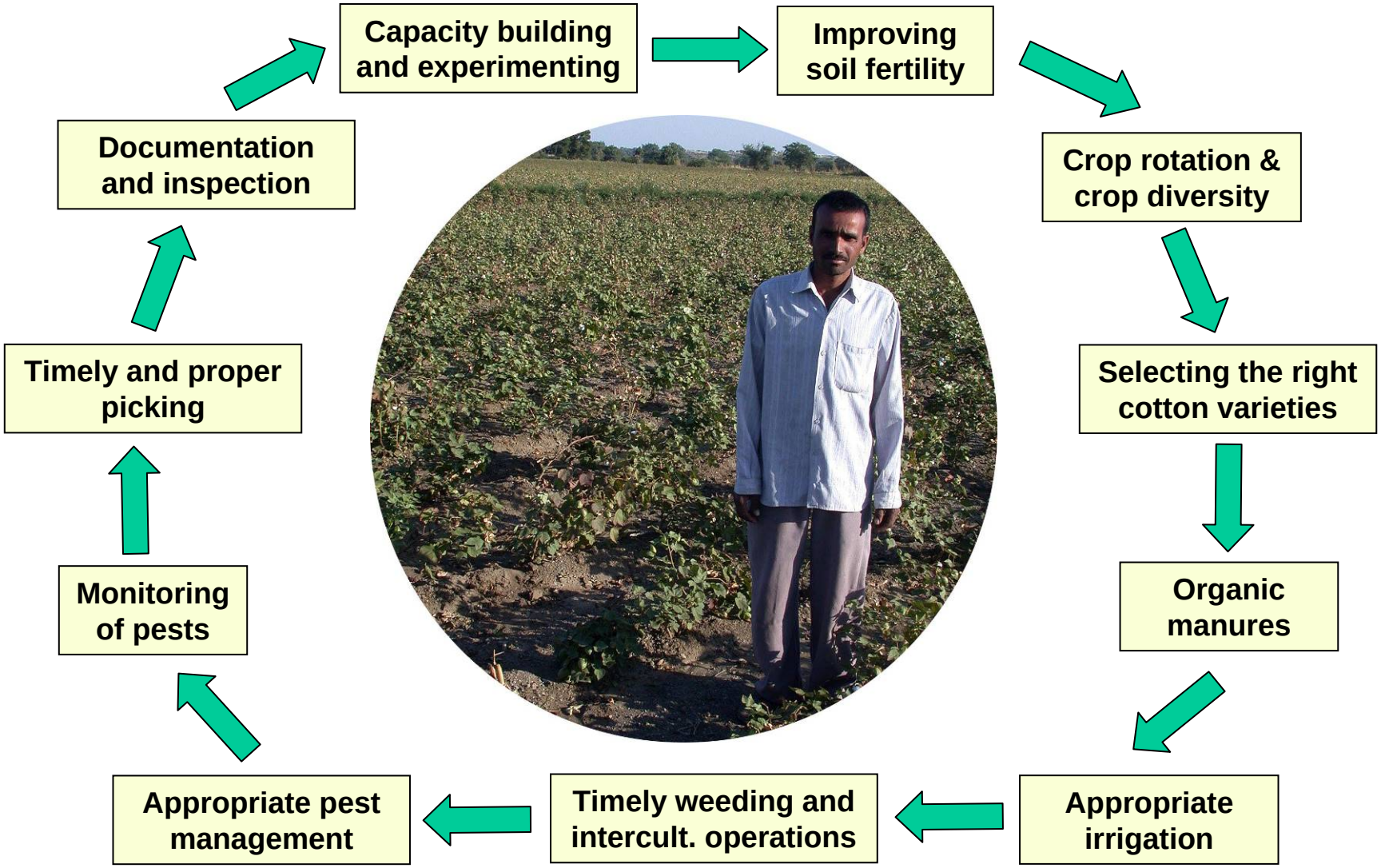
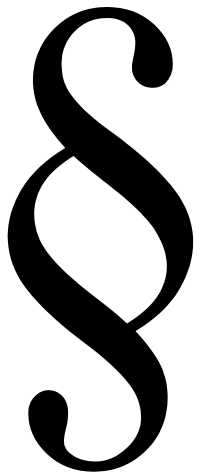
Advantages of cultivating cotton organically

	Conventional Cotton	Organic Cotton
Environment	• Pesticides kill beneficial insects • Pollution of soil and water • Resistance of pests	• Increased bio-diversity • Eco-balance between pests and beneficial insects • No pollution
Health	• Accidents with pesticides • Chronic diseases (cancer, infertility, weakness)	• No health risks from pesticides • Healthy organic food crops
Soil fertility	• Risk of declining soil fertility due to use of chemical fertilizers and poor crop rotation	• Soil fertility is maintained or improved by organic manures and crop rotation
Market	• Open market with no loyalty of the buyer to the farmer • Dependency on general market rates • Usually individual farmers	• Closer relationship with the market partner. • Option to sell products as ‘organic’ at higher price • Farmers usually organized in groups
Economy	• High production costs • High financial risk • High yields only in good years	• Lower costs for inputs • Lower financial risk • Satisfying yields once soil fertility has improved

