demonstration, 500 units through incentives and 125 institutional units through promoting voluntary establishment by 2031.
Deep water extraction	44.7% of the water sources for rural domestic water supply.	Establishing 855 new units by 2030, improving the functionality of all boreholes, and transitioning from using low yield pumps of 1m3/h, to high yield units (> 12 m3/h), which use solar powered pumps.
Runoff harvesting	Cumulative storage capacity of water for production was 38.87 MCM (in 2018)	Constructing 100 large-scale units for demonstration, promoting 200 units from roads and paths using incentives and motivating 50 voluntary units through advice by 2030.

Rooftop rainwater Harvesting (RWH)

The ambition for technology transfer of RWH is to establish 167,000 tanks of 10 m^3 capacity, which will supply about 1 million persons by 2030 (1 tank of 10 m3 serves a household of 6 persons/y). The following actions are proposed to achieve this.

- Strengthen coordination for implementation of RWH
- Develop a catalogue or database of information on RWH technology
- Enable functional private sector engagement in RWH
- Improve household access to financing for RWH

Key activities and resources needed are summarized in **Table 2**. These will potentially be funded by the Government of Uganda with support from development partners, especially the Climate Fund.

Table 2. Key activities for Rooftop Rainwater Harvesting

Action	Activities to be implemented	Responsible body	Budget (USD)
Strengthen coordination for implementation of RWH	Conduct a study on the potential of rainwater harvesting at each district (desk work)	Ministry of Water and Environment (MWE)	11,000
	Mobilise and form a RWH coordination committee at district level	Directorate of Water Development (DWD); MWE	31,000

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
	Develop district RWH strategies	DWD, MWE	61,000
	Implement RWH strategy	Rural Water Supply & Sanitation Dept; Local Gov't	38,000
	Set up information sharing hub	DWD, MWE	226,000
Develop a catalogue or database of information on RWH technology	Conduct studies to develop a RWH catalogue.	MWE; Appropriate Technology Centre	5,400
	Popularize the existing guidebook and catalogue	MWE, Media	6,000
Enable functional private sector engagement in RWH	Reduce tax on finished tanks and other RWH equipment	Uganda Revenue Authority	38,000
	Develop partnerships with banks to provide soft loans for RWH.	DWD, MWE	46,000
	Provide capacity support for small and medium enterprises	MWE; Local Government	821,000
Increase household access to financing for RWH	Support community groups to access finance for RWH	MWE; Local Government	25,000

Deep well water extraction (DWWE)

The ambition for technology transfer of DWWE is to supply 200 boreholes of about 12000 liters per hour to supply 20,000 rural households and 20 high-capacity solar-powered units in municipalities by 2030. The following actions are proposed to achieve this.
a) Reduce costs of ground water extraction
b) Strengthen technical skills for borehole installation and management
c) Strengthen institutions for groundwater management

Key activities and resources needed are summarized in **Table 3**. The envisaged sources of funding to achieve this are potentially the Government of Uganda with support from development partners, especially the Climate Fund.

Table 3. Key activities for Deep-Well Water Extraction

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
Reduce costs of ground water extraction	Enable local fabrication of spare parts.	DWD; Vocational institutions	54,000
	Invest in large diameter boreholes	DWD, MWE	35,200
	Develop Partnerships with private sector	Directorate of Water Development	40,000
	Operationalise the tax waiver on DWWE equipment	DWD, MWE	11,000
	Conduct feasibility studies for DWWE	DWD, MWE	25,000
Strengthen technical skills for borehole installation and management	Establish a practical demonstration of model borehole setup and management	MWE; Universities; Vocational institutions	374,000
	Develop courses on hydro geology tailored to DWWE needs	MWE Universities Vocational Institutes	9,000
Strengthen institutions for groundwater management	Build capacity of WUC members on ground water governance	Rural Water Supply & Sanitation Department; Technical Support Units	230,400
	Provide recurrent budget support for WUC for administration of DWWE facilities	DWD, MWE	11,300
	Secure land tenure in places with high potential for DWWE	DWD, MWE; Local governments Government	11,300

Surface Runoff Harvesting (SWRH)

The ambition for technology transfer of SRH is to establish 600 storage tanks of 100,000 m3 in communities living in the uni-modal rainfall belt in northern and eastern Uganda and the cattle corridor by 2030. This will serve about 3.1M people.
The following actions are proposed to achieve this:

- Increase access to capital and equipment
- Strengthen the capacity of water officers
- Create awareness

- Conduct feasibility studies for surface runoff water harvesting.
- Strengthen water management stakeholders' organizations.

Key activities and resources needed are summarized in **Table 4.** The envisaged sources of funding to achieve this are potentially the Government of Uganda with support from development partners, especially the Climate Fund.

Table 4. Key activities for Surface Runoff Harvesting

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
Increase access to capital and equipment	Mobilise and train community members to establish SRH committees and collectively work with credit institutions and NGOs	MAAIF, LG, MWE	23,400
	Partner with private sector for equipment, capital supply and co-investment in SRWH	MWE, MAAIF; LG Private entities	57,000
	Directly invest in establishing SRWH community schemes	MWE, MAAIF; LG	113,000
Strengthen capacity of water officers	Strengthen the capacity of extension workers in supporting SRWH	MWE, MAAIF, LG	678,000
	Train local artisans in repairing and maintaining SRH equipment	LG; MAAAIF, MWE	11,300
Create awareness	Establish SRH demonstration centers	MAAIF, MWE	169,400
	Facilitate farmer exposure to SRWH	LG; MAAIF, MWE	28,200
Conducting research to increase potential for managing surface runoff	Map out catchment areas for potential runoff water harvesting	MWE, MAAIF	14,100
	Conduct feasibility studies for SRH and associated rural enterprises for different contexts and scenarios	MWE, MAAIF	14,100
Strengthen water management stakeholders' organizations	Strengthen the organizational capacity water user associations in of SRWH management	LG; MWE, MAAIF	42,400

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
	Provide realistic budget support for local water user committees to manage SRWH.	LG; MWE, MAAIF	14,000
	Develop local SRWH bylaws and ensure good quality and equitable distribution of water resources	MAAIF, LG, MWE	61,000

Action Plan for Technology Transfer in the Agricultural Sector

The agricultural sector plays a central role in Uganda's economy, providing most of the domestic food needs, contributing 24% of the Gross Domestic Product (GDP) and accounting for 54% of the country's export earnings, and employing about 70% of the population. The increase in temperature due to climate change will potentially change rainfall seasonality and intensity and affect biological processes of agricultural crops and livestock and their associated growth environment. The erratic and unpredictable weather patterns are likely to disrupt farm calendars with high potential field-level and post-harvest losses resulting in frustration of farmers. Under the existing policies and measures for reducing climatic impacts in the agricultural sector, the status of the prioritized technologies is outline in **Table 5.**

Table 5. Prioritized Technologies for the Agriculture Sector

Technology	Current level of uptake	Future targets
Community based irrigation	567,000 hectares of the potential 3.03 million.	Additional 1,500,000 hectares by 2040 including micro, medium and large-scale irrigation systems.
Crop breeding	33-35% farmers use improved seed (National Seed Policy 2018) and about 30-40% of seed traded in the market is counterfeit (ISSD 2015);	To increase the generation of quality and climate resilient seed varieties for major food and commercial crops and making it available to farmers through a commercially viable system targeting approximately 60% of farmers by 2030.
Responsive agricultural extension	Current ratio of extension worker to farmer is 1: 1,800 and primary focus is on production	Achieve ratio of extension worker to farmer of 1:1,500 with multiple providers addressing diverse needs along the agricultural value chains by 2030.

Action Plan for Crop Breeding Technology

The ambition for technology transfer of crop breeding is to increase access to improved seed varieties adapted to climate related conditions for 200,000 smallholder farmers by 2030. The following actions are proposed to achieve this.

- Mitigate cost of producing climate-adapted seed varieties and increase improved variety affordability.
- Strengthen enforcement of regulations to reduce counterfeits
- Improve research capacity to generate improved varieties for different contexts

Key activities and resources needed are summarized in **Table 6.** The envisaged sources of funding to achieve this are potentially the Government of Uganda with support from development partners, especially the Climate Fund.

Table 6 Key activities for Crop breeding

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
Mitigate cost of producing climate-adapted seed varieties and increase improved variety affordability	Procuring precision equipment and methods for variety selection and testing	National Agricultural Research Organisation (NARO); Department of crop production and marketing, MAAIF	494,100
	Strengthen regional cooperation in crop improvement Programs	MAAIF; Department of Crop production and Marketing; East Africa Community	50,000
	Establish seed banks at lower government levels and deliberately link farmers to genuine seed companies	MAAIF; LG; seed companies	19,000
Strengthen enforcement of regulations to reduce counterfeits	Develop a participatory tracking system for ensuring seed authenticity	MAAIF; National seed certification services	226,000
	Build capacity of breeding programs to overcome counterfeits	MAAIF; Department of Crop production and Marketing; universities	288,000
	Strengthen coordination for controlling counterfeits	MAAIF; NSCS; UNBS; Police	150,000

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
	Establish information hubs for controlling	MAAIF; ZARDI	17,000
Improve research capacity to generate improved varieties for different contexts	Conduct studies to map farmer contexts, traditional knowledge of seed varieties and potential of breeding programs	MAAIF; NARO	28,200
	Invest in decentralized seed breeding	MAAIF; NARO	565,000

Action Plan for Community-based Irrigation

The ambition for technology transfer of community-based irrigation (CBI) is to establish 500 CBI units to serve 100,000 ha by 2030. This will focus on 5 districts experiencing water stress (Nakasongola Luwero Apac Arua Karamoja) and an additional 5 near ready urban market (Agog Tororo Rakai Iganga Kabale). The following actions are proposed to achieve this.

- Invest public funds in CBI
- Build capacity of extension officers and user communities in managing CBI
- Mitigate and avoid potential conflict related to ownership and management

Key activities and resources needed are summarized in **Table 7**. The envisaged sources of funding to achieve this are potentially the Government of Uganda with support from development partners, especially the Climate Fund.

Table 7 Key activities for Community-Based Irrigation

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
Invest public funds in CBI	Contract private companies to set up infrastructure for CBIs.	Directorate of Water Ministry of Water and Environment	4,080,000
	Provide direct support for CBI construction.	MAAIF, MWE, Local governments	2,040,000
	Support communities to set up CBI	MAAIF, MWE, Local governments MAAIF, universities and other tertiary institutions	1,020,000

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
Build capacity of extension officers and users in CBI management	Train extension staff in participatory advisory support for CBI operation and management.	MAAIF, universities and other tertiary institutions	28,200
	Support participatory engagements of extension officers with CBI user communities	Local government, MWE, Climate Change division, NGOs	99,000
	Demonstrate and provide hands-on training for operating CBIs.	Local government, MMAIF, MWE	2,040,000
	Strengthen organizational capacity of water user communities in managing CBIs as an enterprise.	Private sector partners, MWE, MAAIF	36,000
Mitigate and avoid conflict in CBI	Develop equitable rules of engagement for CBI	MAAIF, MWE, Local Governments	16,000
	Conduct community dialogues on CBI management needs.	LG, MWE MAAIF	41,000

Action Plan for Responsive Agricultural Extension

The ambition for technology transfer of Responsive Agricultural Extension (RAE) is to establish a national strategy and capacity building for RAE and pilot it in districts which are most vulnerable to climate change (including crop, livestock and fisheries farmers) by 2030. The following actions are proposed to achieve this.

- Increase financing and efficiency in agricultural extension
- Strengthen technical capacity for responsive agricultural extension
- Strengthen extension farmer linkages
- Improve RAE monitoring and evaluation

Key activities and resources needed are summarized in **Table 8**. The envisaged sources of funding to achieve this are potentially the Government of Uganda with support from development partners, especially the Climate Fund.

Table 8. Key activities for Responsive Agricultural Extension

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
Increase financing and efficiency in agricultural extension	Develop partnerships with private sector & NGO	Directorate of Agricultural Extension Services (DAES)	28,200
	Design & invest in ICT strategy for RAE	MAAIF	45,200
Strengthen technical capacity for RAE	Recruit more agricultural extension staff & local technical assistants and facilitate them.	MAAIF; Ministry of Public service	678,000
	Train agricultural extension staff & local technical assistants in RAE.	MAAIF; DAES	37,000
Strengthen extension farmer linkages	Create farmer awareness	DAES; Local government	15,000
	Strengthen their capacity to participate in RAE	DAES; Local government	23,000
	Create platforms for linking different farmer groups for information sharing & marketing	DAES; Local government	45,200
Improve RAE monitoring and evaluation	Train extension staff in monitoring, analysis and adaptive learning.	MAAIF; DAES	58,000
	Form partnerships for information acquisition and transfer	DAES; UBOS Academic institutions	33,000
	Set up community-level RAE monitoring committees, including school and youth clubs.	DAES; Local Government	45,200

Action plan for technology transfer in the Forestry Sector

Farmer-managed natural regeneration for forest landscape restoration

The ambition for technology transfer of farmer managed regeneration for forest landscape restoration crop as described in the TAP will directly benefit at least 300,000 households (i.e., 1,800,000 people)

directly, of which at-least 30% should be women and youth. Furthermore, the interventions are targeted at contributing towards restoration of 569,403 Ha across the selected forest landscapes in Uganda. The following actions are proposed to achieve this.

1) Improving access to inputs and services
2) Targeted awareness creation
3) Strengthen policy implementation and enforcement
4) Responsive/targeted institutional capacity building

Key activities and resources needed are summarized in **Table 9** The envisaged sources of funding to achieve this are potentially the Government of Uganda with support from development partners such as: Climate Change Adaptation Fund; United Nations Development Program; United Nations Environment Program; National Civil Society Organizations and International Non-Governmental Organizations;

Table 9. Key activities for farmer-managed natural regeneration for forest landscape restoration

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
1) Improving access to inputs and services	a) Provide incentives for land allocation and tree ownership for investment in landscape restoration through FMNR (private & state-owned forests	National Forestry Authority (NFA)	2,100
	b) Promote enterprises with short term benefits	National Agricultural Advisory Services (NAADS); MWE – Forest Sector Support Department (FSSD); Local Government	81,100
	c) Provide incentives to support land restoration.	Local Government (LG)	81,100
	d) Provision of improved (e.g drought resistant, early maturing) pastures as alternatives for grazing of livestock.	NAADS	72,000
	e) Promoting alternative gender responsive technology for easing land clearing and opening for agricultural production e.g use of tractors, oxen ploughs and minimum tillage.	LG; Ministry of Agriculture, Animal Industries and Fisheries (MAAIF)	141,000

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
	f) Improved access to structured support for up scaling FMNR.	LG	8,400
2) Targeted awareness creation	a) Conduct targeted awareness about the diverse and immediate benefits that arise from FMNR.	MWE – FSSD; LG; CSOs	174,000
	b) Publish literature quantifying the social, economic & environmental benefits of the FMNR technology	National Forestry Resources Research Institute; Academic Institutions; CSO	13,000
	c) Work with cultural institutions and local leadership to change mind-set, behavior and attitudes linked to bush burning & stray livestock grazing.	Ministry of Local Government, CSO	6,100
3) Strengthen policy implementation and enforcement	a) Update/review outdated policies-laws – for discouraging bush burning & stray livestock grazing.	MWE- FSSD; MAAIF -Directorates of Animal and Crop Resources.	27,000
	b) Conduct structured policy dialogues on FMNR with policy and decision makers within the forest landscapes.	CSOs	22,000
	c) Development and operationalization of land-use plans within the forest landscapes.	Ministry of Lands, Housing and Urban Development (MLHUD); MWE - FSSD	25,000
	d) Strengthen extension within the forestry/agriculture sectors to provide responsive advice to address community and farmer's needs in respect to application of FMNR.	MWE - FSSD Local Governments -Environment & Natural resources and Production departments.	9,000

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
4) Responsive/ targeted institutional capacity building	a) Build institutional capacity for area land committees to provide effective information on land rights & administration	MLHUD; Local Government; CSOs	47,400
	b) Strengthen capacity of cultural/ customary institutions to deliver on their roles in respect to administration/ management of customary land.	MLHUD; Local Government	47,400
	c) Targeted training of community & famers (including men, women & youth) to enhance their knowledge and skills for application of FMNR.	Local Governments (LG); CSO	47,400
	d) Establishment of coordinated research agenda and teams to generate the required evidence for FMNR at different scales.	Uganda National Council for Science and Technology; NaFORRI, CSOs	8,000

Action Plan for Integrated Pest Management (IPM) in natural forests and forest plantations.

The ambition for technology transfer of Integrated Pest Management in natural forests and forest plantations as described in the TAP will directly benefit 400,000 households (i.e., 1,400,000 people) directly, of which at-least 30% should be women and youth. Furthermore, the interventions are targeted at having 365,956 Ha of forests across the 7 forest landscapes under integrated pest management technology. This is 20% of the total land covered by forests under the various forest tenures in Uganda (MWE,2016b).

The following actions are proposed to achieve this.

1) Improving access to inputs and services
2) Responsive/targeted institutional capacity building
3) Targeted awareness creation
4) Strengthen policy implementation and enforcement.

Key activities and resources needed are summarized in **Table 10**. The envisaged sources of funding to achieve this are potentially the Government of Uganda with support from development partners such as: Climate Change Adaptation Fund; United Nations Development

Program; United Nations Environment Program; National Civil Society Organizations and International Non-Governmental Organizations.

Table 10. Key activities in Integrated Pest Management (IPM) in natural forests and forest plantations

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
1) Improving access to inputs and services	a) Advance access to chemical pesticides by community and smallholders – including men, women and youth.	Private sector	43,200
	b) Improve access to information about IPM and its application by farmers – including men, women & youth.	NAFORRI; NFA; National Environment Management Authority (NEMA); Universities; CSOs; Uganda Timber Growers Association (UTGA)	69,000
2) Responsive/ targeted institutional capacity building	a) Strengthen institutional organization of smallholders (including men, women & youth) to access chemical pesticides.	MWE - FSSD; UTGA; LG	47,400
	b) Strengthen the forestry extension services at the Local Government levels for effective service delivery to farmers and communities.	MWE - FSSD; LG – Environment and natural resources (ENR) department,	9,000
	c) Provide adequate training in IPM techniques and their application – especially among smallholders – including men, women & youth	NAFORRI; NFA; UTGA; LG – ENR Department; CSO; NEMA	47,400
	d) Strengthen regular monitoring and surveillance of pests and diseases.	MWE - FSSD; MAAIF; NAFORRI; NFA	8,400
3) Targeted awareness creation	a) Promote targeted awareness and information about IPM to influence attitude and practice.	NEMA; NAFORRI; NFA; University; UTGA; CSO; LG - ENR Department.	174,000

Action	Activities to be implemented	Responsible body and focal point	Budget (USD)
4) Strengthen policy implementation and enforcement	a) Advocate for reduction of taxes and levies charged by Government on the pesticides.	CSO; UTGA; NFA	34,400
	b) Strengthen adaptation to Climate variability and change in forest plantations and the landscape through for instance, applying responsive agronomic & pest management practices; planting proven resistant tree varieties.	NAFORRI; NFA; University; UTGA; CSO; LG - ENR Department.	122,000
	c) Increase investment in research to develop responsive IPM solutions.	MWE - FSSD; MAAIF; NAFORRI; NFA	36,000

Promoting Forest based enterprises in the Forestry sector.

Overall, the proposed planned intervention in the TAP will benefit 200,000 households (i.e. 1,200,000 people) directly, of which at-least 30% should be women and youth. Furthermore, the interventions are targeted at contributing towards restoration of 838,740 Ha across the selected forest landscapes. This is 20% of the available land available for restoration across the 7 forest landscapes in Uganda through agroforestry (MWE, 2016b) Overall, the proposed planned intervention in the TAP will benefit 200,000 households (i.e 1,200,000 people) directly, of which at-least 30% should be women and youth. Furthermore, the interventions are targeted at contributing towards restoration of 838,740 Ha across the selected forest landscapes. This is 20% of the available land available for restoration across the 7 forest landscapes in Uganda through agroforestry (MWE, 2016b).
The following actions are proposed to achieve this. 1) Improving access to inputs and services 2) Responsive/ targeted institutional capacity building 3) Strengthen policy implementation and enforcement 4) Targeted awareness creation

Key activities and resources needed are summarized in **Table 11**. The envisaged sources of funding to achieve this are potentially the Government of Uganda with support from development partners such as: Climate Change Adaptation Fund; Green Climate Funds; World Bank; United Nations Development Program; European Union; Danish International Development Agency, Norwegian Agency for Development Cooperation; United Nations Environment Program; National Civil Society Organizations and International Non-Governmental Organizations.

Table 11 Key Activities for Forest based enterprises

Action	Activities	Responsible body and focal point	Budget (USD)
1) Improving access to inputs and services	a) Improve access by men, women and youth to market infrastructure and information.	LG - Commercial officer	-
	b) Improve access to transport forest-based enterprises (FBE) products and services agro-forestry, products and services to the market.	LG; Ministry of Transport.	9,100
	c) Promote the saving culture by the forest adjacent communities and their organizations, for investment in FBEs.	LG - Community Development Office (CDO); Micro Finance Support Centre; CSOs	54,100
	d) Promote access and control to financial management trainings and advisories through collaboration with financial institutions and civil society organization.	LG-CDO; Micro Finance Support Centre; CSOs	31,400
	e) Provision of various alternative livelihood options and services based on preferences of the various gender categories.	LG-CDO, Forestry Officer (FO); CSOs	81,100
	f) Provision and establishment of improved pastures within the community.	National Agricultural Research Organization; LG - Veterinary Officer; CSOs	82,300
	g) Promoting alternative gender responsive technology for easing land clearing and opening for agricultural production	MAAIF - Agricultural Engineering and Appropriate Technology Research Institute; Ministry of Gender, Labour and Social Development; LG -	141,000
2) Responsive/ targeted institutional capacity building	a) Strengthen institutional capacity of community-based institutions including collaborative forest management groups for effective management of FBE groups.	NFA; Uganda Wildlife Authority (UWA); LG - FO; CSO;	47,400

Action	Activities	Responsible body and focal point	Budget (USD)
	b) Strengthen institutional capacity of mandated institutions to effectively support/promote FBE	MWE - FSSD, MOFPED Development Partners; CSOs	47,400
	c) Support visioning, action and business planning for the collaborative forest management groups and associated FBE.	NFA; UWA; LG - FO; CSO	27,000
	d) Strengthen leadership skills of the collaborative forest management group leaders.	NFA, Uganda Wildlife Authority, LG-CDO, FO; CSO	27,000
	e) Strengthen organizational and business skills especially among community-based organizations and forest adjacent community organizations/community forest management groups.	NFA; UWA, LG-CDO, FO; CSO	47,400
	f) Promote access to structured training, exposure and mentoring.	NFA; UWA, LG-CDO, FO; CSO	32,300
	g) Improve organization & coordination capacity by the forest adjacent communities – through bulk production and marketing.	NFA, UWA, LG-CDO, FO; CSO	36,300
	h) Conduct targeted and responsive trainings, mentoring and backstopping to forest adjacent communities in FBE management	NFA; UWA, LG-CDO, FO; CSO	47,400
	i) Strengthen knowledge and skills in respect to management of savings and credit schemes by forest adjacent communities and their organizations.	NFA; UWA, LG-CDO, FO; CSO	47,400
3) Strengthen policy implementation and enforcement	a) Update/review of outdated policies-laws – ordinances- bylaws for discouraging bush burning and stray livestock grazing.	MWE - FSSD; MAAIF; LG – Council, ENR & Production Dep't	27,000

Action	Activities	Responsible body and focal point	Budget (USD)
	b) Strengthen enforcement of forestry & land policies through proactive stakeholder engagement & standards at different scales.	MWE-FSSD, MLHUD; LG	123,400
	c) Strengthen agriculture & forestry extension services at LG levels to address needs of communities in FBE management.	MWE-FSSD, MAAIF; MLHUD	9,000
	d) Strengthen enforcement of guidelines & standards for quality at different scales.	MWE-FSSD, LG	123,400
	e) Strengthen implementation/ enforcement of bush burning & livestock grazing bylaws and ordinances where they exist.	LG ENR/ Production Department	82,100
4) Targeted awareness creation	a) Advance awareness creation on impacts of bush burning & stray livestock grazing.	LG - ENR / Production Department. CSOs	174,000
	b) Work with cultural institutions to change mindset, behavior and attitudes linked to bush burning and stray livestock grazing.	LG - ENR / Production Department; CSOs	6,100
	c) Promote targeted awareness on existing policies & laws on these rights & obligations.	CSO; MWE-FSSD; MLHUD	117,300

CHAPTER 1: Technology Action Plan And Project Ideas For The Water Sector

1.1 TAP for the Water Sector

1.1.1 Sector overview

The water sector ensures supply of water of adequate quality and quantity to key economic sectors including agriculture, energy, housing, health, services and industry for enhancing livelihoods, progress and development.

It invests in safe drinking water supply sources e.g., protected wells and springs, piped stand points, reservoirs and improved sanitation. It also establishes facilities such as reservoirs and canals for agricultural production. It also ensures availability of water for the manufacturing and services sector. The sector also manages river flow for hydro energy generation. It plays a key role in managing water resources and controlling of flooding and damage to infrastructure including human settlements, social infrastructure and transport (Uganda NDC 2015).

Vulnerability of the sector

Climate change is predicted to cause temperature rise and alter rainfall seasonality and intensity. The increase in temperature predicted at 0.8-2.1°C by 2050 (SNC 2014) is likely to accelerate evaporation from water and soil surfaces and evapotranspiration in vegetation. This is likely to increase the frequency of low rainfall and droughts in the north-eastern and south-western parts, the cattle corridor and the northern parts of Uganda causing lowering of surface water levels and driving increased abstraction of ground water sources. Population growth is predicted to increase the demand for water from between 2010 and 2050 from 408 million m3 to 3,963 m3 (MWE 2015). The potential outcome of this is water shortage and scarcity, which may lead to trekking of long distances, consumption of unsafe water, migration of populations, conflict, and disruption of hydro-electricity generation (NAPA 2007). The damage of drought is estimated at USD 237 million per year. The largest economic loss on water availability is expected in Lakes Victoria, Albert and Kyoga watersheds (MWE 2015; NAP-Ag 2018). In the Northern and West Nile sub-regions, rainfall intensity is predicted to increase with increase incidences of flooding, contamination of water sources, water-borne diseases, soil erosion, land degradation and landslides in mountainous areas (SNC 2014; CDC 2015; UBOS 2018).

Table 12. Existing policies and measures related to the sectors development and technology deployment

Policy	Main content	Current Tech profile	Target
Water Policy (1997)	To manage, and develop the' water, resources of Uganda, in an integrated and sustainable manner,' so as to secure and provide water of Adequate quantity and quality for all social and economic needs of the present and future generations, with the full participation of all stakeholders. With regard to water for Production, the objective is to promote development of water supply for agricultural production in order to modernize agriculture and mitigate effects of climatic variations on rain-fed agriculture	Supply: Bulk water supply; fuel powered water pumps to solar powered piped water supply systems; bore holes; protected springs; piped water supply schemes; large gravity flow piped water systems, solar powered mini-piped water supply systems based on groundwater Sanitation: pit latrine, cesspool truck, 2no gulping equipment and sludge barrels to support the fecal sludge service chain	Access to basic safe and affordable water supply from 69% to 80% of rural households by 2030 Access to piped water from 15% in 2010 to 100% of population by 2040; Access to modern toilet facilities to 100% of population by 2040.
National Irrigation Policy (2018).	Ensuring sustainable availability of water for irrigation and its efficient use to contribute to food security and wealth creation. Enhance investments for irrigation development; Promote Integrated Water Resources Management approach in irrigation planning, development and management	Valley tanks anddams.	From 14,418 ha in 2010 to an additional 1,500,000 ha by 2040.
National Policy for the Conservation and Management of Wetland Resources (1995)	To promote the conservation of Uganda's wetlands in order to sustain their ecological and socio-economic functions for the present and future well- being of the people.	The policy is to ensure that there is; no drainage of wetlands, sound management of wetlands, conservation of wetlands, recovery of previously drained wetlands and sustainable use of wetlands	Restore at least 760 square kilometers of degraded wetlands & associated catchments in 20 districts in Eastern and South Western Uganda by 2030 using the Green Climate Fund

Sources: Ministry of water and Environment Water Sector investment plan 2018; Ministry of Water and Environment Water Sector Strategic Investment Plan 2018

Table 13. Selected Technologies

Technology	Current level of uptake	Future targets
Rooftop rainwater harvesting	11.3% of rural water supply	Rooftop rainwater harvesting is to be increased by establishing 50 rainwater harvesting units for demonstration, 500 units through incentives and 125 institutional units through voluntary establishment by 2031 (MWE SSIP 2018).
Deep water extraction	44.7% of the water sources for rural domestic water supply (SPR 2020), but most installations perform poorly.	Deep well extraction is to be enhanced by establishing 855 new units by 2030, improving the functionality of all boreholes, and transitioning from using low yield pumps of 1m3/h, to high yield units (> 12 m3/h), which use solar powered pumps (MWE MPS 2020).
Runoff harvesting	Cumulative storage capacity of water for production was 38.87 MCM (in 2018)	The target for surface runoff harvesting is constructing 100 large-scale units for demonstration, promoting 200 units from roads and paths using incentives and motivate 50 voluntary units through advice by 2030. This contributes to the target increasing water storage capacity to163.67 by 2030 (MWE SSIP 2018). Stronger emphasis is on rural areas.

1.1.2. Action Plan for Rooftop Rainwater Harvesting

1.1.2.1 Introduction

Rooftop rainwater harvesting involves collecting water off a roof surface into storage containers for domestic use, livestock watering or irrigation (Danert and Motts 2009). It can potentially provide water for domestic use, mini-irrigation and watering of livestock at farm level, and supply of institutions such as schools, hospitals, local government offices and prisons. It enables households to have direct control of their own water supply without need for energy and chemicals for water purification.
A basic RWH unit includes a roof surface, gutters, pipes, a storage tank, filters, waterproofing agents and tap fittings. Other key accessories are first-flush diverters, a pump, hard or concrete ground below the taps and channels to drain off excess water in ways that minimize creating a muddy conditions and soil erosion. Hard roof surfaces are considered to be the most efficient in rainwater collection and are on about 70%

of the houses in Uganda and about 65% of the rural houses (UBOS 2016). However, roof sizes vary widely from less than 10 m2 to more than 80 m2 (Danert and Motts 2009). Rainwater harvesting systems can be developed at small and large scales. Storage tanks are ready-made or built-in places on the surface, underground or partially buried and can be of plastic, mortar, polyfibre, tarpaulin, interlocking stabilized soil bricks, and corrugated iron. The ideal storage tank capacity for a rural household of 6 people is more than 10 m3 to ensure all-year supply in bimodal rainfall area with three months of no rainfall, based on an estimated daily per capita water consumption of 20 litres (Martinson and Thomas 2003).

1.1.2.2 Ambition for the TAP.

With an average rainfall of 500-1180 mm a year, RWH could potentially supply many rural families with water for domestic use, watering of animals and irrigation, but its adoption is still under-developed (Nsubuga et al. 2014; SPR 2019).

The target for the transfer and adoption of roof rainwater harvesting for adaptation to climate change is to establish 200,000 rainwater harvesting tanks of about 10 m^3 to serve 1,151,222 persons in up to 40 districts by 2030 (1 tank of 10 m^3 serves a household of 6 persons/y).

1.1.2.3 Actions and Activities selected for inclusion in the TAP

Table 14. Barriers and measures to overcome barriers

Barrier category	Barrier	Measure
Financial	Low private investment in rooftop rainwater harvesting	Enable functional private sector engagement in RWH
		Improve household access to financing for RWH
Non-financial barriers	Inadequate extension advisory capacity for supporting RWH	Develop a catalogue or database of information on RWH technology
		Demonstrate the value of RWH in different climate scenarios
		Strengthen technical capacity in RWH
	Low social culture of RWH	Strengthen community organization for RWH
	Inadequate policy and legal support for RWH	Strengthen coordination for implementation of RWH policy provisions

Actions selected for inclusion in the TAP

a) Strengthen coordination for implementation of RWH policy provisions

Government and NGOs working to promote RWH need to be well coordinated to avoid oversupply of some areas while neglecting others. To realize the potential of obtaining water for domestic and agricultural use, the water and agricultural sectors need to work closely and harmonise their planning and regulatory processes (Farahbakhsh et al. 2009; Baguma et al. 2012; Staddon et al. 2018). Gender inclusion should be key in RWH initiatives (Grant et al. 2017).

b) Develop a catalogue or database of information on RWH technology

The existing rainwater harvesting guideline which shows technical details for construction and design and options for different household sizes, material and associated accessories, needs to be promoted widely and translated into local languages. Communities also need a RWH catalogue to inform them of complementary accessories and equipment, a data base on availability and prices of the different designs, contacts of service providers (Adler et al. 2014; Durodola et al. 2020) and special information for areas like the cattle corridor (Blanchard 2012, Kiggundu et al. 2018). The Appropriate Technology Centre can provide this database (Cruddas 2007).

c) Improve household access to financing and engage the private sector for RWH

Financial support packages are needed to help rural households install RWH installation. Strengthening local savings and credit schemes and merry-go-round initiatives can help low-income households to afford upfront investment in RWH. Bolstering local livelihoods and also increase their capacity to invest in RWH (Malesu et al. 2010).

d) Strengthen technical capacity in RWH

Develop a comprehensive course for RWH and a job structure to employ technical personnel at local government level (Baziwe 2011). Train rural masons, households and communities in RWH including fabrication of parts and construction of storage tanks using available materials (Alford 2007; Adler et al. 2014). Mobilize farmer groups to invest in shared storage for adjacent households that individually have small roof surface.

Activities identified for implementation of selected actions

a) Strengthen coordination for implementation of RWH

- Conduct a study on the potential of RWH at each district estimating potential volume expected, socio-economic potential to invest under different climate scenarios, and map potential locations and stakeholders for RWH.
- Mobilise and form a rainwater harvesting coordination committee at districts including technical experts from water, agriculture and other relevant government sectors, NGOs, private businesses, farmers and other relevant actors.
- Facilitate the committee to meet regularly to develop a joint rainwater harvesting strategy and plan showing sources of inputs and funding, technical

personnel needed.
- Implement RWH strategy through mobilization of implementation actors and resources
- Set up an information sharing hub on RWH

b) Develop a catalogue or database of information on RWH technology

- Develop catalogue on RWH to include details that enable business to develop between vendors and consumers of RWH equipment and services.
- Popularise the existing guidebook and catalogue, translating it into key local languages and making e-version options such as audios, video, active query-response platform with feedback from users of the technology etc.

c) Enable functional private sector engagement in RWH

- Reduce tax on finished tanks and other RWH equipment from 16% to 13% as an incentive to increase profit margin for suppliers.
- Provide capacity support for small and medium enterprises to invest in supply of equipment and service for RWH, which are becoming critical for enabling WASH in public service institutions especially due to the COVID-19 pandemic.
- Develop partnerships with private sector actors to provide soft loans for RWH harvesting equipment in cash or in kind

d)Improve household access to financing for RWH

- Support community groups to access finance for RWH for capital-intensive stages e.g., building of storage tanks.

Actions to be implemented as Project Ideas

Promoting RWH will require an inter-sectorial coordinated effort to ensure that Uganda takes full advantage of its rainfall endowment especially in regions where bimodal seasons occur. In addition to the coordination within government sectors, there is need to enable functional private sector engagement in RWH technology transfer and diffusion. A key barrier to adoption of RWH is lack of information especially on available options and technical support on installation and operation. Therefore, the selected actions to be implemented as project ideas are:
- 1.Strengthen inter-sectorial coordination for implementation of RWH
- 2.Develop a catalogue or database of information on RWH technology
- 3.Enable functional private sector engagement in RWH

1.1.2.4 Stakeholders and Timeline for implementation of TAP

Table 15. Overview of Stakeholders for the implementation of the TAP

Stakeholder	Role
Ministry of Water and Environment	Strengthen coordination for setting national strategy planning and budgeting for RWH
Ministry of Finance, Planning and Economic Development,	- Provide coordination and support for tax amendments for RWH equipment and enforcement - Negotiate soft loans for RWH equipment

Stakeholder	Role
Local government water and agricultural officers	Mobilise and set up stakeholders committees at district and lower levels for RWH planning, oversight of implementation, monitoring and evaluation ▸ Expand and update information in the RWH guidebook ▸ Provide advisory support for RWH ▸ Build household capacity in financial literacy for RWH
Vocational institutes; Appropriate Technology Center; Universities	Strengthen curricula on RWH; Conduct studies on RWH to update information in the guidebook
Enterprise Uganda	Support capacity for small and medium enterprises to invest in supply of equipment and service for RWH
Private sector	▸ Supply equipment; ▸ Give recommendation on regulatory issues that affect businesses ▸ Provide information on RWH equipment ▸ Train consumers of the benefits of RWH to generate demand for services and equipment ▸ Supply material for making water tanks and accessories ▸ Develop a commercial rainwater storage product promotion strategy and provide advisory support
Men, women and youth farmers	Bring farmers' needs into RWH plans and mobilise fellow farmers.
NGOs	▸ Build capacity and track information of RWH implementation. ▸ Co-develop RWH guidebook, popularise it, monitor use of the information and provide feedback ▸ Support formation of financial community groups to access finances for RWH
Media	Popularise the RWH guidebook, translate into key local languages and make e-versions.

