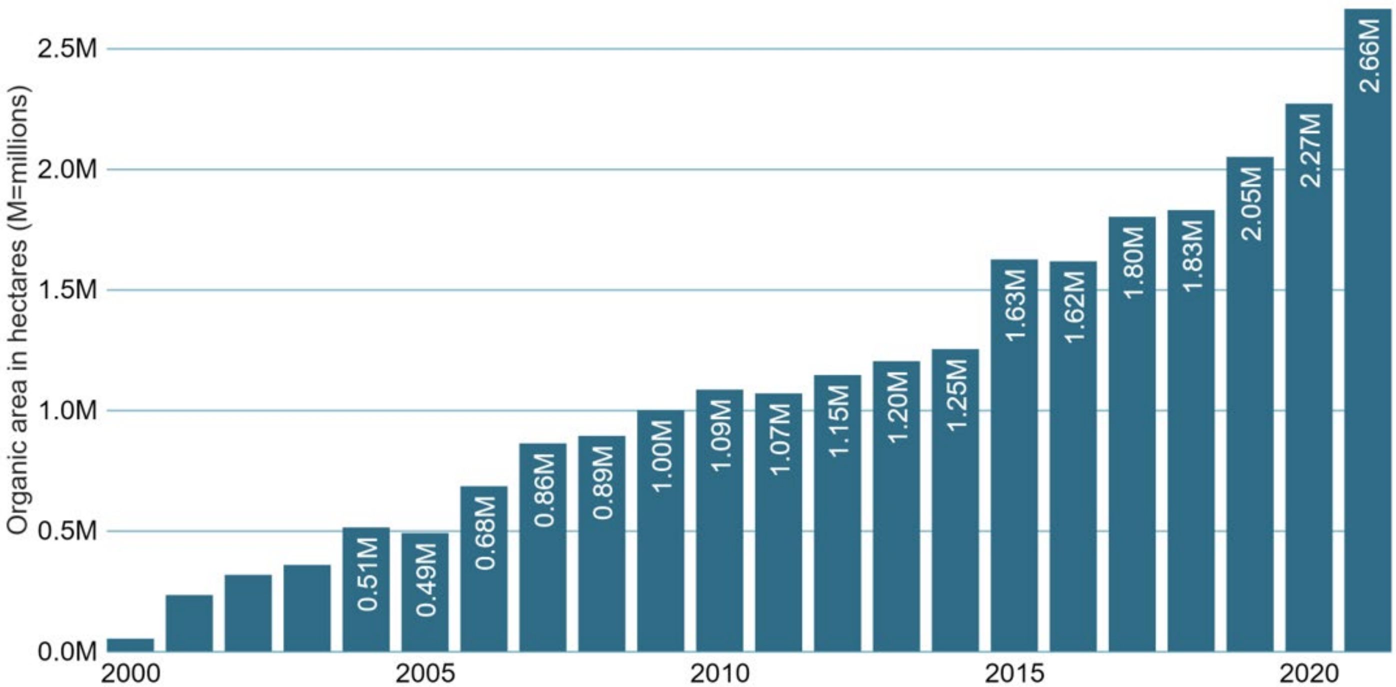
What is organic agriculture?

Organic agriculture in Africa – a growing practice

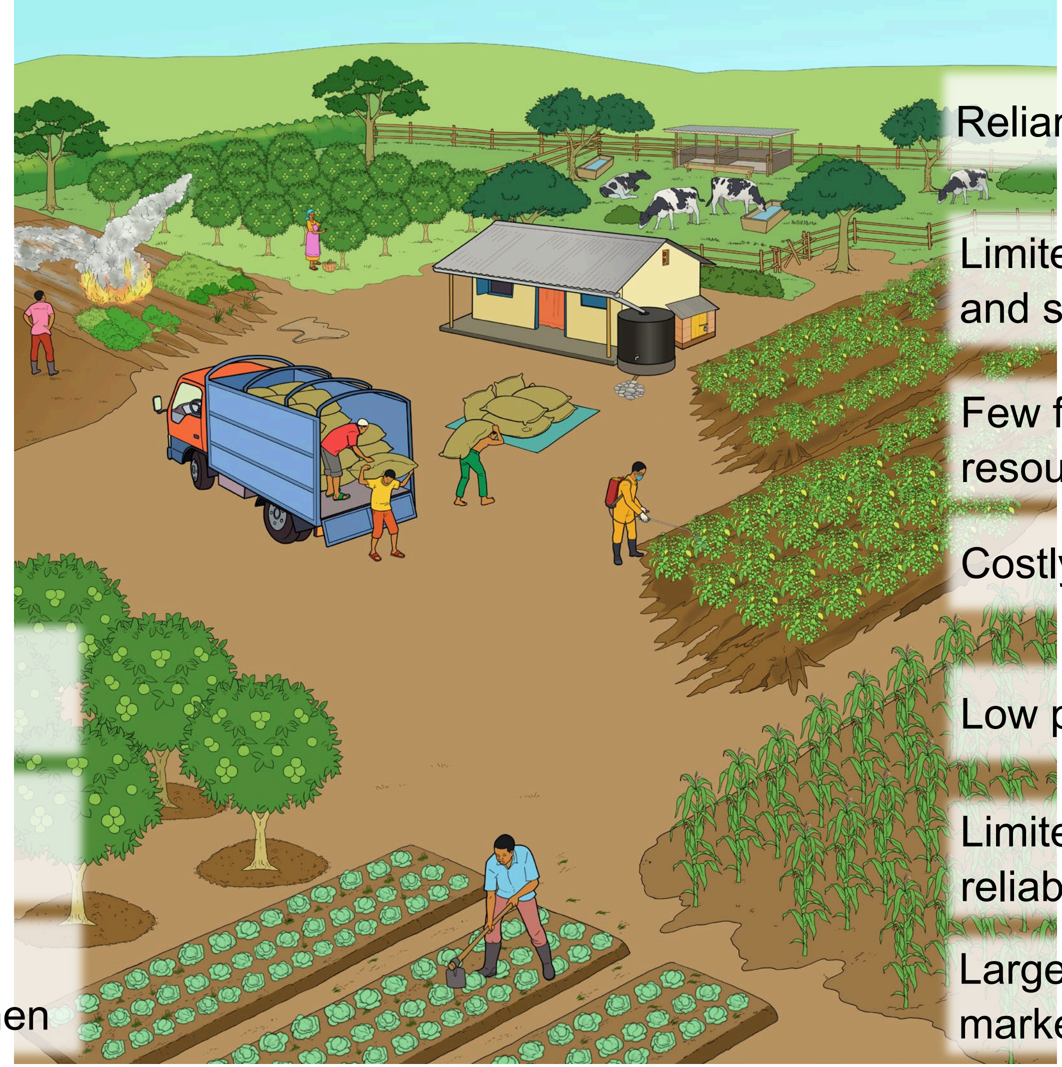
Development of organic agricultural land 2000 to 2021



Source: FiBL-IFOAM-SOEL surveys

- Organic surface is projected to grow more over the next years.
- African initiatives (EOA-I, etc.) are spurring growth.

