

1 Vegetables

Field: 1. Vegetable Production

Item: 1.1 OKRA (*Hibiscus esculentus*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Land Preparation	1. Select good site	i) Should have adequate water ii) To be accessible
	2. Choose good soil	i) Loamy and well drained the best ii) Clear all bushes iii) Destump fully
	4. Plough deeply	i) Ridges ii) Flat Dig 9" deep
2. Planting	1. Seeds i) Choose good seeds ii) Choose marketable variety	i) Clean and viable seeds ii) Use Emerald green, Perkins mammoth, Clemson spineless and White velvet.
	2. Observe proper spacing	i) Flat cultivation 60-80 cm x 20-30 cm ii) Ridge 60 cm x 20-30 cm
	3. Apply basal fertiliser	i) 5-10 g phosphoric fertiliser/hole ii) Farm Yard Manure Two handfuls/hole and mix with soil iii) Put 2 seeds/hole in moist soil and cover lightly.
3. Husbandry /Management Practices	1. Thinning at right time	Retain one healthy plant/hole when they are 8-10cms high
	2. Watering should be proper	i) Regular and adequate. ii) Moisture content at field holding capacity (75%).
4. Timely Weeding	1. Weeding	As soon as weeds appear.
	2. Top dressing	Add CAN at a rate of 100kg/ha or 3gm/plant after 3 weeks from planting.
	3. Mulching	Use any available mulching material.
5. Proper Pest Control	1. Melon aphid <i>Aphis gossypii</i>	i) Early planting ii) Burning crop debris immediately after harvest iii) Use Karate. Mix 10 ml of chemical in 15-20 lts of water and spray.
	2. Cotton stainer <i>Dysdercus superstitionis</i>	i) Use chicken in small plots ii) Use Karate as in aphids.
	3. Ballworm <i>Earrias insulana</i>	Remove flowers after blooming
	4. Leaf hopper <i>Empoasca spp</i>	i) Use tolerant varieties ii) Use Karate as in aphids
	5. Corn earworm <i>Heliothis amigera</i>	i) Remove host plants (Cotton, Roselle, Sunset hibiscus, maize and sweetcorn).

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	6. Leaf eating beetle <i>Lagria villosa</i>	ii) Use Karate as in aphids.
	7. Root knot nematodes <i>Meloidogyne spp</i>	Cultural control i) Use resistant varieties ii) Practice crop rotation iii) Carryout deep ploughing and let the soil dry. iv) Flood the soil and plough in organic residues e.g <i>Ricinus communis</i> , <i>Arachis hypogea</i> etc.
	8. Flea beetle <i>Nisotra gemella</i>	Use Karate
	9. Leaf beetle <i>Podagrica uniforma</i>	Use tolerant varieties
	10. Pink bollworm <i>Pectinophora gossypiella</i>	i) Remove crop debris ii) Allow time laps between successive crops iii) Use Carbaryl.
5. Diseases	1. Pod spot <i>Ascochyta abelmoschii</i>	i) Practice Crop rotation ii) Use resistant varieties iii) Good field sanitation
	2. Least spo <i>Cecospora hibisci</i>	Use copper salts or maneb (Zinc based sprays) in severe infection.
	3. Powdery mildew <i>Erysiphe cichoracearum</i>	Use Bayfidan
	4. Dry rot <i>Microphomina phaseolina</i>	i) Crop rotation ii) Field sanitation iii) Soil fumigation
6. Harvesting	1. Time: 2-3 months after sowing.	Size of pod; ≤ 10cm long about 4 -5 days after flowering.
	2. Methodology	Give pod a slight twist at fruits stalk.
7. Storage	1. Temperature	7-10oC
	2. Relative humidity	95%
	3. Storage period	10 days maximum

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Item: 1.2 SWEET PEPPER (*Capsicum annuum*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Land Preparation	1. Site selection 2. Soil 3. Land clearing 4. Ploughing	i) To have adequate water ii) To be accessible Loamy and well drained i) Clear bushes ii) Destumping On the flat Dig 9" deep
2. Nursery Preparation	Start January	i) Till the soil to make a fine seed bed ii) Collect trash on seed bed iii) Burn the trash for sanitation purposes iv) Water seed bed to soil field capacity
3. Sowing	1. Apply proper amount 2. Nursery management	1-2 kg/ha i) Cover lightly the most seed bed with soil ii) Water the seed bed iii) Provide light shade until first cotyledon leaves are fully grown. iv) Decrease shade gradually until transplanting time v) Continue watering to field capacity as shade is decreased.
4. Transplanting	1. Size of seedlings 2. Spacing	Transplant seedlings 8-10 cm high i) Single rows 60-80cms x 35-45 cm ii) Square rows 50-60cms x 50-60 cm iii) Double rows 1 m x 1.5 m x 25-30 cm iv) Plant seedlings in moist holes. v) Plant in evening or on cloudy day vi) Water immediately after transplanting
5. Pest Control	1. Fruit fly <i>Ceratis capitata</i>	i) Destroy infested fruits ii) Bait adults flies with a mixture of sugar solution and Karate. iii) Bait adults flies with a mixture of sugar solution and Karate. iv) No economic means of control
6. Disease Control	1. Fruit rot <i>Colletotrichum nigeum</i> 2. Anthracnose <i>Cloletotrichum phomoides</i>	i) Use clean seeds ii) Practice crop rotation iii) Remove infested fruits i) Carry out crop rotation ii) Establish good drainage iii) Remove infesred fruits iv) Spray seedlings with Ziram

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		v) Apply Dithiocarbomates to fruiting plants.
	3. Powdery mildew <i>Leveillula faurica</i>	i) Use resistant varieties ii) Remove host plants iii) Apply sulphur dust or sprays. Avoid scorching during hot dry weather.
	4. Root knot nematode <i>Meloidogyne spp.</i>	i) Warm water treatment of sets ii) Deep ploughing and exposure of soil to dry. iii) Flooding iv) Ploughing in residues
	5. Bacterial wilt <i>Pseudomonas solanacearum</i>	i) Crop rotation with non susceptible crop ii) Plant assistant cultivars
	6. Bacterial leaf and fruit spot <i>Xanthomonas vesicatoria</i>	i) Treat seeds with hot water (50oC) for 25 minutes ii) Crop rotation iii) Avoid overhead irrigation of infected crops iv) Treat dry seeds Hot water treated seeds with Thiram at planting
	7. Cucumber mosaic virus	i) Remove affected plants ii) Grow plants away from alternative host plants iii) Spray chemical against aphid vectors
8. Harvesting	1. Time and methodology	i) Harvest 50-80 days after transplanting ii) Cut stalk near attachment to plant preferably by knife
9. Storage	1. Temperature	7-10oC
	2. Relative humidity	95%
	3. Storage period	Maximum 40 days with good ventilation

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Item: 1.3 CUCUMBER (*Cucumis sativa* -L)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Land Preparation	1. Site selection	i) To have adequate water ii) To be accessible
	2. Good soil	i) Loamy and well drained ii) pH 6.0-7.5 iii) High organic matter
	3. Proper land clearing	i) Clear bushes and carry out ii) Destumping iii) One month before planting
	4. Deep ploughing	i) On the flat; Dig 9" deep Break all clods. Establish fine tilth ii) On ridges; On normal soils: 90 cm between ridges, 25cms high and 5-10 m long On water logged soil: 90cms between ridges, 60-90 cm high and 5-10 m long
	5. Initial fertilisation	Apply well decomposed farm yard manure or compost 2 tin full/5m ridge.
2. Planting	1. Choose good seeds	i) Viability > 80%
	2. Preparer holes	i) Make holes 90 x 60cms
	3. Apply fertiliser	i) Apply 2 handful of organic matter/planting hole and mix with soil ii) Apply NPK 100kgs/ha or 225kgs/9m ² or 1x 9m plot.
	4. Plant timely	i) Mid May -December ii) Plant in situ iii) Plant in a moist hole.
	5. Spacing	90 cm x 60 cm both flat and ridge planting.
	6. Establish proper seed rate	3-5 kg/ha or 4.5 g/ridge of 90 cm x 10 m.
3. Husbandry	1. Watering	Apply adequate water to field capacity
	2. Weeding	i) As soon as weeds appear ii) Use garden hoe
	3. Fertilization	Top dress CAN, 1 large tea spoon full/plant (10 g/plant) at start of trailing and beginning of flowering (3-4 weeks after planting)
	4. Mulching	Soon after 1st top dressing
	5. Staking	Make framework of stakes for trailing types
4. Pest Control	1. Aphid <i>Aphis gossypii</i>	i) Early planting ii) Burning crop debris immediately after harvest

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		iii) Use Karate. Mix 10 ml of chemical in 15-20 lts of water and spray.
	2. Red pumpkin beetle	i) Early planting ii) Burning crop debris immediately after harvest
	3. Control epilachna beetle	iii) Use Karate. Mix 10 ml of chemical in 15-20 lts of water and spray. Spray Karate, 15-20 ml mixed in 15-20 lts of water
	4. Control eel worms	i) Crop rotation ii) Soil fumigation
5. Diseases Control	1. Anthracnose	Use Topsin M
	2. Powdery mildew	Use Byfidan
	3. Fusarium wilt	Practice crop rotation
	4. Downy mildew	Use Byfidan
	5. Cucumber mosaic virus	Plant resistant/tolerant varieties
	6. Musk melon virus	Plant resistant/tolerant varieties
6. Harvest On Time	1. Time	i) 6-8 weeks after sowing ii) When fruit size is 15-20 cm long
	2. Methodology	Cut stalk by sharp knife
7. Proper Storage	1. Temperature	10-13°C
	2. Relative humidity	95%
	3. Storage period	i) ≤ 14 days ii) Pack in 20 kg well ventilated containers

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Item: 1.4 TOMATOES (Capsicum anum)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Land Preparation	1. Site selection	i) To have adequate water ii) To be accessible
	2. Choose proper soil	Loamy and well drained
	3. Proper land clearing	i) August-February ii) Clear bushes iii) De stump properly
	4. Deep ploughing	i) Flat, dig 9" deep ii) Flat raised beds 100 cm wide, 50 cm between beds, 10 m long, 20 cm high during dry season or 35 cm high during wet season.
	5. Basal fertiliser	i) 5-10gms phosphoric fertiliser/hole ii) Farm yard manure Two handfuls/hole and mix with soil
2. Seedbed Preparation	1. Align seedbeds	i) 1 m x 10 m raised flat beds ii) Prepare raised flat bed; 1m wide 10 m long and 15 cm high
	2. Carry out soil treatment	Burn sufficient trash on top of seedbed
	3. Application fertiliser	Put organic manure as in Cucumber
	4. Raise soil moisture	Wet seedbeds to field capacity
3. Drill Seeds	1. Make straight rills	i) Make straight rills along seedbed 6 cm apart. ii) Drill seeds at rate of 750-900 seeds/square meter
4. Nursery Husbandry	1. Maintain soil moisture	i) Mulch all seedbeds ii) Apply water to seedbeds to field capacity iii) Continue to apply water as needed by seedlings. iv) Remove mulch after seedling emergence approximately 8-10days after sowing. v) Prepare nursery shade for young plants.
	2. Thin seedlings	Thin 2-3 days after first two true leaves appear.
	3. Apply Fertilizer	Apply 2.5gms Urea mixed with 1 liter of water
	4. Harden seedlings	i) Remove shade gradually 2 weeks after emergence of seedlings ii) Reduce gradually the amount of water applied one week before transplanting or 3 weeks after emergence of seedlings.
5. Propagation/ Transplanting	1. Select good seedlings	Choose stocky, vigorous seedlings with 4 leaves.

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	2. Transplanting seedling at right time	i) 4 weeks after emergence or 5 weeks after sowing. ii) Plant in late afternoon or in a cloudy day
	3. Plant at correct spacing	i) 60 cm x 40 cm for indeterminate types ii) 70 – 90 cm x 40 cm single row for determinate type.
	4. Prick at the right time	i) Water thoroughly Seedlings 12 hours before pricking. ii) Prick seedling with adequate root soil iii) Use garden fork
	5. Insert seedling in hole	i) Insert up to just below cotyledon level ii) Plant deeper for spindly plants. iii) Firm soil around plant base.
6. Proper Husbandry Techniques	1. Water seedlings	i) Water every plant after firming the soil. ii) Water the field regularly and adequately to field capacity. Excess water to be drained within 1 to 3 days
	2. Mulch beds	i) Mulch all raised beds ii) Spread evenly mulch on the beds.
	3. Stake/Trellis seedlings	i) Cradle type, Lean to type, Conventional type or Tunnel type. ii) Use sturdy wood stakes or bamboo poles. iii) Always stake indeterminate varieties iv) Stake determinate varieties only in the wet season. v) Fix plants securely to stake or string support. vi) Stake two weeks after transplanting.
	4. Prune tomato plants	i) Prune all indeterminate varieties. ii) Prune to one stem during cool-dry season. iii) Prune to two branches per plant during hot dry season. Maintain main branch and second branch below first fruit cluster Pinch flowers to leave four fruits per cluster to get large fruits
	5. Pinch flowers for market need	
	6. Control weeds	i) Remove weeds from furrows by pulling ii) Hoe frequently
7. Proper Pest Control	1. Tomato fruit worm <i>Helicoverpa armigera</i>	i) Apply Guthion or pyrethrins before caterpillars enter fruit ii) Carry out crop rotation
	2. Root knot ellworm <i>Meloidogyne javanica</i> <i>Meloidogyne incognita</i> <i>M. arenaria</i>	i) Plant resistant varieties ii) Carry out crop rotation iii) Practice fallow cultivation

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8. Proper Disease Management

1. Late blight
Phytophthora infestans
 - i) Plant resistant varieties
 - ii) Destroy infested crop debris
 - iii) Carry out crop rotation
 - iv) Fumigate with Bravo or Dithane or Ridomil Gold or copper compounds.
 - v) Avoid planting near potato fields.
2. Early blight
Alternaria solani
 - i) Use fungicides like Bravo, Dithane or Quadris
 - ii) Destroy all infested debris
 - iii) Plant tolerant varieties
3. Bacterial spot
Xanthomonas compestris
 - i) Apply copper compounds eg Maconeb
 - ii) Keep seedbeds away from production fields
 - iii) Use mulch to reduce rain splashes.
 - iv) Use furrow irrigation
 - v) Destroy all infested debris
4. Gray leaf
Stemphylium solani
 - i) Plant resistant varieties
 - ii) Spray fungicides such as Bravo or Dithane
5. Bacterial wilt
Rolstonia (Pseudomonas) solanacearum
 - i) Plant tolerant varieties
 - ii) Exercise good soil drainage
 - iii) Soil pH 5.5 or above
 - iv) Avoid nematode infested areas
 - v) Grow tomatoes after paddy.
6. Southern blight
Sclerotium rolfsii
 - i) Plant when green manure is fully decomposed
 - ii) Apply fungicides
 - iii) Keep bed surface dry
 - iv) Grow tomatoes after paddy or maize.
7. Fusarium wilt
Fusarium oxysporium f. sp. lycopersici
 - i) Good soil drainage
 - ii) Plant resistant varieties
 - iii) Keep bed surface dry
 - iv) Grow tomatoes after paddy.
8. Tomato yellow leaf curl virus (TYLCV)
 - i) Plant tolerant varieties
 - ii) Close season of 60 days
 - iii) Use insecticides for white flies rotatingly.

9. Physiological Disorders

- Control:
1. Catfacing (Cracked, deformed fruits)
 - i) Mulch
 - ii) Regulate irrigation
 - iii) Use fruit set hormones
 2. Blossom end rot
 - i) Mulch
 - ii) Regular controlled irrigation
 - iii) Apply calcium based fertilizers
 - iv) Avoid high nitrogenous fertilizers

10. Harvesting

- Carry out proper harvesting
- i) Harvest at green mature stage or later
 - ii) Harvest when cool
 - iii) Handle fruits carefully
 - iv) Keep tomatoes in cool ventilated containers with high Relative Humidity.

11. Transportation

- Take great care in transporting tomatoes
- i) Transport tomatoes in cool weather
 - ii) Put them in unbreakable containers, eg. Wooden crates.

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Item: 1.5 GARLIC (*Allium sativum*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Site Selection	1. Site selection	i) To have adequate water ii) To be accessible
	2. Choose proper soil	i) Loamy and well drained
2. Land Clearing	1. Carry out proper land clearing	i) Clear bushes ii) De stump properly
3. Seedbed Preparation	1. Carry out deep ploughing	i) Flat, dig 9" deep ii) Flat raised beds iii) Make drills 5-8cm deep iv) Space at 30-40 cm between rows and 10 – 15 cm between plants.
4. Planting or Propagation	1. Select appropriate planting materials	i) Use cloves (fingers) as planting materials ii) Select healthy cloves and separate them into single segments.
	2. Plant properly and timely	i) Planting time May/June ii) Seed rate of 200 – 350 kg per 0.4 of a hectare (1.0 acre) ii) Cover the segments firmly with fine soil.
5. Crop Husbandry.	1. Weed timely and properly	i) Weed as soon as weeds appear ii) Earth up your clones iii) Use hand hoe in weeding
	2. Water the plants adequately	i) Water regularly to field moisture capacity ii) Avoid excessive watering.
	3. Apply correct rate and type of fertilizer	Apply 1.0 table spoon full of NPK per plant at bulbing stage.
	4. Control pests i. Thrips <i>Onion tabacchi</i>	i) Insect pierce and rasp the leaf surface leaving empty spaces on the leaves. ii) Spray Hot paper solution made of 50 g of hot paper powder in 2 litres of water. Then add soap to the mixture iii) Use Karate or Diazinon
	5. Control diseases i. Purple blotch ii. Downy mildew iii. Bulb rot iv. Rusts	i) Use clean seeds ii) Carry out crop rotation iii) Use wider spacing iv) Use chemicals
6. Harvesting	Harvest timely and carefully	i) Harvest after 90-120 days after planting when leaves have fallen off and dried. ii) Few lower leaves can be harvested for flavouring before maturity of the bulbs iii) Dig out the mature bulbs using a

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		hand fork, forked hand hoe or a hand hoe.
7. Processing	Cure the garlic properly	Dry in the sun for 8 to 10 days before marketing
8. Packaging, Storage And Marketing	Store the bulbs properly	i) Store in a cool dry place. ii) At 0 degrees Centigrade can be stored for 90 days. iii) At 25 degrees Centigrade can be stored for 90 days iv) Relative humidity less than 70% with good air circulation.
	Pack properly and sell timely	i) Pack in sacks which allow air circulation ii) Avoid packing in polythene bags.