Table 16. Scheduling and sequencing of specific activities

Activity	Scale	Year							
		2022 -23	2023 -24	2024 -25	2025 -26	2026 -27	2027 -28	2028 -29	2029 -30
Table 16. Scheduling and sequencing of specific activities									
Develop national strategy for RWH	National	xxx	xxx						
Conduct studies on RWH potential	80 districts	xxx	xxx						
Mobilise district RWH coordination committees	80 districts			xxx					
Develop district RWH strategies	District				xxx	xxx	xxx		
Implement RWH strategy	District						xxx	xxx	xxx
Set up information sharing hub	District							xxx	xxx
Develop a catalogue or database of information on RWH technology									
Conduct studies to develop RWH catalogue	National	xxx	xxx						
Popularise the existing guidebook and catalogue					xxx	xxx			
Enable functional private sector engagement in RWH									
Reduce tax on equipment	National		xxx	xxx					
Develop partnerships with financing institutions for RWH.	National			xxx	xxx	xxx			
Provide capacity support for SMEs in RWH.							xxx	xxx	
Improve household access to financing for RWH									
Support communities to access finance for RWH	National						xxx	xxx	xxx

1.1.2.5 Estimation of Resources Needed for Action and Activities

Capacity building needs

The strategy for RWH diffusion and transfer includes key sectors in government and non-government players and will require formation of coordination committees at district levels. It may also involve working with NGOs and vocational institutions for awareness raising and training of community members and local artisans in constructing and installing RWH. Capacity is also needed for consolidating and channelling water from different roof surfaces especially in areas where houses are small, into a shared reservoir which can then be distributed.

Table 17. Estimations of costs of actions and activities

Action	Activity	Cost (USD)
Strengthen coordination for RWH implementation	Conduct study on the potential of RWH at each district	11,000
	Mobilize and form district RWH coordination committee	31,000
	Develop district RWH strategies	61,000
	Implement RWH strategy	38,000
	Set up information sharing hub at districts	226,000
Sub Total		367,000
Develop RWH catalogue or database	Conduct studies to develop a RWH catalogue.	5,400
	Popularise the existing guidebook and catalogue	6,000
Sub Total		11,400
Enable functional private sector engagement in RWH	Reduce tax on RWH equipment	38,000
	Develop partnerships with banks to provide soft loans	46,000
	Provide capacity support for small and medium enterprises	821,000
Sub Total		905,000
Increase household access to financing for RWH	Support community groups to access finance for RWH	25,000
Sub Total		25,000
Total		1,308,400
Project Admin Cost (15%)		196,300
Grand total		1,504,700

Table 18. Risks and Contingency Planning

Activity	Risks	Contingency plan
Strengthen coordination for RWH		
Develop national inter-sectorial strategy for RWH	Slow down decision making; Unclear sharing of budgets and roles	Develop a jointly agreed timeline of action. Set up an inter-sectorial budget and committee. Clear definition of roles.
Conduct district studies on RWH potential	Inadequate reliable information on the actual situation of RWH	Conduct a field /demonstration study on RWH potential of sample districts.
Mobilise and form a RWH coordination committee at district level	Unwillingness of community members to serve on committee. Inactive committee members Politicizing the association	Explaining the importance of a committee; offering non-financial benefits; Careful screening of committee members; Defining committee duties and responsibilities
Develop district RWH strategies	Limited follow up on issues discussed	Report on issues discussed Motivate community members taking on follow up roles
Implement RWH strategy	Non-cooperation of actors Unrealistic demands from implementing actors	Negotiating terms of implementation Stating benefits from cooperating with the committee
Set up information sharing hub (a desk at the sub-county office)	Outdated information/ low maintenance of the hub Inadequate funds to run the hub Low utilisation of the information E-information options limited by inadequate access to phones	Update information regularly Customise info for different users Use radio which is widely available to provide information updates
Develop a catalogue or database of information on RWH technology		
Conduct studies to develop a catalogue.	Catalogue information not easily accessible for users	Popularise the guidebook using radio and other media
Popularize the existing guidebook and catalogue	Users experiencing blockages different from lack of information	Consult with users on blockages and identify ways of addressing them
Enable functional private sector engagement in RWH		
Reduce tax on finished tanks and other RWH equipment	Price reductions too low to make RWH equipment affordable	Package with additional support e.g. subsidised installation services

Activity	Risks	Contingency plan
Develop partnerships with banks to support RWH.	Diversion of capital Likely unprofitability to banks	Disbursing loans in kind
Provide capacity support for small and medium enterprises.	Disinterest of SMEs to venture into RWH business	Provide incentives for SMEs to engage RWH.
Increase household access to financing for RWH		
Support community groups to access finance for RWH	Inadequate financial management capacity	Build capacity of committee leaders in financial management and governance

Next Steps

Increasing the diffusion and transfer of rooftop rainwater harvesting for climate change adaptation will entail the following immediate requirements:

- Coordination between the Ministry of Water and Environment, Ministry of Housing and Urban Development, Ministry of Local Government and the Climate change unit to develop a joint RWH strategy for specialised categories of users. The sanitation potential of RWH in the prevailing COVID 19 will also require involvement of the Ministry of Health.
- Mechanisms of engaging the private sector in a way that makes a business case to increase access to RWH equipment.

Critical requirements include:

- Engagement of construction and water engineers and technicians in developing a strategy for ensuring RWH provisions in house plans.
- Laws, guidelines and incentives for promoting RWH.

Table 19. Rooftop Rainwater Harvesting Overtime Table

TAP overview table

Sector	Water sector
Sub-sector	Water and Sanitation
Technology	Rooftop Rainwater harvesting
Ambition	Establish 200,000 rainwater harvesting tanks of about 10 m3 to serve 1,151,222 persons in up to 40 districts by 2030.
Benefits	Increases access to clean water, reduces run-off, reduces pressure on surface water resources and groundwater, saves time and women and children from making long distances, avails water for livestock and crop irrigation

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Strengthen coordination for implementation of RWH	Conduct a study on the potential of rainwater harvesting at each district	Climate fund, MoFPED	MWE	Year 1-2	Inadequate information on the status of RWH	RWH study conducted	Reports on findings of the study	11,000
	Mobilise and form a RWH coordination committee at district level	MoFPED, development partners	MWE; Directorate of Water Development (DWD)	Year 3	Inactive committee members	Functional RWH committees	Committee formation documents, reports, by-laws	31,000
	Develop district RWH strategies	Development partners,	DWD	Year 4-6	Limited follow up on issues	RWH strategy and plan draft	Reports and meeting minutes	61,000
	Implement RWH strategy	Development partners,	Rural Water Supply & Sanitation Department; District Water Office	Year 6-8	Unrealistic demands from implementing actors	Functional RWH actors committee formed and strategy implemented	MOU documents	38,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Set up information sharing hub	MoFPED, Development partners, GFC	MWE; DWD Local Government	Year 7-8	Inadequate funds to run the hub	Demonstration setup Users utilizing the hub	Information material added to the hub; No. farmer or user visits made	226,000
Develop a catalogue or database of information on RWH technology	Conduct studies to develop a RWH catalogue.	MoFPED, Development partners ,	MWE; Appropriate Technology Centre	Year 1-2	Catalogue information not easily accessible for users	Finding utilized in improving RWH catalogue	Reports on findings of the study	5,400
	Popularize the existing guidebook and catalogue	MoFPED, Development partners	MWE, Media	Year 4-5	Potential users experiencing blockages different from lack of information	Adverts running on mainstream media Guidebook translated in at least 4 languages	Number of adverts and talk shows conducted Number of languages used	6,000
Action 3 Enable functional private sector engagement in RWH	Reduce tax on finished tanks and other RWH equipment	MoFPED, MWE	Uganda Revenue Authority	Year 2 - 3	Price reductions too low to make RWH equipment affordable for rural farmers	Tax reduced on RWH equipment	Tax review meeting minutes Number of tax review meeting held	38,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Develop partnerships with banks to provide soft loans for RWH.	MWE	MWE; DWD; Local Government	Year 4-5	Likely unprofitability to banks	Partnerships established increased access to finance for RWH	Number and amount of RWH loans disbursed, MOU documents of partnerships with financial institution	46,000 821,000 25,000
	Provide capacity support for small and medium enterprises (SME)	MoFPED, MWE, Development partners	MWE; Technical Support Units; Local Government	Year 6-7	Disinterest of SMEs to venture into RWH business	Equipment for RWH; Advertisement setup; RWH SME workshop conducted	Number of RWH systems sold by suppliers workshop accountability	
Increase household access to financing for RWH	Support community groups to access finance for RWH	Development partners	MWE; Technical Support Units; Local Government	Year 6-8	Members defaulting on loans	Financial Community groups established	Meeting minutes Number of RWH financial community group accessing funds	

1.1.3 Action Plan for Deep Well Water Extraction

1.1.3.1 Introduction

Deep Well Water Extraction (DWWE) involves drilling the ground and drawing water from 30 metres or more underground using containers or pumping it through sunk pipes (Sloots 2010). Inside a vertical borehole, an extraction pipe is placed that has a perforated section (filter) and sand trap, surrounded by a filter gravel. Wells can be hand pumped or co-installed with smart energy technology including solar sources (SPR 2019). The vertical borehole of most wells in Uganda is drilled to an average depth of 60 m and up to 120 m and about 100 mm to 600 mm in diameter (Van Steenbergen and Luutu 2012). These yield about of 1m3/h. Alternatively, deep water extraction can be developed for large-diameter (1-2 metres) high-yielding (> 12 m3/h) projects for municipal water supply. These use an inbuilt mechanised pump supplying water to an elevated reservoir that works as a distribution point to a network of pipes. Large-diameter wells are less costly than multiple small wells in the long run (FAO 1985).

Uganda's annual groundwater recharge is estimated at 19.1 - 39.9 mm (NDP III; UNESCO, NWDR 2006) and predicted to increase (Nsubuga et al. 2014). This resource is less prone to pollution than surface supply options and can be potentially developed for supplying water for domestic use, irrigation, livestock watering, aquaculture, industry and health (Taylor et al 2009; NDP III; Foster et al 2012). Based on available groundwater resources maps and information from hydrogeological surveys (MWE JICA 2011), DWWE can be made in a sustainable way.

1.1.3.2 Ambition for the TAP

Supply 200 boreholes of about 12,000 liters per hour to supply 20,000 rural households and 20 high-capacity solar-powered units in municipalities by 2030. The proposed target areas include the cattle corridor and the northern and eastern belt, which experience a prolonged dry season and where some surface water sources are saline.

1.1.3.3 Actions and Activities selected for inclusion in the TAP

Table 20. Summary of barriers and measures to overcome barriers

Barrier category	Barrier	Measure
Financial	High costs especially related to equipment, drilling operation & maintenance and low access to spare parts	Reduce costs of ground water extraction e.g., remove duties from drilling equipment, invest in local fabrication of the parts, incentives for commercial development of groundwater resource, increase supply of technical service providers, invest in more large-diameter / mechanised boreholes, increase road access to potential well sites

Barrier category	Barrier	Measure
Non-financial	Inadequate capacity for constructing, operating & maintaining DWWE	Strengthen technical skills for borehole installation and management
	Water Quality concerns	Improve water quality assurance
	Institutional weaknesses	Strengthen institutions for groundwater management

Actions selected for inclusion in the TAP

a) Reduce costs of ground water extraction

When appropriate standard parts are too costly, users may resort to substandard ones. Strategies for enabling local fabrication need to be promoted. Government aid is limited in some places yet the private sector is given low incentives to diffuse DWWE.
It is necessary to transition from many small diameter wells to large diameter wells which are mechanised and cheaper in the long run.

b) Strengthen technical skills for borehole installation and management

Inadequate skills have been a major limitation for DWWE installation and functionality. Technical skills for DWWE are needed in government and non-government and among community users. Research with GIS analysis and hydro geology needs to be strengthened to generate knowledge for siting of DWWE in locations where sufficient groundwater development is feasible and it makes business sense. Such knowledge needs to be synthesised into easily accessible formats and widely disseminated.

c) Strengthen institutions for groundwater management

Institutional and administrative structures and law enforcement need to be strengthened to build concerns of recharge of ground water and prevention of contamination into water catchment management planning. Sustaining DWWE requires coordination between key government sectors including water, agriculture and energy, also between government and private or non-government entities. Water user association committee members need to be sufficiently prepared to own the technology and thereafter facilitated with budgets for management, mobilisation and supervision to ensure efficient fee collection and sustained functionality of installations (Asaba et al. 2015). They also need to be trained in developing and enforcing by-laws to govern groundwater

use. Institutions that govern land tenure rights also need to be streamlined in DWWE diffusion plan.

Activities identified for implementation of selected actions

a) Reduce costs of ground water extraction

- Enable local capacity for fabrication of spare parts and development of alternative fuel and energy sources which will be more accessible and cheaper for water users locally to reduce on costs on repair of boreholes with strict regulation on quality.
- Invest in sinking more large diameter boreholes than smaller ones. these cut on costs of equipment and can supply to many households.
- Develop partnerships with private sector through incentives to supply required equipment for easy accesibility through business for example set up specialised supply points for subsidised materials and fuel for DWWE establishments
- Operationalise the tax waiver on DWWE equipment.URA to operationalise the 2008 Government decision to make all water related works and services VAT exempted.
- Conduct studies to identify locations where DWWE is hydro geologically and socio-economically feasible.

b) Strengthen technical skills for borehole installation and management

- Develop courses on hydro geology tailored to DWWE needs for extension workers to increase skills in surveying, delineation and monitoring of ground water resources.
- Establish a practical demonstration of model borehole setup and management to enable peer to peer learning

c) Strengthen institutions for groundwater management

- Strengthen institutional capacity of WUC in ground water management
- Provide recurrent budget support for WUC for administration of DWWE facilities.
- Secure land tenure rights for places with potential suitability for DWWE establishment.

Actions to be implemented as Project Ideas

Project ideas for the diffusion and transfer of the DWWE technology could be developed around the following actions:

1. Invest in sinking more large diameter boreholes than smaller ones. these cut on costs of equipment and can supply to many households.

2. Enable local capacity for fabrication of spare parts and development of alternative fuel and energy sources to reduce on costs on repair of boreholes with strict regulation on quality.

3. Strengthen institutional capacity of WUC in ground water management. As borehole ownership is strengthened, users will contribute to long-term operation and functionality.

4. Develop private partnerships to supply equipment for easy accesibility through business e.g., set up specialised supply points for subsidised materials and fuel for DWWE establishments

5. Establish a local information platform and demonstration for DWWE.

1.1.3.4 Stakeholders and Timeline for implementation of TAP

Table 21. Overview of Stakeholders for the implementation of the TAP

Stakeholder	Role
Ministry of Water and Environment Directorate of Water Development	▸ Develop national strategy, plan and budget for DWWE ▸ Regulate DWWE establishment through licensing ▸ Acquire land for DWWE development ▸ Provide information/communication platforms for DWWE coordination.
Local governments	▸ Ensuring monitoring and regulating borehole functionality ▸ Overseeing DWWE establishment
Private sector	Fabricating and supplying equipment and accessories
Vocational institutes, Universities	▸ Conduct biophysical and social economic feasibility studies for DWWE in various districts and climate scenarios ▸ Train advisory officers and artisans in skills for supporting DWWE diffusion
Water user committees	Provide local leadership in management, operation and maintenance of DWWE
NGOs	▸ Contribute to capacity building in DWWE ▸ Advocate for fair access and proper management of DWWE ▸ Hold government accountable in DWWE establishment and management
Development partners	Provide financial support
Uganda Revenue Authority	Reviewing and enforcing tax incentives for DWWE equipment

Table 22. Scheduling and sequencing of specific activities

Activity	Scale	Year							
		2022 -23	2023 -24	2024 -25	2025 -26	2026 -27	2027 -28	2028 -29	2029 -30
Reduce costs of ground water extraction									
Enable local fabrication of spare parts	20 urban centres countrywide				xxx	xxx			

Activity	Scale	Year							
		2022 -23	2023 -24	2024 -25	2025 -26	2026 -27	2027 -28	2028 -29	2029 -30
Reduce costs of ground water extraction									
Invest in sinking more large diameter boreholes	20 urban centres countrywide						xxx	xxx	xxx
Develop partnerships with private sector	20 urban centres countrywide	xxx	xxx						
Conduct feasibility studies for DWWE	National		xxx	xxx					
Operationalise the tax waiver on equipment	National	xxx							
Strengthen technical skills for borehole installation and management									
Establish a practical demonstration of model borehole setup and management	National		xxx	xxx	xxx				
Develop tailored courses for DWWE	National	xxx							
Strengthen institutions for groundwater management									
Build governance capacity of WUC	National				xxx	xxx	xxx		
Provide recurrent budget support for DWWE WUC	National						xxx	xxx	xxx
Secure land tenure for DWWE establishment	National						xxx	xxx	

1.1.3.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

Key capacity needs for strengthening the transfer and diffusion of DWWE are:

- Building local management structures of DWWE establishment and skilling leaders of water user committees in operation and management. Handing over

DWWE establishments for local operation needs setting up of local leadership structures with clear rules of governance. Committees need to be motivated and constantly updated with relevant information to ensure sustained functionality. They need to interface regularly with technical water officers to address any emergent issues.

- Enabling local fabrication of DWWE equipment parts and accessories as well as basic skills of diagnosing and repairing simple mechanical challenges.
- Strengthening capacity of water advisory officers in participatory support for DWWE
- Establishing a DWWE information exchange platform and practical demonstration.

Table 23. Estimations of costs of actions and activities

Action	Activity	Cost (USD)
Reduce costs on DWWE equipment	Enable local fabrication of spare parts	54,000
	Demonstrate Large diameter boreholes	35,200
	Conduct feasibility studies for DWWE	25,000
	Partner with private sector to increase access to DWWE	40,000
	Operationalise the tax waiver on DWWE equipment	11,000
Sub total		**165,200**
Strengthen skills in DWWE installation & management	Establish a practical demonstration of model borehole setup and management	374,000
	Develop courses on hydro geology tailored to DWWE needs	9,000
Sub total		**383,000**
Strengthen institutions for groundwater management	Build capacity of WUC on ground water governance	230,400
	Provide recurrent budget support for DWWE WUC.	11,300
	Secure land tenure in places with high potential for DWWE.	11,300
Sub total		**253,000**
Total		**801,200**
Project Admin Cost (15%)		**120,200**
Grand total		**921,400**

1.1.3.6 Management Planning

Table 24. Risks and Contingency Planning

Activity category	Risks	Contingency plan
Reduce costs on DWE equipment, drilling and construction		
Enable local fabrication of spare parts.	Low demand and acceptance of the locally fabricated parts	Set up demonstrations of locally fabricated parts at water points to gain public trust.
Use of large diameter boreholes	High cost Land acquisition costs	Design cost recovery strategy by charging user fees
Partners with private sector for DWWE equipment access	Low businesses case for dealing in DWWE equipment other than DWWE and services	Create incentives for private engagement in DWWE
Operationalise the tax waiver on equipment	Failure to comply with what is agreed on in the meetings	Fines and penalties given to those that don't comply
Conducting DWWE feasibility study	Studies duration not aligned to implementation time line	Building on existing knowledge and hiring multiple researchers to share study roles.
Increase technical capacity for drilling, constructing and maintenance of DWWE equipment		
Establish a practical demonstration of model borehole setup and management	Inadequate funds or human resource to run the facility Demonstration not aligned to local context	Partner with NGOs and development partners Consult to adapt demonstration to local context
Develop courses on hydro geology tailored to needs	Lack of logistical facilitation to apply acquired knowledge	Facilitating trained staff with the support needed to apply skills and knowledge
Strengthen institutions for groundwater management		
Build capacity of WUC	Lack of logistical facilitation to apply acquired knowledge Elite capture	See above Clear rules and guidelines for leadership
Provide recurrent budget support for WUC for administration of facilities	Misuse of resources Insufficient support for expected WUC responsibilities.	Regular users' accountability meetings Regular accountability meetings Supplement with fees collected or link to development partners and NGOs
Secure land tenure in places with high potential for DWWE.	Unwillingness of Individuals/ communities to release land to water development	

Next Steps

Deep well water extraction is currently being promoted by government, but has challenges of frequent breakdowns, costly operation and abandonment of facilities. Immediate needs for the transfer and diffusion of the DWWE technology relate to building of local capacity through:

- Providing technical skills in operating equipment, increasing access to spare parts and accessories, and supporting and promoting local fabrication.
- Strengthening local DWWE facility management structures by setting up and supporting WUCs with clear rules of engagement and accountability to all beneficiaries.

Critical requirements

- Building the capacity of water advisory officers in participatory DWWE management
- Conducting a biophysical and socioeconomic feasibility study of DWWE will enable identification of scenarios where government investment can be synergised with private investment or local /NGO support for sustained operation.
- Demonstration of DWWE especially the large diameter one will help deepen understanding on what is required and provide more confidence set up and manage new ones.

Table 25. Deep Well Water Extraction Overview Table
TAP overview table

Sector	Water
Sub-sector	Water and Sanitation
Technology	Deep Well Water Extraction
Ambition	Supply 200 boreholes in rural areas especially prone to drought and saline surface water; and 20 high-capacity solar-powered units in municipalities by 2030.
Benefits	Access to clean water by 20,000 rural households especially in drought-prone areas including the cattle corridor and the northern and eastern belt, and about 100,000 urban households

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Reduce costs of ground water extraction	Enable local fabrication of spare parts.	Ministry of Water and Environment Development partners. MWE,	Directorate of Water Development; Vocational institutions	Year 4-5	Low market potential and acceptance of the locally fabricated spare parts	DWWE equipment and accessories locally produced and used in installation and operation.	No. local artisans technically skilled to fabricate borehole equipment and accessories No. local factories producing DWWE equipment and accessories. No. facilities using locally fabricated parts	54,000
Strengthen technical skills for borehole installation and management	Invest in large diameter boreholes	Development partners, MoFPED	MWE; Directorate of Water Development	Year 6-8	High price of large diameter boreholes. Land property and costs	Large-diameter deep well water extraction facilities established and fully functional	No. functional large diameter borehole installed No. households benefiting from the facility	35,200

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Develop Partnerships with private sector	MWE	Directorate of Water Development	Year 1-2	Low businesses case for dealing in DWWE equipment other than DWWE and services	Private sector engaged in DWWE	No. private establishments providing supplies and services for DWWE	40,000
	Operationalise the tax waiver on DWWE equipment	MoFPED	Uganda Revenue Authority	Year 1	Failure to comply with what is agreed on in the meetings	Law on tax waiver on DWWE equipment enforced leading to reduced price	DWWE equipment records reflecting tax waiver	11,000
	Conduct feasibility studies for DWWE	MWE; LG, Development Partners	MWE; Directorate of Water Development	Year 2-3	Studies taking too long and not aligned to implementation time line	Report on DWWE feasibility widely available and informing installations	Report on DWWE feasibility Number of staff trained	25,000
Strengthen technical skills for borehole installation and management	Establish a practical demonstration of model borehole setup and management	MWE; development partners	MWE; Universities; Vocational institutions	Year 2-4	Inadequate funds or human resource to run the facility Demonstration not aligned to local context	More than 50% of water officers skilled in participatory DWWE management Functional borehole demonstration enabling information exchange on DWWE and demonstrating DWWE technology	Number of functional DWWE water user committees with direct engagement of water officers Number of functional DWWE demonstrations established at local government level.	374,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Develop courses on hydro geology tailored to DWWE needs	MoFPED, Development Partners	MWE Universities Vocational Institutes	Year 1	Lack of logistical facilitation to apply acquired knowledge	Courses on DWWE built into curriculum & implemented	No. extension workers trained Number and nature of courses offered	9,000
Strengthen institutions for groundwater management	Build capacity of WUC members on ground water governance	MoFPED; MWE; Development partners	Rural Water Supply and Sanitation Department; Technical	Year 4-6	Lack of logistical facilitation to apply acquired knowledge	Strong and functional DWWE WUCs	No. strong and functional DWWE WUCs	230,400
	Provide recurrent budget support for WUC for administration of DWWE facilities	MoFPED; MWE; Development partners	Support Units MWE; DWD; Technical Support Units	Year 6-8	Elite capture Misuse of resources. Support falling short of responsibilities of the WUC	WUC committees well facilitate with budgets to conduct their responsibilities	Numbers of DWWE WUCs regularly receiving and properly utilizing budget for DWWE management.	11,300
	Secure land tenure in places with high potential for DWWE	MoFPED; Development partners	MWE; Directorate of Water Development; Local governments	Year 6-7	Unwillingness of individuals/ communities to release land to water department for DWWE development	Land secured for DWWE development	Land titles of DWWE potential areas	11,300

1.1.4 Action Plan for Surface Runoff Harvesting

1.1.4.1 Introduction

Surface runoff water harvesting is the collection, accumulation, treatment or purification, and storing of storm water for its eventual reuse for domestic water supply and irrigation of crops in the dry season (Hatibu et al. 2006). The runoff water is usually guided into a type of infiltration enhancing structure. Part of the water seeps into the soil and recharges ground water (Kiggundu et al. 2018). The system, which also traps soil from being eroded, consists of a catchment area (the surface on which runoff is generated), command area (the area where runoff is utilized), runoff transfer infrastructure (channels, gullies, hard surfaces), diversion and storage structures (Lee and Vischer 1990; Mzirai and Tumbo 2010).

Micro-catchment rainwater harvesting systems collect runoff from a catchment area of 10–500 m2 (Biazin et al. 2012; Kiggundu et al. 2018). Macro-catchment systems collect runoff or river flow from large areas including natural and manmade surfaces into reservoirs (Bresci 2008; Temesgen 2012; Kimera 2018; Kiggundu et al. 2018). Bunds or embankments are built around reservoirs sometimes using the soil excavated from the reservoir. Reservoirs are provided with spillways or weirs to allow controlled overflow (Rusoke et al. 2000). They are often fenced around to protect against accidents, vandalism and misuse. Water is abstracted from reservoirs using gravity flow or pumps and channeled where it is needed (MWE 2019). The water quality needs to be monitored regularly and treated for suitability for the different uses (Vikneswaran and Razak 2015).

Surface runoff harvesting is conducted in 121 districts in Uganda with a total of 1300 valley tanks, 34 dams and 53 irrigation schemes and current estimates put the volume of water for production at 124 million cubic meters (SPR 2019). Surface runoff is used mainly for livestock watering, domestic water and to a lesser extent, irrigation (GOU 2005; JWESSP 2013-2018).

1.1.4.2 Ambition for the TAP

The proposed target for SRWH technology transfer and diffusion is to establish 600 storage tanks of 100,000 m3 in communities living in the uni-modal rainfall belt in northern and eastern Uganda and the cattle corridor by 2030. This will serve about 3.1M people.

1.1.4.3 Actions and Activities selected for inclusion in the TAP

Table 26. Summary of barriers and measures to overcome barriers

Barrier category	Barrier	Measure
Financial	High cost of installation and operation of SRWH	Increase access to capital and equipment
	Inadequate skilled personnel to install and operate SRWH.	Strengthen the capacity of water officers
Non-financial	Inadequate information on SRWH.	Create awareness
		Strengthen monitoring and analysis of water runoff data
		Conduct research to increase understanding of the potential for SRWH
		Strengthen SRWH management organizations

Actions selected for inclusion in the TAP

a) Increase access to capital and equipment
Runoff water harvesting establishment can be costly, requiring facilitation of collective action between community members and private credit institutions and NGOs. Increasing community access to credit enables them to develop associated livelihood enterprises (Sivanappan 1997; Hartung 2006; Rugumayo 2016). Import duty charged from equipment needed for runoff water harvesting needs to be removed to increase affordability.

Equipment should be made available at all districts especially in high potential areas. Operation costs need to be properly estimated including budgetary support for WUCs and weighed against water user fees. Larger schemes are less costly per cubic meter, and cost-recovery is possible by supporting of associated businesses among community beneficiaries.

b) Strengthen the capacity of water officers
Extension workers need to be equipped with information, instrumentation and mobility to support farmers. Innovation grants are needed to assist universities and technical schools to strengthen hydrogeology courses, to encourage outreach with industry and farming communities (Kiggundu et al. 2018). Centres need to be established for demonstrating equipment for runoff water harvesting.

c) Create awareness
Aggressive awareness creation is needed to address negative attitudes towards SRWH (MWE 2019). Existing information and manuals on the design and management runoff dams needs to be translated into local languages and disseminated in accessible format.

Potential enterprises associated with SRWH need to be encouraged. Exchange visits and farmer networks in partnership with NGOs might enable peer learning (Purcell 1997).

d) Strengthen monitoring and analysis of water runoff data
Adequate instrumentation is needed to monitor runoff generation. This can be supplemented with documentation of experiences in water harvesting. Collected data needs to be analyzed and disseminated.

e) Conduct research to increase understanding of the potential for runoff water harvesting
Research is needed to map out catchment areas for potential runoff water harvesting, estimate potential volumes and quality, potential benefits, profitability and risks in different smallholder farmer setups. In consideration of different climate scenarios and market scenarios, feasibility studies are needed to evaluate the potential of rural enterprises that could be developed through RWH. Research should use approaches that collaborate with farmers, incorporating local knowledge and more realistic consideration of local context (Temesgen 2012) to increase community cohesion and ownership (Kiggundu et al. 2018).

f) Strengthen water management stakeholder organizations
Coordination of public sectors in agriculture, water and environment needs to be strengthened to enable the establishment and efficient use of runoff water harvesting. Besides national laws and standards, local bylaws are needed to enforce social and environmental safeguards and ensure equitable distribution in times of scarcity. Organizations related to water management need to be

regularly monitored to understand their capacity and operational needs and strengthened to enable equitable representation and participation. Budgets required for institutions to run need to be realistically developed and supported and the sufficiency of user fees needs to be regularly re-evaluated. Sufficient effort should be committed to training and building the capacities of water management entities especially on collection, controlling and allocation of water.

Activities identified for implementation of selected actions.

a) Increase access to capital and equipment

- Mobilise and train community members to establish SRWH committees and collectively work with credit institutions and NGOs to access the necessary capital for installation.
- Partner with private sector in every district with high SRWH potential to set up equipment supply centres
- Directly invest in establishing community schemes that serve large numbers

b) Strengthen the capacity of water officers.

- Strengthen the capacity of extension workers in supporting SRWH
- Train local artisans in repairing and maintaining SRWH equipment

c) Create awareness.

- Establish SRWH demonstration centres
- Facilitate farmer exposure to SRWH

d) Conduct feasibility studies for surface runoff water harvesting.

- Map out catchment areas for potential runoff water harvesting,
- Conduct feasibility studies for SRWH and associated rural enterprises for different contexts and scenarios

e) Strengthen the capacity of water user associations in managing SRWH

- Strengthen the organizational capacity water user associations in SRWH management
- Provide realistic budget support for local water user committees to manage SRWH.
- Develop local SRWH bylaws and ensure good quality and equitable distribution of water

Actions to be implemented as Project Ideas

In order to increase the transfer and diffusion of surface runoff water harvesting for climate change adaptation, the following actions are proposed for development into project ideas.

1. A feasibility study of potential locations where surface runoff rainwater harvesting has potential in sustaining livelihoods through seasonal droughts, and diversifying options, increasing food security and resilience to shocks.

2. Given the high estbablishment costs of shared surface runoff water harvesting facilities, direct government investment is needed with strong investment in establishing formal local management structures which are supported with sufficient capacity and budget.

3. Private sector partnerships and local community groups also need to be mobilised to co-invest in SRH establishment and management.

4. Community capacity needs to be built to set up SRWH at micro-level especially for agricultural production. This may entail exposure and long-term advisory support.

1.1.4.4 Stakeholders and Timeline for implementation of TAP

Table 27. Overview of Stakeholders for the implementation of the TAP

Stakeholders	Roles
MWE; MAAIF	▸ Develop and ensure implementation of national strategy and guidelines for SRWH ▸ Strengthen capacity of extension officers to support SRWH ▸ Strengthen capacity of local governments in management of SRWH. ▸ Directly invest in establishing community RWH schemes
Local government; District water / agricultural officers	▸ Oversee, supervise and offer technical advisory support for SRWH ▸ Mobilize and strengthen the organizational capacity of local institutions for the management of SRWH. ▸ Create awareness and disseminate SRWH information ▸ Develop SRWH bylaws to enforce social and environmental safeguards and ensure equitable distribution of water resources
MoFPED	Provide realistic budget for SRWH
Development Partners	Assist government through funding, training and technical assistance
NGO	▸ Provide technical and financial assistance ▸ Provide awareness on SRWH
Private sector	▸ Co-invest in SRWH with government or development partners ▸ Extend credit to enable SRWH Development ▸ Supply equipment, accessories and services for SRWH
Academic and research institutions	▸ Train engineers in constructing SRWH for different purposes ▸ Train local artisans in repairing and maintaining SRWH equipment ▸ Conduct feasibility studies on SWRH and associated enterprises for different smallholder farmer setups
Farmer Organizations	▸ Co-invest in SRWH ▸ Manage local SRWH establishments ▸ Design and coordinate multiple enterprises around SRWH

Table 28. Scheduling and sequencing of specific activities

Activity	Scale	Year							
		2022 -23	2023 -24	2024 -25	2025 -26	2026 -27	2027 -28	2028 -29	2029 -30
Increase access to capital and equipment									
Invest in establishing community SRWH schemes	25 districts					xxx	xxx		
Mobilise and train SRWH leadership committees	National					xxx	xxx		
Partner with private sector for equipment supply	National						xxx	xxx	
Strengthen technical capacity in supporting SRWH									
Strengthen the capacity of extension workers	National			xxx	xxx				
Train local artisans in repairing SRWH equipment	25 districts			xxx	xxx				
Create awareness of SRWH									
Establish SRWH demonstration centers	25 districts				xxx	xxx			
Facilitate farmer exposure to SRWH	25 districts							xxx	xxx
Conduct feasibility studies for surface runoff water harvesting.									
Map out areas for potential runoff water harvesting	National	xxx	xxx						
Conduct feasibility of associated enterprises	National	xxx	xxx						
Strengthen the capacity of water user associations in managing SRWH									
Strengthen organizational capacity water users	National				xxx	xxx			
Provide budget support for SRWH user committees.	National						xxx	xxx	xxx
Develop SRWH bylaws	National						xxx	xxx	

1.1.4.5 Estimation of Resources Needed for Action and Activities

The transfer and diffusion of SRWH will require the following actions for capacity strengthening:

- Training of extension officers and exposure of communities to SRWH under different climate scenarios, options for SRWH at different scales and associated enterprises.
- Large schemes that are often established by government or investors need development of strong local leadership structures to be managed sustainably. These structures need clear governance guidelines, terms of reference and sufficient budget and advisory support.

Table 29. Estimations of costs of actions and activities

Action	Activity	Cost (USD)
Increase access to capital and equipment	Mobilise & train communities to set up SRWH committees & collectively work with credit institutions & NGOs	23,400
	Partner with private sector for equipment, capital supply and co-investment in SRWH	57,000
	Directly invest in establishing large SRWH schemes	113,000
Sub total		193,400
Strengthen technical capacity in supporting SRWH	Strengthen capacity of extension workers to support SRWH	678,000
	Train local artisans in repairing SRWH equipment	11,300
Sub total		689,300
Create awareness	Establish SRWH demonstration centres	169,400
	Facilitate farmer exposure to SRWH	28,200
Sub total		197,600
Conduct feasibility studies for surface runoff water harvesting.	Map out catchment areas for potential SRWH	14,100
	Conduct feasibility studies for SRWH and associated enterprises for different contexts and scenarios	14,100
Sub total		28,200
Strengthen the capacity of water user associations in managing SRWH	Strengthen the organizational capacity of water user associations in of SRWH management	42,400
	Provide realistic budget support for SRWH WUCs.	14,000
	Develop local SRWH bylaws	61,000
Sub total		117,400
Total		1,225,900
Project Admin Cost (15%)		184,000
Grand total		1,409,900

1.1.4.6 Management Planning

Table 30. Risks and Contingency Planning

Barrier category	Barrier	Measure
Increase access to capital and equipment		
Mobilise and train community members to establish SRWH committees	Failure of trained members to mobilize and motivate SRWH committees.	Identity and provide logistical needs and motivation for SRWH committee formation
Partner with private sector for co-investment in SRWH	Lack of business case to motivate private sector engagement	Create business incentives for private sector
Directly invest in establishing large SRWH community schemes	Unclear ownership and mis-management	Adequate processes for handing over and regular support to WUCs
Strengthen capacity of water officers		
Strengthen capacity of extension workers in supporting SRWH	Non application of acquired skills; inadequate logistical facilitation	Make work environment enabling for trained officers to apply skills
Train local artisans in repairing and maintaining SRWH equipment	Non application of acquired skills and lack of logistical support	Provide start-up resources to enable trained artisans
Create awareness		
Establish SRH demonstration centres	Inadequate conditions for communities to replicate what has been demonstrated	Align demonstration to local context. Conduct exposure visits to communities where it has worked
Facilitate farmer exposure to SRWH	Differences in context that may not enable community to apply SRWH	Conduct community consultations to address blockages to SRWH adoption
Conducting research to increase potential for managing surface runoff		
Map out catchment areas for potential runoff water harvesting	Research timeline not aligned with time for SRWH operation	Working with multiple research institutions to reduce on time
Conduct feasibility studies for SRWH and associated rural enterprises	Low budget to implement the finding/ operationalize	Provide resources for implementation
Strengthen water management stakeholders' organizations		
Strengthen the organizational capacity of SRWH WUCs	Low motivation of leaders to follow proper management processes	Set up systems for holding leaders accountable
Provide realistic budget support for local water user committees to manage SRWH.	Support budget too low in relation SRWH WUC responsibilities	Consultations with SRWH committees; identifying adequate funds enable for SRWH WUCs
Develop SRWH bylaws	Inadequate enforcement of laws	Create incentives for motivating adherence to social and environmental safeguards

Next step

The immediate requirements for the transfer and diffusion of surface runoff water harvesting technology in Uganda are

- Conducting studies to map out potential areas for SRWH and feasibility analysis of its potential to support a variety of enterprises under different climate scenarios.
- Strengthening local water user committees with the capacity to manage SRWH by developing a strategy for long-term engagements to build skills and create local ownership of the facility
- Building the capacity of water extension officers in participatory approaches to SRWH

Critical requirements

- Building partnerships with private sector and others to co-invest in SRWH
- Exposing local communities to different scales of SRWH and its potential to support a wide array of enterprises.

