

A PRACTICAL FIELD GUIDE

Regenerative Agriculture

Farmers' Training Manual



Alice Mwangi

MSc. Human Ecology (VUB) · BSc. Range Management (UoN)

Agroecology and Regenerative Agriculture Consultant



Hillside Organic Garden

Regenerative Agriculture Farmers' Training Manual

Copyright © 2026 Alice Mwangi. All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, mechanical, photocopying, recording or otherwise – without the prior written permission of the author, except for brief quotations in reviews and for non-commercial farmer training with full acknowledgement of the source.

Published by Hillside Organic Garden

First published in September 2026

ISBN: 978-9914-29-410-1

Disclaimer: The information in this manual is provided for education and training. Results depend on local soil, climate and management. Readers should test practices on a small scale before wider adoption, and handle all fermented preparations, mineral salts and caustic chemicals with appropriate protective equipment. The author accepts no liability for loss or damage arising from the use of this information.

Some illustrations in this manual were produced with the assistance of AI image-generation tools.

Contact the author: info@hillsideorganicgarden.co.ke | +254727717230

Contents

Introduction.....	v
Chapter One: Core Principles of Regenerative Agriculture.....	1
The Seven Core Principles.....	1
The Circular Farm: Four Interconnected Loops.....	3
Chapter Two: Soil Health.....	5
What Is Soil Health?.....	5
Factors Influencing Soil Fertility.....	5
Characteristics of Healthy Soil.....	6
The Living Soil Web: Microbe–Plant Symbiosis.....	6
Soil Carbon.....	7
Availability of Minerals in the Soil.....	8
Chapter Three: Soil Amendments, Biofertilizers and Biopesticides.....	9
Microbial Cultures.....	9
Composting.....	11
Biofertilizers.....	14
Biopesticides.....	17
Chapter Four: Cover Cropping.....	19
What Is Cover Cropping?.....	19
What Do Cover Crops Do?.....	19
How to Grow Cover Crops.....	20
When to Grow Cover Crops.....	21
Common Cover Crops and Their Characteristics.....	21
Chapter Five: Agroforestry for Soil Health.....	25
The Importance of Trees in Regenerative Systems.....	25
Agroforestry Systems for Smallholder Farmers.....	26
Chapter Six: Soil Water Management and Erosion Control.....	33
No-Till and Minimum Tillage.....	33
Structures to Slow and Retain Run-off on Sloping Land.....	35
Chapter Seven: Biochar.....	43
How Biochar Works in the Soil.....	43
Soil Conservation Benefits.....	43
Biomass and Biochar Quality.....	44

Charging Biochar Before Use.....45

Biomass Strategy: Biochar or Animal Feed?.....46

How to Apply Biochar.....48

Chapter Eight: The Economics of Regenerative Farming.....51

1. A Shift in How Success Is Measured.....51

2. Reducing Purchased Input Costs.....51

3. Diversifying Income.....51

4. Reducing Risk and Building Climate Resilience.....52

5. The Triple Dividend.....52

Glossary.....55

About the Author.....57

Introduction

Regenerative agriculture is a way of farming that restores the land instead of wearing it out. It rebuilds soil health, brings back biodiversity and makes farms more resilient to drought, floods, pests and changing markets. Rather than relying on purchased fertilizers and chemicals, a regenerative farm works with the living soil, plants, trees and animals to produce most of what it needs on the farm itself.

This manual is a practical training guide for farmers, extension workers and trainers. It moves from the core principles of regenerative farming, through soil health and on-farm inputs, to cover crops, agroforestry, soil and water conservation, biochar and, finally, the economics of regenerative farming.

How to use this manual

- **Read Chapter 1 first.** The seven core principles are the foundation for every practice that follows.
- **Use the illustrations.** Each diagram can be shown to a group of farmers during field training.
- **Look for the boxes.** Shaded boxes highlight key rules, notes for small-scale farmers and safety reminders.
- **Adapt to your farm.** Every farm is different. Start small, observe the results and scale up what works in your own soil, climate and budget.
- **Check the glossary.** Technical terms are explained at the back of the manual.

Core Principles of Regenerative Agriculture

These principles form the foundation of regenerative farming. They guide farmers towards practices that restore soil health, biodiversity and resilience.

The Seven Core Principles

1. Minimize Soil Disturbance CRITICAL

Avoid mechanical tillage and reduce chemical inputs.

- Limit or eliminate **mechanical tillage**.
- Reduce reliance on **synthetic fertilizers and pesticides**.
- Preserve soil structure and fungal networks.

2. Keep the Soil Covered RECOMMENDED

Maintain permanent ground cover using crop residues, mulch or living plants.

- Apply **mulch or crop residues**.
- Use **cover crops** during the off-season.
- Protect soil from **erosion, weeds and temperature extremes**.

3. Maximize Crop Diversity RESILIENT

Integrate multi-species cover crops and crop rotations.

- Practise **complex crop rotations**.
- Introduce **multi-species cover crops**.
- Adopt **agroforestry systems** for layered diversity.

4. Maintain Living Roots Year-Round CONTINUOUS

Ensure continuous photosynthesis through perennial crops or cover crops.

- Plant **perennials or off-season cover crops**.
- Maintain the flow of **carbon exudates that feed soil microbes**.
- Prevent **nutrient leaching**.

5. Integrate Livestock HOLISTIC

Reintroduce animals through managed rotational grazing.

- Use **rotational grazing systems**.
- Simulate natural herbivore–plant cycles.
- Distribute **manure for fertility**.
- Stimulate plant regrowth.

6. Context-Specific Farm Design ADAPTIVE

Tailor practices to local ecological and socio-economic conditions.

- Adapt to **local microclimates**.
- Consider **economic and cultural contexts**.
- Build **long-term resilience and self-reliance**.

7. Circular Resource Utilisation CLOSED-LOOP

Circular farming eliminates the idea of waste by turning every output into an input for another part of the farm. Instead of a linear model (buying inputs, harvesting crops and throwing away waste), a circular farm copies a closed-loop forest ecosystem.

The Circular Farm: Four Interconnected Loops

Figure 1.1 shows how the four primary loops of a regenerative farm work and connect with one another: the nutrient and biomass loop, the water (hydrological) loop, the energy loop and the genetic (seed and microbe) loop.

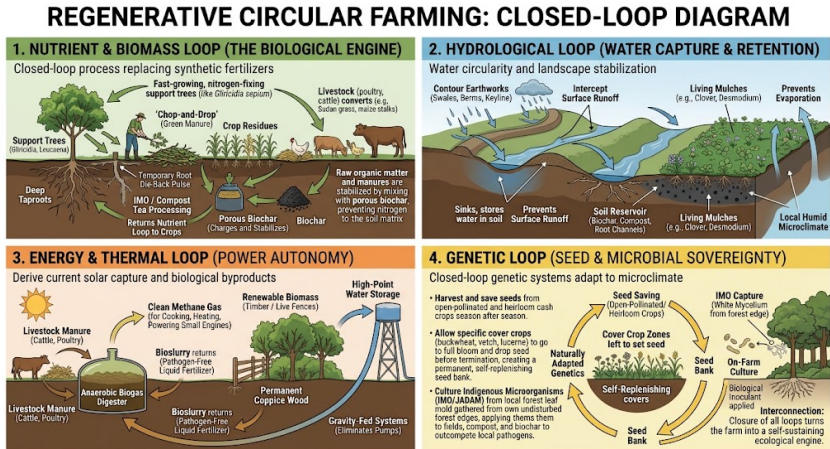


Figure 1.1 Regenerative circular farming: the closed-loop system

Soil Health

What Is Soil Health?

- Soil health is the **capacity of soil to sustain diverse plant communities over time**.
- It reflects a **balance of physical, chemical, biological, hydrological and atmospheric components** that favour plant growth.
- A diversity of plants is a key indicator of soil fertility and resilience.



Figure 2.1 Degraded soil compared with healthy soil

Factors Influencing Soil Fertility

- **Climate** – temperature and rainfall patterns.
- **Nutrient cycles** – the natural recycling of minerals.

- **Human activity** – farming practices, pollution and fertilizer use.
- **Rock type** – the parent material from which the soil formed.
- **Animal and plant activity** – burrowing, root growth and organic matter input.

Characteristics of Healthy Soil

- Fertile and “breathing” (good air exchange).
- Balanced in nutrients (not over-fertilized or chemically imbalanced).
- Weathered to a suitable extent.
- Covered and protected (not exposed to erosion or harsh conditions).
- Cool, deep and moist.
- Free from harmful organisms and pollutants such as plastics.

The Living Soil Web: Microbe–Plant Symbiosis

- **Fungi and bacteria** break down minerals from weathered rock.
- They feed on **plant exudates** – sugars, carbohydrates and amino acids produced by photosynthesis and released through the roots.
- In return, microbes release **enzymes and mineral nutrients** that plants absorb.
- **Protozoa feed on bacteria**, nematodes feed on protozoa and worms feed on nematodes. At each level, excretions increase the availability of minerals.
- Synthetic fertilizers disrupt this natural cycle by creating imbalances and causing nutrient leaching.

