



A Picture Book of Best Practices for Subsistence Farmers: Sub-Saharan African and Caribbean version

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About the Author



Manish N. Raizada received his B.Sc. from the University of Western Ontario (Genetics) and Ph.D. from Stanford University (Plant Molecular Genetics). He held fellowship positions at The International Maize and Wheat Improvement Centre (CIMMYT) in Mexico City and at the California Institute of Technology. He is currently a professor in the Department of Plant Agriculture at the University of Guelph, Canada. Dr. Raizada is Founder of SAKGlobal (SAKs, Sustainable Agriculture Kits), an effort to bring inexpensive technologies to the world's 1 billion subsistence farmers. SAK kits are based on the principles of sustainable, ecological agriculture.

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About the Illustrator



Lisa J. Smith graduated from the Graphic Design Diploma program at Conestoga College in Kitchener, Ontario, Canada in 2014, with her main focus in illustration. In early 2015, Lisa was selected as part of a national competition onto the SAKGlobal team as the illustrator for the picture book along with other illustrated materials. She has created illustrations related to microbiology, genetics, botany, agriculture and international development for scientific journals and presentations during her time with the University of Guelph.

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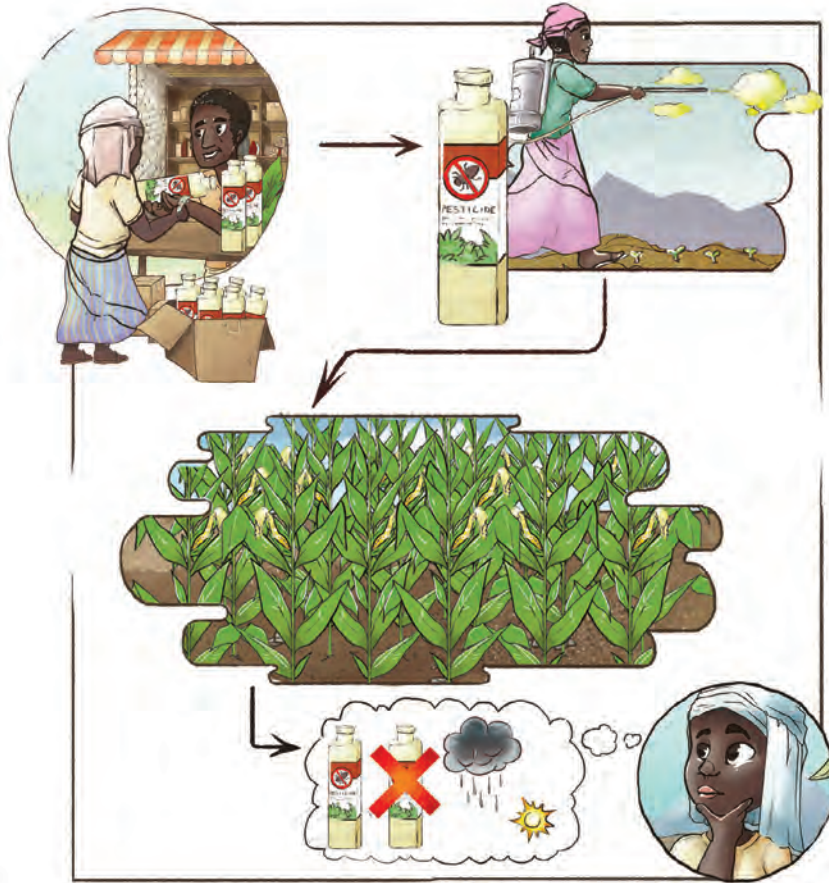
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Chapter 1: Scientific Method

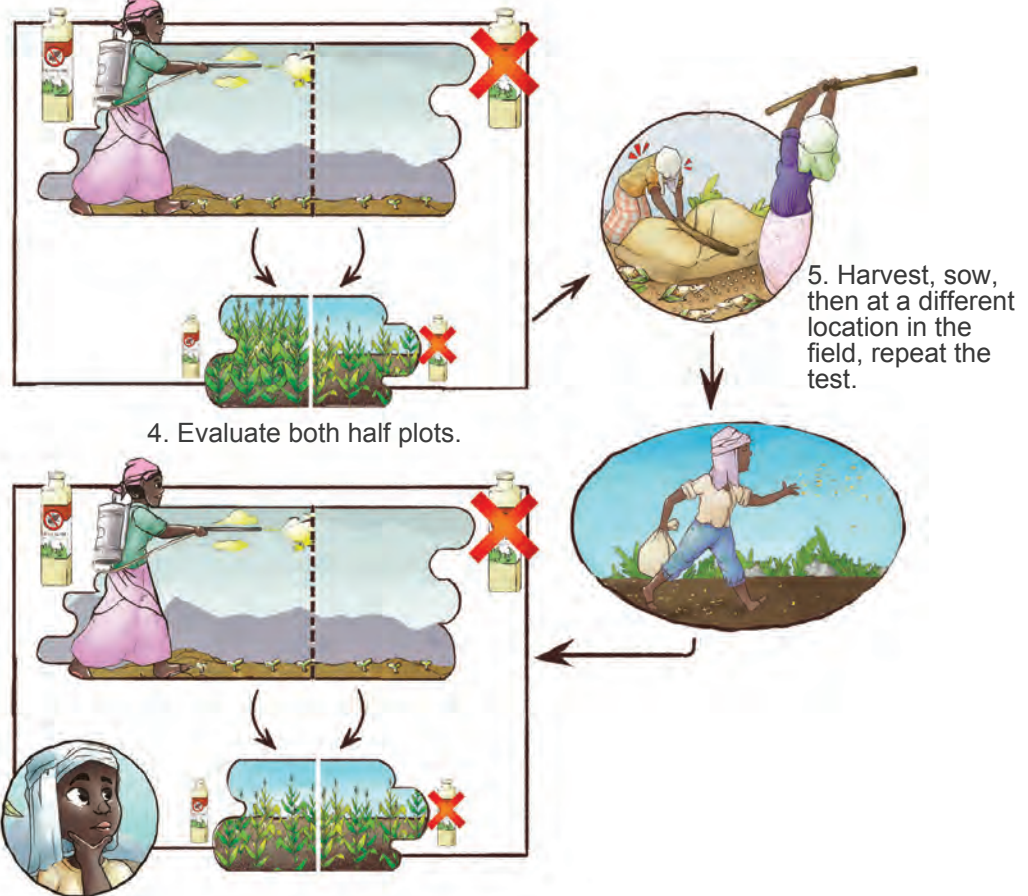
Lesson: Before adopting any new product (e.g. pesticide) or practice, it is important to test it on a small plot using a scientific method.