Table 31. Surface Runoff Water Harvesting Overview Table
TAP overview table

Sector	Water
Sub-sector	Water and Sanitation
Technology	Surface Runoff Water Harvesting
Ambition	The proposed target for SRH technology transfer and diffusion is 600 tanks of 100,000 m3 to communities living the unimodal-rainfall belt in northern and eastern Uganda and the cattle corridor by 2030.
Benefits	Resilience to drought and ensured food security and diversified enterprise through increased access to water for domestic use, irrigation and livestock for about 3.1 million people.

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Increase access to capital and equipment	Mobilise and train community members to establish SRWH committees	MoFPED	MAAIF, LG, MWE	Year 5 - 6	Failure of trained members to mobilize SRWH committee formation	Community members trained in setting up SRWH	No. community members trained	23,400
	Partner with private sector for SRWH equipment supply and co-investment	MAAIF; MWE	MWE, MAAIF; LG Private entities	Year 6 - 7	Lack of business case to motivate private sector engagement Unclear ownership	Agreements for SRWH with private sector set up Community schemes for	No. agreements with private entities	57,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Directly invest in establishing SRWH community schemes	MoFPED Development Partner	MWE, MAAIF; LG	Year 5 - 6	Unclear ownership and mismanagement of the established SRWH scheme	Community schemes for SRWH established in various districts	No. SRWH units established; No. people served	113,000
Strengthen capacity of water officers	Strengthen capacity of extension workers in supporting SRWH	MoFPED	MWE, MAAIF, LG	Year 3 - 4	Non application of acquired skills and inadequate logistical facilitation	Extensions workers hired and trained in SRWH	Training reports No. extension officers hired and trained	678,000
	Train local artisans in repairing and maintaining SRH equipment	MoFPED, DP	LG; MAAAIF, MWE	Year 3 - 4	Non application of acquired skills	Local artisans trained in repair and maintenance of SRWH equipment	No. artisans trained; Training reports; No. SRWH equipments repaired by local artisans	11,300
Create awareness	Establish SRH demonstration centers	MoFPED	MAAIF, MWE	Year 4 - 5	Inadequate conditions for communities to replicate what has been demonstrated	SRWH demonstration centres established	No.SRWH demonstration centres established	169,400
	Facilitate farmer exposure to SRWH	MoFPED	LG; MAAIF, MWE	Year 7 - 8	Certain differences in context that may not enable community to apply SRWH	SRWH farmer exchange visits conducted	No. farmer visits conducted	28,200
Conducting research to increase potential for managing surface runoff	Map out catchment areas for potential runoff water harvesting	DP, MoFPED	MWE, MAAIF	Year 1 - 2	Research process taking too long and not aligned with time for SRWH operation	Potential runoff water harvesting areas mapped	No.farmers participating Map showing potential runoff areas	14,100

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Conduct feasibility studies for SRH and associated rural enterprises	DP, MoFPED MAAIF	MWE, MAAIF	Year 1 - 2	Low budget to implement / operationalize finding	Feasibility study for SRWH conducted	Report findings on SRWH	14,100
Strengthen water management stakeholders organization	Strengthen the organizational capacity water user associations of SRWH management	MoFPED; development partners	LG; MWE, MAAIF	Year 4 - 5	low motivation of leaders to follow proper management processes	Functional and sustainable SRWH institutions	Number of functional SRWH institutions strengthened	42,400
	Provide realistic budget support for local water user committees to manage SRWH.	MoFPED; Development partners	LG; MWE, MAAIF	Year 6-8	Unrealistically low budget contributions in relation to expected SRH committees' responsibilities	Budget for SRWH committees supported	Number of SRWH committees with well supported budgets	14,000
	Develop local SRWH bylaws and ensure good quality and equitable distribution of water resources	MoFPED	MAAIF, LG, MWE	Year 7-8	Inadequate enforcement of laws	Bylaws safeguarding SRWH structures set	Number of bylaws to enforce social & environmental safeguards	61,000

1.2 PROJECT IDEAS FOR THE WATER SECTOR

1.2.1 Brief summary of the Project Ideas for the Water Sector

The following project ideas are based on technologies that were prioritised for climate change adaptation and achievement of national development priorities through a multi-criteria analysis with relevant stakeholders. Project ideas considered mechanisms that would catalyse ongoing related national processes of technology transfer and diffusion, potentially lead to wide impact in areas where they are most needed, and motivate co-investment from non-government players.

- Building co-investment capacity and partnership for rooftop rainwater harvesting
- Building capacity and local leadership for surface runoff water harvesting
- Strengthening local fabrication capacity and advisory support for deep well water extraction.

1.2.2 Specific Project Ideas

1.2.2.1 Building co-investment capacity for rooftop rainwater harvesting

Introduction

Rooftop rainwater harvesting can substantially enable supply of water at different levels of scale and build resilience against drought. It can be implemented at household and institutional scale to provide water for personal needs and farms. It is potentially affordable to local communities and the government has put a number of measures in place already including private sector partnerships, subsidizing equipment for RWH systems, partnering with NGOs for extension, support to water user associations, investment in construction & installation of water infrastructure and community organization. However, the technology is not being utilised to its full potential as it serves as only 0.4% of rural water sources and only 1% of the population is served with rainwater tanks. The barriers for this and proposed measures for addressing these are summarised in Table 14.

Objectives

1.Strengthen coordination between the water. housing and infrastructure, and agricultural sectors
2.Build public-private partnerships to address the high costs preventing installation
3.Build advisory support capacity for RWH

Outputs

- Water, housing and infrastructure, and agricultural sectors combining efforts to promote RWH. Joint strategy and budgets for RWH developed at the national or local government levels. Regulations or by-laws developed or strengthened RWH.
- Specific incentives developed for motivating private companies, NGOs and development partners to provide a wide range of RWH supplies and services. Strategies, budgets and operational processes developed for domestic, institutional and farm installations.
- Targeted training of extension officers and logistical support for participatory RWH advisory support.

Relationship to the country's sustainable development priorities

The right to clean and safe water is a key value in the Ugandan constitution. This technology aligns well with the Water Policy 1999 objective of "Sustainable

provision of safe water within easy reach...". The Water for Production Strategy and Investment Plan/National Irrigation Master Plan for Uganda (NIMP 2010-2035) emphasizes "A Package Approach" which includes construction and installation of infrastructure, and the software aspects of mobilization, community-based planning and monitoring processes, private sector back-up support, and considerations of efficiency, hygiene, sanitation, environmental awareness, gender responsiveness, and sustainability (SDP 2018-2020). The government supports development of facilities under public private partnerships (PPP) where private farmers can acquire technology construction equipment at a subsidised price (SPR 2019). Storage and use of rain and storm water is also a key objective under the strategy of managing flood waters and drought in the policy for disaster preparedness and management.

Project Deliverables

- Inter-sectorial stakeholder consultation assessing the current status of RWH technology deployment, key actors involved, enabling policy framework at national and local government level and relevant interventions needed to increase uptake.
- Map of private companies and actors along the market value chain and recommendations for ways of generating demand for the RWH technology, capacity and incentives needed for technology suppliers, promoters and users.
- Capacity strengthening and logistical support for extension workers and end-users for increased RWH deployment.

Project Scope and Possible Implementation

The project will take 3 years linked to the current focus of deployment for disaster preparedness especially in drought and flood-prone areas. It will require strong engagement of the private sector entities and NGOs.

Project activities

- Mapping key actors actively supporting or involved in RWH, including users (households, institutions, farms, rural, urban etc.), public authorities, private sector/companies, material suppliers, donors, NGOs, research institutes, etc.
- Review of national and other documents and consultations with sector representatives on RWH strategies and current status and avenues for technology deployment.
- Analysis and mapping of private companies and actors along the of market value chain for RWH equipment and service delivery.
- Review existing RWH models and the potential demand and public support that can be generated around this. Which actors need to be involved?
- Recommendations leading to an increase in the uptake of RWH in Uganda, potential partnership/collaboration opportunities, potential for general awareness and capacity development, and financing modalities (loans/grants, public/private) etc.
- Conduct capacity building for RWH and conduct targeted capacity building and facilitation for extension workers in the water and agriculture sectors
- End-user needs assessment and designing of program to address gaps identified e.g capacity, incentives or access to information or local organizational strengthening

Timelines: 3 years

Table 32. Resource requirements

Activity	Amount in USD		
Increase access to capital and equipment	**Year 1**	**Year 2**	**Year 3**
Strengthen coordination between the water. housing and infrastructure, and agricultural sectors	350,000		
Build public-private partnerships to address the high costs preventing installation	42,000	42,000	
Build advisory support capacity for RWH	689,000	689,000	345,000
M&E		73,000	146,000
TOTAL	1,081,000	804,000	491,000

Measurement/Evaluation

- Review report of inter-sectorial consultation event and interventions agreed to by different stakeholders – Year 1
- Map of actors in technology deployment including private and NGO actors, incentives for private sector in place, change in number and nature of actors in supplying RWH.
- Baseline on RWH advisory and user capacity needs; number and nature of capacity building activities for users and extension workers; RWH support in extension plans.

Possible Complications/Challenges

- Lack of enabling mechanisms or willingness for inter-sectorial RWH deployment
- Unclear leadership and slow decision making in inter-sectorial setup for RWH
- Inadequate incentives for a good business case in RWH for private sector.
- Inadequate emphasis of water harvesting in the construction industry
- Extension workers not getting sustained logistical support to enable them to provide advisory support for RWH

Table 33. Responsibilities and Coordination

Stakeholder	Role	When	How
Directorate of water development Ministry of Water & Environment	Strengthen coordination for RWH National strategy setting planning and budgeting for RWH	Year 1	Convene inter-sectorial strategy development meeting
Ministry of Finance, Planning and Economic Development, URA	Provide coordination and support for tax amendments for equipment; enforcement Negotiate soft loans for RWH Propose incentives for private sector	Year 1	Build public-private partnerships

Stakeholder	Role	When	How
Local government water and agricultural officers	Mobilise and set up stakeholders committee at lower levels for RWH Provide advisory support for RWH	Year 1-2	Local consultations and engagements
Vocational institutes; Appropriate Technology Center; Universities	Map baseline for public and private support for RWH; Train extension workers; Study RWH uptake	Year 1-2	Surveys, document review and Training
Enterprise Uganda	Support small and medium enterprises to invest in RWH.	Year 1-2	Training, exposure, apprenticeship
Private sector	Design business strategy for RWH equipment, accessories and services; Design financial mechanisms for easing community access to RWH	Year 2	Engagements with government and NGOs
NGOs	Build capacity and track RWH implementation. Design strategy for RWH co-investment	Year 2-3	Meetings - government and community stakeholders

1.2.2.2 Building capacity and local leadership for surface runoff water harvesting

Surface runoff harvesting can provide water for domestic household and farm needs and has great potential in building resilience against prolonged drought especially in livestock-keeping regions with uni-modal rainfall seasons. The strongest barrier for SRWH is inadequate capacity at local level to manage. Most structures are constructed by government, but more investment is needed in building local capacity to operate them. There is need to strengthen the hand over process and provide regular advisory support to sustain the functionality of the reservoirs. These tend to be large scale, less prone to drying up and with potential to be multipurpose. There is also need to build incentives for private investment.

Objectives

a) Strengthen the capacity of local institutions to manage government installations

b) Develop incentives for setting up medium and small-scale SRWH by private entities and community groups

Outputs

a) Strong local institutions with clear leadership owning and managing SRWH installations and receiving sufficient budgetary & advisory support from government.

b) Private companies and community groups incentivised to set up small-medium scale SRWH in regional vulnerable to prolonged drought.

Relationship to the country's sustainable development priorities

With about 43,942 km2 of wetlands and open water (18% of total area), Uganda is considered fairly well endowed with water resources. Water storage is a priority in Uganda's INDC 2015, the Framework and Guidelines for Water Source Protection. Water storage is a priority in Ministry of Water and Environment Oct 2015. Building public-private partnerships is a key strategy for all stages of the development of water projects

- formulation, implementation, monitoring and evaluation (MWE 2019).

Project Deliverables

Strengthened local institutions with clear ownership and skills in operating large dams provide reliable water supply for domestic use, irrigation and livestock and reduce risks of crop and livestock death. It also enables diversification of food and livelihoods. Local farmer group and private owned small scale options increase distribution and access and enable diversification of uses.

Project Scope and Possible Implementation

Up to 5 pastoralist districts with uni-modal rainfall pattern.

Project activities

- Map out actors and capacity needs for community level SRWH management from user and supplier perspectives
- Build local organisation and leadership capacity in SRWH management
- Engage government in providing enabling regulatory framework and budgets for local SRWH management
- Design incentives strategy for small scale dam management
- Monitor and evaluate the performance of large government installation and smaller private/ community owned investments.

Timelines

There is strong government investment in installing SRWH and the building of local management capacity and non-government investment options requires about 3 years.

Table 34. Resource requirements

Activity	Amount in USD		
	Year 1	Year 2	Year 3
Strengthen local organizational capacity for SRWH management	309,000	309,000	
Design and implement strategy for motivating SRWH investment by private and local community groups		583,000	583,000
M&E		73,000	146,000
TOTAL	309,000	965,000	729,000

Measurement/Evaluation

- Baseline of local capacity for SRWH management will be established.
- Capacity strengthening activities undertaken for leadership committees of at least 10 large-scale government installations and 5 non-government ones
- Nature and size of incentives provided for non-government investment in SRWH and degree of uptake including establishment and local acceptance
- Change in ownership and enterprises developed around SRWH

Possible Complications/Challenges

- Insufficient extension support and budgets support for local leadership
- Insufficient mechanisms to monitor the performance of local leaders and the water quality
- Small-scale dams tend to dry up in very drought-prone areas and may lead to losses for private and community investors
- Different aspects of water reservoirs are managed by different MWE directorates

Table 35. Responsibilities and Coordination

Stakeholder	Role	When	How
MWE	Designing elaborate hand over process and support to build local ownership of reservoirs	Year 1-2	Local community engagements
District Local Government,	Identifying local capacity needs and strengthening local capacity in SRWH Providing advisory support	Year 1-2	Community meetings and training
NEMA	Oversees and coordinates various environmental concerns in the construction and operation of structures for WfP.	Year 1	Coordinating a functional SRWH strategy with water and agricultural sectors
Community based organizations, water users' associations	Manage government establishments and set up their own	Year 2-3	Engagement of users; fee collection; mobilise resources for reservoir establishment
Ministry of Finance, Planning & Economic Development, URA	Negotiate soft loans for RWH equipment Propose incentives for private sector engagement SRWH	Year 1	Build public-private partnerships
Vocational institutes; Appropriate Technology Centre; Universities	Map baseline for public and private sector support for SRWH; train extension workers; Conduct studies on SRWH uptake	Year 1-2	Surveys, document review and Training
Enterprise Uganda	Support capacity for small and medium enterprises to invest in supply of equipment and service for SRWH		Train, demonstrate and give apprenticeships
Private sector	Design and test business strategy SRWH equipment, accessories and set up Design soft financial mechanisms to enable community groups to access SRWH	Year 2	Engagements with government and NGOs
NGOs	Build capacity and track implementation. Design strategy for co-investment in SRWH with government and private sector	Year 2-3	Meetings with relevant stakeholders

1.2.2.3 Strengthening local fabrication capacity and advisory support for deep well water extraction

Although deep well water extraction is widespread (MWE 2017) constituting about 44.7% of the water sources for rural domestic water supply (SPR 2020), most installations perform poorly due to poor siting, use of subpar equipment and inadequate local capacity to sustain their operation. Strengthening local fabrication capacity will enable easy

access to spare parts and technical skills to enable repair and revamping of old installation and ensure sustainable borehole operation and maintenance. Strong advisory support is also needed to build local organizational and leadership capacity for managing DWWE. This is proposed for three pilot districts in the cattle corridor.

Objectives

1. Strengthen capacity of rural youth in fabrication of equipment and accessories and repair of DWWE installations, and support them to set it up as a business
2. Demonstrate and promote locally fabricated DWWE equipment and accessories
3. Strengthen capacity of extension officers in participatory advisory support for DWWE

Outputs

Rural youth trained in fabrication of equipment and accessories and repair of DWWE installations and supported to start it up as a business
Increased demand for locally fabricated DWWE equipment and accessories
Extension officers applying participatory skills to support rural water user committees in charge of DWWE

Relationship to the country's sustainable development priorities

Uganda's annual groundwater recharge is estimated at 19.1 - 39.9 mm (NDP III; UNESCO, NWDR 2006) and predicted to increase (Nsubuga et al. 2014). This resource is less prone to pollution than surface supply options and can be potentially developed for supplying water for domestic use, irrigation, livestock watering, aquaculture, industry and health (Taylor et al. 2009; NDP III; Foster et al. 2012). Deep well water extraction has proven to have great potential in making safe water accessible in remote rural areas and has been strongly promoted in rural water supply, but installations commonly become non-functional due to inadequate capacity to operate and maintain them and limited access to technicians and spare parts. In the long run, recurrent repairs are proving to be expensive.

Project Deliverables

Increased local capacity in fabrication and repair of DWWE equipment and accessories coupled with organisational strengthening of water user committees will potentially increase the functional life time of DWWE. The increased supply of locally fabricated parts will potentially lead to reduced prices and make them more widely accessible. More jobs will be created especially among the youth as fabricators and technicians for DWWE.

Project Scope and Possible Implementation

The project can be piloted in 3 districts where DWWE has been established through government programs. Up to ten young people can be trained in spare part manufacturing and repair and supported to start-up businesses for supplying DWWE parts or technician services.

Project activities

- Consult with the Directorate of Water Development in the Ministry of Water and Environment to identify 3 districts that have been experiencing DWWE break-downs.
- Consult with water officers and water users on the potential of increasing accessibility of spare parts and technician services in sustaining DWWE functionality.
- Coordinate with national and local governments, the private sector and NGOs to train local youth in DWWE equipment fabrication, installation and

repair
- Support start-up business for trained youth to supply DWWE services and equipment
- Build the organisational capacity of WUCs in DWWE management.
- Monitor and evaluate process and application of capacity strengthening
- Strengthen capacity of extension officers in participatory advisory support for DWWE

Timelines: The project will take three years

Table 36. Resource requirements

Activity	Amount in USD		
	Year 1	Year 2	Year 3
Strengthen capacity of rural youth in fabrication for DWWE	28,000	55,000	
Support trained youth in setting up business in DWWE service		412,000	
Demonstrate and promote locally fabricated DWWE equipment			824,000
Strengthen organisational capacity of WUCs for DWWE	420,000		
Strengthen extension capacity in participatory advisory support	689,000	689,000	
M&E	1,137,000	73,000	146,000
TOTAL		1,252,000	970,000

Measurement and evaluation
- Number of rural people trained in fabrication of equipment and accessories and repair of DWWE installations.
- Number of trained rural people supported with setting up business to supply DWWE service equipment and accessories.
- Events promoting locally fabricated DWWE equipment and accessories
- Number of water user committees strengthened with organisational development in operating and managing DWWE installations.
- Extension officers trained and implementing participatory advisory support possible

Complications/Challenges
- On the supply side, rural based fabrication business may require expensive tools, equipment and raw material. Limited access to power may also be a problem.
- On the demand side, rural consumers of the fabricated supplies and services are likely to be management committees depending on user fees, which may not be sufficient.
- Local leaders may overlook local capacity and hire services from urban centres.

Table 37. Responsibilities and Coordination

Stakeholder	Role	When	How
Ministry of Water and Environment Directorate of Water Development	Design strategy to support rural capacity development for fabrication of DWWE equipment, accessories and services.	Year 1	Engagements with local government and WUCs
	Support rural enterprises for fabrication and supply of equipment, accessories and services.	Year 2	Support access to set-up capital
	Demonstrate and promote local equipment, accessories and services for DWWE	Year 3	Demonstration sites
Local governments	Promote local equipment, accessories and services for DWWE Mobilise people for training and supporting with fabrication	Year 1	Awareness creation and meetings
Vocational institutes, Universities	Train rural people in skills for fabrication services.	Year 2	Training programs
Local water user committees	Build capacity in participatory extension Monitor and maintain DWWE functionality using local capacity and locally fabricated parts	Year 2-3	Management meetings with users
Private sector	Contribute to the value chain for local fabrication and provision of DWWE parts and services Co-invest in DWWE installation & maintenance	Year 2-3	Pilot set ups
NGOs	Contribute to capacity of water user associations; Engage and hire local capacity in rural DWWE	Year 2-3	

CHAPTER 2. Technology Action Plan And Project Ideas For The Agriculture Sector

2.1 TAP for the Agriculture sector

2.1.1 Sector overview

The agricultural sector plays a central role in Uganda's economy, providing most of the domestic food needs, contributing 24% of the Gross Domestic Product (GDP) and accounting for 54% of the country's export earnings (World Bank 2019).

Almost 70% of the working population is engaged in rain-fed agriculture which also provides the first job for 75% of those aged between 15 and 24 years. The National Development Plan III strongly rests on the agricultural sector for wealth creation and employment provision along the agricultural value chain. The manufacturing sector predominantly rests on agro-processing, accounting for approximately 60% of its total output (Fowler and Rauschendorfer 2019). Agricultural soils emit about 0.33-0.35 t CO2/ha. They accounted for 36% of national GHG emissions (13.5 Mt CO2 eq/yr) in 2000 (MWE 2019). Enteric fermentation in livestock accounted for 19% of national GHG emissions (7 Mt CO2 eq/yr) in 2000 and is projected to increase by 4 times by 2030 (Uganda NDC 2016).

Vulnerability

The increase in temperature due to climate change will potentially change rainfall seasonality and intensity and affect biological processes of agricultural crops and livestock and their associated growth environment. Rising temperature will potentially increase evapotranspiration and intensify water scarcity during drought periods. Drought is likely to increase in the western, northern, and north-eastern parts of the country.

Increased temperatures also lead to reduction in reproduction of livestock (SNC 2014). Uganda fish production is from fresh water sources which have low buffering capacity and are very sensitive to climate variability. An increase in water temperatures is also likely to depress freshwater vegetation, reduce fish production, change species composition and increase risk of fish diseases and parasites (FAO 2010; Souchon and Tissot 2012; Dell, Pawar and Savage 2014). The impact of climate change is likely to exacerbate losses already associated with poor fishing practices, introduction of non-native species, habitat destruction and lake pollution (FAO 2018).

Change in rainfall intensity will lead to events of prolonged droughts and intense rainfall. Intense rainfall will potentially increase soil erosion and landslides in steep terrain, and waterlogging and flooding in valleys. Flood events and severity are likely to increase are in

mountainous and lake shore regions. The destruction of infrastructure due to flooding is also likely to reduce farmers' access to advisory support services and inputs compounded by post-harvest losses.

Many crops are vulnerable to rising temperatures, increasing dry season and unrealizable rainfall. Most least sensitive sensitive crops are: Arabica coffee, Robusta coffee, rice, maize, East African Highland Banana (matooke), beans, sorghum, sweet potatoes, and cassava. (USAID, 2013). Flooding is especially associated with yield loss of sweet potatoes, simsim and groundnuts in the Northern and Teso region (USAID 2013). A combination of erratic rainfall and increased temperature will likely increase disease (e.g., red-berry disease in Robusta coffee, leaf rust disease in Arabica coffee, fungal diseases and aflatoxin degradation of grains) and pest attack (e.g., fall army worm, aphids etc.) leading to crop losses in the field and after harvesting (World Bank 2018). The erratic and unpredictable weather patterns are likely to disrupt farm calendars with high potential field-level and post-harvest losses resulting in frustration of farmers. By 2050, loss in food crops will be worth about USD 1.5 billion per year and the Arabica coffee growing area will significantly reduce.

Table 38. Existing policies and measures related to the sector's development and technology deployment

Policy	Main content	Current Tech profile
National Agricultural Policy 2013	Achieve food & nutrition security & improve household incomes through enhancing sustainable agricultural productivity and value addition.	10-year Climate Smart Agriculture Program (2015-2025); Crop and livestock index-based insurance though not scaled up; integrated fisheries resource management.
Uganda National Seed Policy 2015	Promote highly adaptive and productive crop varieties and cultivars; ensure availability of high quality and safe seed for food security (MAAIF 2015)	Key focus crops have been coffee, maize, cassava, rice, sweet potato, beans, peas, sorghum, millet and bananas. Yet to strengthen advanced techniques such as molecular markers, genetic engineering, and tissue culture(MAAIF 2015)
National Agricultural Extension Policy 2016	Transform extension from a system of parallel institutionally fragmented public and non-state actors to a well-coordinated, harmonized, regulated pluralistic service with multiple providers addressing diverse needs. (NAES 2016) Expand extension beyond production; synergize with other support services; Partner & network for increased resilience.	Technology transfer through a single spine approach with intention to inbuilt ICT systems to support climate resilient agriculture. This so far allows only limited mechanisms for farmer participation and feed-back on technology adoption and adaptation.
National Irrigation Policy 2017	Strengthen water harvesting and irrigation farming to strengthen resilience Support individuals and farmer groups with feasible irrigated agriculture enterprises.	Construction/rehabilitation of valley dams & water tanks; micro irrigation systems; household and community water harvesting. Need to strengthen community and micro-level options beyond macro-level focus

Policy	Main content	Current Tech profile
National land use policy 2008	Provide guidance on sustainable land use based on soil and topographic analysis, agro-ecological principles, social and demographic assessment.	Community land use mapping; improved livestock feeding; sustainable rangeland & pasture management; satellite image analysis; Soil, vegetation & land use surveys; early warning systems using scientific & local climate knowledge.

Table 39. Selected technologies

Technology	Current level of uptake	Future targets
Community based irrigation schemes	15,000 hectares of the potential 3.03 million (BMAU Briefing Paper 2018)	Additional 1,500,000 hectares by 2040 including micro, medium and large-scale irrigation systems (MAAIF & MWE 2017).
Breeding	33-35% farmers use improved seed (MAAIF 2018) and about 30-40% of seed traded in the market is counterfeit (AGRA 2011).	To increase the generation of quality and climate resilient seed varieties for major food and commercial crops and making it available to farmers through a commercially viable system targeting approximately 60% of farmers by 2030 (MAAIF 2015)
Responsive agricultural extension	Current ratio of extension worker to farmer is 1: 1,800 and primary focus is on production	Achieve ratio of extension worker to farmer of 1:1,500 with multiple providers addressing diverse needs along the agricultural value chains by 2030.

2.1.2 Action Plan for Crop Breeding Technology

2.1.2.1 Introduction

Crop breeding is a key national development strategy to safeguard food security and livelihoods. Strengthening agricultural breeding programs is key in climate change adaptation in the National Climate Adaptation Plan of Action (2007), the Second National Communication to the United Nations Framework Convention on Climate Change (Oct 2014); and the Nationally Determined Contribution (2016). It involves the generation and promotion of improved crop varieties with desirable traits. Important steps include collection of germplasm with desirable characteristics, planting and evaluating desired traits, developing new cultivars, selection and testing of progeny, evaluation in performance trials, registration, certification, multiplication, distribution and continued inspection. More advanced techniques use molecular markers in selecting individuals with desirable genes, genetic engineering to introduce genes of desired traits, tissue culture for plant multiplication etc.

2.1.2.2 Ambition for the TAP

The proposed target is to increase access to improved seed varieties adapted to climate related conditions for 200,000 smallholder farmers by 2030.

2.1.2.3 Actions and Activities selected for inclusion in the TAP

Table 40. Summary of barriers and measures to overcome barriers

Barrier category	Barrier	Measures
Financial	High cost of production and distribution of climate-adapted seed varieties	Mitigate cost of producing climate-adapted varieties Increase improved variety affordability through provision of subsidies for farmers, alliances with NGOs to train farmers, providing seed funding for local savings and credit schemes.
Non-financial	Inadequate involvement of farmers and local knowledge variety development	Strengthen community involvement in the development of improved seed
	Inadequate involvement of private sector	Strengthen private sector partnership
	Counterfeit seed in circulation	Strengthen control of counterfeits
	Insufficient compatibility with smallholder farming contexts	Improve research capacity to generate improved varieties for different contexts
	Research and extension are poorly coordinated	Strengthen research extension linkages and information flow

Actions selected for inclusion in the TAP

a) Mitigate cost of producing climate-adapted seed varieties

Increasing budget allocation to NARO to procure high-precision equipment and train personnel to operate them will greatly reduce costs in the long run. Data and information resources need to be developed and made available to cut down labour and field-testing requirements (Tiwari 2017). The breeding steps can be greatly reduced through regional cooperation in crop improvement and adoption of international quality control measures (IDRC 1983; MAAIF 2015). Training and developing functional partnerships with farmers and establishing seed banks at lower government levels also reduces costs.

b) Strengthen community involvement in the development of improved seed

The capacity of research-extension systems needs to be strengthened to nurture farmer engagement and build farmers' voices and indigenous knowledge into breeding processes. This helps to respond well to contexts and increase adoption (Jogo et al. 2013). Traditional knowledge of plant genetic resources needs to be documented (Naluwairo 2006) and the community intellectual property rights in the National Seed Policy 2018 (MAAIF 2018) operationalized. Farmers also need to have rights to register their own varieties (Tuhairwe 2017). Community inclusion is also needed in monitoring the performance of varieties in different farming systems.

c) Strengthen enforcement of regulations to reduce counterfeits

Improved seed needs to be authenticated to reduce counterfeits (De Boef et al. 2014; Ampurire 2019). The National Seed Certification Services needs to be sufficiently funded to recruit enough seed inspectors, train and equip them well to make regular surveillance. The ministry of agriculture needs to coordinate well with the Uganda National Bureau of Standards and with police to ensure strong enforcement to arrest and reprimand those dealing in counterfeits (Ssejjoba 2018; UMC 2019). Local governments need to be supported to certify seeds, pass and enforce ordinances and bylaws to control the sale or supply of counterfeit seed (MAAIF 2018). Border controls also need to be strengthened to prevent entry of fake seed. Research is also needed to understand the costs and risks entailed in fake seed distribution. Making seed quality standards widely available and deliberately linking farmers to genuine seed companies will help farmers avoid fake seed.

d) Improve research capacity to generate improved varieties for different contexts

Routine mapping of farmer contexts is needed to guide the development of multiple options of improved varieties (Asea et al. 2014). Investing in decentralized programs and laboratories will enable consideration of variations in ecological and social context. Breeding programs need to focus on a wide range of crops and multiple wins including poverty reduction, natural resource conservation, and climate adaptation. Farmer research networks need to be established where farmers collaborate directly with researchers in the development, testing and adaptation of varieties to their contexts. Research on profitability also needs to be strengthened.

Activities identified for implementation of selected actions

a) Mitigate cost of producing climate-adapted seed varieties and increase improved variety affordability.

- Invest in precision equipment and methods for crop improvement processes.
- Strengthen regional cooperation in crop improvement and adopt international QC measures
- Establish seed banks at lower government levels and deliberately link farmers to genuine seed companies

b) Strengthen enforcement of regulations to reduce counterfeits

- Develop an up-to-date participatory tracking system to ensure authenticity of seed.
- Strengthen coordination between the National Seed Certification Services, the Uganda National Bureau of Standards and police to prevent counterfeits
- Establish information hubs to make seed quality standards widely known

c) Improve research capacity to generate improved varieties for different contexts

- Conduct studies to map farmer contexts, traditional knowledge of seed varieties and assess potential of breeding programs to achieve multiple wins
- Invest in decentralized seed breeding programs, and seed certifying services

Actions to be implemented as Project Ideas

Build capacity of crop breeding programs to map out different farmer contexts under different climate scenarios and design off-station platforms for interactive collaboration with key stakeholders in crop breeding.

2.1.2.4 Stakeholders and Timeline for implementation of TAP

Table 41. Overview of Stakeholders for the implementation of the TAP

Stakeholder	Role
MAAIF; Department of Crop production and Marketing	▸ Invest in precision equipment for crop improvement ▸ Establish public seed banks ▸ Provide information for improved seed production and distribution ▸ Regional engagements for cooperation in crop breeding
National Agricultural Research Organisation	▸ Conduct crop breeding to enhance performance in different contexts ▸ Test improved seed in consultation with consumers ▸ Build local crop and seed knowledge into breeding programs
Universities, national and zonal agricultural research and development institutes	▸ Build technical capacity building for crop improvement ▸ Research for improved seed in different contexts and scenarios ▸ Disseminate low-cost seed improvement technologies
National Seed Board (NSB)	Provide regulatory mechanisms to the seed industry.
National seed certification service (NSCS) and national variety release committee (NVRC).	▸ Design and enforce certification standards, methods and procedures ▸ Test and register improved varieties in the National List
MAAIF; Directorate of Crop Inspection and Certification	▸ Track authentic improved seed ▸ Set up information hub on authentic seed ▸ Set standards for authentic seed
UNBS	Work with the Directorate Crop Inspection and Certification to assure standards of authentic seed
Police	Work with the Directorate Crop Inspection and Certification to enforce regulations against counterfeit seed
Local governments	▸ Disseminate information and get feedback on improved seed for farmers, researchers and the government ▸ Register seed merchants and seed dealers ▸ Provide decentralized seed certifying services ▸ Provide advisory services for improved seed
Uganda Plant Breeders Association (PBA)	▸ Promote diversification of crops to include in the breeding program ▸ Compile and ensure wide access to information on improved seed
Uganda National Council for Science & Technology (UNCST	Oversee research and development for improved seed.
Farmer groups	▸ Testing and multiplication of seeds ▸ Providing local knowledge to be built into breeding programs

Stakeholder	Role
MOFPED and Development partners	▸ Support investment in precision equipment ▸ Support training and technical assistance.
Private sector	▸ Market and distribute improved seed ▸ Supply equipment to support improved seed development
NGOs	▸ Build local capacity to operate and use community seed banks ▸ Disseminate information on improved seed

Table 42. Scheduling and sequencing of specific activities

Activity	Scale	Year							
		2022 -23	2023 -24	2024 -25	2025 -26	2026 -27	2027 -28	2028 -29	2029 -30
Mitigate cost of producing climate-adapted seed varieties									
Invest in precision-equipment	National			xxx	xxx				
Strengthen regional cooperation in crop improvement	National						xxx	xxx	xxx
Establish seed banks at lower government levels	20 districts					xxx	xxx	xxx	xxx
Strengthen enforcement of regulations to reduce counterfeits									
Develop participatory tracking of seed authenticity	National			xxx	xxx				
Build capacity of breeding programs	National	xxx	xxx						
Strengthen coordination in controlling counterfeit seed	National				xxx	xxx	xxx		
Establish information hubs on improved seed	20 districts			xxx	xxx	xxx			
Improve research capacity to generate improved varieties for different contexts									
Conduct research on seed varieties, farmer contexts, traditional knowledge	National	xxx	xxx						

Activity	Scale	Year							
		2022 -23	2023 -24	2024 -25	2025 -26	2026 -27	2027 -28	2028 -29	2029 -30
Invest in decentralized seed breeding programs	National	xxx	xxx			xxx	xxx		

2.1.2.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

The transfer and diffusion of the crop improvement technology for climate change adaptation requires strengthening of capacities of breeding programs mostly to diversify focus crops, work closely with farmers and build context variations into breeding plans. This will require investment in state-of the-art equipment and methods as well as building of the capacity of breeders in on-station technical as well as off-station participatory skills. Further investment is needed to build off-station organizational platforms for close collaboration between farmers, scientists, private companies and other stakeholders.

Table 43. Estimations of costs of actions and activities

Action	Activity	Cost (USD)
Mitigate cost of producing climate-adapted seed varieties and increase affordability.	Procuring precision equipment	494,100
	Regional cooperation in crop improvement.	50,000
	Establish seed banks	19,000
Sub Total		563,100
Strengthen enforcement of regulations to reduce counterfeits.	Develop a participatory tracking system for ensuring seed authenticity	226,000
	Build capacity of breeding programs	288,000
	Strengthen coordination for controlling counterfeits	150,000
	Establish information hubs to make quality seed standards known	17,000
Sub Total		681,000
Improve research capacity to generate improved varieties for different contexts	Conduct research on seed varieties, farmer contexts, and traditional knowledge	28,200
	Invest in decentralized seed breeding programs	565,000

Action	Activity	Cost (USD)
Sub total		593,200
Total cost		1,837,300
Project Admin Cost (15%)		276,000
Grand total		2,113,300

2.1.2.6 . Management Planning

Table 44. Risks and Contingency Planning

Activity	Risks	Contingency plan
Mitigate cost of producing climate-adapted seed varieties and increase improved variety affordability.		
Procuring precision equipment and methods for crop improvement	Inadequate technical staff to operate the equipment High operational cost	Simultaneously procure equipment and train personnel
Establish local seed banks and deliberately link farmers to genuine seed companies	Mistrust in the authenticity of local seed bank Low capacity to manage seed banks High recurrent cost of seed bank	Promote seed from seed banks Build capacity to manage seed banks Support local operational budgets and use low-cost options.
Strengthen regional cooperation in crop improvement	Political interference in decisions Poor enforcement of regulations The process may become costly	Dialogues to address different interests; Create awareness of regional agreements; Design low-cost options
Strengthen enforcement of regulations to reduce counterfeits.		
Develop a participatory tracking system for ensuring seed authenticity	High recurring costs of conducting inspections	Quick methods of assessment Establish partnership with community, seed companies, schools
Build capacity of breeding programs	Inadequate resources to implement acquired knowledge	Provide necessary resources to enable application of knowledge Motivate technical personnel
Strengthen coordination in controlling counterfeit seed	Delay in decision making Limited budget for coordinated activities; regulations/policy gap	Set time frames for service delivery Set necessary regulation or operationalize existing ones
Establish information hubs to make quality seed standards known	Lack of funds to run the hub; High recurring costs; Inadequate capacity; Low utilisation.	Lobby for a higher budget for seed information hub, Establish participatory demonstration farms.