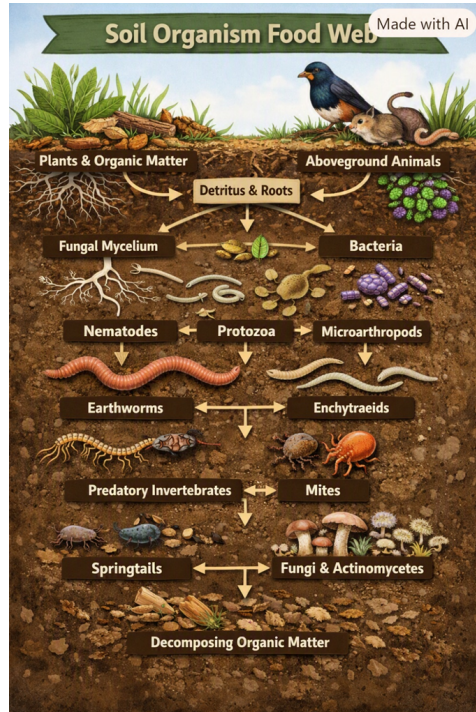


Figure 2.2 *The soil organism food web*

Soil Carbon

- Soil carbon is the primary component of soil organic matter.
- It is drawn down from the atmosphere by plants through photosynthesis and deposited underground.
- It is the foundational building block of healthy, resilient farming ecosystems.

Functions of soil carbon

- Acts as a biological sponge, increasing the soil's water-holding capacity.
- Improves soil structure (aggregation).
- Is the primary energy source for the soil microbiome.

- Drives the nutrient cycling that is essential for plant growth.

How soil carbon is built

- By maximizing continuous photosynthesis and the build-up of biomass.
- By integrating deep-rooted perennials in agroforestry systems.
- By keeping living roots in the soil year-round with cover crops (e.g. clover, vetch, lucerne).
- Through a continuous input of carbon-rich root exudates, which builds stable organic matter.
- By applying a stable form of carbon called **biochar** (see Chapter 7).

How soil carbon is lost

- Mechanical tillage exposes protected carbon to oxygen.
- Rapid microbial breakdown then converts the carbon back into carbon dioxide (CO₂) gas.
- This loss degrades the physical structure and fertility of the soil.
- Leaving soil bare speeds up carbon loss.

Availability of Minerals in the Soil

The availability of key minerals depends mainly on three things:

- **Base rock type** – different rocks contain different levels of minerals.
- **Soil pH** – highly acidic or overly alkaline soils can lock up minerals (such as phosphorus and micronutrients), making them chemically unavailable to roots.
- **Biological activity** – soils with a high diversity of microbes have more minerals available to plants.

Soil Amendments, Biofertilizers and Biopesticides

Microbial Cultures

Culturing microbes on the farm shifts the focus from importing synthetic fertilizers to multiplying indigenous, locally adapted biology that speeds up nutrient cycling and builds soil structure. Because the fungi and bacteria are collected locally, they are already adapted to your specific climate, rainfall and native pathogens.

The three most effective methods for culturing and multiplying microbes at farm scale are described below.

Method 1: Indigenous Microorganisms (IMO) – Korean Natural Farming

This method captures vigorous, beneficial fungi and bacteria from undisturbed local ecosystems (such as a nearby forest) and multiplies them into a dry, spreadable inoculant.

- **Phase 1 – Capture:** Cook a carbohydrate source, usually firm-cooked white rice, and place it in a wooden or bamboo box. Bury the box lightly under the leaf litter of a healthy, old forest or an undisturbed hedgerow. Leave it for 3 to 5 days until white fungal threads (mycelium) cover the rice.
- **Phase 2 – Stabilization:** Weigh the colonized rice and mix it with an equal weight of raw brown sugar. The sugar draws out moisture and puts the microbes into a dormant, shelf-stable paste (IMO-2).
- **Phase 3 – Expansion:** Mix a small amount of the paste with water and a large volume of a carbon carrier such as wheat bran or rice husks. Heap it under a shaded, breathable cover. The pile will heat up as the microbes wake and multiply. Once it cools, you have a large volume of dry, biologically active material (IMO-3), ready to be spread over mulched beds or used to charge biochar.

Method 2: Aerated Compost Tea (ACT)

Compost tea is a liquid extraction and rapid multiplication technique used to make a biological spray for soil drenches or foliar feeding.

- **The inoculant:** Start with a few handfuls of high-quality, highly diverse compost or vermicast (worm castings).
- **The food:** Unsulphured molasses feeds bacteria, while kelp meal, humic acids and fish hydrolysate feed fungi.
- **The process:** Suspend the compost in a mesh bag in a barrel of clean, unchlorinated water. Use a strong air pump to aerate the water vigorously for 24 to 48 hours. High oxygen levels favour beneficial aerobic microbes and suppress harmful anaerobic ones.
- **Application:** Spray or drench the tea immediately after brewing, because the microbe population crashes once the oxygen and food run out. It is very effective for inoculating freshly roller-crimped cover crop residue to speed up decomposition.

Method 3: JADAM Microbial Solution (JMS)

JMS is a very low-cost, low-technology method for making a large volume of liquid soil inoculant without air pumps or complex brewing equipment (Figure 3.1).

1. **The substrate:** Boil whole potatoes or sweet potatoes until soft, mash them into a barrel and fill it with unchlorinated water to create a starchy broth.
2. **The inoculant:** Gather a handful of rich leaf mould (partly decomposed leaves and soil) from a local forest and add a small amount of sea salt for trace minerals.
3. **The process:** Cover the barrel and leave it at ambient temperature. The starch feeds the native bacteria, and within 1 to 3 days the liquid bubbles vigorously (peak activity).

4. **Application:** Apply the solution at the peak bubbling phase as a deep soil drench along planting rows or in orchards, and to prime the soil before transplanting.

VISUAL AID: ON-FARM MICROBE CULTIVATION (JADAM-STYLE METHOD)

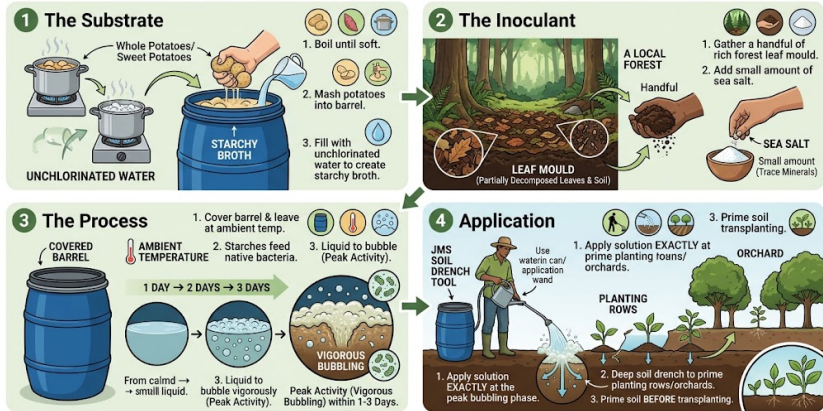


Figure 3.1 On-farm microbe cultivation using the JADAM-style method

Vital application rules for microbial inoculants

Whatever the culturing method, biological inoculants are living organisms and are sensitive to their environment.

- Apply them **late in the evening or on overcast days** – direct sunlight (ultraviolet light) quickly kills microbes.
- Apply them to **pre-moistened** soil, compost piles or biochar – microbes need a film of water to travel and establish themselves in a new environment.

Composting

Composting turns farm and household waste into humus that feeds the soil. Figure 3.2 shows the farm composting loop: inputs are collected, decomposed and applied back to fields and gardens.

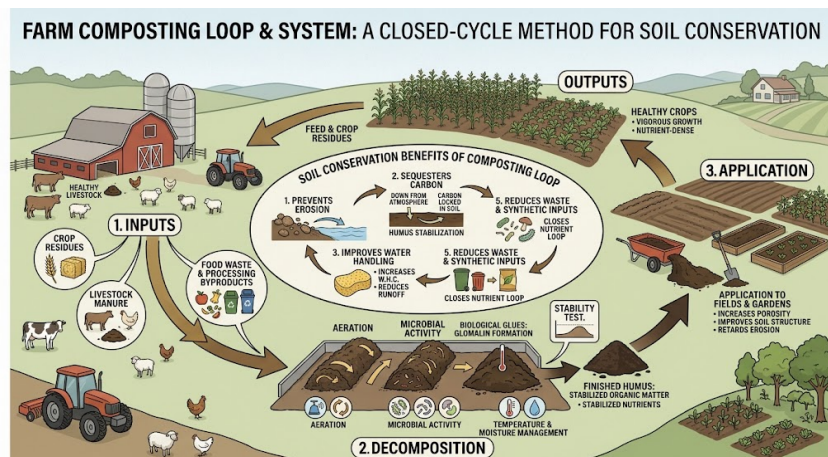


Figure 3.2 The farm composting loop

Cold composting (passive)

- Uses mesophilic (moderate-temperature) bacteria, fungi, earthworms and other decomposers.
- Organic materials are piled or placed in bins as they are generated, with no strict carbon-to-nitrogen (C:N) ratio and no turning.
- Pile temperature stays close to air temperature, rarely above 32 °C (90 °F).
- **Benefits:** Low labour and management; continuous disposal of waste without stockpiling.
- **Drawbacks:** A slow process (6 months to 2 years); weed seeds and pathogens may survive.

Hot composting (active)

- Relies on thermophilic (heat-loving) aerobic bacteria to consume organic matter rapidly.
- Requires building a large pile all at once – at least 1 m × 1 m × 1 m (about 3 × 3 × 3 feet) – to insulate the core.
- Needs a carbon-to-nitrogen ratio of roughly 30:1 and moisture like a wrung-out sponge.

- Frequent turning introduces oxygen.
- Core temperatures reach 55–70 °C (130–160 °F).
- **Benefits:** Destroys weed seeds, pathogens and diseases; produces finished humus quickly (4–12 weeks).
- **Drawbacks:** Labour-intensive; requires careful monitoring and stockpiling of raw materials.