1. Traditional practice: Purchase seed or product, such as pesticide, then apply onto entire plot.



2. The field may show improvement, but the improvement may not be due to the new seed or product, but instead due to other factors. A scientific method can help to evaluate the effectiveness of a new seed or product, to determine whether or not it should be re-purchased.

3. Improved practice: Apply the new seed or practice on only half of the plot, keeping the other side with the traditional seed or practice. Conduct the test using only a small portion of the farm.

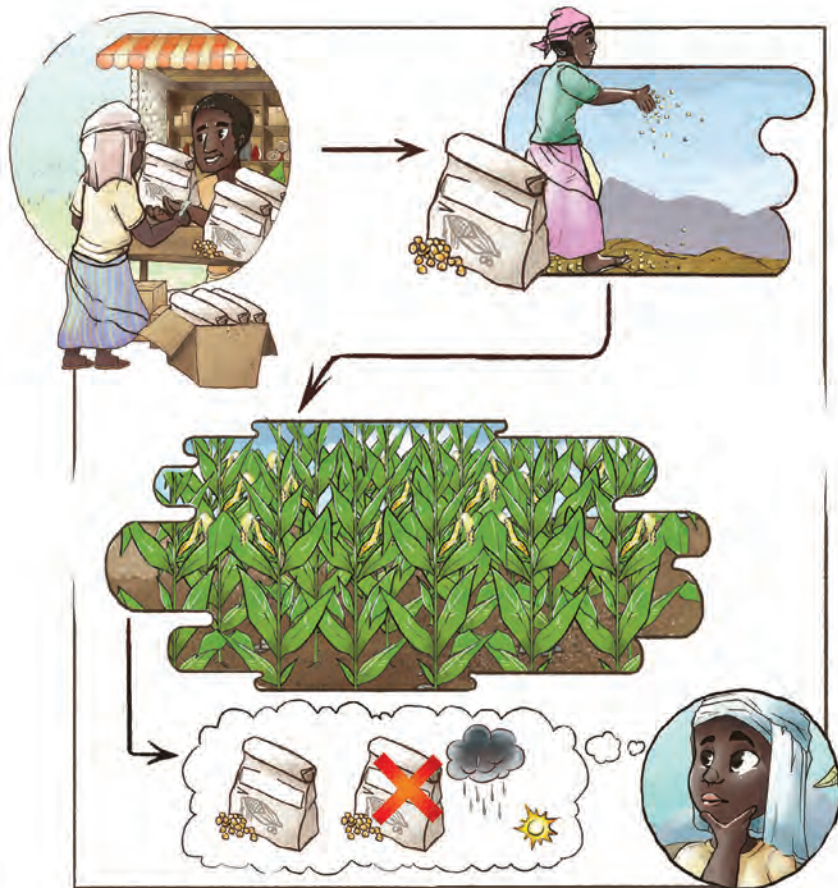


4. Evaluate both half plots.

6. Evaluate both half plots (second trial). If the new seed or product resulted in benefits in both years, then it is beneficial.

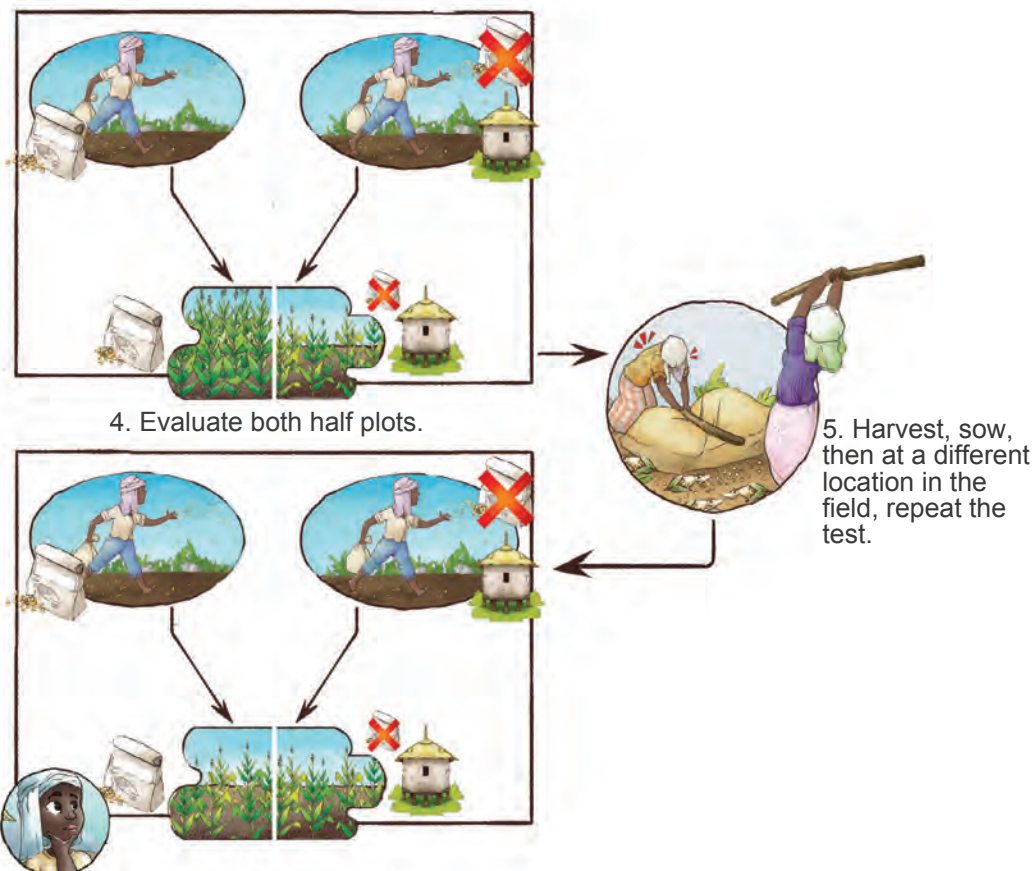
Lesson: Before adopting any new product (e.g. seed packet) or practice, it is important to test it on a small plot using a scientific method.

1. Traditional practice: Purchase seed or product, then apply onto entire plot.



2. The field may show improvement, but the improvement may not be due to the new seed or product, but instead due to other factors. A scientific method can help to evaluate the effectiveness of a new seed or product, to determine whether or not it should be re-purchased.

3. Improved practice: Apply the new seed or practice on only half of the plot, keeping the other side with the traditional seed or practice. Conduct the test using only a small portion of the farm.



4. Evaluate both half plots.
5. Harvest, sow, then at a different location in the field, repeat the test.
6. Evaluate both half plots (second trial). If the new seed or product resulted in benefits in both years, then it is beneficial.