General challenges of smallholder farmers



Low soil fertility

Low yields

Shortage of land

Effects of climate change

Health risks of synthetic pesticides

Strenuous work, particularly for women

Reliance on few crops

Limited access to safe and sustainable inputs

Few financial resources

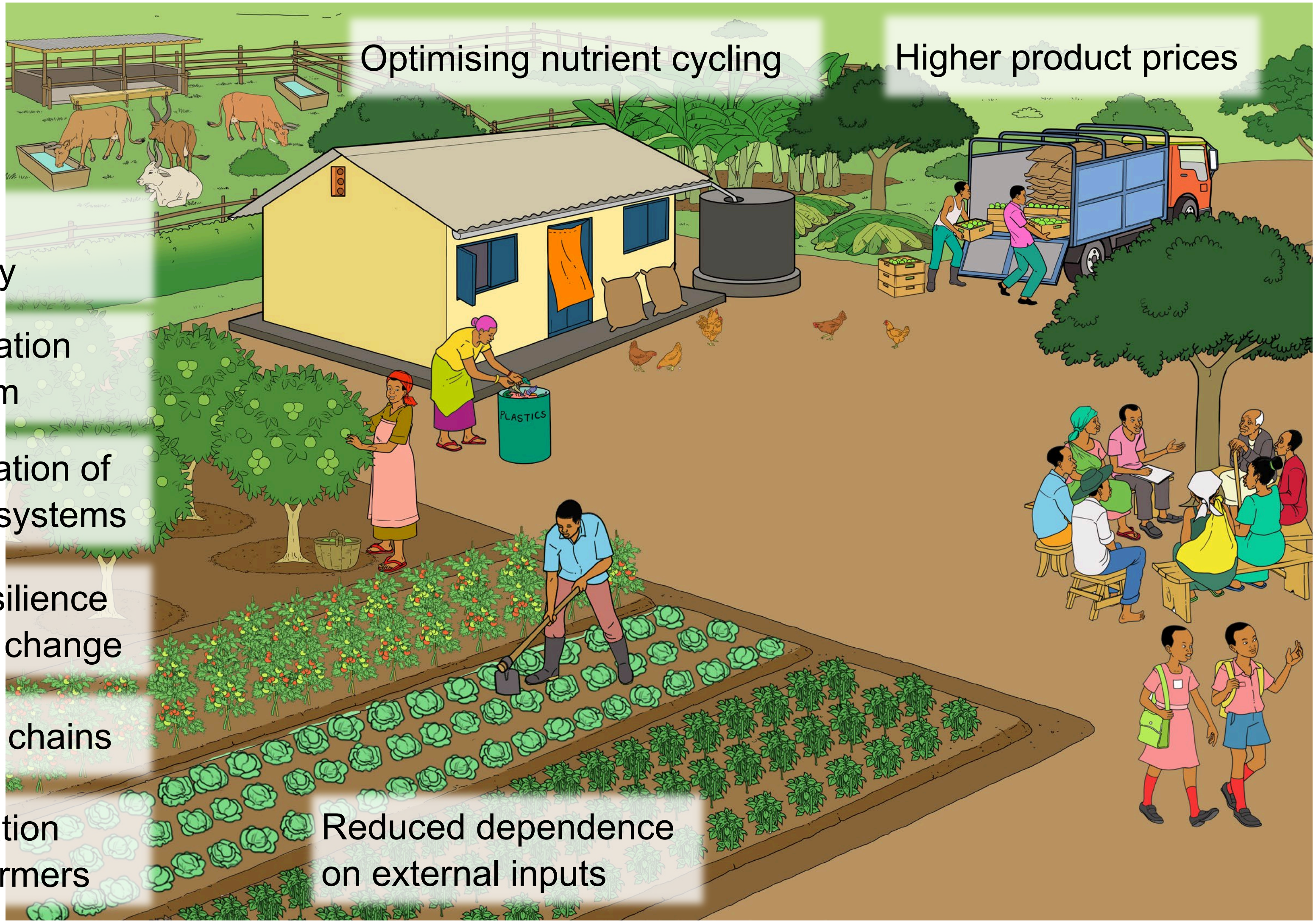
Costly external inputs

Low product prices

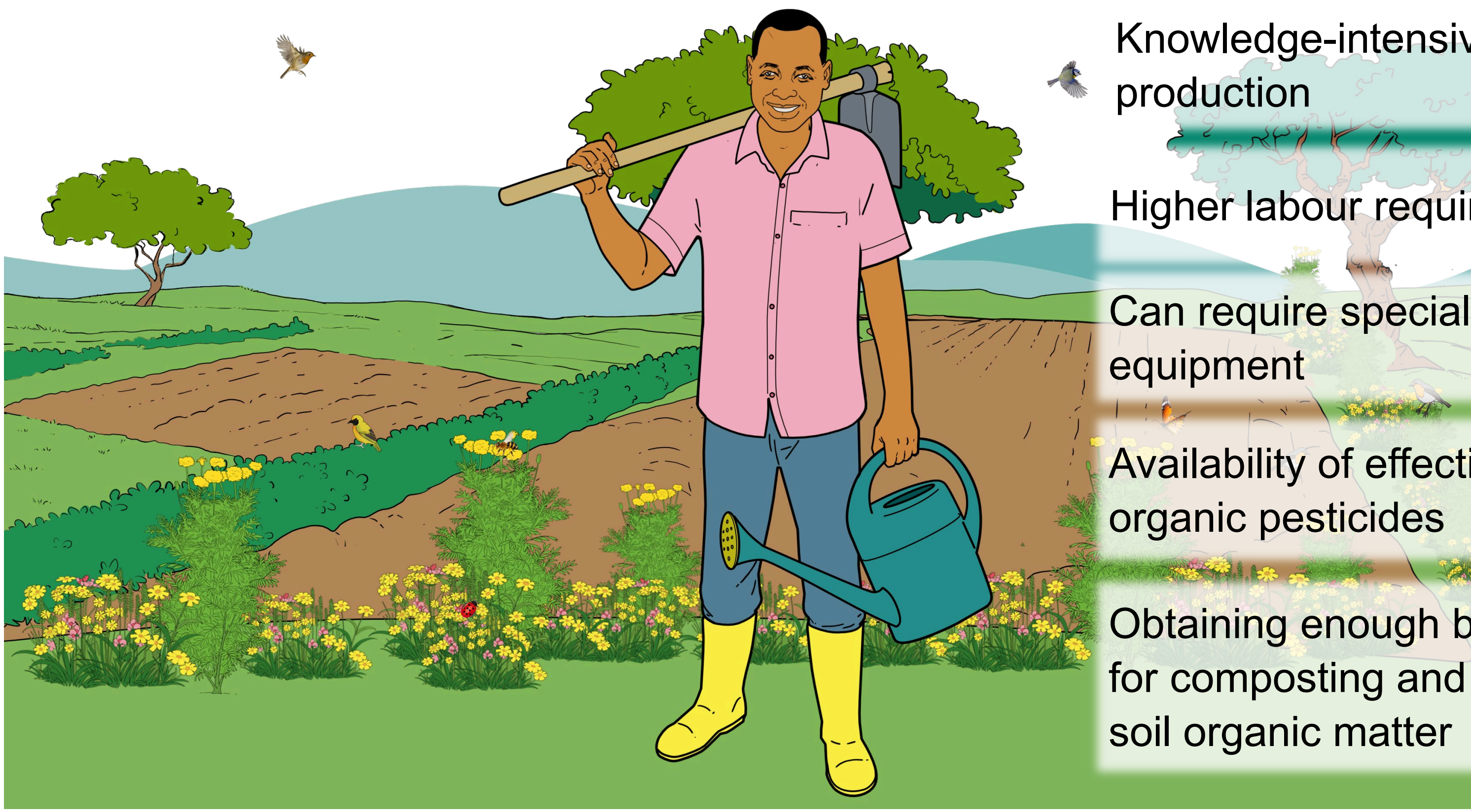
Limited access to reliable markets

Large distance to markets

Potential solutions of organic agriculture



Challenges of organic agriculture

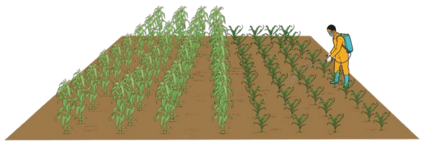


- Knowledge-intensive production
- Higher labour requirements
- Can require specialised equipment
- Availability of effective organic pesticides
- Obtaining enough biomass for composting and managing soil organic matter

Differences of conventional and organic agriculture

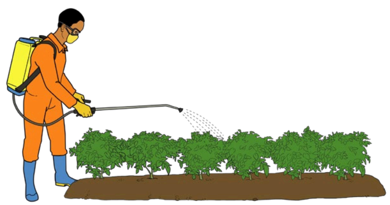
Conventional | **Organic**

Standard approach
- Short-term focus on efficiency, yields and -profitability.
- Treating problems instead of preventing them.