Successful organic cotton farming with a system approach

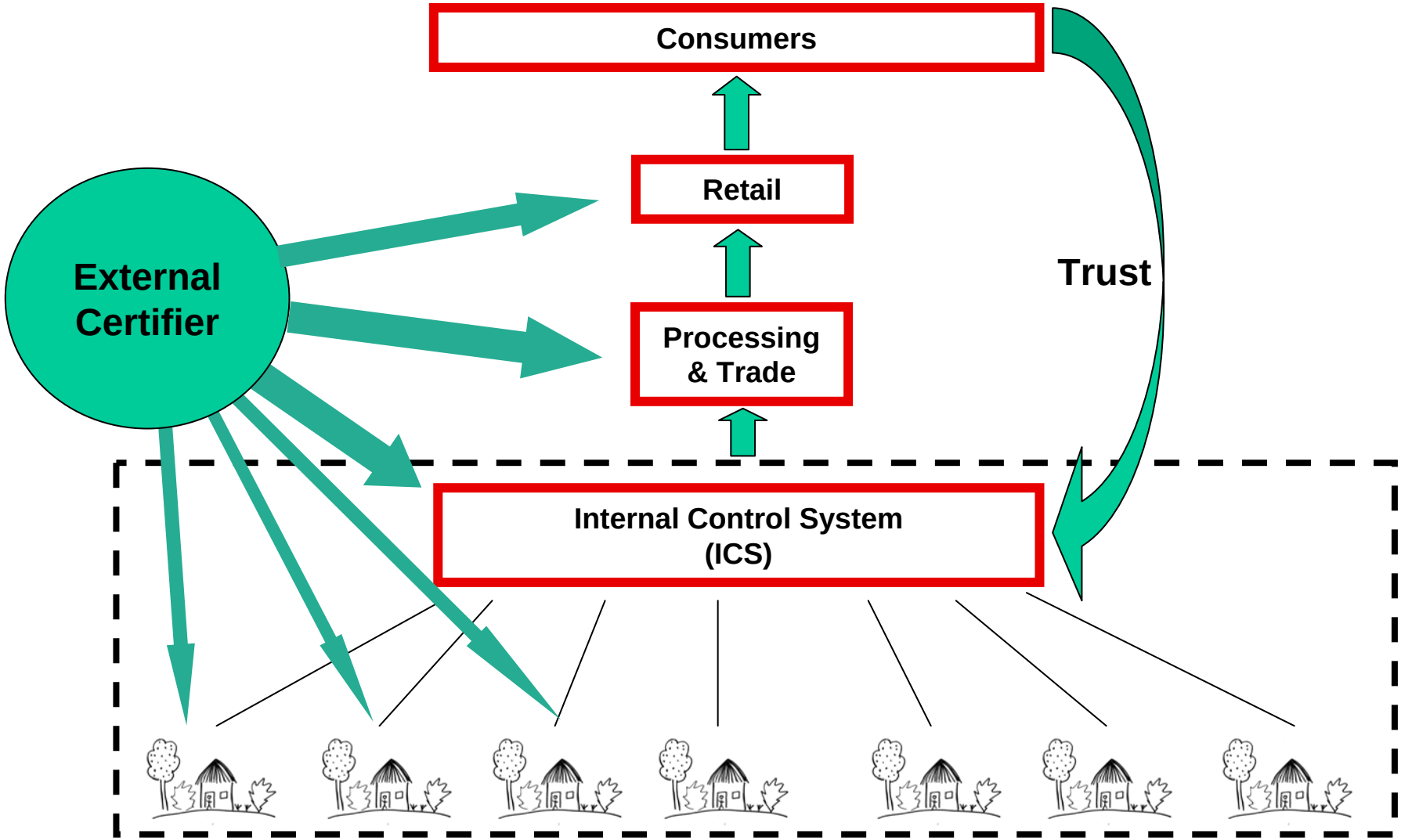


Organic standards in cotton farming



- No application of any synthetic fertilizers such as urea, NPK, DAP etc.
- No application of synthetic pesticides (including herbicides, insecticides, fungicides) or growth promoters.
- No use of genetically modified organisms (GMO) such as Bt-cotton varieties.
- Crop rotation (no cotton after cotton in the same field in two subsequent years) and/or intercropping.
- Prevent spray drift from neighbouring conventional fields, e.g. by growing border crops.
- Maintain records and documents for inspection and certification.

Internal control and external certification – building trust



(adapted from IFOAM)

Requirements of the cotton crop

Ideal climatic conditions

- High temperature (ideally 30°C)
- Long vegetation period
- Ample sunshine
- Dry climate
- Min. 500 mm rainfall or irrigation

Ideal soil conditions

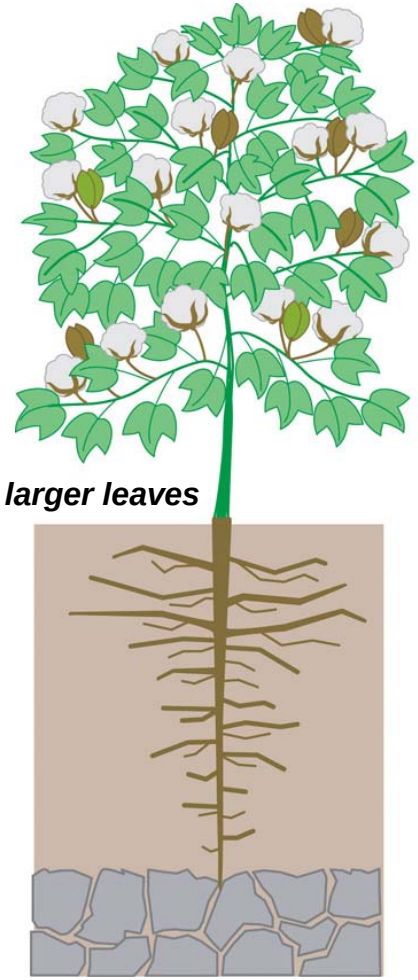
- Deep soils
- Heavy clay soils, ideally black cotton soils (vertisols)
- No water logging

Crop development

- Strong root growth in first two weeks
- Natural bud shedding (only approx. 1/3 of flowers develop bolls)
- Plant compensates for damage through increased growth

Selecting the right cotton varieties

American Upland cotton *(G. hirsutum)*



Advantages:

- High yields
- Longer staple (higher price)

Disadvantages:

- Needs more water
- Needs more manure
- More prone to pests

Suitable for:

- Deep soils
- Heavy soils
- Good irrigation

Indian 'desi' varieties *(G. arboreum, G. herbaceum)*

Advantages:

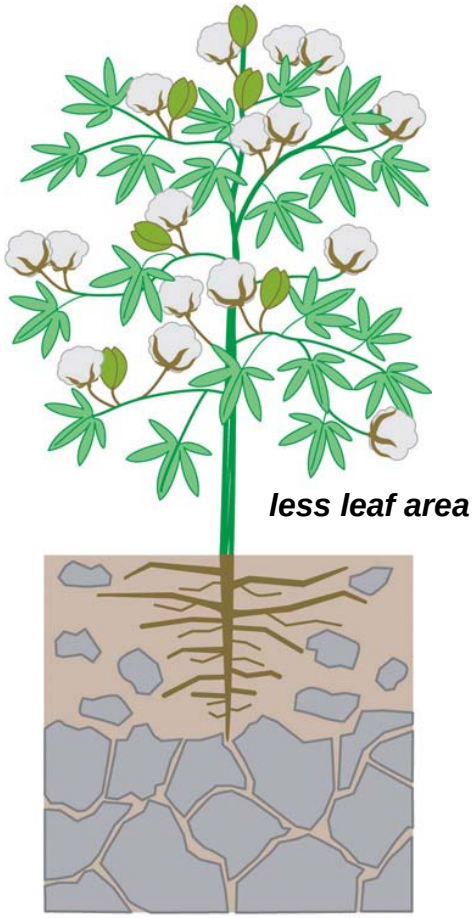
- Better drought resistan
- More pest tolerant

Disadvantages:

- Smaller yields
- Mostly shorter staple (lower price)

Suitable for:

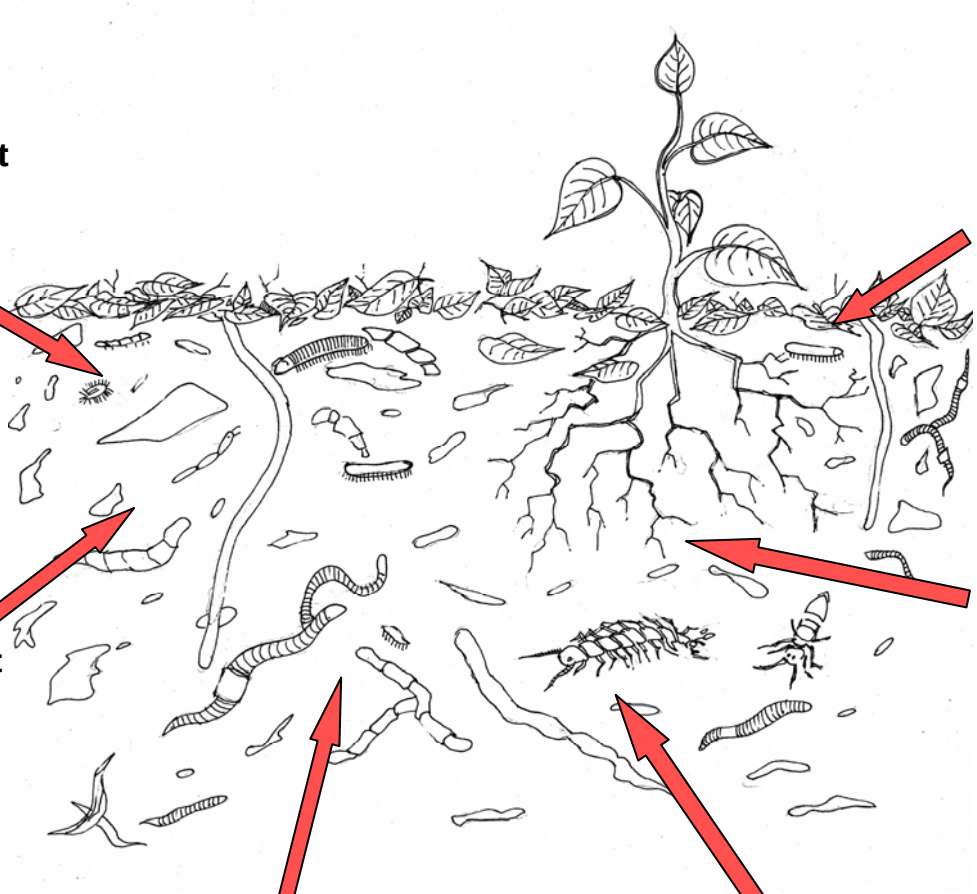
- Shallow soils
- Sandy soils
- Little/no irrigation



Soil types and their management

Light soils	Heavy soils
Shallow; roots do not penetrate very deeply	Deep; roots penetrate deeply
Light colours	Dark colour; cracks when dry
Sandy; easy to cultivate	Rich in clay; muddy when wet, hard when dry
Low water retention capacity → affected by drought!	High water retention capacity → less risk of being affected by drought
Nutrients easily get leached out → need sufficient compost; supply of mineral fertilizers in several doses	Very fertile → need sufficient manures because of high productivity
Drought-resistant crops: sorghum, maize, pigeon pea (desi varieties), moong, millet, castor; desi cotton varieties	High performance crops: chilli, soya bean, banana, sugarcane, hybrid cotton varieties, pigeon pea (hybrid varieties); wheat
Intercrop to reduce risk of crop failure	Intensive crop rotation; green manures
Compost and mulching to improve water holding and nutrient supply	Compost to activate soil life and improve soil structure
Shallow ploughing, little soil cultivation	Deep ploughing, frequent intercultural operations (shallow soil cultivation)
Increase infiltration with trenches and bunds	Risk of waterlogging!

Why organic matter is so important



A loose and soft soil structure with a lot of cavities

Good aeration and good infiltration of rain and irrigation water

Visible parts of organic matter act like tiny sponges

Non-visible parts of organic matter act like a glue, sticking soil particles together

Many beneficial soil organisms such as earth worms feed on organic material

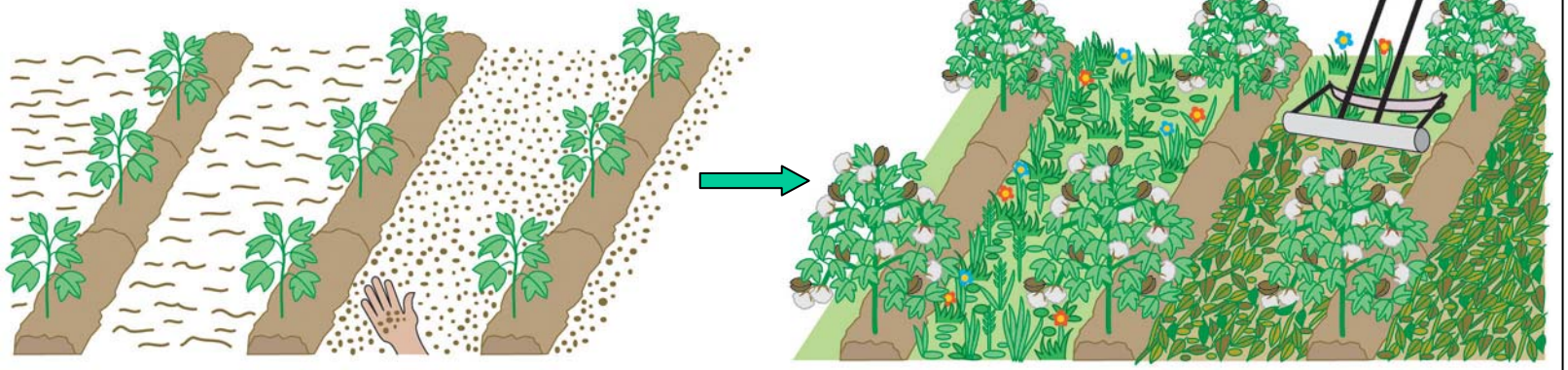
Soil organic matter provides a suitable environment for soil organisms

Crop rotation – rotation crops

Rotation Type	1st year	2nd year	3rd year
Pulses + cereals	Cotton (winter crop: wheat or pulses)	Pulses (soya, moong beans, cow pea, black gram, pigeon pea), maize or sorghum	Cotton (winter crop: wheat or pulses)
Vegetable	Cotton (winter crop: wheat or pulses)	Chilli, onion or other intensive vegetable crop	Cotton (winter crop: wheat or pulses)
Sugar cane	Cotton	Sugar cane	Sugar cane
Diverse rotation (from Tanzania)	Cotton	Sesame, safflower, sorghum or maize	Pulses (moong, chick pea, cow pea, pigeon pea, groundnut)
Rotation with herbal plants (from Egypt)	Cotton (winter crop: wheat or pulses)	Herbs (anise, basil, fennel etc.)	Maize with clover intercrop