Table 3.1 *Hot composting compared with cold composting*

Feature	Hot composting	Cold composting
Speed	1 to 3 months	6 months to 2 years
Labour input	High (frequent turning and monitoring)	Low (dump and leave)
Pathogen and weed destruction	Excellent (due to high heat)	Poor to none
Input method	Batch (all materials at once)	Continuous (add as you go)
Main organisms	Thermophilic aerobic bacteria	Fungi, worms, mesophilic bacteria

How to make hot Bokashi compost

Bokashi compost is a hot compost prepared under controlled conditions.

Materials needed

- **Green materials (high in nitrogen):** manure, green leaves, coffee husks, kitchen waste.
- **Brown materials (high in carbon):** dry leaves, bran, stalks, husks, sawdust.
- **Additives:** molasses, ash, charcoal or rock dust, native microbe culture, non-chlorinated water.

Controls

Factor	Target
Moisture	About 50%
Aeration	Daily turning
Temperature	Rises by day 5 and stabilizes by day 14
pH	7.0–7.5
C:N ratio	25–30 : 1

Procedure

1. Prepare molasses water (1 litre of molasses in 20 litres of water).
2. Add the native microbes.
3. Build the heap in layers: brown material → molasses water → ash → green material → molasses water → ash.
4. Repeat the layers until the heap is formed.
5. Turn twice daily for the first 5 days, then once daily for the next 14 days.
6. Rest the heap for 14 days. Finished compost should smell like forest soil.

Application of Bokashi compost

Use	Rate
Planting holes	1 handful mixed with soil
Tree planting	5 kg compost + 5 kg soil
Nursery	Mix with coco peat (1 : 1)
Top dressing	Spread lightly, then mulch

Biofertilizers

Farmers can produce fertility inputs locally. Compost, teas and ferments improve soil life and reduce dependence on synthetic inputs.

The biofertilizer formula

Microbes + minerals + energy (molasses) = biofertilizer

Animal manure tea

- **Objective:** Convert manure into a liquid biofertilizer and microbial inoculant.
- **Procedure:** Ferment manure in water, dilute, and apply as a foliar spray or soil drench.
- **Benefit:** An easy, low-cost way to recycle nutrients.

Fermented plant teas

Extract minerals from nutrient-accumulating plants through microbial fermentation.

Nitrogen extract (blood meal and papaya)

1. Mix blood with vinegar, molasses water and milk.
2. Ferment for 5 days in a sealed bucket.
3. Dilute to 3% for foliar application.

Phosphorus and potassium biofertilizer

1. Use cow dung microbes (*Bacillus subtilis*).
2. Add rock phosphate, molasses water, milk and yeast.
3. Ferment for 30 days.

Nitrogen from animal hair and fleece

1. Clean and cut the fleece.
2. Add a sodium hydroxide or potassium hydroxide (NaOH/KOH) solution (1–5%) and heat to 60–90 °C.

3. Hydrolyse for 2–6 hours.
4. Neutralize with a dilute acid to pH 6–7.
5. Filter and store the liquid fertilizer.
6. **Application:** Spray at 1% dilution.

Safety first

Sodium and potassium hydroxide are caustic and can cause serious burns. Wear gloves and eye protection, work in a well-ventilated place, always add the chemical to water (never water to the chemical), and keep children and animals away. Take the same care with the mineral salts used in the biopesticide recipes below.

Multi-micronutrient biofertilizers

Ferment a mix of natural mineral sources (see the table below) with molasses water, cow dung, yeast and milk. This provides the essential trace elements needed for plant growth.

Table 3.2 *Natural nutrient sources*

Source	Nutrients	Notes
Rock phosphate	P, Ca	Slow release; supports root growth
Green sand	K, Fe, Mg	Improves soil structure
Limestone	Ca, Mg	Neutralizes acidity
Gypsum	Ca, S	Reduces compaction
Basalt dust	Trace minerals	Enhances microbes
Azomite	70+ minerals	Boosts resilience
Langbeinite	K, Mg, S	Balanced nutrients
Bone meal	P, Ca	Supports flowering

Biopesticides

Biopesticides provide safer pest and disease control, especially during the transition to regenerative farming.

Table 3.3 *Biopesticide formulations*

Formulation	Ingredients and preparation	Application
Aphid repellent	Garlic, ginger, chilli, alcohol, NM liquid, molasses and water. Ferment for 3 days.	Apply at 2–3% dilution
Armyworm ash brew	Ash and soap flakes boiled in water.	Apply at 2–5% dilution
Antifungal brew	Lime, zinc sulphate, magnesium sulphate, copper sulphate, borax, potassium permanganate (KMnO ₄), NM and molasses water. Brew for 3 days.	Apply at 50% dilution
Bordeaux mix	Lime and copper sulphate solutions combined.	Apply at 3 : 10 dilution
Anti-powdery mildew	Sodium bicarbonate and fermented milk whey in water.	Spray on affected plants

NM = native microbes (see Microbial Cultures above).

CHAPTER FOUR

Cover Cropping

Soil conservation practices are farming and land management methods designed to prevent soil degradation, maintain fertility and protect the soil from damage caused by water, wind and extractive farming. This chapter and the next two cover the main soil conservation practices: cover cropping, agroforestry, and soil and water management.

What Is Cover Cropping?

- Cover cropping is key in regenerative farming because it follows nature's own way of restoring soil health. Plants play a vital role in restoring degraded soil and maintaining healthy soil.
- Cover crops are a strategic way to restore soil health on a larger scale than is possible with compost alone.

What Do Cover Crops Do?

- **Erosion control:** Cover crops hold and cover the soil so that raindrops cannot cause erosion or compaction.
- **Nitrogen fixation:** Legumes host bacteria in their roots that fix nitrogen from the air into the soil, benefiting the commercial crop that follows.
- **Microbial activity:** Cover crops release exudates (sugars and proteins) that microbes need. In turn, microbes break up soil particles and release mineral elements, making them available to plants. This cycle keeps the soil healthy naturally.
- **Weed suppression:** Nature always wants to cover and regenerate soil – that is why weeds grow on any open patch. An intentional cover crop occupies the space where weeds would grow, and mulch made from the cover crop also suppresses weeds.
- **Pest and disease control.**

- **Lower costs:** Cover crops regenerate soil health without the need for animals, which means less cost.

Things to keep in mind

- Cover crops can compete with the main crop for moisture.
- Changes in soil health from cover cropping take several cropping cycles to show.
- For farmers with small plots, or urban farmers, cover cropping may not be feasible.
- Some cover crops will not do well in very poor soils. For example, a farmer may need to grow jack bean for a while before lablab will grow well.

How to Grow Cover Crops

Figure 4.1 summarizes the seven steps for establishing and managing cover crops: select the right species, prepare the seedbed with minimal disturbance, inoculate legume seed, sow, ensure adequate moisture, terminate at the right time and return the biomass to the soil.

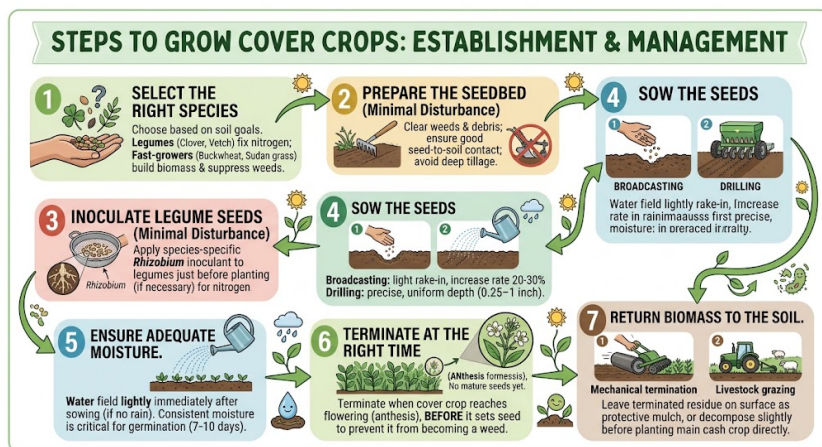


Figure 4.1 Steps to grow cover crops: establishment and management

When to Grow Cover Crops

These are the main timing strategies for establishing cover crops in the tropics:

- **During the short rains (biomass building):** Plant fast-growing varieties such as buckwheat or Sudan grass at the onset of the short rains. They quickly produce large amounts of organic matter, suppress early weeds and can be terminated and left as a protective mulch just before planting the main cash crop in the long rains.
- **Simultaneous intercropping (continuous cover):** Low-growing or shade-tolerant legumes such as desmodium and clover can be planted at the same time as, or shortly after, the main crop (such as maize). Desmodium is especially effective as a “living mulch”: it repels pests (it is widely used in push–pull systems), fixes nitrogen and keeps the soil cool and covered throughout the season without competing for sunlight.
- **Towards the end of the rainy season (dry-season protection):** To stop the soil baking bare in the dry season, sow deep-rooted, drought-tolerant species such as lucerne or vetch just before the last heavy rains end. They use the remaining surface moisture to establish deep taproots, survive the dry spell, keep feeding the soil microbes and shield the soil from sun and wind erosion.
- **Year-round perennial establishment (agroforestry):** For permanent or semi-permanent systems, plant perennial shrubs and trees such as gliricidia at the onset of the long rains, so that their deep roots are established before the dry season. Once established, they act as boundary fences or alley-cropping anchors and provide a year-round supply of nitrogen-rich leaves (green manure) that can be pruned and dropped onto the soil in any season.

Common Cover Crops and Their Characteristics

Cover crop	Best characteristic
Lablab <i>Lablab purpureus</i>	Exceptional drought tolerance and deep roots; produces high biomass and edible green manure and fixes substantial nitrogen in warm climates.

