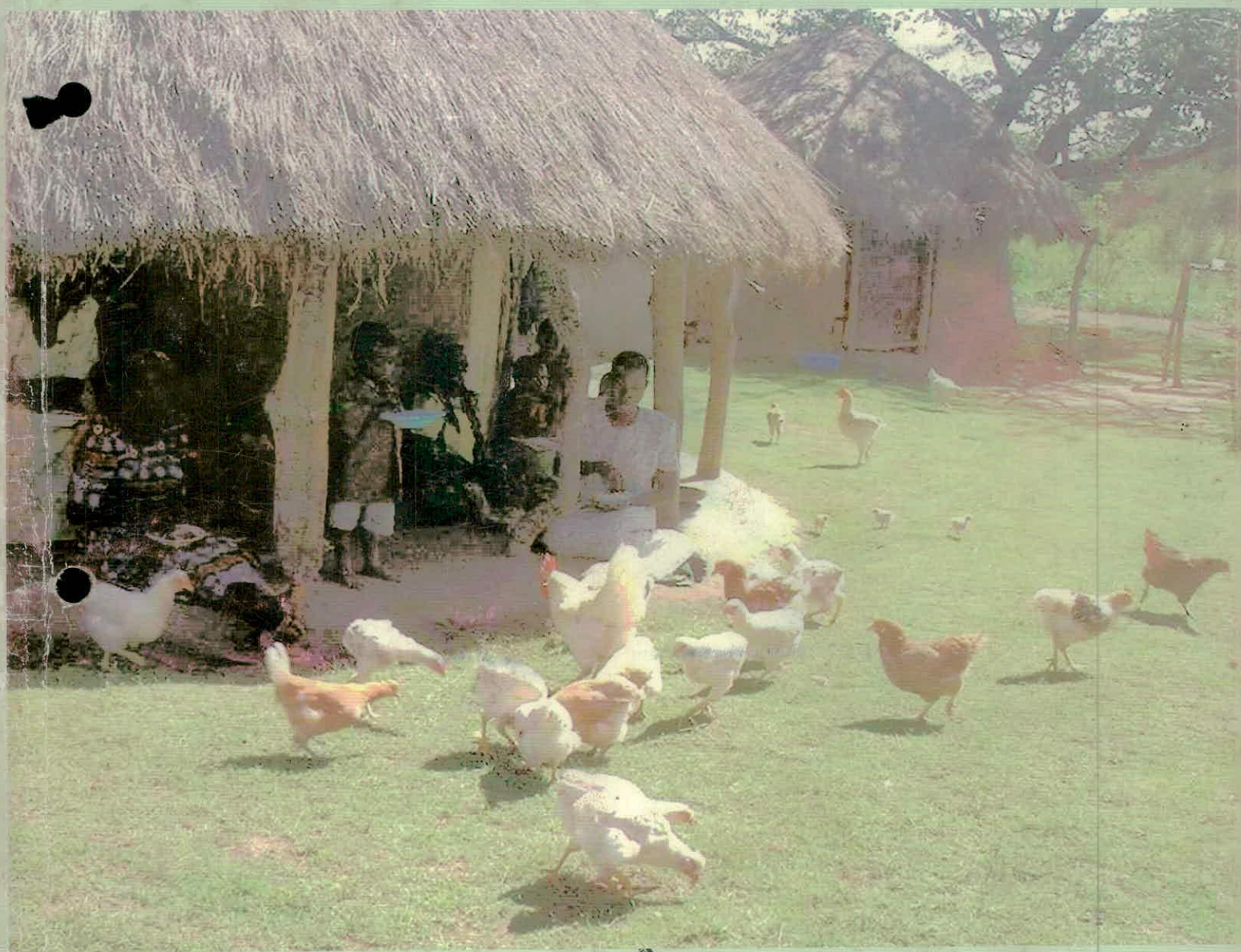
Addressing the Challenges of Poverty Eradication and Modernisation of Agriculture

Improved Technologies by NARO, 1992 - 2002



NARO

National Agricultural Research Organisation

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Addressing the Challenges of Poverty Eradication and Modernisation of Agriculture

Improved Technologies by NARO, 1992 -2002

National Agriculture Research Organisation

Foreword

The National Agricultural Research Organisation (NARO) was established in Uganda with a mandate to undertake, promote and coordinate research in all aspects of crops, fisheries, forestry and livestock, and to ensure dissemination and application of research results throughout the country. Recent changes in Government policies, as expressed in the Plan for Modernisation of Agriculture, place emphasis upon commercialisation, privatisation, decentralisation and broader participation in the provision of agricultural services, including research. NARO welcomes these challenges and feels they will greatly contribute to the utilisation of technologies and methods which NARO and others have developed over the past decade to the benefit of large numbers of producers and consumers. This technology inventory should also contribute to the greater utilisation of improved technologies, by increasing awareness of what is currently available.

This technology inventory summarises the major agricultural technologies developed by NARO from 1992 to 2002. Further information on many of these are available from NARO's Research Institutes, District Agricultural Offices and elsewhere, in the form of leaflets, brochures, posters, etc. One of the core functions of public research institutes in Uganda is to promote agricultural information to agricultural advisers, farmers and other end-users; and this inventory will help potential users to be aware of the improved technologies currently available. With this awareness, farmer groups will be better able to demand advisory services from their agricultural advisers.

It is my sincere hope that the information provided in this inventory will contribute to the development of a farmer-driven, demand-led agricultural research and advisiory services in Uganda.



Dr. George William Otim-Nape
Ag. Director General, NARO

Acknowledgement

This Technology Inventory is a product of a team effort of the Client-oriented Agricultural Research and Dissemination Project at the Serere Agriculture and Animal Research Institute. It was compiled by Florence Imaikorit-Oumo, David Rees, Thomas Areke and Nathan Nangoti from SAARI.

We would like to thank the Director General, NARO, for his support, and DFID for funding the work. We also wish to acknowledge the technical support provided by AEATRI, CORI, FIRRI, FORRI, FOSRI, LIRI, NAARI, KARI and SAARI. Above all, many thanks go to COARD project staff who actively participated in proof reading and refining the document.

List of abbreviations/Acronyms

ACMD	African Cassava Mosaic Disease
AEATRI	Agricultural Engineering and Appropriate Technology Research Institute
CNp	Cyanogenic potential
COARD	Client Oriented Agricultural Research and Dissemination
CORI	Coffee Agricultural Research Institute
DFID	Department of International Development
DBM	Diamond Black Moth
ETL	Economic Thresh Level
F. System	Farming System
FIRRI	Fisheries Resource Research Institute
FORRI	Forestry Resource Research Institute
FOSRI	Food Science Research Institute
GOT	Ginning Out Turn
IPM	Integrated Pest Management
KARI	Kawanda Agricultural Research Institute
LIRI	Livestock Industry Research Institute
NAARI	Namulonge Agricultural and Animal Research Institute
NABE	Namulonge Bean
NARO	National Agricultural Research Organisation
NASE	Namulonge Serere selections
NASPOT	Namulonge Sweet Potato
MSV	Maize Streek Virus
PMA	Plan for Modernisation of Agriculture
SAARI	Serere Agricultural and Animal Research Institute
CNP	Cyanogenic Potential

Table of Contents

Foreword i
Acknowledgements ii
List of abbreviations/acronyms iii
Introduction. 1

SECTION 1: CROPS 2
Cassava 3
Varieties 3
Management 4
Post-harvest and storage 4
Sweet Potatoes 5
Varieties 5
Management 6
Post-harvest and storage 6
Irish Potato 6
Varieties 6
Maize 7
Varieties 7
Management 7
Post-harvest and storage 8
Beans 9
Varieties 9
Management 10
Post-harvest and storage 11
Rice 11
Varieties. 11
Finger millet 12
Varieties. 12
Management. 12
Post-harvest and storage. 12
Pearl millet 13
Varieties. 13
Management. 13
Post-harvest and storage. 13
Sorghum 14
Varieties 14
Management 14
Post-harvest and storage. 14
Groundnut 15
Varieties 15
Management 15
Post-harvest and storage 16
Simsim 16
Varieties 16

Management 16
Post-harvest and storage 17
Sunflower 17
Varieties 17
Management 17
Post-harvest and storage 18
Cowpeas 18
Varieties 18
Management 18
Post-harvest and storage 18
Pigeon Pea 19
Varieties 19
Post-harvest and storage 19
Cotton 20
Varieties 20
Management 20
Post-harvest and storage 21
Banana 22
Cultivars 22
Management 23
Post-harvest & storage 23
Mango 25
Varieties 25
Management 26
Avocado 26
Varieties 26
Orange 27
Varieties 27
Fruit Post harvest and Storage 27
Cabbage and other Brassica 28
Management 28
Hot pepper and Cayenne 29
Management 29
Okra 29
Management 29
Pineapple 29
Post-harvest and storage 29
Passion Fruit 30
Post-harvest and storage 30
Coffee 30
Post-harvest and storage. 30

SECTION 2: FORESTRY. **31**
Natural forestry 32
Management 33
Plantation forestry 35

Management of *Leucaena psyllid* 35
Species 35
Management 35
Fire management 37
Agro-forestry 38
Species 38
Management 38
Processing 40

SECTION 3: LIVESTOCK. **41**
Cattle 42
Breeds 42
Management 42
Cattle health 43
Vectors 44
Human health 44
Goat 45
Breed 45
Management 45
Goat health 45
Pig 45
Management 45
Chicken 46
Breed 46
Management 46
Poultry health 46

SECTION 4: FISHERIES **47**
Capture Fisheries 48
Fish farming 50
Breeding 50
Pond Management 50
Harvesting 50

SECTION 5: FARM MACHINERY **51**
Farm power 52
Conservation farming 52
Processing equipment 53
Household energy systems 53
Water harvesting and utilization 53

SECTION 6: SOIL. **54**
Soil conservation 55
Soil conservation (liquid manure-tea) 56

SECTION 7 OTHERS **56**

Introduction

Technologies are the building blocks for development. Through partnerships with the many and varied development workers active in developing Uganda, improved agricultural technologies will lead to agricultural transformation and improved livelihoods. NARO is proud to be contributing to these processes through its development of improved agricultural technologies.