Holistic system approach
- Focus on: long-term farm sustainability, diversity, quality, health and livelihood.
- Preventing problems with best practices.

Low quality commercial inputs
- Synthetic agrochemicals, e.g., pesticides, herbicides and fertilisers, used.
- Threaten human and environmental health.
- Expensive for small-scale farmers in the tropics.



High quality organic inputs
- Organic composts and botanicals made from local resources.
- Safe for the farmer and environment.
- Higher labour required, but more affordable.

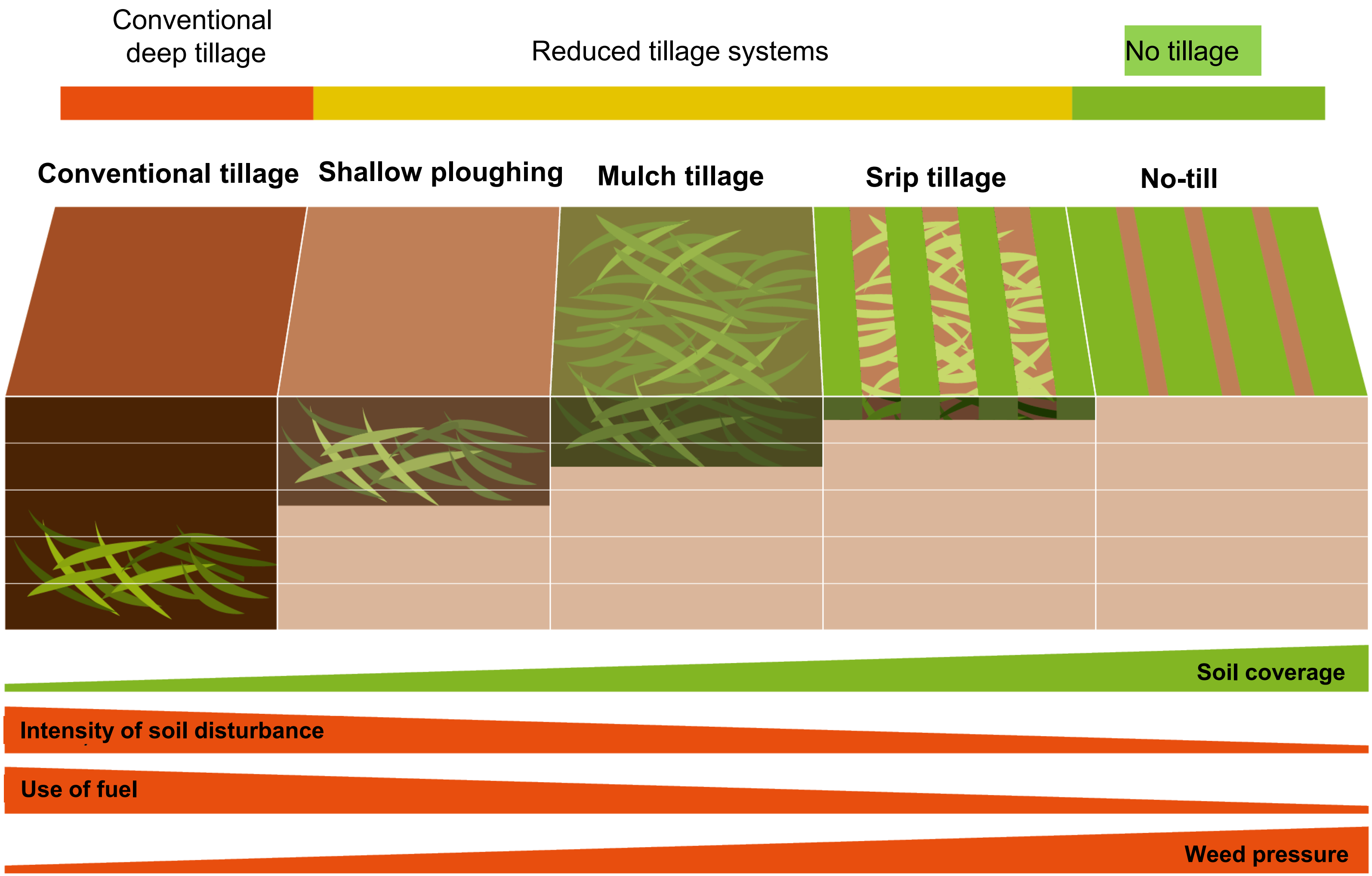
Sole-/monocropping system
- Repeated cultivation of a single crop on a field depletes soil fertility and health.
- Higher risk for erosion in weather extremes.
- Increases risks of pest, disease and weed invasion.

Diversified cropping system
- Intercropping of crops.
- Planned crop rotations.
- Diversification lessens the risk for farmers, increase productivity and food security, suppresses weeds.

Compost production

Compost is a highly valuable soil amendment. However, its production is labour-intensive. Mechanisation can greatly facilitate this work and enable larger quantities of compost to be produced.

Types of tillage



Benefits of reduced tillage systems

Better soil structure

- Better soil structure by driving over the grown soil and avoiding intensive and deep soil cultivation
- Less soil compaction
- No plough sole

Erosion control and water storage

- Plant residues on the soil surface protect the soil from rain and wind.
- Improved water infiltration during heavy rain
- Less surface runoff and erosion
- Less waterlogging
- Reduced water evaporation, better water conservation, and better water supply from the deeper soil layers due to capillarity

Conservation of soil organic matter and soil organisms

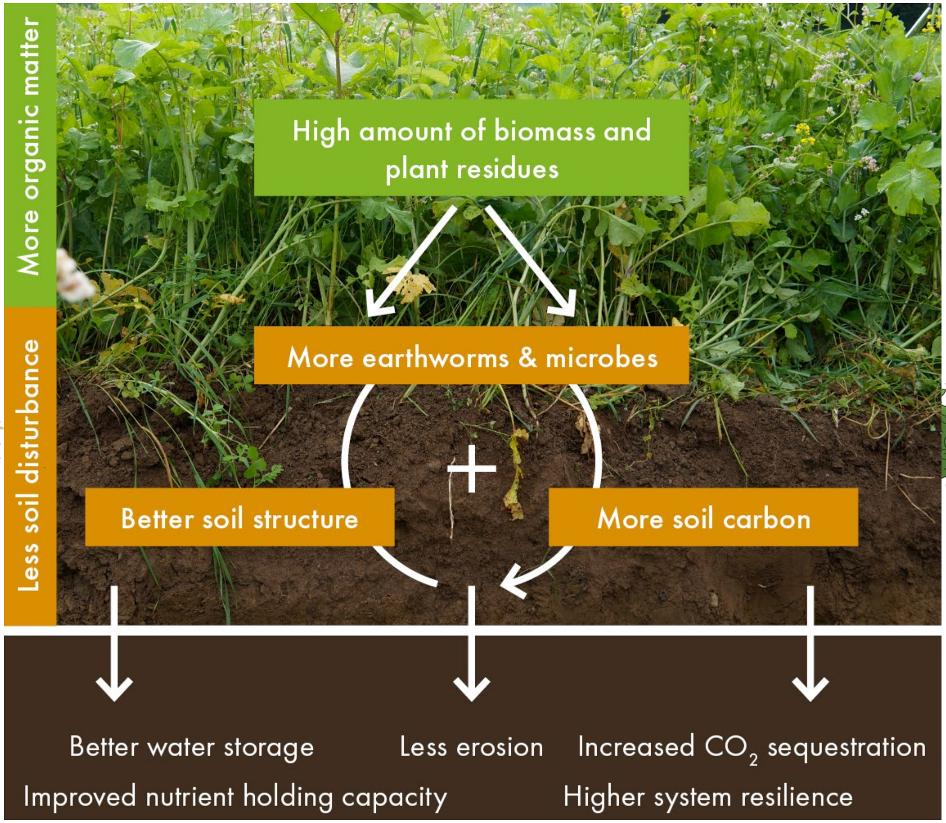
- Reduced decomposition of soil organic matter
- Protection and promotion of earthworms and other soil organisms
- Food (biomass) for earth-worms and soil organisms