Cover crop	Best characteristic
Cowpea <i>Vigna unguiculata</i>	Rapid growth and high heat tolerance; an excellent short-duration cover crop that suppresses weeds and provides edible, protein-rich leaves and seeds.
Velvet bean / Mucuna <i>Mucuna pruriens</i>	Outstanding weed and nematode suppression; smothers stubborn invasive grasses while producing large amounts of organic matter and nitrogen.
Sunn hemp <i>Crotalaria juncea</i>	Very fast upright growth in high temperatures; a powerful biofumigant that deters plant-parasitic nematodes while fixing nitrogen quickly.
Jack bean <i>Canavalia ensiformis</i>	Remarkable resilience in poor, acidic or marginal tropical soils; tolerates drought, partial shade and heavy pest pressure.
Crimson and white clover <i>Trifolium</i> spp.	Excellent shade tolerance and use as a living mulch in multi-cropping systems; reliable nitrogen fixation and attracts pollinators.
Vetch <i>Vicia</i> spp.	Prolific vine growth that forms a dense, weed-smothering mat while accumulating large amounts of fixed nitrogen for the next crop.
Buckwheat <i>Fagopyrum esculentum</i>	Rapid emergence and a fast growth cycle (flowers in about 3–5 weeks); smothers early weeds, draws up tightly bound phosphorus and feeds beneficial insects with its nectar.
Sesbania / river hemp <i>Sesbania rostrata</i>	Superior tolerance of waterlogged or flooded soils; well suited to paddy and tropical lowland systems while rapidly accumulating nitrogen.
Pigeon pea <i>Cajanus cajan</i>	Deep taproot that breaks up heavy, compacted subsoils; provides perennial biomass, wind protection and edible, protein-rich pods.
Cereal rye <i>Secale cereale</i>	Cold hardiness and vigorous early growth; germinates in cold soils, scavenges excess nutrients and suppresses weeds through allelopathy.
Oats <i>Avena sativa</i>	Rapid cool-season biomass that controls erosion; in cold climates some varieties die back to leave a natural surface mulch.

Cover crop	Best characteristic
Forage / tillage radish <i>Raphanus sativus</i>	Thick, deep taproots act as a “biological chisel” that breaks compacted subsoil layers and scavenges deep nitrogen.
Annual ryegrass <i>Lolium multiflorum</i>	Extensive, fibrous root network that holds topsoil against erosion and builds deep soil structure.
Lucerne / alfalfa <i>Medicago sativa</i>	Very deep taproot (often several metres) that reaches subsoil moisture and minerals; high nitrogen fixation and persists for several years.
Sudan grass / sorghum-Sudan grass <i>Sorghum bicolor</i> × <i>S. var. sudanense</i>	Massive, rapid warm-season biomass and dense roots that crowd out weeds, suppress root-knot nematodes and add large amounts of organic carbon.
Hairy vetch <i>Vicia villosa</i>	Cold-tolerant vetch that survives harsh conditions while producing large volumes of rich green manure and dense ground cover.
Field pea <i>Pisum sativum</i>	Excellent cool-season vigour; rapid early nitrogen fixation and palatable, high-protein forage or residue that decomposes quickly.
Mustard <i>Sinapis alba</i>	Fast-growing cool-season brassica that releases natural biofumigant compounds (glucosinolates) when terminated, suppressing soil-borne pathogens and pests.
Desmodium <i>Desmodium</i> spp.	Powerful perennial ground cover known for its role in push-pull pest management: repels stemborers, attracts beneficial insects, fixes nitrogen and suppresses the parasitic weed <i>Striga</i> (witchweed).

Agroforestry for Soil Health

Regenerative agriculture focuses on restoring soil health, rebuilding ecosystems and enhancing biodiversity. Agroforestry – the deliberate integration of trees and shrubs with crops and livestock – is a powerful driver of regenerative farming because it aligns with its core principles.

The Importance of Trees in Regenerative Systems

1. Maintaining continuous living roots

Trees provide deep, multi-year root systems that anchor the soil year-round. Their roots reach into subsoil layers to draw up nutrients that annual crops cannot reach, returning them to the surface through leaf drop.

2. Enhancing soil organic matter and nutrient cycles

A continuous input of organic matter (prunings, fallen leaves and root exudates) feeds soil microorganisms and fungi. Mycorrhizal networks stimulated by tree roots help transfer nutrients between plants, building long-term soil carbon and fertility without synthetic fertilizers.

3. Moderating the microclimate and retaining water

Tree canopies act as thermal buffers. By reducing wind speed and blocking direct sunlight, tree cover lowers surface soil temperatures, greatly reduces evaporation and protects crops during heat stress.

4. Carbon sequestration

While annual crops store carbon only temporarily, woody perennials capture significant amounts of atmospheric carbon dioxide and store it long-term in their above-ground biomass and deep roots.

5. Biodiversity and natural pest management

Agroforestry creates vertical habitat layers. Trees attract pollinators, birds and predatory insects, establishing biological controls that naturally regulate pest populations.

6. Economic diversification and resilience

Beyond ecological repair, regenerative systems prioritize economic stability for farmers. Agroforestry creates several income streams on the same plot, combining short-term cash crops or livestock products with medium- and long-term yields such as timber, fruit, nuts and fodder.

Agroforestry Systems for Smallholder Farmers

Agroforestry systems can be tailored to fit small spaces while maximizing land productivity, soil restoration and income. For smallholders balancing food security, income and limited resources, the following models are especially practical.

System 1: Alley cropping

Food crops (such as maize, beans or vegetables) are grown in the “alleys” between rows of trees or shrubs – often nitrogen-fixing species such as *Leucaena* or *Gliricidia*.

Alley cropping suits small plots because it makes more use of vertical space. Tree prunings are chopped and applied directly to the soil as a nutrient-rich mulch (green manure) for the food crops, reducing the need for expensive synthetic fertilizers and suppressing weeds.

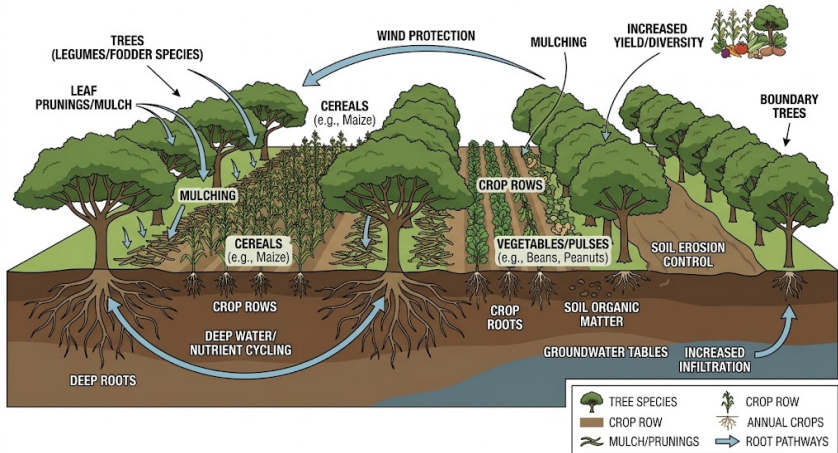


Figure 5.1 Alley cropping: trees and food crops in alternating rows

System 2: Silvopasture

- **How it works:** Fodder trees, shrubs and pasture grasses are integrated into a single system where livestock graze or forage.
- **Suitability for smallholders:** High for mixed livestock keepers. Farmers raising poultry, dairy goats or cattle benefit greatly: multipurpose trees provide high-protein fodder in the dry season when grasses dry up, and live fences remove the need for costly wooden posts.

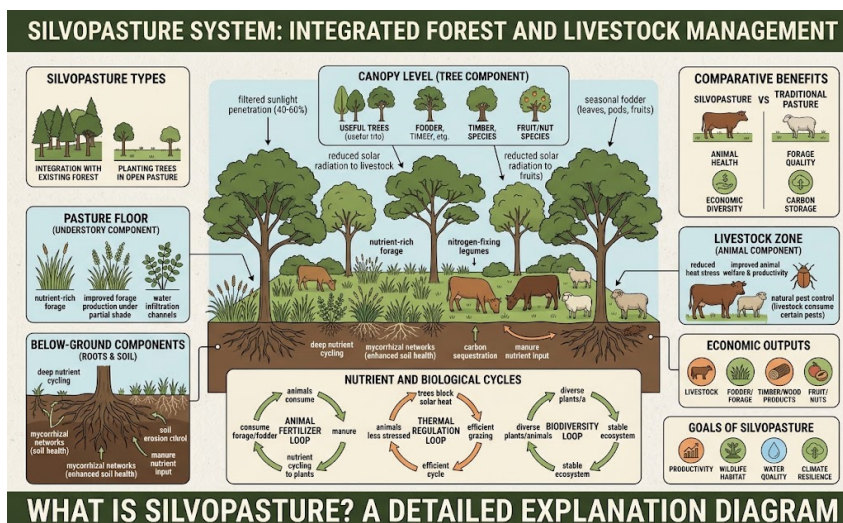


Figure 5.2 Silvopasture: integrated tree and livestock management

System 3: Boundary planting and living fences

- **How it works:** Trees are planted along property boundaries, farm borders or internal pathways.
- **Suitability for smallholders:** Very high. It takes almost no space away from crops. Boundary trees serve as living property markers, windbreaks for delicate crops and a sustainable source of firewood, timber or stakes (for example, for climbing beans and tomatoes) without encroaching on the main field.