Green manures and intercrops

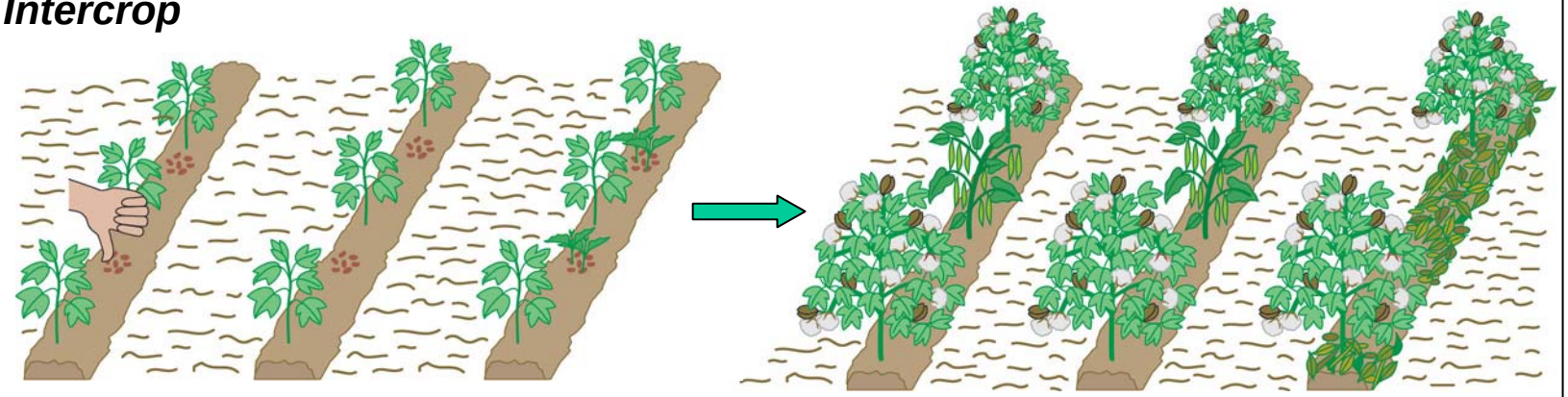
Green manure



Sowing the green manure crop

Mulching the green manure crop

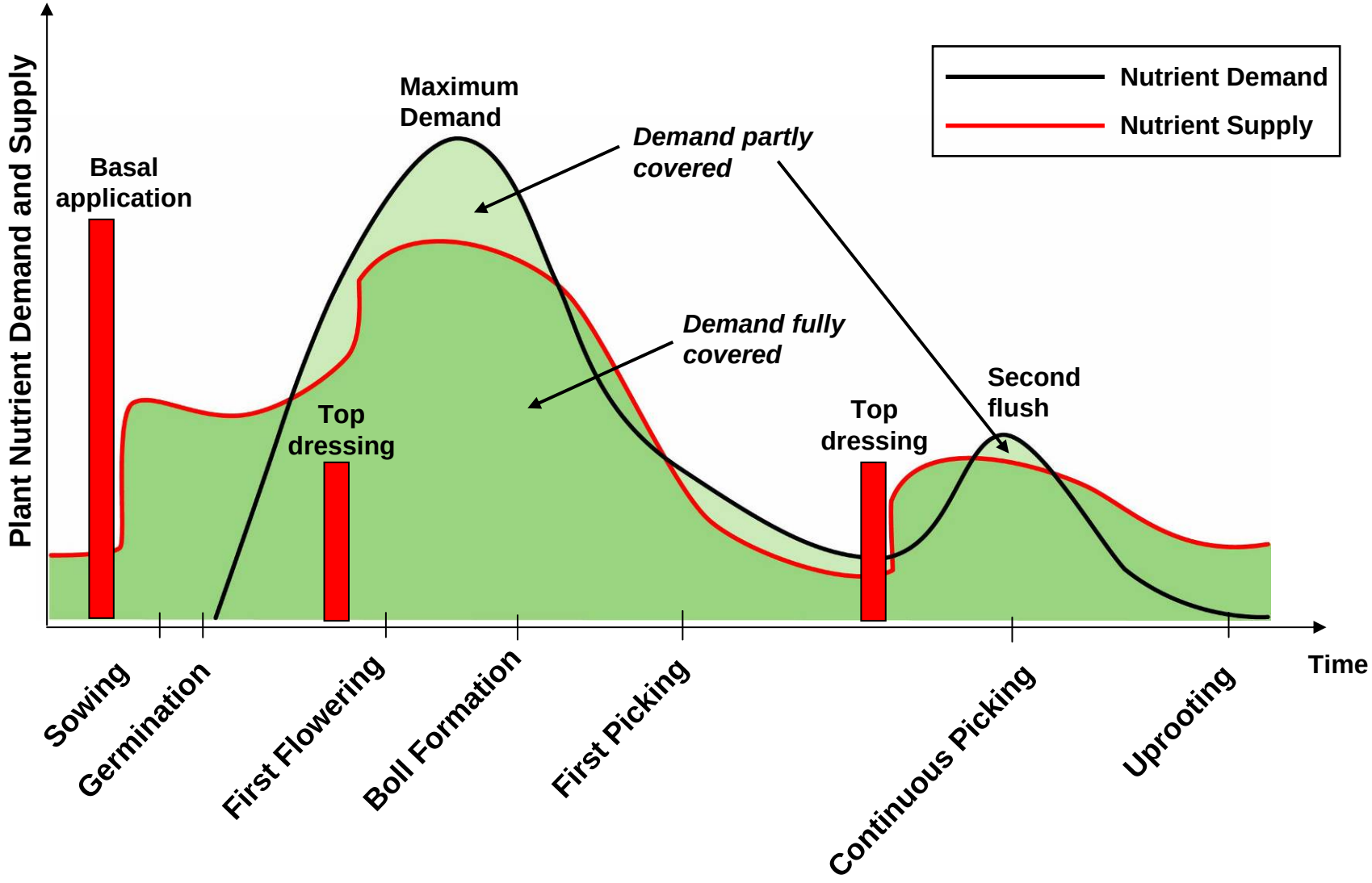
Intercrop



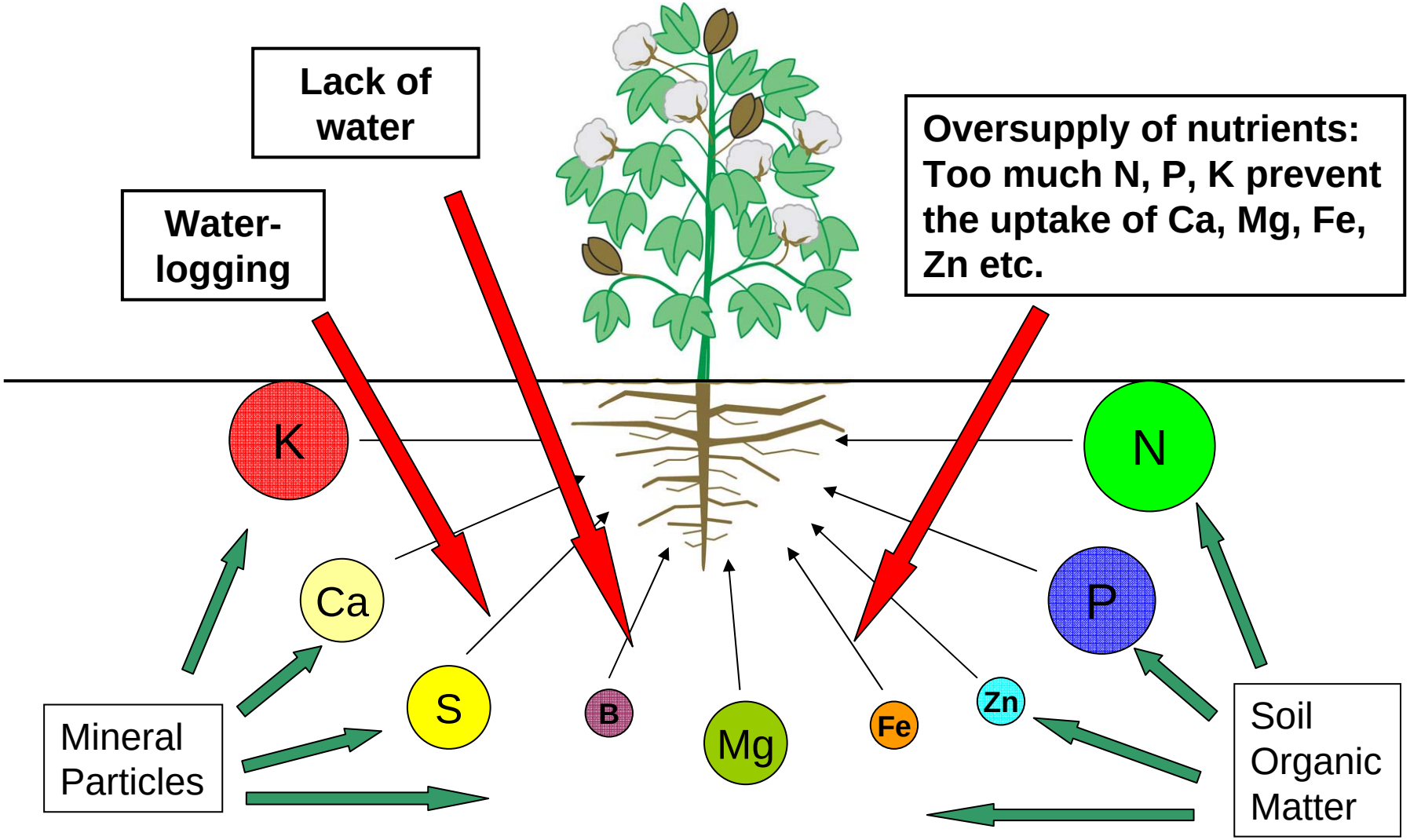
Sowing the intercrop

Harvesting the intercrop

Timing of nutrient supply in the cotton crop



Disturbance of nutrient uptake



Nitrogen immobilisation in soil → retarded growth

Symptoms

- Yellowish leaves
- Stunted growth
- Delayed development

The reason

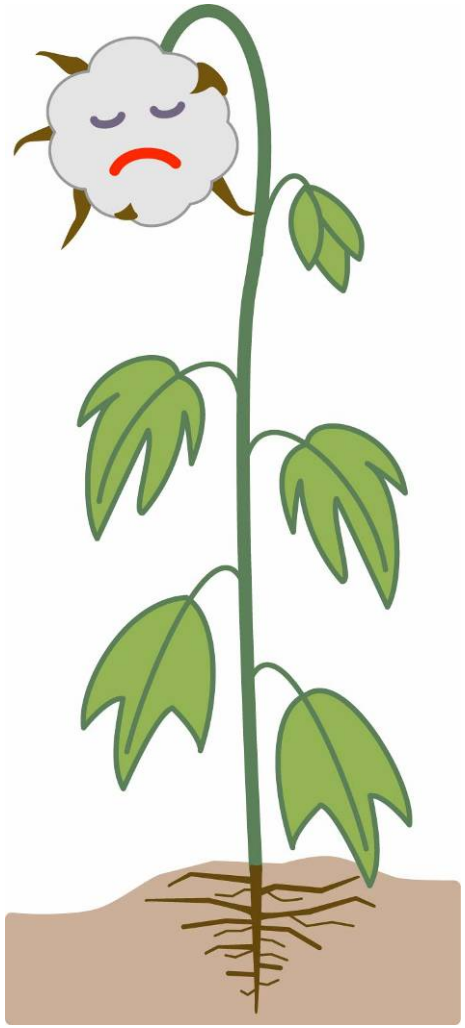
Decomposable material in the soil (half rotten compost or manure, straw, crop residues)

↓

The decomposition of carbon-rich organic material requires nitrogen

↓

Little organic material with high nitrogen content (e.g. oil cake)



Preventive measures

- Remove sturdy crop residues (stalks) from the field and compost them
- Ensure that the compost is well decomposed
- Apply compost at least two weeks before sowing
- Apply sufficient nitrogen-rich organic manures (e.g. de-oiled cakes)
- Note: Organic manures need 1-3 weeks until they release nitrogen
- Shallow soil cultivation helps to accelerate decomposition of organic matter

Organic manures and natural mineral fertilizers for cotton

Manure/Fertilizer	Comment	Nitrogen (total N)	Phosphate (P_2O_5)	Potash (K_2O)
