SUSTAINABLE URBAN AGRICULTURE FOOD SYSTEMS IN KENYA

A manual on the production and utilization of traditional leafy vegetables

AgriFoSe2030
Agriculture for Food Security 2030
Translating Science into Policy & Practice

UNIVERSITY OF NAIROBI

Food and Agriculture Organization of the United Nations

COUNTY GOVERNMENT OF NAKURU

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Sustainable Urban Agriculture Food Systems in Kenya
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A Guide for Small Scale Farmers and consumers

Authors

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1 Introduction

The recent trends in addressing malnutrition in many developing countries have focused towards optimal utilization of the underutilized traditional leafy vegetables at a household level. In Kenya for example, the consumption of traditional traditions leafy vegetables at household level has more than doubled in the last five years. However, the production and utilization of these vegetables have not been optimized. This manual intends to provide a step by step guide for farmers to produce these nutritionally important traditional leafy vegetables, and postharvest handling and cooking methods to maintain their nutritional quality.

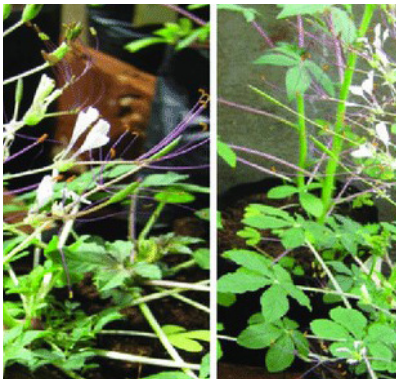
Traditional leafy vegetables are grown using two basic agronomic approaches. The first technique is to maximize the vegetables' growth limiting factors, and the second is to protect them from insect and disease damage. Traditional leafy vegetables face three major growing constraints: water, nutrients, and extreme temperatures. All these must be addressed by the producer during the growing season.

Vegetables are harmed by pests and pathogens. This damage can be so severe that the vegetables either die or have a lower yield, both in quantity (less output) and quality (lower quality). Poor quality vegetable produce can prevent or reduce the profitability of produce sales. In this manual, we present guidelines for the production of selected popular traditional leafy vegetables in Kenya. This information should allow you to effectively cultivate these vegetables while protecting them from pests and diseases. The guidelines were compiled with the small holder set up in mind and the emphasis is on the use of resources that are locally available.

1.1 THE IMPORTANCE OF TRADITIONAL LEAFY VEGETABLES IN KENYA

Traditional leafy vegetables are:

- A source of food which enhance food and nutrition security
- Have high nutritional content
- Have high returns per unit area
- They respond well to inputs such as fertilizer and irrigation
- Can be grown as a source of income



Spider plant local names:
Chinsaga, Deki, Sisaka

African nightshade local names:
Osuga, rinagu

Jute mallow local names:
murenda, omotere

Amaranthus local names:
ododo, emboga

2 Production of traditional leafy vegetables

2.1 GENERAL REQUIREMENTS

Site selection

- Choose a location with full sun – avoid areas shaded with buildings or trees
- Avoid planting vegetables near busy roads
- Choose a site near water supply
- Select well drained and aerated soil
- Protect vegetables from livestock, birds etc

Land preparation

- Do first ploughing to break the hard pan
- Do second ploughing to break soil into fine pieces
- Remove logs and stones from the field
- Add matured compost or manure to increase soil fertility
- Apply manure at a rate of 6-8 tons per acre

Seed sources and quality

Seeds for traditional leafy vegetables can be sourced from:

- Saved own seed (ensure they are of high quality)
- Open air markets
- Agrovets
- Research institutions such as KALRO

Water and nutrient application

- Traditional leafy vegetables can be grown during rainy season or year round when irrigated
- Irrigation methods include: drip irrigation, sprinkler irrigation
- Organic or inorganic fertilizer can be used to supply nutrients to the plants but should not be in excess

Food safety concerns

- Always use clean water for irrigation
- Do not plant vegetables near busy roads & in contaminated soils
- Clean your hands while handling vegetables after harvesting
- Use clean water to wash vegetables
- Do not spread vegetables directly on the ground while selling – place them on a raised surface such as a stall or rack
- Transport vegetables in well-aerated containers such as crates

2.2 SUMMARY OF THE CONSIDERATIONS BEFORE YOU PLANT YOUR VEGETABLES

Land preparation is essential for getting the field ready for planting. A well-prepared field keeps weeds at bay, recycles plant nutrients, and provides a soft soil mass for transplanting as well as a good soil surface for direct seeding.