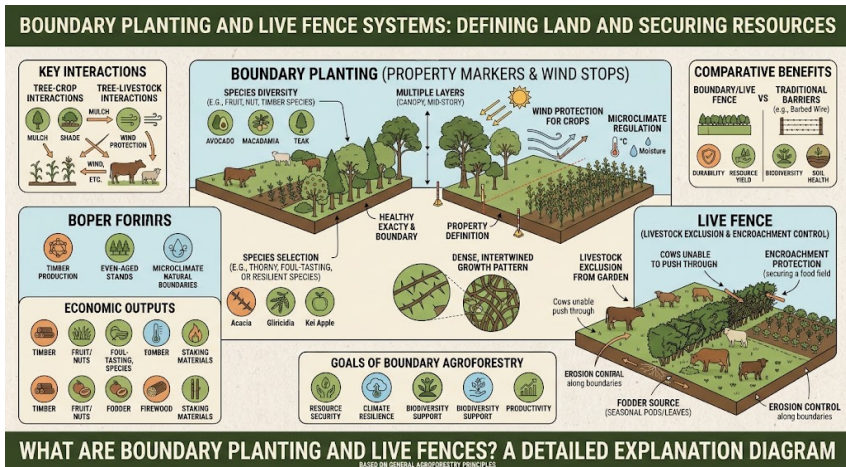


Figure 5.3 Boundary planting and living fences

System 4: Food forests, home gardens and multi-strata systems

How it works: A dense, multi-layered mix of annual crops, fruit trees, root crops and sometimes small livestock or poultry, clustered around the homestead.

Often considered the most productive system for smallholders, food forests copy the structure of natural forests, with canopy, middle and ground layers. They provide a continuous, year-round harvest of fruit, vegetables, medicinal plants and spices, improving household nutrition and generating steady daily or seasonal income. Because the food forest is close to the home, it allows daily management, continuous harvesting and easy use of household waste and water in the soil.



Figure 5.4 The seven layers of a food forest

The layers (strata) of a food forest

In a fully developed multi-strata system, up to seven layers share the same plot without out-competing one another:

1. **Canopy (tall trees):** Large fruit, nut or timber trees (e.g. mango, avocado, macadamia) that capture the top-level sunlight.
2. **Understorey (short trees):** Shade-tolerant fruit trees or cash crops (e.g. banana, papaya, coffee, cocoa).
3. **Shrub layer:** Woody perennials, berries or medicinal bushes.
4. **Herbaceous layer:** Annual and perennial vegetables, culinary herbs and leafy greens.
5. **Ground cover:** Creeping plants (e.g. sweet potato vines, pumpkins) that act as a living mulch to suppress weeds and keep the soil moist.
6. **Rhizosphere (root layer):** Tubers and root crops (e.g. cassava, yams, ginger, garlic) that loosen the soil.

7. **Vertical layer (climbers):** Vines (e.g. passion fruit, climbing beans) that use the trunks of taller trees for support.

How a food forest works in regenerative agriculture

- **Maximum photosynthesis and yield:** By capturing sunlight at several heights, the system produces much more total biomass and food per square metre than a flat monoculture field.
- **Closed nutrient loops:** Being close to the household makes circular farming easy. Kitchen waste and crop residues are composted and returned directly to the beds, while deep-rooted canopy trees pull up subsoil minerals and drop them as leaf litter that feeds the shallow-rooted vegetables below.
- **Microclimate creation:** The upper canopy buffers extreme weather. It breaks heavy rain to prevent erosion and casts filtered shade that cools the soil and reduces evaporation for the sensitive crops below.
- **Poultry and small livestock integration:** Multi-strata systems are ideal for free-ranging small livestock. Chickens forage safely in the understorey on fallen fruit, seeds, insects and kitchen scraps. In return, they help manage pests, loosen the topsoil and deposit nitrogen-rich manure directly into the system.

System 5: Improved fallows

Fast-growing, soil-restoring leguminous trees or shrubs are planted during a short fallow period to rebuild depleted soil fertility quickly before returning to annual food crops.

Improved fallows are ideal for smallholders facing declining soil health from continuous cultivation. Instead of leaving land idle for years to recover naturally, a planted tree fallow restores soil organic matter and nitrogen in a fraction of the time.

How improved fallows work

Unlike natural fallows, where land is simply left to wild weeds for a decade, an **improved fallow** uses carefully selected, fast-growing woody species to shorten soil regeneration from about 10 years to 1–3 years. This fits well into

circular farm design because it generates inputs on the farm instead of relying on external chemical fertilizers.

- **Biological nitrogen fixation:** Leguminous fallow species partner with soil bacteria to take nitrogen from the air and store it in their root nodules and leaves.
- **Deep nutrient pumping:** Taproots reach below the normal crop root zone, retrieving leached minerals (such as phosphorus and potassium) and returning them to the topsoil when the leaves fall.
- **Weed suppression:** The fallow trees quickly close their canopy and shade out aggressive, hard-to-control weeds, cleaning the field for the next crop.
- **Dual output:** While the soil rests, the system still produces valuable products such as livestock fodder, stakes and firewood.

Soil Water Management and Erosion Control

Soil erosion is the loss of topsoil through surface run-off or wind. Erosion happens when soil is left exposed to wind, water and trampling by animals. To prevent this exposure, a farmer needs to keep the soil covered with cover crops or other forms of mulch, and on sloping land, to slow down and hold rainwater with conservation structures.

No-Till and Minimum Tillage

No-till and minimum tillage mean reducing how much the soil is broken up and turned over. This preserves soil structure, the soil microbial web and soil minerals. Although tillage increases soil aeration, it breaks down soil aggregates and causes the loss of minerals and moisture. Exposed soil dries out quickly and loses volatile nutrients such as nitrogen.

Minimum and no-till methods

Rolled (roller-crimped) cover crops

Instead of digging in the cover crop, as is done with green manuring, the farmer rolls and crimps the cover crop to form a thick mulch, then plants the cash crop directly through it.

REGENERATIVE AGRICULTURE: NO-TILL COVER CROP TERMINATION & SUCCESSION DIAGRAM

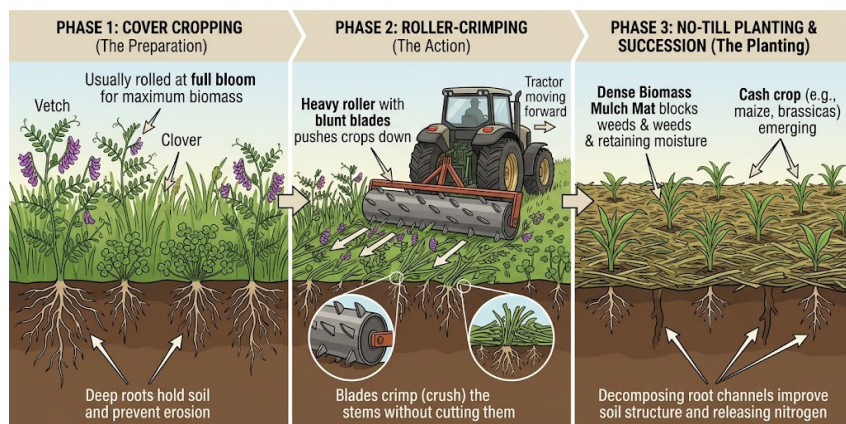


Figure 6.1 No-till cover crop termination and succession

The chop-and-drop mulching cycle

Support trees are pruned (coppiced) and the green biomass is left on the soil as a thick mulch. The trees regrow and the cycle repeats, turning them into a permanent, living fertilizer factory for the main crops.

AGROFORESTRY: THE CHOP AND DROP CYCLE

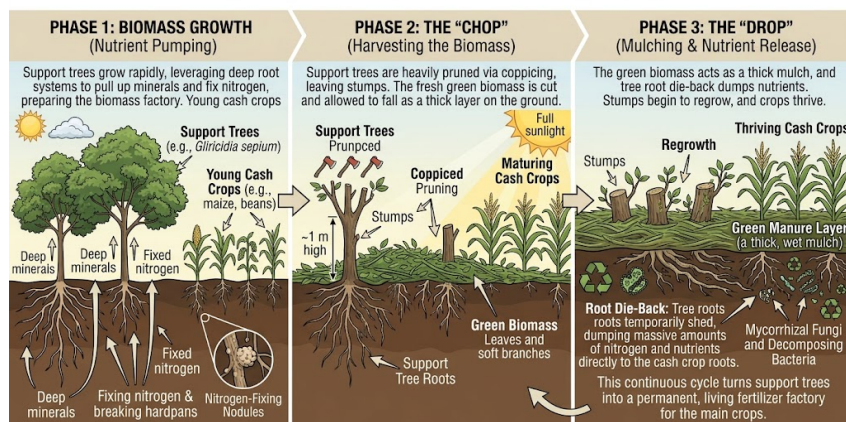


Figure 6.2 Agroforestry: the chop-and-drop cycle

Sheet mulching

Sheet mulching means covering the soil with a continuous layer of material such as wood chips, leaves and grass, plastic sheets or cardboard. Organic mulching materials eventually decompose and add to soil fertility.

Sheet mulching is a very effective no-till method for keeping weeds down and conserving soil moisture. However, some materials (such as plastic sheeting) are costly and require an investment to purchase.



Plastic sheet mulch



Wood-chip sheet mulch

Figure 6.3 Examples of sheet mulching

Animal grazing and “animal tractors”

Animals can be used to clear and fertilize an enclosed plot through short, intensive grazing – for example, the chicken tractor and rabbit tractor methods. Cattle, goats and sheep can also be used.