In this context we define agricultural technologies as the products and processes of research which result into agricultural outputs. Examples of improved agricultural technologies include improved crop varieties, animal breeds, farm implements, production methods and practices. This technology inventory lists the technologies developed by NARO up to December 2003. They are organised into sections on crops, livestock, fisheries, forestry, farm machinery, soils and "other", in that order. Each section is further subdivided into product/practice, applicable farming system, and research institute where more information about the technology can be obtained.

The detailed contact addresses for each Research Institute are as follows;

The Director of Research Institute
Agricultural Engineering and Appropriate Technology Research Institute
P. O. Box 7144,
Kampala
Tel: 041 566161
E mail: aeatri@starcom.co.ug

The Director of Research Institute
Fisheries Resource Research Institute
P. O. Box 343,
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Tel: 041 22071
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The Director of Research Institute
Forestry Resource Research Institute
P. O. Box 1752,
Kampala
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E mail: forri.af@utlonline.co.ug

The Director of Research Institute
Food Science Research Institute
P O Box 1752,
Kampala
Tel: 041 222657
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The Director of Research Institute
Coffee Research Institute
P.O. Box 185, Mukono,
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The Director of Research Institute
Kawanda Agricultural Research Institute
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The Director of Research Institute
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Tororo
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The Director of Research Institute
Namulonge Agricultural and Animal Research Institute
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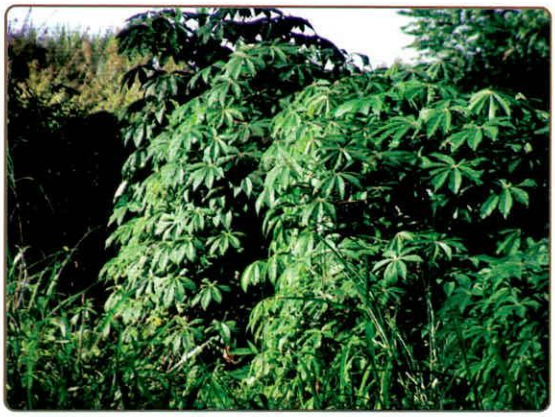
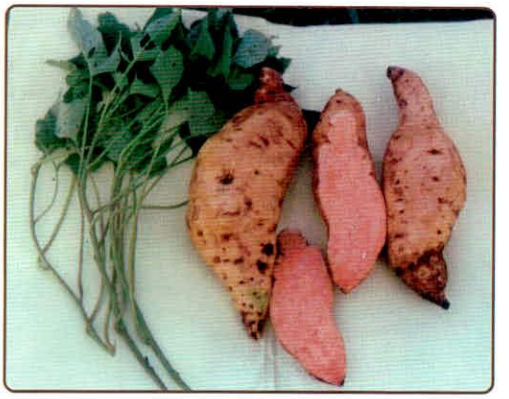
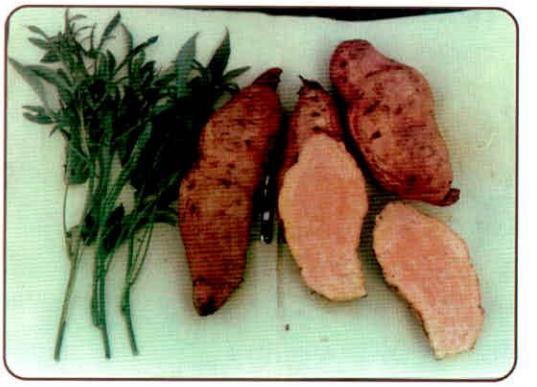
SECTION 1
CROPS

Product/Practice	F System	Institute
Cassava		
 		
Varieties ▸ NASE 1 (TMS 60142) matures in 14 months and yields 23 t/ha. It is resistant to Cassava Mosaic Disease (CMD) and low in cyanogenic potential (CNp) ▸ NASE 2 (TMS 30337) matures in 14 months and yields 27 t/ha. It is resistant to CMD and low in CNp ▸ NASE 3 (TMS 30572) matures in 12 months and yields 26 t/ha. It is resistant to CMD ▸ NASE4 (SS4) matures in 12 months and yields 50t/ha. It is resistant to CMD ▸ NASE 5 (SS5) matures in 12 months and yields 40 t/ha. It is resistant to CMD and low in cyanogenic potential (CNp). ▸ NASE 6 (TMS 4 (2) 1425) matures in 12 months and yields 35 t/ha. It is resistant to CMD and low in CNp. ▸ NASE 7 (CE 85) matures in 12 months and yields 45 t/ha. It is resistant to CMD and low in CNp. ▸ NASE 8 (CE 98) matures in 12 months and yields 40 t/ha. It is resistant to CMD and low in CNp. ▸ NASE 9 (TMS 30555-17) matures in 12 months and yields 45 t/ ha. It is resistant to CMD. ▸ NASE 10 (00063) matures in 12 months and yields 35 t/ ha. It is highly resistant to CMD and low in CNp. ▸ NASE 11 (TC 1) matures in 12 months and yields 35 t/ ha. It is resistant to CMD and low in CNp. ▸ NASE 12 (TME 14) matures in 12 months and yields 40 t/ ha. It is highly resistant to CMD and low in CNp. TME 204	West Nile, Acholi, Lango, Teso, Bunyoro, Busoga and L.Victoria Crescent.	NAARI

Product/Practice	F System	Institute
Management ▸ Prepare land when soils are moist and cultivate deeply. ▸ Obtain stem cuttings for planting from pest/disease free ▸ Mature plants (8-18 months old), Do not use bruised or sprouted stems. ▸ Cuttings should have 5-7 nodes to increase chances of sprouting. ▸ Plant one cutting (20 - 30cm long) at a depth of 5-20cm. ▸ Space 1m within and between rows. ▸ Plant just before rains or shortly after the start of the rains to enable cuttings sprout and establish well. ▸ Weed whenever weeds appear, Cassava is particularly susceptible to weeds in the first four months after planting. ▸ Use resistant or tolerant varieties to control Cassava Mosaic Disease (CMD). ▸ Plant on ridges to control soil erosion. ▸ Most improved cassava varieties attain optimum yield and mature at 12 months.	All	NAARI
Post-harvest and storage ▸ Avoid damaging the root tubers during and after harvest. ▸ Keep fresh tuber roots under shade or in soil if their use is extended to a period exceeding one day. ▸ Process bitter cassava varieties using manual/ power graters, chippers/slicers, hydraulic press, ▸ Dry in a clean dryer, drying racks, or biomass dryers. ▸ The shelf-life of cassava is prolonged by processing it into bakery and confectionery recipes using a range of processing equipment available on the market. ▸ Parboiling and solarisation for storage pest management. ▸ Storage technologies include cement brick silo, mud-straw and basket granaries and drum hermetic storage. ▸ Store in cool, dry and hygienic place.	All	NAARI

Product/Practice	F System	Institute
Sweet potatoes		
 		
Varieties ▸ Wagaboligye (No. 39) is white/brown fleshed, matures in 150 days and yields 24 t/ ha. ▸ Tanzania is pale yellow/ cream fleshed, matures in 120 days and yields 23 t/ha. ▸ Bwanjule (No. 29) is white/red fleshed, matures in 150 days and yield 21 t/ha. ▸ Sowola (389A) is cream/brown fleshed, matures in 120 days and yields 26 t/ha.	Teso, Lango, Acholi	NAARI
▸ NASPOT 5 (NIS/91/324) is orange/cream fleshed, matures in 150 days and yields 30 t/ha. It is high in Vitamin A. ▸ NASPOT 6 (NIS/91/324) is white/cream fleshed, matures in 120 days and yields 28 t/ha.	L. Victoria Crescent	
▸ New Kawogo (NKA) is white/red fleshed, matures in 150 days and yields 23 t/ ha.	L. Victoria agro - ecological zone	NAARI
▸ NASPOT 1 (NIS/9/52) is pale yellow/cream fleshed, matures in 120 days and yields 45 t/ha.	Except highland	NAARI
▸ NASPOT 2 (NIS/91/178) is white/red fleshed, matures in 120 days and yields 33 t/ha. ▸ NASPOT 3 (NIS/91/218) is cream/brown fleshed, matures in 150 days and yields 29 t/ha. ▸ NASPOT 4 (NIS/91/282) is pale/yellow fleshed, matures in 120 days and yields 28 t/ha.	Short and tall grasslands	NAARI

Product/Practice	F System	Institute
Management ▸ Plant 3 vines per mound or 1 vine for every 30 cm on ridges for maximum yield. ▸ Use rapid multiplication methods to increase availability of healthy vines and varieties in short supply. ▸ Use resistant varieties to control sweet potato virus diseases and alternaria wilt. ▸ Plant on ridges to control soil erosion. ▸ Use organic manure to improve soil fertility. ▸ Practice crop rotations, early planting, earthing up. ▸ Harvest early, Destroy crop residues and volunteer plants to control weevils. ▸ Remove caterpillars and nests by hand. ▸ Use recommended insecticides to control serious attacks of sweet potato butterfly.	All	NAARI
Post-harvest and storage **Processing:** ▸ Drum washers. ▸ Sweet potato manual slicers. ▸ Process into sweet potato based snack products (mandazi, chapatti, buns, cakes, crisps, and cookies) to increase self-life and value. ▸ You can use three different forms of sweet potato (fresh grated, boiled mashed and flour) Incorporate in a proportion of 30 - 60%. Hand slice. Bake in improved local ovens. **Drying:** ▸ Stabilised drying yards. ▸ Raised drying racks. ▸ Bio-mass and commercial dryers. ▸ Cement-brick and cassava flour binder and stabliser – bricks.	All	KARI
Irish Potato		
Varieties ▸ Malirahinda is white/cream/red, fleshed matures in 110 days and yields 15 t/ha. ▸ Victoria (381381.2) is light yellow/red, fleshed matures in 90 days and yields 2t/ha. ▸ Kisoro (381379.9) is cream fleshed matures in 100 days and yields 20 t/ha.	Highlands	NAARI