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Item: 1.6 AVOCADO (*Persia americana*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Site Selection	1. Proper site selection	<ul style="list-style-type: none"> i) To have adequate water ii) To be accessible iii) Near market outlet iv) Temperature 12-28°C v) There should be a natural wind break or make one.
	2. Choose proper soil	<ul style="list-style-type: none"> i) Loamy and well drained ii) Impervious layer below 90 cm. iii) Altitude 100 – 2,300m asl.
2. Land Clearing	1. Carry out proper land clearing	<ul style="list-style-type: none"> i) Clear all bush ii) De stump properly
3. Land Preparation	1. Prepare land properly	Plough 15cm deep
4. Planting Materials Selection and Preparation	1. Prepare good planting materials	<ul style="list-style-type: none"> i) Grafting should be done when the seedlings reach pencil thickness. ii) Wedge grafting method is the best. iii) Grafting to be done at the point where the rootstock is soft iv) The scion should be dormant at the time of grafting.
5. Field Layout And Holing	1. Prepare planting holes	<ul style="list-style-type: none"> i) Spacing can be 6 x 6 m; 10 x 10 m; or 12 x 12 m.
		<ul style="list-style-type: none"> ii) Holes should be 60 cm x 60 cm x 60 cm iii) Separate top soil from subsoil iv) Mix top soil with 2 tin full of kraal manure and return the soil with manure into the hole. v) Put a stick upright at the centre of the hole.
5. Transplant	1. Transplant properly at the right spacing	<ul style="list-style-type: none"> i) Plant at the beginning of the long rainy season ii) Choose good healthy grafted seedlings iii) At 12 x 12 meters plant population is 69 seedlings per ha. iv) Transplant at a depth corresponding to that at the nursery. v) Give light shade if necessary
6. Crop Husbandry	1. Weed early	<ul style="list-style-type: none"> i) Field should be clear of weeds all the time ii) Control weeds by using hand hoe iii) Intercrop with annuals in the initial years of avocado establishment. Remove all dried and overhanging and interlocking branches.
	2. Prune properly	

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	3. Prop where necessary	Prop producing branches by strong poles.
7. Harvesting	1. Harvest properly and timely	i) Harvesting normally from April to September ii) Harvest mature fruits iii) Use harvesting poles or harvesting baskets.
8. Marketing	1. Sell timely	i) Sell fruits immediately after harvesting. ii) They have a short shelf life under ambient temperatures.
9. Storage	I. Store properly	For longer shelf life store at low temperatures of from 10 - 15° C under dry conditions.

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Item: 1.7 PINEAPPLE (*Ananas comosus*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Site Selection	1. Proper site selection	i) To have adequate water ii) To be accessible iii) Near market outlet
	2. Choose proper soil	i) Loamy and well drained ii) Ph 5.0-6.5 iii) Altitude 100 – 1200 asl.
2. Land Clearing	1. Carry out proper land clearing	i) Clear bushes ii) De stump properly
3. Land Preparation	1. Prepare land properly	i) Plough 15 cm deep ii) Incorporate 10-15 tons of kraal manure
4. Planting Materials Selection	1. Select good planting materials.	i) Use suckers or slips ii) Larger suckers are better
	2. Prepare planting materials	Keep the planting material under shade for 3 days before planting to activate rooting.
5. Transplant	1. Transplant properly at the right spacing	i) Plant at the beginning of the long rainy season
		ii) Spacing is 0.6m. between rows x 0.3 between plants and 0.8m between double rows.
		iii) Plant population is 50,000 seedlings per ha.
		iv) Dip the plant material in Diazinon or Fenthion solution for 5 minutes before transplanting to control mealy bugs
		v) Transplant at a depth of 7.5 to 10 cm.
6. Crop Husbandry	1. Weed early	i). Deep cultivation recommended during land preparation
		ii) Control weeds by chemical eg Dalapon.
		iii) Use hand hoe in weeding.
	2. Apply recommended type and rate of fertiliser	i) Apply NPK 50 – 70 gm/plant during transplanting
		ii) Apply CAN at 85 g per plant at 6 months after transplanting; 3 months after first harvest and 3 months later.
		iii) Return the soil and press it firmly
3. Control pests i. Nematodes	i) Damage by eating the roots, forms undesirable knots and produce toxins in the roots.	
	ii) Control by Fumigation with nematocides.	
	iii) Crop rotation	

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	ii. Pineapple Mealy bug	i) Damage plant by curling the tip of the leaves and discolouring the leaves. ii) Controlled by dipping the planting materials or spraying them with Diazinon or Fenthion
	4. Control diseases	
	i. Top and root rot <i>Phytophthora spp</i>	i) Damage is evidenced by changing colour of heart leaves to light brown with a red tinge. ii) Control is by planting in raised beds, 23 cm high in less drained soil iii) Spray copper fungicide
	5. Prune properly	i) Remove all slips after harvesting. Leave only one strong and healthy sucker.
6. Harvesting	1. Harvest timely and properly 2. Apply recommended type and rate of fertiliser	i) Harvest after 18 to 24 months ii) Harvest the fruit stalk when its basal part has changed to golden yellow. iii) Cut the fruit stalk 30 cm long so that it is intact with the fruit. iv) Trim the crown for easy handling
7. Storage	Store properly	i) Store the harvested fruit in a cool dry place with the stalk facing upwards.

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Item: 1.8 BANANAS (*Musa spp.*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Site Selection	1. Proper site selection	i) To have adequate water ii) To be accessible
	2. Choose proper soil	Loamy and well drained
2. Land Clearing	1. Carry out proper land clearing	i) Clear bushes ii) Destump properly
3. Land Preparation	1. Prepare land properly	Ripp. Plough and harrow Plough 200 - 300 mm in moist soil
	i. Flat land	i) Establish grass waterways ii) Design conservation structures For a 25% or more make contour channels and banks with binding grass and trash lines.
	ii. Sloping land	i) Make hole 30cm x 30cm x 30cm. ii) Space the hole at 3.6 x 3.6 meters in a straight line. iii) Add 2 tinful of manure to the top soil and mix thoroughly iv) Cover the hole with soil containing manure v) Put a stick to mark the centre of the hole vi) Leave the holes for 3 months
	2. Make field layout	
4. Planting	1. Select good planting materials	i) Choose sword suckers for planting ii) Select planting materials which are free from pests and diseases.
	2. Plant at the right time	i) Plant at the onset of the rains. ii) Remove the stick at centre of hole iii) Remove the soil to a depth of 30 cm. iv) Place the sucker upright in the hole v) Return the soil and press it firmly
5. Crop Husbandry	1. Apply adequate mulch	i) Spread dry grass, straws, or banana leaves near the base of the stems. ii) Keep mulch 30 cm from the base of the banana stem.
	2. Weed properly	i) Weed lightly to avoid damaging roots ii) Weed as soon as weeds appear iii) Use herbicides under the direction of the Agricultural Extension Officer.
	3. Carry out proper thinning	i) Remove all water and week suckers. ii) Thin the stool to maintain a stand of one bearing plant, a follower and a sucker.
	4. Carry out proper pruning	Prune all dried leaves

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	5. Prop up heavy bearers	Use strong poles to support plants with big bunches
	6. Control pests	
	i. Banana weevil <i>Cosmopolites sordidus</i>	i) Control weeds ii) Chopp into small pieces effected pseudostems. iii)Use chemical available at the market.
	ii. Burrowing nematodes	i) Use Nematocides ii) Carry out crop rotation iii)Dip suckers in water at 55° C. for 15 minutes iv)Use resistant varieties.
	iii. Thrips, Mites and Moths	i) Use chemicals available in the market.
	7. Control diseases	
	i. Black sigatoka <i>Mycosphaerella zizensis</i>	i) Symptoms are Leaf Spots that coalesce to form large necrotic patches ii) Control by use of resistant cultivars iii)Eradication of infected materials iv)Use of disease free planting materials v) Use of systemic chemicals
	ii. Panama Disease <i>Fusarium wilt</i>	i) Symptoms: Bananas wilt ii) Control is by use of resistant cultivars iii)Eradication of infected materials iv)Use of disease free planting materials v) Use of systemic fungicides.
6. Harvesting	Proper and timely harvesting	i) First harvest 9 – 18 months after planting depending on cultivar ii) Cut the stem near the base of the bunch when fruits are fully mature and are light green with shiny appearance.
7. Storage	Store the bananas properly	i) Store bunched in a cool dry store ii) Hang the branches to avoid damaging the fingers.
8. Marketing	Market at the right time	i) Bananas for export should be sold before they are ripe ii) When transporting, wrap bananas in grass or banana leaves to avoid bruising them. iii)Sell as soon a you harvest.

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Item: 1.9 OYSTER MUSHROOM (*Pleurotus spp*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1. Site Selection	1. Proper site selection	i) To be accessible ii) Near market outlet
2. Construction of Shed	1. Construct proper shed for mushroom production	i) Thatch the structure with grass ii) Size is 5 m x 8 m for small scale growers iii) Divide the shed into two compartments iv) One is Dark Room and should be 2 m x 3 m. v) The other is ventilated room vi) Construction materials can be Bricks, timber or mud and dub.
3. Spawn Preparation	1. Prepare good spawn	i) Use grounded grain spawn of wheat, finger millet etc ii) Boil the spawn iii) Sterilize in glass jar or jam bottle at 121°C for 30 minutes for 2 consecutive days iv) The spawn should be dormant at the time of grafting. v) Inoculate the spawn with mushroom culture and incubate for 10 – 15 days at 25° C.
4. Substrate Preparation	1. Prepare quality substrate	i) Use rice or wheat straws, grass, banana pseudostem, sawdust, cotton or sisal wastes, corn cobs etc. ii) Chop the substrate into small pieces. iii) Pack them in such a way that they can provide just enough space for colonization. Not too loose and not too compact. iv) Moist the substrate lightly. v) If the substrate is slightly acidic, add either lime or gypsum to make pH neutral vi) Sterilize the substrate by heating at 85 - 100°C or heat by steaming it overnight.
5. Spawning (Seed Sowing)	1. Carry out proper spawning	i) Acquire clear and clean transparent polythene bags of 75 x 50 cm or 45 x 33.5 cm or 30 x 25 cm. ii) Mix substrate and spawn hygienically. Double Layer method: Mix substrate and spawn in alternating layers Top Spawning method: Spawn on top of the substrate

		Thorough Spawning: Mix thoroughly substrate and spawn. iii) Tie the bag with a clean sisal twine. iv) Seed rate is 2 teaspoonful per 1 kg bag of substrate.
6. Crop Management	1. Carry out proper management	i) Ensure that the dark room remains dark ii) Ensure that there is sufficient moisture in the substrate iii) Ensure that there is appropriate humidity in the shed.
	2. Control pests <i>Nematodes</i>	i) Control temperature and humidity within the shed by sprinkling water
	3. Mites	i) Controlled by good sanitation
	4. Rats	10 Rat proof shed
	5. Fruit flies <i>Drosophilla meloidogyne</i>	i) Controlled by timely harvesting and proper sanitation
	6. Control Diseases	i) Control by good sanitation
	i. Moulds/ Green Moulds	ii) Control also by disinfecting the shed before putting in a new crop.
	ii. Viral diseases	i) Controlled by use of spawn free from virus ii) Eradication of infested materials.
	iii. Bacterial diseases	i) Controlled eradicating all infested materials ii) Steam the shed iii) Disinfect by using hypo chlorite 10% by mixing 150 mls in 100 liters of water.
7. Harvesting	1. Carry out timely and proper harvesting	i) Harvest fully developed and bright coloured mushroom 25 – 30 days after spawning ii) Harvest by twisting or cutting with a knife at the base of the mushroom.
8. Storage	1. Store properly	i) Fresh Storage: Store in a cool place at 6-10 ° C. or store in sealed polythene bags at 15 – 21°C for shelf life of 5 – 7 days. ii) Dehydrated Dry the mushroom under the sun or use a solar drier and store the product. iii) Canning Can as whole mushrooms or slice into half or smaller pieces. Keep in jars or bottles and add 2% brine (Na Cl), 2% sugar and 0.3% citric acid and sterilize.
9. Marketing	1. Sell timely	i) Sell mushrooms that are of high quality Free from pests and diseases Free from physical damage Mushrooms stored less than 5 days after harvesting.

Field: 1. Vegetable Production

Item: 1.10 CARROTS (*Daucus carota*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1.Site Selection	1. Proper site selection	i) Should be have adequate water with warm climate ii) Should be accessible
	2. Choose good soil	i) Fertile, well drained sandy loams or silty loams. PH 6.0-7.0
2. Land Preparation	1. Land clearing	i) Clear all bushes ii) De-stump completely
	2. Ploughing	i) Plough deeply 9" deep on the flat Flat ridges 12" deep
	3. Seedbed preparation	i) Allign seedbeds 1.0x10m ii) Prepare raised seedbeds
3. Sowing	1. Apply correct seed rate	i) 5.5 Kg/ha ii) Varieties include: =Chantenary for fresh market =Nantes for fresh market and canning
	2. Sow evenly	i) Mix seeds with some soil evenly ii) Make straight light furrows 30 cm apart. iii) Sow the seeds mixed with soil in the furrows evenly. iv) Cover the furrows lightly with soil v) Water the seedbed vi) Provide light shade until first cotyledonous leaves are fully mature. vii) Continue watering to field capacity as shade is decreased
4.Husbandry/Management Practices	1. Thin at the right time	i) Thin 4 weeks after sowing ii) Thin out to 2-4 cm between plants
	2. Apply the correct rate and type of fertilizer	i) Apply 200kg. Double super Phosphate/ah at planting. ii) Apply 200 kg C.A.N. per ha. When plants are 10 cm high.
	3. Water plants properly	i) Water regularly and adequately ii) Maintain moisture content at field capacity
	4. Weeding timely	i) Weed as soon as weeds appear
	5. Control pests	
	6. Green Aphids <i>Brevicoryne brassicae</i>	i) Found at the base of leaves ii) Spray Diazinon or Fomothion or Dimethoate.
5. Harvesting	1. Harvest at right time	i) Crop ready for harvest 10-12 weeks after planting. ii) Leave longer for carrots to be dehydrated.

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	2. Harvest properly	i) Lift roots by using hand fork or a hand hoe. ii) Yield depend on harvesting time. iii)4 tons for tender roots and 8 tons for market stage and 20 tons for dehydration plants
6. Storage	1. Store properly	i) Temperature: 15-20 degrees C. ii)Relative humidity: 80-90/100 iii)Storage period: 10 days max.