Activity	Risks	Contingency plan
Improve research capacity to generate improved varieties for different contexts		
Conduct studies to map farmer contexts and traditional knowledge of seed varieties	Low utilisation of study findings Low budget to implement the finding/ operationalize	Provide resources for implementation
Invest in decentralized seed breeding programs, seed certifying services and	Inadequate levels of rigor at lower government levels; high costs in building off-station crop breeding organisational structures; mistrust in the seed developed at lower government levels	Encourage community participation in seed certifying centres Synergise with existing stakeholder platforms Promote seed varieties from lower government programs

Next steps

The transfer and diffusion of the crop improvement for climate change adaptation requires transformation of crop breeding programs to design variety options from a wide range of crops to match the heterogenous farming context. Therefore, the following immediate steps are recommended:

- Procuring precision-equipment and methods for crop improvement
- Mapping farmer contexts and scenarios and designing crop breeding strategy
- Building capacity of breeding programs to focus on a diverse range of crops
- Strengthening capacity of crop breeding officers in participatory skills.

Critical requirements

- Establishing community seed banks and linking farmers to genuine seed companies
- Investing in decentralized seed breeding and certification.
- Establishing information hubs to make quality seed standards known
- Operationalizing regulation against counterfeits and strengthening coordination between the National Seed Certification Services, the Uganda National Bureau of Standards and police.

Table 45. Crop Breeding Overview Table

TAP overview table

Sector	Agriculture
Sub-sector	Crops resources
Technology	Crop breeding
Ambition	The project aims to increase access to improved seed varieties for 200,000 smallholder farmers, of which 50,000 will access certified seed by 2030.
Benefits	Increased food security, reduced crop failure due to climate change; increased and stable crop productivity for food and income generation.

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Mitigate cost of producing climate-adapted seed varieties and increase improved variety affordability	Procure precision equipment and methods for variety selection and testing	MoFPED; development partner	National Agricultural Research Organisation; Department of crop production & marketing, MAAIF	Year 3 - 4	Inadequate technical staff to operate the equipment	Precision equipment and methods established and used	-Equipment and methods for improved seed production in place	494,100
	Strengthen regional cooperation in crop improvement programs	MoFPED; development partner; MAAIF; Global climate fund (GCF)	MAAIF; Department of Crop production and Marketing; East Africa Community	Year 6 - 8	Political interference in regional decisions on crop improvement	Regional agreement on improved seed	-minutes of regional cooperation meetings -common standards for crop improvement established	50,000
	Establish seed banks at lower government levels and deliberately link farmers to genuine seed companies	MoFPED; development partner; MAAIF; GCF	MAAIF; LG; seed companies	Year 5 - 8	Mistrust in quality credibility of seed bank Low capacity in managing seed banks	Functional seed banks established	- Number of districts with functional seed banks	19,000
Strengthen enforcement of regulations to reduce counterfeits	Develop a participatory tracking system for ensuring seed authenticity	MoFPED; DP; MAAIF; GCF	MAAIF; National seed certification services	Year 3 - 4	High recurring costs of conducting inspections	Participatory seed tracking system in place	Seed tracking reports	226,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Build capacity of breeding programs to overcome counterfeits	MoFPED; DP; MAAIF; GCF	MAAIF; Department of Crop production and Marketing; universities	Year 1 - 2	Staff turnover Inadequate resources to implement acquired knowledge	Strong seed counterfeit control programs with skilled personnel established	-Number of seed counterfeit control officers trained - Systems for cont-rolling counterfeits strengthened	288,000
	Strengthen coordination for controlling counterfeits	MoFPED; development partner; MAAIF; international Climate fund	MAAIF; NSCS; UNBS; Police	Year 4 - 6	Delay in decision making Limited budget for coordinated activities	Coordinated systems for controlling counterfeits established	-Agreements between responsible institutions	150,000
	Establish information hubs for controlling	MAAIF; development partner	MAAIF; ZARDI	Year 3 - 5	Inadequate technical capacity in hub management Low utilisation.	Functional information hubs established	Number of functional information hubs	17,000
Improve research capacity for context-relevant varieties	Conduct studies to map farmer contexts, traditional knowledge of varieties & potential of breeding programs	MoFPED; GCF; development partner	MAAIF; NARO	Year 1 - 2	Low utilisation of study findings Low budget to operationalize the findings	Study on traditional knowledge and farmer contexts conducted	report findings on traditional knowledge and farmer contexts,	28,200
	Invest in decentralized seed breeding	MoFPED; GCF	MAAIF; NARO	Year 5 - 6	Inadequate rigor in certifying at lower governments	Decentralised seed breeding centres established at ZARDI level	Number of seed breeding centres	565,000

2.1.3 Action Plan for Community based Irrigation

2.1.3.1 Introduction

Community-based irrigation (CBI) is the harvesting of rain water in constructed reservoirs or use of existing natural sources (e.g., rivers, lakes and wetlands; ground water) to irrigate farms often covering an area of 200 ha or less. The infrastructure of a CBI consists of a water source, a conveyance system of in-take and discharge pipes, drainage canals, an energy source for pumping water to different points of distribution and a mechanism for controlling the water movement. The area equipped for irrigation is less than 3 per cent of the total potential irrigable area in Uganda estimated at 567,000 hectares. Therefore, by exploiting the irrigation potential, Uganda can be more food secure and export more agricultural products.

Environmental benefits of community irrigation are reduced runoff and better ground water recharge, year-round ground cover, minimizing soil erosion, diversification of crops and farming options in the farming landscape, reduction of water pollution, restoration and rehabilitation of degraded ecosystems, rehabilitation of degraded watersheds to sustain and enhance water catchment functions, improvements in farming practices and soil fertility management. Social and economic benefits of community irrigation are increased and stable production, crop diversification and value chain development for high value crops. Increased opportunities towards industrialization, employment and increased and stable income,
Organized communities can increase land productivity and market their produce collectively and at a good price.

2.1.3.2 Ambition for the TAP

The proposed target is 500 CBI units to serve 100,000 ha by 2030. Each unit will serve up to 200 ha and about 660 households. In line with the National Irrigation Policy (MAAIF & MWE 2017), community-based irrigation schemes establishment will focus on 5 districts experiencing water stress (Nakasongola Luwero Apac Arua Karamoja) and an additional 5 near ready urban market (Agog Tororo Rakai Iganga Kabale).

2.1.3.3 Actions and Activities selected for inclusion in the TAP

Table 46. Summary of barriers and measures to overcome barriers

Barrier category	Barrier	Measures
Financial	High cost of establishment, operation and management	Direct public investment in CBI Contracting CBI set up to private companies who later hand over to communities Support community to construct and manage CBI
Non-financial	Limited farmer capacity in organizing and managing irrigation system	Build farmer capacity in organizing and managing irrigation system.
	Inadequate capacity of extension officers to support CBI	Train extension staff and farmers in planning, design and implementation of a CBI set-up
	Potential conflict related to land, water, infrastructure ownership rights	Mitigate and avoid potential conflict related to land, water, and infrastructure ownership

Actions selected for inclusion in the TAP

a) Public investment in CBI from direct implementation or contracting private companies

Public financing is needed to rehabilitate existing valley dams with community participation in planning, construction and operation to motivate understanding and ownership. Support for community construction builds ownership and confidence in managing the structures. This could be done through direct financing and provision of technical support to rural communities through contracting of private companies to set up CBIs and build local capacity, or through permits to private investors to set up the infrastructure and later contract it to community members.

b) Build farmer participation capacity in managing CBI schemes.

Farmers need to be made aware of climate risks and the potential role of CBI in helping them to adapt. The capacity of water users' associations needs to be reoriented towards managing an irrigation scheme as an enterprise. This can be done through exposure visits, training and facilitation of discussions of the potential feasibility and business case of a CBI in the farmers' context. Farmers need to be made aware of irrigation equipment including pumps, pipes, sprinklers, channels and drip lines with demonstrations and practical hands-on training. Farmers also need to develop mechanisms of ensuring their membership receive information equitably and in a timely manner. Gender equality should be fostered in all phases of the project including design, implementation and monitoring and evaluation of the irrigation system (FAO, 2018).

c) Build capacity of extension personnel in irrigation skills

There is need to review and implement water catchment plans to create resilience at the landscape level. Extension staff and farmers need to be trained in skills of establishing, installing and operating CBI equipment, managing group-owned property and agricultural water management technologies including understanding agronomic needs of crops and timing of water release in appropriate quantities in relation to weather conditions. Local artisans also need to be trained to fabricate irrigation equipment, repair and maintain it because they would be more affordable and accessible when needed. Courses on planning, design and implementation of a CBI set-up are needed for engineering students in tertiary institutions. Skills are also needed to enable farmer groups to analyse the business case, social suitability and enabling conditions of investing in a CBI. Skills are also needed in conducting topographic surveys, assessing social and environmental impact of the scheme, and communicating (including use of ICT).

d) Mitigate and avoid potential conflict related to land, water, and infrastructure ownership

To motivate farmer investment in irrigation infrastructure, farmers need land titles to secure their ownership rights. Communities need to be facilitated to develop equitable rules of engagement, specifying how ownership of irrigation structures (reservoirs, pumps and distribution networks), management responsibilities and benefits are to be shared. Using existing micro- and medium irrigation set-ups, studies should be made on management needs and findings disseminated to develop realistic expectations of the water user

committees and to ensure they are sufficiently supported. Participation of women and men should be ensured recognizing their different needs, inputs, interests and benefits in the irrigation system including land and water use rights. Access and control over land and water is critical in irrigation (FAO 2018; Theis et al. 2017) and deliberate provisions are needed to ensure inclusion of women and disadvantaged groups such as persons with disabilities in CBI programs.

Activities identified for implementation of selected actions

a) Invest public funds in CBI

- Contract private companies to set up infrastructure for CBIs and later contract its operation to community members.
- Provide direct support for community construction and operation for CBI systems
- Support communities to set up CBI

b) Build capacity of extension officers and user communities in managing CBI

- Train extension staff in participatory advisory support for CBI.
- Support participatory engagements of extension officers with CBI user communities
- Demonstrate and provide hands-on training for operating CBIs.
- Strengthen organizational capacity of water user communities in managing CBIs.

c) Mitigate and avoid potential conflict related to ownership and management

- Develop equitable rules of engagement, specifying ownership of infrastructure, management responsibilities and benefits sharing
- Conduct community dialogues on CBI management needs.

Actions to be implemented as Project Ideas

Build capacity of extension officers and user communities in organizing and managing CBI

2.1.3.4. Stakeholders and timeline for implementation of TAP

Table 47. Overview of Stakeholders for the implementation of the TAP

Stakeholder	Role
MWE	▸ Set up infrastructure for CBIs and later contract it to community members. ▸ Guide the investment ▸ Train community organizations in managing CBI ▸ Construct the irrigation schemes ▸ Mobilizing, advising, regulating CBI management
Local governments	▸ Provide advisory support for CBIs ▸ Develop byelaws for CBI regulation ▸ Mobilise and strengthen organizational capacity for CBI management ▸ Train communities in CBI management ▸ Demonstrate CBI management ▸ Conduct community dialogues on CBI management
MWE with MAAIF	▸ Invest directly in setting up infrastructure for CBIs ▸ Contract private sector in setting up infrastructure for CBI ▸ Support local communities to construct their own CBI

Stakeholder	Role
Private companies	▸ Co-invest with public entities or community groups in CBI set up ▸ Supply equipment and services for CBI set up and management
Universities and vocational institutes	▸ Train extension officers and community leaders in CBI management ▸ Conduct feasibility studies for CBIs
NGOs	▸ Build local capacity in CBI management

Table 48. Scheduling and sequencing of specific activities

Activity	Scale	Year							
		2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Public investment in CBI									
Contract private companies for CBIs	6 districts					xxx	xxx	xxx	
Provide direct support for construction & operation	2 districts				xxx	xxx	xxx		
Support set up of CBI	2 districts						xxx	xxx	xxx
Build capacity of extension officers and user communities in managing CBI									
Train extension staff in participatory CBI support	10 districts	xxx	xxx						
Support participatory engagement of extension officers with CBI users	10 districts			xxx	xxx	xxx	xxx	xxx	xxx
Strengthen organizational capacity of CBI users.	10 districts	xxx	xxx						
Demonstrate; CBI hands-on.	2 districts			xxx	xxx				
Mitigate and avoid potential conflict									
Develop equitable rules	10 district				xxx	xxx			
Conduct community dialogues on CBI	10 districts								

2.1.3.5. Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

Setting up CBI schemes requires the following capacity building actions:

- Training extension staff in participatory advisory support for CBI management.
- Supporting participatory engagements of extension officers with CBI users
- Demonstrating and provide hands-on training for operating CBIs.
- Strengthening organizational capacity of WUCs in managing CBIs as an enterprise.

Table 49. Estimations of costs of actions and activities

Action	Activity	Cost (USD)
Invest public funds in CBI	Contract private companies to set up CBI infrastructure	780,000
	Provide direct support for CBI construction and operation	2,040,000
	Support community construction of CBI	780,000
Sub Total		3,600,000
Build capacity of extension officers and WUCs in managing CBI	Train extension staff in participatory advisory support	28,000
	Support participatory engagements of extension officers	99,000
	Demonstrate and provide hands-on training for CBIs.	2,040,000
	Strengthen organizational capacity of WUCs	36,000
Sub Total		2,203,000
Mitigate and avoid potential conflict	Develop equitable rules of engagement in CBI	61,000
	Conduct community dialogues on CBI management needs.	41,000
Sub Total		102,000
Total		5,905,000
Project admin Cost 15%		885,750
Grand total		6,790,750

2.1.3.6 Management Planning

Table 50. Risks and Contingency Planning

Action	Risks	Contingency plan
Invest public fund CBI		
Contract private companies to set up infrastructure for CBIs	Weak business case for private sector; Low sense of ownership; inadequate community handover.	Negotiate good business case for mutual benefit; Clear procedures of accountability and local handover

Action	Risks	Contingency plan
Invest public fund CBI		
Provide direct support for CBI systems construction and operation	Inadequate local capacity to construct CBI; Lack of strong community group to operate CBI	Train the community; Strengthen WUC organisational capacity; Monitor and give advisory support
Build capacity of extension officers and user communities in organizing and managing CBI		
Train staff in participatory extension.	Non application of acquired skills; inadequate logistical facilitation;	Generate demand; Lobby for budget facilitation of extension staff
Support participatory engagements of extension officers with CBI users	High expectations by the community; Apathy; Expensive in the short run	Work with channels such as traditional institutions and local government development officers
Demonstrate and provide hands-on training for CBIs.	Incompleteness & biased analysis; Inadequate contextualization of demonstration	Have potential beneficiary on the consultancy team
Strengthen organizational capacity of CBIs users.	Technology too complicated for communities to replicate	Advisory support and use of material that is locally available
Mitigate and avoid potential conflict related to ownership and management		
Develop equitable rules of engagement, for CBI	Low capacity to enforce the rules	Awareness trainings and sensitization on rules for CBI management
Conduct community dialogues on CBI management.	Inadequate mechanisms to ensure that parties adhere to agreed ways. Inadequate inclusion of voices of critical stakeholders	Demonstrate the potential of functional CBIs; Farmer exposure visit to functional CBIs; Ensure meaningful inclusion of stakeholders

Next Steps: Immediate requirements:

- Building local organisation capacity to manage CBI
- Training, demonstration and exposure of local communities to functional CBIs and enterprises developed around them.
- Training of extension officers in participatory approaches in providing advisory support for CBI set up and management

Critical requirement:
Government investment in construction of CBIs through direct investment, or co-investment with private sector or local farmer organisations

Table 51. Community Based Irrigation Overview Table.
TAP overview table

Sector	Agriculture
Sub-sector	Ministry of Water and Environment
Technology	Community Based Irrigation
Ambition	To establish 500 CBI units to serve 100,000 ha covering 5 districts experiencing water stress (Nakasongola Luwero Apac Arua Karamoja) and 5 near ready urban market (Agog Tororo Rakai Iganga Kabale by 2030.
Benefits	Improvements in farming practices and soil fertility management, Reduced runoff and better ground water recharge. Food security and climate resilience. Diversification of rural enterprises

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Invest public funds in CBI	Contract private companies to set up infrastructure for CBIs.	MOFPED; climate fund Private company	Directorate of Water Ministry of Water and Environment	Year 5 - 7	Weak business case for private company	CBI infrastructures setup by private companies operated and managed well by local communities	Contracts signed by private companies for CBI infrastructures	780,000
	Provide direct support for CBI construction & operation.	MOFPED; climate fund	MAAIF, MWE, Local governments	Year 4 - 6	Weak local organizational capacity to manage CBI	Communities supported to construct and manage CBIs	No. CBI schemes established by government	2,040,000
	Support communities to set up CBI	MOFPED; climate fund	MAAIF, MWE, Local governments	Year 6 - 8	Inadequate local skills to construct and manage CBIs	CBI units set up by communities	No. CBI schemes established & owned by communities	780,000
Build capacity of extension officers and users in CBI management	Train extension staff in participatory advisory support for CBI operation and management.	MWE, MAAIF, development partners	MAAIF, universities and other tertiary institutions	Year 1 - 2	Non application of acquired skills due to inadequate logistical facilitation	Strong community organizations for irrigation management	Number CBI groups strengthened	28,000
	Support participatory engagements of extension officers with CBI user communities	MOFPED, climate fund, MAAIF	Local governme-nt, MWE, Climate Change division, NGOs	Year 3 - 8	Expensive in the short run	Extension staff using participatory approach for CBI support	No. participatory mechanisms for CBI set up and applied	99,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Demonstrate & provide hands-on training for operating CBIs.	MOFPED, climate fund, MAAIF	Local government, MAAIF, MWE	Year 4 - 5	Inadequate contextualisation of the demonstration	Business case for CBI for farmers known	CBI feasibility study report	2,040,000
	Strengthen organizational capacity of water user Committees	MAAIF, MWE	Private sector partners, MWE, MAAIF	Year 1 - 2	Non-application of skills gained	CBI set-up demonstrated and communities trained	No. CBI demonstration sites; Reports of community training; No. people exposed.	36,000
Mitigate and avoid conflict in CBI	Develop equitable rules of engagement for CBI	MOFPED	MAAIF, MWE, Local Governments	Year 4 - 5	Low capacity to enforce the rules	Rules guiding irrigation structures set	Draft rules for CBI	61,000
	Conduct community dialogues on CBI management needs.	MoFPED	LG, MWE MAAIF	Year 2 - 3	Inadequate inclusion of voices of critical stakeholders	Inclusive community dialogues on CBI management conducted	Number of CBI dialogue meetings and minutes	41,000

2.1.4 Action Plan for Responsive Agricultural Extension

2.1.4.1 Introduction

The impact of climate change on crops and livestock, the whole agricultural value chain and market trends, requires extension that is agile and that provides relevant advice, with appropriate incentives. Responsive extension is the provision of advisory support that addresses the changing needs of farmers as well as keeping them updated about the new developments in technology. It involves collaboration with farmers in research where modern knowledge and indigenous knowledge are integrated in developing solutions that are tailored to different farmer contexts. It maintains constant presence and interest in what happens in farming systems with two-way exchange of information and knowledge between the farms, research entities and policy makers in technology development, testing and adaptation.

2.1.4.2 Ambition for the TAP

Establish national strategy and capacity building for Responsive Agricultural Extension (RAE) and pilot it in districts which are most vulnerable to climate change (including crop, livestock fisheries farmers) by 2030. This is in line with Uganda's National Agricultural Extension Policy (NAEP) 2016, with the goal of a gender responsive, market oriented, decentralized extension service delivery system.

2.1.4.3 Actions and Activities selected for inclusion in the TAP

Table 52. Summary of barriers and measures to overcome barriers

Barrier category	Barrier	Measure
Financial	Inadequate financing and budget allocations for agricultural extension	Increase budget allocation, develop partnerships and improve efficiency; use ICT and farmer-based research.
Non-financial	Limited human capacity to provide effective extension support for resilient farming in different contexts	Strengthen technical capacity of extension workers to become more responsive to changing needs of farmers
		Strengthen extension-farmer linkages; develop partnership with NGOs.
	Inadequate monitoring and surveillance	Improve monitoring and surveillance; engage the youth
	Weak structures to engage farmers	Strengthen coordination in extension service delivery.

Actions selected for inclusion in the TAP

a) Increase budget allocation, develop partnerships and improve efficiency

Budget allocation to extension needs to be increased in accordance with CAADP commitments to enable hiring and training of staff, logistical facilitation, monitoring, conducting studies and use of

ICT in extension of agricultural advisory services and inputs. Private sector partnerships need to be developed to increase investment in some extension processes such as nurturing linkages to markets, agricultural insurance and financial services. Targeted subsidies are needed when introducing farmers to new technologies and ensuring that marginal farmers are not excluded.

b) Strengthen technical capacity of extension workers to become more responsive to changing needs of farmers

More staff needs to be recruited to fill the established structure and these need to be supplemented with para technical service providers to increase reach and responsiveness to farmer needs. Officers and technical assistants need to be trained in methods of collaborating with farmers in monitoring performance, and building on local knowledge and resources to design appropriate adaptations. Training institutions need to design appropriate agricultural extension courses enabling adaptation to different climate scenarios. Extension staff and farmers also need to be taken to exposure visits to get insights on what is feasible. Terms of reference and performance evaluations of extension staff also need to be reviewed to motivate them.

Farmers too need to be made aware of their role in ensuring that extension support addresses their felt needs. Information needs to be made more accessible to farmers and technology applications and digitalized resources on mobile phones needs to be built up (NAES 2016; Barungi et al. 2017). Extension messages and impact can be strengthened through engagement of private enterprises (NAES 2016). Farmers' cooperative and marketing organizations need to be strengthened as nuclei for knowledge building.

c) Strengthen extension-farmer linkages

Recognition of farmers' knowledge and contribution to extension processes is needed to motivate farmers to own and actively participate. Annual awards and paid engagement in certain activities should be considered to build farmers' confidence as key participants in the extension work. Farmers should be included in the development of extension manuals and communication materials, consolidation and analysis of data to enable the system to transition to demand-driven service provision (Babu et al. 2013, Barungi et al. 2016). Local leadership needs to be involved in extension systems to build trust with farmers and ensure that their concerns are followed up in future planning. Different groups need to be strategically linked for information sharing, developing market value chains.

d) Improve monitoring and surveillance

Extension staff needs to be made aware of the importance of monitoring as a basis for responsiveness to farmers' needs. Bio-physical and social economic context variations need to be mapped out regularly to design responsive programs. The impact of the technology also needs to be tracked not only at production level, but across the value chain. As such, adequate and up-to-date monitoring equipment and tools are needed for timely gathering and analysis of information. Extension staff need to be trained to use existing data collection tools established by Directorate of Agricultural Extension Services (DAES) and the Statistics Division for data monitoring and analysis. Extension should also partner the academia, research entities or the national bureau of statistics. Information from sources such as meteorological units, disaster preparedness surveillance etc.

needs to be integrated with extension monitoring and analysis to strengthen planning. Partnerships are also needed with private companies and NGOs in information generation and transfer. Monitoring should also aim at scope for potential services for farmers e.g., input and value addition markets, insurance, financial institutions etc. Outcomes of monitoring and evaluation need to be synchronized with planning cycles to give coherence.
Setting up community-level monitoring committees will ensure follow up using agreed performance indicators of the technology or knowledge transferred (Buyinza et al. 2015). Monitoring clubs can also be established among young people in schools to help with data gathering.

e) Coordinate extension service provision

Improved coordination between public sectors and other non-governmental entities will create synergies, avoid redundancy, ensure a common message, standardize successful practices, and leverage resources from the private sector, development partners, and other non-state actors (NAES 2016). It is essential for the agricultural extension services system to have formal and explicit mechanisms for coordination and collaboration established at every level of the extension system. Coordination is also needed between national level entities and local governments (Barungi et al. 2017).

Activities identified for implementation of selected actions

a) Increase financing and efficiency in agricultural extension
- Develop partnerships with private sector & NGOs to increase investment in RAE
- Design and invest in ICT strategy for RAE

b)Strengthen technical capacity for responsive agricultural extension
- Recruit agricultural extension staff & local technical assistants and facilitate them.
- Train agricultural extension staff and local technical assistants in RAE.

c) Strengthen extension farmer linkages
- Create farmer awareness and strengthen their capacity to participate in RAE.
- Create platforms for linking farmer groups for information sharing & marketing.

d) Improve RAE monitoring and evaluation
- Train extension staff in monitoring, analysis and adaptive learning.
- Partner with institutions such as academia, research entities, the bureau of statistics and NGOs to map context variation and contribute to information acquisition and transfer.
- Set up community-level RAE monitoring committees, including school and youth clubs.

Actions for project ideas
- Strengthen technical capacity for responsive agricultural extension
- Strengthen extension farmer linkage

2.1.4.4 Stakeholders and Timeline for implementation of TAP

Table 53. Overview of Stakeholders for the implementation of the TAP

Action	Contingency plan
Invest public fund CBI	
Ministry of finance, planning and economic development and Development partners	Mobilise and provide financial resources for agricultural extension
Directorate of agricultural extension services (DAES)	▸ Design and implement strategy for responsive agricultural extension to context variation and scenarios ▸ Coordinate co-investments in agricultural extension between public and non-government entities ▸ Strengthen organisational capacity of farmer groups to participate in agricultural extension ▸ Facilitate linkages to actors along the agricultural value chain. ▸ Facilitate linkage to agricultural information and technologies ▸ Train agricultural extension staff in monitoring, ▸ Design logistical resources and incentives for farmer engagement in agricultural extension
MAAIF	▸ Support skilling, manpower development and farmer institutional development for RAE ▸ Provide adequate agricultural extension staff structure and recruit competent officers and assistants ▸ Conduct monitoring and evaluation of RAE
Local government	▸ Mobilize and train groups for participation in RAE ▸ Build local partnerships for RAE with eg NGOs, schools etc ▸ Design incentives for motivating participation in RAE
Farmer groups	▸ Participation in design and implementation of agricultural extension strategy ▸ Provide active feedback and contribute local knowledge Undertake farmer to farmer extension services
Academic and agricultural research institutions private entities	▸ Map out contexts and scenarios in agricultural support needs ▸ Generate agricultural knowledge and technologies ▸ Generate and analyse regular farmer satisfaction surveys
Ministry of ICT	▸ Design ICT framework for RAE ▸ Acquire ICT equipment and services to support RAE

Table 54. Scheduling and sequencing of specific activities

Activity	Scale	Year							
		2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Increase financing and efficiency in agricultural extension									
Develop partnerships	National						xxx	xxx	xxx
Invest in ICT for RAE	National	xxx	xxx	xxx	xxx				
Strengthen technical capacity for RAE									
Recruit extension personnel	National		xxx	xxx				xxx	
Train agric. extension personnel	National			xxx	xxx	xxx			
Facilitate trained extension staff in RAE	National					xxx	xxx	xxx	xxx
Strengthen extension farmer linkages									
Create farmer awareness and capacity in RAE	National				xxx	xxx			
Create platforms for linking farmers in RAE.	National						xxx	xxx	
Improve RAE monitoring and evaluation									
Train staff in monitoring	National			xxx	xxx	xxx			
Form partnerships for information sharing	National						xxx	xxx	
Set up RAE monitoring committees	National						xxx	xxx	xxx

2.1.4.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs
The transfer and diffusion of Responsive Agricultural Extension requires re-orientation of the agricultural extension program to focus on the context variation in farmers' advisory needs over time and space. As such, priority investment should focus in strengthening the following capacity building needs:

a) Agricultural extension staff
- Recruit adequate numbers of competent officers and community level assistants
- Train agricultural extension staff in RAE implementation, monitoring and adaptive learning

b)Farmer organizations

- Conduct organizational strengthening of local farmer groups
- Train farmer groups in assessing their contexts and contributing to the design and implementation of a responsive extension strategy with active feedback mechanisms and adaptive learning

Table 55. Estimations of costs of actions and activities

Action	Activity	Cost (USD)
Invest public fund CBI		
Increase financing and efficiency in agricultural extension	Develop partnerships with private sector and NGO	288,000
	Design and invest in ICT strategy for RAE	100,000
Sub total		388,000
Strengthen technical capacity for responsive agricultural extension	Recruit more agricultural extension staff and local technical assistants and facilitate them to implement RAE in 5 pilot districts over 5 years	900,000
	Train agricultural extension personnel	689,000
Sub total		1,589,000
Strengthen extension farmer linkages	Create farmer awareness	40,000
	Strengthen farmer capacity to participate in RAE	150,000
	Create platforms for linking different farmer groups	45,000
Sub total		235,000
Improve RAE monitoring and evaluation	Train extension staff in monitoring.	150,000
	Form partnerships for information sharing	33,000
	Set up community-RAE monitoring committees	45,000
Sub Total		
Total		228,000
Project Admin cost 15%		2,440,000
Grand Total		366,000

2.1.4.6 Management Planning

Table 56. Risks and Contingency Planning

Activity	Risks	Contingency plan
Increase financing and efficiency in agricultural extension		
Develop partnerships with private sector and NGO for RAE	Weak business case for investment partners	Conduct a study to identify the business case for non-state actors
Design and invest in ICT strategy for RAE	Low access to ICT devices in remote areas	Invest in increasing radio and broaden ICT access
Strengthen technical capacity for responsive agricultural extension		
Recruit more agricultural extension staff and local technical assistants	Lack of sustainable funding for salaries	Partner with non-state actors Strengthen capacity for extension workers to operate privately
Train agricultural extension staff and local technical assistants	Inadequate logistical facilitation to apply acquired skills	Provide sufficient logistical facilitation and regularly monitor staff
Strengthen extension farmer linkages		
Build farmer awareness and capacity to participate in RAE.	Inadequate customisation of information to farmer needs	Design awareness feedback process to adjust to farmers' needs
Create platforms for linking farmers for information sharing and marketing.	Insufficient logistical support for functioning platforms; Low participation and willingness	Develop partnerships for enabling functioning of platforms; Expose farmers to functioning platforms
Improve RAE monitoring and evaluation		
Train extension staff in monitoring,	Non application of acquired skills	Give adequate logistical facilitation for extension workers; Supervise staff
Form partnerships for information sharing	Inadequate budget; Non-alignment of work plans	demonstrate how the partnership will benefit the different actors
Set up community-level RAE monitoring committees, including school and youth clubs.	Unwillingness of community members to engage in monitoring; High costs to community monitors	Communicate potential benefits from community monitoring; establish clear duties, responsibilities and incentives for community monitoring

Next Steps

The transfer and diffusion of RAE requires the following immediate steps:

- Mapping out the different contexts of farmers in the different climate scenarios
- Designing a strategy for RAE
- Building partnerships to co-invest in RAE

Critical requirements

- Strengthening technical capacity for low-cost responsive agricultural extension
- Conducting organizational strengthening of local farmer groups
- Training farmer groups in assessing their contexts and contributing to RAE
- Strengthening extension farmer linkages

Table 57. Responsive Agricultural Extension Overview Table

TAP overview table

Sector	Agriculture sector
Sub-sector	Agricultural Extension and Skills Management
Technology	Responsive Agricultural Extension (RAE)
Ambition	Set up Responsive Agricultural Extension especially in districts which are most vulnerable to climate change by 2030.
Benefits	Makes extension advice more responsive to farmers' needs to ensure agriculture productivity, networking among farmers, increased food security, and responsive to changing market and market trends

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Increase financing and efficiency in agricultural extension	Develop partnerships with private sector and NGO	MAAIF	Directorate of Agricultural Extension Services (DAES)	Year 6 - 8	Weak business case for investment partners	RAE Partnerships formed	Agreements with non-state actors to contribute to RAE	288,000
	Design and invest in ICT strategy for RAE	MoFPED; Development partners	MAAIF	Year 1 - 4	Low access to ICT devices in remote areas	Good financial governance and accountability	Procedures for financial governance for RAE established and implemented	100,000
Strengthen technical capacity for responsive agricultural extension	Recruit more agricultural extension staff and local technical assistants and facilitate them.	MoFPED	MAAIF; Ministry of Public service	Year 2 - 3	Lack of sustainable funding for salaries	Para technical service providers recruited	Employment contracts for RAE para technical service providers	900,000
	Train agricultural extension staff and local technical assistants in RAE.	MoFPED	MAAIF; DAES	Year 3 - 5	Inadequate logistical facilitation to apply acquired skills	Officers and technical assistants trained in RAE	Training reports	689,000
Strengthen extension farmer linkages	Create farmer awareness	MAAIF, Development partners	DAES; District Agricultural Office	Year 4 - 5	Inadequate customization of information to prevailing farmer needs		Advocacy meeting Minutes	40,000
Improve RAE								

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Strengthen their capacity to participate in RAE.	MAAIF, Development partners	DAES; District Agricultural Office	Year 5 - 6	Inadequate resources to sustain farmer participation	Farmers trainer of trainers team established	Training Reports Farmer groups attendance list	150,000
	Create platforms for linking different farmer groups for information sharing and marketing	Development partners International climate fund	DAES; Local Government	Year 6 - 7	Insufficient logistical support for the functioning of platforms	Platforms for linking different farmer groups established	Platform attendance lists	45,000
Improve RAE monitoring and evaluation	Train extension staff in monitoring, analysis and adaptive learning.	MOFPED; Development partners; international climate fund	MAAIF; DAES	Year 3 - 5	Non application of acquired skills	Staff skilled in monitoring RAE	Training reports	150,000
	Form partnerships for information acquisition and transfer	MAAIF	DAES; UBOS Academic institutions	Year 6 - 7	Inadequate budget to facilitate partnership	Partnerships created	Agreements between responsible institutions	33,000
	Set up community-level RAE monitoring committees, including school and youth clubs.	Development partners	DAES; Local Government	Year 6 - 8	Unwillingness of community members to engage in monitoring.	Community RAE monitoring committees formed	Minutes from committee meetings Attendance lists	45,000

2.2 Project Ideas for the Agriculture Sector

2.2.1 Brief summary of the Project Ideas for the Agriculture Sector

The following project ideas are based on technologies that were prioritised for climate change adaptation and achievement of national development priorities through a multi-criteria analysis with relevant stakeholders.

Project ideas considered mechanisms that would catalyse ongoing related national processes of technology transfer and diffusion, potentially lead to wide impact in areas where they are most needed, and motivate co-investment from non-government players.

- Build capacity for developing and promoting climate resilient and context relevant crop varieties
- Build capacity of extension officers and user communities in organizing and managing CBI
- Strengthen technical capacity for responsive agricultural extension

2.2.2 Specific Project Ideas

2.2.2.1 Building capacity for promoting climate resilient crop varieties

Introduction

Farming contexts vary and are likely to be impacted by climate change differently. Breeding programs need to design varieties that are responsive to these variations and changes. Crop breeding programs need to map out these contexts under different climate scenarios and design off-station platforms for interactive collaboration. Programs also need to broaden the range of focus crops to include what is best adapted to context. Such a program requires functional community engagement, feedback and monitoring of performance.

Objectives

1. Map out different farming contexts, their climate vulnerabilities and potential types of crops to consider for breeding
2. Design strategy for interactive collaboration with key stakeholders in crop breeding

Outputs

- Map describing biophysical and socioeconomic contexts of farms, their climate vulnerabilities and potential types of crops to consider for breeding
- Strategy for interactive collaboration with key stakeholders in crop breeding

Relationship to the country's sustainable development priorities

Uganda prioritises increased support to agricultural research for further breeding of crops that are disease, drought and high temperature tolerant as well as other technologies (Uganda 2nd climate change communication). Expanding diversification of crops and livestock and expanding research on climate resilient crops and animal breeds are key priority adaptation actions (NDC 2016). The country also seeks to create community awareness and adoption of high yielding and drought resistant varieties; promote research in pest resistant crops; conduct surveillance of crop diseases and

monitor crop production (Republic of Uganda 2010)

Project Deliverables

Designing context relevant crop breeding strategy has a number of advantages including;

- Increased potential for improved varieties to generate expected benefits for many farmers, leading to increased productivity and food security.
- Reduced risk of unforeseen ecological vulnerabilities or social rejection of varieties
- Reduced needs on synthetic inputs to boost production

Project Scope and Possible Implementation

This project can be countrywide and is achievable in 4 years.

Project activities

- Review existing zonal maps and design GIS analysis to map biophysical variations in farm contexts
- Conduct socio-economic survey
- Conduct stakeholder consultations
- Design and implement context responsive crop breeding strategy

Table 58. Resource requirements

Activity	Amount USD			
	Year 1	Year 2	Year 3	Year 4
Review existing zonal maps and design GIS analysis to map biophysical variations in farm contexts	52,000			
Conduct socio-economic survey	20,000			
Conduct stakeholder consultations				
Design context responsive crop breeding strategy		15,000	50,000	
Implement context responsive crop breeding strategy		50,000	60,000	200,000
TOTAL	72,000	65,000	110,000	200,000

Measurement/Evaluation

- Review seed breeding documents for biophysical and socio-economic farm context maps and their use in designing crop breeding programs
- Review changes in national crop breeding strategy to include context responsive off-station actions and engagements of relevant stakeholders

Challenges

- Costs might be prohibitive in implementing context responsive crop-breeding strategy
- Biophysical and socio-economic scenarios may change too fast for breeding programs to keep up

Table 59. Responsibilities and Coordination

Activity	Who	When	How
Review existing zonal maps and design GIS analysis to map biophysical variations in farm contexts	NARO in collaboration with universities	Year 1	Desk review including public and web-based resources and publications GIS analysis of existing maps
Conduct socio-economic survey	NARO with universities	Year 1	Desk review existing socio-economic context documents Encoding and analysis of in GIS
Conduct stakeholder consultations. design and implement context responsive crop breeding strategy	NARO	Year 2-4	Consultant for stakeholder consultation Meetings for developing strategy Piloting activities on the ground

2.2.2.2 Building capacity of extension officers and user communities in managing CBIs

Community based irrigation has potential in enabling farmers to develop resilience to seasonal rainfall variations and diversify enterprises. Communities need to be supported to get organised and do this collectively including getting advised on agronomic crop water needs in terms of timing and quantities. Community groups also need support in ensuring social equity and inclusion in distributing CBI benefits and managing conflict.