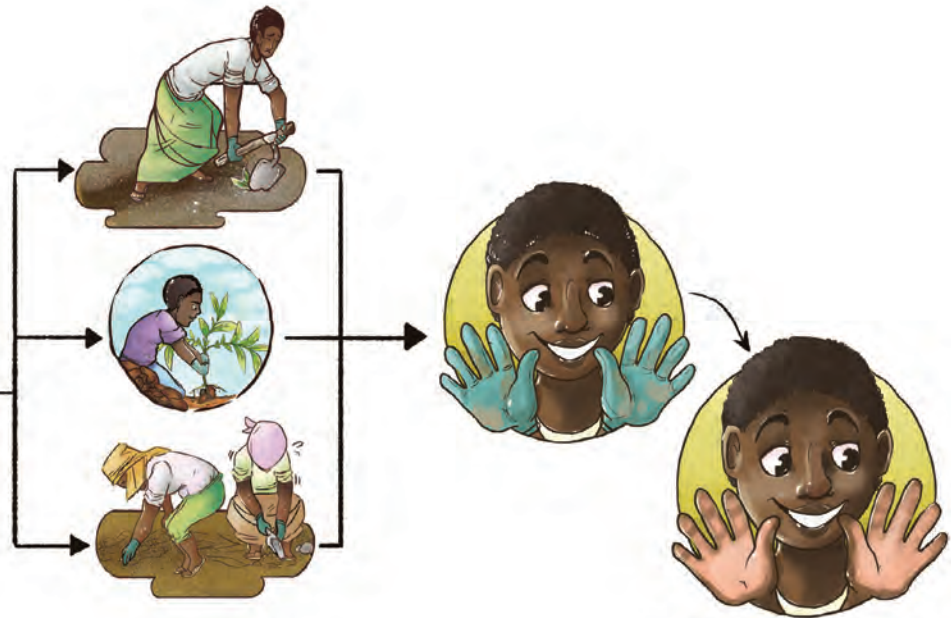
Chapter 2: Land Preparation & Sowing

Lesson: Gloves reduce pain and damage to hands.

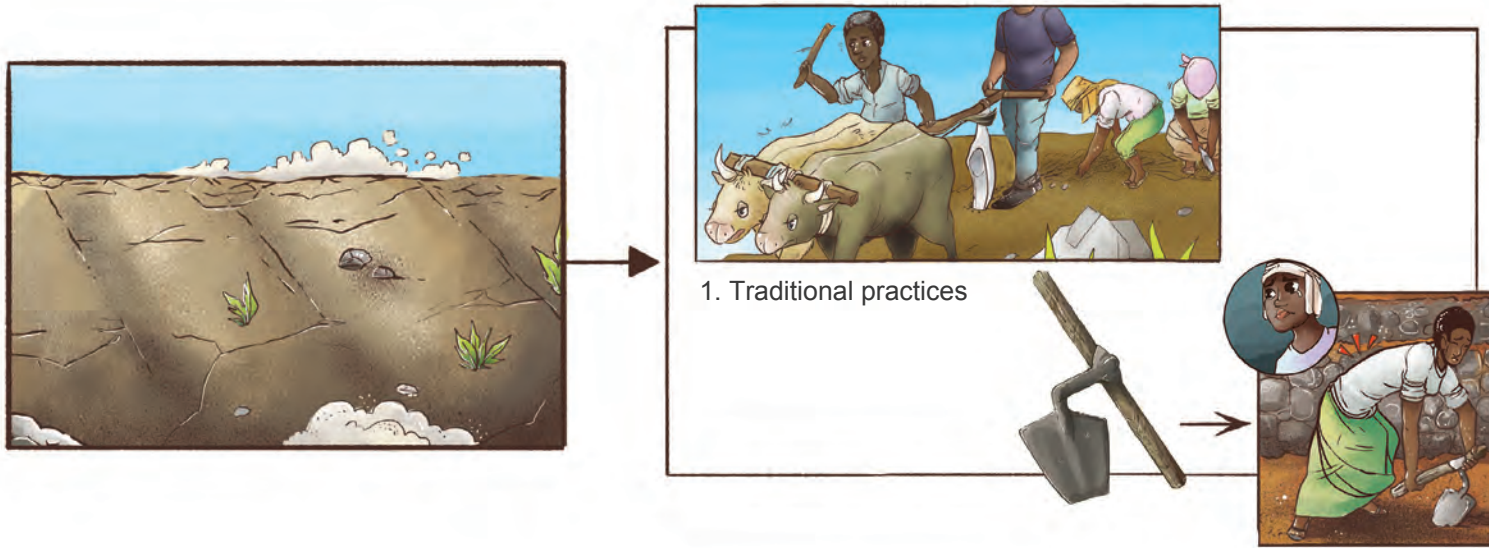
1. Traditional practice



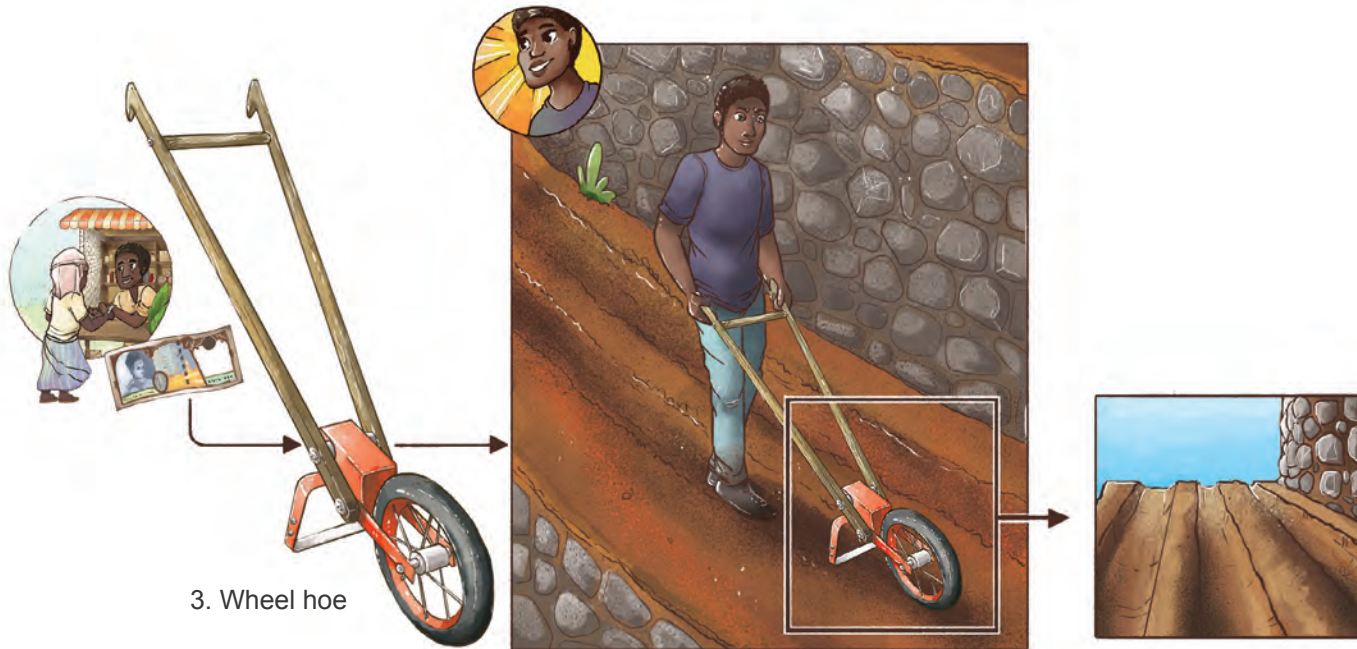
2. New method:
Gloves protect hands.
Request from local vendors.