Field: 1. Vegetable Production

Item: 1.11 WATER MELON (*Cucumis welo*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1.Site Selection	1. Proper site selection	<ul style="list-style-type: none"> i) Accessible ii) Near permanent, reliable source of water iii) Near to the market iv) Good soils, well drained v) Good moisture retaining capacity vi) Sadly loams are highly preferred.
2. Land Preparation	1. Good Land preparation	<ul style="list-style-type: none"> i) Clear the bush ii) De-stump iii) Fine tillage iv) Incorporate soil with organic manure one debe per plant mature one v) Make ridges-sunlen, raised or plant surface according to weather vi) Prepare the land from early July
3. Planting/Sowing	1. Proper and timely planting	<ul style="list-style-type: none"> i) Plant from late July or early August ii) Plant directly or transplant. iii) Use clean, improved seeds. iv) For direct sowing, plant at a spacing of 2m between rows by 1m between plants or 3m x 2m. v) Sow 1-3 seeds per hole, 2-4 cm deep. vi) Thin to 1-2 seedlings per station. vii) Seedrate 1.5-4kg/acre.
4. Crop Husbandry	<ul style="list-style-type: none"> 1. Water properly and adequately. 2. Do proper mulching 3. Weed timely and properly 4. Apply fertilizers efficiently 5. Control pests 	<ul style="list-style-type: none"> i) Water the plants regularly throughout the growing period. ii) Avoid excessive watering i) Use dry grass to straws ii) Mulch just after seed germination around the planting hole iii) Can make small pillows using dry grass for each fruit. i) As early as weeds appear ii) Avoid plant injury i) Apply NPK/CAN 65g/Plant when the plant starts to spread; then 130g/plant during flowering stage. i) Fruit flies (<i>Dacus SPP</i>) Damage: They pierce into the fruit making holes Control: Field sanitation, Spray with fenthion

	6. Control Disease	<p>ii) Nematodes – Neloidegyne SPP The plant roots swells ad form modules. Control: Fumigate using nematicides Uproot the affected plants and burn. Plant trap crops eg. African merry gold</p> <p>i) Leaf Spot</p> <p>ii) Anthracuose</p> <p>iii) Powdery mildem</p> <p>iv) Wilt</p> <p>v) Control: Use resistant varieties Field sanitation Wider spacing Spray with sulphur or cropper dusts.</p>
5. Harvesting	1. Harvest properly and timely	<p>i) 80-100 days after sowing</p> <p>ii) Continue harvesting for 40-50 days under good management.</p> <p>iii) Harvest when the fruit is full ripe and if tapped it sound dull and follow. Down surface changed to yellow, shining fruit and when trendoils dries up.</p> <p>iv) Avoid fruit injury.</p>
6. Marketing and Storage	1. Store properly and sell timely	<p>i) Maintain a good quality of the produce.</p> <p>ii) Store the water melon in a cool condition 15-20 c with a relative humidity of 80-85%</p> <p>iii) Sell the watermelon when it is jucy, sweet and red flesh.</p>

Field: 1. Vegetable Production

Item: 1.12 ONIONS (*Allium cepa*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1.Site Selection	1. Proper site selection	i) Should have adequate water with warm climate ii) Should be accessible
	2. Choose good soil	i) Fertile, well drained sandy loams or silty loams. PH 6.0-7.0
2. Land Preparation	1. Land clearing	i) Clear all bushes ii) De-stump completely
	2. Ploughing	i) Plough deeply =9"deep on the flat =Flat ridges 12" deep
	3. Seedbed preparation	i) Allign seed beds 1.0 x 10m ii) Prepare raised seedbeds 1.0 x 10.0m x 10cm high iii) Incorporate manure and phosphatic fertilizer
3. Sowing	1. Apply correct seed rate	i) 1.75-2.0 kg /ha ii) Varieties include: =Red Creole, Tropicana Hybrid, White Creole for dehydrated onions.
	2. Sow evenly	i) Mix evenly seeds with some soil ii) Make straight light furrows 15 cm apart iii) Sow the seeds mixed with soil in the furrows evenly iv) Cover the furrows lightly with soil v) Water the seedbed 2 x a days vi) Provide light shade vii) Decrease shade gradually until seeding are ready for transplanting viii) Continue watering to field capacity as shade is decreased
4. Transplanting	1. Adopt correct spacing	i) Transplant when plants are pencil thick ii) Transplant at 30 cm between rows and 10 cm between plants
5.Husbandry/Management Practice	1. Weed timely	i) Start careful weeding 2 weeks after transplanting and when weeds appear
	2. Apply the correct rate and type of fertilizer	i) Apply 200 kg. Double super Phosphate/ ah at planting. ii) Apply 240 kg. per ha. of Ammonium sulphate 4 months to maturity.
	3. Water plants properly	i) Water regularly and adequately ii) Maintain moisture content at field capacity.

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	4. Control pests	i) Silvering and withering of leaves from the top downwards
	i. Onion Thrips (<i>Thrips tabaci</i>)	ii) Spray Diazinon or Fenithion or Fenitrothion
	5. Control Disease	i) Oval grey lesions with purple centers on leaves, curlin, dieback
	i. Purple Blotch (<i>Alternaria porii</i>)	ii) Destroy crop residues, carry out crop rotation.
	ii. Downy Mildew (<i>Peronospora destructor</i>)	iii) Spray Chlothalonil or Maneb. i) Leaves covered with brown mildew, later turning into brown and killing the leaves ii) Destroy crop residues, carry out crop rotation. iii) Spray Ridomil or Benomyl.
6. Preharvesting	1. Cure onions	i) Stop watering 4.5 months after transplanting. ii) Bend down onion stems iii) Leave onion leaves to dry
5. Harvesting	1. Harvest at right time	i) Crop ready for harvest 20 weeks after transplanting. ii) Pull up onions and leave on ground to dry for 3 days iii) If very hot shade the onions iv) Turn onions daily to dry properly v) Yields are up to 17 tons /ha.
6. Storage	1. Grade and Store properly	i) Grade according to size ii) Store in slated boxes in cool area iii) Can Tie in bunches and hand in cool area. iv) Inspect regularly v) Remove spoilt onions
7. Marketing	1. Market timely	i) Sell very large and thick necked onions first ii) Market in net bags.

Field: 1. Vegetable Production

Item: 1.13 GARDEN EGGPLAMT/BRINJAL /AUBERGINE (*Solanum melongina*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>
1.Site Selection	1. Select good site	i) Should have adequate water with warm climate ii) Should be accessible iii) Clear all bushes iv) De-stump completely
	2. Choose good soil	i) Fertile, well drained sandy loams or silty loams. PH 6.0-7.0
2. Land Preparation	1. Ploughing	i) Plough deeply =9" deep on the flat =Flat ridges 12" deep
3. Sowing	1. Apply correct seed rate	i) 5.5 Kg /ha ii) Varieties include: = Chantenary for fresh market = Nantes for fresh market and canning
	2. Sow evenly	i) Mix seeds with some soil evenly ii) Make straight light furrows 30 cm. apart. iii) Sow the seeds mixed with soil in the furrows evenly. iv) Cover the furrows lightly with soil v) Water the seedbed vi) Provide light shade until first cotyledonous leaves are fully mature. vii) Decrease shade gradually until seedling are ready for transplanting viii) Continue watering to field capacity as shade is decreased.
4.Husbandry/Management Practices	1. Thin at the right time	i) Thin 4 weeks after sowing ii) Thin out to 2-4 cm between plants
	2. Apply the correct rate and type of fertilizer	i) Apply 200 kg. Double Super Phosphate/ah at planting. ii) Apply 200kg C.A.N. per ha. when plants are 10 cm high.
	3. Water plants properly	i) Water regularly and adequately ii) Maintain moisture content at field capacity.
	4. Weeding timely 5. Control pests i. Green Aphids <i>Brevicoryne brassicae</i>	i) Weed as soon as weeds appear i) Found at the base of leaves ii) Spray Diazinon or Fomothion or Dimethoate.
5. Harvesting	1. Harvest at right time	i) Crop ready for harvest 10-12 weeks after planting. ii) Leave longer for carrots to be dehydrated.

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	2. Harvest properly	i) Lift roots by using hand fork or a hand hoe. ii) Yield depend on harvesting time. iii)4 tons for tender roots and 8 tons for market stage and 20 tons for dehydration plants
6. Storage	1. Store properly	i) Temperature: 15-20 degrees C. ii)Relative Humidity: 80-90/100 iii)Storage period: 10 days max.

Field: 1. Vegetable Production

Item: 1.14 MANGOES (*Mangifera idica*)

<u>TECHNOLOGICAL PACKAGE</u>	<u>MESSAGE</u>	<u>IMPACT POINTS</u>	
1.Site Selection	1. Select Appropriate Site	i) Accessible ii) Near Market iii) Near permanent source of water	
	2. Choose Good Soil	i) Sandy loamy Soil ii) Fertile Soil. iii) Well drained soil and deep. iv) Altitude is up to 1,500 metres above sea level.	
	3. Look for appropriate ecological condition	i) Temperature: 20 – 27C ii) Rainfall 1000 to 1800mm	
2. Selection of Variety and Seeds	1. Select Good variety and seeds	i) Known Varieties in Tanzania are: Dodo, Boribo, Ngowe, Batawi, Sindano, Alphonso, Florida Peach and Sabre. ii) Select seeds from good mother trees Sweetness, Less fibre and high yielding. iii) If grafts is to be used then the root stock and the scion should be Of different variety.	
	3. Land Preparation	1. Prepare the Land well	i) Clear all bush ii) De stumping iii) Kay out the farm i) Spacing grafted trees 12mx12m. Un-grafted trees 14mx14m.
		2. Prepare appropriate Planting Holes	i) Planting Holes to be dug (60x60x60cm) 1-3 months before planting the seeds. ii) Separate top and sub soil. iii) Cover the hole. Start with top soil then down soil on top. Mark the center of the hole with a peg.
3. Crop Husbandry	3. Plant the Seedling well	i) Remove the Peg ii) Plant the Seedling in a hole dug to the size of seedling . iii) Planting should be done at the Beginning of rainfall season.	
		1. Weed Properly	i) Intercrop with annual crops for proper weeding. ii) Remove flowers produced during the first year of planting the seedlings to prevent breaking of small branches. iii) Do not plant anything a metre away the tree.

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|--|---|
| 2. Timely and proper fertilizer application | i) Apply at the beginning of the rains by scattering in the ring round each tree
Year 1 – 50g
OF CAN/tree
Year 2-100g/tree
Year 3-150g/tree
Subsequent year if the tree is bearing a heavy crop apply 200g/tree. |
| 3. Proper Pruning | i) Remove dead, dry and diseased plant. |
| 4. Proper Pest Control. | i) Mango weevil (<i>Stemochetus mangifera</i>) larva enter the fruit and attack the young seed.
Control; field hygiene and regular removal of fallen fruits.
ii) Fruit Fly (<i>Ceratitis capitata</i>) causes pre-mature colouring of the fruit.
Control: Spray with fenthion and removal of fallen fruits. |
| 5. Proper diseases control | i) Powdery Mildew (<i>Oidium mangifera</i>) white mildew mainly on the flowers and leaves. Control by spraying chemicals (Fungicides) fortnightly from flowering to fruit setting.
ii) Anthracnose (<i>Colletotrichum gloeosporioides</i>)
Control by spraying copper fungicide by routine spray.
iii) Black spots on fruit from just before flowering to harvesting Control by spraying fungicide |
| 6. Water the plant properly | i) Watering should be necessary to the young trees |
| 7. Transplant timely. | i) Transplant at the beginning of rain season |
| 8. Weed properly | i) Clear excessive vegetation regularly from the beneath the trees. |
| 4. Planting Materials Selection and Preparation | 1. Harvesting timely
i) Use ladder during harvesting if necessary.
ii) Handle fruits gently when picking and packing.
iii) Cut the fruit leaving 5-10cm stalk.
iv) For export cut the stalk 2 cm.
v) Wash the fruit to remove dirt and any spray residue and sell immediately after harvest.
vi) Pack in single layers in box with of wood wool. Store in a cool/dry place Relative humidity less than 10%.
2. Prepare good planting materials
i) Grafting should be done when the seedlings reach pencil thickness.
ii) Wedge grafting method is the best.
iii) Grafting to be done at the point where the rootstock is soft
iv) The scion should be dormant at the time of grafting. |
| 5. Field Layout and Holing | 1. Prepare planting holes
i) Spacing can be 6 x 6 m; 10 x 10m; or 12 x 12m. |

- ii) Holes should be 60cm x 60cm x 60cm
- iii) Separate top soil from subsoil
- iv) Mix top soil with 2 tin full of kraal manure and return the soil with manure into the hole.
- v) Put a stick upright at the center of the hole.

2 Fruit

Field: 2. Fruit Production

Item: 2.1 Preparation of Rootstocks (for Grafting and Budding)

Outline: Generally rootstocks are chosen on the basis of their adaptability to various soil conditions, resistance to soil-born diseases, compatibility with different scions and tolerance to specific virus diseases.

For budding of citrus, Rough Lemon, Sour Orange, Mandarin or other suitable citrus crops are commonly used.

Select good ripe fruits of the rootstock crop. Take seed from the ripe fruits and wash them with clean water. Sow the seeds in a well prepared seed bed. The spacing should be 15 to 20 cm by 25 cm. Seeds normally take 2 to 4 weeks to germinate. Tend seedlings well by watering and weeding.

When the rootstock seedlings are about 5 to 8 months old, they are ready for transplantation into the seedling pots.

Remove any seedlings which are weak or deformed. Uproot each good seedlings carefully and then prune it. Cut the stem of each seedling about 40 to 50 cm above ground level. Also cut root system about 25 cm below ground level. Then transplant the seedling into seedling beds at a spacing of 90 cm by 30 cm, or into seedling pots.

Three to six months after transplanting the seedlings are ready for budding. At that time, the thickness of the stem should be similar to that of ordinary pencil. Make sure that the soil has enough moisture all the time.



Advantage: - Proper preparation for budding or grafting.

Caution: - Don't mix cattle manure with the soil of mango seedling pots, because it may disturb uptake of certain nutrients.

Input:

- Common farming tools
- Seeds
- Seedling pot (4" or 6" polythene tube, or equivalent)

Source: "Principles of Crop Production"

Field: 2. Fruit Production

Item: 2.2 Grafting (Mango, Cashew, Avocado, etc.)

Outline: Grafting fruit trees enables you to clone the commercial qualities of a particular fruit variety on another tree - whereas the quality of the fruit from trees grown from seed can be highly variable. Also, grafted trees come into production much earlier than trees grown from seeds - they usually bear fruit within 2-3 years, whereas in the case of trees grown from seed you have to wait 5-10 years before harvesting.

Low quality trees, grown from discarded seeds, are found in abundance throughout the countryside, but their fruit has little commercial value. It is estimated that less than 25% of Haiti's fruit trees are of acceptable commercial quality. Low quality trees are being systematically cut down for sale as fuel and wood products with devastating effects on the environment. Top-grafting these trees is a very effective method of transforming them into commercial quality fruit trees. The high income from the sale of the fruits, generally protects top-worked trees from the widespread tree-cutting that has devastated Haiti's ecology. They provide an important source of revenue and at the same time help to safeguard the environment.

Preparation of Rootstock;

A rootstock is obtained by planting a mango seed. The seeds should be planted at a depth of 1/2 inch in trays or pots for later transplanting. The rootstock should be fertilized, watered and grown to be about 1/4 inch or the diameter of a pencil prior to grafting.

Preparation of Scion;

Scions are obtained by removing the ending 2 to 3 inches of a twig that is just beginning to make a vegetative flush.

Step 1) The first thing to do is to cut about a 2 to 4 inch scion (some people prefer 4 to 6 inches) from the mature tree that will be used to graft to another tree. Cut off all the leaves as shown.

Step 2) Cut off all the excess from the leaves as close as possible to the root or base of the scion. Be very careful not to damage the top, since this is where the new growth will develop.

Step 3) The next thing to do is to slice the scion. You need to make a long slice on one side which will be the one joined to the branch or root stock. The other side which is shown is just a smaller sharp slice.

Step 4) We need to clean the area where the graft will be attached by removing leaves from the area. Now we need to make two slices on the root stock or the branch of the tree to be grafted. The first slice should only be about 3/4 inches and the second slice should be about 3 to 4 inches above the first one. The second slice will penetrate the branch and go all the way down to the first cut. You remove the piece from the second cut and should be left with the 3/4 to 1 inch piece from the first cut.

Step 5) The final step is to cover the scion with plastic tape all the way from the bottom to the top. Keep covered for 21 to 24 days and then remove the tape from the top of the scion. Let the new tree grow 4 to 5 inches and then remove the rest of the tape.

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Advantage:

- obtaining uniformity of the cultivar.
- obtaining special forms of plant growth, e.g. dwarfing effects.
- changing cultivars of established plants to improve quality, growth habit or disease resistance.
- early fruiting (mostly 2 - 4 years).
- grafting of old trees (topworking) in order to react on market trends.
- obtaining benefits of certain rootstocks, e.g. to adapt a scion cultivar to various soil conditions and diseases.

Limitation:

- fruit trees remain longer in nursery that involves more labour intensive activities.
- not 100% success guaranteed for success of grafted/budded trees.
- requires some input.
- requires special skills/techniques.
- one has to get improved scions.
- requires proper management and time schedule.
- one way of dissemination of diseases like viral diseases.

Input: Rootstocks and buds
Knife (about TShs. 1,000), Sharpener, Covering materials, etc.

Source: JICA Study Team

Field: 2. Fruit Production

Item: 2.3 Budding (Citrus, etc.)

Outline: 'Budding' refers to the particular form of grafting best suited for the propagation of citrus trees. In a bud graft, a bud, along with some bark (budwood), is removed from the variety of tree (scion) the grower is trying to propagate. The bud is then inserted beneath the bark of a host tree (rootstock). As the 'T' budding procedure is the one generally recommended for the inexperienced grower.

Step 1:

Select the variety of tree you wish to cultivate. Look for a tree that is vigorous and healthy. Remember that some states prohibit the importation of budwood due to disease concerns so check with local authorities if you plan to use imported budwood or even budwood from quarantined areas of your own state.

Step 2:

Budwood is usually collected during the growth period when the bark can be separated easily from the wood. Carefully collect rounded budded twigs that have begun to harden. Do not use very young buds from the current growth flush. Trim the budwood to 8 or 12 inch lengths. Try to use the collected budwood as soon as possible. If you must store the wood for a period, place it in a sealed polyethylene bag in the vegetable crisper of your refrigerator. Check periodically for moisture build-up or mould. Use the stored buds within 3 months.

Step 3:

Select the young citrus tree that you wish to use as rootstock. Look for a variety of tree best suited for vigorous growth in your area. With a sharp knife, make a one-inch vertical cut through the bark of a healthy rootstock stem about six inches above the ground. At the bottom of the vertical cut, make a horizontal cut, the two cuts forming an upside down 'T'.