Objectives

1.Train extension officers in participatory skills to support CBIs
2.Strengthen community organisational capacity to manage CBIs

Outputs

1.Extension officers trained in participatory skills to support CBIs
2.Functional community organisations managing CBI

Relationship to the country's sustainable development priorities

The National Irrigation Policy (MAAIF & MWE 2017) aims at ensuring sustainable availability of water for Irrigation and its efficient use for enhanced crop production, productivity and profitability to contribute to food security and wealth creation. The Policy targets an additional 1,500,000 ha to be irrigated by 2040. Irrigation is part of Uganda's strategy to reduce the country's dependency on rain-fed agriculture and to increase food security. It is implemented by Ministry of Agriculture Animal Industry and Fisheries together with Ministry of Water and Environment. The country invests in CBIs as part of its strategy to increase storage capacity for water for production. MWE is constructing small scale irrigation systems countrywide with GoU funding and medium scale irrigation schemes under the Farm Income and Enhancement and Forestry Conservation (FIEFOC) Project 2. These schemes contribute to reduction in rural poverty by serving as livestock watering, crop irrigation needs and enable diversification of crops and farm enterprises (SPR MWE 2018).

Project Deliverables

1.Reduced vulnerability to seasonal variations in rainfall patterns and intensity
2.Increased and stable production and incomes
3.Diversification of farm enterprises

Project Scope

Districts where CBI schemes have already been established.
Timeline: 3 years

Project activities

- Train extension officers in participatory skills to support CBIs
- Strengthen community organisational capacity to manage CBI
- Monitor CBI implementation

Table 60. Resource requirements

Activity	Amount USD		
	Year 1	Year 2	Year 3
Train extension officers in participatory skills to support CBIs	400,000		
Strengthen community organisational capacity to manage CBIs	120,000	150,000	
Monitor CBI implementation			150,400
Total	520,000	150,000	150,000

Measurement/Evaluation

- Number of officers trained
- Number of local CBO management committees set up and trained in organisational development

Possible challenges

- Low trust in CBI scheme and therefore low willingness among community members to contribute user fees for running of scheme
- Costs of CBI management exceeding available resources and exerting too much time and skill demands on water user committee leaders.

Table 61. Responsibilities and Coordination

Activity	Who	When	How
Train extension officers in participatory skills to support CBIs	MAAIF MWE	Year 1	Training
Strengthen community organisational capacity to manage CBIs	MAAIF MWE and local governments with NGOs	Year 1-2	Mobilisation; training; meetings; exposure visits
Monitor CBI implementation	MAAIF MWE	Year 3	Survey interviews

2.2.2.3 Strengthening technical capacity for Responsive Agricultural Extension

Introduction
The transfer and diffusion of Responsive Agricultural Extension requires re-orientation of the agricultural extension program to focus on the context variation in farmers' advisory needs over time and space. As such, investment in capacity strengthening of extension staff and farmer organization is needed.

Objectives
1.Strengthen the capacity of agricultural extension staff in participatory extension skills
2.Strengthen farmer organisational capacity to participate in, demand relevant agricultural advisory support and give feedback

Outputs
1.Extension officers with participatory skills that enable RAE
2.Farmer groups that participate meaningfully in RAE

Relationship to the country's sustainable development priorities
The impact of climate change on crops and livestock, the agricultural value chain and market, requires extension that is agile providing relevant advice, with appropriate incentives. Uganda's National Agricultural Extension Policy (NAEP) 2016 seeks to achieve a gender responsive, market oriented, decentralized extension service delivery system. This requires capacity strengthening at national and local government levels and in multiple sectors (environment, agriculture, water, governance and education). This is highlighted in the Agriculture Sector Development Strategy and Investment Plan (2015).

Project Deliverables
- Community participation in institutional development and contribution of their knowledge and observations to knowledge development
- Networking among farmers and with researchers and extension workers.
- Increase in agricultural technical capacity and exposure of farmers and players in the agricultural support system.
- Increased efficiency through improved targeting of advisory services

Project Scope
National. Three years.
Project activities
- Recruit adequate numbers of competent officers and community level assistants
- Train extension staff in RAE implementation, monitoring and adaptive learning
- Conduct organizational strengthening of local farmer groups
- Train farmer groups in assessing their contexts and contributing RAE with active feedback mechanisms and adaptive learning

Table 62. Resource requirements

Activity	Amount USD		
	Year 1	Year 2	Year 3
Recruit adequate numbers of competent officers & community assistants	900.000		
Train agricultural extension staff in RAE implementation, monitoring and adaptive learning	689,000	689,000	
Conduct organizational strengthening of local farmer groups		150,000	
Train farmer groups in assessing their contexts and contributing to RAE		120,000	330,000
Total	1,589,000	959,000	330,000

Measurement/Evaluation

- Number of competent officers and community level assistants recruited
- Number of competent officers and community level assistants trained in participatory skills to undertake RAE
- Number of farmer groups trained in organisational development and participating actively in RAE

Possible Complications/Challenges

- Inadequate logistical resources to apply skills and knowledge in RAE
- Costs might be too high to implement RAE
- Attitude change in farmers and extension officers may deter progress

Table 63. Responsibilities and Coordination

Activity	Who	When	How
Recruit officers and community level assistants	MAAIF	Year 1	
Train agricultural extension staff in RAE	MAAIF	Year 1-2	Training
Conduct organizational strengthening of local farmers	MAAIF; Local governments; NGOs	Year 1-2	Mobilisation; consultation meetings; training.
Train farmer groups to participate in RAE	MAAIF; Local governments; NGOs	Year 2-3	Mobilisation; meetings; training.

CHAPTER 3: Technology Action Plan And Project Ideas For The Forestry Sector

3.1.1 Sector overview

The forestry sector in Uganda comprised the following tenure categories as described in the National Forestry Policy, (2001) (MWLE, 2001): Central Forest reserves (constitute 15% of the total forest cover); Forests in wildlife and national parks (constitute 15% of the total forest cover); Forests on private and community forests (constitute 70% of the total forest cover).

Uganda's forest cover status has followed a drastic negative trend during the last 30 years. Thus, it reduced from 24 to 9% of the total land area in 1990 and 2015. This is largely attributed to key drivers of deforestation and forest degradation as described in the National Reducing Emissions from Deforestation and Forest Degradation (REDD+) strategy for Uganda (MWE 2017c and MWE 2017a) including: expansion of commercial and subsistence agriculture; unsustainable harvesting of tree products, mainly charcoal, firewood and timber; expanding human settlements including growing numbers of refugees; free-grazing livestock; wild fires; artisanal mining operations and oil exploration.

The reported climate change and variability impacts (such as: prolonged droughts, unreliable rainfall patterns, flooding) (MWE 2015) exacerbate the forestry sector that is already facing huge pressures through provision of ecosystem services and forest products to the burgeoning Uganda population, with an annual growth rate in Uganda is 3.3%, thus Uganda is ranked 32nd globally in 2018 and is estimated at 45 and 61 million Ugandans currently/ now and by 2030, respectively (National Population Council 2017).

Whereas there is no comprehensive national climate change vulnerability assessment for Uganda across all the sectors including forestry, the reported (NAPA 2007) vulnerabilities in the forestry sector in Uganda include the following: a) Emerging and proliferation of trees pests and diseases; b) Increased risk to destruction from wild fires due to prolonged droughts; and c) Increased encroachment on forests and forest land by community due to escalating land degradation and food insecurity among households with forest landscapes. Uganda as a country has made progress with various achievements in the policy, legislative and institutional framework in respect to advancing climate change adaptation across sectors with aim of reducing the climate change vulnerabilities. Thus, existing key policies and measures related to the forest sector's development and technology deployment in respect to

climate change adaptation is presented in **Table 64**. However, what remains is required investments at different levels for effective implementation of these policies and strengthening of institutional capacity to effectively respond to the emerging climate change impacts.

3.1.2 Farmer Managed Natural Regeneration (FMNR) for forest landscape restoration

3.1.2.1 Introduction

FMNR is a simple technique/practice of systematically regenerating mainly tree species in the natural form living tree stumps, roots or seedlings. It involves a process of selecting healthy and vigorous natural seedlings and removing (by proper pruning) of the unwanted ones. It started in West Africa, motivated by the severe drought of the mid 1970s that prompted innovative farmers working with a development agent called Tony Rinaudo to develop specific techniques for regenerating trees from existing stumps of indigenous trees – combined with low-cost soil and water conservation techniques (ICRAF 2013). It promotes regeneration of degraded forest landscapes. Thus, it's a low-cost sustainable landscape restoration technique that aims to improve the productivity of agricultural lands while increasing tree cover and biodiversity. It does not require seedlings as planting materials, thus the trees are managed to regrow naturally from the tree stamps. Furthermore, it's applicable to all types of forest landscapes across the country. Thus, it can easily be adapted to the landscapes.

In Uganda FMNR has been promoted by International (e.g. the International Union for Conservation of Nature, World Agroforestry Centre) and local Non-Governmental Organizations through pilots to advance forest landscape restoration. The technology is applicable nationwide across the 7 forest landscapes and results in the generation of several timber forest and non-timber forest products that have a huge market potential at the local, sub-regional and national levels.

FMNR is easily understood, managed and maintained by the local farmers in the community. Besides, it promotes forest landscape restoration, which fits within the national priorities and commitments for instance the Bonn Challenge and the Nationally Determined Contributions for Uganda. In the medium terms it contributes to community climate change adaptations as the restored forest landscape contribute to food security, provision of firewood and regulation of the local community climate. Furthermore, it contributes towards increased water infiltration and slowing runoff flow, stabilizing and protecting stream banks within the forest landscapes.

Some of the economic and social attributes of FMNR include the following: Creation of jobs and or employment during maintenance and harvesting of timber and non-timber forest products. Creation of saving on public and private expenditure costs in respect to management of the trees/forests. This is largely because the trees grown regenerate naturally with minimum inputs in terms of fertilizers. It increases the income earned and inputs saved through improvements in the farm resource base and products for sale. Through increased yields, it provides significant savings for households on fire wood, forage and fertilizer purchase.

It promotes the conservation of the natural tree species, which are also associated with several attributes in respect to medicinal properties known to treat various ailments in community.

Table 64. Existing key policies and measures related to the forest sector's development and technology deployment in respect to climate change adaptation.

Name of Policy	When enacted	When revised	Main contents
Uganda Vision 2040 (NPA 2007)	2007	Not Applicable (N/A)	The Uganda Vision 2040 is, 'A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country within 30 years.' Besides, the Government commits to promote the development, adoption and equitable transfer of environmentally sound technologies and assist the population to internalize the full environmental and social cost of goods and services.
National Development Plan (NDP) III, 2020/21-2024/25 (NPA 2020)	2015	N/A	The goal for the NDP III is, 'Increased Household Incomes and Improved Quality of Life of Ugandans,' with the overall theme of, 'Sustainable Industrialization for inclusive growth, employment and sustainable wealth creation. Thus, one of the strategic objectives for the NDP III program on Innovation, Technology Development and Transfer is to, 'increase development, transfer and adoption of appropriate technologies and innovations.' Furthermore, the goal for the Natural Resources, Environment, Climate Change, Land and Water Management Programme of the National Development Plan III, 2020/21-2024/25 (NPA 2020). The goal of the programme is, 'to reduce environmental degradation and the adverse effects of climate change as well as improve utilisation of natural resources for sustainable economic growth and livelihood security.' One of the programme's key result in the forest sector is to increase land area covered by forests from 9.1 percent to 15 percent (NPA 2020).
National Adaptation Programmes of Actions (NAPA 2007)	2007	N/A	NAPAs provide a quick channel of communicating urgent and immediate adaptation needs of Least Developed Countries (LDCs) to the Conference of the Parties (COP) of United Nations Framework to Combat Climate Change. While the NAPAs are for LDCs, they provide an opportunity of learning by doing for the climate change process, which may be used by other developing countries. The Uganda NAPA, (2007) analysed the national circumstances in 2007 in terms of climate change impacts and related vulnerability in key sectors (such as: Forestry, Water, Agriculture, Wildlife, Health) and suggested responsive coping and priority intervention areas for advancing national adaptation to climate change impacts. The Uganda NAPA, 2007 identified 9 priority projects for investment and implementation towards national adaptation to climate change. The projects included the following: Community tree growing; Land degradation management; Strengthening metrological services; Community water and sanitation; Water for production; Drought adaptation; Vectors, Pests and Diseases control; Indigenous knowledge and Natural resources management; and Climate Change and development.

Name of Policy	When enacted	When revised	Main contents
Nationally Determined Contributions for Uganda (NDC 2016)	2016	2020 – ongoing	The priority actions under the priority sector of forest towards delivery of Uganda NDCs are: a) Promoting intensified and sustained forest restoration efforts (afforestation and reforestation programmes, including in urban areas); b) Promoting biodiversity & watershed conservation (including re-establishment of wildlife corridors); c) Encouraging agro-forestry; and d) Encouraging efficient biomass energy production and utilization technologies. Thus, the target is to reverse deforestation trend to increase forest cover to 21% in 2030, from approximately 14% in 2013, through forest protection, afforestation and sustainable biomass production measures.
Uganda National Climate Change Policy, (MWE 2015)	2015	N/A	The goal of the National Climate Change Policy, (2015) is, 'to ensure a harmonised and coordinated approach towards a climate resilient and low-carbon development path for sustainable development in Uganda' One of the common priorities of the policy as committed by the Government is, 'Promoting research and development, transfer and diffusion of technology through the use of appropriate information sharing, incentive schemes and support mechanisms, as relevant to the various sectors concerned' Thus, Technology development and transfer are crucial components in addressing climate change adaptation and mitigation challenges in different sectors. The policy emphasizes that Uganda also needs to pursue its own efforts to develop appropriate technologies to address climate change. The policy's priority under the forestry sector is, 'to ensure the sustainable management of forestry resources so that they can continue to provide global services, including mitigating climate change, while supporting the sustainable development needs of communities and the country.'
National Climate change Bill, 2020 (UPPC 2020).	2020	N/A	The objective of this Bill is to give the force of law in Uganda to the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement; to provide for climate change response measures; to provide for participation in climate change mechanisms; to provide for measuring of emissions, reporting and verification of information; to provide for institutional arrangements for coordinating and implementing climate change response measures; to provide for financing for climate change; and other related matters (UPPC 2020).
Climate change mainstreaming guidelines, (MWE 2014).	2014	N/A	The Climate change mainstreaming guidelines provide highlights of the approaches that can be used to mainstream climate change in sector plans and budget. They are designed to provide different sectors with approaches on how to: a) Carry out impact and vulnerability assessments; b) Identify opportunities and entry points for integration of climate change mitigation and adaptation measures; c) Propose options for integrating climate change adaptation and mitigation into the policy formulation process,

Name of Policy	When enacted	When revised	Main contents
			financing, implementation and evaluation at national, local and community levels; and d) Assist to improve resilience.
National Forestry Policy, (MWLE (2001)	2001	2020 – ongoing	The Vision of the National Forestry Policy is, 'a sufficiently forested, ecologically stable and economically prosperous Uganda.' The policy goal is, 'An integrated forest sector that achieves sustainable increases in the economic, social and environmental benefits from forests and trees by all the people of Uganda, especially the poor and vulnerable.'
National Reducing Emissions from Deforestation and Forest Degradation (REDD) + strategy for Uganda (MWE, 2017c).	2017	N/A	The Ministry of Water and Environment through the National REDD+ Secretariat initiated the processes for preparation of Uganda mechanisms for REDD + since 2010. The process involved active participation of all stakeholders at national and local levels and has recently resulted in the National REDD+ Strategy, which presents strategic options for addressing the key drivers of deforestation and degradation in Uganda (MWE, 2017b). The strategic options include the following Strategic option 1: climate smart Agriculture Strategic option 2: Sustainable forest wood and (commercial) charcoal production Strategic option 3: Large scale timber plantations Strategic option 4: Restoration of natural forests in the landscape Strategic option 5: Energy efficient cooking stoves Strategic option 6: Integrated wildfire management Strategic option 7: Livestock rearing in the cattle corridor Strategic option 8: Strengthening policy implementation of REDD+
Forest Landscape Restoration (FLR) Opportunities report (MWE 2016)	2016	N/A	In 2016, the Government of Uganda through the Ministry of Water and Environment, launched the Opportunities report for FLR in Uganda (MWE, 2016b). The report provides steps in the right direction in respect to understanding exactly where the opportunities for forest restoration and related appropriate interventions are in various landscapes. Thus, through assessment conducted, Uganda is categorized into 7 forest landscapes, including: Afro-motane; Karamoja; Northern moist; Southern rangeland; South East Lake Kyoga flood plain; Western mid-altitude; and Lake Victoria crescent. Hence, the Government of Uganda has prioritized FLR in the national development plans with the aim of restoring forest cover to 24% (1990 levels) and also support transition of the achievement of the committed Bonn challenge for restoration of 2.5 million hectares of degraded and deforested land through application of the FLR approach (MWE 2016). This revealed that that Uganda has a total of 8,079,622 hectares of land available for restoration, with the highest restoration opportunities being in the Northern moist, Karamoja and South West rangelands (MWE, 2016). The report underpins the following as key consideration in the strategies for advancing forest restoration across the forest landscapes: a) Afforestation (for sites

Name of Policy	When enacted	When revised	Main contents
			that have not been under forest for the last ten years), reforestation, agro forestry and natural regeneration (passive restoration) will be promoted; b) Natural regeneration will be considered suitable for restoration in the Karamoja landscape and western mid altitude whereas Riparian vegetation restoration/riverine buffer zoning was highly recommended by the stakeholders in the Lake Victoria crescent; and c) Indigenous tree species are preferred for restoration due to high ecological value while the exotic trees will be considered for their higher commercial value.
Forestry Investment Program (FIP 2017) (MWE 2017a)	2017	N/A	The FIP for Uganda is a cross-sectoral policy document at national level. Its goal is, 'A low carbon and climate resilient development in the land use.' This is in line with global objectives and the Climate Investment Fund- Forest Investment Program (CIF-FIP) target catalytic outcomes. The core objectives of the Uganda FIP are to reduce greenhouse gas emissions from deforestation and forest degradation, enhance forest carbon stocks and strengthen forestry governance. It also has co-benefit objectives including: (i) reducing poverty through improved quality of life of forest de-pendent indigenous peoples and local communities, (ii) reducing biodiversity loss and increasing resilience of forest ecosystems to climate variability and change, and (iii) improving governance of forestry resources.
Uganda National Forest Stewardship Standards (NFSS), (FSC, 2018)	2018	2018	The NFSS for Uganda is development by the Standards Development Group in Uganda (SDG-Uganda). This was endorsed in 2012 during a National Workshop, after consultations with a wide range of stakeholders in the forestry sector at national and sub-national levels. In the same meeting, Environmental Alert, a local non-governmental organization, was endorsed to serve as the Secretariat of the SDG-Uganda. The SDG was subsequently approved by Forest Stewardship Council (FSC) International and officially launched on 4th September 2012. A Final Draft of the NFSS, (2018) was endorsed by the SDG-Uganda was re-submitted to the FSC in March 2018 after integrating the comments by the FSC policy and standard committee for their approval. In terms of timeline we are optimistic that the standard will be approved and launched before end of 2018 in June. The standard takes into consideration the application of globally recognized Principles, Criteria and nationally relevant indicators. The principles (P) include: P1: Compliance with laws; P2: Workers' rights and employment conditions; P3: Indigenous peoples' rights; P4: Community relations; P5: Benefits from the forest; P6: Environmental values and impacts; P7: Management planning; P8: Monitoring and assessment; P9: High conservation values; P10: Implementation of management activities.

Name of Policy	When enacted	When revised	Main contents
Uganda National Green Growth Strategy, 2017/18-2030/2031 (NPA 2017)	2017	N/A	This was developed by the Government of Uganda through the National Planning Authority. It presents the stepwise approach for implementation of the principles of green growth as enshrined in the Sustainable Development Goals that are domesticated for implementation through the Uganda Vision 2040 and the National Development Plan II. The implementation of the strategy is commenced in the financial year 2017/18 and is on until 2030/2031. The strategy earmarks the following strategies for advancing Uganda development following green pathway: a) Sustainable agriculture production and value chains; b) Pursuit of Eco-tourism, agroforestry and other green practices aimed at restoring Uganda's forest and wetland covers; c) Implementation of planned climate change mitigation measures; d) Planned urbanization (green cities); e) Enhanced energy use efficiency and diversification to renewable energy at domestic, industrial and institutional levels; and f) Partnerships- Technology transfers and skills enhancement.
National Environment management Policy for Uganda (draft, 2017) (MWE 2017b).	2017	N/A	The vision of the National Environment management Policy for Uganda is, 'Mutual co-existence of human beings and their environment for sustainable development.' The overall policy goal is, 'to promote, maintain and improve environmental quality and resource productivity for socio economic transformation and sustainable development.'
National Environment Act, (UPPC, 2019)	2005	2019	The National Environment Act is an Act to repeal, replace and reform the law relating to environmental management in Uganda; to provide for the management of the environment for sustainable development; to continue the National Environment Management Authority as a coordinating, monitoring, regulatory and supervisory body for all activities relating to environment; to provide for emerging environmental issues including climate change, the management of hazardous chemicals and biodiversity offsets; to provide for strategic environmental assessment; to address environmental concerns arising out of petroleum activities and midstream operations, to provide for the management of plastics and plastic products; to establish the Environmental Protection Force; to provide for enhanced penalties for offences under the Act; to provide for procedural and administrative matters; and for related matters (UPPC 2019).
National Forest and Tree Planting Act, (UPPC 2003).			The National Forest and Tree Planting Act (2003) is an act that provides for the conservation, sustainable management and development of forests for the benefit of the people of Uganda; to provide for the declaration of forest reserves for purposes of protection and production of forests and forest produce; to provide for the sustainable use of forest resources and the enhancement of the productive capacity of forests; to provide for the promotion of tree planting; to consolidate the law relating to the forest sector and trade in forest produce; to establish a National Forestry Authority; to repeal the Forests Act, Cap. 246 and the Timber (Export) Act Cap. 247; and for related matters.

3.1.2.2 Ambition for the TAP

Whereas the FMNR technology can be implemented across all the 7 forest landscapes, it's important to consider a structured approach for investment for uptake of this technology based on criteria with the following practical key considerations: i) Existence of previous pilot engagements promoting FMMR; ii) Existence of development players in the landscape willing to support and invest in the technology; and iii) Based on the recommendations by the forest landscape restoration assessment report that natural regeneration is a possible option for landscape restoration (MWE 2016).

In this context, therefore, 3 forest landscapes are selected where the proposed/planned strategies for advancing the FMNR in the Technology action plan will be implemented as the direct entry points. These are: a) Afro-motane; b) Karamoja; and c) Northern moist.
However, other forest landscapes, where upscaling of the technology should be targeted include: a) Southern rangeland; b) South East Lake Kyoga flood plain; c) Western mid-altitude; and d) Lake Victoria crescent.

Furthermore, area wide interventions/ activities (e.g. targeted awareness should be prioritized) to promote the technology in all the 7 forest landscapes in terms of upscaling and out-scaling. Overall, the proposed planned intervention in the TAP will directly benefit at least 300,000 households (i.e. 1,800,000 people) directly, of which at-least 30% should be women and youth. Furthermore, the interventions are targeted at contributing towards restoration of 569,403 Ha across the selected forest landscapes. This is 20% of the available land available for restoration across the 7 forest landscapes in Uganda through FMNR (MWE 2016). The interventions will advance community climate change adaptation by contributing towards alternative livelihood opportunities for the beneficiaries in the respective landscape. Besides, they are in line with the forestry sector priority adaptation actions as committed in the Nationally Determined Contributions for Uganda and associated national forestry programs, policies and laws in respect to forest landscape restoration, biodiversity conservation and sustainable forest management. Furthermore, the proposed interventions in the TAP are inline and will directly contribute towards achievement of the goal for the Natural Resources, Environment, Climate Change, Land and Water Management Programme of the National Development Plan III, 2020/21-2024/25 (NPA 2020). The goal of the programme is, 'to reduce environmental degradation and the adverse effects of climate change as well as improve utilisation of natural resources for sustainable economic growth and livelihood security.' One of the programme's key result in the forest sector is to increase land area covered by forests from 9.1 percent to 15 percent (NPA 2020).

The proposed planned interventions as described in the Technology Action Plan will be implemented within a period of 10 years, through leadership and coordination of the Forest Sector Support Department. Other key institutions who will be involved in the implementation are: District Forest Services anchored within the Local Governments; National Forestry Authority (NFA); National Forestry Research Institute; Civil Society Organizations; and the Private and community forest owners.

3.1.2.3 Actions and Activities selected for inclusion in the TAP

Summary of barriers and measures to overcome barriers

The key identifued barriers and measures (as earlier documented in the barrier analyses and enabling environment report for the forestry sector), (Uganda BAEF Report, 2020), which must be addressed to deliver the described ambition (in Section 1.1) for transfer of the technology are presented in **Table 65.**

Table 65. Summary of barriers and measures to overcome barriers

Farmer Managed Natural Regeneration for forest landscape restoration		
Barrier category	**Critical barrier**	**Measure to address the barrier**
Financial	i) The main benefits of FMNR are realized in the medium term at least five to ten years after establishment; this means that farmers must be prepared to invest in their establishment and management during several years before the main benefits are generated.	▸ Promote enterprises with short term benefits with due consideration of preferences of men, women & youth for diversification with farmer managed natural regeneration. ▸ Provide incentives to support land restoration in the forest landscapes. ▸ Create targeted awareness to change community mindset/attitude in respect to short-term gains/ benefits.
Financial	ii) Limited land available for investment in forest restoration within the landscapes.	▸ Develop and implement land-use plans ▸ Provide incentives for land allocation for investment in landscape restoration through FMNR. Some of the incentives could be inform of small grants and or technical support for development of forest management plans.
Non-financial	iii) The bush burning and stray livestock destroy regenerated trees, especially in Northern Uganda, yet the ordinances and byelaws for regulation of wildfires are lacking or inadequately implemented.	▸ Enhance knowledge of the community (including men, women & youth) & other key stakeholders about impacts of bush burning and stray livestock. ▸ Provision of alternative livelihood options for the men and boys involved in the hunting ▸ Work with cultural institutions to change mindset, behavior and attitudes linked to bush burning and free-range grazing. ▸ Advance targeted mass awareness creation on unregulated bush burning ▸ Promoting alternative gender responsive technology for easing land clearing and opening for agricultural production e.g. use of tractors, oxen ploughs and minimum tillage. ▸ Provision of improved (e.g. drought resistant, early maturing) pastures as alternatives for grazing of livestock, especially during the dry season. ▸ Strengthen response for control & regulation of bush fires and stray livestock through implementation of bylaws/ordinances & integrated

Barrier category	Barrier category	Measure to address the barrier
		fire management. ▸ Update/review of outdated policies-laws – for discouraging bush burning
Non-financial	iv) Limited awareness and appreciation of the technology among policy and decision makers at the national, landscape and local levels.	▸ Increased publication of literature quantifying the social, economic & environmental benefits ▸ Increased targeted community awareness about the diverse benefits that arise from FMNR. ▸ Increased invested in targeted research, training and development in FMNR to contribute to livelihoods, landscape restoration. ▸ Support more champions for FMNR through establishment of demonstration sites/centres in the forest landscapes in the country. ▸ Conducting structured policy dialogues on FMNR with decision makers in forest landscapes.
Non-financial	v) Long-held beliefs by farmers that trees on farmland will attract pests and/or reduce yields, and so trees should be completely cleared.	▸ Increased publication of literature quantifying the social, economic & environmental benefits of the technology ▸ Targeted training of community & famers (including men, women & youth) to enhance their knowledge and skills for application of FMNR. ▸ Increased targeted community awareness (including men, women & youth) about the diverse benefits that arise from FMNR. ▸ Streamlining of priorities and communication from various Government development programs in agriculture, environment and natural resources management to avoid contradictions.
Non-financial	vi) FMNR falls outside the mainstream of agroforestry, agriculture and forestry sub-sectors, thus making it difficult to access structured support for up scaling, but also acceptance by the appropriate research communities	▸ Improved access to structured support (e.g. inputs, monitoring/backstopping for up scaling FMNR ▸ Strengthen extension within the forestry/ agriculture sectors to provide responsive advice to community and farmers (including women, youth & men) in respect to application of FMNR. ▸ Establishment of coordinated research agenda and teams to generate the required evidence for FMNR at different scales.
Non-financial	vii) Land tenure regimes especially the communal land tenure in Northern Uganda and West Nile regions where there are common property rights that compromise effective management and hence survival of the regenerating trees	▸ Advancing targeted community awareness creation on information on land policies and laws to guide sustainable land-use and management of communal land through FMNR involving men, women, youth and cultural institutions. ▸ Strengthen capacity of cultural/customary institutions to deliver on their roles in respect to administration/management of customary land.

Barrier category	Barrier category	Measure to address the barrier
		▸ Strengthen institutional capacity for area land committees in providing effective information on land rights & administration.
Non-financial	viii) Limited access, control of resources and decision making in respect to land use and management by women and youth	▸ Conduct structured engagements with cultural institutions to influence and change beliefs, attitude and customs that limit women's land ownership. ▸ Targeted community engagement (including men) to change their attitude for support of women's and youth's access & control of resources. ▸ Creating targeted awareness on women land rights as provided for in the existing policies and laws. ▸ Create opportunities for women's and youth's financial and leadership empowerment.

Actions selected for inclusion in the TAP

The key measures as selected actions for addressing the major barriers advancing adaptation in the forestry sector through FMNR, are derived from the BAEF report, (Uganda BAEF Report, 2020). These were prioritized based on the following key considerations during the key forestry stakeholder national validation workshop: a) Cost associated with the implementation the strategy/action/response; b) Acceptability and practicability; and c) Ongoing initiatives in support of implementation of the strategy/action/response for addressing the barriers for the prioritized technology. Thus, the most important measures for addressing the major barriers advancing adaptation in the forestry sector through FMNR as prioritized during the BAEF identification phase of the Technology Needs Assessment for the forestry sector include the following:

a) Improving access to inputs and services:

b) Targeted awareness creation about FMNR:

c) Strengthen policy implementation and enforcement:

d) Responsive/targeted institutional capacity building:

Hence, overall these were considered the most important measures by the key forestry sector stakeholders largely because these measures are cost effective, can easily be adapted given that they are acceptable and practical. Besides, they easily fit within the sector priorities in respect to climate change adaptation as derived from the ongoing initiatives in terms of policy reviews, program development and implementation.

Activities identified for implementation of selected actions

Each category of the measures for addressing the major barriers advancing adaptation in the forestry sector through FMNR, has identified

activities for implementation of the measures. These activities were identified through the problem and solution tree analyses during the BAEF phase II of the Technology Needs Assessment for the forestry sector. Besides, they were validated during key forestry stakeholder national validation workshop held on 16-17th March 2020 (Uganda BAEF Report, 2020). Thus, the key activities under each measure are presented as follows:

a) Improving access to inputs and services supporting application of FMNR:

- Provide incentives for land allocation and tree ownership for investment in landscape restoration through FMNR (private & state-owned forests):
- Provide land for private sector investment in FMNR
- Promote enterprises with short term benefits (based on preferences of various gender categories i.e. men, women & youth) for diversification with farmer managed natural regeneration. existing interactions – apiary, eco-tourism;
- Procurement and distribution of inputs for selected short term enterprises for diversification with FMNR
- Provide incentives to support land restoration. For instance, small grants and or technical support for development of forest management plans.
- Provide technical support for development of forest management plans for community forests.
- Provision of improved (e.g. drought resistant, early maturing) pastures as alternatives for grazing of livestock, especially during the dry season.
- Procurement and distribution of planting materials for improved pastures among the targeted beneficiaries.
- Promoting alternative gender responsive technology for easing land clearing and opening for agricultural production e.g. use of tractors, oxen ploughs and minimum tillage.
- Procurement and distribution of gender responsive technology for easing land clearing and opening for agricultural production (e.g. use of tractors, oxen ploughs and minimum tillage) among the targeted beneficiaries.
- Improved access to structured support (e.g. inputs, monitoring/backstopping) for up scaling FMNR.
- Conduct regular backstopping, monitoring and evaluation targeting the farmers and community stakeholders.

b) Targeted awareness creation about FMNR:

- Increased targeted awareness about the diverse and immediate benefits that arise from FMNR;
- Organize an awareness meeting targeting key stakeholders at the community level - involving at least 100 people;
- Organize an awareness meeting targeting key stakeholders at district level - involving at least 30 people;
- Organize an awareness meeting targeting key stakeholders at landscape level - involving at least 100 people;
- Organize an awareness meeting targeting key stakeholders at National level involving at least 60 people;
- Organize Interactive radio programs targeting stakeholders at the forest landscape level;
- Organize Interactive radio programs targeting stakeholders at the National level.
- Increased publication of literature quantifying the social, economic & environmental benefits of the FMNR technology:
- Conduct responsive research studies;
- Documentation and publication of the research studies.
- Work with cultural institutions and local

leadership to change mind-set, behavior and attitudes linked to bush burning & stray livestock grazing.
- Conduct awareness and dialogue meetings with cultural institutions with a target of changing mindset, behavior and attitudes linked to bush burning and stray livestock grazing.

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c) Strengthen policy implementation and enforcement to support application of FMNR:

- Update/review of outdated policies-laws – for discouraging bush burning & stray livestock grazing. Tree ownership/rights;
- Conduct a regulatory impact assessment for the policy;
- Conduct Stakeholder consultations at national and within forest landscapes;
- Organize meetings with Cabinet and Parliamentary committees.
- Conducting structured policy dialogues on FMNR with policy and decision makers within the forest landscapes;
- Conduct policy dialogues on FMNR with key policy and decision makers within the forest landscapes.
- Development and operationalization of land-use plans within the forest landscapes.
- Commission consult/expert to develop the plans;
- Conduct Stakeholder consultations for further inputs and validation meetings.
- Strengthen extension within the forestry/agriculture sectors to provide responsive advice to address community and farmer's (including women, youth & men) needs in respect to application of FMNR.
- Recruitment of forest extension staff at the sub-county level

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d) Responsive/targeted institutional capacity building for application of FMNR:

- Strengthen institutional capacity for area land committees in providing effective information on land rights & administration;
- Conduct a capacity needs assessments and development of responsive capacity building plan;
- Implementation of the capacity development plan.
- Strengthen capacity of cultural/ customary institutions to deliver on their roles in respect to administration/ management of customary land;
- Conduct a capacity needs assessments and development of responsive capacity building plan;
- Implementation of the capacity development plan.
- Targeted training of community & famers (including men, women & youth) to enhance their knowledge and skills for application of FMNR;
- Conduct a capacity needs assessments and development of responsive capacity building plan
- Implementation of the capacity development plan.
- Establishment of coordinated research agenda and teams to generate the required evidence for FMNR at different scales.
- Conduct a national stakeholder meeting to identify and agree on reasearch priority areas for FMNR.

3.1.2.4 Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The proposed planned interventions as described in the Technology Action Plan will be implemented within a period

of 10 years, through leadership and coordination of the Forest Sector Support Department. The key stakeholders who will be involved in the planning and implementation of the activities under the respective actions are presented as follows:

a) Improving access to inputs and services supporting application of FMNR:
National Forestry Authority (NFA); District Forest Services within the Local Governments; National Agricultural Advisory Services (NAADS); Forest Sector Support Department (FSSD) in the Ministry of Water and Environment (MWE); National Livestock Research Institute; Ministry of Agriculture, Animal Industries and Fisheries (MAAIF); and Civil Society Organizations (CSOs).

b) Targeted awareness creation about FMNR:
FSSD in the MWE; National Forestry Research Institute (NAFORRI); CSOs; and District Forest Services within the Local Governments.

c) Strengthen policy implementation and enforcement to support application of FMNR:
FSSD in the MWE; MAAIF; Ministry of Lands, Housing and Urban Development (MLHUD); District Forest Services within the Local Governments; and CSOs.

d) Responsive/targeted institutional capacity building for application of FMNR:
MLHUD; District Land Officer - Local Government; District Forest Services within the Local Government; NAFORRI; Uganda National Council for Science and Technology (UNCST); Ministry of Science and Technology (MoSTI); and CSOs.

Scheduling and sequencing of specific activities
The detailed activities for each of the actions, the associated responsible key stakeholders who will be involved in the planning and implementation; and the sequencing and timelines for implementation of each of the planned activity in the TAP is detailed in Table 67.

3.1.2.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs
The key capacity building needs for the key actors involved in the implementation of the TAP are largely technical knowledge and skills in preparation of the detailed concept notes/proposal targeting potential development and based on the proposal/concept formats as required by the development partner.

Estimations of costs of actions and activities
The estimated cost for the actions and activities of the TAP (see Table 67) were determined by building on the earlier based economic asssessment undertaken as part of the process for preparation of the Uganda BAEF Report, 2020. Besides, these were updated based on estimation of costs of inputs in the implementation of these actions and activities.

3.1.2.6 Management Planning
The contingency planning as the response for mitigation of the identified risks as described in **Table 66.** The actions in the contigency plan should be implemented along with the TAP.