Lesson: New tools to prepare field

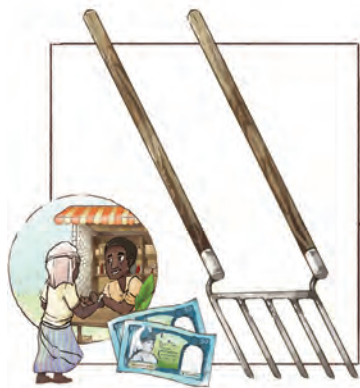


2. New tools: ask a local vendor to supply or ask blacksmith to construct



3. Wheel hoe

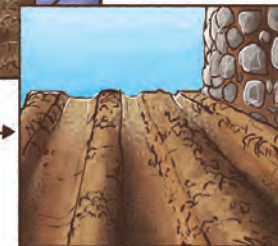
Lesson: New tools to prepare field



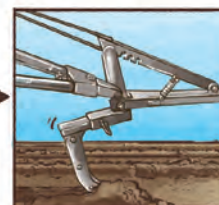
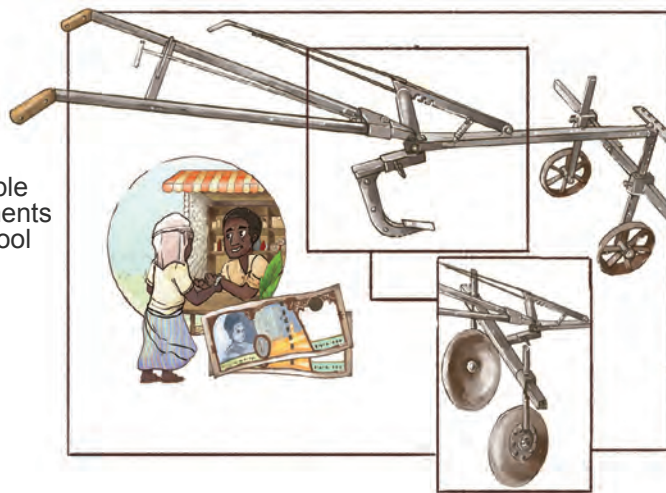
4. Broad fork to loosen soil