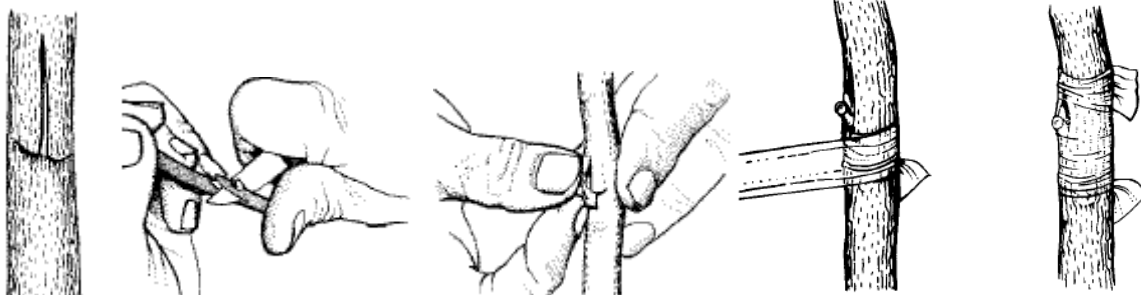
Step 4:

Using your knife, remove a bud along with a one-inch sliver of wood and bark from a budded twig. Carefully insert the bud under the flaps of the 'T' cut of the rootstock with the wood of the bud sliver completely enclosed by the 'T' flap. Wrap the graft with budding tape making two or three rounds below the bud and two or three rounds above. Wraps should be removed not later than 30 days after the graft. A green, healthy looking bud will indicate that the graft has succeeded.

Step 5:

In order to stimulate the growth of the union, the bud must be forced into growth. To force growth, cut 2/3 of the way through the rootstock about 1.5 inches above the bud and on the same side as the bud. Then push the rootstock over to lay on the ground. After the bud has grown 3 to 4 inches, the top of the rootstock can then be cut off about one inch above the top of the bud. To prevent competition from rootstock buds, they should be removed as soon as they develop.

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Advantage:

- obtaining uniformity of the cultivar.
- obtaining special forms of plant growth, e.g. dwarfing effects.
- changing cultivars of established plants to improve quality, growth habit or disease resistance.
- early fruiting (mostly 2 - 4 years).
- grafting of old trees (topworking) in order to react on market trends.
- obtaining benefits of certain rootstocks, e.g. to adapt a scion cultivar to various soil conditions and diseases.

Limitation:

- fruit trees remain longer in nursery.
- not 100% take guaranteed for grafted/budded trees.
- requires some input.
- requires special skills/techniques.
- one has to get improved scions.
- requires proper management and time schedule.
- one way of dissemination of diseases like viral diseases.

Input: Rootstocks and buds
Knife (about TShs. 1,000), Sharpener, Covering materials, etc.

Source: TreeHelp Ltd. (Web page)

Field: 2. Fruit Production

Item: 2.4 Selection of Mango Varieties

Outline: The following varieties of mango are available in (A) Zegezeni farm (possibly from the year of 2005), (B) Sokoine University of Agriculture, and (C) Provate mango farm in Mkuranga.

Apple	Good quality, Good for transportation, Round fruit, Yellow-orange to red [A, B, C]
Tommy Atkins	Early mature, High-yielding, Fruits of 400 - 700g, Red (peel), Good looking, Good taste, Good for trasportation [A, B, C]
Kent	Early mature, Fruits of 450 - 550g, Light red (peel), Yellow-orange (pulp), Juicy [A, B, C]
Keite (Keitt)	Late mature, Very large fruits of 750 - 1,000g, Yellow-orange (pulp), Juicy, High-yielding [A, B, C]
Haden	Fruits of 500 - 600g, Red-yellow (peel), Good taste, Good for transportation [A, B, C]
Alphonso	*** [A, B, C]
Dodo	*** [B, C]
Zill (Red Indian)	Fruits of 300 - 500g, Very sweet, Not good for transportation [A, B, C]
Ngowe	Good quality, Large long fruit, Deep yellow (pulp), Good for transportation [B, C]
Sensation	Mid mature, Fruits of 300 - 400g, Red (peel), Yellow (pulp) [B, C]
Boribo	High yielder, Good quality, Large and long orange-red [B, C]
<i>Others</i>	Hot, Palma, Rubby, Vandaik, Jury, Lady Hindia, Sebin, Kesan, Koga, Bonyoa [C]

Advantage: - Information for better choice of mango varieties.

Limitation: - Farmers of agricultural officers should contact director or owner of the farms on seasonal availability and price.

Input: - Communication and transportation
- Budget for purchasing

Source: JICA Study Team

Field: 2. Fruit Production

Item: 2.5 Selection of Citrus Varieties

Outline: The following varieties of citrus are available in (A) Zegereni farm (possibly from the year of 2005), (B) MOFA Mpiji Farm at the border between Dar es Salaam and Bagamoyo, (C) Sokoine University of Agriculture, and (D) Provate farm in Kibaha.

Sweet Orange

Magombo	[A, B, C, D]
Matombo	[A, B, C, D]
Binti Juma	Early mature [A, B, C, D]
Valencia	Late mature, Growing at El. 0 - 1500m [A, B, C, D]
Pineapple	Late mature, Growing at El. 0 - 1500m [A, B, C, D]
Jaffa	Similar to Matombo [A, B, C, D]
Orando	Large, Good smell [A, B, C, D]
Washington Navel	Growing at El. 1000 - 1800m [A, B, C, D]
Hamlin	Growing at El. 0 - 1500m [A, B, C, D]
Person Brown	[A, B, C, D]

Tangerine/Mangarin

Tangerine	Common Tangerine in Tanzania [A, B, C, D]
Satsuma	Very sweet tast, Growing at El. 0 - 1500m [A, B, C, D]

Grapefruit/Lime/Lemon

Pomelo	Popular grapefruit in Tanzania [A, B, C, D]
Tahiti	Lime, Green peel, Seedless , Growing at El. 0-1500m [A, B, C, D]

Advantage: - Information for better choice of citrus varieties.

Limitation: - Farmers of agricultural officers should contact director or owner of the farms on seasonal availability and price.

Input: - Communication and transportation
- Budget for purchasing

Source: JICA Study Team

Field: 2. Fruit Production

Item: 2.6 Handling of Scions

Outline: The scions to be grafted should be handled carefully not to be deteriorated. The scions always have to be kept with some moisture and without direct sunshine. After harvesting of scions they should be kept in cool and wet place.

1) Cooler box with wet newspaper:



2) Stem of Banana: Wrapping scions directly with banana stem, and then tying fast by bark.



3) Other plant materials in wet: Wrapping scions with wet plant materials, such as palm leaves, and then tying fast.

Advantage: The scions can be kept in good health for longer period; for example, several days in cooler box, and more than 1 week in banana stem.

Limitation: None.

Input: Cooler box (about TShs. 10,000 to 50,000), paper, panga, knife, etc. as necessary.

Source: Specialists in Tanzania

Field: 2. Fruit Production

Item: 2.7 Pruning of Fruit Trees

Outline: Pruning is essential for some tree crops. Pruning is done for several purposes. The actual purpose depends on the type of crops. Some of the purposes of pruning are to control fruit production, to make the picking of fruits easy, and to modify the environment around the plants so that pests and diseases do not attack them very much. In addition, pruning makes the spraying of pesticides more efficient.

Crops which require systematic pruning are bananas, coffee and tea. Cashewnut trees and citrus trees require very little pruning. In citrus, pruning is done mainly to remove suckers and to remove some branches which are dead and branches which touch the ground.

On banana plants pruning is done in order to remove unwanted suckers from each stool. The recommended practice is to leave three banana plants in each stool, one bearer plant, one sucker called a follower and another smaller sucker called a pimper.

Advantage:

- To allow good development and shape of the tree.
- To maintain healthy fruit trees, free of pest and diseases.
- To encourage the tree production.
- To stimulate frequent production and avoid alternating yield.
- To expose all fruits to sunlight for ripening and allow good aeration.

Caution: - Requirement of pruning depends on type of crops.
--

Input: - Pruning secateurs, Pruning saw

Source: "Principles of Crop Production"

3 Agriculture General

Field: 3. Agriculture

Item: 3.1 Crop Rotation

Outline: For annual crops, crop rotation is recommended. Crop rotation is the process of growing a different type of crop on the same piece of land in successive years or seasons. For example, in the first year the farmer may plant tomato and okra, in the second year he may plant maize and in the third year he may plant cowpea. From the fourth year, the cycle is repeated. When you grow annual crops, plan a good rotation in your farm. It is advisable to take into consideration the following principles.

1) Some crops absorb a lot of nutrients from the soil, called as heavy feeders. Other plants absorb only small quantity of nutrients from the soil, called as light feeders. It is important to interchange heavy feeders with light feeders in successive years or seasons.

2) Some plants have short roots which occupy mainly the surface soil, called as shallow rooted. Other plants have long roots which go down deep into the soil, called as deep rooted. In order to get maximum benefit from the soil, it is advisable to alternate deep rooted crops with shallow rooted crops in the rotation.

3) Plants which are members of the same family are normally attacked by the same type of insect pests and disease. For this reason, when crop plants of the same family are planted continuously on the same field, the number of pests and disease organisms increases. To prevent this from happening, it is advisable to plant crops of different families in successive years or seasons.

4) Different plants have different growing habits. For example, sweet potatoes plants cover the soil more fully than maize or millet. Sweet potatoes, therefore, suppress weeds. Such plants should be included in the rotation in order to control weeds.

5) It is recommended to include a legume in the rotation. Legumes improve soil fertility.

Advantage: - Crop rotation helps to control insect pests, crop diseases and weeds.

- Soil nutrients are utilized more fully by crop plants in a rotation.

- When legumes are included in the rotation, soil fertility is improved.

Limitation: - None

Input: - Common farm inputs and instruments.

Source: "The Principles of Crop Production"

Field: 3. Agriculture

Item: 3.2 Usage of Farm Yard Manure (Chicken Manure and Cattle Manure)

Outline: Farm Yard Manure is commonly used as a basal fertiliser for crop production. Most farmers use chicken manure or cattle manure depending on availability. However, these FYMs have different characteristics in nutrition contents and effectiveness, as follows. Farmers had better select a suitable FYM for their purpose.

A) Chicken manure contains high levels of Nitrogen, Phosphate and Potassium, and low level of organic matter. The chicken manure is a quick-acting fertiliser. About 70 % of the total Nitrogen can be utilized by plants.

B) Cattle manure contain high level of organic matters (about 78 %) including hardly-decomposed ones. Therefore, cattle manure is valuable as a soil improvement material. Although the content of N, P, K of cattle manure is lower than chicken manure, cattle manure contain trace elements in good balance.

The basal application of FYM should be done few days before sowing or trasplanting. The FYM should be mixed with surface soils well and keep moisture in few days.



Advantage: - Better selection of FYM.

Limitation: - Limited availability at site.

Input: - FYM

Source: "Tropical Agriculture Handbook, JICA (in Japanese)"

Field: 3. Agriculture

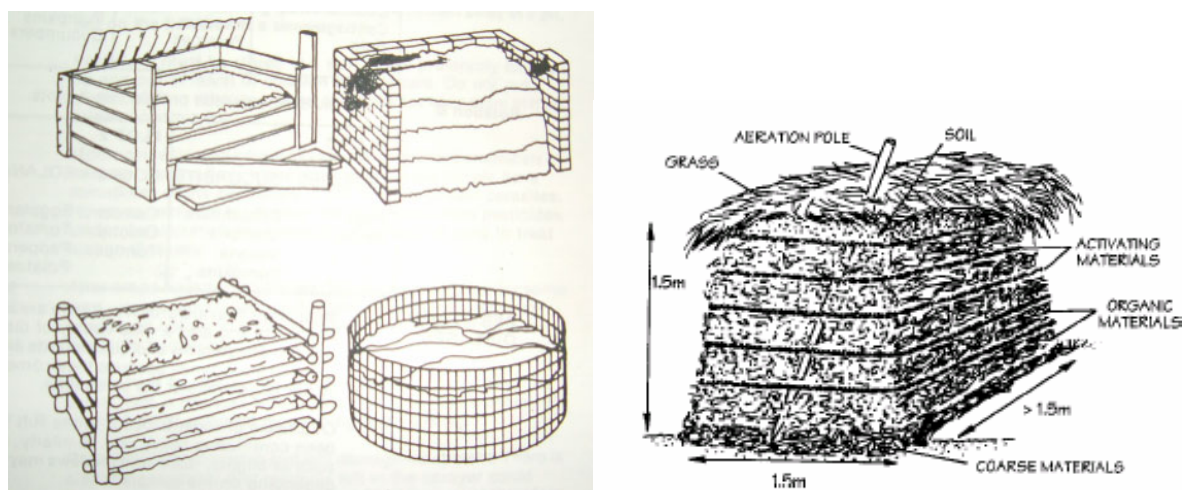
Item: 3.3 Composting

Outline: Compost is a type of fertilizer derived from the decomposition of plant and animal wastes.

Compost is an excellent source of plant nutrients, commonly in home garden.

There are many ways to prepare compost (in a pit, above ground, in a field, etc.).

Moisture content, an adequate supply of air and temperature control are important parameters for quality compost production.



Advantage: - Decaying compost generates nutrients for crops.

- Mounds are good for tuberization since the volume of rooting zone is increased.
- Safety for plant growth
- Long fertilizer effect

Limitation: - Compost mounds requires a large quantity of plant material (up to 40 ton/ha).

- Cannot be used in the lowlands where severe weed infestation is a problem.
- Cannot be practiced on steep slopes.
- High labour requirement.

Input:

- Labour
- Common tools (shovel, etc.)
- Materials (animal dung, crop residue, kitchen waste, weed, etc.)
- Simple storage facilities (wooden frame, etc.)

Source: "FAO"
"Fruit and Vegetable Technical Handbook, Agricultural Information Centre in Kenya"
"Farmer Training Handbook on Fruit and Vegetable Propagation and Management, A working document by SECAP-Lushoto (GTZ)"

Field: 3. Agriculture

Item: 3.4 Making "Bokashi" Fertiliser

Outline: "Bokashi" is a Japanese traditional fertiliser and commonly used now in other countries like Indonesia and Costa Rica. Bokashi is a fermented fertiliser, which is made from several kinds of organic fertiliser and soils.

The major characteristics of Bokashi are;

- 1) organic fertiliser mixed with soils,
- 2) moisture content is about 50 %,
- 3) temperature during fermentation is about 50 °C, and
- 4) fermentation period is 1 week to 2 weeks

The materials of Bokashi depend on the availability in site; for example, chicken or cattle manure, rice bran, forest soils and so on.

The processes of Bokashi making are as follows;

- 1) Select the good place not affected by rain.
- 2) Mix the materials well and heap them.
- 3) Add water to 45 % of moisture contents.
- 4) Cover the heap by some materials to keep moisture.
- 5) Keep the height of the heap; starting from 60 cm and to 20 cm gradually.
- 6) Keep temperature at 50 °C for 1 week to 2 weeks.
- 7) Well-fermented Bokashi is covered by white yeast colony.



Advantage: - Higher nutrient content than common FYM.
- Bokashi can be used top dressing instead of chemical fertiliser.

Limitation: - None

Input: - Selected materials

Source: "Tropical Agriculture Handbook, JICA (in Japanese)"

Field: 3. Agriculture

Item: 3.5 Neem as an Insecticide

Outline: Neem, known as "Marbaini", is commonly used as a natural medicine for 40 kinds of human disease. It can be used for organic insecticide for field crops. The wide benefits can be get, as follows.

Store-Product Insects: Neem leaves are mixed with grain kept in storage for 3-6 months. Neem oil is an extremely effective and cheap protection for stored beans, cowpeas, and other legumes. Neem has also been used to protect stored roots as well as tubers against the potato moth.

Armyworm: Azadirachtin has proved an effective prophylactic against armyworms at extremely low concentrations-a mere 10 mg per hectare.

European Corn Borer: Laboratory tests using neem products on this corn borer larvae produced 100 percent mortality at 10 ppm azadirachtin; 90 percent mortality at 1 ppm.

Mosquitoes: The larvae of a number of mosquito species are sensitive to neem. They stop feeding and die within 24 hr after treatment.

Aphids: In the Dominican Republic, water extracts of neem seed proved effective against *Aphis gossypii* on cucumber and okra and against *Lipaphis erysimi* on cabbage.

Fruit Flies: Fruit flies pupates underground, and spraying dilute neem solution under fruit trees resulted in 100 percent control.

Gypsy Moss: A neemseed-extract formulation for use on gypsy moth, a pest that is ravaging forests in parts of North America. In laboratory trials, a commercial neem formulation (Margosan-O®) produced 100 % kill at very low concentrations (0.2 liters per hectare).

Horn Flies: Ground-up neem seed and stabilized neem extracts can prevent horn flies from breeding in cattle manure.

Blowflies: In Australia neem products have been tested against blowflies on sheep. In the tests, azadirachtin kept blowflies from "striking" (that is, laying their eggs on sheep).

Nematode: Neem products affect various types of nematodes. Certain limonoid fractions extracted from neem kernels are proving active against root-knot nematodes, the type most devastating to plants. Tomato plants were obviously improved by neem products, but there was no significant difference in the numbers of nematodes. However, among treated and untreated soils the majority was extracted from the roots of plants in untreated soil.

Snails: Various neem extracts kill snails. This appears to be beneficial in some cases.

Crustaceans: Little is known about neem's effects -beneficial or detrimental- on crustaceans. However, in one intriguing set of experiments in the Philippines, it proved beneficial.

Fungi: Neem has demonstrated antifungal activity. The availability of a natural fungicide that can be grown, extracted, and applied by farmers themselves could be of great consequence to worldwide agriculture and food supply. Not a lot is known about neem's practical use against rots, smuts, wilts, mildews, die-backs, and other fungal plant diseases. However, several tests have indicated

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considerable promise.

Plant Viruses: Crude extracts seem to bind certain plant viruses effectively, and so limit infection.

However, for the moment at least, neem seems most effective at interfering with the transmission of plant viruses carried by insects.