Site selection

- Choose a sunny location, as most traditional leafy vegetables like direct sun. Most vegetables need at least 6 hours of sunlight daily.
- Do not grow vegetables next to the road or on the roadside, if possible. The exhausts that cars produce are toxic and make the vegetables unsafe for human consumption!
- Do not plant where weeds do not grow; vegetables will not grow well there either.
- Plant the garden near a water supply if possible. Is there a river, stream, pond, or well nearby? In many areas, a garden can grow without watering, but it is more likely to be successful if it is irrigated. Water is needed especially during long dry periods or when planting seeds.
- The soil should be well drained. Do not choose low areas where water stands or the soil stays wet. Remember, only African nightshade and slender leaf like moist soils.
- Protect your crops from predators such birds, chickens, goats, and other animals.
- You may need to put up fences or nets.

Land preparation

Before planting, invest time in preparing your field. Although burning and heavy ploughing are popular ways of clearing fields quickly, you might consider other approaches which are more gentle on the environment and lower cost.

As part of your preparation:

If your soil is very compact, plough the field manually or with a cow or donkey.

The use of heavy machinery for ploughing, such as a tractor, is not recommended as the thin, fertile layer of topsoil can get buried underneath the less fertile soil below.

Seed selection

Selecting high-quality seeds can save farmers time (labour) and money. Look for seeds

That:

- are not mixed with any other seeds,
- have a high germination rate (85 out of 100 seeds are able to germinate),
- produce healthy seedlings, and
- are not damaged.

Every seed that fails to germinate means a food and profit loss for the grower. It is therefore critical to ensure the seeds are capable of germinating

Sources of seeds

Unlike farmers growing hybrid varieties of vegetables, farmers planting traditional leafy vegetables may source seeds from many places. Community seed sharing helps farmers avoid paying for seeds and maintains the right to those seeds in the community. Seeds can be bought in open markets and agrovets (shops that sell agricultural inputs). Farmers may also source traditional leafy vegetables seeds from research institutions, such as KALRO and university researchers. These institutions work with farmers over the long term to develop varieties that are reliable, high quality, and meet farmer and consumer preferences. Seed companies also produce good seeds that are not necessarily improved in terms of traits, but, ensure checks such as purity.

3 Step-by-step production guide of individual vegetables

3.1 SPIDER PLANT

Local names:

Kiswahili: *Mgagani*
Luo: *Dek/Akeyo/Alot*;
Kikuyu: *Thageti*
Luhya: *Tsisaka*/Esaka
Kisii: *Chinsaga*
Kalenjin: I*sakchat/ Sageet*
Kamba: *Mwianzo/Sake*
Maasai: *Lemba-e nabo*

Some types of spider plant

Purple stem

Green stem

Conditions for growing the vegetable

- Altitude – 0 – 2400 meters above sea level
- Temperature – 18-25 °C
- Rainfall – 500-1,500 mm of rainfall
- Soil – deep well-drained and fertile soils

Planting

Spider plant is sensitive to cold, therefore planting between July and august should be avoided. Planting at the onset of rain is advisable for rainfed farms. Farmers with irrigation can plant spiderplant throughout the year.

- Seed rate – use 0.5kg per acre
- Spider plant is planted directly into the soil
- Mix the seeds and soil/sand at a ratio of 1:10
- Plant in rows by drilling the seeds that are 30cm between rows and thin to 15 cm between plants
- Cover the seeds with a thin layer of soil.
- If buried too deep, the seeds will not emerge out of the soil after germination.