Compost	Soil improvement	0.6 - 1.5 %	0.5 - 1.0 %	0.5 - 2.0 %
Farmyard manure	Less stable humus	0.7 - 1.5 %	0.5 - 0.9 %	0.4 - 1.5 %
Vermi-compost	Very stable humus	0.6 - 1.5 %	0.4 - 0.9 %	0.5 - 1.0 %
De-oiled Castor	N- and P-supply	4.5 - 6.0 %	0.8 - 1.8 %	1.3 - 1.5 %
Cane press mud	Soil improvement	1.4 - 1.8 %	0.1 – 1.0 %	0.4 - 0.6 %
Rock phosphate	P-supply, in compost heap	0	15 - 30 %	0
Muriate of potash	Natural potassium fertilizer	0	0	ca. 60 %
Wood ash	K, Mg, Ca, Mg etc.	0	1 - 3 %	1 – 8 %

Note: Figures are given in percent of dry matter. The nutrient contents vary from source to source.

Compost and farmyard manure – proper handling pays off!

Nutrient contents of different compost and dung heaps collected in the Nimar region, India

Manure / Compost type	Nitrogen (total N)	Phosphate (P_2O_5)	Potash (K_2O)
Cow dung heap, well maintained	**1.5%**	**0.7%**	**0.8%**
Cow dung heap, poorly maintained (too wet)	**0.9%**	**0.5%**	**1.2%**
Compost in good condition (with heat process and turning)	**1.3%**	**0.9%**	**0.8%**
Compost, poorly maintained (too dry)	**0.8%**	**0.5%**	**0.5%**
Vermi-compost in good condition	**1.5%**	**0.9%**	**0.7%**
Vermi-compost, poorly maintained	**0.6%**	**0.4%**	**0.7%**

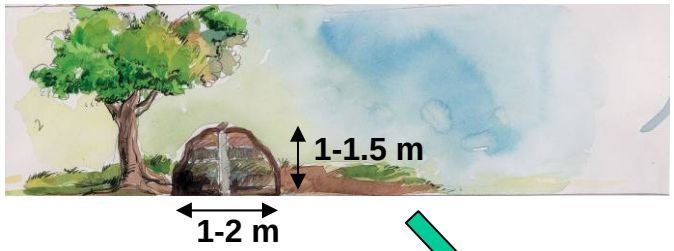
Setting up a compost heap

Collect the composting material.