In farmer's level, the following processes are recommended to use Neem as a insecticide for crop husbandry.

- 1) Collect Neem fruits which are ripened and fallen on the ground.
- 2) Take seeds out.
- 3) Dry the seeds under the sun.
- 4) Store the dry seeds in good ventilation.
- 5) When use them, remove shell, then crush or grind kernels well.
- 6) Make 5 kg of dry powder (for a half acre).
- 7) Put the powder in a 20 lit. bucket and fill up by water.
- 8) After 12 hours, Filter the solution using cloth.
- 9) Add another solution made of 10 g of soap and 200 ml of water.
- 10) Add water up to 100 lit.
- 11) Spray the solution to plants using a knapsack-type sprayer.
- 12) For vegetables, spray it once or twice a week for protection.



Advantage: - No burden for farmers to pay lots of cash for insecticide.
- Not harmful for human being.
- Very wide effect against pests.
- No side effect to plants.

Limitation: - Require a lot of Neem seeds.

Input: - Neem seeds, Soap, and Water
- Some tools.

Source: "<http://www.theneemtree.com>"
"Tropical Agriculture Handbook, JICA (in Japanese)"

4 Post Harvest and Processing

Field: 4. Post Harvest and Processing of Fruits and Vegetables

Item: 4.1 Drying Fruits and Vegetables

Outline: Drying removes most of the water from fruits and vegetables to extend their shelf life and to increase their convenience and value. The reduction in weight and bulk also makes transport cheaper and easier although many dried foods are fragile and require packing in boxes to prevent them from being crushed. The low-volume, higher-value foods such as dried fruits, vegetables herbs and spices offers better opportunities for profitable production by small scale processors.

Air-dried products are the most common type of dried fruit and vegetables. Some products may be blanched or sulphured/sulphited to protect their natural colour and help preserve them.

Some vegetables and a few fruits such as limes may also be salted before drying. In this case the high salt concentration preserves the food by both drawing out water by osmosis and by the anti-microbial properties of the salt. Salt tolerant micro-organisms begin to grow while the product is sun dried and these produce acids and characteristic flavours. High salt concentrations also prevent the action of some enzymes, which would cause a loss in quality of the dried food during storage. Vegetables must be washed to lower the salt concentration before they are eaten.

Fruits and vegetables must be carefully selected before drying. If fruits in particular are over-ripe they are easily damaged and may be difficult to dry. If they are under-ripe, they have a poorer flavour, colour and appearance. Care and attention to hygiene are essential because any bacteria or moulds that contaminate vegetables before drying are likely to survive on the dried food. The temperature of drying is not high enough to kill them and when the food is re-hydrated, they can grow again and cause food poisoning.

Process:

1) Harvesting: Harvest matured but not over-ripened fruits/vegetables as carefully as possible to reduce bruising, etc.

2) Wash: Use clean water to remove stones, leaves, pesticide residues or soil.

3) Sort/Grade: Sort by hand to get similar colour or maturity. Uniform maturity is important to get similar drying time for all pieces.

4-1) Peel: Peeling is usually done by hand using sharp knives, to increase the rate of drying. Check that all traces of peel are removed.

4-2) Cut/Slice/Core: To reduce the size of pieces and allow faster blanching, sulphur dioxide treatment and drying. Check for uniform sized pieces.

4-3) Pulp: Only for fruit leathers. Small scale pulpers are preferable, but this stage can also be done by hand or using steamers. The pulp is spread on polythene sheets for drying.

4-4) Blanch: More often used for vegetables. Care is needed to prevent blanched foods from being recontaminated before drying.

4-5) Acid dip, Treatment with sulphur dioxide, Syruping: Optional as necessary.

5) Dry: The rate of drying depends on the temperature, humidity and wind speed, the type of dryer and the size of the food pieces. Generally fruits and vegetables are dried at 40-60 °C. Different types of dryer are available.

6) Pack: Required to keep producer pieces together. If product risks gaining moisture, package must be moisture-proof.

7) Label and Store: Correct label for type of product and store in a cool dry place away from sunlight. Fragile foods may need protection from crashing.



Dryer:

It is necessary to make a careful assessment of the expected increase in income from better quality products compared to the additional expense, to make sure that this type of dryer is cost-effective. Sun drying is only possible in areas where, in an average year, the weather allows foods to be fully dried immediately after harvest. The main advantages of sun drying are the low capital and operating costs and the fact that little expertise is required.

Advantage: - Long life of fruits and vegetables
- Higher market value of fruits and vegetables

Limitation: - Requirement of initial investment on facilities and technical knowledge (some institutions or NGOs may support)
- Labour and time consuming

Input: - Drying facilities
- Packing facilities and materials
- Chemical materials

Source: - Guidelines for small-scale fruit and vegetable processors (FAO, 1997)
- Photos by JICA Team

Field: 4. Post Harvest and Processing of Fruits and Vegetables

Item: 4.2 Cassava Flour

Outline: Cassava (*Manihot esculenta* Crantz) is a traditional staple food crop for the most people in Tanzania. Fresh cassava roots contain about 60-70% water and are therefore bulky thus transportation from rural to urban area for marketing is difficult and expensive, and dried cassava also reduces the stability of products. Processing the roots to dry form reduces bulkiness and also improves the quality of products through detoxification to remove hydrogen cyanide and increases the shelf life of products.

Technology of processing cassava developed and modified has shown that it is possible to use cassava flour 100% in preparation of bakery products such as cakes, doughnut, chinchin, queen cakes and biscuit.

Process:

- 1) Wash: Wash and clean the cassava roots first to remove soil and dirt.
- 2) Removal of Wooden Portion: Remove the woody portion of the roots with a knife.
- 3) Peel: Peel the cassava roots to prevent lower quality flour that includes coarse texture of the peel.
- 4) Chipping: The roots are cut into more manageable sizes to facilitate drying and easy handling. Chipping is often done manually.
- 5) Dry: Sun drying remains the simplest and cheapest way of drying. Before the drying, submerge the chips in boiling water for three to five minutes to prevent browning. Spread them on mats, concrete floor or wooden board, and expose them for two to three sunny days to reduce moisture content to 10 to 12 per cent.
- 6) Mill: Flour making can be done on a small-scale by using either a handy corn mill or a milling machine.
- 7) Sieve: Sieve twice using mesh 80 wire screen to obtain fine texture.

Advantage: - Processed flour from cassava is an excellent substitute for wheat flour in the manufacture of bakery products.

Caution: - Good cassava flour must have certain characteristics. Moisture content must be reduced to 10 per cent for longer storage.
- The flour should also be light in colour, odourless, clean and fine without any foreign particles.

Input:

- Cassava
- Peeling and cutting devices
- Drying facilities
- Packing facilities and materials

Source: - Agribusiness Opportunities (1988)

Field: 4. Post Harvest and Processing of Fruits and Vegetables

Item: 4.3 Mala Milk

Outline: Milk is difficult to stock long, and without refrigeration it may last less than one day. Mala Milk has self-life of 10 days without refrigeration.

Process:

1) Mala Milk Culture: It is an accelerator for fermenting milk to be Mala Milk.

1-1) A half litre of fresh milk shall be filtered and sterilized to 90°C not to be boiled, and it shall be cooled for 24 hours, which is used as a starter.

1-2) Another half litre of fresh milk shall be filtered and boiled, and it shall be cooled until it reaches room temperature.

1-3) Only 2-3 spoons of the boiled and cooled milk shall be added into the starter. The starter added with the boiled and cooled milk shall be boiled and cooled for 24hours. This is Mala Milk culture.

2) Mala Milk:

2-1) The fresh whole milk shall be filtered and sterilized by heating to 90°C, and cooled in a water bath. All this takes place in standard 50-liter aluminium milk cans.

2-2) When the milk has reached room temperature, the Mala Milk culture is added to start the fermentation process. The fermentation process takes 20 hours.

2-3) The final product shall be poured into plastic bags, heated and sealed.

Advantage: - Long-term milk preservation is possible.
- Nutritional food.

Caution: - This processing shall be done in sanitary condition.
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Input: - Fresh milk
- Stove
- Water bath
- Milk cans

Source: - Food Cycle Technology Source Books DAIRY PROCESSING

Field: 4. Post Harvest and Processing of Fruits and Vegetables

Item: 4.4 Tomato Preservation

Outline: Fresh tomatoes are difficult to stock long. This method realises to preserve tomatoes for a long time.

Process:

- 1) Clean and sterilize a screw-top jar and lid in boiling water.
- 2) Wash and cut tomatoes into small pieces. Skin and cut onion in to thin rings.
- 3) Wash and cut chillies in halves and mix them with tomatoes and onions in a bowl.
- 4) Wash, cut and squeeze out juice of lemon and put in the sterilized jar.
- 5) Mix all ingredients together and add salt.
- 6) Pour immediately in to jar and screw lid on.
- 7) Put jar out in sunlight for seven days, for 2-3days or even a week, depending on the intensity of the sun.
- 8) Always shake the bottle to mix ingredients.

Advantage: - Long-term preservation will be possible.
- Selling it at the local market will generate income.

<p>Caution: - This processing should be done in sanitary condition. - Tomatoes should be fresh and firm.</p>

Input: - Screw-top bottles
- Pan
- Stove
- Tomatoes, onions, green chillies, lemons and salt

Source: - Tanzania Cook Book

Field: 4. Post Harvest and Processing of Fruits and Vegetables

Item: 4.5 Mango Jam

Outline: Jam is a typical preservation method for fruit. This is the method of producing mango jam.

Process:

- 1) Clean and sterilise a screw-top jar and a lid in boiling water.
- 2) Wash and peel mangoes, and slice them into small pieces.
- 3) Weigh mango pieces, and measure out equal weight of sugar.
- 4) Grate rind from the lemon, and squeeze juice from lemon.
- 5) Put the mangoes, sugar, lemon rind and lemon juice in a pan. Mix and heat slowly bring to boil. Raise heat and boil quickly stir frequently for 15-20 minutes until the jam thickens.
- 6) Pour into warm screw-top jar while hot. Close the jar and cool.

Advantage: - Long-term preservation will be possible.
- Selling it at the local market will generate income.

<p>Caution: - This processing should be done in sanitary condition. - Mango should be firm and ripe.</p>

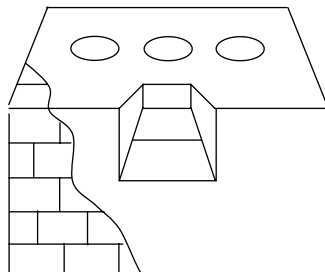
Input: - Screw-top bottles
- Pan
- Stove
- Mango, sugar and lemon

Source: - Tanzania Cook Book

Field: 4. Post Harvest and Processing of Fruits and Vegetables

Item: 4.6 Improved Cooking Stove

Outline: Using a lot of firewood for cooking damages the environment conditions. This improved cooking stove can save consumption of firewood.



Process:

1) Make the base with the dried mud bricks. If bricks are unavailable, stones can be used. However, stones have the disadvantage of not withstanding strong heat.

2) Shape the base with mud.

3) The same procedure shall be carried out for forming walls and slabs.

4) Smoothen the surface with clay after three or four days so that the body becomes dry.

5) Prevent it from becoming very dry by sprinkling water several times a day for two weeks.

Advantage:

- Reducing the amount of firewood, comparing traditional three-stones fireplace, because this cooking stove is effective in consuming firewood.
- Saving time to look for firewood and utilising that time for other economic activities.
- Preventing infants from a burn since this cooking stove has height of 30 to 50 cm from the floor. Even if infants fall down, they cannot fall into the fire, since that is above them.
- Cooking efficiently a variety of foodstuff, since two or three pans and pots can be on this stove at once. Provision of boiled water can reduce the prevalent cases of diarrhoea

Limitation:

- Mud should be supplied in the neighbourhood.
- Requiring a proper technique and training to make dried mud bricks.
- Installing this stove by oneself is difficult.

Input:

- Mud/clay
- Bricks pattern

Source: - Introducing the improved cooking stove ENZARO JIKO

5 Water Use

Field: 5. Water Use

Item: 5.1 Improvement of Kisima

Outline: Digging Kisima deeper makes the labouring harder, since the volume of soil to be dug increases. Moreover, if sheeting is not set, earth wall will collapse gradually. Improvement of Kisima recommended here uses wooden frame as sheeting. The wooden frame made beforehand is set, and can be used for a small-scale retaining wall. It is effective to dig additional 50cm at the bottom of Kisima.

Process:

- 1) Wooden frame shall be made with the dimension of about 1.0mx1.0mx0.5m.
- 2) The bottom of Kisima shall be excavated.
- 3) Wooden frame is installed, after the excavation.



Advantage: - Improved Kisima can prolong the duration of watering.

Limitation: - Size of frame can be also enlarged according to the size of Kisima and the area of a farmland, which requires more cost.
- Since it is wood, it will not be an eternal structure. Moreover, when always submerged into water, corrosion will be slow. However, corrosion will be fast when in contact with air.

Input: - Timber
- Nails

Source: - JICA Study Team

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Field: 5. Water Use

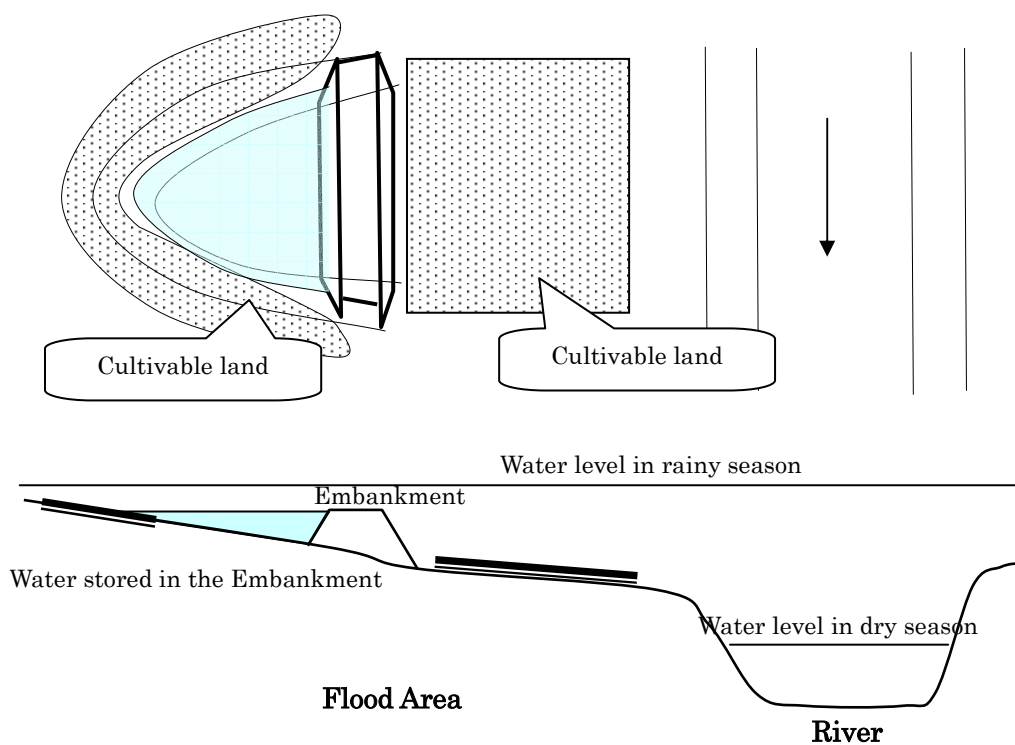
Item: 5.2 Flood Water Use by Small-scale Pond

Outline: The difference of water level of Ruvu River is very large in the dry season and the rainy season. Using this difference, vegetables are grown in the dry season properly using stored water by this method, as well as paddy in the rainy season.

The excess water from the flood at the rainy season shall be stored in a small-scale pond, and shall be used in the dry season.

Process:

Embankment shall be made on the flood area for storing water and uses it as water source after water level going down. (See the following figure)



Advantage: - It is possible to store the excess water during the flood and use it during the dry season as water source for irrigation.

Limitation: - Hard labouring is required.

Input: - Labouring

Source: - JICA Study Team

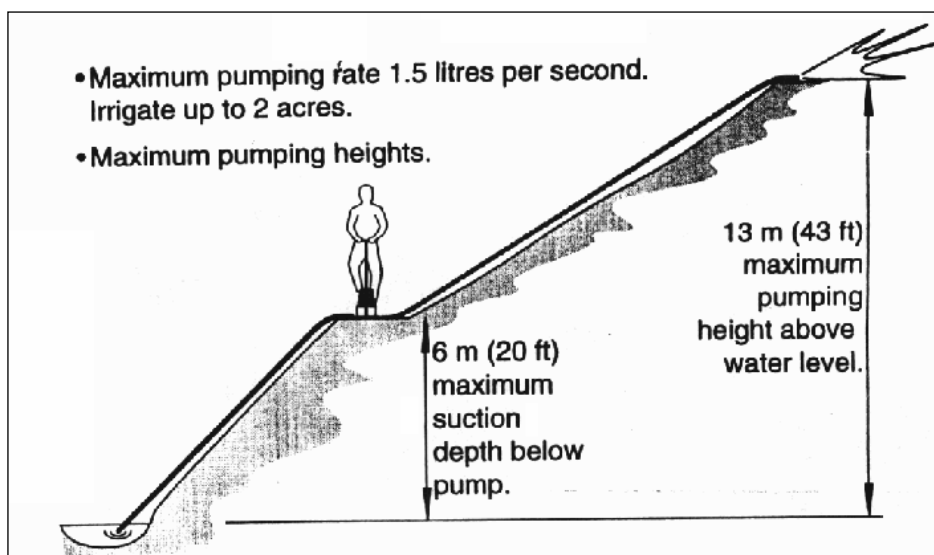
Field: 5. Water Use

Item: 5.3-1 Treadle Pump

Outline: Where water sources are Kisimas or rivers, these sources are usually located lower than the farmland. Therefore, water needs to be lifted from the water sources to the required height using pumps. Since a treadle pump can be operated manually, fuel and operation cost are not needed. However, the treadle pump fits small-scale irrigation, since it is restricted by its pump head and small discharge.