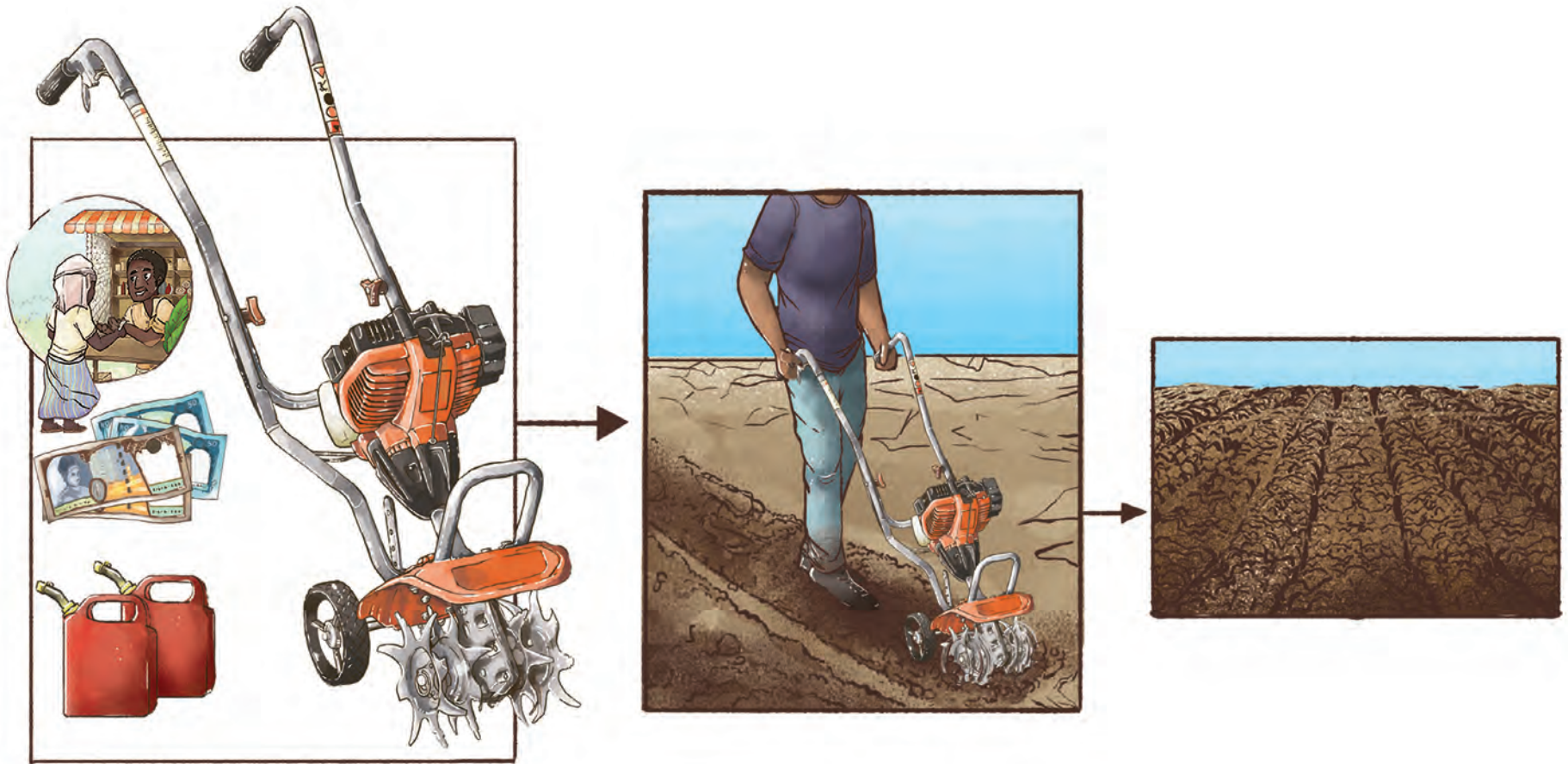
5. Shovel



6. Multiple attachments to one tool



Lesson: New tool to prepare field



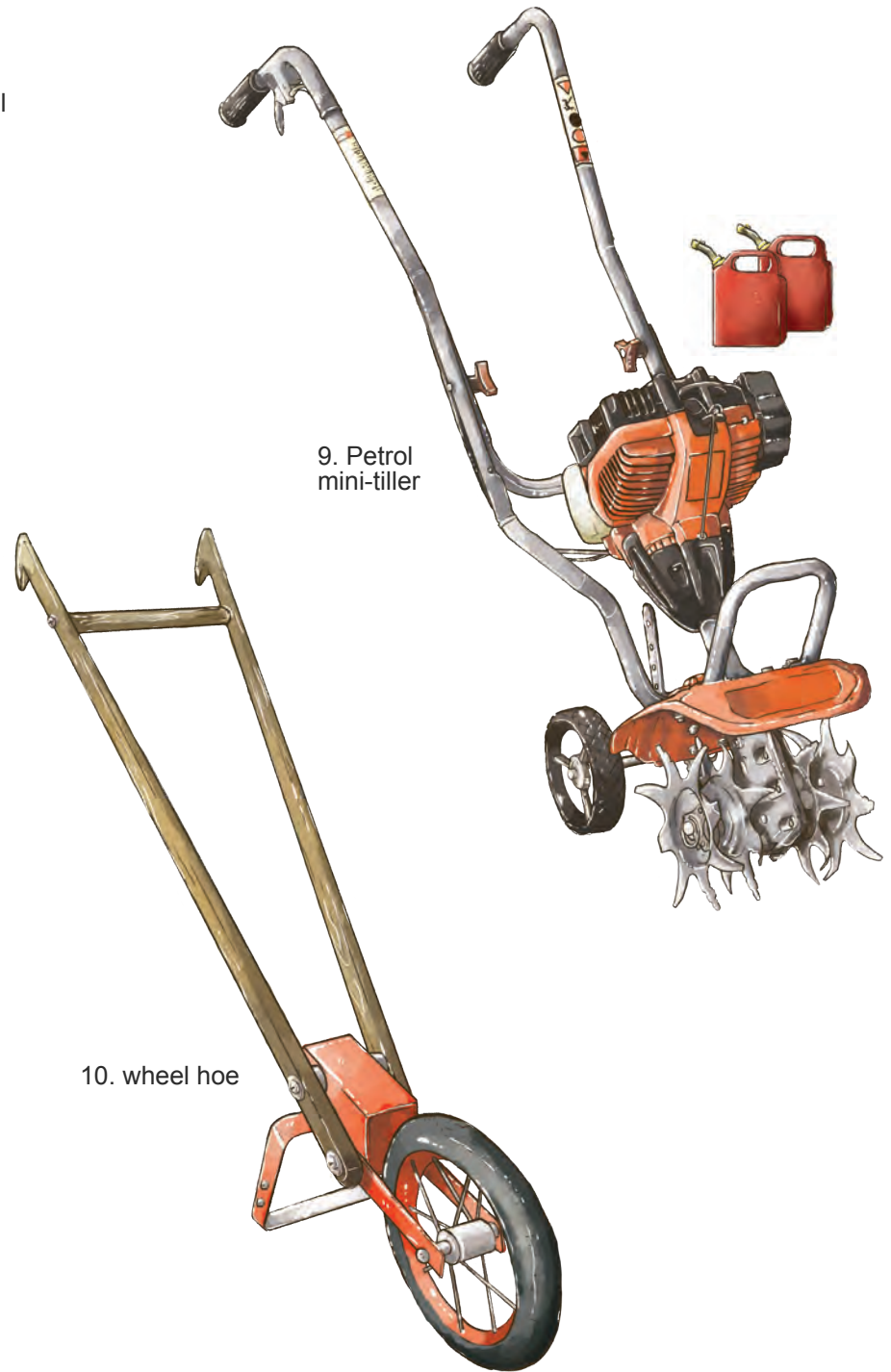
7. Petrol mini-tiller

Lesson: New tools to prepare field: detailed pictures

8. Multiple attachments to one tool



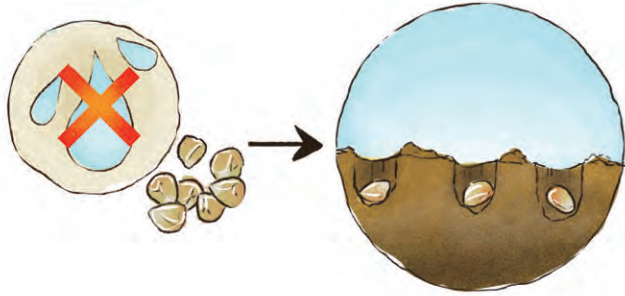
9. Petrol mini-tiller



10. wheel hoe

Lesson: Soaking seeds in water before planting will improve germination and make plants healthier

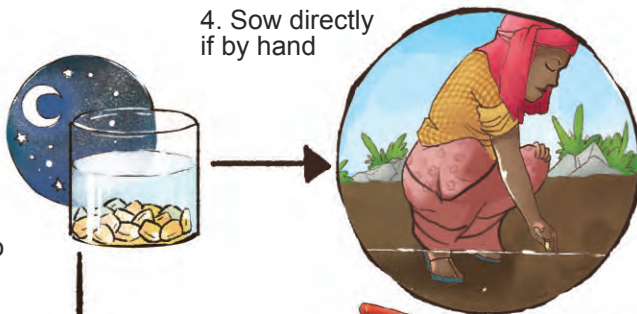
1. Traditional practice is to sow seeds dry