Product/Practice	F System	Institute
▸ Kabale (374080.5) is cream fleshed matures in 120 days and yields 30 t/ha. ▸ NAKPOT 1 (382171.4) is white/cream and matures in 100 days and yields 38 t/ha.	Lowlands using seed from highlands	NAARI

Maize





Varieties ▸ Longe1 is a composite variety, matures in 120 days, yields 5 t/ha and is resistant to Maize Streak Virus(MSV). ▸ Longe 4 is a composite variety, matures in 105 days, yields 4t/ha and is resistant to drought and MSV. ▸ Longe 5 is a composite variety, matures in 120 days, yields 5 t/ha is resistant to MSV and has a high protein content. ▸ Longe 2H is a hybrid variety, matures in 125 days, yields 8 t/ha and is resistant to MSV. ▸ Longe 3H is a hybrid, matures in 125 days, yields 8 t/ha and is resistant to MSV. ▸ PAN 67, SC 627 and SC 407 are other hybrid varieties.	Lake Victoria Crescent, Busoga, Masindi, Kamwengye, Kapchorwa	NAARI
Management ▸ Plant in good seed beds at a seed rate of 20 kg/ ha and at a spacing of 75 x 30 cm for one plant per hole and 75 x 60cm for two plants per hole. ▸ Keep weed free. Weed at least twice. Control weeds with pre-emergent chemicals like Lasso Atrazine, Round-up or	All	NAARI

Product/Practice	F System	Institute
Basagrim on big hectarage as per manufacturer's recommendatons. Roundup & Basagrim can be used as pre- emergence to kill hedges and 2,4-D kills broad-leaved weeds. ▸ Apply one bottle cap of DAP per hole at planting and side dress with 2 bottle caps of urea. ▸ Control stem borer using Integrated Pest Management approach: Planting improved varieties, practising crop sanitation, chemical (Sevin 5% or Carbarly) and/or biological control (*Cotesia flavipes* wasp). ▸ Control Maize Streak Virus (MSV), northern leaf blight and grey leaf spot by the use of resistant varieties.	All	NAARI
Post-harvest and storage ▸ Harvest maize when the drying cob turns yellow. Leaving maize in the field after harvest increases chances of weevil infestation. ▸ Store in crib, stabliser brick silos, mud-straw and basket woven granaries and sealed drums. ▸ Dry on drying racks, yards, raised platforms, mats. ▸ Use hand-held, rotary and hand cranked maize shellers, power seed/grain thresher, cleaner/sorter to shell and clean maize. ▸ Use Actellic, Actellic Super and Malathion to control storage pests. ▸ Observe strict store hygiene.	All	NAARI

Product/Practice	F System	Institute
Beans		
		
Varieties ▸ NABE 7C is a climbing variety, suitable where land is limiting. ▸ NABE 8C (Ngwinurare) is a large red- seeded, climbing variety which matures in 110 days, yields 4 t/ha and is suitable where land is limiting. ▸ NABE 9C (Gisenyi) is a white black speckled - seeded, climbing variety, matures in 115 days, yields 3 t/ha and is suitable where land is a big limitation. ▸ NABE 10C (Umubano) is a small red -seeded, climbing variety, matures in 100 days, yields 3.5 t/ha and is suitable where land is limiting. ▸ K131 (MCM 5001) is a bush variety, matures in 90 days and yields 3 t/ha. ▸ K132 (CAL 96) is a large red, mottled- seeded and bush variety. It matures in 80 days and yields 2 t/ha. ▸ K132 (OBA 1) is a bush variety, matures in 90 days and yields 2 t/ha. It is tolerant to low Nitrogen, Phosphorus and manganese toxicity. ▸ NABE 1 is a bush variety. ▸ NABE 2, (MCM 1015) is a black-seeded bush variety, matures in 90 days and yields 2.5 t/ ha. ▸ NABE 3, (MCM 2001) is a red-seeded bush variety, matures in 88 days and yields 2.5 t/ha. ▸ NABE 4 (POA 2) is a red mottled seeded bush variety, matures in 82 days and yields 2.5 t/ha. ▸ NABE 5 (SUG. 73) is a bush variety, matures in 85days and yields 2 t/ha. It lodges under heavy rains. ▸ NABE 6 (UBR 92) 25 ML is a small, white-seeded, bush variety, matures in 90 days and yields 2.5 t/ha.	Teso, Lango, Western L.Victoria Crescent	NAARI

Product/Practice	F System	Institute
Management ▸ Plant on a fine seed bed when there is enough soil moisture. Use a seed rate of 45 kg/ha for small seeded varities and a spacing of 50 x 10 cm or 29 x 20 cm, one plant per hole for large seeded varieties. Plant 2 - 3 cm deep. ▸ Select a site with good soil fertility. ▸ Apply 20 - 40 kg/ha of nitrogen fertilizer (1-2 bags of urea), 30-60 kg/ha of Phosphate (1.3 - 2.6 bags of TSP) and 30 - 60 kg/ha of Potash in equal doses at planting and 6 weeks after planting. Banding application is preferred. Apply organic materials when well decomposed: Farm yard manure (6 - 8 t/ha), Crop residues (8 -10 t/ha) and Green manure (8 - 10 t/ha). ▸ Intercrop beans with crops such as maize, cassava, banana, sorghum. Plant beans at the same time with maize, cassava and sorghum. ▸ Keep beans weed free for the first four to six weeks after planting. ▸ **Control stem maggot** by growing improved tolerant varieties, planting within three weeks at the onset of rain, earthing up and then mulching after first weeding. Apply manure or fertilizer at planting. ▸ **Control aphids and beetles** by spraying with Dimethoate, Primicard, Ambush, Sumithion, Cypermethrin or chlorpyrifos as per the manufacturers'recommendations. ▸ **Control diseases** which attack beans as follows: - Planting resistant or tolerant varieties. - Use clean or disease free seed. Carry out crop rotation and rouging of diseased plants. - Practice proper weed control to eliminate weed reservoirs. - Use organic and inorganic soil amendments to improve soil fertility. - Carry out earthing up three weeks after planting. - Use raised seed beds and deep plowing. - Apply Dithane M4S or Benlate to control fungal diseases. - Control vectors such as aphids.	All	NAARI

Product/Practice	F System	Institute
Post-harvest and storage ▸ Harvest the crop when pods turn yellowish brown before shattering. ▸ Store in cribs, stabliser brick silos, mud- straw, and basket woven granaries and sealed drums. ▸ Use botanicals for pest management (Tobacco and Tagetes). ▸ Dry on drying rocks, stabilised drying racks, bio mass and commercial dryers, cement floor and drying mats. ▸ Use KARI legume thresher, seed/grain cleaner/sorter.	All	NAARI
Rice		
		
Varieties ▸ Abilony is an upland variety, disease resistant and non-shattering. ▸ K 2 is an upland variety, disease resistant and non-shattering. ▸ NP 2 is an upland variety, disease resistant and non-shattering. ▸ NP 3 is an upland variety, disease resistant and non-shattering.	Tororo, Acholi, Lango, Teso Bundibugyo L.Victoria Crescent, Busoga.	NAARI

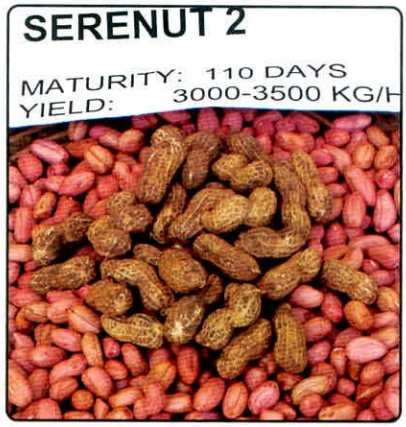
Product/Practice	F System	Institute
Finger millet		
		
Varieties ▸ Pese 1and Seremi 1 are brown seeded varieties. They are high yielding and good for food and local brewing. ▸ Seremi 3 matures between 100 - 110 days and is good for mid - altitude areas. It is a high yielding variety and good for food and local brewing. ▸ Seremi 2 matures in 85 - 90 days and it is good for erratic or short rainfall areas. It is good for food and local brewing.	Teso, Acholi, Lango, Tororo, Ankole, Bunyoro.	SAARI
Management ▸ Plant in a fine seed bed, when there is enough moisture in the soil. Plant at a seed rate of 8 kg per ha, at a spacing of 40 x 5 cm and thin to one plant per hole. ▸ Weed twice as weeds appear. ▸ Scare birds when necessary.	All	SAARI
Post-harvest and storage ▸ Harvest when millet seed is at its real colour. ▸ Store unthreshed in rat proof granaries and/or cool stores.	All	SAARI

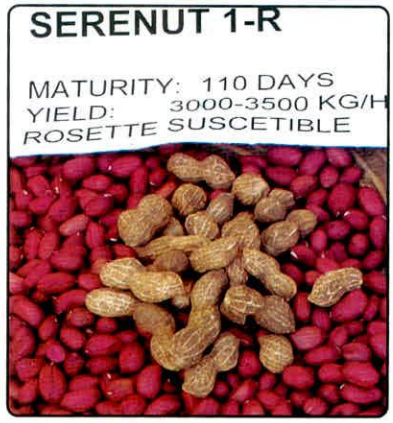
Product/Practice	F System	Institute
Pearl millet		
		
Varieties ▸ Serere Composite 1 and II varieties mature within 90 days and both yield 2 to 2.5 t/ ha. They are both tolerant to drought and they are suitable for food, brewing and livestock fodder.	Teso, Lango Acholi	SAARI
Management ▸ Plant in a fine seed bed, when there is enough moisture in the soil, at a seed rate of 10 kg per ha, space at 60 x 20 cm and thin to two plants per hole. Plant in second rains to avoid massive bird damage. ▸ Weed once a season or as weeds appear.	All	SAARI
Post-harvest and storage ▸ Store unthreshed in rat proof granaries and/or in cool dry stores.	All	SAARI