Intensive grazing removes ground cover, so the farmer may need to find new mulching material to keep weeds down, but planting can then be done directly without tilling.

Structures to Slow and Retain Run-off on Sloping Land

Sloping land is more vulnerable to water erosion than flat land. On slopes, structures that slow down and hold rainwater may be needed.

Bench terraces

Bench terraces convert a continuous slope into a series of level or nearly level steps. This greatly reduces both the length and steepness of the slope, slowing the water and maximizing water retention for crops grown on the flat benches.

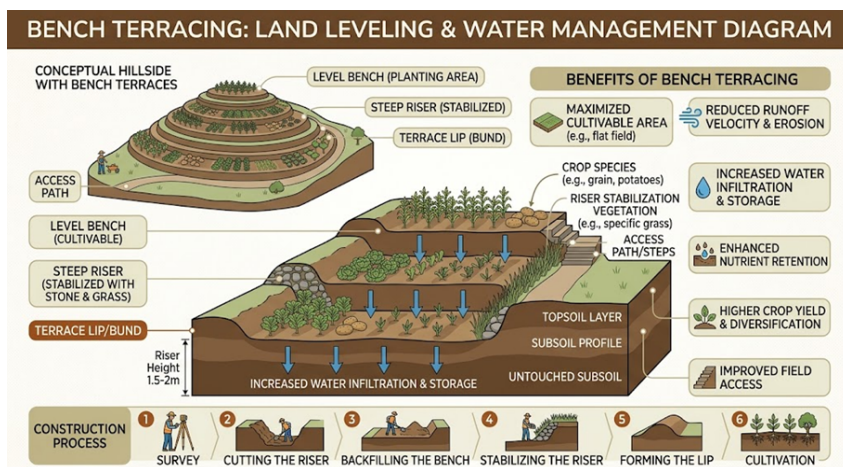


Figure 6.4 Bench terracing: land levelling and water management

Fanya juu terraces

A terracing technique in which a trench is dug along the contour and the soil is thrown *uphill* to form a ridge (*fanya juu* means “throw it upwards” in Kiswahili). Over time, soil moved by run-off fills the area behind the ridge, gradually forming a level bench naturally.

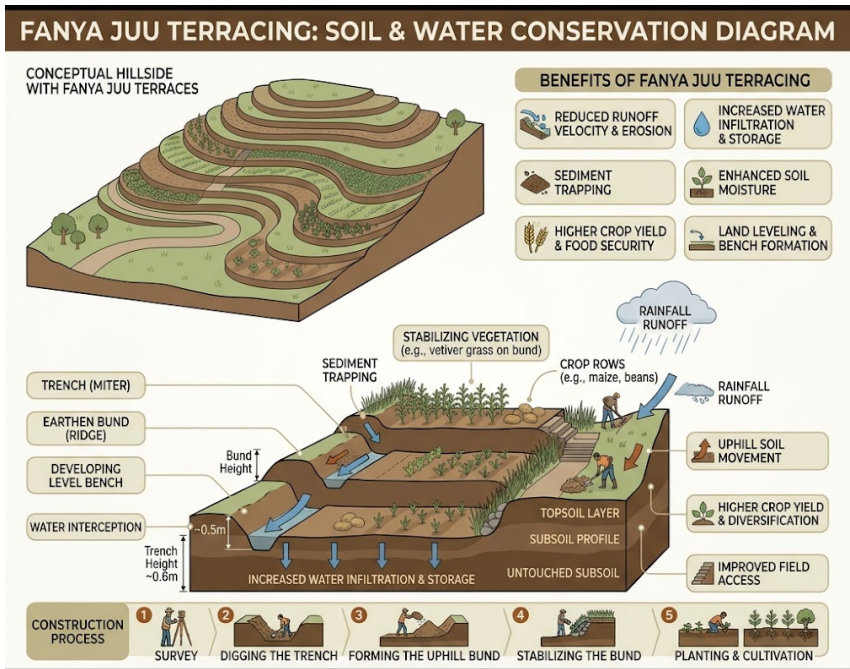


Figure 6.5 Fanya juu terracing for soil and water conservation

Vegetative contour hedges

Dense, deep-rooted vegetation is planted closely along contour lines. Nitrogen-fixing shrubs such as *Gliricidia* or strong grasses such as vetiver form a living, permeable barrier that slows water, traps sediment and increases soil porosity over time.

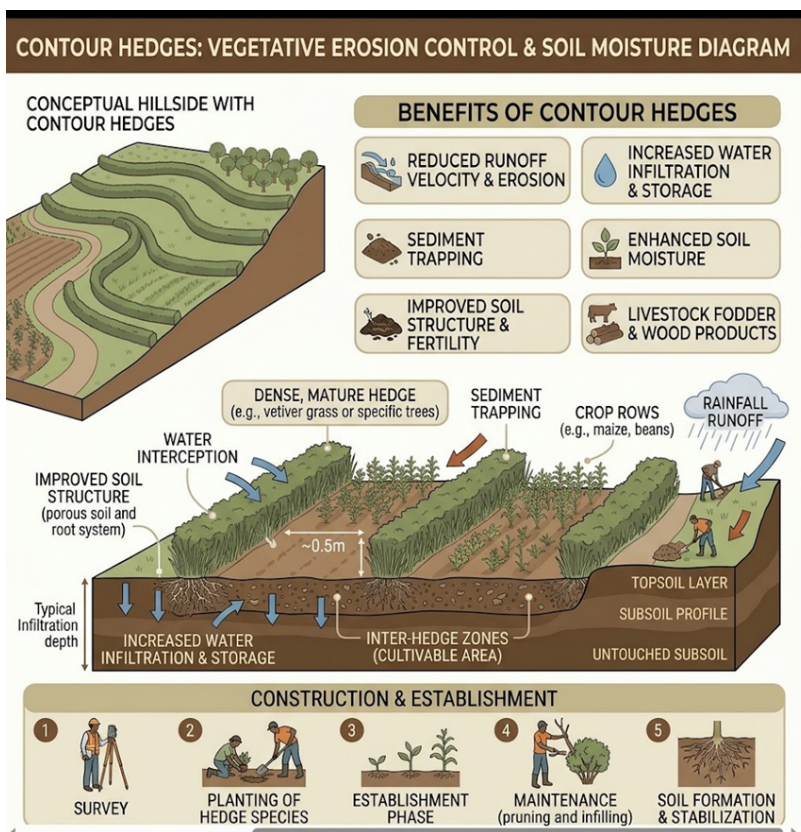


Figure 6.6 Vegetative contour hedges

Contour bunds, trenches (swales) and contour alley cropping

These are earthworks dug precisely along the contour lines of a slope. The trench captures and holds surface run-off, letting it soak slowly into the soil, while the excavated soil forms a protective bund (ridge) on the downhill side to prevent overflow.

In contour alley cropping, rows of woody perennials or timber trees are planted strictly along the contours. The permanent tree rows intercept and slow run-off, while the alleys between them are protected with dense, low-growing cover crops such as *Desmodium*, clover or vetch to maximize ground cover and water infiltration.

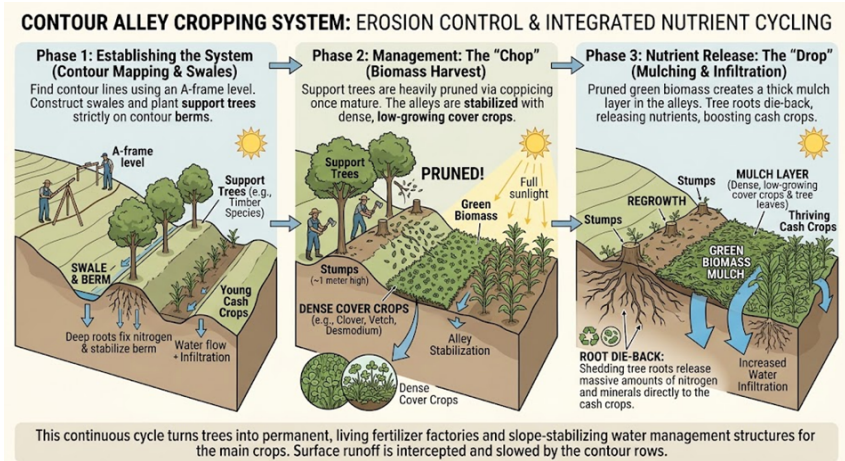


Figure 6.7 Contour alley cropping: erosion control and nutrient cycling

Check dams

Check dams are small barriers made of stones, sandbags or woven organic material, placed across drainage ditches, swales or young gullies. They slow concentrated water flows during heavy rain, prevent gullies from widening and allow suspended sediment to settle.