- Choose a shady location
- Collect plenty of plant material
- Pile it up separately
- Chop coarse material

Set up the heap from bottom:

- N-rich material
- Coarse C-rich material
- Twigs and branches



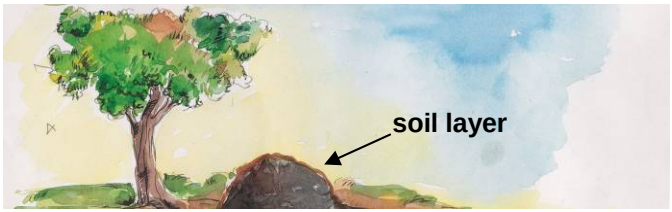
- Humidify the materials
- Pile them up loosely in layers
- Cover with earth or straw

Turn the heap

- after 2–3 weeks
- after 1-2 months

- When temperature declines.
- Outside material goes inside.

Let it rest to mature for up to 3 months.



Nitrogen fixation through leguminous plants

- There is plenty of nitrogen in the air (78% nitrogen gas)
- Leguminous plants fix nitrogen from the air and make it available to the plant
- Examples: pigeon pea, soya bean, moong, cow pea, chick pea, daal etc.
- The fixation is done by bacteria living in root nodules (*Rhizobium* species)
- The nitrogen fixed by the leguminous crop gets available to the associated or following crop (e.g. cotton)
- If a lot of fertilizer is available in the soil, legumes fix less nitrogen

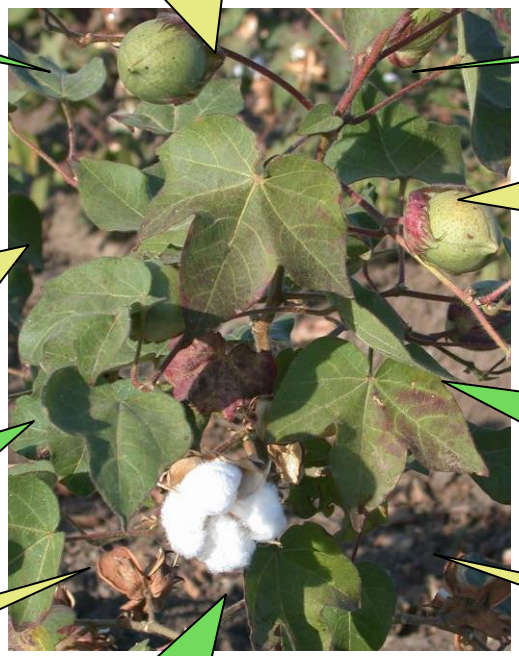
Keeping your cotton crop healthy

Select a variety suitable for the location

Diverse crop rotation

Intercropping, green manure

Not too much manure
(→ tender leaves attract pests; vegetative growth instead of bolls)



Encourage soil aeration (e.g. shallow hoeing)

Promote natural enemies of pests through diverse cropping patterns

Balanced nutrition
(compost, organic manures)

Enrich the soil with organic matter

Avoid water shortage

Avoid waterlogging
(→ boll shedding, less yield)

Important cotton pests

Bollworms and other caterpillars

American bollworm
(Heliothis armigera)

Cutworm
(Agrotis spp.)

Pink bollworm
(Pectinophora gos.)

Armyworm
(Spodoptera spp.)

Spiny Bollworm
(Earias spp.)

Cotton leafworm
(Alabama argillacea)

Sucking pests and other pests

Cotton aphid
(Aphis gossypii)

Spider mites
(Tetranychus spp.)

Grasshoppers
(Locusta spp.)

Whitefly
(Bemisia tabaci)

Cotton jassids
(Amrasca devestans)

Termites
(various spp.)

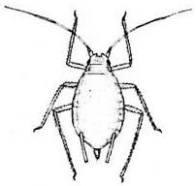
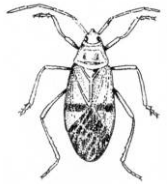
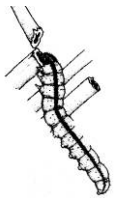
Cotton stainer
(Dysdercus spp.)

Thrips
(Thripidae)

Root knot nematodes
(Meloidogyne spp.)

Photos (top left to bottom right): Paolo Mazzei, Clemson University, Roland Smith, Mississippi State University, James Smith, Winfield Sterling, Douglas Ferguson, Insectcorner, P. Room, Scott Bauer, Cotton SA, University of Georgia, Frank Eyhorn, Insectcorner, Clemson University

Pest management in cotton

	Pest	Preventive measures	Direct control measures
	**Bollworms** *(Helicoverpa and others)*	▪ Trap crops: sunflower, okra, castor ▪ Hand-pick damaged capsules ▪ Encourage natural enemies ▪ Remove cotton stalks ▪ Cattle grazing after picking is over	▪ Bt-spray, NPV spray ▪ Neem, botanical preparations ▪ Buttermilk spray ▪ Pheromone traps, light traps ▪ Trichogramma cards
	**Aphids, jassids, thrips, whitefly** *(Bemisia)*	▪ Intercrop of moong, cow pea etc. ▪ Avoid high manure application ▪ Avoid waterlogging and water shortage ▪ Promote natural enemies by growing flowering plants	▪ Neem, botanical preparations (chilli, sweet flag, turmeric etc.) ▪ Soft soap spray ▪ Cow urine spray ▪ Potato starch spray ▪ Yellow sticky traps
	**Cotton stainers** *(Dysdercus)*	▪ Frequent soil cultivation to destroy the eggs (also along field borders) ▪ Encourage birds (turmeric-coloured rice, bird perches, trees) ▪ Avoid stand-over of cotton	▪ Pyrethrum spray ▪ Botanical sprays (neem, custard apple, garlic bulb, sweet flag, sweet basil, Derris species) ▪ Grazing of chickens
	**Cutworms** *(Agrotis and other species)*	▪ Early soil cultivation ▪ Remove weeds in and around fields ▪ Encourage birds, spiders etc. (bird perches, trees, hedges)	▪ Apply neem cake into the soil ▪ Pyrethrum, Derris or thyme spray ▪ Cutworm baits ▪ Hand picking or Bt-spray at night

Natural enemies of major cotton pests

Parasitoids (e.g. *parasitic wasps*)

Green lacewing (*Chrysoperla spp.*)

Damsel bug (*Nabis spp.*)