Climate protection

- Reduced mineralisation of organic matter in the soil and thus less release of CO_2 from the soil
- Fuel savings due to reduced working depth (despite more passes)

Managing soil fertility with green manures and cover crops

Mulching

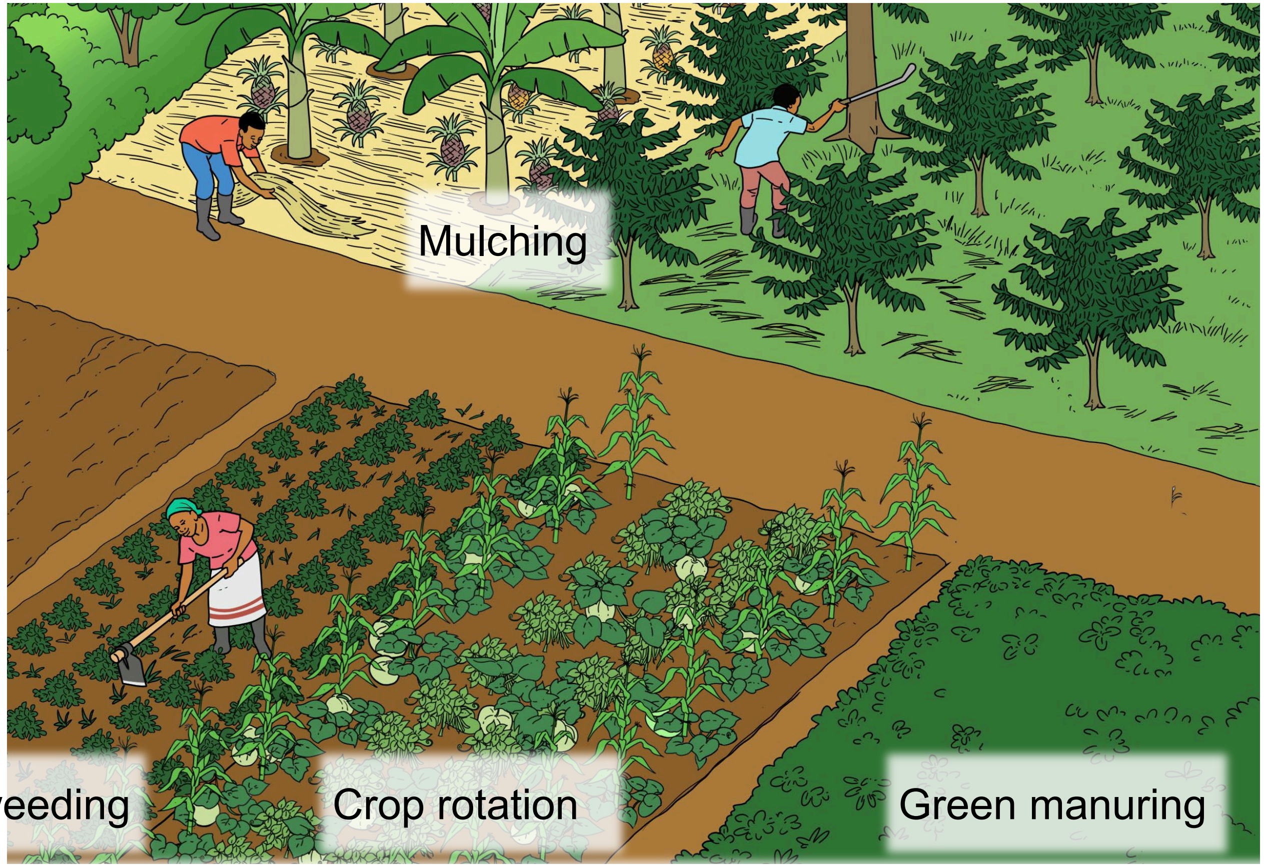


Green manuring

Planting into covered soil or minimally tilled soil

Organic farmers depend on appropriate implements to plant in fields prepared with minimum or no tillage equipment.

Managing weeds timely and effectively

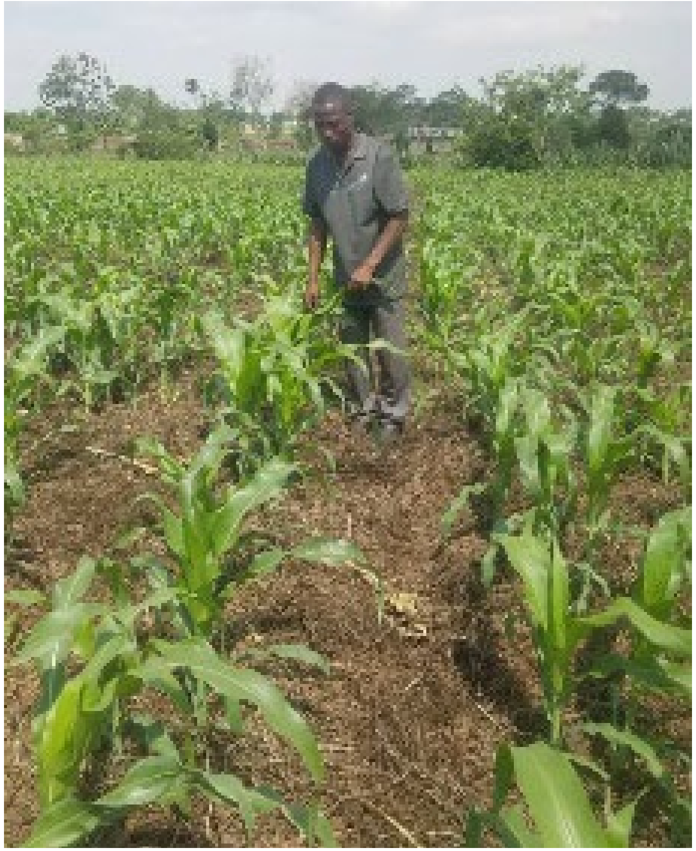


Despite the application of preventive measures to control the weeds, organic farmers depend on effective weeding tools for best results while minimising time and effort.

Primary processing/cleaning of selected arable field grain crops

Mechanisation of harvesting, cleaning and processing of arable field crops can improve farm production due to reduced strenuous work, and reduce crop losses.

Case study: no-till conservation agriculture in Tanzania



Maize grown organically in unploughed fields with biomass/residues from previous maize intercropped with mucuna.

Procedure:

1. Slashing of the maize stover and mixed cover crops in the field with a machete and leaving as mulch. Retaining as much mulch as possible to suppress weeds and enhance soil moisture retention.
2. Opening of planting holes/basins in the mulched fields with a hand hoe
3. Applying cured manure and natural sources of nutrients (e.g. Minjungu, rock phosphate) where available in the holes/basins
4. Planting into the holes/basins with appropriate tools or implements such as a jab planter, a dibble stick or a machete
5. Weeding by hand (by hand pulling of weeds or using a shallow weeder) as necessary
6. Intercropping a cover crop (e.g. Dolichos lablab, pigeon peas or Mucuna (velvet beans) into the main crop to suppress weeds and to provide soil cover once the main crop is harvested.
7. Harvesting and retaining crop residues in the field
8. Managing of the post-harvest weeds before they flower to reduce weed seed bank.