Product/Practice	F System	Institute
Sorghum		
		
Varieties ▸ Epuripur is a white seeded variety. It matures within 110 days and yields between 2500-3000 kg/ha. It is suitable for milling and brewing. ▸ Sekedo is a brown seeded variety. It matures in 110 days and yields up to 3.5t/ha. It is good for drier areas. It serves very well for household food security.	Teso, Lango, Acholi, West-Nile	SAARI
Management ▸ Plant in a good seed bed, when there is enough moisture in the soil. Plant 10 kg per ha, at a spacing of 60 x 20 cm, then thin to two plants per hole. ▸ Plant in second rains to avoid massive bird damage. ▸ Weed once or as soon as weeds appear. ▸ Control shootfly and stem borer with FENNOM-P, ▸ Cut off smut infected heads and bury them in the soil. ▸ Scare birds starting at milky grain stage. ▸ Harvest when the grain is hard when bitten and/or when the seed has attained its real colour or when a black colour is at the tip of the grain.	All	SAARI
Post-harvest & storage ▸ Dress seed with Monceren to control smuts. ▸ Use drying racks, stabilised drying yards, bio-mass or/and commercial dryers, cement-brick and cassava flour binder. ▸ Use powered and/or KARI legume thresher, seed/grain cleaner/sorter. ▸ Store in stabilised brick silos, mud-straw and basket woven granaries and sealed drums.	All	SAARI

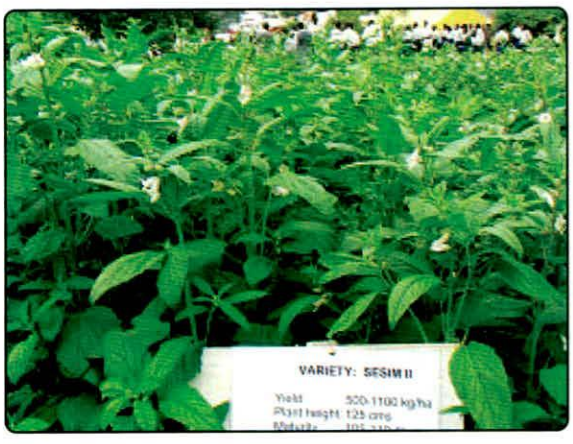
Product/Practice	F System	Institute

Groundnut



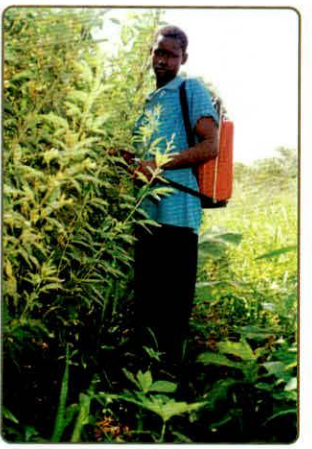


Varieties ▸ Igola 1 is a spreading variety, with an oil content of 46%. ▸ Serenut 1 R is a spreading, red seeded variety with an oil content 41%. It is susceptible to rosette disease. ▸ Serenut 2 is a spreading and tan seeded variety. It has an oil content of 42%. It is resistant to rosette, tolerant to drought and yields up to 3 t/ha. ▸ Serenut 3R is a bunchy red seeded variety. It has an oil content of 47% and matures within 90 to 110 days. It yields up to 2.7t/ ha and it is resistant to rosette disease. ▸ Serenut 4T is a bunchy seed variety. It has an oil content of 43%, matures within 90 to 110 days and yields up to 2.7t/ha. It is resistant to rosette disease.	Teso, Lango, Acholi, Busoga, Masindi Teso	SAARI
Management ▸ Plant in a good seed bed, when there is enough moisture in the soil. Use a seed rate of 90 - 120 kg/ha with a spacing of 45 X10 cm for bunch type and 70 - 100kg/ha with a spacing of 45X15cm for spreading type. Apply SSP or DAP at 100 - 125kg/ha before planting. ▸ Keep crop weed free. The SAARI ox- drawn weeder, and the SAARI ox-plough with the mould board removed, are effective for weeding. ▸ For varieties not resistant to rosette, spray with Rogor, Dimacron, Fenom or Fenkill at 50 - 70mls in 20l of water. Spray 4 times, first at 10 days after planting and preferable after first weeding. Thereafter spray at 10 day intervals.	All	SAARI

Product/Practice	F System	Institute
Post-harvest & storage ▸ Harvest when dark markings inside the shell are seen and the seed attains its real colour. [The SAARI ox-plough with the mould board removed is an effective mechanical harvester. ▸ Use manual groundnut sheller, seed/grain cleaner/sorter to shell, clean and sort groundnuts. ▸ Dry on improved dryers, cement-brick and cassava flour binder. ▸ Store in stablised - brick silos, mud-straw and basket woven granaries and drum-hermetic storage. Store in pods for long term storage.	All	SAARI
Simsim		
 		
Varieties ▸ Sesim 1 is a white seeded variety with an oil content of 45%. It matures in 110 days and yields between 500- 800kg/ha. ▸ Sesim II variety has an oil content of 42% and yields between 600– 900 kg/ha.	Teso, Lango, Acholi, West Nile & Masindi	SAARI
Management ▸ Plant in a fine seed bed, when there is enough moisture in the soil. Plant at seed rate of 6 - 9 kg/ha and at a spacing of 30 x 10 cm. Thin when the crop is 10 -15 cm high, after first weeding. Apply SSP or DAP 100 - 125 kg/ha before planting. Top dress with either CAN or Urea especially at capsule formation. ▸ Weed once or twice as weeds appears. ▸ Control gall midge with FENKILL or Bulldock. Mix 50 - 70 mls	Teso, Lango, Acholi, West Nile & Masindi	SAARI

Product/Practice	F System	Institute
in 20 liters of water. Spray at flowering, bud and capsule formation at 2 week intervals. ▸ Control fungal diseases using Dithane M -45. Mix 45 - 60 gms in 20 liters of water. Spray when there is excessive rain especially at capsule formation.		
Post-harvest & storage ▸ Harvest when crop has shedded leaves but before pod shattering starts. ▸ Use solarisation for pest management, dry on cement-brick and cassava flour binder and stabliser. ▸ Store in brick silos, mud-straw and basket woven granaries and sealed drums.	Teso, Lango, Acholi, West Nile and Masindi	SAARI
Sunflower		
		
Varieties ▸ Sunfola has an oil content of 46%. It matures within 105 - 110 days and yields 500 - 1800 kg/ha. It can be milled for oil as well as livestock feed. ▸ Hybrid 7351 has an oil content of 46.5%. It matures within 105-110 days and yields 1400 - 3500 kg/ha. It is used for oil milling as well as livestock feed.	All	SAARI
Management ▸ Plant in a good seed bed, when there is enough moisture in the soil, at seed rate of 5 - 8 kg/ha. Plant at a spacing of 75 x 50 cm. Thin to one plant per hole when the plants are 15 - 20 cm high. ▸ Weed once or twice as weeds appears. ▸ Scare birds and trap rodents.	All	SAARI

Product/Practice	F System	Institute
Post-harvest & storage ▸ Harvest when apex leaves have turned yellow	All	SAARI
Cowpeas		
		
Varieties ▸ SECOW 1T is a large seeded variety with tan colour. It matures within 90 days and yields 1200 - 1599 kg/ha. ▸ SECOW 2W is large white seeded variety. It matures within 70 - 85 days and yields 1200 -1500kg/ha.	Teso, Lango, Acholi, West Nile & Masindi	SAARI
Management ▸ Plant in a fine seed bed and when there is enough moisture in the soil. ▸ Plant at seed rate of 6 - 9 kg/ha and space at 30 x 10 cm. ▸ Thin when the plant is 10 -15 cm high and after first weeding. ▸ Apply SSP or DAP 100 - 125 kg/ha before planting. Top dress with either CAN or urea at pod formation. ▸ Intercrops well with sorghum planted at the same time at a ratio of 1:1 in alternating rows at a spacing of 60 x 20cm. ▸ Weed twice, within 2 to 4 weeks after germination. ▸ Spray three times, at flower bud formation, flowering and at pod formation.	Teso, Lango, Acholi, West Nile & Masindi	SAARI
Post-harvest & storage ▸ Dry in stabilised drying racks, bio-mass and commercial dryers. Also dry on cement-brick or cassava flour binder and stabliser – brick. ▸ Use KARI legume thresher, seed/grain cleaner/sorter. ▸ Use botanicals for pest management (tobacco, tagetes,	Teso, Lango, Acholi, West Nile & Masindi	SAARI

Product/Practice	F System	Institute
tephrosia and wood ash) to control storage pests. ▸ Do solarisation for pest management. ▸ Store in silos, mud-straw and basket woven granaries and sealed drums.		
Pigeon Pea		
 		
Varieties ▸ Sepi 1 is a large cream seeded variety. It matures within 4 to 5 months which is less than half the period for the local varieties. It yields up to 1300 kg/ha. Sepi 1 intercrops well with finger millet at a ratio of 1:2 (one row of pigeon pea for every two rows of millet at spacing of 30 cm a - part) planted at the same time. ▸ Sepi 2 is a cream seed variety. It matures in 3 to 4 months which is less than half the period for the local varieties. It yields 1.500kg/ha. Sepi 2 intercrops well with beans, green gram, groundnuts and rice at a ratio of 1:1 (one row of pigeon pea followed by one row of intercrop, spaced at 60 cm apart) planted at the same time.	Acholi, Teso, Lango and west Nile	SAARI
Post-harvest & storage ▸ Dry in stabilised drying racks, bio-mass and commercial dryers, and cement- brick or cassava flour binder and stabliser – brick. ▸ Use KARI legume thresher, seed/grain cleaner/sorter. ▸ Use botanicals for pest management (Tobacco, Tagetes, Tephrosia and wood ash). ▸ Do solarisation for pest management. ▸ Store in silos, mud-straw and basket woven granaries, drum-hermetic storage and stone chakki for processing.	Teso, Lango, Acholi, West Nile & Masindi	SAARI