Field care/management

- Weeding is done through shallow cultivation or through hand-pulling of weeds to prevent competition
- Apply adequate manure to delay flowering and prolong leaf production
- Water regularly to also prolong the leaf production period
- Check for presence of pests and diseases and control them early
- Uproot the diseased plants and bury them
- Avoid using strong chemicals and if possible use organic products
- Always ensure you wait for the recommended waiting days before harvesting following application of chemical sprays

Major pest and diseases, identification and management

Spider plant is often affected by spider mites, nematodes and white flies.

Nematodes

- They are small worms that cannot be seen with naked eye
- They live in the soil and feed on plant roots

Symptoms

- Abnormal root development such as root swellings, spots, scars and dry rots
- Stunted plants with yellow leaves
- Early aging and drying of plants
- Early dropping of leaves, flowers and fruits

Roots attacked by nematodes

Management

- Use clean disease free seeds
- Practice crop rotation with sorghum, maize or millet
- Deep plough your land to expose the nematodes to the sun
- Plant repellant plants like Mexican marigold
- Uproot and burn infested plants

Red spider mite

Identification

- Are small tick-like insects, oval in shape, colour ranges from green, yellow, transparent, brown to red-orange
- Colonies are in webs below the leaves
- They cut the leaves as they suck plant fluids
- Attack causes spots on leaves which change colour to yellow or brown
- Deformed leaves which fall off

Management/control

- Chemical control
- Removal and destruction of infected plant materials
- Conserve natural enemies such as predatory mites, ladybugs, and lacewings to feed on the spider mites

Whiteflies

- Whitefly is a very small insect that sucks the juices from the underside of new leaves, which can cause stunted growth, leaf yellowing, and reduced yields.
- As a result, plants become weak and vulnerable to diseases.

Where can you find them in the garden?

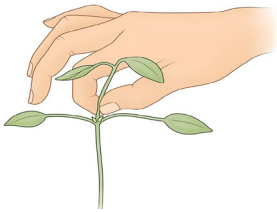
- Whiteflies often attack in crowds and can be found on the undersides of leaves. When infested plants are disturbed, groups of the winged adults fly away from the plant.
- Like aphids, whiteflies produce honeydew, so leaves maybe sticky or covered with a black sooty mould.

How can I control them?

- Add yellow sticky traps to monitor and suppress adult populations and spray plants with a strong stream of water and reduce pest numbers.
- Boost natural predators like ladybirds, which feed on their eggs and the whitefly parasite, which destroys nymphs and pupae.
- Spray neem oil on affected vegetables to kill eggs, larvae, and adults.

Harvesting and harvest methods

- Harvest the plant three weeks after planting by thinning excess plants to achieve required spacing
- Subsequent harvesting is by pinching the top about 10cm from the ground which stimulate branching and delay flowering.



Postharvest handling

- Ensure that the harvested are carried in clean containers to avoid contamination by disease pathogens

Nutritional value of spider plant

- Spider plant contains proteins
- It is rich in Vitamins A, B, E, and C
- It contains calcium, phosphorus and iron
- Rich in folic acid
- Leaves have anti-oxidant and anti-inflammatory properties

3.2 AMARANTHUS

Local names

Kiswahili: *Mchicha*
Kikuyu and Meru: *Terere*
Luo: *Ododo/Omboga*
Luhya: *Litoto/Tsimboka*
Kalenjin: *Mborochot*
Kisii: *Embog*

It is also called pigweed or African Spinach.

Different Types of amaranth vegetable

Conditions for growing the vegetable

- Altitude – 0 – 2400 meters above sea level
- Temperature – 22 – 30°C
- Rainfall – at least 500mm
- Soil – well drained and fertile soil

Planting

Vegetable amaranths is normally propagated by seed. Land should be tilled to a fine tilth, as amaranth has very small seeds. To ensure even distribution, seeds are mixed with sand or fine soil.

This vegetable can be grown either through direct planting or through transplanting.