Manual compost production

1

Collecting materials

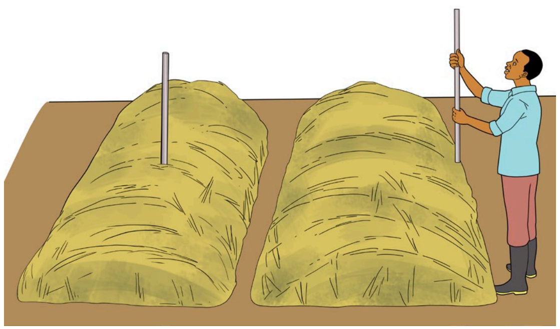
2

Watering and mixing the materials

3

Piling of the mixed materials

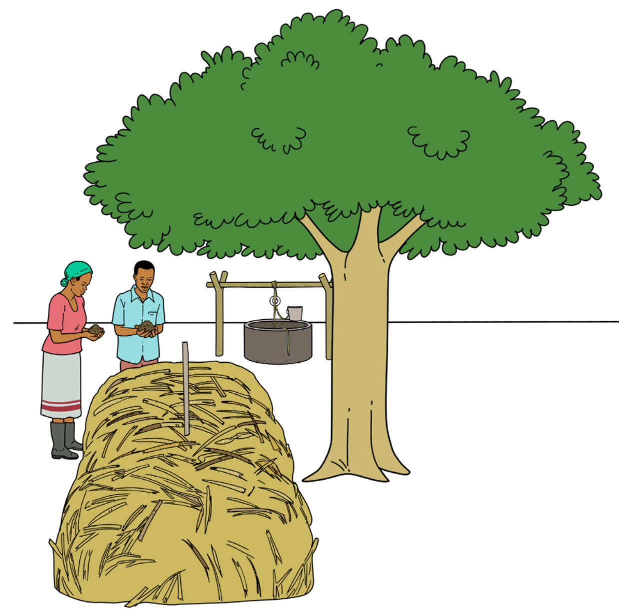
4



Checking regularly the temperature

5

Turning the heaps repeatedly



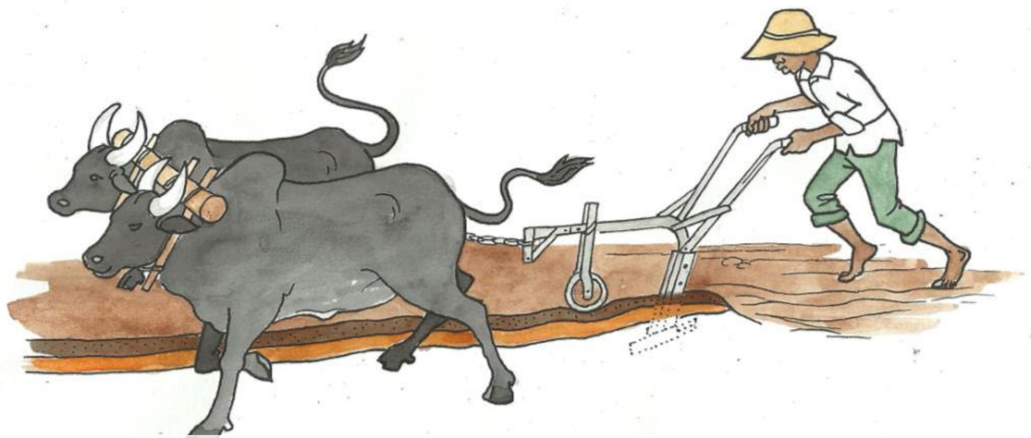
Mechanised compost production

Tractor-drawn machines turn the heaps that are placed in long rows.

(Photo: Daniel Kalala, Zambia)

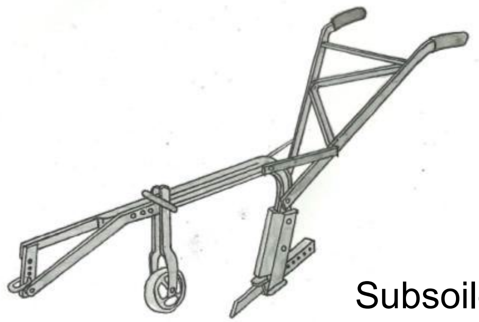
Breaking up soil compaction

By hand – dig planting basins/ pits that extend deeper than the compaction/hard pan.

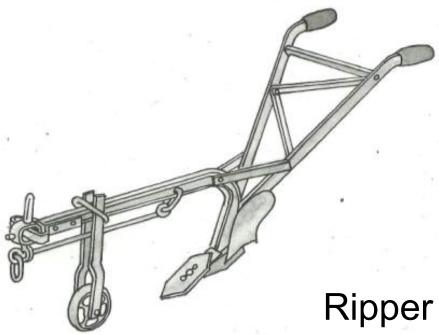


With draught animal power, use a ripper or subsoiler at a depth of 5 cm below the compaction/hard pan.

A subsoiler (L) helps break up a hardpan, while a ripper (R) can break up surface compaction as well as being used for reduced tillage.



Subsoiler



Ripper

Slashing vegetation manually

Knocking down cover crops or vegetation in a fallow field with a machete.

Slashing weeds with a Billhook (Nyengo).

Animal-drawn knife roller

Animal-drawn knife roller in working position. In this type, the metal blades are welded to a metal ring fitted on a solid wooden trunk, with wheels attached for easy transport to the field.

(Photo: Saidi Mkomwa)

Animal drawn knife roller in transport position with staggered and increased numbers of knives.

(Photo: Saidi Mkomwa)

Case study: tractor-drawn knife roller

Using a tractor-drawn knife roller in the humid tropics of Ghana

- The good rainfall allows vigorous growth of indigenous weeds. These are rolled down and crushed with the use of a tractor drawn roller crimper.
- The full soil cover with biomass allows for effective suppression of weeds without the need for any additional measures.
- Tractor-drawn roller crimpers are expensive and generally unsuitable for small plots of land.

A tractor-drawn roller crimper used by the Centre for No Till Agriculture at Amanche in Ghana

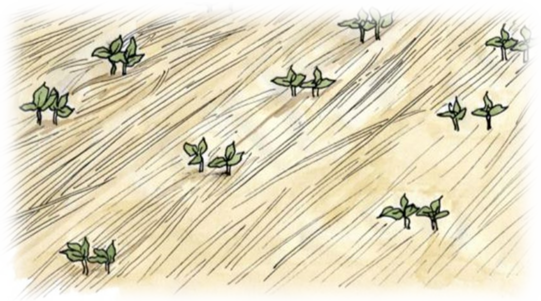
(Photo: Kofi Boa)

Digging planting pits

1. Dig small holes along the rope.

2. Fill some compost or rotten manure into every hole and cover it with topsoil.

3. Place the seeds into the refilled holes.



4. Cover the planting lines with dry mulch.

Hand hoe dug planting basins in a mulched field (Photo: Saidi Mkwoma)

Field preparation by ripping by hand

A hand ripper minimises soil disturbance, time, and effort by confining preparation to planting lines.

A locally-produced hand ripper from Laikipia, Kenya
(Photo: Saidi Mkomwa)

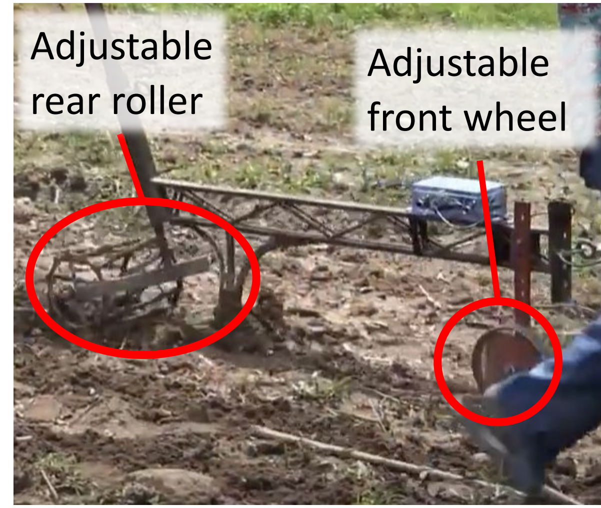
Field preparation by ripping with draught animal power

- Ripper shank designed to be mounted on the standard for a mouldboard plough as commonly used in parts of Kenya and Rwanda

(Photo: Robert Burdick)

- Ripping plough locally manufactured in Burkina Faso without a front wheel and/or a roller on the back.
- Due to the missing stabilisation, a wider shank is used.
- This type makes use by both human and draught animals more difficult, but is relatively simple and cheap to produce.