2. Poor germination, sick plants



4. Sow directly if by hand



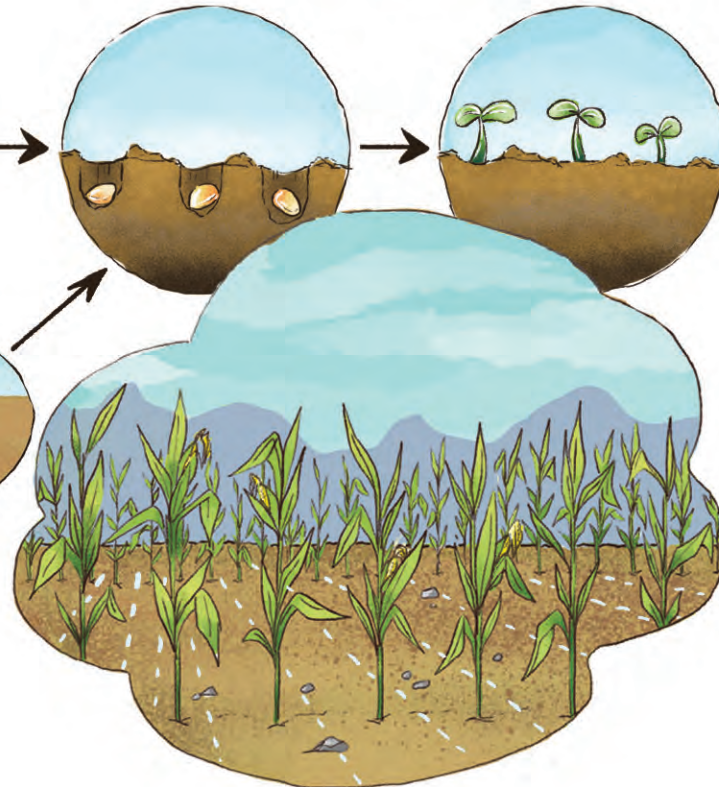
3. Improved practice is to soak seeds overnight first



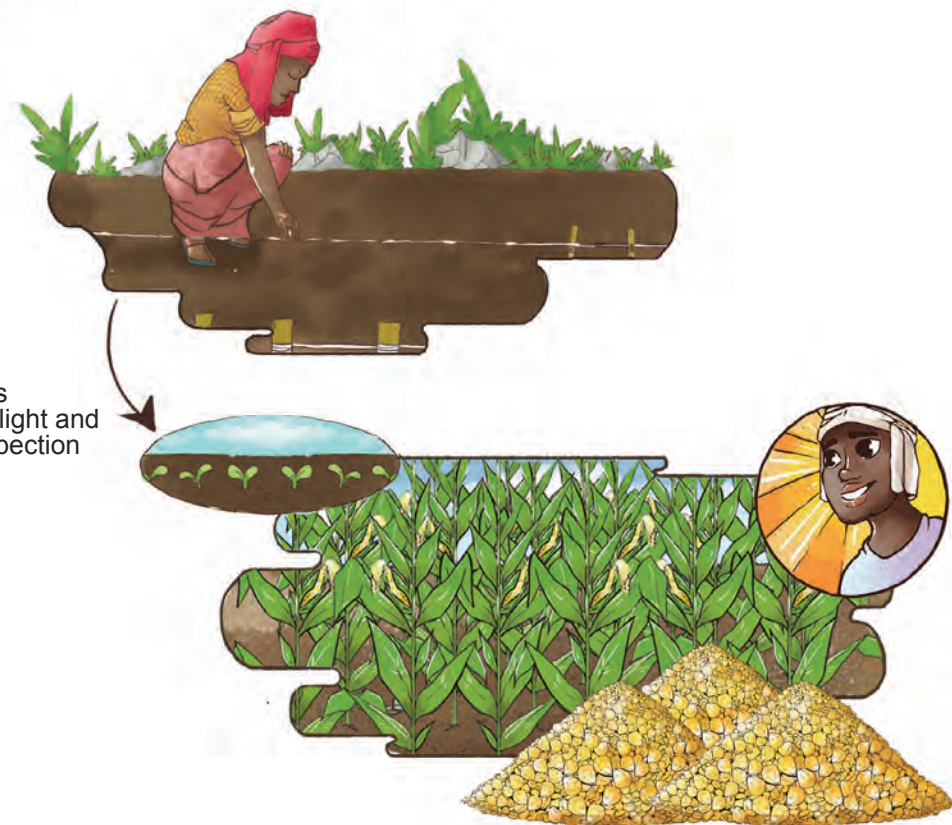
5. Dry seeds if using jab planter



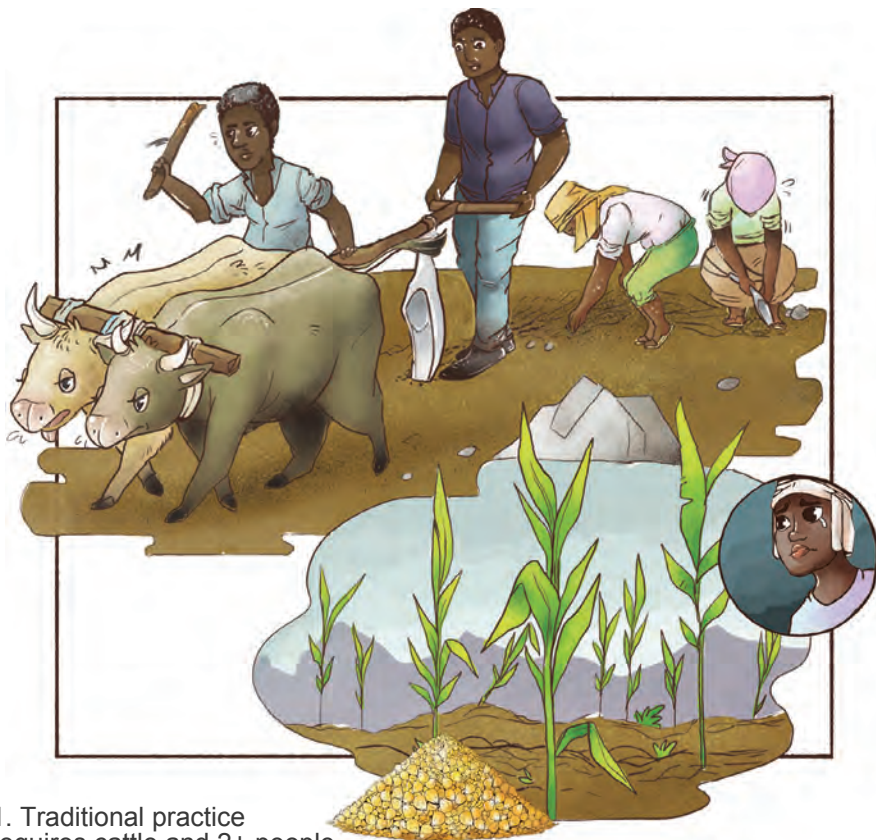
6. Improved germination, healthier plants