Table 66. Risks and Contingency Planning

Risks	Contigency plan
a) The value of incentive may not matchthe benefits from the alternative strategies for land restoration	Document the additional benefits accrued through FMNR so that the land owners can appreciate and hence would consider incentives as additional benefits.
b) Dependence and attitude that Governments gives freebies.	Benefiting communities will be required to provide in-kind contributions
c) Inadequate access to forest extension services	The project will contribute towards delivery of forest extension services in the areas where project interventions will be implemented.
d) The direct beneficiaries could have different perceptions of the FMNR benefits. e) Research is usually not prioritized by the duty bearers i.e. Government policy makers and development partners. Thus, often research is underfunded.	Responsive, targeted and continuos awareness about the benefits of FMNR will be integrated in activities implementation. Targeted and structured engagements for prioritization of research by Government policy makers and development partners will be pursued.
f) Changing mindset and attitude take a long time, thus generations.	Targeted, responsive and continous awareness creation will be implemented.
g) Policy review and formulation takes longer period of time	Project activities implementation should also establish demostrations and illustrations to influence practices change among the community and other key actors.
h) High costs in cases of compensation for land re-allocated.	Cost of compensation will be covered by Government and not within the framework of the project.
i) Capacity building is continuous and the application of the knowledge and skills depends on the beneficiaries	Technical capacity will be created at the community and landscape level for provision of immediate response, guidance, trouble shooting, monitoring and evaluation.
j) The various key actors and players have different interest and priorities in respect to research.	Structured key actors, players and stakeholder's engagements will be persued at national level to develop a shared research agenda on FMNR.

Next Steps

For purposes of achieving a sharpened focus of the TAP in respect to mobilizing the required appropriate resources to advance implementation of the TAP, the following immediate and critical requirements, which will be pursued are described as follows:

a) Immediate requirements

A meeting will be held with key actors identified in the implementation of the TAP that have outstanding roles and responsibilities. The MoSTI will invite the stakeholders to the meeting through coordination by the UNCST. This meeting should engage key senior technical leads, possibly at the level of Directors and Commissioners levels. The following objectives will be achieved by the end of the meeting: To translate the TAP into a program concept note, which will be submitted to potential funding agencies/ development partners; To identify actions in the TAP, which can be integrated in the ongoing sector development plan and programs implementation; Identify issues, which require additional external resources and interrogate practical requirements for tapping into suggested financing opportunities and development partners in the TAP; To engage and bring aboard all the key stakeholders that are proposed in the implementation of the TAP for purposes of bringing them at the same page in respect to content in TAP, but also generation of further inputs and ideas into the concept note.

b) Critical requirements

Furthermore, critical requirements will be pursued with the top leadership of the respective Ministries, Departments and Authorities i.e. at the level of Permanent Secretaries and Executive Directors for further inputs, guidance and support. Thus, in this context therefore, the following will be pursued as critical requirements: Present and discuss the program concept note with top leadership in the Ministry for further inputs, guidance and support; Presentation of the program concept in the relevant sector working groups for approval; and Initiate structured engagement with the identified funding agencies and or development partners for further practical guidance on how to prepare the concept and proposal documents.

Table 67. FMNR for Forest Landscape Restoration Overview Table

TAP overview table

Sector	Water and Environment
Sub-sector	Forestry
Technology	FMNR for forest landscape restoration
Ambition	300,000 households in 3 forest landscapes
Benefits	Creates investment in forestry production inputs equipment and production transformation industry, improves local knowledge about the technology and increased income would increase school attendance, increases water infiltration and slows runoff flow, stabilizes and protects stream banks

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Improving access to inputs and services	Provide incentives for land allocation and tree ownership for investment in landscape restoration through FMNR	Government of Uganda (GOU), Development Partners	National Forestry Authority (NFA)	Year 1-3	The value of incentive may not match the benefits from the alternative strategies	75% of land prioritized/dedicated restored through FMNR	Land area prioritized/dedicated for FMNR	2,100
	Promote enterprises with short term benefits for diversification with farmer managed natural regeneration	Climate Change Adaptation Fund; GoU; Development Partners	(NAADs; MWE– Forest Sector Support Department (FSSD); and LG - Forestry Officer	Year 2-4		80% of population involved in FMNR benefits from enterprises with short term benefits	% of population involved in FMNR benefiting from enterprises with short term benefits	81,100
	Provide incentives to support land restoration.	Green Climate Funds; GoU; Development Partners	LG - Forestry Officer (DFO)	Year 2-6	Demand becomes dependent on incentives	At least 75% of beneficiaries receive incentives to apply FMNR	Number of incentives provided to support land restoration	81,100
	Provision of improved pastures as alternatives for grazing of livestock, especially during the dry season.	Climate Change Adaptation Fund; GoU; Development Partners	NAADs	Year 2-7	Dependence and attitude that Governments gives freebies.	80% of population involved in FMNR benefits from improved pastures	% of population involved in FMNR benefiting from improved pastures established as alternatives for grazing livestock during the dry season	72,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Promoting alternative gender responsive technology for easing land clearing and opening for agricultural production	GoU; World Bank, African Development Bank	LG ;MAAIF	Year 2-7	Dependence and attitude that Governments gives freebies.	>50% of population involved in FMNR benefiting from alternative technology to land clearing for agricultural production	% of population involved in FMNR benefiting from alternative gender responsive technology for easing land clearing and opening for agricultural production e.g. use of tractors, oxen ploughs and minimum tillage.	141,000
	Improved access to structured support for up scaling FMNR.	GoU, Development Partners	LG - DFO	Annually	Inadequate access to forest extension services	80% of those involved in FMNR accessing support for up scaling FMNR.	% of population involved in FMNR accessing structured support (e.g. inputs, monitoring/ backstopping) for up scaling FMNR.	8,400
2) Targeted awareness creation	Conduct targeted awareness about the diverse and immediate benefits that arise from FMNR.	Climate Change Adaptation Fund; GoU; Development Partners	MWE – FSSD; LG – DFO; Civil Society Organizations (CSOs)	Year 1-8	Beneficiaries could have different perceptions of FMNR benefits.	At least 10 awareness engagements on benefits from FMNR conducted.	Number of targeted awareness engagements in respect to diverse and immediate benefits that arise from FMNR conducted.	174,000
	Publish literature quantifying the social, economic & environmental benefits of the FMNR technology	Climate Change Adaptation Fund; GoU; Development Partners	NaFORRI; Academic Institutions e.g. Makerere University; CSOs	Year 3-10	Research is usually not prioritized by the duty bearers - policy makers & development partners. Thus, often research is underfunded.	At least 10 documents on the quantification of the social, economic & environmental benefits of the FMNR technology published.	Number of publications on the quantification of the social, economic & environmental benefits of the FMNR technology	13,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	c) Work with cultural institutions and local leadership	Climate Change Adaptation Fund; GoU; Development Partners	Ministry of Local Government – DFO, Agricultural officer (DAO) ; CSOs	Year 1-5	Changing mindset and attitude takes a long time, thus generations.	100 % of cultural institutions worked with changing community mind-set, on bush burning & stray livestock grazing.	Number of cultural institutions engaged targeted at changing the mind-set, behavior and attitudes linked to bush burning & stray livestock grazing.	6,100
3) Strengthen policy implementation and enforcement	Update/review outdated policies-laws	Government of Uganda, Development Partners	MWE – FSSD; MAAIF-Directorates of Animal and Crop Resources.	Year 2-5	Policy review and formulation takes longer period of time	At least 5 policies/ laws on bush burning and stray livestock grazing.	Number of policies/ legislations reviewed to come up with strategies for discouraging bush burning & stray livestock grazing.	27,000
	b) Conduct structured policy dialogues on FMNR with policy and decision makers within the forest landscapes.	National Civil Society; Development Partners	National Civil Society Organizations,	Year 3-7		At least 10 structured policy dialogues on FMNR with policy and decision makers within the forest landscapes conducted.	Number of structured policy dialogues on FMNR with policy and decision makers within the forest landscapes conducted.	22,000
	c) Development and operationalization of land-use plans within the forest landscapes.	Climate Change Adaptation Fund; GoU; Development Partners,	MLHUD- and MWE – FSSD	Year 3-10	High costs in cases of compensation for land re-allocated.	At least 5 land-use plans developed and operationalized in forest landscapes.	Number of land-use plans developed and operationalized within the forest landscapes.	25,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	d) Strengthen extension within the forestry/ agriculture sectors to provide responsive advice to on FMNR.	Government of Uganda, Development Partners	FSSD, MWE; and LG -Environment & Natural resources and Production departments.	Year 1-10	Inadequate forest extension services	80% of community members involved in FMNR access agriculture and forestry extension services supporting FMNR.	Number of community members and farmers (including women, youth & men) that are accessing agriculture and forestry extension services from the Local Government in respect to application of FMNR.	9,000
4) Responsive/ targeted institutional capacity building	Build institutional capacity for area land committees	GoU, Development Partners	MLHUD; LG - District Lands Officer; CSOs	Year 3-5	Capacity building is continuous and the application of the acquired knowledge and skills depends on beneficiaries	100 % of area land committees benefited from capacity building providing information on land rights & administration	Number of area land committees which have benefited from institutional capacity building for purposes of providing effective information on land rights & administration.	47,400
	Strengthen capacity of cultural/customary institutions	Government of Uganda, Development Partners	MLHUD; and Local Government - District Land Officer;	Year 3-5	Capacity building is continuous and the application of the acquired knowledge and skills depends on beneficiaries	100 % of cultural/ customary institutions benefited from capacity building effectively deliver in administration of customary land.	Number of cultural/ customary institutions which have benefited from institutional capacity building for purposes of effective delivery of their roles in respect to administration/ management of customary land.	47,400

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Targeted training of community & famers to enhance their knowledge and skills for application of FMNR.	Green Climate Funds; Government of Uganda; Development Partners	LG - District Forestry Officer; and CSOs,	Year 3-5	Capacity building is continuous and the application of knowledge and skills depends on beneficiaries	At least 50% of farmers trained applying the FMNR knowledge & skills.	Number of trainings conducted targeting community & famers (including men, women & youth) to enhance their knowledge and skills for application of FMNR.	47,400
	d) Establishment of coordinated research agenda and teams to generate the required evidence for FMNR at different scales.	Climate Change Adaptation Fund; Government of Uganda; Development Partners	UNCST; MoSTI; NaFORRI, CSOs,	Year 2 - 3	Various actors and players have different interest and priorities in research.	A research agenda and evidence for FMNR at different scales generated.	Number of research coordination engagements conducted for purposes of generation of research agenda and evidence for FMNR at different scales.	8.000
Total								812,000
Administration & Management (15% of the total budget)								121,800
Grand Total								933,800

3.1.3 Action Plan for Integrated pest management (IPM) in natural forests and forest plantations

3.1.3.1 Introduction

IPM involves application of integrated approaches, which complement each other for effective pests and diseases management and control. IPM technologies have been widely applied in agricultural farming systems and have been reported to be plausible. Likewise, these have been applied in forestry. Pimentel (1986) described integrated pest and diseases management as a control method that includes judicious use of pesticide and non-chemical technologies – all of which are based on sound ecological principles.

It consists of two basic elements including: a decision and action process. The actions/responses for pest/diseases management/control may consist of one or more ecologically, economically and socially acceptable tactics designed to reduce pest populations to non-damaging levels (Ciesla 1982). IPM in forest plantations in Uganda is promoted by both Government and Private Institutions. The responsible Government Institutions for the research and development of plausible integrated pests and diseases management techniques in forestry include: National Forest Resources Research Institute – NARO and Makerere University School of Forestry, Environmental and Geographical Sciences, College of Agricultural and Environmental Sciences (CAES).

On the other hand, the private sector institutions responsible for promoting the application of the integrated pest and disease management techniques in forest plantations are by large the Uganda Timber Growers Association (UTGA), community and private forest owners. IPM is cheap and cost effective. It promotes biodiversity conservation and allows for ecosystem balance, especially in cases where biological control measures are applied. The technology has been applied and adapted to the local conditions. It has a national wide potential, thus, it's applicable across the 7 forest landscapes in the country and in both natural and plantation forests. The various actors who are applying the technology at different scales, include: National Forest Authority, Uganda Wildlife Authority, Community Forest Association and, Private commercial forest companies. Some of the economic and social attributes of IPM include the following: Creation of jobs in application of the technology through provision of both skilled and unskilled labor. Furthermore, through the supply of pesticides. It creates investment in forestry through provision of the inputs required in IPM and related supportive equipment to support application of the technology. IPM can reduce public expenditure on pesticides, especially in cases were cultural and biological control measures are applied. There is increased income from sale of forest products that have been protected from attack and destruction by pests and diseases. The technology can be associated with health implications especially when chemicals are being applied. Therefore, it's important for the workers applying to have protective gear and also follow the industrial prescriptions for proper and effective application, but also take precautionary measures.

1.1.3.2 Ambition for the TAP

Whereas the technology can be implemented across all the 7 forest landscapes, it's important to consider

a structured approach for investment for uptake of this technology based on criteria with the following practical key considerations:
a) Extent of proliferation of climate change induced pests and diseases attacking trees and forest in the forest landscape;

b) Existence of previous pilot engagements promoting integrated pest management in the forest landscape; and

c) Existence of development players in the landscape willing to support and invest in the technology.

The proposed interventions will target the various forest tenures (i.e. central forest reserves, local forest reserves, private and community forests) and the associated stakeholders and actors. Notable is that the implementation of the proposed interventions will consider a pilot/incubation/demonstration approach for the Integrated Pest Management technology, largely because the technology is not yet fully developed and applied in Uganda across the forest landscapes. Overall, the proposed planned intervention in the TAP will directly benefit 400,000 households (i.e. 1,400,000 people) directly, of which at-least 30% should be women and youth. Furthermore, the interventions are targeted at having 365,956 Ha of forests across the 7 forest landscapes under integrated pest management technology. This is 20% of the total land covered by forests under the various forest tenures in Uganda (MWE 2016$_b$).

The interventions will advance community climate change adaptation by contributing towards alternative livelihood opportunities for the beneficiaries in the respective landscape. Besides, they are in line with the forestry sector priority adaptation actions as committed in the Nationally Determined Contributions for Uganda and associated national forestry programs, policies and laws in respect to forest landscape restoration, biodiversity conservation and sustainable forest management.

The proposed planned interventions as described in the Technology Action Plan will be implemented within a period of 10 years, through leadership and coordination of the Forest Sector Support Department. Other key institutions who will be involved in the implementation are: National Forest Resources Research Institute; Makerere University School of Forestry, Environmental and Geographical Sciences; the District Forest Services/Local Governments; Uganda Wildlife Authority; Civil Society Organizations; and the Private and community forest owners.

3.1.3.3 Actions and Activities selected for inclusion in the TAP

Summary of barriers and measures to overcome barriers
The key identifued barriers and measures (as earlier documented in the barrier analyses and enabling environment report for the forestry sector), (Uganda BAEF Report, 2020), which must be addressed to deliver the described ambition (in Section 1.1) for transfer of the technology are presented in **Table 68.**

Table 68. Summary of barriers and measures to overcome barriers.

Barrier category	Barrier category	Measure to address the barrier
Financial	i) The chemical pesticides are expensive and may not be affordable for smallholders.	Measure to address the barrier ▸ Advance access to chemical pesticides by community and smallholders – including men, women and youth. ▸ Strengthen institutional organization of smallholders to access chemical pesticides ▸ Advocate for reduction of taxes and levies charged by Government on the pesticides. ▸ Strengthen regulation and enforcement of standards for especially chemical pesticides. ▸ Promote local investment into the manufacture of the chemical pesticides.
Non-financial	ii) Existence of counterfeit especially the chemical pesticides on the market, which are not effective in the control and treatment of the pests and diseases.	▸ Strengthen enforcement and regulation of standards for chemical pesticides at all levels. ▸ Strengthen institutional organization and capacity of consumers to demand for chemical pesticides that meet the acceptable standards and quality. ▸ Review policies to include strong penalties or deterrent measures to discourage providers of pesticides that do not meet quality and safety standards.
Non-financial	iii) Inadequate knowledge and application of the IPM especially among the private individual commercial tree growers.	▸ Strengthen forestry extension system, to provide the required adequate support services to farmers and communities - including men, women and youth. ▸ Improve access to information about Integrated Pest Management and its application by smallholder farmers including men, women and youth. ▸ Document targeted simplified Information, Education & Communication materials on application of Integrated Pest Management. ▸ Promote targeted awareness and information of the farmers (including men, women and youth) about Integrated Pest Management to influence attitude and practice for effective application of IPM. ▸ Provide adequate training in Integrated Pest Management techniques – especially among smallholders - including men, women and youth.
Non-financial	iv) Non-uniformity in pest infestation, thus emerging at different stages of the tree cycle, they evolve over time, some IPM technologies are divisible and rarely do complete 'packages' exist for an entire crop or ecosystem.	▸ Strengthen adaptation to Climate variability and change in forest plantations and the landscape through for instance, applying responsive agronomic & pest management practices; planting proven resistant tree varieties. ▸ Increase investment in research to develop responsive IPM solutions.

Barrier category	Barrier category	Measure to address the barrier
		▸ Strengthen monitoring and surveillance of pests and diseases.
Non-financial	v) Limited access, control of resources and decision making in respect to land use by women and youth	▸ Conduct structured engagements with cultural institutions to influence and change beliefs, attitude and customs that limit women and youth' access to and ownership of land. ▸ Conduct targeted community engagement (including men) to change their attitude for support of women's and youth's access and control of resources. ▸ Create targeted awareness on women land rights as provided for in the existing policies and laws. ▸ Create opportunities for women and youths' financial empowerment

Actions selected for inclusion in the TAP

The key measures as selected actions for addressing the major barriers advancing adaptation in the forestry sector through IPM, are derived from the BAEF report, (Uganda BAEF Report, 2020). These were prioritized based on the following key considerations during the key forestry stakeholder national validation workshop: i) Cost associated with the implementation the strategy/action/response; ii) Acceptability and practicability; and iii) Ongoing initiatives in support of implementation of the strategy/action/response for addressing the barriers for the prioritized technology. Thus, the most important measures for addressing the major barriers advancing adaptation in the forestry sector through FMNR as prioritized during the BAEF identification phase of the Technology Needs Assessment for the forestry sector include the following:
a) Improving access to inputs and services:
b) Targeted awareness creation about IPM:
c) Responsive/targeted institutional capacity building:
d) Strengthen policy implementation and enforcement:

Hence, overall these were considered the most important measures by the key forestry sector stakeholders largely because these measures are cost effective, can easily be adapted given that they are acceptable and practical. Besides, they easily fit within the sector priorities in respect to climate change adaptation as derived from the ongoing initiatives in terms of policy reviews, program development and implementation.

Activities identified for implementation of selected actions

Each category of the measures for addressing the major barriers advancing adaptation in the forestry sector through IPM in natural and plantation forests, has identied activies for implementation of the measures. These activities were identified through the problem

and solution tree analyses during the BAEF phase II of the Technology Needs Assessment for the forestry sector. Besides, they were validated during key forestry stakeholder national validation workshop held on 16-17th March 2021 (Uganda BAEF Report, 2020). Thus, the key activities under each measure are presented as follows:

a) Improving access to inputs and services:

- Advance access to chemical pesticides by community and smallholders – including men, women and youth;
- Support private sector to establish shops for chemical pesticides at community level;
- Organize the smallholder farmers to buy the chemical pesticides in bulk.
- Improve access to information about IPM and its application by farmers – including men, women & youth;
- Conduct interactive radio programs for information and awareness creation;
- Documentation and dissemination of Information, Education and Communication (IEC) materials.

b) Targeted awareness creation about IPM:

- Promote targeted awareness and information about IPM to influence attitude and practice.
- Organize an awareness meeting targeting key stakeholders at community level - involving at least 100 people;
- Organize an awareness meeting targeting key stakeholders at district level - involving at least 30 people;
- Organize an awareness meeting targeting key stakeholders at landscape level - involving at least 100 people;
- Organize an awareness meeting targeting key stakeholders at National level involving at least 60 people;
- Organize Interactive radio programs targeting stakeholders at the forest landscape level;
- Organize Interactive radio programs targeting stakeholders at the National level.

c) Responsive/targeted institutional capacity building:

- Strengthen institutional organization of smallholders (including men, women & youth) to access chemical pesticides;
- Conduct a capacity needs assessments and development of responsive capacity building plan;
oImplementation of the capacity development plan
- Strengthen the forestry extension services at the Local Government levels for effective service delivery to farmers and communities:
- Recruitment of forest extension officers at the district and sub county levels
- Provide adequate training in IPM techniques and their application – especially among smallholders – including men, women & youth:
- Conduct a capacity needs assessments and development of responsive capacity building plan;
oImplementation of the capacity development plan.
- Strengthen regular monitoring and surveillance of pests and diseases.
- Conduct regular backstopping, monitoring and evaluation targeting the farmers and community stakeholders in the forest landscapes

d) Strengthen policy implementation and enforcement:

- Advocate for reduction of taxes and levies charged by Government on the pesticides;
- Conduct studies on taxation to generate policy briefs with recommendations on

reduction on taxes and levies.
- Conduct policy dialogues to influence decisions on taxes and levies.
- Strengthen adaptation to climate variability and change in natural forests and plantations in the landscape through for instance, applying responsive agronomic & pest management practices; planting proven resistant tree varieties;
- Conduct targeted trainings on climate change adaptation;
- Procurement and distribution of seedlings of disease resistant varieties.
- Increase investment in research to develop responsive IPM solutions;
- Development of the research strategy and agenda with priorities on IPM;
- Conduct policy dialogues with key policy and decision makers.

3.1.3.4 Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The proposed planned interventions as described in the Technology Action Plan will be implemented within a period of 10 years, through leadership and coordination of the FSSD. The key stakeholders who will be involved in the planning and implementation of the activities under the respective actions are presented as follows:
a) Improving access to inputs and services supporting application of IPM:
Private sector – Uganda Timber Growers Association; NaFORRI; National Forestry Authority; CSOs; and District Forest Services within the Local Governments.

b) Responsive/targeted institutional capacity building for application of IPM
FSSD in the MWE; National Forestry Authority; Private sector – Uganda Timber Growers Association; NaFORRI; CSOs; District Forest Services within the Local Governments; UNCT Uganda Industrial Research Institute; MoSTI; MAAIF; and Makerere University – College of Agriculture and Environmental Sciences;

c) Targeted awareness creation about IPM: NaFORRI); Makerere University - College of Agriculture and Environmental Sciences; Private sector – UTGA; and CSOs.
Scheduling and sequencing of specific activities
The detailed activities for each of the actions, the associated responsible key stakeholders who will be involved in the planning and implementation; and the sequencing and timelines for implementation of each of the planned activity in the TAP is detailed in Table 70.

3.1.3.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

The key capacity building needs for the key actors involved in the implementation of the TAP are largely technical knowledge and skills in preparation of the detailed concept notes/ proposal targeting potential development and based on the proposal formats as required by the development partner.

Estimations of costs of actions and activities

The estimated cost for the actions and activities of the TAP (see Table 70) were determined by building on the earlier based economic asssessment undertaken as part of the process for preparation of the Uganda BAEF Report, 2020. Besides, these were updated based on estimation of costs of inputs in the implementation of these actions and activities.

3.1.3.6 Management Planning

The contingency planning as the response for mitigation of the identified risks as described in **Table 69.** The actions in the contigency plan should be implemented along with the TAP.

Table 69. Risks and Contingency Planning

Risks	Contigency plan
a) Inappropriate use and application of the chemicals has health, safety and environmental impacts.	The responsive, targeted and practical training and awareness creation on appropriate use and appplication of chemicals will be conducted to ensure health and safety of the users and the public and also reduce associated impacts on the environment.
b) Information can be distorted and misinterpreted.	Preparation and publication of simplified information, education and communication materials on IPM targeting the farmers and community.
c) Poor attitudes of the different targets in respect to use and application of IPM	Conduct responsive, targeted and continuous awareness creation in respect to benefits from application of IPM.
d) Capacity building is a continuous engagement and the application of the acquired knowledge and skills is largely dependent on the beneficiaries	Technical capacity will be created at the community and landscape level for provision of immediate response, guidance, trouble shooting, monitoring and evalutaion and technical backstopping for beneficairies.
e) Inadequate access to forest extension services	The project will contribute towards delivery of forest extension services in the areas where project interventions will be implemented.
f) Research is usually not prioritized by the duty bearers i.e. Government policy makers and development partners. Thus, often research is underfunded.	Targeted and structured engagements for prioritization of research by Government policy makers and development partners will be pursued.
g) Changing mindset and attitude take a long time, thus generations.	Targeted, responsive and continous awareness creation will be implemented through from inception upto the end.
h) Policy review and formulation takes longer period of time	Project activities implementation should also establish demostrations and illustrations to influence practices change among the community and other key actors.
i) The development partners interests could be different.	Structured engagements will be pursued with the development partners and other key stakeholder to solicit their support for investment in IPM reasearch.
j) Government is interested in generation of revenue through taxation. Thus, potential resistance from taxation authorities.	This will not be pursued as a priority action in the implementation of the TAP, given the potential resistance from Government.
k) Climate uncertainty in terms of variability.	Responsive actions will be implemnted within the TAP for strenthening community based adapation to climate change and variability impacts.

Next Steps

For purposes of achieving a sharpened focus of the TAP in respect to mobilizing the required appropriate resources to advance implementation of the TAP, the following immediate and critical requirements, which will be pursued are described as follows:

a) Immediate requirements
A meeting will be held with key actors identified in the implementation of the TAP that have outstanding roles and responsibilities. The MoSTI will invite the stakeholders to the meeting through coordination by the UNCST. This meeting should engage key senior technical leads, possibly at the level of Directors and Commissioners levels. The following objectives will be achieved by the end of the meeting: to translate the TAP into a program concept note, which will be submitted to potential funding agencies/development partners; to identify actions in the TAP, which can be integrated in the ongoing sector development plan and programs implementation; Identify issues, which require additional external resources and interrogate practical requirements for tapping into suggested financing opportunities and development partners in the TAP; to engage and bring aboard all the key stakeholders that are proposed in the implementation of the TAP for purposes of bringing them at the same page in respect to content in TAP, but also generation of further inputs and ideas into the concept note.

b) Critical requirements
Furthermore, critical requirements will be pursued with the top leadership of the respective Ministries, Departments and Authorities i.e. at the level of Permanent Secretaries and Executive Directors for further inputs, guidance and support. Thus, in this context therefore, the following will be pursued as critical requirements: Present and discuss the program concept note with top leadership in the Ministry for further inputs, guidance and support; Presentation of the program concept in the relevant sector working groups for approval; Initiate structured engagement with the identified funding agencies and or development partners for further practical guidance on how to prepare the concept and proposal documents.

Table 70. Integrated Pest Management (IPM) technology overview table.
TAP overview table

Sector	Water and Environment
Sub-sector	Forestry
Technology	IPM in natural forests and forest plantations
Ambition	300,000 households in 3 forest landscapes
Benefits	Creation of jobs in application of the technology through provision of both skilled and unskilled labor. Furthermore, through the supply of pesticides, increases income from sale of forest products that have been protected from attack and destruction by pests and diseases, it promotes biodiversity conservation for both flora and fauna;

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Improving access to inputs and services	Advance access to chemical pesticides by community and smallholders.	Private sector	Private sector	Year 1-10	Inappropriate use and application of the chemicals has health, safety and environmental impacts.	At least 50% of smallholders (i.e. including men, women and youth) accessing chemical pesticides.	Number of smallholders (i.e. including men, women and youth) accessing chemical pesticides	43,200
	Improve access to information about IPM and its application by farmers	Global Environment Facility; Development Partners	NaFORRI; NFA; NEMA; Makerere University; CSOs; UTGA	Year 1-10	Information can be distorted and misinterpreted.	At least 50% of smallholders (i.e. including men, women and youth) accessing information on IPM.	Number of smallholders (i.e. including men, women and youth) accessing information on IPM.	69,000
Responsive/ targeted institutional capacity building	Strengthen institutional organization of smallholders (including men, women & youth) to access chemical pesticides.	Global Environment Facility; Development Partners	MWE – FSSD; UTGA; LG - DFO	Year 3-8	Poor attitudes of the different targets in respect to use and application of IPM	>50% of the smallholder's farmer organizations trained are accessing chemical pesticides	Number of smallholders (i.e. including men, women and youth) farmers organizations trained on aspects of institutional organization and are accessing chemical pesticides	47,400

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	b) Strengthen the forestry extension services at the Local Government levels for effective service delivery to farmers and communities.	Government of Uganda, Development Partners	MWE – FSSD; LG – Environment and natural resources department,	Year 1-10	Capacity building is a continuous engagement and the application of the acquired knowledge and skills is largely dependent on the beneficiaries	At least 50% of farmers and community members accessing forest extension services from the Local Government.	Number of farmers and community accessing forest extension services from the Local Government	9,000
	c) Provide adequate training in IPM techniques and their application among smallholders – including men, women & youth.	Global Environment Facility; Development Partners	NaFORRI; NFA; UTGA; LGs – Environment and Natural Resources Department; CSOs; National Environment Management Authority,	Year 3-5	Inadequate access to forest extension services	At least 50% farmers trained applying knowledge & skills on IPM	Number of smallholder farmers training in IPM techniques and their application	47,400
	d) Strengthen regular monitoring and surveillance of pests and diseases.	Government of Uganda, Development Partners	MWE – FSSD; MAAIF; NaFORRI; NFA;	Year 1-10	Inadequate forest extension services	At least 20 regular pests and diseases monitoring, surveillance and evaluation engagements conducted.	Number of regular pests and diseases monitoring, surveillance and evaluation engagements conducted.	8,400
Targeted awareness creation	a) Promote targeted awareness and information about IPM to influence attitude and practice.	Global Environment Facility; Development Partners	NEMA; NaFORRI; NFA; Makerere University; UTGA; CSOs; LG – ENRD.	Year 1-10	Changing mindset and attitude takes a long time, thus generations.	At least 10 targeted awareness creation and information sharing events conducted.	Number of targeted awareness creation and information sharing events conducted.	174,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
4) Strengthen policy implementation and enforcement;	a) Advocate for reduction of taxes and levies charged by Government on the pesticides.	National Civil Society Organizations and International Non-Governmental Organization; Development Partners	CSOs; UTGA; NFA	Year 3-5	Government is interested in generation of revenue through taxation. Thus, potential resistance from taxation authorities.	At least 4 engagements targeted at Advocate for reduction of taxes and levies charged by Government on the pesticides.	Number of engagements targeted at Advocate for reduction of taxes and levies charged by Government on the pesticides.	34,400
	b) Strengthen adaptation to Climate variability and change in forest plantations and the landscape.	Climate Change Adaptation Fund; Government of Uganda; Development Partners	NaFORRI; NFA; UTGA; LG – Environment and Natural Resources Department; CSOs;	Year 2-8	Climate uncertainty in terms of variability	At least 10 climate change adaptation actions, technologies implemented in the natural and plantations forests within the landscape.	Number of climate change adaptation actions, technologies implemented in the natural and plantations forests within the landscape.	122,000
	c) Increase investment in research to develop responsive IPM solutions.	Government of Uganda, Development Partners	MWE – FSSD; MAAIF; NaFORRI; NFA;	Year 1-10	The development partners interests could be different.	At least a 5% increase of research funds invested in research to develop responsive IPM solutions.	Proportion of funds allocated to research towards development of responsive IPM solutions	36,000
	Total							**590,800**
	Administration & Management (15% of the total budget)							**88,600**
	Grand Total							**679,400**

3.1.4 Action Plan for Promoting Forest Based Enterprises

3.1.4.1 Introduction

Forest based enterprises is community-based technology that is established within the buffer zones and the protected forests, so long as it has minimum negative impacts on the forest in terms of degradation. Thus, overall the selected enterprises must be promoting forest restoration and conservation and at the same time improving the livelihoods of the forest adjacent communities through income generation and food security. The technology is largely managed by the forest adjacent communities after they are equipped with the requisite knowledge and skills to manage the enterprises efficiently and effective. Forest based enterprises allow generation of multiple forest products, thus some short and medium terms – especially those from the forest-based enterprises. It provides the directly dependent forest adjacent communities with alternative income and livelihood opportunities, thereby reducing over dependency on the forest resources, hence encroachment on the forest.

In Uganda over the years since the forestry reforms in 2001-2003, various forest responsible bodies have promoted forest-based enterprises. Some of these are enlisted as follows: National Forestry Authority – has promoted the enterprises in collaboration with the civil society (both local and international) and local governments. This is within the framework and guidelines of collaborative forest management targeting forest adjacent communities living near the central forest reserves. The Uganda Wildlife Authority has promoted the forest-based enterprises targeting communities living adjacent to the national parks in various parts of the country. Commercial Tree Companies, Private tree growers/members of the UTGA have promoted forest-based enterprises within the forest plantation and also targeting participation of the surrounding communities.

Forest based enterprises are well understood by local farmers and the forest adjacent communities. Often, there exist farmers associations/ cooperatives which can reduce initial investment costs by sharing the cost of seedling production. Besides, the maintenance of the enterprises can be done by beneficiaries themselves, thus reducing the overall maintenance costs. Hence forth, forest-based enterprises are applicable nationwide across the 7 forest landscapes and result in the generation of several timber forest and non-timber forest products that have a huge market potential at the local, sub-regional and national levels.

Some of the economic and social attributes of FBEs include the following: Creation of jobs in seedling preparation, land preparation, plantation, maintenance, harvesting and marketing of products from the forest-based enterprises; Creation of investment in inputs, equipment required for establishment of the various enterprises – apiary, ecotourism, fruit trees. Additional investment is in training for generation of specialized skilled labor for effective and efficient management of the enterprises along the value chain i.e. from production, harvesting, storage, packaging and marketing. Besides, the technology can reduce public and private expenditures in respect to monitoring and surveillance around the forests, because this becomes a shared role between the responsible body and the

beneficiary community. The products (e.g. honey, fruits, mushrooms,) from some of the selected enterprises have positive impact on the nutrition and health in the community when consumed as part of the diet.

3.1.4.2 Ambition for the TAP

Whereas the technology can be implemented across all the 7 forest landscapes, it's important to consider a structured approach for investment for uptake of this technology based on criteria with the following practical key considerations: i) Existence of previous pilot engagements promoting FBEs; ii) Presence of CFM groups who have signed agreements with the duty bearers to advance forest-based enterprises within the central forest reserves and the landscape; iii) Existence of development players in the landscape willing to support and invest in the technology; iv) The size and extent of degradation deforestation of the major forest reserves in the forest landscape; and v) Based on the recommendations by the forest landscape restoration assessment report that natural regeneration is a possible option for landscape restoration (MWE 2016).

In this context, therefore, 7 forest landscapes are selected where the proposed/planned strategies for advancing the FBE in the Technology action plan will be implemented as the direct entry points. These are: a) South East Lake Kyoga flood plain; b) Afro-montane; c) Southern rangeland; d) Northern moist; e) Karamoja; f) Lake Victoria crescent; and g) Western mid-altitude.

Overall, the proposed planned intervention in the TAP will benefit 200,000 households (i.e. 1,200,000 people) directly, of which at-least 30% should be women and youth. Furthermore, the interventions are targeted at contributing towards restoration of 838,740 Ha across the selected forest landscapes. This is 20% of the available land available for restoration across the 7 forest landscapes in Uganda through agroforestry (MWE 2016). The interventions will advance community climate change adaptation by contributing towards alternative livelihood opportunities for the beneficiaries in the respective landscape. Besides, they are in line with the forestry sector priority adaptation actions as committed in the Nationally Determined Contributions for Uganda and associated national forestry programs, policies and laws in respect to forest landscape restoration, biodiversity conservation and sustainable forest management. Furthermore, the proposed interventions in the TAP are inline and will directly contribute towards achievement of the goal for the Natural Resources, Environment, Climate Change, Land and Water Management Programme of the National Development Plan III, 2020/21-2024/25 (NPA 2020). The goal of the programme is, 'to reduce environmental degradation and the adverse effects of climate change as well as improve utilisation of natural resources for sustainable economic growth and livelihood security.' One of the programme's key results in the forest sector is to increase land area covered by forests from 9.1 percent to 15 percent (NPA 2020).

The proposed planned interventions as described in the Technology Action Plan will be implemented within a period of 10 years, through leadership and coordination of the National Forestry Authority. Other key institutions who will be involved in the implementation are: District Forest Services/Local Governments; Uganda Wildlife Authority;

National Forestry Research Institute; Civil Society Organizations; and the Private and community forest owners.