(Photo: Robert Burdick)



- Ripping plough from Burkina Faso with an adjustable front wheel and a rear roller to control the ripping depth, and to improve stabilisation.
- The narrow shank reduces the pull for the draught animals, however, it is more complicated and expensive to produce.

(Photo: Timothy Harrigan)

Case study: using a ripper in dry, compacted soil

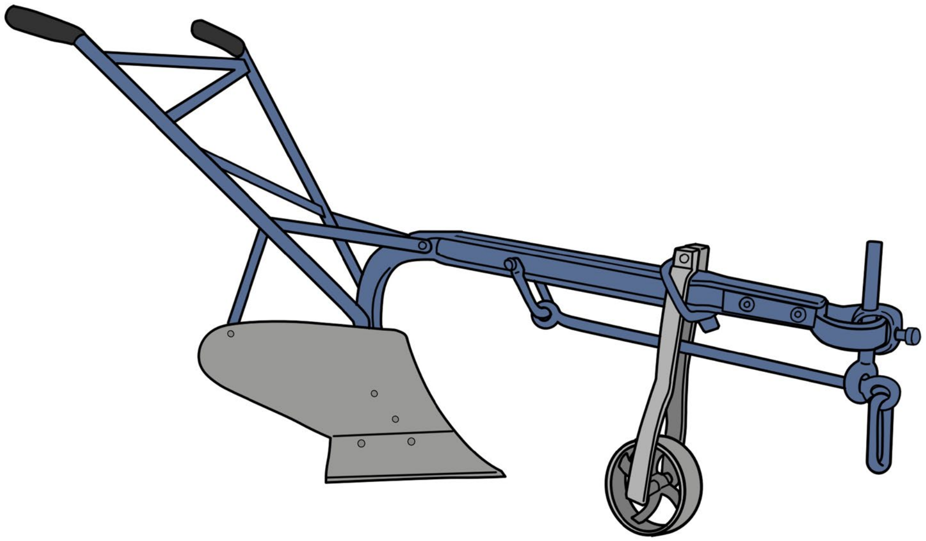
Preparing lines for planting in two passes with a ripper in Koumbia, Burkina Faso:

1. Shallow initial pass (left)
2. Deeper second pass (right) to achieve planting depth

Two passes are recommended in dry, compacted soil, especially if there is a hard pan. This procedure also reduces strain on the animals.

(Photos: Robert Burdick)

Mouldboard plough



- A mouldboard plough can be used as a starting point to reduced tillage, but should be replaced by more appropriate minimum or no-tillage implements.
- The mouldboard plough turns the top layer of soil over to cover weeds or cover crops, and incorporate manure, compost, or other amendments.
- The conventional working depth of 12 to 15 cm should be reduced to 6 to 8 cm.
- At reduced working depth, weed control and seedbed preparation are still ensured.

Skim ploughing

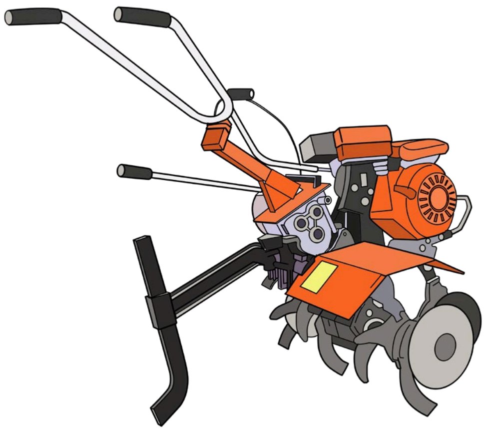
- Skim ploughs disturb, but do not invert the top layer of soil at a depth of 5 to 8 cm
- Options for skim ploughing: a moulboard plough with removed mouldboard, a cultivator running at a minimal depth, or traditional ploughs such as the ard plough
- Loosens the soil for planting and uproots weeds.

Farmer ploughing in Ethiopia with a traditional ard plough, which acts at a reduced depth compared to a mouldboard plough and does not invert the soil.

(Photo: Pixabay)

Tractor powered seedbed preparation

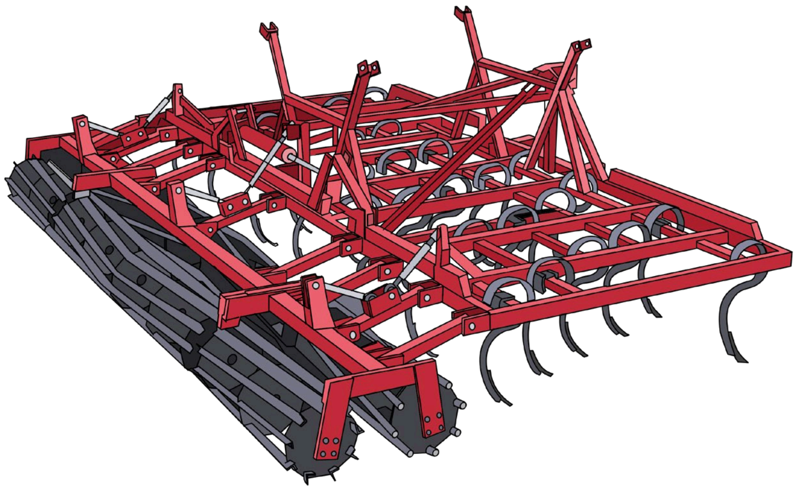
Single-axle tractors



Rotary hoe for use on heavy soils mainly

Note: Rotary hoes work the soil intensively. This degrades soil structure. Therefore, their use should be strictly limited.