Direct seeding

- Mix seed with sand at a ratio of 1:10
- Make furrows that are 0.5 to 1.0 cm deep
- Plant in rows that are 30-40 cm apart
- Cover the seeds with a thin layer of soil
- Thin the seedlings 2-3 weeks after planting to get a spacing of 10-15 cm between plants

Transplanting

- Transplant seedlings three weeks after planting
- Transplant early in the morning or late evening
- Water the nursery before transplanting
- Plant seedlings 10cm between rows and 5cm between plants – first harvesting will be through uprooting excess planting
- Or plant seedlings 30 cm between rows and 15cm between plants – harvesting will be through plucking the terminal shoot to promote lateral growth
- Planting can be done year round, especially if a reliable irrigation system is available

Field care/management

Major pest and diseases, identification and management

Green Aphids

Black Aphids

Amaranth is very tolerant to pests and diseases, however, some of the important pests include:

Aphids

Identification

- Aphids are pale green, black or dark brown insects with soft bodies, mainly found under leaves
- They are destructive during the dry season
- They suck the plant's sap
- Cause leaves to curl and unattractive
- Young plants may dry out because of heavy aphid infestation

Management/control

- Practice field hygiene through weeding
- Sprinkle ash on leaves
- Use appropriate insecticide
- Practice crop rotation
- Conserve natural enemies such as parasitic wasps, hover fly, lacewings, and lady beetle to help control the aphids

Red spider mite

Identification

- Are small tick-like insects, oval in shape, colour ranges from green, yellow, transparent, brown to red-orange
- Colonies are in webs below the leaves
- They cut the leaves as they suck plant fluids
- Attack causes spots on leaves which change colour to yellow or brown
- Deformed leaves which fall off

Management/control

- Chemical control
- Removal and destruction of infected plant materials
- Conserve natural enemies such as predatory mites, ladybugs, and lacewings to feed on the spider mites

DISEASES

Leaf Blight

- Blight is caused by fungal or bacterial infections

Identification

- Small, round, water-soaked spots,
- The spots turn dark brown to black and become hard and dry
- The spots initially appear on oldest leaves and then to new leaves
- Wilting and dying of plants

Management

- Keep the farm clean by removing waste under plants
- Prune affected leaves
- Remove and burn infected plants after harvesting
- Practice crop rotation

Harvesting and harvest methods

- Harvesting can be done by uprooting or by ratoon harvesting or cutting the young tender shoots and leaves.
- The first harvest is done during thinning.
- The first harvesting is done through uprooting of excess plants to achieve required plant density when direct planting method is used
- Start harvesting 4-5 weeks after transplanting or 40-60 days after direct planting
- Harvest the crop early in the morning
- Cut the terminal and lateral stems 5-10 cm from the tip – this stimulates growth of side shoots
- Harvest weekly for about 4 months

Nutritional value

- Vegetable amaranth is rich in protein
- It is rich in vitamins A, C, E, B2
- Rich in folic acid, calcium, potassium, phosphorus and iron

3.3 AFRICAN NIGHTSHADE

Kiswahili:	*Mnavu*
Luo:	*Osuga*
Kisii:	*Rinagu*
Luhya:	*Lisutsa*
Kamba:	*Ndulu*
Kalenjin:	*Isocho*
Giriama:	*Mnavu*
Kikuyu:	*Managu*

Some types of the African Nightshade

Types

- *Solanum Villosum* – produce edible orange coloured fruits
- *Solanum Americanum* – produces small purple fruits
- *Solanum Scabrum* – has big leaves and big purple fruits
- *Solanum Eldoreti* – produce small greenish to purplish fruits

Conditions for growing the vegetable

- Altitude – 0 – 2,400 meters above sea level
- Temperature – warm temperatures (20 – 300C)
- Grows well in areas receiving rainfall amounts of between 500 – 1,200 mm per year
- Soils – well drained and aerated soils rich in organic matter content

Planting

- You can use direct planting or transplanting of seedlings. However, the seedlings do not suffer the transplanting shock so it is advisable to start in the nursery then transplant the seedlings to main filed
- Plant seeds at the onset of the rains

Direct planting

- Mix seed with dry sand at a ratio of 1:10
- Plant in rows that are 30cm (1 foot) apart
- Place the seeds in the soil and cover with a thin layer of soil
- When three weeks old, remove the excess plants to give a spacing of 20 cm between plants to reduce competition for nutrients, light and water