Ladybird beatle (*Harmonia spp.)*

Hoverfly (*Eristalis spp.*, *Volucella spp.)*

Bollworms

Aphids

Cutworms

Assassin bugs (*Prithesancus spp.)*

Ants

Big-eyed bugs *(Geocoris spp.)*

Spiders

Birds

Photos: left: WURL, Insectcorner (3), J.K. Lindsey; middle: Paolo Mazzei, Roland Smith, Clemson University; right: Joseph Berger, Bradley Higbee, University of Tennessee (2), Olivier Olgiati

Direct pest management methods

Trichogramma

Biological control

- Trichogramma cards (parasitic wasp)
- Bt-spray (Bacillus thuringensis)
- NPV (Nuclear polyhedrosis virus)
- Beauvaria bassiana (fungus)

Giant milkweed

Natural pesticides

- Neem
- Botanical mixtures
- Buttermilk spray
- Soft soap spray

Pheromone trap

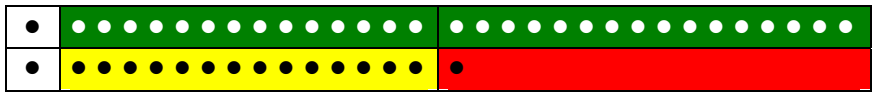
Mass trapping

- Light traps
- Sticky traps
- Pheromone traps

Monitoring pests - Economic threshold

Scouting for pests with the pegboard

Pest control only if pest populations are beyond the economic threshold



(Graphics: gtz-IPM Project Shinyanga, Tanzania)

Soil cultivation and weed management

Preparing the field

- Early ploughing to expose pests to the sun
- Earthing up ridges
- Soil cultivation speeds up the decomposition of organic matter

Sowing

- Appropriate spacing
- 2-4 seeds per spot
- Gap filling with trap crops
- Timely thinning

Weed management

- Crop rotation prevents weeds
- Weeds can also be beneficial
- Timely intercultural operations

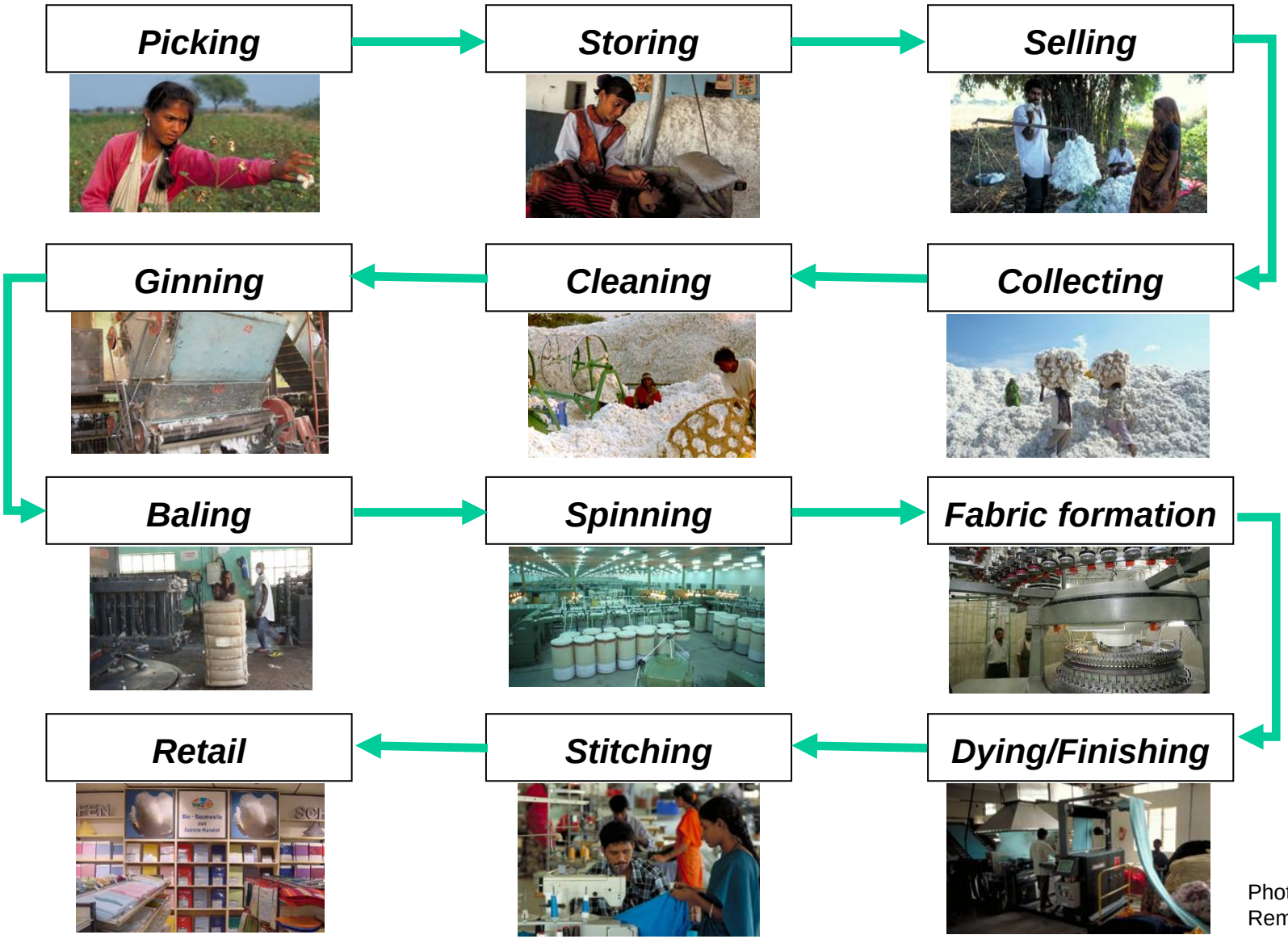
Low-cost drip irrigation in cotton

Normal drip system
(approx. 1100 US$ per ha)

“Easy Drip” system
(approx. 400 US$ per ha)

“Pepsee” drip system
(approx. 220 US$ per ha)