Tractor powered

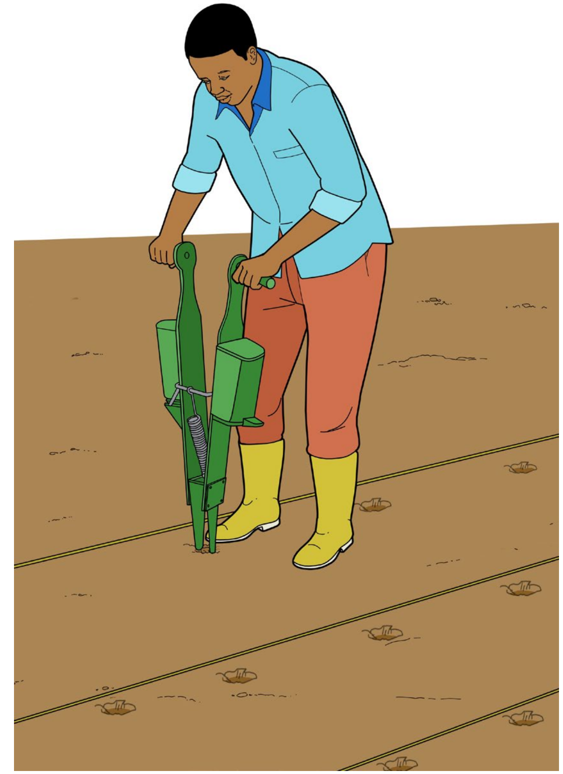


Tine cultivator with a cage roller / packer for use on light soils

Jab planters

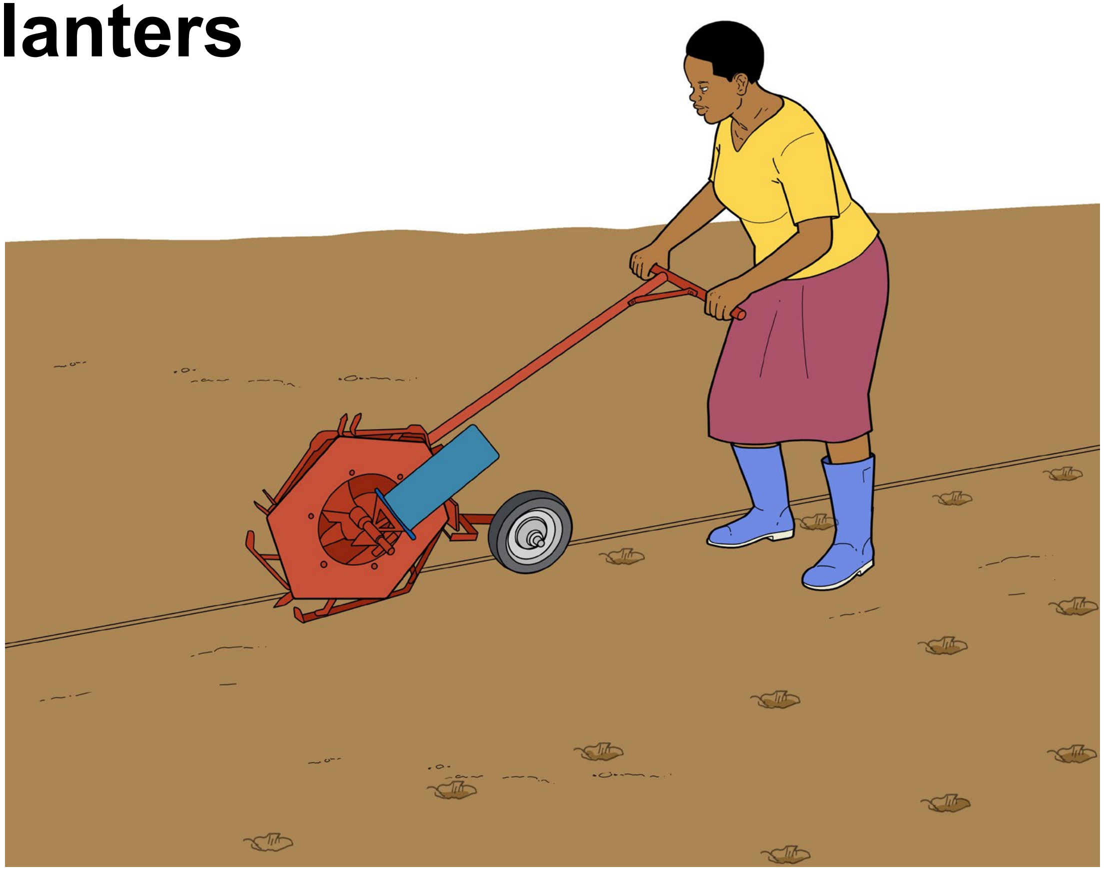
Different types of jab planters, without fertiliser hoppers (left) and with fertiliser hoppers (right)

(Photos: Saidi Mkomwa)



A jab planter can increase planting efficiency and reduce drudgery in cleared fields or fields covered by mulch.

Punch planters



- Punch planters can increase the accuracy and ease of planting.
- They are useful on tilled or untilled fields.
- Added weights can help to ensure proper planting depth in thick mulch or compacted soil.

Animal-drawn planters for use in soils with mulch

Direct injection planter with fertiliser hopper as used in Southern Africa. The front coulter cuts through a cover crop to allow the planter easy access. The back drive wheel serves to turn the seed plates.

(Photo: Robert Burdick)

A direct planter prototype from Tanzania. The idea was to make the planter as low-cost as possible. In theory, this planter could be used through cover crops.

(Photo: Robert Burdick)

Animal-drawn planters

Planter prototype from Burkina Faso designed for use in fields with or without residue.

(Photo: Robert Burdick)

A direct injection planter with fertiliser hopper from South Africa without coulter for planting into mulch.

(Photo: Robert Burdick)

Operator view of the planter with the seed covering discs.

(Photo: Robert Burdick)

Seed delivery plate inside a planter with modified backing plate to avoid grains sneaking behind and messing everything up.

(Photo: Robert Burdick)

Tractor-drawn planters

A 4 row planter modified for tractor use from Senegal.

(Photo: Robert Burdick)

A planter for sesame in Ethiopia.

(Photo: Selina Ulmann)

Case study: improving planter mechanisation in Burkina Faso

Improvements:

- Replacement of the seed plate spiral bevel gear drive by an inexpensive, open spur gear drive (cost red. of 50 %).
- Creation of mold-injected planter seed plates for better fit and functionality.
- Development of a new furrow opener.
- Replacement of the high crown sweeps by small concave discs.
- Reduction of press wheel width by 50 %.

Results:

- Faster and more consistent germination of the seeds due to a uniform planting depth and spacing.
- Increased maize grain yield of 50 to 150 % compared to hand planting.
- No seed losses by birds – no second planting.
- Early planting before the rains possible.

Local blacksmiths are now proficient in building and repairing in-line subsoilers for conservation cropping systems.

Local farmers, blacksmiths and extension educators are closely involved in testing and evaluating the improved planter.

Planter evaluation and training session with farmers and blacksmiths.

Fertiliser application with draught animal power

A simple drag can greatly improve efficiency and decrease the drudgery of applying larger volumes of organic fertiliser.

Mechanisation of hand weeding

A shallow weeder can be a very efficient hand tool for removing weeds.

(Photo: Saidi Mkomwa)

A hand-held weeder with protective discs, as used for row crops by small farms in Europe.

(Photo: FiBL)

Animal-drawn weeder with duckfoot sweeps

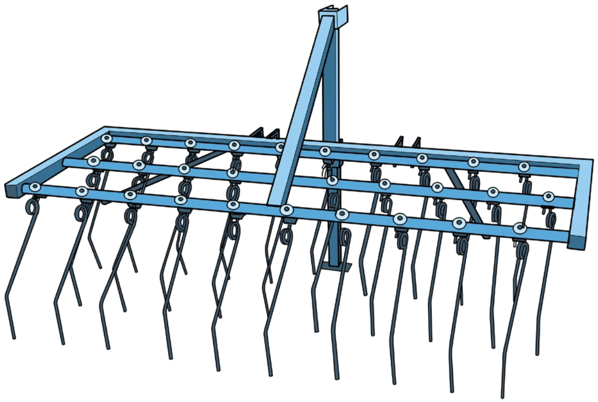
Weeder from Burkina Faso with three sweeps with low angle low crown for shallow weeding

(Photo: Robert Burdick)

Weeder in action; it can also be used as skim plough with a 3-times higher area performance and a much lower draft necessary draft than a traditional plough

(Photo: Robert Burdick)