Transplanting

- Transplant seedlings when they have six true leaves
- Plant seedlings 20cm from each other and 30 cm between the rows
- Apply well decomposed manure 3 weeks before transplanting
- Plant at onset of rains or use irrigation during the dry season

Field care/management

Major pest and diseases, identification and management

Root-knot nematode

- Just like African nightshade and spider plant, Amaranth is also affected by root knot nematodes

Identification

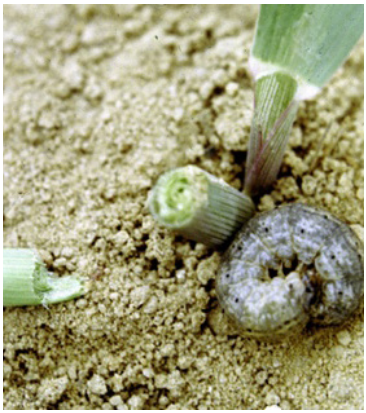
- Swelling of the roots
- The swellings prevents movement of water and minerals leading to stunted growth
- Leaves turn yellow in colour
- Early shedding of leaves
- Poor yields
- Drying and early aging of plants

Management/control

- Practice crop rotation with cereals like sorghum, maize or millet
- Keep land fallow for one or two seasons
- Use of manure to improve health of plants
- Uproot and destroy infected plants

Cutworms

Signs and symptoms:



- You will find cutworms hiding in soil near seedlings that they have damaged
- Colour of cutworms ranges from grey to black
- They mostly feed at night, they cut the stem

Management/control

- Early weeding destroys eggs and laying sites
- Hand removal or worms
- Use appropriate chemicals to control – ask extension officer

Red spidermites

Identification

- Are small tick-like insects, oval in shape, colour ranges from transparent, brown to red-orange
- Colonies are in webs below the leaves
- Attack causes spots on leaves which change colour to yellow or brown and deformed leaves which fall off

Management/control

- Use appropriate chemical control – consult extension officer
- Removal and destroy infected plant materials
- Conserve natural enemies such as predatory mites, ladybugs, and lacewings

Aphids

Identification

- Aphids are pale green, black or dark brown insects with soft bodies, mainly found under leaves
- They are destructive during the dry season
- They suck the plant's sap
- Cause leaves to curl and unattractive
- Young plants may dry out because of heavy aphid infestation

Management/control

- Practice field hygiene through weeding
- Sprinkle ash on leaves
- Use appropriate insecticide
- Practice crop rotation
- Conserve natural enemies such as parasitic wasps, hover fly, lacewings, and lady beetle

Diseases

Leaf Blight in African night shade

- Blight is caused by fungal, bacterial or viral infections

Identification

- Small, round, water-soaked spots,
- The spots turn dark brown to black and become hard and dry
- Circular brown spots on the leaves
- The spots initially appear on oldest leaves and then to new leaves
- Wilting and dying of plants

Management

- Keep the farm clean by removing waste under plants
- Prune affected leaves
- Remove and burn infected plants after harvesting
- Practice crop rotation

Harvesting and harvest methods

- You can harvest by uprooting the whole plant while thinning to recommended spacing three weeks after planting
- Harvest the leaves 4-5 weeks after transplanting
- Cut the terminal stem about 5-10 cm from the tip to stimulate growth of side shoots
- Harvest weekly
- Harvest early in the morning

4 RECORD KEEPING

- It is important to keep a record of all the activities, costs and income of your vegetable production enterprise. This helps to keep track of your business
- Records will help you know whether your business is profitable or not

Example of production record

Year/month	Crop	Land size	Yield	Comments
June 2023	Black night shade	0.5 acres	2000kg	Good harvest

Financial records

This is a very basic form to help you assess how much money you spend producing your vegetables and how much you make from it. Copy it into your notebook and add more rows as needed.

Example:

Date.....Crop..... Farm size.....