Conditions:

As shown in the following figure, pump head is the height difference between the water source and the farmland. In this case, the maximum head between the water source and the pump is 6m, and 7m between the pump and the farmland. However, one needs to be careful about discharge becoming small, when pump head increases.



Advantage: - Fetching water hardship is mitigated with a treadle pump.

Limitation: - When watering directly to crops using a hosepipe, at least two persons would be required.

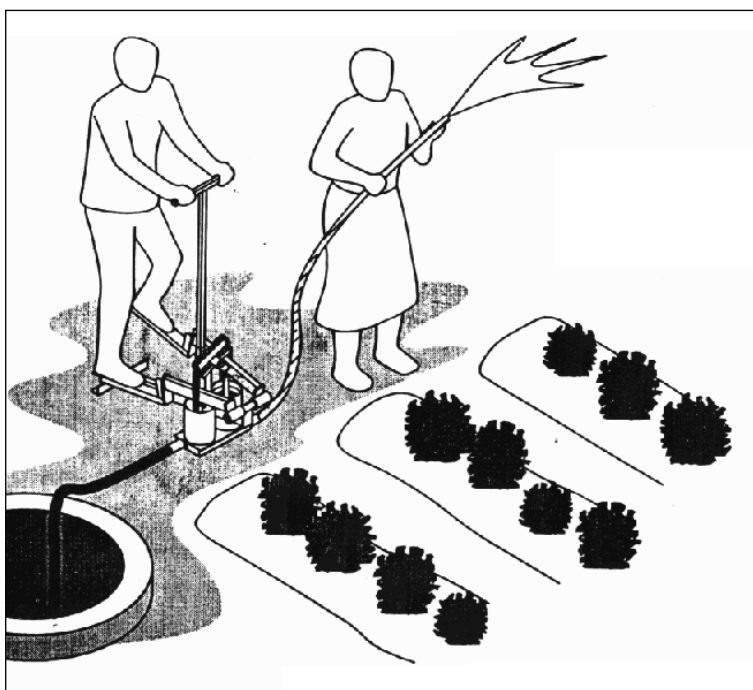
Input: - Treadle pump

Source: - Treadle Pumps for Irrigation in Africa (FAO)

Item: 5.3-2 Treadle Pump

Conditions:

Where percolation rate is too big and water source is not sufficient, the watering method shown in the figure below is recommended. This method is supplying water directly to crops. Therefore, the area to irrigate is small, and will require a small amount of water as a result.



Advantage: - The amount of water supplied can be less by direct watering to crops.

Limitation: - Someone to operate the pump, and someone to operate the hose are required. The delivery hose needs to be long enough longer crop rows. Since head loss increase with longer hose, discharge becomes small. Therefore, one needs to increase the number of water source and shorten distance from a water source.

Input: - Treadle Pump

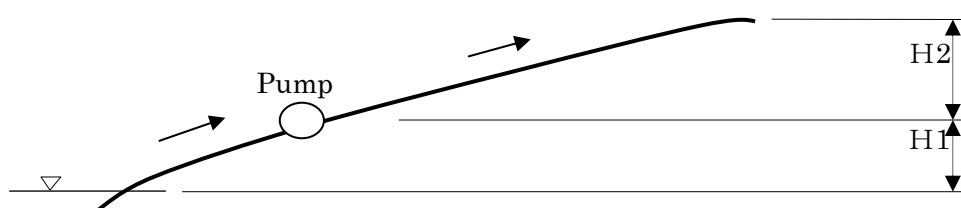
Source: - Treadle Pumps for Irrigation in Africa (FAO)

Field: 5. Water Use

Item: 5.4 Engine Pump

Outline: When engine pumps are used, the following two points need to be considered. The first point is that water source shall have enough water. The second point is that farmer can perform the maintenance management including the operation cost of the machine.

Engine pumps are defined by the size of the pump diameter. 2-inch engine pumps are generally the smallest pump available in Dares Salaam. Here, the outline of the 2-inch engine pump is shown. In selecting a pump, the geographical feature of the farmland and the water sources for irrigation need to be grasped first. Moreover, characteristic such as pump head to assess whether or not the irrigation by pump is possible need also to be grasped. The total sum of height difference H_1+H_2 as shown in the following figure is the pump head.



Conditions:

It is necessary that the water source can provide enough water and shall be located near the farmland. Since discharge decrease if height difference increase, careful attention is needed. The relation between discharge and total pump head are shown in the table below.

Total pump head (m)	Discharge (L/sec)	Remark
5	550	
1 0	480	
1 5	400	
2 0	300	
2 5	170	

In addition to the height difference between the water source and farmland, various friction losses need to be added, when calculating total pump head.

Advantage: - Fetching water hardship is mitigated with an engine pump.

Limitation: - Fuel consumption shall be considered to be added to the production costs.

Input: - Engine pump

Handbook of Useful Techniques

Source: - JICA Study Team

Field: 5. Water Use

Item: 5.5 Procedure of Water Right

Outline: To use water from rivers, it is normally needed to get water right.

Process:

Steps for obtaining water right are as follows.

1) Collecting information : It is necessary to visit Central Water Board Unit to ask about water right at first and to explain about summary of one's project and to collect application form.

2) Application of water right : Water right is applied after fixing the site, irrigation method and amount of water use. Application form is submitted with application fee, which is TShs35,000.- (2002)

2-1) Field trip by concerned officer : The officer will visit the site. One water right can cover all groups (person) whose intake facilities are located less than 200m apart from each other. It means that individual groups (persons) must get individual water rights when their intake facilities are located more than 200m apart from each other.

2-2) Discussion with environment officer : The following three matters were pointed out by the environment officer of Central Water Board Unit when we submitted the application form. (1) It is prohibited to use land within 200m distance from riverbank. (2) It is necessary to take counter measure to avoid chemical pollution. (3) It is necessary not to affect quantity of water. Therefore the above points are needed to be taken into consideration when one submits an application.

2-3) Acceptance of application : Judgment on application is delivered almost every three months by the Water Board. However, the exact time this judgment is delivered is not set. Therefore, It is desirable to apply well ahead of time to minimise delays.

Conditions: - A water rights need to be acquired prior to operation. Depending on water sources whether acquiring a water right would be necessary or not, should be confirmed with the above authority. A beneficiary will pay money according to the amount of water used. Therefore, a beneficiary needs to grasp water use for the year.

Source: - JICA Study Team

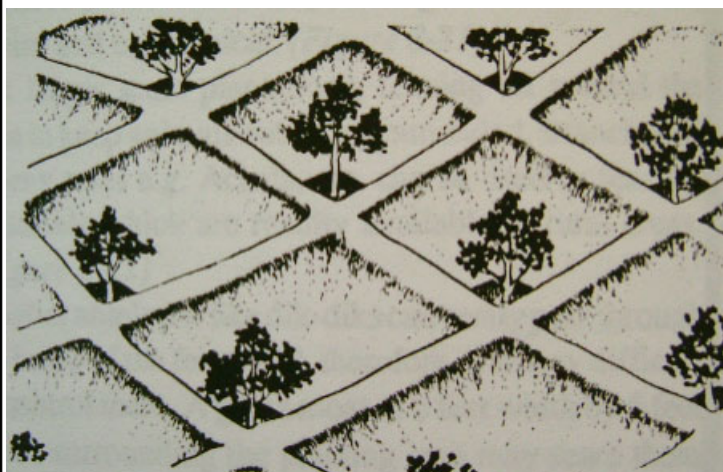
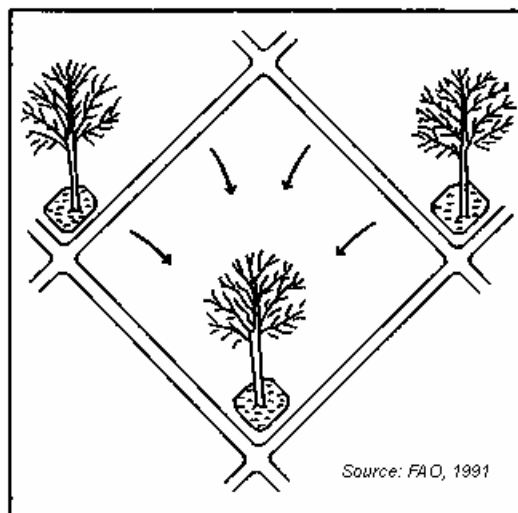
6 Soil and Water Conservation

Field: 6. Soil and Water Conservation

Item: 6.1 Water Harvesting - Micro Catchment

Outline: Small-scale water harvesting is most successful when operated as a system with the catchment area, the reservoir and the service area.

Catchment area of sufficient size is needed to drain water into the reservoir.



Advantage:

- Improves food production.
- Promotes conservation and ecological balance.
- Involves low investment cost per hectare.
- Easy to construct.
- Provides alternative uses to offset sacrificed land area.
- Protects against drought.
- Allows irrigation by gravity.
- Mostly individually owned, hence, minimal social problems.

Limitation:

- Requires large amount of labour.
- High seepage and evaporation losses possible.
- Floating vegetation may infest reservoir.

Caution:

- Uncontrolled runoff in high intensity rainfall areas can overtop and damage the embankment.
- Poor design and management can lead to erosion and flooding.

Input:

- Labour
- Common farming tools (hoe, shovel, etc.)
- Planting materials (seedlings of trees)

Source: "Water Harvesting (FAO, 1991)"
"Farmer Training Handbook on Fruit and Vegetable Propagation and Management (GTZ)"

Field: 6. Soil and Water Conservation

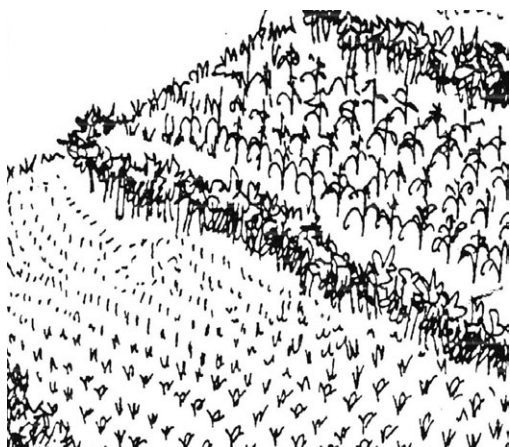
Item: 6.2 Contour Farming

Outline: Contour tillage or planting is practiced on sloping lands to reduce soil erosion and surface runoff.

Structures and plants are established along the contour lines following the configuration of the ground.

Contour planting may involve construction of soil traps, bench terraces or bunds, or the hedgerows.

Contour tillage is being promoted for sustainable upland farming.



Advantage:

- Reduces runoff and soil erosion
- Reduces nutrient loss.
- Cultivation is faster if using draft animals or machinery since the equipment moves along the same elevation.

Limitation:

- Needs special skills to determine contour lines.
- Labour-intensive maintenance.

Caution: - Improperly laid-out contour lines can increase the risk of soil erosion.

Input:

- Labour
- Common farming tools (hoe, shovel, etc.)
- Planting materials (seedlings of trees)

Source: FAO

Field: 6. Soil and Water Conservation

Item: 6.3 A-Frame or A-Plumb

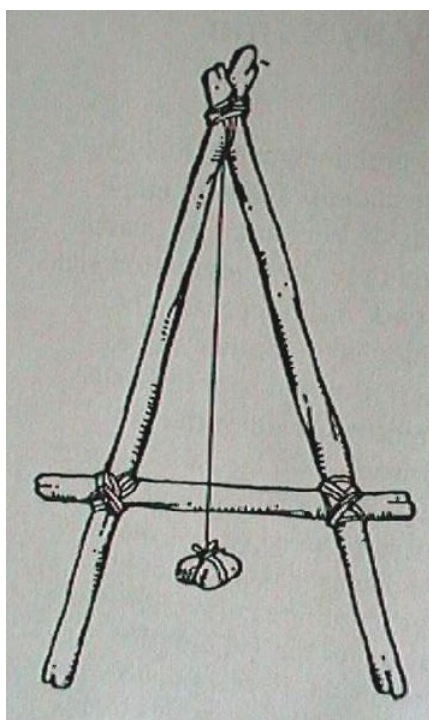
Outline: A- Frame or A-Plumb is a simple tool to make contour line on a sloping land. It is useful to prepare contour ridge for contour farming.

To make an A-Frame;

- prepare wood poles (2 with 1.2 m and 1 with 0.6 m length approximately) and a string,
- put up them as a A-shape,
- put string from the top and tie a stone on the end, and
- put a mark on a crossing point of a horizontal pole and a string when the A-Frame is placed in a level.

To use an A-Frame;

- place an A-Frame on a slope as the string crosses at the mark (At the time, the right and left bottoms are at the same elevation),
- move right or left next and place an A-Frame at the same way,
- continue to the end of a land, and
- draw an contour line by connecting the traces of and A-Frame.



Advantage: Cheap and easy way to find contour line.

Limitation: The contour line is not very accurate.

Input: Poles, String, Stone, Labour only. No cost to pay.

Source: FAO, SCSR (SUA Centre for Sustainable Rural Development)

Field: 6. Soil and Water Conservation

Item: 6.4 Ngolo Farming Method

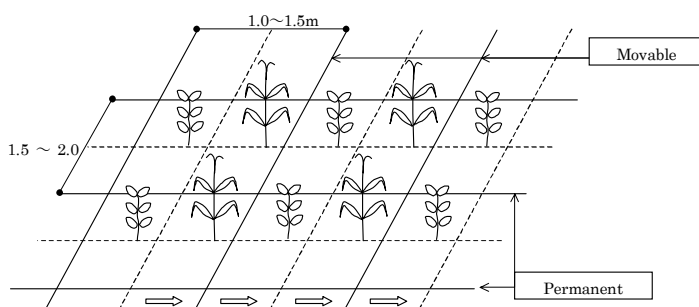
Outline: This system is to keep soil fertility on the slope land.

To make Ngoro Farming Method;

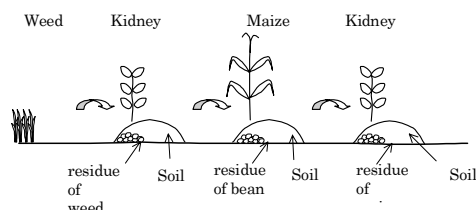
- Cut and make bundle of weeds then set them in lattice,
- Dig soil in the lattice and put it on the bundle,
- The distance of the ridges is one to two metres,
- Rain water is kept in the hole and the land is conserved. The weeds decay then the soil becomes fertile.

To use Ngoro Farming Method;

- Cultivate a kidney pea in the first year,
- The residue of the pea is put on the ridge,
- Cultivate maize in the second year,
- The residue of the maize is set in the middle of the ridge or in the centre of the hole and is covered by soil
- Move a half of ridge every cultivation



First year: Kidney bean
Second year: maize



Advantage: Farmland conservation is developed, and soil is kept fertile.

Limitation: Hard labour.

Conditions: Slope land of gradient shall be until 30 degree. Horizontal ridge must be set strict. Rotation of maize, cowpea and fallow shall be carried out strictly.

Input: Manpower, Farm equipment (hoes and spades).

Source: JICA Frontier March
SUA Centre for Sustainable Rural Development (SCSRD)

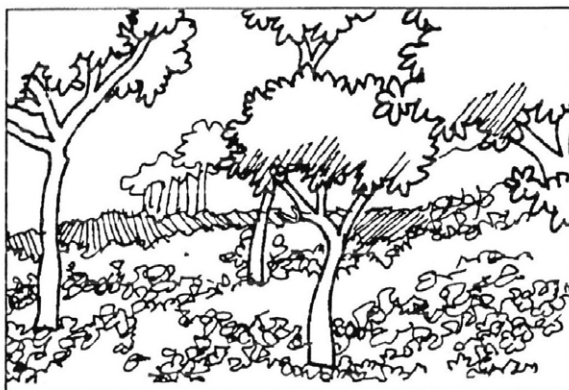
Field: 6. Soil and Water Conservation

Item: 6.5 Cover Crops

Outline: Cover crops are grown to protect the soil from erosion and to improve it through green manuring.

Cover crops are usually short-term crops, planted in fields or under trees during fallow period, interplanted or relay-planted with grain crops, or planted once in a cropping cycle.

Most of the plants used as cover and green manure belong to the legume family.



Cover crops in long-term fallow system



Cover crops in alley cropping during dry season

Advantage:

- Improves soil fertility and physical and chemical properties.
- Reduces soil erosion and water loss.
- Suppresses weeds.
- Reduces need for fertilizer and herbicides.
- Provides human food and animal forage.
- Increases soil organic matter.
- Helps retain moisture in the soil and prevent soil from drying.
- Some cover crops can provide good cash income through sale of products.

Limitation:

- May compete for soil moisture and nutrients with the perennial crops.
- Involves additional farm labour and inputs.
- May result in weed problems.
- May be alternate host for pests.

Caution:

- Some cover crop species may contain chemicals which inhibit subsequent crop growth.
- Rats or snakes may hide in dense cover crops foliage.