Tine weeder



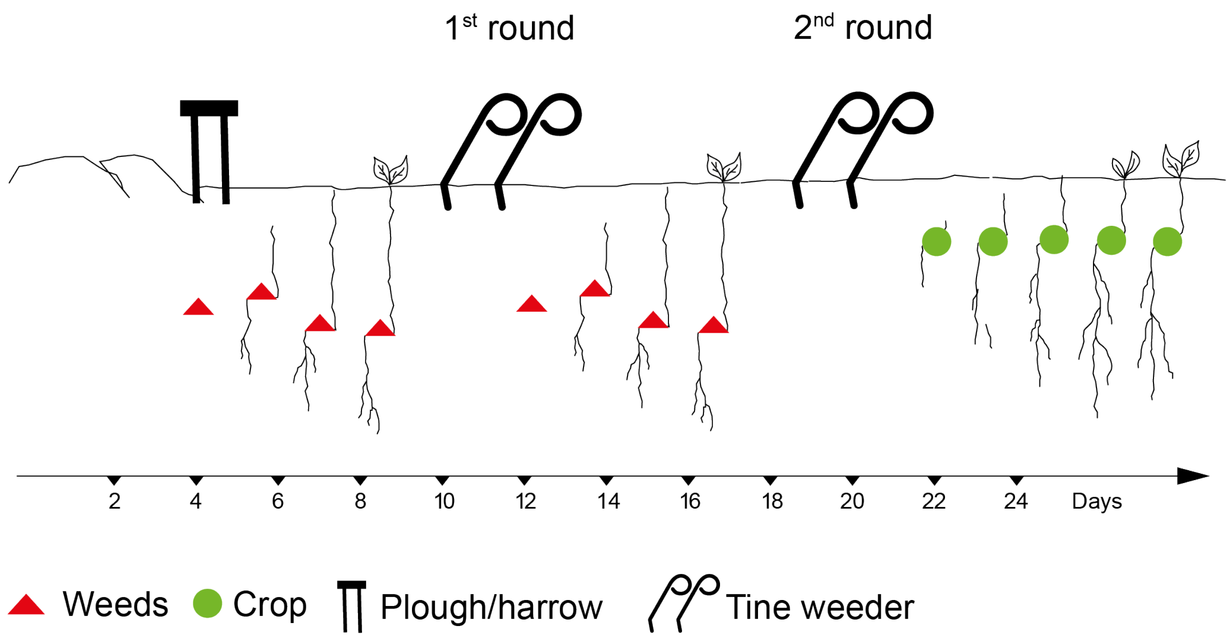
- Effective against small weeds.
- Buries and pulls out the weeds and crumbles the soil surface.
- Highest efficacy under sunny and windy conditions.
- Angled tines for a light pressure on the soil. The tines should slightly point forward into the soil.
- The aggressiveness does not depend on the angle of the tines but on the speed and structure of the soil. Ideal are two passes at lower speed going the opposite direction the second time through.
- Often used for blind harrowing (pass before crop appearance) against weed threads. Working depth should be about 2.5 cm, not to disturb the seedbed.
- The efficiency against weed seedlings can be 80 to 90%.

Tractorised weeder

A two-wheeled tractor with weeding sweeps from Senegal.

(Photo: Robert Burdick)

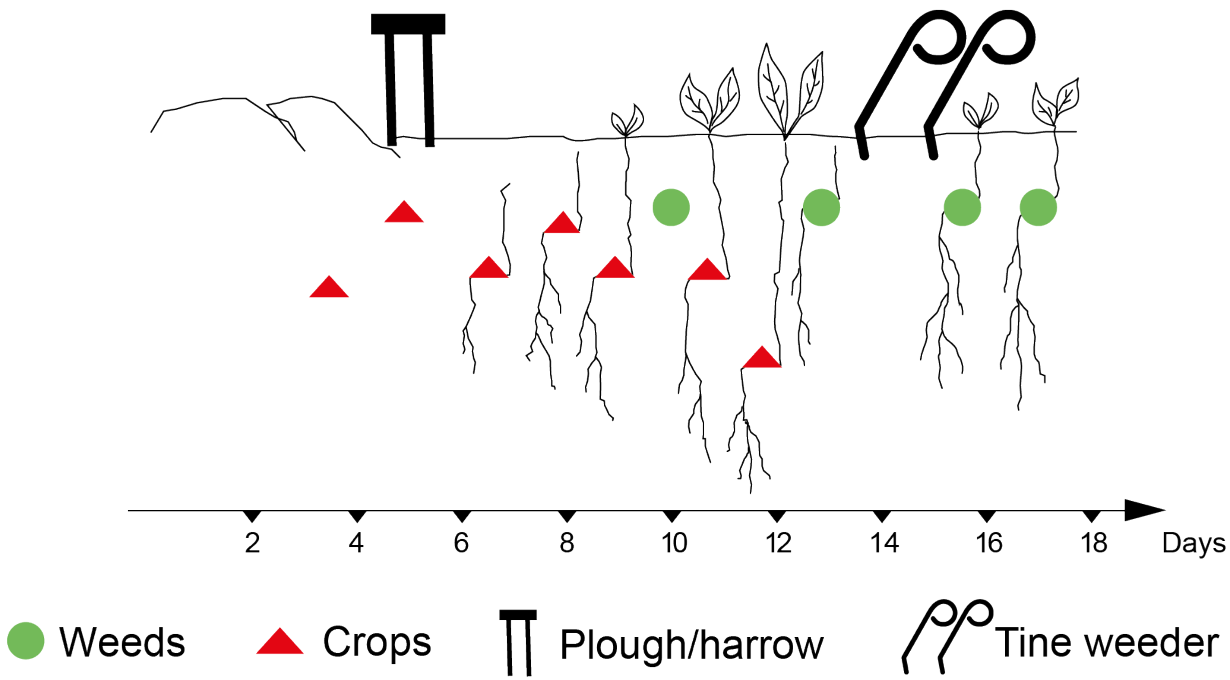
Controlling weeds between sowing and crop emergence: false seedbed



1. Prepare the seedbed early (2 to 4 weeks before seeding or planting).
2. Wait until the weeds have emerged.
3. Destroy the weeds at intervals of 7 to 10 days using a tine weeder.

Controlling weeds between sowing and crop emergence: blind harrowing

In ploughed fields with bare soil weeds can be controlled using a tine weeder.



After emergence of the weeds, but before emergence of the crop weeds are removed with a tine weeder.

Mechanised harvesting

Harvesting potatoes.

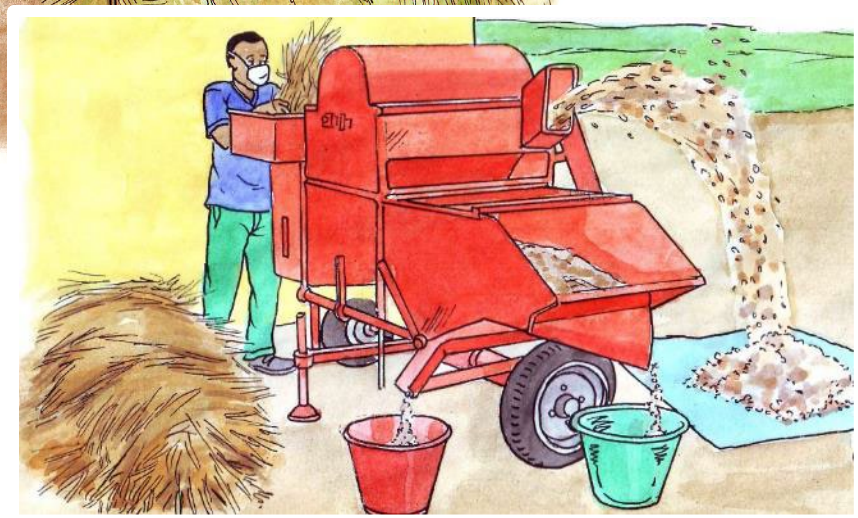
Harvesting rice.

(Photo: Saidi Mkomwa)

Postharvest processing

Tractorised forms of harvestors and threshers are also available.

Other relevant equipment, not shown, include shellers of different sizes and powering mechanisms.



Dehuller

Comparison of hand-held, animal-drawn and tractorised mechanisation options in smallholder faming

Issue to consider	Hand-held	Animal-drawn	Tractorised
Scale of operation	Home gardens and small farms	Home gardens, small to medium farms	Medium to large scale farms
Availability	Commonly available	Can be available, but require animal draught power	Less commonly available
Indicative initial capital outlay	• Hoe: as little as USD 5 or lower • Jab planter: minimum of USD 60 to 80	• Bull: minimum of USD 300 • Ox-drawn plough, yoke and ropes: USD 150	• 2-wheel tractor: about USD 600 • 16 horsepower tractor: at least USD 2,300
Technical know-how by farmers	Simple	Medium	Highly specialised knowledge and skills
Ownership models	Individual	Individual and group	Own use, hire services through entrepreneurs etc.
Operational costs maintenance and / replacement	• No fuel needed • Low replacement costs • Might require some additional labour for households with elderly or vulnerable people	• No fuel required • Animal draft power needed • Supporting materials like yoke, ropes are needed • Manpower to guide animals and/or control the implement • Depreciation and replacement	• Fuel required • Replacement costs for implement parts • Depreciation and replacement