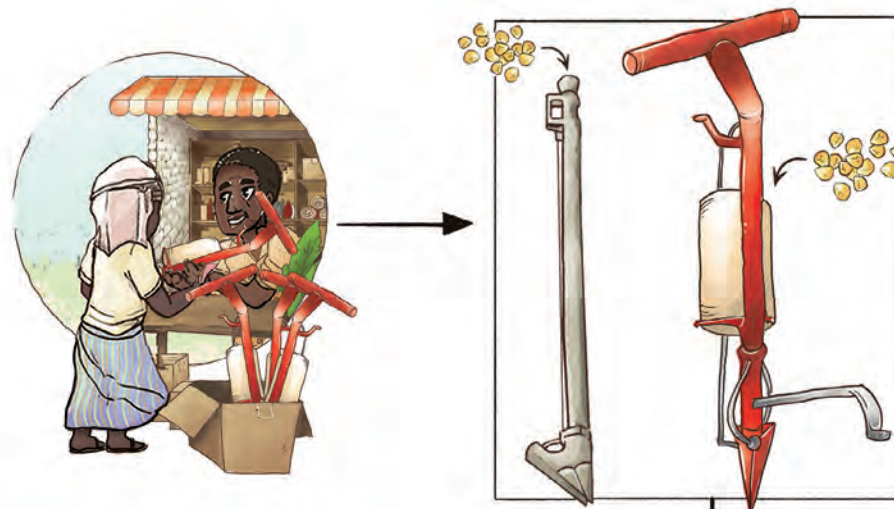
Lesson: Sowing seeds in rows can improve yields compared to broadcasting



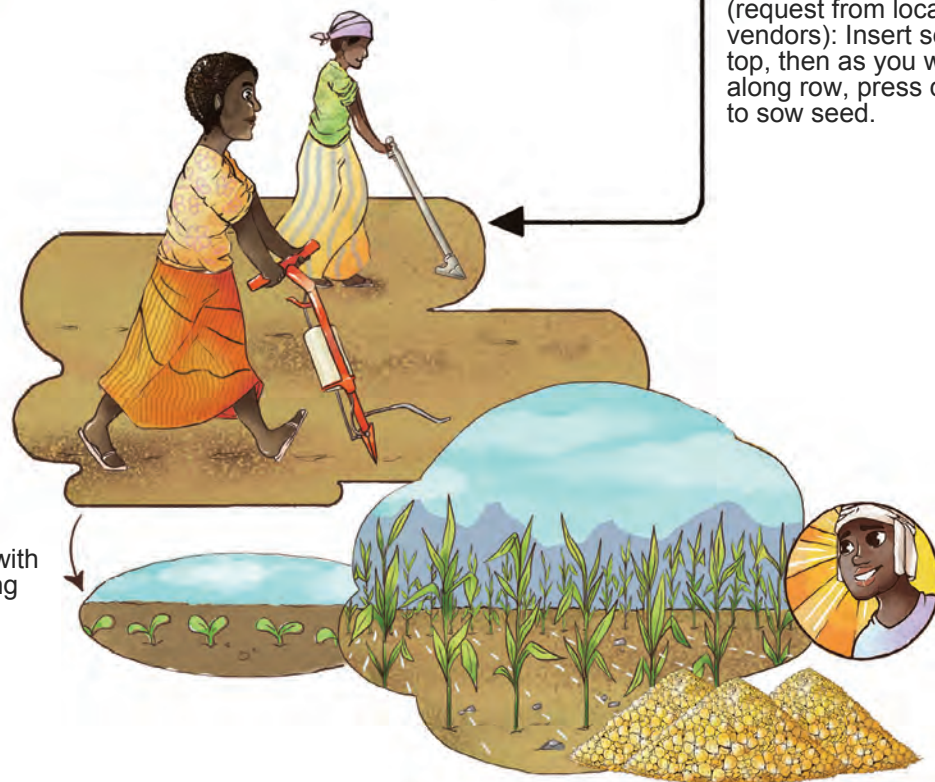
Lesson: A job planter reduces people and livestock required to sow seeds



1. Traditional practice requires cattle and 2+ people. Difficult on steep hillside or narrow terrace.



2. New tool: job planter (request from local vendors): Insert seed at top, then as you walk along row, press down to sow seed.