The cotton processing chain

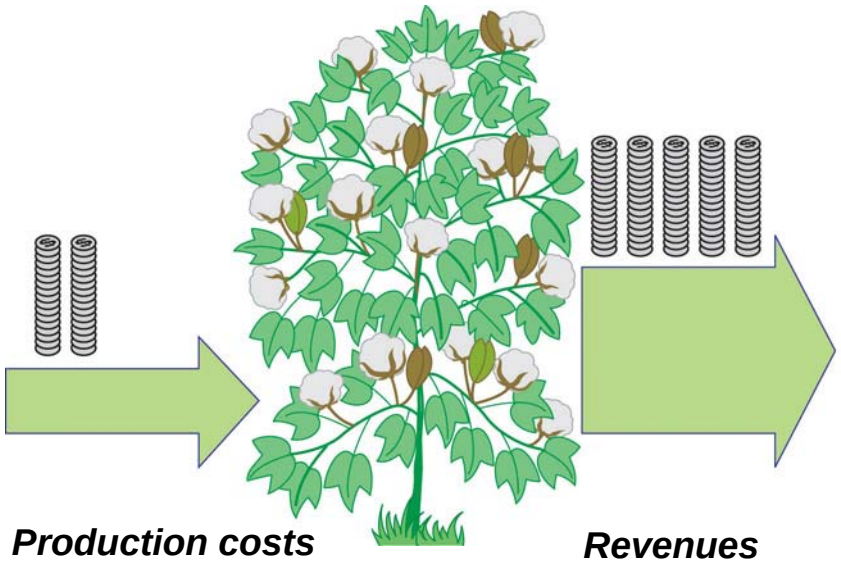


Photos:
Remei AG

Strategies in organic cotton farming

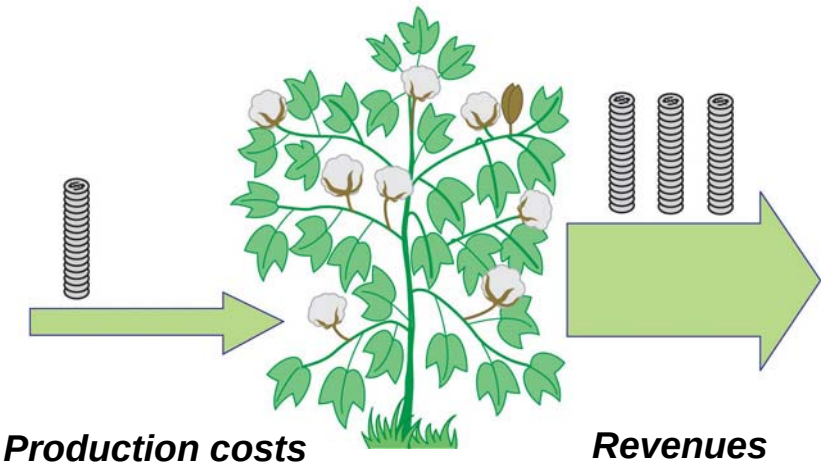
Strategy I: Intensive organic

- **High yields, but relatively high production costs**
- **High loss in case crop fails**

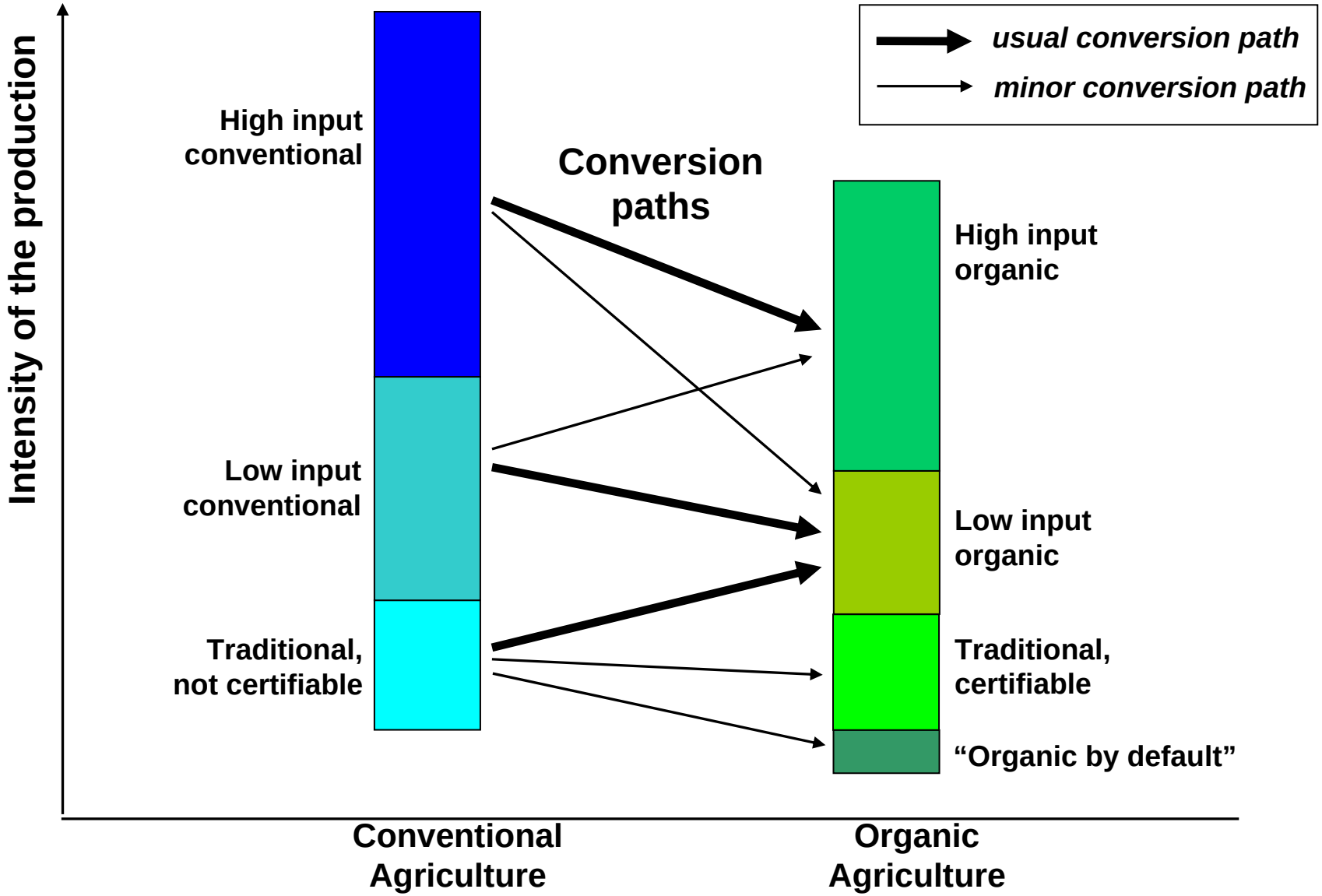


Strategy II: Low input, low risk

- **Smaller yields, but also lower production costs, thus still good income**
- **Lower loss in case crop fails**



Farming intensities in conventional and organic cotton production



Success factors in the conversion to organic cotton farming

Getting ready

- Adequate training in organic agriculture and organic cotton production
- Involve the family in decision making
- Develop strategies to cope with initial drop in yields and higher labour requirement
- Competent and timely advice on organic crop management
- Regular exchanges with experienced organic farmers

Adapting the production system

- Try out organic technologies on small plots to gain experience
- Identify suitable crop rotation, green manures and intercrops
- Ensure sufficient input of organic matter (if necessary from outside the farm)

The role of women in organic cotton farming

Impact on women

- Work load
- New activities
- Food crops

Involvement of women

- Decision making
- Role sharing
- Experience sharing

Support to women

- Training on organic farming
- Learning new skills
- Forming of women's groups