Product/Practice	F System	Institute
Cotton		
 		
Varieties ▸ BPA 2000 variety yields 3000kg/ha. It has high Ginning Out Turn (GOT) of up to 39%, with staple length of over 33mm and fibre strength of over 30 g/tex. ▸ BPA 2002 variety yields 3500kg/ha. It has ball size of 6g and GOT upto 40% with staple length of 33 mm and fibre strength of over 30 g/tex.	Eastern, Northern, Western and Central regions	SAARI AND NAARI
Management ▸ Plant between May and July in a good a seed bed, 3 to 6 weeks after first ploughing. Use land which has fallowed for at least 3 years. Plant when there is enough moisture in the soil, at seed rate of 25 kg/ha for undelinted seed and 18gk/ha for delinted seed, at a spacing of 75 x 30 cm. Plant seed dressed with Bronopol/Bronocot at 1kg of chemical to 150 kg of seed. ▸ Plant between August and September, in a good seed bed 3 to 6 weeks after first ploughing in the land which has fallowed for at least 3 years. Plant when there is enough moisture in the soil, at seed rate of 20 kg/ha (8 kg/acre) for undelinted seed and 13 kg/ha (5 kg/acre) for delinted, at a spacing of 90 x 30 cm. Plant seed dressed with Bronopol/ Bronocot at 1 kg of chemical to 150 gk of seed.	Eastern, Northern, Western and Central regions	SAARI
▸ For areas with low soil fertility apply 125 - 250 kg/ha of SSP before planting and top dress with 125 - 250 kg/ ha of NPK.	Low Soil fertility	SAARI

Product/Practice	F System	Institute
▸ Gap fill when necessary but must be before 2 weeks after germination. ▸ Thin to two plants per hole when the seedling is 5 cm high. ▸ Weed 15 - 30 days after germination and weed 3 - 4 times. ▸ For very fertile areas, control vegetative growth by topping cotton crop at 45 - 60 days from planting or spray with 1 liter of Pix at 45 - 60 days from planting. ▸ Cotton can be intercropped with beans, soybeans or groundnuts. Plant cotton at the spacing of 90 x 30 cm. Plant at the same time or at 1 -2 weeks interval. **Disease and Pest control using IPM packages:** ▸ Seed dressing with Bronopol/Bronocot at 1 kg of chemical to 150 kg of seed, or use varieties resistant to bacterial blight, wilts and nematodes. ▸ Carry out weekly scouting for lygus bugs, ball worms and stainers from 60 days after planting. Spray according to Economic Threshold Levels (ETL) of 6 boll worm larvae per 100 plants sampled, 15 lygus bugs/ 50 sweeps of the sweep net or 22 aborted squares of flowers or bolls on plants. ▸ If ETLs are exceeded use synthetic pyrethroids e.g. Ambush Super, fenkill, Bulldock, Cypermethrin e.t.c at recommended rates. Or use combination of synthetic Pyrethroids with organophosphates eg. Sydon super etc. **Disease and Pest control using IPM packages:** ▸ For biological control, use predatory ants or intercrop cotton with crops which attract predatory ants , such as beans, groundnuts and cowpeas.	Eastern, Northern, Western, and Central regions	SAARI
Post-harvest & storage ▸ Pick cotton when dry and don't mix with trash. Dry cotton properly on clean surfaces. Sort and store in clean, dry and rat proof place.	Eastern and Northern region	SAARI

Product/Practice	F System	Institute
Banana		
		
Cultivars ▸ **KABANA 1H:** Produces cylindrical bunches, has stout pseudo-stem, robust, droopy and gluey leaves. It matures in about 14.5 months and yields 39 t/ha. It is resistant to Black Sigatoka, Fusarium wilt and is tolerant to nematodes and weevils. It is used for dessert, juice and cooking. ▸ **KABANA 2H:** Produces cylindrical bunches, has stout pseudo-stem, robust, droopy and gluey leaves. It matures in about 14.5 months and yields 33 t/ha. It is resistant to Black Sigatoka. It is good for juice (yields over 70% W/W). ▸ **KABANA 3H:** Produces cylindrical bunches, has stout pseudo-stem, robust, droopy and gluey leaves. It matures in about 15 months and yields 45 t/ha. It is resistant to Black sigatoka, Fusarium wilt and is tolerant to nematodes and weevils. It is used for dessert and cooking. ▸ **KABANA 4H:** Produces cylindrical bunches, has stout pseudo- stem, robust, droopy and gluey leaves. It matures in about 15 months and yields 40t/ha. It is resistant to Black Sigatoka, Fusarium wilt and is tolerant to nematodes and weevils. It is used for dessert and cooking. ▸ **KABANA 5H:** Produces cylindrical bunches, has long but strong pseudo stem, robust and erect leaves. It matures in about 17 months and yields 25 t/ha. It is resistant to Black Sigatoka, Fusarium wilt and is tolerant to nematodes and weevils. It is used for dessert and juice.	All	KARI

Product/Practice	F System	Institute
▸ **KISANSA:** Is an AAA-East African highland cooking banana. It is high yielding and produces big bunches good for market. It is currently popular for export. ▸ **MPOLOGOMA:** Is an AAA-East African highland cooking banana. It is high yielding and produces big bunches good for market. It is currently popular for export. ▸ **MUSAKALA**: Is an AAA-East African highland cooking banana. It is high yielding and produces big bunches good for local market. ▸ **ATWARIRA:** Is an AAA-East African highland cooking banana. It is high yielding and produces big bunches good for local market. ▸ **KIBUZI:** Is an AAA-East African highland cooking banana. It is high yielding and produces big bunches good for local market. It is currently popular for export. ▸ **NAKITEMBE:** Is an AAA-East African highland cooking banana.It is high yielding and produces big bunches good for local market.	All	KAARI
Management ▸ Select fields with good deep soils, avoid water logged, clay and sandy sites. ▸ Plant in holes of about 60x60x60 cm at a spacing of 3 x 3 meters. Choose a cultivar that fits your interest (cooking, juice/beer, dessert or roasting). Use clean planting material. ▸ Use cultural control methods for banana weevils and nematodes, i.e practice crop sanitation, use clean planting materials, trap weevils, use of break crops (crop rotation) for nematodes, enhanced plant nutrition for pests and diseases control. ▸ Use organic manures, inorganic fertilizers, trenches, grass bands and mulching to conserve water and improve soil fertility. ▸ Practice mulching, de-trashing and pruning to control weeds, conserve moisture, control pests and improve soil fertility.	All	KAARI
Post-harvest & storage ▸ Harvest when the fingers are full round or 3/4 full round depending on the purpose and length of storage/in transit before utilisation. ▸ **Utilisation of dried bananas**: Banana flour can be used for porridge, paste and a range of confectionery products.	All	KAARI

Product/Practice	F System	Institute
Composite flour can be used for porridge, paste and range of confectionery products. ▸ **Banana beverages**: Enzymatic extraction of banana juice, preservation and acceptance enhancement through blending of banana juice with other juices. ▸ **Banana drying technologies**: Apple banana (Ndizi) local variety is suitable for drying. It attains bunch maturity at 125 days and has a total soluble solids of 18 - 21 %. ▸ **Packaging of apple bananas:** – Bunch sleeve to control physical damage on banana fingers before harvest. – Commercial harvest maturity is about 101 - 106 days. Partially chop the banana pseudo stem half way to allow the bunch to bend and hand. Clusters are then de-handed using sharp knives. – Carry de-handed bananas in wooden trays and pack in cushioned boxes.	All	KARI

Product/Practice	F System	Institute

Mango





Varieties

- **Tommy Atkins Fruit** is a round to ovate variety with a red skin when mature; fruit weights 500 to 680 gms. Theyellow flesh is usually firm, juicy and fibreless. It is good for juice processing and export as fresh fruit. Grafted plants mature in 24 months and flowers mature to fruits in 60 days. It tends to mature late into the flowering season. It yields 9 to 14 t/ha with manure application.
- **Alfonso Fruit** is oblong to ovate variety with a purple skin when mature; fruit weighs 450 to 680 gms. The yellow flesh is usually juicy and fibreless. It is not good for juice processing. Grafted plants mature in 18 to 24 months. It yields 10 to 16 t/ha.
- **Glenn Fruit** is a around to ovate variety with greenish purple skin when mature. The fruit weighs 500gms. The yellow flesh is usually juicy. It is not good for fresh fruit export but good for juice processing, local market and dry fruits. Grafted plants mature in 18 to 24 months. It yields 13 to 18 t/ha.
- **Florigon Fruit** is ovate, plump and slightly flattened base variety with a purplish green skin when mature. The fruit weighs 450 gms. The deep yellow flesh is usually firm, juicy and fibreless. Grafted plants mature in 18 months. It yields 16 to 20 t/ha.
- **Palvin Fruit** is an oblong to ovate variety with a light purple to red bluish skin when mature. The fruit weights 450 to 680 gms. The yellow flesh is usually firm, juicy and fibreless. Grafted plants mature in 9 to 14 months. It yields 10 to 16 t/ha.
- **Palmer Fruit** is an oblong variety with a pale red bluish skin when mature. The fruit weights 650 gms. The yellow flesh is usually firm and juicy. Grafted plants mature in 16 to 18 months. It yields 9 to 14 t/ha.