Input:

- Common farming tools
- Labour

Source: FAO

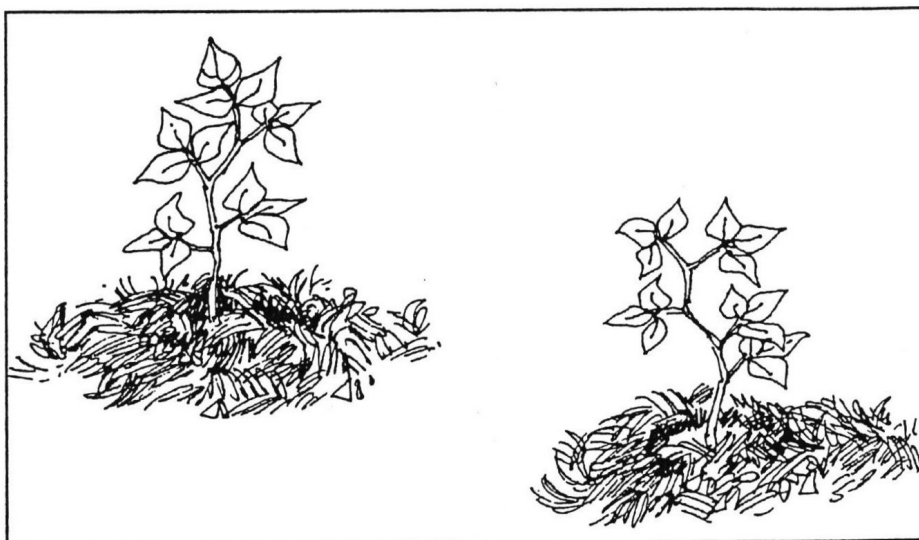
Field: 6. Soil and Water Conservation

Item: 6.6 Mulching

Outline: In mulching, a covering of cut grass, crop residues or organic materials is spread over the ground, between rows of crops or around the trunks of trees.

It is commonly used in areas subject to drought and weed growth infestation.

Optimum density of soil cover ranges between 30% and 70%.



Advantage:

- Intercepts the direct impact of raindrops on bare soil and reduces runoff and soil loss.
- Suppresses weeds and reduces labour costs of weeding.
- Increases soil organic matter.
- Improves soil chemical and physical properties.
- Increases the moisture-holding capacity of the soil.
- Helps to regulate soil temperature.

Limitation:

- Not applicable in wet conditions.
- Difficult to spread evenly on steep land.
- Lack of available materials suitable for mulching.

Caution:

- Possible habitat for pests and diseases.
- Some grass species used as mulch can root and become a weed problem.

Input:

- Materials
- Common farming tools
- Labour

Source: FAO

7 Construction

Field: 7. Soil and Water Conservation

Item: 7.1 Concrete Block

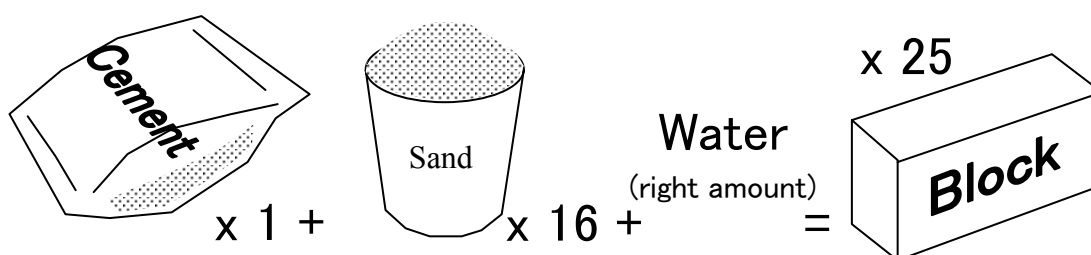
Outline: The following procedures describe the construction of blocks in ascending order.

Process:

1) Batching of Materials: Batching can be done by 2 ways, either by weight or by volume. The by weight method was not used because of the following reasons.

- The sand to be used in the construction had moisture content more than 15%.
- Weighing machines were not available.

According to the standards, one bag of cement can provide 18 up to 28 strong ratio blocks of 150mm x 225mm x 450mm. To make 25 blocks per each bag, 16 buckets (10 liters) of sand were provided.



2) Mixing: Firstly, cement and sand are mixed under dry condition by spades. After making sure the mixture is through, then water was poured and then the mixture is remixed.

3) Block Construction: Then the mixture is filled in the block making machine. Then it is compacted by pulling the blower up and forcing it downwards for about 10 to 15 times. Then the block is removed after well compacted and transported to the yard.

4) Curing: Curing of block starts the same day (in the evening) and proceeds for 7 days. Watering is done 2 times a day (morning and evening).

Advantage: Cement blocks are stronger and more durable than soil.

Limitation: Cement is costly. The machine is necessary.

Input: Construction material, labour works.

Conditions: Clean materials should be used. Silty sand and muddy water are not good. Curing is important otherwise cracks may occur. Curing tends to be attached little importance, but it is very important process.

Source: JICA Study Team

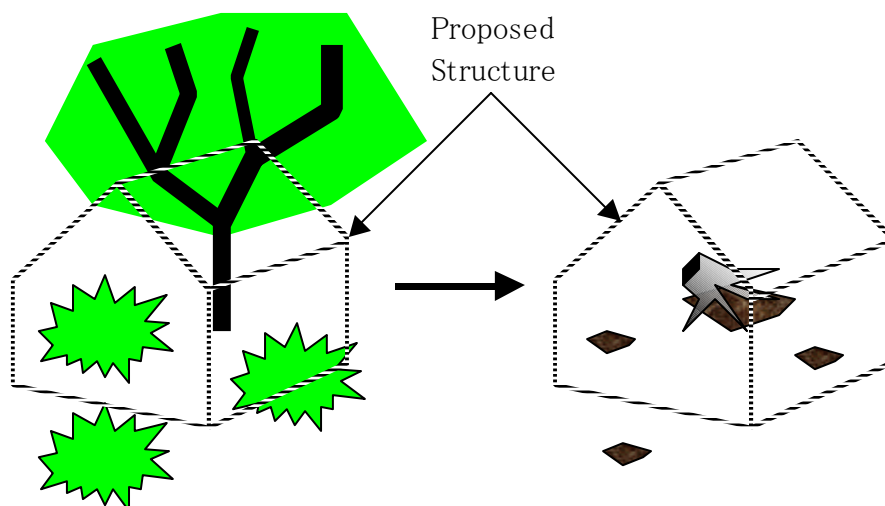
Field: 7. Soil and Water Conservation

Item: 7.2 Site Clearing

Outline: Site clearing, the first procedure in the construction site, includes;

Process:

- Removal (cutting) of trees and bushes within and around the site.
 - Removal of vegetable topsoil if there is any.
- Villagers can use these trees and branches as firewood.



Advantage: Organic materials are removed so that steadiness shall be secured.

Limitation: The environmental measures should be taken into consideration to ensure that trees are not cut un-necessarily.

Input: Labour works.

Conditions: Stumps and vegetation should be removed completely at the site. Clearance of necessary area should be done thoroughly.

Source: JICA Study Team

Field: 7. Soil and Water Conservation

Item: 7.3 Setting Right Angle by 3:4:5 Method

Outline: In most of construction work, setting right angle is important and it is done purposely to ensure right angles and proper alignment of the structure.

Preparation:

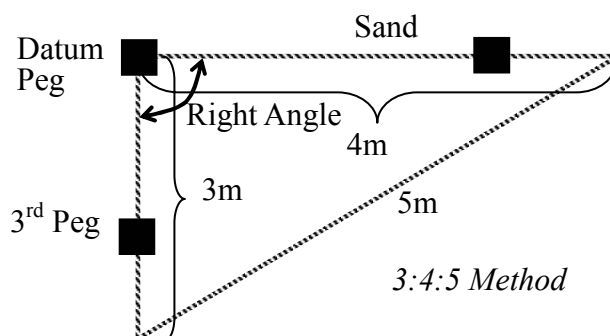
1) Pegs Preparation: Pieces of timber of 2"x2" are used. They are cut into pieces of the same length. The lengths of the pegs are determined with respect to the photographically nature of the site. Shorter pegs are suitable for gentle slope and longer pegs are suitable for steeper slope.

After cutting them into equal pieces, one end of pegs shall be sharpened to make the hammering process easy.

2) Rope Preparation: The selection of rope is very important for the job. Since nylon ropes tends to go slack when it is hot unlike sisal rope that is not affected by temperature change but can not be tense. It is better to use both according to the circumstances that fit best.

Setting:

1) First you choose one sight away from a corner of the structure, then you hammer one peg there. Then, hammering a nail on top of it. This pegs is known as datum peg upon which all measurements are refereed from it.



2) Three ropes (lines) are prepared, either of 3m, 4m and 5m or 9m, 12m and 15m this depends on the lengths and widths of the structure.

3) One end of 3m & 4m rope is tied up on the nail and then they are stretched.

4) Five meters rope is tied at free ends of other ropes, and you stretch them to form a triangular shape. Then, right angle is formed.

Advantage: Right angle is measured at site.

Limitation: Basic knowledge for mathematics and timbers is necessary.

Input: Materials, Labour works.

Conditions: Ropes or threads should be pulled with appropriate strength. Pegs and nails should be piled steadily. Accuracy should be secured.

Source: JICA Study Team

Field: 7. Soil and Water Conservation

Item: 7.4 Sub-structure

Outline: Process:

1) According to the designed alignment, 70cm trench is excavated for construction of foundation footing.

2) Levelling: Levelling of trenches is done by putting white sand within trenches, compacting and then levelling by using spirit level.

3) Foundation Footing:

- The concrete of 20cm thickness and width of 70cm is firstly poured and it is the mixing ratio of 1:2:4, and then well mixed and placed in position.
- Then the concrete shall be compacted gently to remove the air voids entrapped inside.
- After pouring, the concrete shall be cured for seven days.

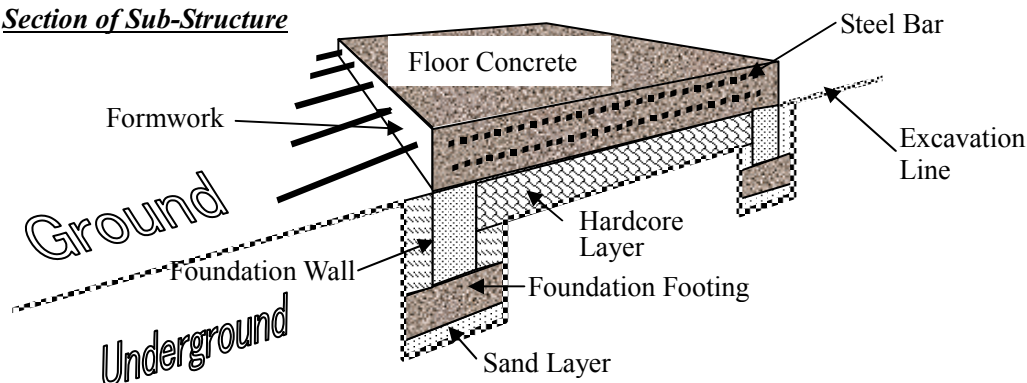
4) Foundation Wall: The foundation wall is constructed on the foundation footing up to the ground level.

5) Hardcore Placing: Hardcore layer of 20cm thickness is placed in position and the farmers compact and level it.

6) Floor Concrete Pouring: Floor concrete pouring procedure is as follows.

- The formwork is constructed and fixed on the position.
- The steel work is done and fixing them on the appropriate place.
- The concrete is batched, mixed and transported to the place by using wheelbarrows, buckets and pans.
- The concrete is placed, well compacted and levelled.
- Then the final stage is curing of concrete as usual.

Section of Sub-Structure



Advantage: Well-constructed sub-structure supports super-structure steadily.

Limitation: Concreting needs intensive labour works. Formwork and steel work require skills.

Input: Construction materials, Labour works.

Conditions: Watering is done for trench excavation in case the soil is very hard. Curing is important otherwise cracks may occur. Backfilled portion must be compacted well, otherwise voids may occur. Formwork and steel work should be done carefully to secure steadiness

Source: JICA Study Team

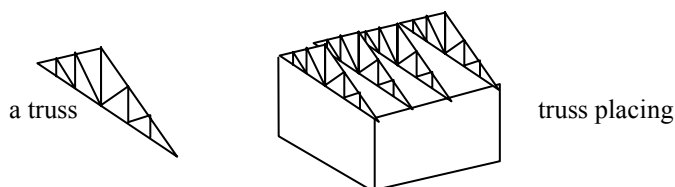
Field: 7. Soil and Water Conservation

Item: 7.5 Roofing

Outline: Roofing includes technical works such as truss fabrication & purlin fixing. Therefore, one carpenter, specialized for roofing, shall be hired. And the truss lifting & works on the roof require enough attention.

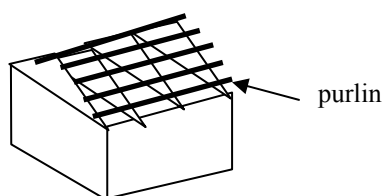
1) Truss Construction:

A truss is fabricated to absorb the weight of the roof and to transform it to the wall.



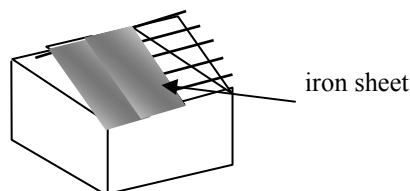
2) Purlins Fixing:

Purlins were well aligned as required and straightened by using ropes (lines).



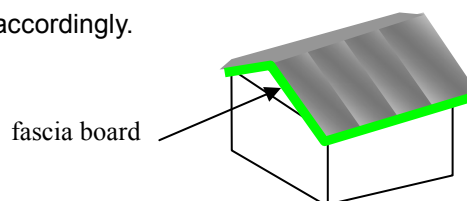
3) Iron Sheets Work:

The fixing of iron sheets could only be done in the morning and in the evening since it is difficult to do it in the afternoon because of the high temperature.



4) Fascia Boards Fixing:

The fascia boards are well prepared and well saw accordingly.



Advantage: A place where there is no rain is very valuable in the rural area in Tanzania.

Limitation: The structure requires a lot of timbers and iron sheets, so that it is expensive. Works are implemented in a high place, so that workers should pay attention.

Input: Construction materials, Labour works.

Caution: The truss lifting should be done carefully to prevent accidents. And, workers working on the roof should pay extra attention. Carpentry works, especially truss fabrication, require skills. Carpentry works, especially truss fabrication, require skills.

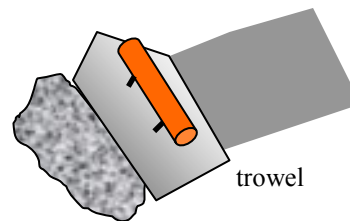
Source: JICA Study Team

Field: 7. Soil and Water Conservation

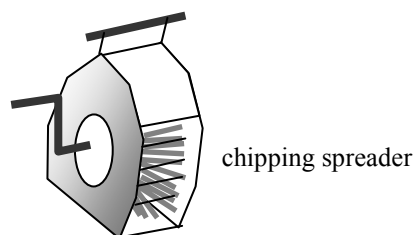
Item: 7.6 Finishing

Outline: At this stage there are several works that were to be done and this includes.

Plastering: Plastering shall be done by farmers.
- Materials were batched, well mixed and then applied on the wall surfaces. Also the ratio used for batching is the same in plaster.
- After when the setting of the plaster starts, then lime, which has been soaked for the whole night, is applied on the surface also to have the smooth finishing.

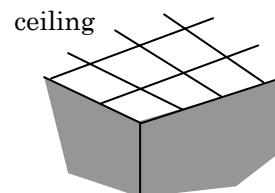
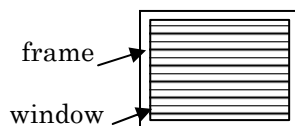
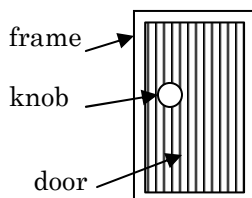


Wall Grazing:
- This is done only on the outer part of the wall.
- And by means of chipping spreader the mixture of cement and lime with sand is applied on the surface of the wall.

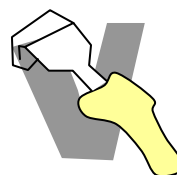


Flooring:
The flooring is among stages of finishing. And also the same ratio is used for the construction of the floor. Lastly the colour additives were added on top of newly laid floor to make the appearance nicer.

Doors, Window, & Ceiling:
Doors and windows are fixed with frames and ceiling boards are also fixed.



Painting and Vanishing:
This is the last stage in construction where by the appropriate type of paint is chosen by farmers and applied on the surfaces.



Advantage: With the finishing work, the structure becomes usable at last.

Limitation: Various materials are needed. Choices of them depend on the budget.

Input: Construction materials, Labour works.

Conditions: An appearance of the structure depends on the finishing works. Therefore, the works should be done carefully. Appearance is very important.

Source: JICA Study Team

8 Approach to Credit

Field: 8. Approach to Credit

Item: 8.1 SACCOs (SAVINGS AND CREDIT COOPERATIVE SOCIETIES)

Outline: All subsistent farmers lack monetary capital to uplift their farming activities because they cannot access credit from financial institutions. Lack of collateral needed by the financial institutions hinder the small scale farmers from acquiring credit. If this situation is not solved, the farmers will continue to be perpetually poor. In order to enable the farmers establish their own ability to advance small credit among themselves, they have to start SACCOs (Savings and Credit Cooperative Societies).