3.1.4.3 Actions and Activities selected for inclusion in the TAP

The key identified barriers and measures (as earlier documented in the barrier analyses and enabling environment report for the forestry sector, (Uganda BAEF Report, 2020), which must be addressed to deliver the described ambition (in Section 1.1) for transfer of the technology are presented in **Table 71**

Table 71. Summary of barriers and measures to overcome barriers

Forest based enterprises e.g. bee keeping/apiary, butterfly farming, fruit trees production		
Barrier category	**Critical barrier**	**Measure to address the barrier**
Financial	i) Inability to sell products at competitive prices compromises overall revenue and profits from the forest-based enterprises.	▸ Improve access to transport for their forest-based and agro-forestry enterprises' products and services. to the market. ▸ Improve access to market infrastructure and information ▸ Improve organization and coordination capacity of the forest adjacent communities – through bulk production and marketing. ▸ Support generation of high-quality products on the market: ▸ Strengthen the forestry extension services at the local Government levels for effective service delivery; Conduct targeted and responsive trainings, mentoring and backstopping to forest adjacent communities in establishment and management of forest-based enterprises; Strengthen enforcement of guidelines and standards for quality at different scales.
Financial	ii) Limited access to credit services by forest adjacent communities.	▸ Promote a saving culture by the forest adjacent communities and their organizations, including men, women and youth. ▸ Strengthen knowledge and skills for mobilization and management of savings and credit schemes by forest adjacent communities. ▸ Promote access to financial services, training and advisories through collaboration with financial institutions and CSOs. ▸ Conduct responsive trainings on organizational development for forest adjacent communities.
Financial	iii) Mismanagement of resources and income by individuals.	▸ Support visioning, action and business planning for collaborative forest management and associated forest-based enterprises. ▸ Strengthen leadership skills of the collaborative forest management group leaders, including men, women and youth. ▸ Strengthen measures for disciplining or punishment of culprits/ wrong doers.
Non-financial	iv) Weak negotiation capacities of collaborative forest management groups/ associations.	▸ Strengthen organizational and business skills for forest adjacent communities. ▸ Promote access to structured training, exposure and mentoring-targeting and involving men, women and youth. ▸ Reduce vulnerability of the collaborative forest management groups through provision of livelihood options and services. ▸ Conduct targeted lobbying and advocacy responsive actions to address concerns of the collaborative forest management groups

Barrier category	Critical barrier	Measure to address the barrier
Non-financial	v) Bush burning and stray livestock destroy forest-based enterprises and other properties - especially in Northern Uganda and Wet Nile regions.	▸ Enhance knowledge of the community about impacts of bush burning and stray livestock. ▸ Provision of alternative livelihood options for the men and boys involved in the hunting of edible rats and mud fish. ▸ Work with cultural institutions to change mindset, behavior and attitudes linked to bush burning ▸ Advance targeted mass awareness creation on unregulated bush burning and stray livestock grazing. ▸ Promote alternative gender responsive technology for easing land clearing and opening for agricultural production. ▸ Strengthen implementation or enforcement of bush burning bylaws and ordinances where they exist. ▸ Update or review outdated policies and laws deterring bush burning and grazing by stray livestock.
Non-financial	vi) Insecure tenure and land use rights – especially for the forest adjacent communities.	▸ Promote targeted awareness about existing policies and laws, which provide for and protect these rights and obligations. ▸ Strengthen enforcement of forestry policies, laws and guidelines – through proactive stakeholder engagement. ▸ Strengthen institutional capacity for collaborative forest management groups in forest-based enterprises. ▸ Strengthen institutional capacity (to effectively support/promote forest-based enterprise value chains.
Non-financial	vii) Limited access, control of resources and decision making in respect to land use by women and youth	▸ Conduct structured engagements with cultural institutions to influence and change beliefs, attitude and customs that limit women's land ownership. ▸ Conduct targeted community engagement to change their attitude and support access and control of resources. ▸ Create targeted awareness on womens' land rights as provided for in the existing policies and laws. ▸ Create opportunities for women and youth financial empowerment.

Actions selected for inclusion in the TAP

The key measures as selected actions for addressing the major barriers advancing adaptation in the forestry sector through FBE, are derived from the BAEF report, (Uganda BAEF Report, 2020). These were prioritized based on the following key considerations during the key forestry stakeholder national validation workshop: i) Cost associated with the implementation the strategy/action/response; ii) Acceptability and practicability; and iii) Ongoing initiatives in support of implementation of the strategy/action/response for addressing the barriers for the prioritized technology.

Thus, the most important measures for addressing the major barriers advancing adaptation in the forestry sector through FBEs as prioritized during the BAEF identification phase of the Technology Needs Assessment for the forestry sector include the following:

a)Improving access to inputs and services:
b)Targeted awareness creation about FBEs:
c)Strengthen policy implementation and enforcement:
d)Responsive/targeted institutional capacity building.

Hence, overall these were considered the most important measures by the key forestry sector stakeholders largely because these measures are cost effective, can easily be adapted given that they are acceptable and practical. Besides, they easily fit within the sector priorities in respect to climate change adaptation as derived from the ongoing initiatives in terms of policy reviews, program development and implementation.

Activities identified for implementation of selected actions

Each category of the measures for addressing the major barriers advancing adaptation in the forestry sector through FBEs, has identified activities for implementation of the measures. These activities were identified through the problem and solution tree analyses during the BAEF phase II of the Technology Needs Assessment for the forestry sector. Besides, they were validated during key forestry stakeholder national validation workshop held on 16-17th March 2021 (Uganda BAEF Report, 2020). Thus, the key activities under each measure are presented as follows:

a)Improving access to inputs and services:

- Improve access by men, women and youth to market infrastructure and information;
- Construction and maintenance of feeder roads to facilitate transportation to markets by men, women and youth;
- Improve access by women and men, youth to transport forest-based enterprises products and services agro-forestry, products and services to the market;
- Organize the women, men and youth to access and use common transport for their forest-based enterprises products and services agro-forestry, products and services to the market.
- Promote the saving culture by the forest adjacent communities and their organizations, (including men, women and youth) for investment in FBEs.
- Conduct training and awareness Village Savings and Loan Association (VSLA) schemes targeting forest adjacent communities and their organizations, including men, women and youth.
- Provide seed funds to boost the VSLAs established targeting forest adjacent communities and their organizations, including men, women and youth.
- Promote access to financial management and trainings by women and youth and advisories through collaboration with financial institutions and civil society organization.
- Conduct training, awareness & advisory meetings on financial management targeting women, youth with the forest landscape;
- Create linkages between the women & youth to financial institutions for continuous provision of financial services.
- Provision of various alternative livelihood options and services based on preferences of the various gender categories i.e. men, women & youth.
- Procurement and distribution of inputs for selected livelihood options and services based on preferences of the various gender categories i.e. men, women & youth.
- Provision and establishment of improved pastures within the community.
- Targeted trainings involving key actors at community level;

- Procurement and distribution of improved pastures seeds and planting materials.
- Promoting alternative gender responsive technology for easing land clearing and opening for agricultural production e.g. use of tractors, oxen ploughs and minimum tillage.
- Responsive and targeted awareness creation on gender and associated application of technologies easing land clearing and opening for agricultural production - targeting stakeholders at community level;
- Providing appropriate equipment through a revolving fund arrangements.

b) Targeted awareness creation about FMNR:

- Advance targeted community & mass awareness creation on impacts of bush burning & stray livestock grazing.
- Organize an awareness meeting targeting key stakeholders at community level - involving at least 100 people;
- Organize an awareness meeting targeting key stakeholders at district level - involving at least 30 people;
- Organize an awareness meeting targeting key stakeholders at landscape level - involving at least 100 people;
- Organize an awareness meeting targeting key stakeholders at National level involving at least 60 people;
- Organize Interactive radio programs targeting stakeholders at the forest landscape level;
- Organize Interactive radio programs targeting stakeholders at the National levels.
- Work with cultural institutions to change mindset, behavior and attitudes linked to bush burning and stray livestock grazing.
- Conduct awareness and dialogue meetings with cultural institutions with a target of changing mindset, behavior and attitudes linked to bush burning and stray livestock grazing.
- Promote targeted awareness about existing policies and laws, which provide for and protect these rights and obligations.
- Organize Interactive radio programs targeting stakeholders at the forest landscape level;
- Organize Interactive radio programs targeting stakeholders at the National levels;
- Documentation and dissemination of Information, Eductation and Communication (IEC) materials.

c) Strengthen policy implementation and enforcement:

- Update/review of outdated policies-laws – for discouraging bush burning and stray livestock grazing.
- Conduct a regulatory impact assessment for the policy;
- Conduct stakeholder consultations at national and within forest landscapes;
- Organize Meetings with Cabinet and Parliamentary committees.
- Strengthen enforcement of forestry & land policies, laws and guidelines – through proactive stakeholder engagement and standards for quality at different scales.
- Conduct interactive radio programs for awareness creation about forestry & land policies, laws and guidelines - at landscape level;

oConduct Interactive radio programs targeting stakeholders at the National levels;

- Conduct regular monitoring and patrols to enforce the forestry & land policies, laws and guidelines.
- Strengthen the agriculture and forestry extension services at the local Government levels for effective service delivery to address the needs of the communities and farmers (including women, youth & men) as applied to management of forest-based enterprises.

oRecruitment of forest extension staff at the subcounty level
Strengthen enforcement of guidelines and standards for quality at different scales.
oConduct interactive radio programs for awareness creation about forestry & land policies, laws and guidelines at the landscape level;
- Organize Interactive radio programs targeting stakeholders at the National levels;
- Conduct regular monitoring and patrols to enforce the forestry & land policies, laws and guidelines;
- Strengthen implementation/ enforcement of bush burning & livestock grazing bylaws and ordinances where they exist.
- Support development of bylaws and ordinances on bush burning and livestock grazing through stakeholder consultations meetings at the district and community levels
- Conduct interactive radio programs for awareness creation about bylaws and ordinaces on bush burning and livestock grazing
- Conduct regular monitoring and patrols to enforce the bylaws and ordinaces on bush burning and livestock grazing.

d) Responsive/targeted institutional capacity building.
- Strengthen institutional capacity community-based institutions including collaborative forest management groups for effective management of forest-based enterprises management groups. For instance, signing collaborative forest management agreements with them.
- Capacity needs assessments and development of responsive capacity building plan;
- Implementation of the capacity development plan.
- Strengthen institutional capacity (limited resources allocation) of mandated institutions (e.g. Local Governments, National Forestry Authority and Uganda Wildlife Authority) to effectively support/ promote.
- Capacity needs assessments and development of responsive capacity building plan;

oImplementation of the capacity development plan.
- Support visioning, action and business planning for the collaborative forest management groups and associated forest-based enterprises. forest-based enterprise value chains.
- Conduct training and awareness meetings on visioning, action & business planning targeting collaborative forest management groups and associated forest-based enterprises.
- Strengthen leadership skills of the collaborative forest management group leaders.
- Conduct leadership trainings targeting Collaborative Management Group leaders
- Strengthen organizational and business skills especially among community-based organizations and forest adjacent community organizations/community forest management groups, involving men, women and youth.
- Capacity needs assessments and development of responsive capacity building plan.
- Implementation of the capacity development plan
- Promote access to structured training, exposure and mentoring- targeting and involving men, women and youth.
- Organize exposure visits targeting and involving men, women and youth.
- Conduct placement for the youth at organizations, which are successfully running similar enterprises.
- Improve organization & coordination capacity by the forest adjacent communities – through bulk production and marketing.
- Creating linkages between the forest

adjacent communities with structured markets for their products from the forest-based enterprises;
- Conducting responsive training targeted at meeting the market needs, demands and standards.
- Conduct targeted and responsive trainings, mentoring and backstopping to forest adjacent communities (including men, women & youth) in respect to establishment and management of forest-based enterprises.
- Capacity needs assessments and development of responsive capacity building plan;
- Implementation of the capacity development plan
- Strengthen knowledge of women youth and men and skills for mobilization and management of savings and credit schemes by forest adjacent communities and their organizations.
- Capacity needs assessments and development of responsive capacity building plan;
oImplementation of the capacity development plan.

3.1.4.4 Stakeholders and Timeline for implementation of TAP

Overview of Stakeholders for the implementation of the TAP

The proposed planned interventions as described in the Technology Action Plan will be implemented within a period of 10 years, through leadership and coordination of the National Forestry Authority. The key stakeholders who will be involved in the planning and implementation of the activities under the respective actions are presented as follows:
a) Improving access to inputs and services supporting application of FBEs: District Commercial officer – Local Government; MAAIF; Local Government; Ministry of Works and Transport; Uganda National Roads Authority; District Community Development Officer – Local Government; CSOs; Uganda Micro Finance Support Centre; National Livestock Research Institute; District Veterinary Officer – Local Government; Agricultural Engineering & Appropriate Technology Research Centre (AEATREC); National Agricultural Research Institute; Academic Institutions, such as Makerere University – College of Agriculture and Environment; Private (e.g. Commercial Tree Companies, Private tree growers/ members of the Uganda Timber Growers Association); and Uganda Wildlife Authority.

b) Responsive/targeted institutional capacity building for application of FBEs: National Forestry Authority; Uganda Wildlife Authority; District Forestry Officer – Local Government; CSOs; FSSD; MWE; Ministry of Finance, Planning and Economic Development; Development Partners; District Community Development Officer, Local Government; District Forestry Officer – Local Government.

c) Strengthen policy implementation and enforcement to support uptake of FBEs: FSSD; MWE; MAAIF; MLUHD; Local Governments; CSOs; and Cultural Institutions;

d) Targeted awareness creation about FBEs:
Local Governments (district and sub-county); CSOs; MAAIF; FSSD; MWE; MLHUD; and Cultural Institutions.

Scheduling and sequencing of specific activities
The detailed activities for each of the actions, the associated responsible

key stakeholders who will be involved in the planning and implementation; and the sequencing and timelines for implementation of each of the planned activity in the TAP is detailed in Table 73.

3.1.4.5 Estimation of Resources Needed for Action and Activities

Estimation of capacity building needs

The key capacity building needs for the key actors involved in the implementation of the TAP are largely technical knowledge and skills in preparation of the detailed concept notes/ proposal targeting potential development and based on the proposal/concept formats as required by the development partner.

Estimations of costs of actions and activities. The estimated cost for the actions and activities of the TAP (see Table 73) were determined by building on the earlier based economic asssessment undertaken as part of the process for preparation of the Uganda BAEF Report, 2020. Besides, these were updated based on estimation of costs of inputs in the implementation of these actions and activities.

3.1.4.6 Management Planning

The contingency planning as the response for mitigation of the identified risks is described in **Table 72**. The actions in the contigency plan should be implemented along with the TAP.

Table 72. Risks and Contingency Planning

Risks	Contigency plan
a) Some of the target especially women and youth may not afford the facilities/tools (such as telephone, radio, internet) which enable access to market information	Proactive and deliberate response actions will be pursued to facilitate access to these facilities through strengthening existing community training and information centres within the respective forest landscapes.
b) Government priorities for investments in construction of transport infrastructure may differ and henceforth may not be within the project's timelines.	Relevant Government agencies will be engaged (through the area political leaders e.g. members of parliament) with a clear justification of influencing the priorities for investment in infrustrure in the forest landscapes.
c) The savings can be used on several other uses.	Documemtation of the benefits accrued through investment of the saving in FBEs and with this information/facts engage the community for informed decision making.
d) The decision to apply and or practice the knowledge and or alternative livelihood option is with the trained beneficiaries.	The trainings will be tergeted so that they are received by the right beneficiaries, thus must be responding to the knowldege gaps and livelihood needs of the beneficiaries. This will facilitate their application/adoption by the beneficiaties.
e) Women are less likely to benefit because the big livestock (cow, cattle, goats & sheep) are usually owned by the men.	The planned interventions should equally promote and support the small livestock owned by women and or other alternative enterprises owned and managed by women.
f) Operation and maintenance of the equipment requires additional knowledge and skills, which may not be resident in the community.	Local community capacity (especially, men, youth) will be mobilized and equiped with knowledge and skills to provide regular operation and maintenance.

Risks	Contigency plan
g) Capacity building is a continuous engagement and the application of the acquired knowledge and skills is largely dependent on the beneficiaries	Capacity will be created at the community and landscape level for provision of immediate response, guidance and trouble shooting. Furthermore, participatory Monitoring and evaluation will be conducted along with responsive technical backstopping for beneficairies.
h) The trained leaders can potentially be taken up/recruited into other leadership positions in the community.	The trainings will target and benefit atleast 2 people in each leadership category i.e. the leader and counterpart/vice to serve the purpose of continuity in case any of the trainees moved on.
i)The various actors along the value chain value different interest and expectations, which will not all the addressed by the interventions.	Structured key actors, players and stakeholder's engagements will be pursued at national and landscape level for management of stakeholder interest and expectations, but also come with shared goals and also facilitate linkage among stakeholders so that expectations which cannot be delivered through the implementation of the TAP are provided by another actor/stakelholder.
j) Inadequate access to forest extension services	The project will contribute towards delivery of forest extension services in the areas where project interventions will be implemented.
k) Inadequate capacity of the Uganda National Bureau of Standards	The Uganda National Bureau of Stanards will be engaged for purposes of strengthening its collaboration with Local Governments to support enforcement of guidelines and standards of products from FBEs.
l) Changing mindset and attitude take a long time, thus generations.	Targeted, responsive and continous awareness creation will be implemented through the project right from inception upto the end.
m)Policy review and formulation takes longer period of time	Project activities implementation should also establish demostrations and illustrations to influence practices change among the community and other key actors.

Next Steps

For purposes of achieving a sharpened focus of the TAP in respect to mobilizing the required appropriate resources to advance implementation of the TAP, the following immediate and critical requirements, which will be pursued are described as follows:

a) Immediate requirements
A meeting will be held with key actors identified in the implementation of the TAP that have outstanding roles and responsibilities. The Ministry of Science, Technology and Innovations will invite the stakeholders to the meeting through coordination by the Uganda National Council for Science and Technology. This meeting should engage key senior technical leads, possibly at the level of Directors and Commissioners levels. The following objectives will be achieved by the end of the meeting: to translate the TAP into a program concept note, which will be submitted to potential funding agencies/development partners; to identify actions in the TAP, which can be integrated in the ongoing sector development plan and programs implementation; Identify issues, which require additional external resources and interrogate practical requirements for tapping into suggested financing opportunities and development partners in the TAP; to engage and bring aboard all the key stakeholders that are proposed in the implementation of the TAP for purposes of bringing them at the same page in respect to content in TAP, but also generation of further inputs and ideas into the concept note.

b) Critical requirements
Furthermore, critical requirements, will be pursued with the top leadership of the respective Ministries, Departments and Authorities i.e. at the level of Permanent Secretaries and Executive Directors for further inputs, guidance and support. Thus, in this context, the following will be pursued as critical requirements: Present and discuss the program concept note with top leadership in the Ministry for further inputs, guidance and support; Presentation of the program concept in the relevant sector working groups for approval; and Initiate structured engagement with the identified funding agencies and/or development partners for further practical guidance on how to prepare the concept and proposal documents.

Table 73. Promoting the Forest Based Enterprises Technology Overview Table.
TAP overview table

Sector	Water and Environment
Sub-sector	Forestry
Technology	Promoting Forest based enterprises e.g. bee keeping/apiary; butterfly farming, fruit trees production; ecotourism
Ambition	300,000 households in 3 forest landscapes
Benefits	Reduces public and private expenditures in respect to monitoring and surveillance around the forests, because this becomes a shared role between the responsible body and the beneficiary community. The products (e.g. honey, fruits, mushrooms,) from some of the selected enterprises have positive impact on the nutrition and health in the community when consumed as part of the diet. Increased biodiversity especially within the forest buffer zones for protected forests.

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Improving access to inputs and services	Improve access by men, women and youth to market infrastructure and information.	Government of Uganda; World Bank; European Union	District Commercial officer – Local Government	Year 1-5	Some of the targets especially women and youth may not afford the facilities/ tools to access to market information.	At least 50% of men, women and youth with better access to market infrastructure and information.	Number of men, women and youth with better access to market infrastructure and information.	-
	Improve access by women and men, youth to transport forest-based enterprises products and services agro-forestry, products and services to the market.	Government of Uganda; World Bank; European Union	Local Government; Ministry of Transport.	Year 1-5	Government priorities for investments in construction of transport infrastructure differ and henceforth may not be within the project's timelines.	At least 50% of men, women and youth with better access to transport for forest-based enterprises products and services agro-forestry, products and services to the market.	Number of men, women and youth with better access to transport for forest-based enterprises products and services agro-forestry, products and services to the market.	9,100
	Promote the saving culture by the forest adjacent communities and their organizations, .	Government of Uganda of Uganda, Development Partners	Local Government - Community Development Officer; Micro Finance Support Centre; CSOs	Year 2-7	The savings can be used for several other uses.	A large proportion (70%) of men, women and youth involved in financial savings activities within their forest adjacent community.	Number of men, women and youth involved in financial savings activities within their forest adjacent community organizations.	54,100

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Promote access and control to financial management trainings through collaboration with financial institutions.	Government of Uganda; Development Partners	Local Government - Community Development Officer; Micro Finance Support Centre; CSOs	Year 2-4	The decision to apply and or practice the knowledge is with the trained beneficiaries.	At least 50% of farmers trained applying the knowledge & skills on financial management	Number of men, women and youth that have benefited from financial management trainings through collaboration	31,400
	Provision of various alternative livelihood options and services.	GCF; Government of Uganda; Development Partners	LG - District Community Development Officer, DFO; CSOs	Year 1-5	The decision to adapt/ adopt and or practice the alternative livelihood options is with the beneficiaries	At least 50% of beneficiary farmers practicing alternative livelihood options	Number of men, women and youth that have benefited from various alternative livelihood options and services.	81,100
	Provision and establishment of improved pastures within the community.	GCF; Government; Development Partners	NARO; Local Government - District Veterinary Officer; CSOs	Year 1-5	Women are less likely to benefit because the big livestock are usually owned by the men.	At least 50% of men, women and youth have benefited from the improved pastures.	Number of men, women and youth that have benefited from the improved pastures	82,300
	Promoting alternative gender responsive technology for easing land clearing and opening for agricultural production.	Government of Uganda; World Bank; European Union	MAAIF - Agricultural Engineering and Appropriate Technology Research; MGLSD; LG- District Agricultural Officer;	Year 1-10	Operation and maintenance of the equipment requires additional knowledge and skills, which may not be resident in the community.	At least 50% of women, men and youth accessing alternative gender responsive technology for easing land clearing and opening for agricultural production e.g. use of tractors, oxen ploughs and minimum tillage	Number of women, men and youth accessing alternative gender responsive technology for easing land clearing and opening for agricultural production e.g. use of tractors, oxen ploughs and minimum tillage	141,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
Responsive/ targeted institutional capacity building	Strengthen institutional capacity community-based institutions	Green Climate Funds; Government of Uganda; Development Partners	NFA; UWA; LG - District Forestry Officer; Civil Society Organizations;	Year 2-5	Capacity building is a continuous engagement and the application of the acquired knowledge and skills is largely dependent on the beneficiaries	100 % of the community-based institutions whose institutional capacity was built effectively managing forest-based enterprises	Number of community-based institutionsthat have benefited from institutional capacity building	47,400
	Strengthen institutional capacity of mandated institutions to effectively support/ promote forest-based enterprises	Green Climate Funds; Government of Uganda; Development Partners Cooperation	MWE – FSSD, MOFPED; Development Partners and Civil Society Organizations	Year 2-5	Capacity building is a continuous engagement and the application of the acquired knowledge and skills is largely dependent on the beneficiaries	100 % of the mandated institutions which benefited from capacity building interventions supporting/ promoting fores-based enterprises	Number of mandated institutions that have benefited from capacity building interventions targeted at providing effective support/ promotion of forest-based enterprises	47,400
	Support visioning, action and business planning for the collaborative forest management groups and associated forest-based enterprises.	Government of Uganda, Development Partners	NFA; UWA; LG - District Forestry Officer; Civil Society Organizations;	Year 3-5	i) Decision to apply and or practice the knowledge is with the trained beneficiaries. ii) Trained leaders can be taken up/ recruited into other leadership position in the community.	100% collaborative forest management groups and associated forest-based enterprises associations applying visioning, action and business planning engagements	Number of collaborative forest management groups and associated forest-based enterprises associations that have benefited from visioning, action and business planning engagements.	27,000
	Strengthen leadership skills of the collaborative forest management group leaders.	Government of Uganda, Development Partners National Civil Society Organizations	NFA, UWA, LG - District Community Development Officer, District Forestry Officer; Civil Society Organizations	Year 2-5	The trained leaders can potentially be taken up/recruited into other leadership position in the community.	100% collaborative forest management groups leaders applying leadership knowledge and skills.	Number of collaborative forest management group leaders that have benefited from leadership skills and knowledge enhancement.	27,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Strengthen organizational and business skills among forest adjacent community organizations	Government of Uganda, Development Partners	NFA, UWA, Local Government - District Community Development Officer, District Forestry Officer; CSOs	Year 4-6	Capacity building is a continuous engagement and the application of the acquired knowledge and skills is largely dependent on the beneficiaries	At least 50% community-based organizations and forest adjacent community organizations/ community forest management groups applying organizational and business skills.	Number of community-based organizations and forest adjacent community organizations that have benefited from organizational and business skills engagements.	47,400
	f) Promote access to structured training, exposure and mentoring- targeting and involving men, women and youth.	Government of Uganda, Development Partners	NFA, UWA, Local Government - District Community Development Officer, DFO, CSO	Year 4-6	Capacity building is a continuous engagement and the application of the acquired knowledge and skills is largely dependent on the beneficiaries	At least 50% of men, women and youth applying the knowledge and skills from structured training, exposure and mentoring.	Number of men, women and youth that have benefited from structured training, exposure and mentoring.	32,300
	g) Improve organization & coordination capacity by the forest adjacent communities – through bulk production and marketing.	Government of Uganda, Development Partners	NFA, UWA, Local Government - District Community Development Officer, DFO, CSO	Year 2-8	The various actors along the value chain value different interest and expectations, which will not all the addressed by the interventions.	At least 50 engagements in respect to bulk production and marketing conducted by the forest adjacent communities in a coordinated manner.	Number of engagements in respect to bulk production and marketing conducted by the forest adjacent communities in a coordinated manner.	36,300
	h) Conduct targeted trainings, mentoring and backstopping in forest-based enterprises.	Government of Uganda, Development Partners	NFA; LG - District Commercial Officer; DFO, CSO	Year 2-10	Inadequate forest extension staff at Local Government	At least 50% of the trained forest adjacent communities apply the knowledge & skills in forest-based enterprises.	Number of trainings, mentoring and backstopping engagements conducted in forest-based enterprises.	47,400

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	i) Strengthen knowledge and skills on savings and credit schemes by forest adjacent communities and their organizations.	Government of Uganda, Development Partners	NFA; LG - District Forestry Officer, District Commercial Officer; Civil Society Organizations	Year 2-6	Capacity building is continuous and the application of the acquired knowledge and skills is largely dependent on the beneficiaries	At least 50% of the trained women youth and men apply the knowledge & skills for mobilization and management of savings and credit schemes.	Number of women youth and men who have benefited from skills and knowledge in savings and credit schemes by forest adjacent communities	47,400
3) Strengthen policy implementation and enforcement	a) Update/review of outdated policies-laws – ordinances- bylaws for discouraging bush burning and stray livestock grazing.	Government of Uganda, Development Partners	MWE – FSSD, MAAIF; LG– District Council, ENR Department, Production Department	Year 2-5	Policy review and formulation takes longer period of time	At least 5 outdated policies/laws reviewed to come up with strategies for discouraging bush burning and stray livestock grazing.	Number of outdated policies/laws reviewed to come up with strategies for discouraging bush burning and stray livestock grazing.	27,000
	Strengthen enforcement of forestry & land policies, laws and guidelines –s.	Government of Uganda, Development Partners	MWE – FSSD, MLHUD; Local Governments	Year 1-10	Inadequate forest extension staff at Local Government	At least 50% of cases flouting land policies, laws and guidelines that have been reported and reprimanded.	Number of cases flouting land policies, laws and guidelines that have been reported and reprimanded.	123,400
	Strengthen the agriculture and forestry extension services at the local Government levels for effective service delivery	Government of Uganda, Development Partners	MWE – FSSD, MAAIF; Ministry of Lands, Housing and Urban Development;	Year 1-10	Inadequate forest extension staff at Local Government	At least 80% of community members and farmers (including women, youth & men) managing forest-based enterprises effectively.	Number of community members and farmers (including women, youth & men) that are accessing agriculture and forestry extension services from the Local Government for effective management of forest-based enterprises.	9,000

Action	Activities to be implemented	Sources of funding	Responsible body and focal point	Time frame	Risks	Success criteria	Indicators for Monitoring of implementation	Budget (USD)
	Strengthen enforcement of guidelines and standards	Government of Uganda, Development Partners	MWE – FSSD, Local Governments	Year 1-10	Inadequate capacity of the Uganda National Bureau of Standards	At least 50% of cases flouting standards and guidelines reported & reprimanded.	Number of cases flouting standards and guidelines reported & reprimanded.	123,400
	Strengthen implementation/ enforcement of bush burning & livestock grazing bylaws and ordinances where they exist.	Government of Uganda, Development Partners	LG ENR Department, Production; CSOs	Year 1-10	Inadequate forest extension staff at Local Government	At least 50% of cases flouting bush burning & livestock grazing bylaws and ordinances that have been reported and reprimanded.	Number of cases flouting bush burning & livestock grazing bylaws and ordinances that have been reported and reprimanded.	82,100
4) Targeted awareness creation	Advance community & mass awareness on bush burning & stray livestock grazing.	Government of Uganda; Development Partners	LG ENR Department, Production; CSOs	Year 1-10	Changing mindset and attitude takes a long time, thus generations.	At least 10 community and mass awareness events on bush burning & stray livestock grazing conducted.	Number of community and mass awareness creation events on bush burning & stray livestock grazing conducted.	174,000
	Work with cultural institutions to change mindset, behavior and attitudes on bush burning and stray livestock grazing.	Green Climate Funds; Government of Uganda; Development Partners	LG ENR Department, Production; CSOs	Year 1-10	Changing mindset and attitude takes a long time, thus generations.	100 % of cultural institutions worked at changing community mind-set, behavior and attitudes linked to bush burning & stray livestock grazing.	Number of cultural institutions engaged targeted at changing the mind-set, behavior and attitudes linked to bush burning & stray livestock grazing.	6,100
	Promote targeted awareness on policies and laws, on these rights and obligations.	GCF; Government of Uganda; Development Partners	CSO; MWE – FSSD; MLHUD;	Year 1-10	Changing mindset and attitude takes a long time, thus generations.	At least 50% of the forest adjacent community households have received information on policies and laws.	Number of forest adjacent community households who have received information on policies and laws.	117,300
Total								1,420,900
Administration & Management (15% of the total budget)								213,100
Grand Total								1,634,000

3.2 Project Ideas for Forestry Sector

3.2.1 Brief summary of the Project Ideas for the Forestry Sector

In this section, the proposed project ideas with the concrete actions for supporting the realization of the overall target of the TAP are described. They were derived from the technologies and associated actions as prioritized by the forestry sector stakeholders during the validation workshop for the BAEF report (Uganda BAEF Report, 2020). It's anticipated that further development of these project ideas into proposals and subsequent implementation of the activities and outputs there-in will contribute to the transfer, diffusion and delivery of the targets for the respective technologies for advancing climate change adaptation. The proposed project ideas will be implemented within a period of 10 years.

3.2.2 Specific Project Ideas

3.2.2.1 Building Communities and Forest Landscapes in Uganda that are Resilient to Climate Change Impacts

Introduction

One project idea is proposed for the forestry sector as summarized in Table 76. It aims at having resilient forest landscapes and adjacent and immediate community to climate change impacts through supporting application, transfer and diffusion of the 3 prioritized and selected technologies i.e. Farmer Managed Natural Regeneration; Forest Based enterprise; and integrated pest management. This project idea is recommended largely due to the similarities in respect to outcome and impacts derived from implementation of the measures/action/strategies for addressing the barriers for each of the technologies, thus resulting into further application, transfer and diffusion of the technologies. The outcomes and impacts in this respect as derived from the barrier analyses report are: Reduced vulnerability to climate change impacts; and Reduced and or avoided deforestation & forest degradation in the landscape.

Specific objectives:

1.To support community-based adaptation to climate change impacts among communities living adjacent and within forest landscapes

2. To build forest landscape ecosystems, which are resilient to climate change impacts for continuous provisioning of products and services.

The outputs for proposed project ideas and associated indicators for measuring and monitoring implementation performance are presented in **Table 74.**

Table 74. Outputs for building resilient forest landscapes

Outputs	Indicators/Means of verification
i) Enhanced community adaptation capacity to climate change/variability impacts	Number of climate change adaptation actions, technologies implemented in the natural and plantations forests within the landscape.
ii) Enhanced knowledge and skills of communities and other stakeholders in respect to climate change adaptation	Number of responsive and targeted trainings on climate change adaptation at the national and forest landscape levels Number community members and actors trained

Outputs	Indicators/Means of verification
	Number climate change responsive and targeted climate change awareness engagements at the national and forest landscape level Number of community members and actors reached with information of climate change & variability
iii) Enhanced stakeholder coordination in the landscape for advancing climate adaptation	Number of climate change coordination mechanisms among stakeholders established at the National and forest landscape levels Number of climate change coordination engagements involving stakeholders at the national and forest landscape level implemented.
iv) Degraded forests and landscapes restored	Size of degraded forests in the landscape restored Number of trees planted in the forest reserves within forest landscape
v) Responsive control of Pests and diseases in forest landscapes.	Number of regular pests and diseases monitoring, surveillance and evaluation engagements conducted.
vi) Responsive policy formulation, implementation, enforcement & regulation in forest landscapes.	Number of outdated policies/laws reviewed to come up with strategies for discouraging bush burning and stray livestock grazing. Number of cases flouting land policies, laws and guidelines that have been reported and reprimanded.

Relationship to the country's sustainable development priorities

The proposed project ideas are in line with the national development priorities for the forestry sector in respect to climate change adaptation as stipulated in the National commitments, policies and planning frameworks. For instance, they will contribute towards achievement of the national commitments as described in the Uganda's NDCs, the Bonn challenge, National REDD+ strategy and the NDP III.

Project Scope and Possible Implementation

The proposed project idea will be implemented in the 3 forest landscapes, including: i) Afro-motane; ii) Karamoja; and iii) Northern moist.

These are selected and proposed for implementation of the project interventions based on the following criteria/considerations: Existence of previous pilot engagements promoting FMMR; Existence of development players in the landscape willing to support and invest in the technology; and Based on the recommendations by the forest landscape restoration assessment report that natural regeneration is a possible option for landscape restoration (MWE, 2016).

However, other forest landscapes, where upscaling of the technologies (i.e. FMNR and FBEs) should be targeted include: a) Southern rangeland; b) South East Lake Kyoga flood plain; c) Western mid-altitude; and d) Lake Victoria crescent.

The proposed project is linked and will build and consolidated some of the previous initiatives and projects by the Government and development partners in respect to promoting FMNR and FBEs. However, the planned interventions in this respect will be implemented in the context of advancing community-based adaptation to climate change and building resilience of the forest landscape ecosystems to climate change and variability impacts. The proposed project interventions are feasible largely because they will contribute to improved livelihoods of the community living adjacent and within the immediate forest landscapes.

Budget/Resource requirements

The total budget to support implementation of the proposed project ideas is **2,196,367 USD**, as detailed in **Table 75**. These funds will be mobilised through engagements with the Government of Uganda (GoU) and the strategic development partners. A Consultant/s will be required to support generation of further information and content for compilation/packaging into a concept note/proposal based on the requirements and guidelines of the identified strategic development partners. The GoU will provide the required co-financing. The identified and relevant Government Ministries, Authorities and Civil Society Organizations will collaborate/partner to ensure that the project deliverables are implemented and associated aspirations/outcomes are achieved within the project life time.

Table 75. Budget – resilient landscapes.

Activity	Amount USD									
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
a) Strengthen institutional capacity community-based institutions	23700	23700	-	-	-	-	-	-	-	-
b) Strengthen adaptation to Climate variability and change in forest landscape.	20333	20333	20333	20333	20333	20333	-	-	-	-
c) Support visioning, action and business planning for the collaborative forest management groups and associated forest-based enterprises.	-	9000	9000	9000	-	-	-	-	-	-
d) Strengthen leadership skills of the collaborative forest management group leaders.	-	9000	9000	9000	-	-	-	-	-	-
								-		-

Activity	Amount USD									
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
e) Strengthen organizational and business skills for forest adjacent communities.	-	15800	15800	15800	-	-	-	-	-	-
f) Promote access to structured training, exposure and mentoring-	-	-	10767	10767	10767	-	-	6050	-	-
g) Improve organization & coordination capacity by the forest adjacent communities –	-	-	6050	6050	6050	6050	6050	5925	-	-
h) Conduct targeted and responsive trainings, mentoring and backstopping to forest adjacent communities.	-	5925	5925	5925	5925	5925	5925	-	5925	-
i) Strengthen knowledge and skills in mobilizing and managing savings and credit schemes by forest adjacent communities	-	11850	11850	11850	11850	-	-	21750	-	-
j) Advance targeted community & mass awareness on bush burning & stray livestock grazing	-	21750	21750	21750	21750	21750	21750	21750	21750	-
k) Promote targeted awareness on IPM to influence attitude and practice	-	21750	21750	21750	21750	21750	21750	21750	21750	-
l) Increase targeted awareness on the diverse benefits from FMNR	-	21750	21750	21750	21750	21750	21750	6050	21750	-
m) Improve organization & coordination capacity by the forest adjacent communities	-	-	-	6050	6050	6050	6050	-	6050	-

Activity	Amount USD									
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
n) Establish coordinated research teams to generate the required evidence for FMNR	-	-	9000	9000	-	20275	-	-	-	-
o) Provide incentives to support land restoration.	-	-	20275	20275	20275	20275	-	-	-	-
p) Promote enterprises with short term benefit diversification in FMNR – apiary, eco-tourism	-	-	20275	20275	20275	-	-	-	-	-
q) Targeted training of community & famers for application of FMNR.	-	15800	15800	15800	-	3600	-	3600	-	3600
r) Increase investment in research to develop responsive IPM solutions.	3600	3600	3600	3600	3600	8400	3600	8400	3600	8400
s) Strengthen regular monitoring and surveillance of pests and diseases.	8400	8400	8400	8400	8400	12340	8400	12340	8400	12340
t) Strengthen enforcement of forestry & land policies, laws and guidelines	12340	12340	12340	12340	12340	-	12340	-	12340	-
u) Update/review policies-laws, ordinances & bylaws on bush burning & stray livestock.	30000	30000	30000	-	-	12340	-	12340	-	12340
v) Strengthen enforcement of guidelines and standards for quality at different scales	12340	12340	12340	12340	12340	20000	12340	-	12340	-
w) Development and operationalization of land-use plans within the forest landscapes.	-	20000	20000	20000	20000	11730	-	11730	-	11730
x) Promote targeted awareness on existing policies and laws	11730	11730	11730	11730	11730	5500	11730	-	11730	-

Activity	Amount USD									
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
y) Conduct structured policy dialogues on FMNR with decision makers in forest landscapes.	-	-	5500	5500	5500		-		-	
Sub totals (USD)	**122,443**	**275068**	**323235**	**299285**	**240685**	**218068**	**131685**	**131685**	**125635**	**48410**
Total (USD)	**1,916,199**									
Contribution to administration costs (15% of total cost) (USD	**280,168**									
Grand Total (USD)	**2,196,367**									

Measurement/Evaluation

- Hectares of degraded forests degraded forests in the forest landscapes restored
- Number of climate change adaptation actions, technologies implemented in the natural and plantations forests within the landscape.