All	KARI

Product/Practice	F System	Institute
Management ▸ Plant a grafted plant when the union is at least 30 cm above the ground. ▸ Remove any branches that appear below the union. ▸ Prune the tree to a level where spraying (if any) is easy. ▸ Ring weed and apply manure at every 6 months. ▸ Apply higher level of K at flowering eg. wood ash.	All	KARI
Avocado		
Varieties ▸ **Fuerte Fruit** is pear shaped towards the neck, with slightly rough and green but thin and easy to peel skin when mature. The fruit weighs 168 to 392 gms with a small seed. The flesh is green near the skin and creamy inside. It bears twice a year and yields 4 to 8 t/ha. It has high wind tolerance.	Good for high elevations	KARI
▸ **Hass Fruit** is pear shaped to ovoid, with pebbled rough and dark green to nearly black when ripe but medium to fairly thick and easy to peel skin when mature. Fruit weighs 140 to 336 gms with medium sized seed . The flesh is creamy. It tends to be moderate to high bearing and yields 5 to 9 t/ha. It has low wind tolerance. ▸ **Semil Fruit** is pear shaped, with medium rough and waxy and green but thin and easy to peel skin when mature. Fruit weighs 230 to 520 gms with medium seed. The flesh is creamy. This variety tends to be moderate to high bearing and yields 5 to 8 t/ha. It has high wind tolerance. ▸ **Drsom 1 Fruit** is round shaped with medium smooth, waxy and green but thin and very easy to peel skin when mature. The fruit weighs 400 to 630 gms with medium seed. The flesh is creamy with green layer near the skin. It tends to be high bearing and yields 5 to 9 tons per ha. It has high wind tolerance. ▸ **Drsom 2 Fruit** is round shaped with smooth, waxy and dark green but thin to medium and very easy to peel skin when mature. The fruit weighs 500 to 680 gms with medium seed. The flesh is deep creamy yellow with thick green layer near the skin. This variety tends to be heavy bearing and yields 8 to 10 t/ha. It has high wind tolerance.	All	KARI

Product/Practice	F System	Institute
▸ **Drsom 3 Fruit** is pear shaped to ovate with smooth waxy and green but medium thickness and easy to peel skin when mature. The fruit weighs 450 to 650 gms with small seed. The flesh is deep creamy yellow. This variety tends to be high bearing and yields 6 to 9 t/ha. It has high wind tolerance.	All	KARI
Orange		
Varieties ▸ **Nova Fruit** is a seedless variety and is a cross between Clementine Mandarin and Orlando Tangelo. It is ovate to sub- globule, without neck, slightly rounded base. The fruit colour is deep yellowish with slightly pebbled skin surface but thin, leathery, and easy to peel skin when mature. The flesh is deep orange and juicy. Grafted plant matures in 18 months. ▸ **Seminole Fruit** is a seedless variety and is hybrid between grape fruit and Tangerine. It is ovate and without neck, fruit colour is deep reddish orange with pebbled skin surface but thin and easy to peel skin when mature. The flesh is deep orange and juicy. Grafted plant matures in 18 months and is resistant to scab. It matures in 16 to 18 months. ▸ **Washington navel Fruit** is a seedless variety. It is spherical or ellipsoid, apex with distinct navel and base with a prominent furrow. Fruit color is light green, with slightly pebbled to rough skin surface but medium to thick, and easy to peel skin when mature. ▸ **Valencia Fruit** is a seeded variety, with few seeds. It is oblong to spherical. Fruit colour is light greenish yellow to light yellow with smooth skin surface but medium thick, though leathery when mature. The flesh is light yellowish orange and juicy. Grafted plant matures in 18 months, with prolific productivity. ▸ **Hamlin Fruit** is a seeded variety with many seeds. It is globule to slightly oblate. Fruit colour is light green with smooth skin surface but thin skin when mature. The flesh is yellowish and juicy. Grafted plant matures in 18 months, with prolific poductivity.	All	KARI
Fruit Post-harvest & storage		
▸ **Fruit Solar dryers**: These use solar energy. Biomass energy can be used to supplement solar energy in cloudy and rainy periods. - Hybrid tunnel has capacity of 20 kg fresh sliced pineapple yielding 3.5 kg of dried pineapples. Dry in 2 - 3 days.	All	KARI

Product/Practice	F System	Institute
- Cabinet Hybrid dryer has capacity of 20 kg fresh sliced pineapple yielding 3.5 kg of dried pineapples. Dry in 2 - 3 days. ▸ **Solar drying packages**: Varieties of fruits suitable for drying include the local varieties Naluzaale and Doodo family. They should be orange fleshed, low fiber content and with high dry matter. ▸**Fruit drying techniques/methods**: - Select fruit which is ripe but firm, healthy and without physical damage . - Wash the fruit in dilute solution of Jik 2 mls/20 lts of water. - Peel the fruit. - Slice the fruit in thin slices of 3 - 4 mm thickness. - Load the slices without overlapping onto clean drying tray. - Load the trays into the dryer. - Make sure that these operations get accomplished by 9.00 am to ensure maximum loss of water from the drying slices on the first day.	All	KARI
Cabbage and other Brassica		
Management ▸ **Management - IPM package for controlling Diamond Black Moth (DBM)** - Practice crop rotation. - Destroy debris of previous crops. - Scout for DBM before spraying pesticides as opposed to blanket spraying. ▸ Use proper application of pesticides when levels of the DBM infestations warrant. Use correct dosage and spray underthe leaves where the larvae hang by threads. - Use different pesticide types to avoid resistance build up.	All	KARI

Product/Practice	F System	Institute
Hot pepper		
Management ▸ **Management - IPM packages for pepper pest management** – Practice crop rotation and destroy debris of previous crops. – Plant clean and virus free seed. – Scout for pests before spraying any pesticides and spray only when levels of infestaton warrant. – Use approved pesticides when spraying for export market. – Apply different pesticides types to avoid resistance build up. – Use Neem oil whenever available to avoid harmful pesticide residues. – Rouge out plants infected by die-back.	Lake Victoria Crescent and Kasese	KARI
Okra		
Management ▸ **Management - IPM packages for okra pest management** – Practice crop rotation. – Using certified seed and sow at correct spacing. – Destroy all debris of previous crops. – Scout for pests before spraying pesticides as opposed to blanket spraying. – Identify pests because, some are more destructive than others. Some can be left without spraying for whole season. – Use approved pesticides when spraying for export market. Spray only when levels of infestations warrants, i.e. correct dosage, spraying under the leaves where most insects are found. – Apply different pesticides types to avoid resistance build up. – Use Neem oil or pesticides with short waiting intervals especially during harvesting to avoid harmful pesticide residues.	Lake Victoria Crescent and Kasese	KARI
Pineapple		
Post-harvest & storage ▸ **Solar drying packages**: Use hybrid tunnel and brick dryer, KARI cabinet solar dryer. – Smooth cayenne pineapple variety has fruit suitable for drying. It should have a moisture content of 81%. Select fruit which is ripe but firm, healthy and without physical damage. Wash the fruit in a dilute solution of Jik 2 mls/20 lts of water.	Lake Victoria Crescent Ankole	KARI

Product/Practice	F System	Institute
- Rinse fruit in water before peeling. - Slice the fruit in thin slices of 3 - 4 mm thickness and load. - Place slices without overlapping onto clean drying trays. - Load the trays into the dryer. - Accomplish operations by 9.00 am to ensure maximum loss of water from the drying slices on the first day.	Lake Victoria Crescent Ankole	KARI
Passion Fruit		
Post-harvest & storage ▸ Use clippers and scissors to harvest passion fruit. ▸ Packaging of passion fruits: - Field containers: Use basket or any other smooth containers like plastic basins to collect passion fruits. Pack 48 passion fruits in a carton such that the fruits are immobile.	Nebbi Kasese Mbale	KARI
Coffee		
 		
Post-harvest & storage ▸ **Drying racks** Bio-mass and commercial dryers, Seed/grain cleaner/ sorter, solarisation technique for pest management using: Cement-brick and cassava flour binder store with stabliser: brick silos,	Lake Victoria Crescent Busoga highlands	KARI

SECTION 2
FORESTRY

Product/Practice	F System	Institute
Natural Forestry		
Tree nursery (propagation) techniques ▸ **Seed pre-treatments** – Soak in cold water for 12-48 hours e.g *Maesopsis eminii.* – Soaking in hot water: this can be done for 2-3 minutes then immerse in cold water to soften the hard coat, e.g *Calliandra* and *Leucaena* spp. – Nicking: use a knife and make a small opening on the seed e.g. *Tamarindus indica*. – No treatment: tiny and light species don't need treatment e.g Grevillea, Casuarina, Markhamia. ▸ **Grafting:** – Top wedge (cleft). – Splice and whip and tongue grafting. – T- budding. – Patch budding method. ▸ **Cuttings:** Cut parts of a plant into smaller components and use them to produce new plants with or without the use of rooting hormones e.g *Ficus natalensis* .	All	FORRI
Tree management techniques ▸ **Crown pruning** is the removal of the lower branches of the tree. The recommended height for crown pruning is 1/3 of the total tree height. The remaining 2/3 of the crown is spared for photosynthesis. ▸ **Rooting pruning** is the process of cutting live shallow roots in the surface soil. Open a trench of 30-50cm away from the tree and about 30cm deep and cut all the roots within that depth. It is recommended for trees which are 4 years and above depending on the species performance. ▸ **Lopping** is the selective cutting of the branches so as to obtain fodder, fuel wood and / or medicine. ▸ **Coppicing** is the operation of felling a tree/shrub so as to induce re-growth. Trees commonly managed in this way are fodder, soil fertility, timber and pole tree species. ▸ **Pollarding** is the cutting of the tree top or total removal of the crown so as to harvest fodder, reduce shade over companion crops, obtain fuel wood and / or mulch. This management practice is commonly carried out on fodder, boundary, scattered and compound trees. ▸ **Thinning** is the exercise of reducing the number of trees originally planted or growing so as to allow the remaining ones grow to the required sizes to meet the objectives of	All	FORRI

Product/Practice	F System	Institute
the technology. It is more economical to carry out this operation when the tree has reached utilizable/marketable size. For example, at the age of 3, Grevillea and Markhamia are ready for poles. **Fodder production techniques** ▸ **Tree/shrub hedges:** Are established as hedges on the internal or external boundaries of the farm, around homesteads and along soil and water conservation structures. The recommended spacing is 0.5m. They can be established as a single row or double rows or scattered in pasture. ▸ **Fodder bank:** Is a plot set a side for fodder production. In this plot, fodder shrubs can be grown together with the grasses to ease labour for harvesting. The recommended spacing is 1 row of fodder trees e.g Callindra to 2 rows of grass e.g napier. Use spacing of 1m between rows and 0.5m within rows of both fodder trees and grasses. ▸ **Trees scattered in pasture land** Fodder trees which grow into big trees can be scattered in pasture to provide shade to the animals and fodder during the dry season. Species such as *Ficus natalensis* and *Sapium ellipticum* found around the lakeshore region and the *Acacia* spp in the semi-arid areas of Uganda provide shade and fodder to livestock and conserve water shades.	All	FORRI
Fodder Management ▸ The common management practices used on fodder trees/shrubs are coppicing, pollarding and lopping. ▸ The first cutting is made at below 30cm to induce the spread, later it can be higher (0.5-1m) as preferred by the farmer. A minimum of 30 trees should be left for sustainable seed production. About 500 trees/shrubs can suffice one cow for one year.	All	FORRI
Wood and Energy management techniques ▸ **Boundary and scattered planting:** Is the growing of trees on the farm boundary and/or scattering of trees in the cropland. This technique is very ideal for farmers with small pieces of land. Farmers can easily access wood for timber, poles, fuel for home use and also for income.	All	FORRI