CHECK DAMS: EROSION CONTROL & SEDIMENT RETENTION DIAGRAM

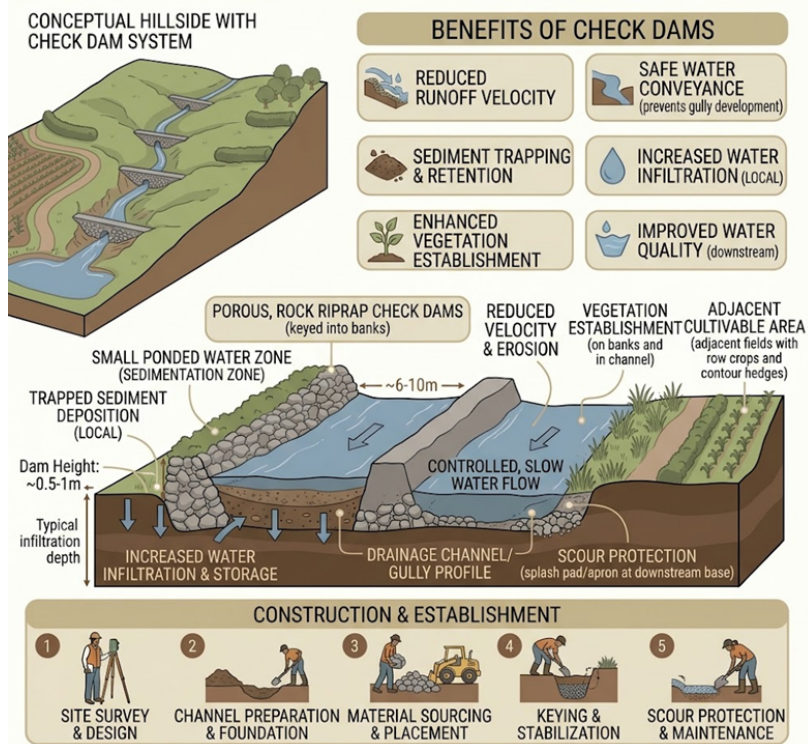


Figure 6.8 Check dams for erosion control and sediment retention

Grassed waterways

Grassed waterways are broad, shallow channels planted with thick, erosion-resistant grasses. They carry excess run-off safely down a slope without causing erosion and act as a controlled release for overflowing contour trenches or terraces during extreme rainfall.

GRASSED WATERWAYS: SAFE RUNOFF CONVEYANCE & STABILIZATION DIAGRAM

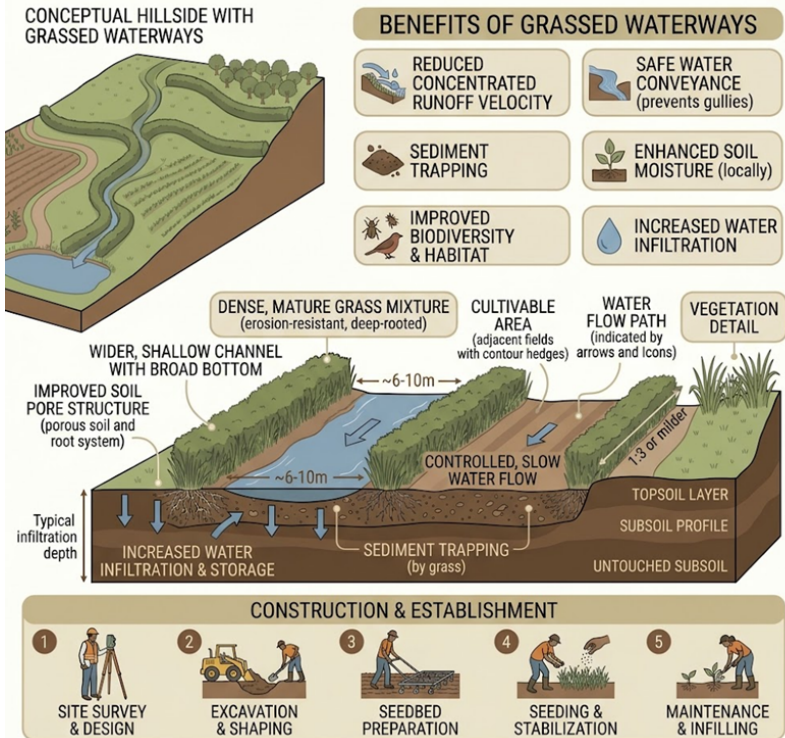


Figure 6.9 Grassed waterways for safe run-off conveyance

Biochar

Biochar is a highly porous, carbon-rich form of charcoal made by heating organic biomass (such as wood chips, crop residues or manure) with little or no oxygen – a process called pyrolysis. In farming, it acts as a permanent structural soil amendment rather than a temporary fertilizer, making it a powerful tool for long-term soil conservation.

How Biochar Works in the Soil

- **Microscopic porosity:** Pyrolysis burns off volatile compounds and leaves a rigid, highly porous carbon skeleton. Under a microscope, biochar looks like a sponge with a huge internal surface area.
- **Cation exchange capacity (CEC):** Biochar carries a strong negative electrical charge on its surface. This allows it to attract and hold positively charged plant nutrients (cations such as calcium, potassium and magnesium).
- **Recalcitrant (stable) carbon:** Unlike compost or crop residues, which break down continuously, the carbon in biochar is chemically stable. It resists microbial decomposition and remains in the soil for hundreds to thousands of years.

Soil Conservation Benefits

- **Permanent carbon storage:** Turning fast-decaying biomass into stable biochar locks carbon out of the atmosphere. This builds soil and helps mitigate climate change.
- **Drought resilience and water retention:** The tiny pores hold large amounts of water, increasing the soil's water-holding capacity. This buffers crops against drought and prevents dry, dusty topsoil from blowing away.

- **Preventing nutrient leaching:** By holding nutrients through its high CEC, biochar stops nitrogen and phosphorus from washing out of the soil in heavy rain, keeping them in the root zone and protecting local waterways.
- **Microbial habitat:** The porous structure gives beneficial soil microbes – especially mycorrhizal fungi and nitrogen-fixing bacteria – a refuge from predators and extreme temperatures.

Biomass and Biochar Quality

The basic raw material for biochar is biomass.

What is biomass?

Biomass is the total organic material that makes up a plant – its leaves, fruits, stems and roots. It is the immediate biological fuel for the soil ecosystem.

Biomass is the energy a plant has accumulated over time through photosynthesis. Plants with a larger photosynthetic surface accumulate more biomass than those with less photosynthetic capacity. The type of biomass determines the quality of the biochar produced.

Table 7.1 Biomass sources and the quality of biochar they produce

Biomass source	Biochar characteristics and best use
Hardwood <i>e.g. oak, beech, hickory</i>	Quality: Very rigid, microscopic sponge structure with maximum porosity and surface area. Carbon stability: Very high – stable for hundreds to thousands of years. Ash and nutrients: Low ash; very few immediate nutrients. Best use: Permanent carbon storage, maximizing water-holding capacity and building long-term microbial habitat.
Softwood <i>e.g. pine, fir</i>	Quality: Excellent porosity and surface area, though slightly less dense and more fragile than hardwood. Carbon stability: High. Ash and nutrients: Low ash; low initial nutrients. Best use: Improving soil aeration and water retention; an excellent base for charging in a compost loop.

Biomass source	Biochar characteristics and best use
Crop residues <i>e.g. straw, maize stover, husks</i>	Quality: Fragile structure with less internal surface area; breaks down under heavy soil pressure. Carbon stability: Moderate – breaks down faster than woody biochar. Ash and nutrients: High ash; rich in immediate minerals such as potassium and silica. Best use: Short-term pH buffering (acts as a liming agent to raise pH) and rapid mineral cycling.
Animal manure <i>e.g. poultry, dairy, pig</i>	Quality: Very low porosity; granular or powdery rather than a rigid carbon skeleton. Carbon stability: Low – mineralizes and degrades much faster in the soil. Ash and nutrients: Very high ash; rich in available phosphorus and nitrogen. Best use: A slow-release, nutrient-dense organic fertilizer rather than permanent soil infrastructure.
Bamboo and fast grasses <i>e.g. bamboo, Miscanthus</i>	Quality: Excellent, highly uniform pore structure; fast-growing and renewable. Carbon stability: High – strong carbon matrix. Ash and nutrients: Moderate ash; highly alkaline pH. Best use: Filtering soil toxins and heavy metals and rapidly improving CEC.

Charging Biochar Before Use

Raw biochar acts like a biological vacuum: if applied directly to a field, it will temporarily absorb nutrients and water away from plants. To be effective, biochar must first be **charged** (or **inoculated**).

This is usually done through a **compost loop**. Mixing raw biochar into an active compost pile, or soaking it in aerated compost tea, fills its pores with water, soluble nutrients and thriving microbial communities. Once fully charged, it is applied to the soil, where it releases nutrients on demand while permanently improving the soil's physical structure.

How to charge biochar

1. Crush a 20-litre bucketful of charcoal into small pieces that pass through a coffee mesh.
2. Add ½ kg of native microbes and 1 litre of biofertilizer mix to 10 litres of molasses water.
3. Mix the charcoal dust thoroughly with the molasses water.
4. Pack it tightly into a bucket, leaving about 10 cm (4 inches) of space between the charcoal and the lid.
5. Leave to ferment for 30 days.

Biomass Strategy: Biochar or Animal Feed?

After harvest, the remaining biomass (stover, straw, stalks and husks) is pulled in three directions: livestock need it for dry-season fodder, the soil surface needs it as mulch, and the kiln needs it to make stable carbon (biochar).

If livestock eat all the residue, the soil degrades and no permanent carbon is stored. If everything goes into the kiln, the animals face a feed shortage and the soil is starved of the fast-decaying food it needs for immediate nutrient cycling. The answer is to move from competition to strategic sorting and “stacking” of functions.

1. Sort by toughness (lignin content)

- **For livestock (easily digested):** Allocate leafy, green or softer materials such as legume tops, fresh grass and the upper, softer parts of cereal stalks. These have a lower carbon-to-nitrogen ratio and are easily digested by cattle, sheep and goats to produce meat, milk and energy.
- **For biochar (high lignin and silica):** Allocate tough, woody materials such as maize cobs, hard lower stalks, rice husks, nut shells and agroforestry prunings. Livestock cannot digest them and they take too long to break down as mulch, making them ideal for pyrolysis.