Possible Complications/Challenges

- Very high expectations of the community and other actors in the forest landscapes. These cannot adequately be provided and addressed directly by the proposed project interventions.
- Building climate change resilience, both for the community and forest ecosystems is a moving target, which is influence by the climate variability & change and adaptation capacity and impacts.

Responsibilities and Coordination (Who does what, when and how?)

The Ministry of Science, Technology and Innovations will have the overall responsibility and coordination in pursuing further steps towards development of the project idea into a concept note and or proposal for submission to a potential development Partner for funding. Engagements in this respect will be initiated by organizing a meeting in which the key stakeholders will be invited to the meeting through coordination by the Uganda National Council for Science and Technology. This meeting should engage key senior technical leads, possibly at the level of Directors and Commissioners levels. The following objectives will be achieved by the end of the meeting: To translate the project ideas into a program concept note, which will be submitted to potential funding agencies/ development partners; To identify actions in the project ideas, which can be integrated in the ongoing sector development plan and programs implementation; Identify issues, which require additional external resources and interrogate practical requirements for tapping into suggested financing opportunities and development partners in respect to the project ideas; and to engage and bring aboard all the key stakeholders that are proposed in the implementation of the project idea for purposes of bringing them at the same page in respect to content in project ideas, but also generation of further inputs and ideas into the concept note. The roles & responsibilities of the key actors & stakeholders during the implementation of the project ideas are presented in **Table 76.**

Table 76. Responsibilities and Coordination.

Activity	Who	When	How
a) Strengthen institutional capacity community-based institutions	National Forestry Authority (NFA); Uganda Wildlife Authority (UWA); LG - District Forestry Officer (DFO)	Years 1&2	Facilitating organization development and responsive institutional capacity building/training.
b) Strengthen adaptation to Climate variability and change in forest plantations and the landscape.	National Forestry Resources Research Institute (NaFORRI); NFA; Uganda Timber Grower's Association (UTGA); LG – Environment and Natural Resources Department (ENR); Civil Society Organizations (CSOs)	Years 1-6	Conducting responsive and targeted training. Furthermore, promote access to technologies.
c) Support visioning, action and business planning for the collaborative forest management groups \	NFA; UWA; LG - DFO; CSOs;	Years 2-4	Consultant for stakeholder consultation; developing strategy & Piloting activities
d) Strengthen leadership skills of the collaborative forest management group leaders.	NFA, UWA, LG - District Community Development Officer, DFO; CSOs	Years 2-4	Conducting responsive and targeted training.
e) Strengthen organizational and business skills of forest adjacent communities.	NFA, UWA, LG - District Community Development Officer, DFO; CSOs	Years 3-5	Conducting responsive and targeted training.
f) Promote access to structured training, exposure and mentoring-	NFA, UWA, LG - District Community Development Officer, DFO; CSOs	Years 3-5	Facilitate internship attachments/ apprenticeship, exposure visits
g) Improve organization & coordination capacity by the forest adjacent communities –	NFA, UWA, LG - District Community Development Officer, DFO; CSOs	Years 3-8	Conducting responsive and targeted training.
h) Conduct targeted and responsive trainings, mentoring to forest adjacent communities.	NFA; LG - DFO, District Commercial Officer; CSOs	Years 2-9	Targeted training, mentoring and backstopping
i) Strengthen knowledge and skills in mobilizing and managing savings and credit schemes by forest adjacent communities	NFA; LG - DFO, District Commercial Officer; CSOs	Years 2-5	Responsive and targeted trainings for selected enterprise value chains. access to seed funds for boosting savings.
j) Advance targeted community & mass awareness on bush burning & stray livestock grazing	LG (ENR Department, Production; CSOs	Years 2-9	Targeted awareness creation through publication and media engagements.

Activity	Who	When	How
k) Promote targeted awareness on IPM to influence attitude and practice	National Environment Management Authority (NEMA); NaFORRI; NFA; Makerere University; UTGA; LG – ENR Department.	Years 2-9	Targeted awareness creation through publication and media engagements.
l) Increase targeted awareness on the diverse benefits from FMNR	MWE– Forest Sector Support Department; LG – Forestry Officer; CSOs	Years 2-9	Targeted awareness creation through publication and media engagements.
m) Improve organization & coordination capacity by the forest adjacent communities	NFA, UWA, LG - District Community Development Officer, DFO; CSOs	Years 4-9	Conducting responsive and targeted training.
n) Establish coordinated research & teams to generate the required evidence for FMNR	UNCST; Ministry of Science, Technology and Innovations (MoSTI); NAFoRRI, CSOs,	Years 3-4	Organize joint planning and priority setting meetings.
o) Provide incentives to support land restoration..	Local Government - DFO	Years 3-6	Provide small grants and or technical advisory support.
p) Promote enterprises with short term benefit diversification in FMNR – apiary, eco-tourism	National Agricultural Advisory Services (NAADs); MWE – FSSD; LG- Forestry	Years 3-6	Responsive and targeted trainings for enterprise value chain;, promote access to inputs and associated technologies.
q) Targeted training of community & famers for application of FMNR.	LG - District Forestry Officer; and CSOs,	Years 2-4	Practical trainings through demonstrations.
r) Increase investment in research to develop responsive IPM solutions.	MWE – FSSD; MAAIF; NaFORRI; NFA;	Years 1-10	Structured engagement with decision makers to influence prioritizations of research in IPM.
s) Strengthen regular monitoring and surveillance of pests and diseases.	MWE – FSSD; MAAIF; NaFORRI; NFA;	Years 1-10	Establish and operationalize and monitoring and surveillance mechanisms.
t) Strengthen enforcement of forestry & land policies, laws and guidelines	MWE – FSSD, Ministry of Lands, Housing and Urban Development (MLHUD); LG	Years 1-10	Provide adequate resources (i.e. human, financial, technical) of duty bearers to effectively deliver
u) Update/review policies-laws, ordinances & bylaws on bush burning & stray livestock.	MWE – FSSD; MAAIF-Directorates of Animal and Crop Resources.	Years 1-3	Consultants for policy reviews - desk reviews and stakeholder engagement /consultations.
v) Strengthen enforcement of guidelines and standards for quality at different scales	MWE – FSSD, LG	Years 1-10	v) Strengthen enforcement of guidelines and standards for quality at different scales

Activity	Who	When	How
w) Develop and operationalize land-use plans within the forest landscapes.	MLHUD- and MWE – FSSD	Years 2-6	Consultants for policy reviews - desk reviews and stakeholder engagement /consultations.
x) Promote targeted awareness on existing policies and laws,.	MWE – Forestry Sector Support Department; MLHUD; CSOs	Years 1-10	Targeted awareness creation through publication and media engagements.
y) Conduct structured policy dialogues on FMNR with decision makers in forest landscapes.	National Civil Society Organizations,	Years 3-6	Conduct issue-based policy dialogues involving duty bearers and rights holders.

Chapter 4: Cross-cutting Issues

The following policies and actions can help address barriers for technologies from multiple sectors

Capacity building of extension officers

Inadequate technical capacity for providing advisory support is common barrier for technology transfer and diffusion. Extension officers also need capacity building in participatory approaches since the prioritised technologies require sustained engagement with communities and officers need to support them to collectively install, operate and manage technologies and provide feedback for further improvements.

Research to understand context and assess feasibility of the technology
The need to adapt technologies to local contexts and to respond to changing climatic scenarios requires strong research support. Contexts maps enable making the necessary adjustments in the way technologies are transferred and diffused and in turn enable provision of appropriate technical support. Technologies are not one-size-fits-all and understanding the differences in biophysical, social, economic conditions enables (re)designing of technologies and engaging the right set of stakeholders to increase adoption.

Strengthening capacity of community groups
Technologies often require collective approach and this rests on strong and functional local organisations. This enables communities to access services and to negotiate more strongly to make the technology work for them. Strong local organisations which are inclusive and accountable also enable communities to diversify innovations around the technology and build networks around related enterprises which augment their resilience to shocks. Building community ownership and capacity to operate and manage technologies is key in ensuring that technologies serve those that need them most.

Private sector partnerships
Private sector partnerships build opportunities for co-investment in technology transfer and diffusion, widening the penetration beyond places and communities reached by public entities alone. The role of private entities is even stronger in contributing to sustained functionality of installations through supply of equipment, accessories and technical services. Private involvement also catalyses evolution of enterprises around technologies, creating demand. Partnership with private entities providing financial services also help communities to overcome short-term cost barriers.

Awareness creation
Building awareness about technologies, how they operate and their potential for climate change adaption has come as a key measure for all the technologies prioritized. This includes not only announcing the information, but demonstrating how technologies work, exposing potential users to places where such technologies work and building a dialogue on what it might take to build

it into local context and its potential benefits and tradeoffs.

Coordination between public sectors and with non-government entities
Creating means for inter-sectorial dialogue and planning helps to reduce wasteful duplication and build coherent messaging for users.

Monitoring and evaluation
Monitoring and evaluation are key in understanding whether the technologies are contributing to climate change adaptation. Methods and structures for achieving this can be harmonized and shared across sectors. Partnerships need to be developed even outside the key public sectors to reduce costs and increase understanding and ownership of the process of using technologies for climate change adaptation.

List Of References

Adler, I., Campos, L. C., & Bell, S. (2014). Community participation in decentralized rainwater systems: a Mexican case study. Alternative Water Supply Systems, 117.

AGRA (2011). Country Case Studies on the PASS Value Chain Strategy/Approach and Its Impact/Effect on Smallholder Farmer Yields in Africa: Kenya, Tanzania, Uganda. East Africa Synthesis Report.

Alford, D. (2007). Impact and potential of self-supply in Amuria District, Uganda. Master of Science, Cranfield University, https://www.rural-water-supply.net/_ressources/documents/default/257.pdf accessed on 28th September 2020

Ampurire, P. (2019). Government launches national seed policy to eliminate fake seeds. Retrieved from Softpower: https://www.softpower.ug/govt-launches-national-seed-policy-to-eliminate-fake-products/

Asaba, R. B., Fagan, G. H., & Kabonesa, C. (2015). Women's access to safe water and participation in community management of supply. Water is Life: Progress to secure safe water provision in rural Uganda, P 15-29, Practical Action Publishing, Rugby, United Kingdom,. https://core.ac.uk/download/pdf/297022961.pdf accessed on 28th September 2020

Asea, G., Serumaga, J., Mduruma, Z., Kimenye, L., & Odeke, M. (2014). Quality protein maize production and post harvest handling handbook for East and Central Africa. Entebbe: ASARECA. Retrieved from https://www.asareca.org/sites/default/files/publications/QPM HANDBOOK FINAL.pdf (pdf for the web)

Babu, S. C., Joshi, P. K., Glendenning, C. J., Kwadwo, A. O., & Rasheed, S. V. (2013). The state of agricultural extension reforms in India: Strategic priorities and policy options. Agricultural Economics Research Review, 26(347-2016-17086), 159-172.

Baguma, D., Hashim, J. H., Aljunid, S. M., Hauser, M., Jung, H., & Loiskandl, W. (2012). Safe water, household income and health challenges in Ugandan homes that harvest rainwater. Water policy, 14(6), 977-990.

Barungi, M. (2016). Government should commit more funding for the single spine agricultural extension reform. Retrieved from EPRC: https://eprcug.org/blog/459-government-should-commit-more-funding-for-the-single-spine-agricultural-extension-reform

Barungi, M., Guloba, M., & Adong, A. (2016). Uganda's agricultural extension systems: how appropriate is the single spine structure? Kampala: EPRC. Retrieved from https://ageconsearch.umn.edu/record/253558/files/16 Uganda_s Agricultural Extension Systems.pdf

Baziwe, D. (2011). Putting women at the forefront in accelerating self-supply through domestic rain water harvesting. Paper presented at 6th RWSN Forum, Kampala, Uganda. https://rwsnforum.files.wordpress.com/2011/11/126-putting-women-at-the-forefront-in-accelerating-self-supply-through-domestic-rain-water-harvesting.pdf accessed on 28th September

Blanchard, J. P. (2012). Rainwater Harvesting Storage Methods and Self Supply in Uganda. Graduate Theses and Dissertations. HYPERLINK "https://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=5175&context=etd"accessed on 28th September 2020

BMAU Briefing Paper (2018). Modernization of Agriculture in Uganda. How much has government done through irrigation? Briefing Paper (6/18). May 2018.

Bresci, E. (2008) Improving crop production through rainwater harvesting: Moroto district case study Uganda (Doctoral dissertation, University of Florence). HYPERLINK "https://sswm.info/sites/default/files/reference_attachments/ANNENA%202008%20Improving%20Crop%20Production%20through%20Rainwater%20Harvesting.pdf" Accessed on 29th September 2020

Buyinza, J., Agaba, H., Ongodia, G., Eryau, K., Sekatuba, J., Kalanzi, F., . . . Nansereko, S. (2015). On-farm Conservation and Use Values of Indigenous Tree Species in Uganda. Research Journal of Agriculture and Forestry Sciences, Vol. 3(3), 19-25. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/37667867/FINAL_Utilisation_and_Use_Values_1.pdf?1431957241=&response-content-disposition=inline%3B+filename%3DOn_farm_Conservation_and_Use_Values_of_I.pdf&Expires=1601413546&Signature=ABtCeMg1-vmwvgbhWaZ8kd5rXSSYfhcOl

CDC (Centers for Disease Control and Prevention) (2015). Public Water Systems. https://www.cdc.gov/healthywater/drinking/public/water_treatment.html Accessed on

Ciesla, W.M. (1982). IPM: New approaches to old problems. American Forests 88(2): 40-44, 51-52.

CRS, & MEAS. (2015). Organizing and managing farmers' groups: A smart skills manual. Baltimore, MD,: Catholic Relief Services. Retrieved from https://www.crs.org/sites/default/files/tools-research/organizing-and-managing-farmers-groups-smart-skills-manual.pdf

Cruddas, P. (2007). An investigation into the potential to reduce the cost of constructed rainwater harvesting tanks in Uganda. Master of Science, Cranfield University, HYPERLINK "https://www.rural-water-supply.net/_ressources/documents/default/246.pdf"Accessed on 28th September 2020

Danert, K., & Motts, N. (2009). Uganda water sector and domestic rainwater harvesting subsector analysis. Washington, DC.

DeBoef, W., & Prabhala, P. (2014). Counterfeiting in African Agriculture Inputs – Challenges & Solutions. Retrieved from https://www.agrilinks.org/sites/default/files/resource/files/BMGF_Addressing%20Counterfeit%20Ag%20%20Inputs_Research%20Read-out%20%282%29%20%281%29.pdf

Dell, A. I., Pawar, S., & Savage, V. M. (2014). Temperature dependence of trophic interactions are driven by asymmetry of species responses and foraging strategy. Journal of Animal Ecology, 83(1), 70-84

Durodola, O. S., Bwambale, J., & Nabunya, V. (2020). Using every drop: rainwater harvesting for food security in Mbale, Uganda. Water Practice and Technology (2020) 15 (2): 295–310

FAO (1985), Food and Agricultural Organisation, Irrigation and Drainage, Self Help wells Paper 30. Rome http://www.fao.org/3/X5567E/x5567e00.htm#Contents Accessed on 28th September 2020

FAO (2010). The State of the World Fisheries and Aquaculture. http://www.fao.org/3/ai1820e.pdf. Accessed on 15th September 2019

FAO (2018). Guidelines on irrigation investment projects. Rome. Retrieved from http://www.fao.org/3/CA2608EN/ca2608en.pdf

Farahbakhsh, K., Despins, C., & Leidl, C. (2009). Developing capacity for large-scale rainwater harvesting in Canada. Water Quality Research Journal, 44(1), 92-102.

Foster, S., Tuinhof, A., & Van Steenbergen, F. (2012). Managed groundwater development for water-supply security in Sub-Saharan Africa: investment priorities. Water SA, 38(3), 359-366.

Fowler, M., & Rauschendorfer, J. (2019). Agro-industrialisation in Uganda. Current status, future prospects and possible solutions to pressing challenges. November, F-IH-UGA-006-2

FSC (2018). National Forest Stewardship Standard for the Republic of Uganda (NFSS 2018). Kampala. https://www.mwe.go.ug/sites/default/files/National%20FSC%20Forest%20Standard_Uganda .pdf. Accessed on 10th November 2019.

GOU (2005). Draft Guidelines for Managing Small Dams. Small dam guidelines: Development of a Dam Safety Regulatory Framework for Uganda. SMEC draft final report. HYPERLINK "http://documents1.worldbank.org/curated/en/319261468174900826/pdf/E30020EA-0v30P10mall0Dams0Guidelines.pdf" Accessed on 29th September 2020

Grant, M. L., Huggett, C., Willetts, J., & Wilbur, J. (2017). Gender Equality and Goal 6: The Critical Connection. Australian Water Partnership. HYPERLINK "https://opus.lib.uts.edu.au/bitstream/10453/115346/1/Gender-Goal6-Critical-Connection.pdf" Accessed on 28th September

Hartung, H. (2006). Local financing mechanisms for roofwater harvesting in Uganda. Waterlines-London-, 24(4), 8.

Hatibu, N., Mutabazi, K., Senkondo, E. M., & Msangi, A. S. K. (2006). Economics of rainwater harvesting for crop enterprises in semi-arid areas of East Africa. Agricultural Water Management, 80(1-3), 74-86.

ICRAF (2013). World Agroforestry Centre. Farmer Managed-Natural regeneration. How to regenerate pasture and farmland on a low budget. Nairobi.

IDRC (1983). IDRC annual report 1982-1983. Ottawa, Ont. 77 p. /Annual report. https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/37044/ar1982-83.pdf?sequence=1&isAllowed=y accessed on 30th May 2021

Jogo, W., Karamura, E., Tinzaara, W., Kubiriba, J., & Rietveld, A. (2013). Determinants of Farm-Level Adoption of Cultural Practices for Banana Xanthomonas Wilt Control in Uganda. Journal of Agricultural Science. Retrieved from http://www.bioversityinternational.org/fileadmin/_migrated/uploads/tx_news/Determinants_of_farm-level_adoption_of_cultural_practices_for_banana_xanthomonas_wilt_control_in_Uganda_1754.pdf

JWESSP (2013). Joint Water and Environment Sector Support Programme 2013-2018 https://www.mwe.go.ug/sites/default/files/Final%20JWESSP%20Programme%20Document%20-April%202013.pdf Accessed on 26th May 2021

Kiggundu, N., Wanyama, J., Mfitumukiz, D., Twinomuhangi, R., Barasa, B., Katimbo, A., & Kyazze, F. (2018). Rainwater harvesting knowledge and practice for agricultural production in a changing climate: A review from Uganda's perspective. Agricultural Engineering International: CIGR Journal, 20(2), 19-36.

Kimera, F. (2018). Economic benefits of surface runoff harvesting for supplemental irrigation for sub-saharan Africa: Case study of Soroti, Uganda. [Master's thesis, the American University in Cairo]. AUC Knowledge Fountain. HYPERLINK "htt-

ps://fount.aucegypt.edu/cgi/viewcontent.cgi?article=1472&context=etds"Accessed on 29th September 2020

Lee M.D. and Visscher J.T. (1990). Water harvesting in five African countries. Occasional Paper 14 UNICEF IRC. The Hague, Netherlands.

MAAIF (2015). Uganda National Seed Strategy 2014/15 – 2019/20. Entebbe. Retrieved from http://extwprlegs1.fao.org/docs/pdf/uga175068.pdf

MAAIF (2016). Agriculture Sector Investment Plan 2015/16-2019/20. Entebbe. Retrieved from https://www.agriculture.go.ug/wp-content/uploads/2019/05/Agriculture-Sector-Strategic-Plan-ASSP.pdf

MAAIF (2018). National Seed Policy. Entebbe. Retrieved from http://agriculture.go.ug/wp-content/uploads/2019/05/Ministry-of-Agriculture-Animal-Industry-and-Fisheries-National-Seed-Policy.pdf

MAAIF and MWE (2015). Uganda Climate Smart-Agriculture Country Program 2015-2025. Kampala. https://hdl.handle.net/10568/76225. Accessed on 13th November 2019

MAAIF & MWE. (2017). National Irrigation Policy: Agricultural Transformation Through Irrigation Development. Entebbe. Retrieved from https://www.mwe.go.ug/sites/default/files/library/Uganda National Irrigation Policy.pdf Accessed on 29th May 2021

Malesu, M. A., Oduor, K., Cherogony, D., Nyolei, D., Gachene, C. K. K., & Karuma, A. (2010). Investing in rainwater harvesting to boost food security in East Africa. Icraf HQs, Nairobi.

Martinson, B., & Thomas, T. (2003). Economically viable domestic roof-water harvesting. In Sustainable environmental sanitation and water services (pp. 281-284). WEDC.

MWE (2014). Ministry of Water and Environment. Climate change mainstreaming guidelines, 2014. Kampala. Available at: http://ccd.go.ug/wp-content/uploads/2018/04/National-Climate-Change-Mainstreaming-Guidelines-.pdf

MWE (2015). Economic assessment of the impacts of climate change in Uganda. Final Report.

MWE (2015). Ministry of Water and Environment. Uganda National Climate Change Policy. Available at:https://www.mwe.go.ug/sites/default/files/library/National%20Climate%20Change%20Policy%20April%202015%20final.pdf

MWE (2016). Ministry of Water and Environment. Forestry Landscape Restoration Opportunity Assessment for Uganda. Kampala. https://portals.iucn.org/library/sites/library/files/documents/2016-076.pdf

MWE (2017). Uganda National Report, Water Supply Atlas. https://www.mwe.go.ug/sites/default/files/library/Atlas%202017_1_Introduction.pdf. Accessed on

MWE (2017a). Ministry of Water and Environment. Forestry Investment Program (FIP). Kampala. Available at: https://mwe.go.ug/sites/default/files/library/FINAL%20FIP%20Uganda%20draft%20%28Version%203rd%20May%29.pdf

MWE (2017b). Ministry of Water and Environment. National Environment Management Policy for Uganda (draft, 2017). Kampala.

MWE (2017c). Ministry of Water and Environment. National Reducing Emissions from Deforestation and Forest Degradation (REDD) + strategy for Uganda. Kampala. https://www.mwe.

go.ug/sites/default/files/Uganda%20National%20REDD%2B%20Strategy_0.pdf. Accessed on 23rd May 2021

MWE (2019). Uganda's First Biennial Update Report to the United Nations Framework Convention on Climate Change. Ministry of Water and Environment, Kampala.

MWE (2019). Water and Environment Improving livelihoods through Water for Production. HYPERLINK "https://www.mwe.go.ug/sites/default/files/library/Improving%20Livelihoods%20through%20Water%20for%20Production.pdf" Accessed on 29th September 2020

MWE JICA (2011). The Development study on water resources development and management for Lake Kyoga Basin. https://openjicareport.jica.go.jp/pdf/12025227_02.pdf https://openjicareport.jica.go.jp/pdf/12025219_01.pdf Accessed on 30th May 2021

MWE MPS (2020). Water and Environment Ministerial Policy Statement HYPERLINK "https://www.csbag.org/download/ministerial-policy-statement-of-the-ministry-of-water-and-environment-for-fy-2020-21/" accessed on 26th September 2020

MWE NIMP (2011). A National Irrigation Master Plan for Uganda (2010-2035). Water for Production Strategy and Investment plan file:///C:/Users/Royrital/Downloads/a-national-irrigation-master-plan-for-uganda-_compress.pdf https://silo.tips/queue/a-national-irrigation-master-plan-for-uganda?&queue_id=-1&v=1622037034&u=MTU0LjIyNi4xNzQuMTU2 Accessed on 26th May 2021

MWE SSIP (2018). Water and Environment Sector Strategic Investment Plan 2018 HYPERLINK "https://www.mwe.go.ug/sites/default/files/library/Water%20and%20Environment%20Sector%20Investment%20Plan%20%202018.pdf" Accessed on 25th September 2020

MWLE (1999). National Water Policy 1999. HYPERLINK "http://extwprlegs1.fao.org/docs/pdf/uga158331.pdf" Accessed on 29th September 2020

MWLE (2001). Ministry of Water, Lands and Environment. National Forestry Policy, (2001).

Mzirai O.B and S.D. Tumbo (2010). Macro-catchment rainwater harvesting systems: challenges and opportunities to access runoff. Journal of Animal & Plant Sciences. Vol. 7, Issue 2: 789-800. Publication date: 29/06/2010, HYPERLINK "http://www.biosciences.elewa.org/JAPS" http//www.biosciences.elewa.org/JAPS ISSN 2071 - 7024 789 JAPS

NAES (2016). National Agricultural Extension Strategy.

Naluwairo, R. (2006). From concept to action: the protection and promotion of farmers rights in East Africa. Kampala: ACODE. Retrieved from https://media.africaportal.org/documents/Farmers_Book_Final.pdf

NAPA (National Adaptation Program of Action) (2007). National Adaptation Program of Action on Climate Change in Uganda. http://www.preventionweb.net/english/policies/v.php?id=8578&cid=180. Accessed on

NAP-Ag (National Adaptation Plan for Agriculture) MAAIF (2018). National Adaptation Plan for Agricultural Sector. November 2018.https://www.agriculture.go.ug/wp-content/uploads/2019/09/National-Adaptation-Plan-for-the-Agriculture-Sector-1.pdf. accessed on 23rd May 2021

NDC (Nationally Determined

Contribution) MWE (2016). Uganda's Nationally Determined Contribution HYPERLINK "https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Uganda%20First/INDC%20Uganda%20final%20%2014%20October%20%202015.pdf"

NPA (National Planning Authority) (2007). Uganda Vision 2040. National Planning Authority. Kampala. http://npa.go.ug/wp-content/themes/npatheme/documents/vision2040.pdf. Accessed on 10th May 2021

NPA (National Planning Authority) (2015). The Second National Development Plan. National Planning Authority. Kampala. http://npa.ug/wp-content/uploads/NDPII-Final.pdf Accessed on 10th May 2021

NPA (2017). National Planning Authority. Uganda's green Growth Development Strategy, 2017/18-2030/2031. National Planning Authority, Kampala. http://npa.ug/wp-content/uploads/2017/11/Uganda-GGDS-FINAL.pdf

NPA (2020) National Development Plan (NDP III) HYPERLINK "http://www.npa.go.ug/wp-content/uploads/2020/08/NDPIII-Finale_Compressed.pdf" Accessed on 28th September 2020

Nsubuga, F. N., Namutebi, E. N., & Nsubuga-Ssenfuma, M. (2014). Water resources of Uganda: an assessment and review. Journal of Water Resource and Protection, 6(14), 1297.

Pimentel, D. (1986). Status of integrated pest management. In: Pimentel, D. Some aspects of integrated pest management. Department of Entomology, Cornell University, Ithaca, NY.

Purcell, R. (1997). Potential for small-scale irrigation in sub-Saharan Africa: The Kenyan example. Irrigation Technology Transfer in Support of Food Security. Water Reports – 14. Proceedings of a sub-regional workshop. Harare, Zimbabwe 14-17 April 1997. FAO Rome.

Republic of Uganda (2010). The National Policy for Disaster Preparedness, 2010. https://www.ifrc.org/docs/IDRL/Disaster%20Policy%20for%20Uganda.pdf Accessed on 12th May 2021

Rugumayo, A. (2016). Rural water service delivery and innovations in Uganda. Ensuring availability and sustainable management of water and sanitation for all. 39th WEDC International Conference, Kumasi, Ghana, 2016. Loughborough University.

Rusoke CGA, Nyakuni A, Mwebaze S, Okorio J, Akena F, Kimaru G. (2000). Land Resources Management: A Guide for extension workers in Uganda. RELMA Technical Handbook Series 20. Nairobi, Kenya: Regional Land Management Unit (RELMA), Swedish International Development Cooperation Agency (Sida).

SDP MWE (2015-2020). Water and Environment Sector Development Plan http://npa.go.ug/wp-content/uploads/2018/01/Water-and-Environment-Sector-Development-Plan-2020new.pdf Accessed on 27th May 2021

Sivanappan, R. K. (1997). Technologies for water harvesting and soil moisture conservation in small watersheds for small-scale irrigation. Irrigation Technology Transfer in Support of Food Security. Water Reports – 14. Proceedings of a sub-regional workshop Harare, Zimbabwe

14-17 April 1997. FAO Rome. HYPERLINK "http://www.fao.org/3/w7314e/w7314e0q.htm" http://www.fao.org/3/w7314e/w7314e0q.htm Accessed on 29th September 2020

Sloots, R. (2010). Assessment of groundwater investigations and borehole drilling capacity in Uganda. Government of Uganda (MWE) and UNICEF.

SNC (Second National Communication) (2014). Uganda Second National Communication to the United Nations Framework Convention for Climate Change. https://unfccc.int/resource/docs/natc/uganc2.pdf. Accessed on 26th May 2021

SPR MAAIF (2018). Agriculture, Animal Industry and Fisheries Performance Report 2017-18. https://www.agriculture.go.ug/wp-content/uploads/2020/06/MAAIF-Annual-Performance-Report-2017-18.pdf

SPR MWE (2008). Water and Environment Sector Performance Report 2008. HYPERLINK "https://www.ircwash.org/sites/default/files/UgandaMWE-2008-Water.pdf"Accessed on 28th September 2020

SPR MWE (2018). Water and Environment Sector Performance Report 2018. HYPERLINK "https://www.mwe.go.ug/sites/default/files/library/SPR%20 2018%20%20FINAL_0.pdf"

SPR MWE (2019). Water and Environment Sector Performance Report 2019. HYPERLINK "https://www.mwe.go.ug/sites/default/files/library/SPR%20 FINAL%20BOOK%202019.pdf" Accessed on 26th September 2020

SPR MWE, (2020) Water and Environment Sector Performance Report 2020 https://www.mwe.go.ug/sites/default/files/library/Water%20 and%20Environment%20Sector%20 Performance%20Report%202020.pdf Accessed on 26th May 2021

Ssejjoba, E. (2018). Seed dealers call for improved inspection of seed. Retrieved from New Vision: https://www.newvision.co.ug/news/1482479/seed-dealers-improved-inspection-seed

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., & Smith, J. (2008). Greenhouse gas mitigation in agriculture. Philosophical transactions of the royal Society B: Biological Sciences, 363(1492), 789-813.

Souchon Y. & Tissot L. (2012). Synthesis of thermal tolerances of the common freshwater fish species in large Western Europe rivers. Knowledge and Management of Aquatic Ecosystems, (405), 03.

Staddon, C., Rogers, J., Warriner, C., Ward, S., & Powell, W. (2018). Why doesn't every family practice rainwater harvesting: Factors that affect the decision to adopt rainwater harvesting as a household water security strategy in central Uganda. Water International, 43(8), 1114-1135.

Taylor, R. G., Koussis, A. D., & Tindimugaya, C. (2009). Groundwater and climate in Africa—a review. Hydrological Sciences Journal, 54(4), 655-664.

Temesgen, B. B. (2012). Rainwater harvesting for dryland agriculture in the Rift Valley of Ethiopia. HYPERLINK "https://research.wur.nl/en/publications/rainwater-harvesting-for-dryland-agriculture-in-the-rift-valley-o" Accessed on 29th September 2020

Theis, S., Lefore, N., Meinzen-Dick, R., & Bryan, E. (2017). What happens after technology adoption? Gendered aspects of small-scale irrigation technologies in Ethiopia, Ghana, and Tanzania. https://mail.wocan.org/sites/default/files/What%20Happens%20after%20 Technology%20Adoption_IFPRI2017.pdf Accessed on 30th May 2021

Tiwari, A. (2017). Plant Breeding: A Prospect in Developing World. ECronicon. Retrieved from https://www.researchgate.net/publication/318469005_Plant_Breeding_A_Prospect_in_Developing_World

TNA Barrier Analysis and Enabling

Framework Report (2020). Technology Needs Assessment Report for Climate Change Adaptation. TNA report for Climate Change Adaptation in the Agriculture, Forestry and Water Sectors of Uganda. The Republic of Uganda. https://tech-action.unepdtu.org/wp-content/uploads/sites/2/2021/01/adaptation-report-baef-uganda.pdf Accessed on 26th May 2021

Toro, F. (2014). Fake seeds force Ugandan farmers to resort to 'bronze age' agriculture. Retrieved from The Guardian: https://www.theguardian.com/sustainable-business/counterfeit-fake-seeds-uganda-farmers-crop-failure

Tuhairwe , H. (2017). Farmers' Rights and Plant Variety Protection in Uganda: Considerations and Opportunities. Journal of Intellectual Property Law & Practice Volume 12, Issue 12, 1004–1011. Retrieved from https://ssrn.com/abstract=3021734

UBOS, (Uganda Bureau of Statistics) (2016). National Population and Housing Census 2014. Main report. Kampala Uganda. https://www.ubos.org/wp-content/uploads/publications/03_20182014_National_Census_Main_Report.pdf Accessed on 26th May 2021

UBOS (Uganda Bureau of Statistics) (2018). Uganda National Household Survey (UDHS) 2016/2017. Kampala, Uganda; UBOS HYPERLINK "https://www.ubos.org/wp-content/uploads/publications/03_20182016_UNHS_FINAL_REPORT.pdf"

UGGS (2019). The Uganda Green-growth Strategy 2017/18 – 2030/31.

UMC Uganda Media Centre (2019). MAAIF Cautions Nation on Escalated Counterfeit Agro-Inputs. https://www.mediacentre.go.ug/media/maaif-cautions-nation-escalated-counterfeit-agro-inputs Accessed on 30th May 2021

UNESCO (2006). National Water Development Report; Uganda (NWDR, 2006), UN-WATER/WWAP/2006/9 HYPERLINK "https://unesdoc.unesco.org/ark:/48223/pf0000146760" Accessed on 28th September 2020

UNFCCC (United Nations Framework to Combat Climate Change) (2019). Differentiated impacts of climate change on women and men; the integration of gender considerations in climate policies, plans and actions; and progress in enhancing gender balance in national climate delegations. FCCC/SBI/2019/INF.8 https://unfccc.int/sites/default/files/resource/sbi2019_inf8.pdf

UPPC (2003). Uganda Printing and Publishing Corporation. National Forest and Tree Planting Act, 2003. The Uganda Gazette No. 37, Volume XCVI, dated 8th August, 2003.

UPPC (2019). Uganda Printing and Publishing Corporation. National Environment Act, 2019. The Uganda Gazette No. 10, Volume CXII, dated 7th March, 2019. Entebbe.

UPPC (2020). Uganda Printing and Publishing Corporation. National Climate change Bill, 2020. The Uganda Gazette No. 8, Volume CXIII, dated 7th February, 2020. Entebbe.

USAID (2013). Uganda Climate Change Vulnerability Assessment Report. https://www.climatelinks.org/sites/default/files/asset/document/ARCC-Uganda%2520VAReport.pdf. Accessed on 6th May 2021

Van Steenbergen, F., & Luutu, A. (2012). Managed groundwater development in Uganda. HYPERLINK "https://metameta.nl/wp-content/uploads/2012/09/Managed_Groundwater_Development_in_Uganda.pdf"Accessed 28th September 2020

Vikneswaran, M., & Razak, M. A. (2015). Study on Surface Runoff Harvesting for Sustainable UPNM Campus. International Journal of Applied Engineering Research, 10(95).

World Bank (2018). Closing the Potential-Performance Divide in Ugandan Agriculture: Fact Sheet. https://www.worldbank.org/en/country/uganda/publication/closing-the-potentialperformance-divide-in-ugandan-agriculture-fact-sheet. Accessed on 19th May 2021

World Bank (2019). Agriculture forestry and fishing, value added (%GDP) – Uganda. World Bank National Accounts data and OECD Accounts data files. https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=UG, Accessed June 22, 2020.

Annex 1. List of stakeholders

Work at this stage was based on document review and application of advice and guidance from consultations done during the prioritization and barrier analysis stages. Stakeholders could not be convened for validation of the findings due to COVID-19 restrictions and connectivity challenges. The list provided herewith is that of stakeholders consulted in previous stages on the basis of whose recommendations the action plan was developed supplemented with review of documented sources.

Working group	Name
Agriculture sector working group	Ms. Christine Talwisa
	Dr. Damalie Akwango, National Agricultural Research Organisation
	Ms. Christine Kaaya Parliamentary Forum for Climate Change
	Ms. Deborah Kasule, Uganda National Council for Science and Technology
Water sector working group	Ms. Ashabrick N. Bamutaze Rural Water & Sanitation Dept, Ministry of Water and Environment (MWE)
	Mr. Brian Ssemakula, Directorate of Water, MWE
	Prof John-Baptist Kaddu, Makerere University
Forestry sector working group	Mr. Xavier Mugumya National Forestry Authority
	Prof. Joseph Obua CAES, Makerere University
	Dr. Robert Nabanyumya Green Approaches
	Mr. A. Kalema Private Sector
	Dr. Hilary Agaba, National Forestry Resources Research Institute
	Chief Executive Officer Uganda Timber Growers Association

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