Product/Practice	F System	Institute
▸ **Wood lot:** Is a piece of land grown with a specific tree species for a particular purpose i.e Grevillea, Maesopsis for timber, poles and fuel wood. **Home- garden techniques** ▸ Trees can be planted in home gardens and yards to provide shade, as well as fruits, medicines and other services e.g windbreak and/ or ornamental. Common fruit trees grown in home gardens are mangoes, tamarind, avocadoes, citrus etc. Common medicinal trees grown near homes are; *Neem, Moringa, Prunus* etc.	All	FORRI
Soil fertility improvement techniques ▸ **Improved fallows:** Is the replacement or enhancement of natural fallow vegetation by the introduction of selected trees/ shrub species. The purpose is to shorten the fallow period while restoring soil fertility. The common leguminous tree/ shrub species used are *Leucaena , Calliandra, Gliricidia, Cajanus cajan, Sesbania sesban, Tephrosia* and *Crotalaria.*	Densely populated areas with poor soils, Low lands	FORRI
▸ **Rotational wood lots:** Is the establishment a fast growing tree species that can improve on the soils before a crop is planted. Trees are harvested at 2-3 years and used as poles, stakes and fuel wood, e.g *Alnus* and *Acacia* spp.	High lands	FORRI
▸ **Biomass transfer** Is the growing and cutting of trees/ shrubs so as to provide mulch or green manure for soil fertility improvement e.g *Tithonia, Lantana* and *Thevetia* spp.	Lowlands	FORRI
Soil and water conservation techniques ▸ **Contour hedges:** Is the establishment of tree/shrubs on contour for soil erosion control. This technique is ideal in high land areas. Food crops, wood and fruit trees plus animal production can be integrated with this technique.	High lands	FORRI
▸ **Wood lots:** A wood lot keeps the soil surface covered and acts as a soil and water conservation measure. Examples of tree species ideal for a wood lot are; *Alnus, Acacia, Senna* and *Grivellea* . A part from covering the soil surface, wood lots serve as principal sources of fuel wood.	Low lands and High lands	FORRI

Product/Practice	F System	Institute
Plantation Forestry		
		
Management of *Leucaena psyllid* ▸ Growing of *Leucaena leucocephella*, a nitrogen fixing multipurpose tree has been constrained by serious attacks from the *Leucaena psyllid*. Leucaena/ sorghum intercrop reduces damage from the *Leucaena* psyllid. Maize or cassava/*leucaena* intercrops also reduce the amount of damage from the psyllid although to a lesser extent.	All	FORRI
Species ▸ **Timber:** *Pinus caribaea, P. oocarpa* and *Araucaria* spp, for lowland areas < 1,200m	Low wet farming systems	FORRI
▸ **Timber:** *Pinus patula, Cupressus lusintanica* for high land areas > 1,200m	High wet farming systems	
Species ▸ **Fuel and Timber** : *Eucalyptus grandis* for humid highland areas ▸ **Fuel and Timber:** *Eucalyptus camaldurensis* and *E. tereticornis* for drier areas.	High wet farming systems	FORRI
Management ▸ **Nursery establishment techniques** - **Nursery site selection**: Good permanent water supply, good supply of suitable soils, good communication (accessibility) and gently slopping well-drained soils. - **Avoid:** Heavy clay soils, swampy valley bottoms and exposed hill tops.	All	FORRI

<table>
<tr><th>Product/Practice</th><th>F System</th><th>Institute</th></tr>
<tr><td>- Soil mixtures for:
o Seed bed : mix 50% forest soil with 50% sand
o Transplanting bed/polythene tubes: Fill with 60% unsieved forest soil, 10% sand, 10% small stones (less than 1cm diameter), 10% clay and 10% kraal manure, peat or composite manure.
- Orientation of shades: East-west.</td><td>All</td><td>FORRI</td></tr>
<tr><td>▸ Planting/establishment techniques
- Plant conifers for timber plantations at a space of 2.74 x 2.74m. Dig planting holes about 15cm deep and wide.
- Plant Eucalyptus plantations at 2.4x2.4m for fuel crops on 7-10 year rotations and 1.8 x 1.8 m for pole crops.
- Assess seedling survival three months after planting and gap-fill during the following rain season.
- Weed pines by slashing and spot hoeing for Cupressus and hard woods.</td><td>All</td><td>FORRI</td></tr>
<tr><td>Management
▸ Thinning
<table><tr><th colspan="3">Thinning schedule in plantations</th></tr><tr><td>Age in years</td><td>Thinning (T)-Trees left per ha</td><td>Remarks</td></tr><tr><td>1</td><td>1370</td><td>Planted at 2.7x2.7m</td></tr><tr><td>6 – 8</td><td>990+ 10%</td><td>1st thinning</td></tr><tr><td>13 – 15</td><td>570 -640</td><td>2nd thinning (occasionally down to 490)</td></tr><tr><td>20 – 22</td><td>300-345</td><td>3rd thinning (If necessary)</td></tr></table></td><td>All</td><td>FORRI</td></tr>
</table>

<table>
<tr><th>Product/Practice</th><th>F System</th><th>Institute</th></tr>
<tr><td>

▸ **Pruning**

<table>
<tr><th colspan="3">Pruning Schedule in plantations</th></tr>
<tr><td>Age in years</td><td>Maximum height (m)</td><td>Remarks</td></tr>
<tr><td>1</td><td></td><td>Planted at 2.7x2.7m</td></tr>
<tr><td>5 – 7</td><td>2</td><td>Pruning 1</td></tr>
<tr><td>7 – 9</td><td>5</td><td>Pruning 2</td></tr>
<tr><td>11 – 13</td><td>7</td><td>Pruning 3</td></tr>
<tr><td>14 – 16</td><td>10</td><td>Pruning 4</td></tr>
</table>

</td><td>All</td><td>FORRI</td></tr>
<tr><td>

▸ **Pest and disease management**

– Water appropriately to control damping-off disease in nursery.
– Plant pest resistant tree species.
– Apply Regent 3 against termites.
– Use biological control agents such as *Pauesia juniperorum* against cypress aphid and *Tetraphleps raoi* against pine woolly aphid.

</td><td>All</td><td>FORRI</td></tr>
<tr><td>

Fire management

- **Basic information**
  - o Sensitize neighbouring communities on the dangers of fire.
  - o Train staff and workers in fire fighting tehniques.
  - o Maintain fire fighting equipment and tools in good condition (large commercial plantations).
  - o Clear fire lines before onset of dry period.
  - o A radio or other telecommunication system should be operational throughout the year (large commercial plantations).
  - o Man fire tower 24 hours during the dry season (large commercial plantations).
  - o Carry out controlled burning at the start of the dry season.
  - o Maintain water reservoirs with water during the dry season.

</td><td>All</td><td>FORRI</td></tr>
</table>

Product/Practice	F System	Institute
▸ **Processing** – Harvesting: directional felling. – Conservation: Practice low impact harvesting, yield optimization (recovery). – Seasoning: Use Air seasoning techniques or solar kilns. – Preservation: Use dip diffusion. – Matching species to end use: observe structural and non - structural applications.	All	FORRI
Agro Forestry		
		
Species **High value timber:** Mahoganies, *Milicia*, *Albizia* etc.	All	FORRI
Management ▸ **Nursery establishment techniques:** – **Nursery site selection:** Select site with good permanent water supply, suitable soils, good communications (accessibility) and gently slopping well-drained soils. – Avoid heavy clay soils, swampy valley bottoms and exposed hill tops. – **Soil mixtures:** o Seed bed : use 50% forest soil and 50% sand. o Transplanting bed/polythene tubes: use mixture of 60% unsieved forest soil, 10% sand, 10% small stones (less than 1 cm diameter), 10% clay and 10% kraal manure, peat or composite manure. – **Orientation of shades** East-west.	All	FORRI

Product/Practice	F System	Institute
▸ **Planting/establishment technologies** – **Planting/enrichment planting:** Suitable species for enrichment planting should have the following attributes; o Fast growth to avoid a long weeding period. o Easily marketable timber. o Resistant to pests and diseases. o Self pruning. **Examples**: *Measopsis eminii, Khayaanthotheca, Entandrophragma angolense, Cedrela odorata, Terminalia superba, T. ivorensis, Burttdavya nyassica, Acrocarpus fraxinifolius, Nauclea diderichii, Cordia millenii, Olea welwitschii, Fagara angolensis, Fagara macrophylla, Araucaria spp, Agathis robusta* ▸ **Planting/establishment technologies** - **Natural regeneration:** stimulate by pre-and post exploitation operations like climber cutting, canopy opening and light thinning. ▸ **Tending:** carry out Climber cutting, canopy opening, light thinning, and felling damage repair. ▸ **Pest and disease management:** Use natural enemies to control pests and diseases in forests undergoing exploitation and silvicultural practices. ▸ **Fire management:** - **Basic information:** o Sensitize neighbouring communities on the dangers of fire. o Train staff and workers in fire fighting tehniques. o Maintain fire fighting equipment and tools in good condition (large commercial plantations). o Clear fine lines before onset of dry period. o A radio or other telecommunication system should be operational throughout the year(large commercial plantations). o Man fire tower 24 hours during the dry season(large commercial plantations). o Carry out controlled burning at the start of the dry season. o Maintain water reservoirs with water during the dry season.	All	FORRI

Product/Practice	F System	Institute
Processing - *Harvesting:* Carryout directional felling. - *Conservation:* Practice low impact harvesting, yield optimization (recovery). - *Seasoning:* Use air seasoning techniques, solar kilns. - *Preservation*: Use Dip-diffusion, sap-displacement methods. - *Matching species to end use*: Follow Structural and non-structural applications.		