2. The “pass-through” method

Livestock feed and soil biomass need not compete: animals act as biological digesters that turn soft residues into a more useful form. They take the energy from the residues and excrete the rest as nitrogen-rich manure. This manure – pre-processed, biologically active biomass – is the perfect “green” material to mix with raw, porous biochar in the compost loop. The livestock do not remove biomass from the system; they upgrade it for the compost pile.

3. Stacking functions: biochar as a feed additive

Adding small amounts of raw biochar (typically 1–3% of the daily feed ration) to livestock feed or mineral licks creates a very efficient shortcut:

- **In the animal:** Biochar acts as a digestive aid. It binds toxins in the gut, improves feed conversion and reduces methane emissions from digestion.
- **In the manure:** As biochar passes through the gut, its pores absorb water, digestive enzymes and nutrients. When excreted, it is already fully charged and inoculated with gut biology, so it no longer needs to be soaked in compost tea before field application.

The circular workflow

1. **Harvest:** The main crop is removed.
2. **Sort:** Soft residues go to the feed trough; woody residues and cobs go to the biochar kiln.
3. **Feed:** Animals eat the soft residues, supplemented with a small percentage of the new biochar.
4. **Compost:** The biochar-rich manure is collected and composted with any remaining medium-grade residues.
5. **Apply:** The finished, biochar-stabilized compost is returned to the field, permanently improving soil structure while feeding the next crop.

How to Apply Biochar

1. In compost

Adding biochar to compost is the most efficient way to charge it while also improving the compost. Biochar acts as a sponge, capturing nitrogen (ammonia) that would otherwise escape as gas, reducing odours and speeding up microbial activity. It also helps keep compost pH close to neutral.

How to apply: Layer into the compost pile together with green and brown biomass, or mix into livestock bedding (e.g. poultry litter) before composting.

Rate: 10–20% by volume of the total compost pile.

2. Nursery and seedling propagation

In the nursery, biochar improves the structure of the growing medium, increasing porosity, drainage and water retention, and gives beneficial mycorrhizal fungi a safe place to colonize young roots. It is particularly useful in tree nurseries.

How to apply: Blend thoroughly into the potting mix or seed-starting medium before filling trays or bags.

Rate: 5–10% by volume. Do not exceed 15–20%, because the alkaline nature of most biochar can raise the pH of the mix too high and inhibit germination or nutrient uptake.

3. Field application

Once charged, biochar provides long-term improvements in soil structure and moisture retention and a permanent home for the soil food web. The method depends on the cropping system.

Row crops and market gardens

How to apply: Broadcast over the field and lightly work into the top 10–15 cm of soil. Apply just before planting cover crops, so that the root exudates of crops such as vetch or buckwheat help integrate the biochar into the soil.

Rate: 1–5 tonnes per hectare (about 100–500 g per square metre). In intensive raised beds, apply 5–10% by volume of the topsoil layer.

Agroforestry, orchards and multi-strata systems

How to apply: Mix into the backfill soil of the planting hole when transplanting trees or shrubs (such as gliricidia, fruit trees or timber species). This places the carbon exactly where the developing roots need it.

Rate: 5–10% of the backfill soil volume – typically 1 to 2 cups (250–500 ml) of charged biochar per standard planting hole.

Pasture and silvopasture

How to apply: Apply on the surface, ideally mixed with compost or manure to prevent wind drift. Earthworms, dung beetles and livestock trampling will gradually work the biochar into the soil.

Rate: 1–2 tonnes per hectare, applied during the rainy season.

The Economics of Regenerative Farming

Regenerative agriculture brings a shift away from conventional farm economics in the following ways.

1. A Shift in How Success Is Measured

- **Metric:** From *gross yield per hectare* – to *net profit per hectare*.
- **System:** From *linear extraction* – to *circular biological systems*.
- **Outcome:** An internal supply chain, less money leaving the farm, and soil that becomes a long-term asset.

2. Reducing Purchased Input Costs

Conventional input	Regenerative replacement
Synthetic fertilizers	Indigenous microorganism (IMO) inoculants
Nitrogen fertilizers	Chop-and-drop agroforestry
Commercial seed	Saved open-pollinated cover crop seed (e.g. vetch, desmodium)
Fuel and irrigation	Biological soil functions

Result: Major operating expenses are replaced by free, local, biological processes.

3. Diversifying Income

- **Monoculture risk:** A single crop is vulnerable to pests and market price swings.

- **Regenerative multi-strata farming** spreads income over time:
 - **Short-term:** vegetables and grains.
 - **Continuous:** livestock and poultry.
 - **Long-term:** timber and fruit trees.
- **Benefit:** Several cash flows and a more stable income.

4. Reducing Risk and Building Climate Resilience

- **Conventional:** Degraded soils — costly irrigation and chemical support.
- **Regenerative:**
 - Contour swales + biomass mulches = a “sponge” that holds water in the landscape.
 - Free “crop insurance” against droughts and floods.
 - Lower energy and fuel costs.

5. The Triple Dividend

- **Economic:** Premium prices through direct-to-consumer sales of nutrient-dense food.
- **Social and cultural:** Local food hubs keep money circulating in the community.
- **Ecological:** New income streams from carbon credits, biodiversity offsets and watershed payments.

Key takeaways

- Profitability comes from **cutting costs, diversifying income** and **reducing risk**.
- Regenerative farming builds **soil as capital**, ensuring long-term resilience.
- Farmers gain **triple returns**: economic, ecological and community benefits.

Glossary

Key terms used in this manual.

Aerobic – Needing oxygen. Aerobic microbes thrive in well-aerated compost and soil.

Agroforestry – Deliberately growing trees and shrubs together with crops and/or livestock.

Allelopathy – The release by a plant of natural chemicals that suppress the growth of other plants, such as weeds.

Anaerobic – Without oxygen. Anaerobic conditions favour many harmful microbes and bad odours.

Biochar – A porous, stable form of charcoal made by heating biomass with little or no oxygen, used to improve soil.

Biofumigant – A plant that releases compounds which suppress soil pests and diseases when it is cut and incorporated.

Biomass – The total organic material that makes up plants (leaves, stems, roots, fruits) or other living things.

Bokashi – A fermented or hot compost made under controlled conditions using molasses and microbes.

C:N ratio – The ratio of carbon to nitrogen in organic materials; it controls how quickly they decompose.

Cation exchange capacity (CEC) – The ability of soil or biochar to hold positively charged nutrients such as calcium, potassium and magnesium.

Chop and drop – Cutting plants or tree prunings and leaving them on the soil surface as mulch.

Contour – A line across a slope joining points at the same height.

Cover crop – A crop grown mainly to protect and improve the soil rather than for harvest.

Exudates – Sugars, proteins and other compounds released by plant roots that feed soil microbes.

Fanya juu – A terrace made by digging a trench along the contour and throwing the soil uphill (Kiswahili for “throw it upwards”).

Green manure – Fresh plant material returned to the soil to add nutrients and organic matter.

IMO – Indigenous microorganisms – beneficial local microbes collected and multiplied on the farm.

Inoculant – A material containing living beneficial microbes that is added to soil, seed, compost or biochar.

JMS – JADAM Microbial Solution – a low-cost liquid microbial inoculant brewed from potatoes, leaf mould and water.

Leaching – The washing of nutrients down and out of the root zone by water.

Mesophilic – Thriving at moderate temperatures (roughly 20–40 °C).

Mycorrhizal fungi – Fungi that live in partnership with plant roots, extending them and exchanging nutrients and water for plant sugars.

Pyrolysis – Heating organic material with little or no oxygen; the process used to make biochar.

Recalcitrant carbon – Carbon in a stable form that resists breakdown and stays in the soil for a very long time.

Silvopasture – A system that combines trees, pasture and grazing livestock on the same land.

Swale – A shallow trench dug along the contour to capture and hold rainwater run-off.

Thermophilic – Thriving at high temperatures (roughly 45–70 °C), as in a hot compost pile.

About the Author

Alice Mwangi

MSc. Human Ecology (VUB)

BSc. Range Management (UoN)

Agroecology and Regenerative Agriculture Consultant

Alice Mwangi is an agroecology and regenerative agriculture consultant and the founder of Hillside Organic Garden. She holds a Master of Science in Human Ecology from the Vrije Universiteit Brussel (VUB), Belgium, and a Bachelor of Science in Range Management from the University of Nairobi (UoN), Kenya.

This manual brings together practical regenerative farming methods – from soil biology and on-farm inputs to agroforestry, soil and water conservation and biochar – in a form that farmers and trainers can put to work in the field.

Also by Alice Mwangi

Mwangi, A. (2026). *Regenerative Kitchen Gardening in Non-Irrigated Drylands*. Hillside Organic Garden, Kabete, Kenya. ISBN 978-9914-29-414-9.

Notes

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Notes

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Notes

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Regenerative Agriculture

Farmers' Training Manual



ABOUT THE AUTHOR

Alice Mwangi

Alice Mwangi is a health and fitness enthusiast whose interest in permaculture and agroecology grew alongside her academic training as a Human Ecologist (VUB, 2006). Her passion for healthy organic food for all took her beyond buying organic produce from the shop to growing it herself – and to inspiring many households to use whatever space they have to produce organic, ecologically grown food for themselves.

Alice continually learns, researches and develops growing methods that achieve high productivity without chemical fertilizers or pesticides, and she teaches and trains people in these methods across Kenya, especially in urban and peri-urban settings like her own home. Hillside Organic Garden has grown into a demonstration site for the many growing techniques she has been working on.

This is her passion and purpose: to see as many families as possible gain affordable access to safe, nutritious food, while upholding the ecological integrity of our environment.

Hillside Organic Garden

info@hillsideorganicgarden.co.ke

+254 727 717 230

ISBN 978-9914-29-410-1