Date	Item	Unit	Cost	Income (Shs.)	Expenditure (Shs.)
write date here	1st ploughing	1	2000		2000
write date here	2nd ploughing	1	1000		1000
write date here	Seed	1 packet 0.25kg	2000		2000
write date here	Planting	5 people	400		2000
write date here	Weeding	2 people	500		1000
write date here	1st harvest	200kg	30	6000	
write date here	2nd harvest	300kg	35	10500	
write date here	3rd harvest	200kg	30	6000	
write date here	4th harvest	100kg	25	2500	
			Total	25000	8000
			Profit	17000	

5 COOKING METHODS

Traditional leafy vegetables contain substantial quantities of micronutrients such as vitamin A, iron, calcium, zinc, magnesium, and phosphorus.

When consumed in adequate amounts as recommended, traditional leafy vegetables contribute effectively to prevention and alleviation of micronutrient-associated medical conditions such as:

- night blindness,
- iron deficiency disorders,
- osteoporosis (weak bones), and weak teeth.

The introduction of exotic vegetables in the traditional continent had some negative impacts on the cultivation and consumption of African leafy vegetables. Also the cooking methods of these vegetables were condemned and indicated to lead to loss of nutrients in the vegetables.

5.1 METHODS USED FOR COOKING TRADITIONAL LEAFY VEGETABLES IN KENYA

- Cooking has been shown as one of the factors that affect nutrient contents of vegetables.
- The main methods of cooking in Kenya involves:
    - boiling in unspecified amounts of water
    - using additives like bicarbonate of soda, lye (traditional salt), milk, sesame and groundnut paste
    - Microbial fermentation
    - Frying
- Cooking of vegetables in traditional households is done by using pots rather than pans and these retain heat and give better simmering effects that helps to retain steam and prevent loss of volatile nutrients and the aroma.
- There is evidence that thermal processing can also enhance bioavailability of vitamins and carotenoids by releasing them from the plant matrix.
- Also fermentation helps to lower compounds that inhibit mineral absorption hence very good for those vegetables that contain such chemicals e.g. phytates.

5.2 EFFECTS OF COOKING METHODS ON NUTRIENTS AND MINERAL CONTENT

- Chopping before washing leads to loss of vitamin C and vitamin B complex since they are water soluble vitamins
- Repeated boiling and frying destroys vitamin C and addition of sodium bicarbonate leads to loss of vitamin B complex i.e. B1, B2 and niacin.
- However, fermentation results in increased β-carotene, iron and zinc levels in Solanum nigrum, Manihot esculenta, Crotolaria brevidens, Brassica carinata and Basella alba. The increase in the β-carotene levels could be attributed to synthesis of the vitamins by micro flora during fermentation.
- Boiled Curcubita moschata, Vigna unguiculata, Ipomea batatas, Solanum nigrum, Crotolaria ochroleuca, Brassica carinata, Cleome gynandra and Basella alba have been shown to have significantly higher β-carotene levels than when they were boiled with lye and milk while Amaranthus blitum, Corchorus olitorius and Manihot esculenta recorded significantly lower mean β-carotene levels when boiled than when boiled with lye and milk. This means that different vegetables respond differently in their nutrient content when using the traditional cooking methods.

5.3 EFFECTS OF COOKING METHODS ON VITAMINS AND NUTRIENTS

- The reduction of β-carotene in some of the vegetables when boiled with lye and milk or when fried could be attributed to oxidative destruction of β-carotene in the presence of increased levels of iron from tomatoes that are used during frying and also from the milk that has also been shown to increase the iron content in the recipe and this iron catalyzes the oxidative destruction of vitamin A (β-carotene)
- Cooking traditional leafy vegetables with lye increases levels of extractable iron. Furthermore, frying vegetables using oil and tomatoes increases the amounts of extractable iron. This increased iron levels probably enhances oxidation of vitamin C and eventually reduces its amounts in the vegetables.

Note:

- Vegetable amaranth is often cooked in combination with other vegetables like African nightshade, spiderplant, or pumpkin leaves.
- This will also influence the amounts and types of nutrients available as consumed.
- Therefore, there is nothing wrong with cooking the vegetables using the traditional methods, so long as we are aware of the nutrients we are targeting in the diet for nutrition improvement

State the main messages presented in this guide (Use this space to concisely state it)

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