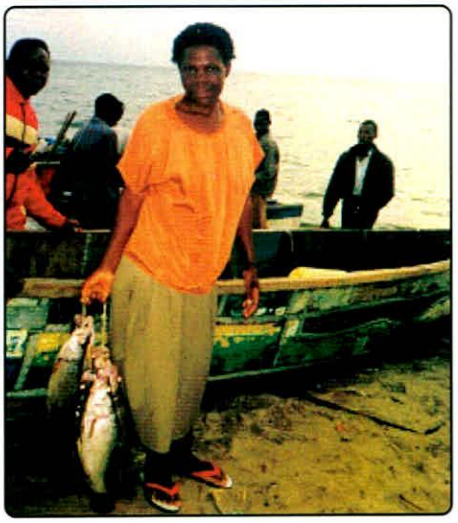
SECTION 3
LIVESTOCK

Product/Practice	F System	Institute
Cattle		
		
Breed ▸ Improved Nganda cattle.	Lake Crescent	SAARI
▸ Zebu crossed with Boran for improved beef production. ▸ Zebu crossed with Sahiwal for improved traction power.	Teso and Lango	SAARI
Management ▸ Feed beef cattle with hay and silage in the dry season. ▸ Plant the following forage legumes: – *Chaemocrista ratundofolia* establishes easily,is of high nutritive value, high yielding,and is pest and drought tolerant. – *Macroptilium atropurpureum* establishes easily, is high seed yielding and drought tolerant – *Scabra* establishes easily, is high seed yielding and drought tolerant	All	SAARI and NAARI
Forage legume production ▸ Prepare fine seed bed. ▸ Planting methods: – Over sow legume seed to existing grass pastures. – Spot seeding on existing grass pastures. – Plough and plant legume and grasses together. ▸ Management techniques: – Weed 3 weeks after germination, continue weeding as weeds appear. – Rouge unwanted weeds. – Spray against pests on lablab at flower bud formation and flowering. – Fire management - have fire breaks and a fine seedbed.	All	SAARI

Product/Practice	F System	Institute
▸ Forage legume utilization techniques: – Fodder banks - reserve pasture for the dry season. – Graze in standing pasture - in - situ. – Hay making - cutting and carry. – Use lablab or calliandra as leaf meal. – Mix with maize stover or elephant grass for dry season feeding for dairy cattle.	All	SAARI
Cattle health		
▸ **Diagnostic technologies** – Antibody ELISA for CBPP. – Coated antigens for rapid detection of CBPP (Penside). – Detect CBPP carrier animals with PCR – Antibody/antigen (ELISA), PCR, CATT, CIATT, IFAT, TACT, stained smears, tissue culture) for trypanosomosis. – Antigen/antibody ELISAs for Brucellosis, Tick borne diseases and Rinderpest. - Fd vc6. Modified California Rapid Test for mastitis ▸ **Disease control technologies** – Appropriate regimes for animal trypanosomosis (Nagana) for pastoral and agro pastoral systems. – Detecting and monitoring trypanocidal drug sensitivity/ resistance by tissue culture. – Immunisation against East Coast Fever by infection and treatment. – Observation of grazing management of calves to control ticks.	All	LIRI

Product/Practice	F System	Institute
Chicken		
		
Breed ▸ Bovane Brown crosses, produce 2- 3 times more eggs and weigh twice as heavy	All	LIRI
Management ▸ Management of free-range birds.	Teso and Lango	SAARI and LIRI
Poultry health		
▸ Diagnosis of New Castle disease by ELISA and Haemoaglutination. ▸ Inhibition test. ▸ Health management package for poultry. ▸ Thermostable vaccines for control of New Castle Disease.	Teso and Lango	LIRI

SECTION 4
FISHERIES

Product/Practice	F System	Institute
Capture Fisheries		
		
Lake productivity processes ▸ Information on composition, distribution and abundance patterns of food organisms for fish available. ▸ Recommendations on regulation of commercial exploitation of key food organisms available.	All	FIRRI
Water quality ▸ Information on physico-chemical condition of Victoria and Kyoga basin lakes generated and available. ▸ Strategic actions to reduce influx of nutrients / pollutants into water bodies. ▸ Recommendations for effective watershed management e.g. community sensitisation programmes.	Lakes Victoria and Kyoga	FIRRI
Water hyacinth and other aquatic weeds ▸ Control methods of water hyacinth: Biological control and community involvement in removal, biological control and monitoring. ▸ Resurgence potential of the weedand identified hot spots mapped. ▸ Information on impact of sunken water hyacinth available. Experiences in management of water hyacinth in Uganda have been documented.	All	FIRRI
Management of fish stocks ▸ Use of minimum gill net mesh size of 127 mm (5inches) to sustainably exploit Nile perch & Nile tilapia. ▸ Controlled fishing effort i.e. the number of boats and the number and types of gears established. ▸ Recommendation of 50 to 85 cm total length for Nile perch	All	FIRRI

Product/Practice	F System	Institute
to be harvested and processed recommended to be incorporated in the Fisheries Act. ▸ Recommendations to regulate harvesting of major food Nile perch (*Caridina nilotica* and *Rastrineobola argentea* (Mukene) have been made. ▸ Tilapias (*Oreochromis esculentus* and *Oreochromis variabilis*) conservation - Regulate access to satellite lakes containing Ngege (*O.esculentus* and *O. variabilis*) to stock more small lakes, dams and ponds. ▸ **Haplochromies (Nkejje) conservation:** Recommendation to regulate access to rocky habitats, marginal aquatic macrophytes, buffer zones and satellite lakes and to culture Nkejje should be cultured for ornamental fish trade. ▸ **Nile tilapia (*Oreochromis niloticus*):** Recommendation to prohibit fishing within 100m of lakeshore. Regulate access to marginal (lakeshore) aquatic macrophtes and buffer zones. ▸ ***Rastrineobola argentea* (mukene):** Recommendation to legalise and regulate light fishing for mukene to avoid fishing for mukene in small bays (<3km diameter) and in areas less than 1.5 km (1500m) from the shoreline and prohibit use of beach seines to harvest mukene.	All	FIRRI

Product/Practice	F System	Institute
Fish farming (Aquaculture)		
		
Breeding ▸ **Breeding Techniques** - Induced breeding of catfish (male). - Induced breeding of *Labeo victorianus*. - Environmental manipulation for breeding mirror carp. - Brood stock management. ▸ **Seed production techniques** - Nursing of pure Nile tilapia seed. - Nursing of catfish, carp seed and labeo. - Nursing of fish fry in happas. - Live feeds production. - Conditions, packaging and transportation of fish ▸ **Grow out technologies** - Nile tilapia production using sunflower oil cake, organic manure and compost manure. - Polyculture of N. tilapia and catfish, All- male culture of N. tilapia. - Pelleted feeds for Cyprinid culture	All	FIRRI / Kajjansi
Pond Management ▸ Site selection, construction, preparation and management.	All	FIRRI / Kajjansi
Harvesting ▸ Kajjansi Dip net. ▸ Low technology methods of catching pond fish.	All	FIRRI / Kajjansi

SECTION 5
FARM MACHINERY

Product/Practice	F System	Institute
Farm Power		
		
▸ Light plough weighing 28kgs (half the weight of those currently on the market). ▸ 5-horsepower walking tractor. ▸ Manually pulled eight-row lowland rice planter and Hand - pushed weeders for lowland rice. ▸ Interrow animal drawn weeder.	All	AEATRI
Conservation farming ▸ Adapted and integrated exotic and indigenous cover crops to the farming systems. The following equipment has been developed: – Knife roller. – Ripper planter. – Manually operated and animal drawn pesticide or herbicide applicators	Teso, Lango Achol	AEATRI

Product/Practice	F System	Institute
Processing equipment		
		
– Manual and motorised cassava chipper. – Manual and motorised cassava grater. – Manual and motorised maize shellers. – Manual and motorised forage choppers. – Multi-crop motorised thresher. – Commercial rice mill. – Feed mixer. – Both manual and motorised cassava/sweet potato chipper/slicer. – Assorted designs of fully tested outdoor and indoor crop storage structures	All	AEATRI
Household energy systems ▸ Fixed dome bio-gas plants. ▸ Floating dome bio-gas plants for cooking and lighting. ▸ Three different designs of bio-gas stoves.	All	AEATRI
Water harvesting and utilization ▸ Manually operated treadle pump. ▸ A wind powered water pump. ▸ A motorised water pump.	All	AEATRI

SECTION 6
SOILS

Product/Practice	F System	Institute
Soil Conservation		
		
▸ Grass strips. ▸ Trash lines or stone lines along the contour (spacing for each determined by slope steepness).	All	KARI
▸ Terraces - width and spacing depends on slope.	South-west and - mountainous areas	KARI
▸ Water harvesting by construction of contour bunds along the contour - spacing depends on slope. ▸ Water harvesting from roof tops and road sides.	Bare hills and degraded rangelands	KARI

Product/Practice	F System	Institute
Soil conservation (Liquid manure - Tea)		
		
▸ Integrated organic and inorganic nutrients sources. ▸ Proper use of inorganic fertilizers and organic residues. ▸ Appropriate ways of handling and application of farm yard manure. ▸ Preparing and applying composts. Incorporating biological nitrogen fixation into farming systems. ▸ Mulching. ▸ Use of improved/short rest periods. ▸ Rotations to recycle nutrients.	All	KARI

SECTION 7
OTHERS

Product/Practice	F System	Institute
▸ Cleaning guide for fresh food factories - Software tools- Log it, Cleanse it, Ice it.	All	FOSRI
▸ Determination of planting windows. ▸ Development of farmer research groups	All	NAARI
▸ Improved extension methods: - Farmer Field Schools. - Solidarity groups for micro-credit and savings management by farmers. - Primary Schools as conduits for technology dissemination.	All	AEATRI

CBD incidence ≤ 1

CMD ≤ 0