The following is the procedure to start a SACCO.

- (i) Farmers request the District Cooperative Officer to visit and educate them on how to establish a SACCO.
- (ii) The Cooperative Officer educates the farmers on how to start a SACCO and also enlightens them on the importance of the cooperative.
- (iii) Farmers nominate their interim Chairman, Secretary and Accountant. These leaders will start the initial activities of calling the formative meetings for establishment of a SACCO.
- (iv) The minimum number of members who can start a SACCO is 10. It will be advantageous to the SACCO if it will have many members in order to have sizeable contributions and enable members to acquire workable loans
- (v) After the farmers have agreed to start the SACCO, they begin registering themselves, form the SACCO's Bylaws and Regulations and every member contributes some money for registering their SACCO.
- (vi) The members fill in Cooperative Form No. 1 which is shown below.

Full Name	Age	Place of Domicile	Village	District	Signature

- (vii) A letter to express the member's intention to form a SACCO is forwarded to the Cooperative Officer together with 4 copies of the SACCO's Laws and Regulations, 4 copies of Form No.1 and Registration processing fee and Registration fee.
- (viii) Information on membership and application for registration should be signed by 4 people or more and should contain the following:

Name and Registration and No. of Society.	Area of Operation	Region/District	Name of signatory	Signature
1.
2.
3.
4.
5.

- (ix) A document showing a financial analysis and economic viability should be available and how the SACCO will sustain itself should also be available.
- (x) After registration, the Society shall call a general meeting of all the members and hold a general election to get a Chairperson, Deputy Chairperson, Secretary, Deputy Secretary, Members of Committee and nominate an Accountant.
- (xi) Shares and monthly contributions from the members will continue to be given to the Society.

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Advantage: - The SACCO will collect shares and monthly contributions from members and give credit to individual members depending on their requests and committees assessment of the member to be loaned.

- Every farmer who gets credit will pay low interest rate as compared to the rate charged by financial institutions.
- Supervisors of the credit are the committee members who belong to the same cooperative. The members know the situation of every farmer who has been credited.
- Every farmer has an equal right to access credit from the SACCO.

Limitation: - There should be 10 or more members in order to register as a SACCO.

- Members have to wait until the monthly contributions and the shares are big enough to enable loans to be given.
- Most farmers are not conversant on how to manage SACCOs and hence need training.

Source: Regional Secretariat, Coast Region

Field: 8. Approach to Credit

Item: 8.2 INPUT TRUST FUND

Outline: Input trust fund can be obtained from NGOs, International Organisations, Financial Institutions and Government through the Ministry of Agriculture (Exim Bank).

Input trust fund from International Organisations can be obtained after the organisation has approved a write up on the same which has been prepared by the members of the SACCOs and show a positive margin of return and that it can be sustainable. The project must aim at small scale farmers who are poor but are struggling to extricate themselves from that situation

Credit form Exim Bank can be obtained through Cooperative Societies, SACCOs and the District Council. District Councils can get the credit and advance it to the farmers or can act as a surety for the Cooperatives.

In order to smoothly run the agricultural input credit, there must be conditions and regulations that can ensure repayment of the loans advanced to the farmers. The following conditions must prevail:

- (i) Farmers have to form their own Agricultural Production Cooperative Society.
- (ii) There must be leaders who have been elected by the farmers forming the cooperative.
- (iii) There should be a memorandum of association which will be the guiding document for the cooperative and will also show how the credit is going to be disbursed and how it will be repaid.
- (iv) Every farmer who applies for credit should sign a form and enter into an agreement with his Cooperative to show how much he intends to be credited, date of maturity of credit for repayment, period for the repayment, interest rate, security, etc.
- (v) There should be an agricultural extension Officer who will visit all prospective input credit applicants to make sure that they have already prepared their plots and are ready for planting. He will also judge as to whether the amount of inputs requested on the loan agreement form are sufficient for economical production or are overstated. The extension officer will also be responsible for giving scientific advice to the loanees on how to profitably produce the intended crops. fruits and vegetables.
- (vi) In order to ensure that the input credit is repaid, the management should ascertain that the loaned has guarantor or asserts which can more than cover the loan. A guarantor should be a person who is resident of the same village and has ability to more than pay the credited amount. The farmer can mortgage his farm with permanent trees like cashew nuts.
- (vii) The farmer should be given material agricultural inputs worth his credit and not money. The borrower will pay cash when reimbursing the input credit.
- (viii) The Village or Ward Agricultural Extension Officer will make planned follow up to every farmer to record progress made by every farmer in crop production. The Officer will record all the farm activities and produce a biweekly report which will be presented to the proper authorities.
- (ix) In order to ensure that the farmer is in a position to repay the input credit, he should grow crops that have a market at the time of harvesting.

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Advantage: - The farmer gets a loan that has a very low interest rate.
- The farmer repays the loan as he sells his crops in the market.
- There is a grace period of 90 days between the times he gets the credit until when it matures.

Limitation: - Vagaries of weather can disrupt production and render the farmer unable to repay the credit.
- There can occur an outbreak of either pests or diseases and destroy all the crops. In some cases it may need some extra money to contain such an outbreak.
- Training is needed for farmers and extension staff to enable them to manage the project both technically and physically. Special training is needed for the cooperative leaders to enable them to properly handle the input credit.
- There are several producing areas that send the same crops to the same market. As a result, the prices become very low and at times below economic price.

Source: Regional Secretariat, Coast Region

9 Group Activities

Field: 9. Group Activities

Item: 9.1 Community Participation

Outline: Community participation refers to a method or process by which all people or all groups in a community are encouraged to get involved in the project. Villagers can enhance their own development through community participation by means of workshops where responsible village leaders assisted by village extension officers and the donor agency involved in the project encourage and awaken people to realize that they themselves have the abilities, the energies and some of the resources, to take initiatives and bring about their own development by themselves. Some key points to keep in mind in community participation are as follows.

- 1) A community has the creative capacity to identify and solve its own problems. Extension workers or a particular donor should not plan or act FOR the community, but WITH the community.
- 2) People should form groups to solve their problems, as they will get greater output rather than from one or few persons, cut down on project costs, and share ideas that can lead to more constructive contribution than individual.
- 3) Most efforts have to come from the people because many programs have failed because people expected too much on government and donors, who should mainly give guidance on ideas and minimum support.
- 4) The central issue in community participation is to guard against segregating against anyone regardless of gender, region or social class.
- 5) In order to create a spirit of ownership, the project leadership should be selected at the first day of workshop.

Advantage: - People gain greater confidence in their abilities by actively participating in project planning and decision-making. When people see that they are capable to plan, implement and manage a successful project, they will more easily start other development activities on their own.

Source: JICA Study Team

Field: 9. Group Activities

Item: 9.2 Sensitisation

Outline: Some Tips for Good Organisation and Communication Techniques in Community Participation Workshops.

- 1) Given the lack of facilities observed in the villages to hold meetings, the best places could be under the shed of a tree, classrooms (when school is resting), or a central point of the village such as market, closer to village government offices, etc.
- 2) Orderly organize the sessions, notifying the participants enough in advance of the time and place of the meeting through the Village Leader who can notify his ten-cell leaders for a wider diffusion.
- 3) Create a good atmosphere for the participants by “breaking the ice” and putting a little warmth in the discussions. Throwing quick games, jokes, or singing popular songs together to motivate participation could be a good idea.
- 4) After discussion on the different project components, give opportunity to the participants to ask some questions, make comments on the different topics and clarification.
- 5) During a session, make sure to get women involved, for instance by encouraging them to participate and speak up in group discussion, and take up leadership roles in group activities for their empowerment, or organize special sections for them to hear their opinions on the project.
- 6) Try as much as possible to conduct the session using didactic support such as writing with felt-tipped pen, chalk on the black board, if the majority of participants is educated, or show illustrations, pictures, use cassette tapes, record the discussions and make the participants listen to their intervention, etc.

Source: JICA Study Team

Field: 9. Group Activities

Item: 9.3 Making a Group Constitution

Outline: It is essential to prepare a constitution that provides a clear guideline for members of a group. It could help minimize conflicts between group members and improve efficiency of group decision-making.
A constitution is a written agreement made by members of a group. Only members can modify it with consensus of other members.
It is advised that a constitution include the following items;

Items	Issues for discussion
Objectives of the group	What to achieve
Membership	Names, Responsibility, Duration
Committee	Types of posts, Duties of the committee and the committee members, How long elected for
Disciplinary action against committee members	What to do if duties are not carried out, e.g. fines, dismissal
Meeting schedule	Place, Time, Day, Number of members needed for decisions, Unanimous or majority decision making, Reporting absence, Representation for Absentees allowed, Can representatives vote?
Contributions	When to pay and how much, joining fee and regular contributions, Instalments of payments, Who to pay, Where to keep the money, Purpose of contributions, What to do if the money is lost, Record keeping
Disciplinary actions against members	For absences, Late arrival, Accepted excuses amount of fines, When to pay, What to do in case of non-payment of fines, what to do if non-payment of contributions
Record keeping	What to be recorded, by whom
Saving	Purpose; Where to be kept, How to save record keeping
Profit	Use of profits, Sharing, When and who, What to do in case of death, Drop out, Absences and negligence of work
Loans	Rules of re-lending of group savings to members, interest rate terms of repayment, penalties of non-repayment

All members' approval is needed before enacting a constitution.

Effect/Impact: Preparation takes time and effort for discussion on the above-mentioned items. Through such discussions, ① members would fully recognize what situation they are facing to, and ② members would become more both responsible for his/her action and active for group activities.

Source: JICA Study Team

Field: 9. Group Activities

Item: 9.4 Group Formation

Outline: It is often said that working individually faces more difficulty than working in a group. This can be seen more apparently on those who have few resources, such as a small farmer, landless and widows. Therefore, you may try to form a group in order to achieve something benefits for a living.

Conditions: Features of a successful participatory group.

- Members have common interests
- Members have clear objectives
- Members are honest and work hard to achieve their objectives
- Members write the constitution for their group and agree to obey it
- Members hold regular meetings
- Members elect a committee
- Members participate in discussions, decision-making, activities, savings and record-keeping etc
- Members share benefits

The above should be understood and agreed upon among participants of a group.

Effect/Impact: Impact arising should be considered carefully. Only when you assure that benefit group activity brings can outweigh those cost, it is worth belonging to a group.

Limitation: Holding a meeting, for example, requires participants to share their free time. Contribution on a group they belong to may need to sacrifice something they have.

Input: Place to gather and discuss

Source: JICA Study Team

Field: 9. Group Activities

Item: 9.5 Registration of Group

Outline: Group registration is one of key aspects for group formation. Unless you register your group, it cannot be regarded as an official group. Main benefit from registration will be easy access to public services such as technical support by Ministry of Cooperative and also private services like banking facilities. However, it is carefully considered that a type of group you belong really need to access to these services. If not necessary and if money is not involved in its activities, you might find it better to skip this procedure, since a registration is time consuming.

Conditions: There are two possible ways of registration, either to Ministry of Cooperative or Ministry of Home Affairs. A prevailing movement of organizing a cooperative at village level has been seen recently, since backup from its related Ministry could be easily obtained for small farmers' group. It is recommended that.

	Ministry of Cooperative and Marketing	Ministry of Home Affairs
Registration fee	1,800Tsh	100,000Tsh
Requirement for registration	Preparing own constitution Being economically viable With at least 4 members	Preparing own constitution Being economically viable
Renewal of certification	Not required	40,000Tsh/year
Auditing	Compulsory every year by COASCO or any registered auditing board	Compulsory every year by any registered auditing board

Effect/Impact: With registration, groups could benefit in ways that support from outside could be easily obtained.

Source: Regional Cooperative Officer, Coast Region

Handbook of Useful Techniques

Field: 9. Group Activities

Item: 9.6 Registration of Group

Outline: Record keeping is an important step for forming a group. Without it, misunderstanding may develop between members. It is critical to know what kind of activity members are involved and from their activity what members get and also lose. All records should be kept in order to serve as a future reference for a group
Record keeping on routine work should be done regularly either daily, weekly or monthly. However, record on discussion in a meeting should be taken whenever it takes place.

Conditions: The following is an example that you can use for keeping a record of meetings.

Minutes of Meeting

No. _____

Mwezi wa _____

	AGENDA	Result	Desion-making
Date	①Changes on the members		
from	②		
to	③		
Place			
Expected no. of attendance			
Actual no. of attendance			
Visitors' name			

Record should be kept by leadership of a group and should be reviewed by all members at a meeting on a regular basis, in order to evaluate the group's progress.

Effect/Impact: Minutes of meeting can help members not to misunderstand what they speak during meeting and make communication go smoothly.

Input: Record book, Pen

Source: JICA Study Team

Handbook of Useful Techniques

Field: 9. Group Activities

Item: 9.7 Record Keeping – Daily Activity Record

Outline: Recording daily activity of a group is highly recommended in order to trace what goes well and what not. Analysing the record, members could find causes of problems the group may face. The following table is the one used for a milling machine business in Mwanabwito, Kibaha and Vigama.

Village		<i>Mwanabwito</i>												
Items	Mill				Huller				Sales	Expenditure	To Bank	To KKM	Cash at hand	
	Maize		Cassaba		Maize		Rice							
Date	No.	Kg	No.	Kg	No.	Kg	No.	Kg						
5/1	19								9.100	6.700			2.400	
5/2	43								19.425	5.300			16.525	
5/3	25								10.815	10.100			17.240	
5/4	26								9.835	4.900			22.175	
5/5	33								11.095	10.500			22.770	
5/6	28								14.245	3.200			33.815	
5/7	36								12.950	9.000			37.765	
5/8	29								11.830	10.900			38.695	
5/9	30								9.835	5.800			42.730	
5/10	27								10.990	9.900			43.820	
5/11	20								7.315	0			51.135	
5/12	27								6.720	11.000			46.855	
5/13	31								13.790	0			60.645	
5/14	23								7.735	11.000			57.380	
5/15	27								11.130	0			68.510	
5/16	20								8.470	11.000			65.980	
5/17	21								7.350	0			73.330	
5/18	21								6.405	5.300			74.435	
5/19	25								8.225	0			82.660	
5/20	21								5.985	6.800			81.845	
5/21									7.280	5.300			83.825	
5/22									4.830	5.300			83.355	
5/23									8.085	6.300			85.140	
5/24									10.395	0			95.535	
5/25									7.315	5.300			97.550	
5/26									6.545	5.300			98.795	
5/27									5.845	5.300			99.340	
5/28									6.335	10.100			95.575	
5/29									5.425	0			101.000	
5/30									4.270	0			105.270	
5/31									5.494	17.000			93.764	
Total	532	0	0	0	0	0	0	0	3,000	0			93,764	

Conditions: This also requires someone to take responsibility for keeping a record. A record keeper should be selected among members in consideration of organizing and arithmetic ability. Since it has to be done frequently, for example everyday for a milling machine business, it is preferred that someone living near a place of activity would be appointed in order to keep time spent for a record keeping purpose as short as possible.

Input: Record book, pen

Source: JICA Study Team

Field: 9. Group Activities

Item: 9.8 Milling Machine Safety Instructions

Outline: Safety instructions for a milling machine shall be delivered to prevent accidents, when the machines are provided with.

1) **No Smoking, No Fire and Keep Fuel in the Store!**

It may cause fire and destroy everything.

2) **Don't Touch or Stand beside Belt!**

You may be drawn into it and it may mince you.

3) **Keep Children Away!**

They may cause severe accidents or injuries. Do you want to lose your child?

4) **Secure Ventilation!**

You may suffer suffocation afterward.

5) **Don't Spill Fuel and Oil!**

It may cause slip or fire.

6) **Stop Engine before Service and Repair!**

You may encounter an accident.

7) **Don't Touch Engines and Exhaust Pipes!**

They may burn you.

8) **Keep Clean!**

Clean minimizes accidents.

9) **Don't Wear Cloth with Frill!**

It draws you into belts.

10) **Open Radiator Cap Carefully!**

It may rocket or hot water may shoot out.

11) **Be Physically Fit!**

Unhealthy body may cause misjudge and mistakes.

12) **Use Fire Extinguisher or Run Away!**

Water may not be effective to extinguish fire. Just run away when you cannot handle.

Conditions: A set of milling machine consists of two diesel engines (8 and 16 horse power), a milling machine, and a huller, and it is fixed in a shed. Workers must be very cautious about machine handling.

Effect/Impact: To keep these rules prevents accidents.

Limitation: It is not very easy to understand and to keep all these rules

Input: Notice

Source: JICA Study Team

Field: 9. Group Activities

Item: 9.9 Securing Properties and Asset

Outline: Once your group obtains some properties such as a pump, a hose and small machine like a maize mill, a proper handling is important for their security. Appointing someone to be a person responsible for a particular property would be a good initial step. She/he should take a responsibility for timely maintenance and keeping a property available to other members in a good condition. If you have something valuable but have to leave it at a common place, watchpersons taking care of it through a night should be posted.

Once money is collected through group activities and is at a member's hand, more attention should be paid for a security purpose. There is no place without any threaten from thief or robber. In fact, Ruvu Darajani, Bagamoyo, more than 300,000Tsh collected as repayments of the pumps were robbed in December 2002. It happened just before they registered as a formal group to Bagamoyo District. Unless they have its registration, they cannot deposit money to a bank.

Conditions: Duty and right for each person in charge of security should clearly indicated and it should be agreed on between members, since this may involve money as incentive or salary.

Effect/Impact: Group property can be protected securely.

Source: JICA Study Team