3. Single person can use

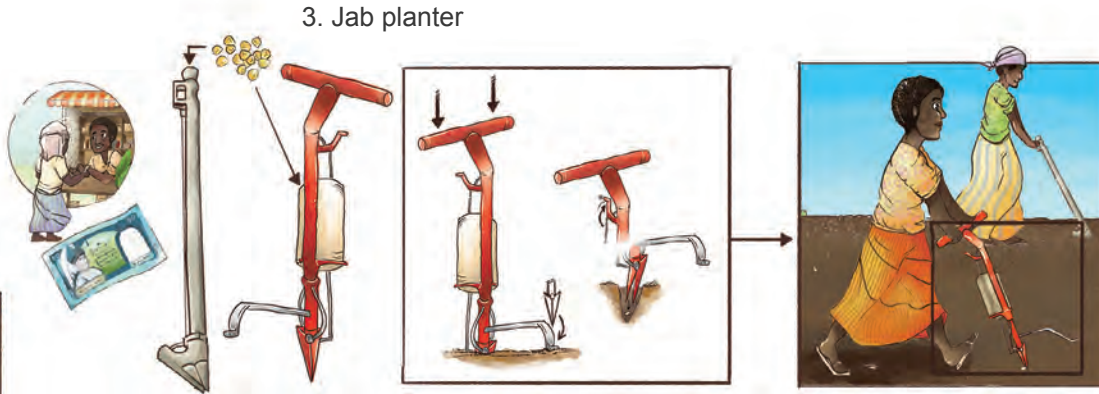
4. Helps with line sowing

Lesson: Tools to sow seeds with less labour

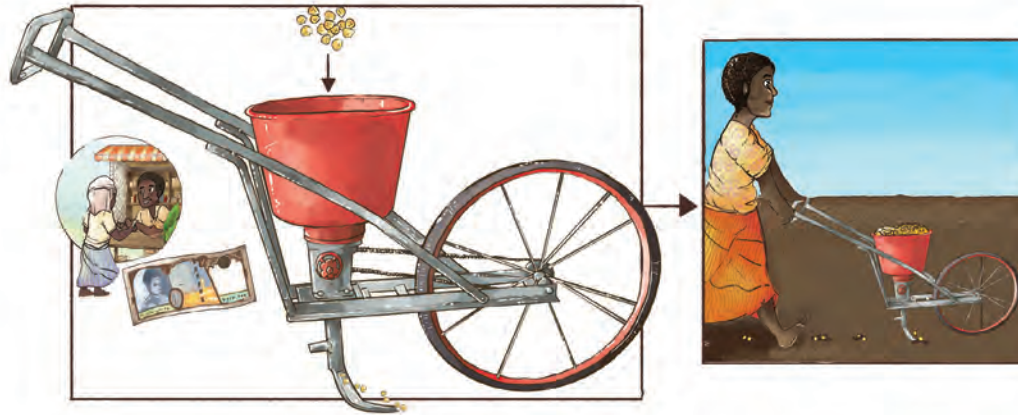
1. Traditional practices



2. New tools: ask local vendor to supply or blacksmith to construct



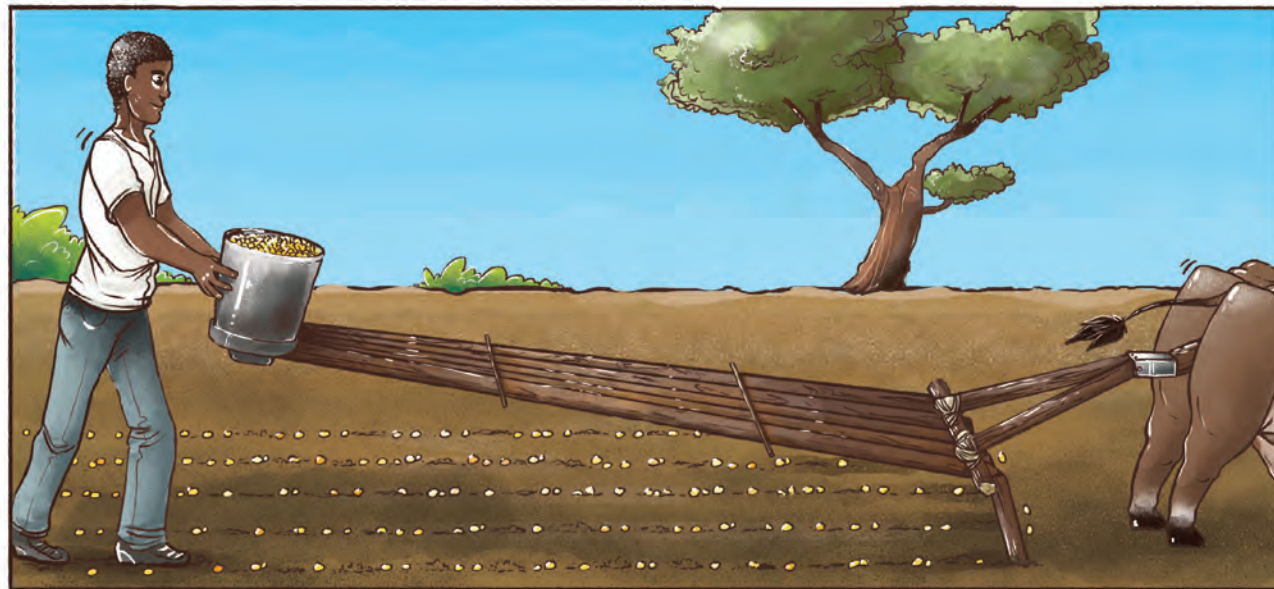
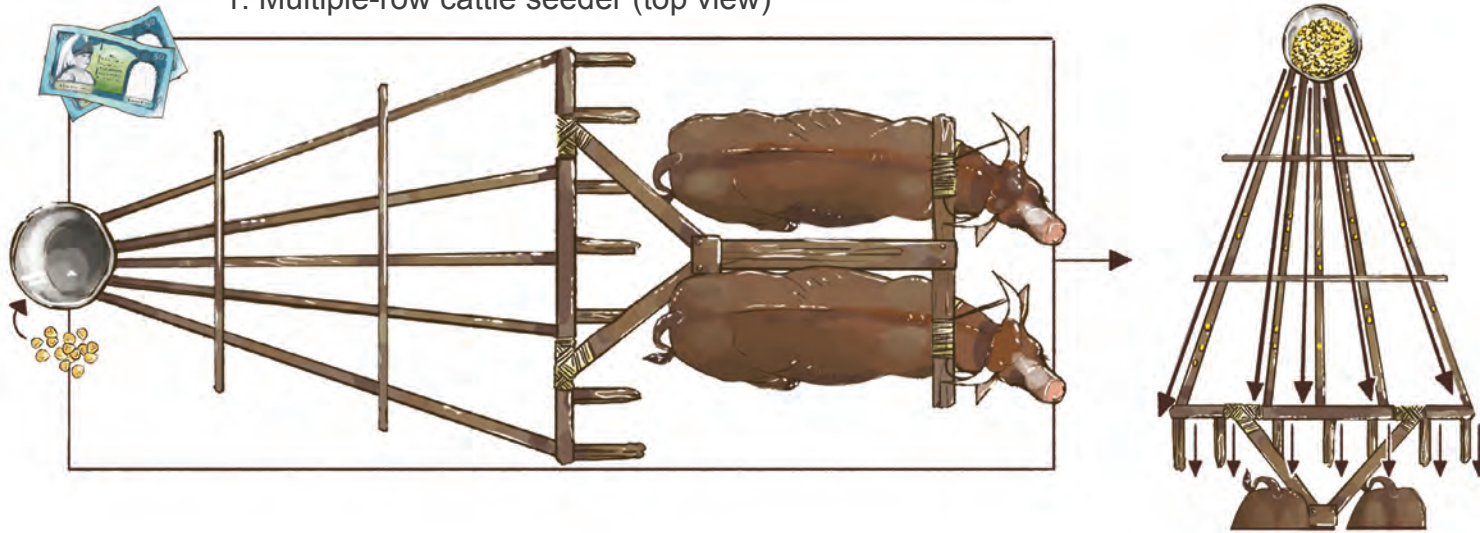
3. Jab planter



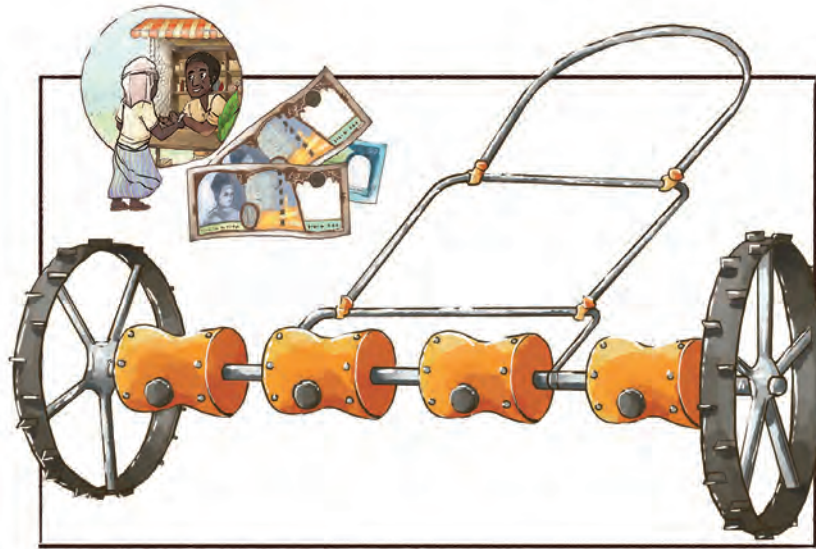
4. Wheel seeder

Lesson: Tools to sow seeds with less labour

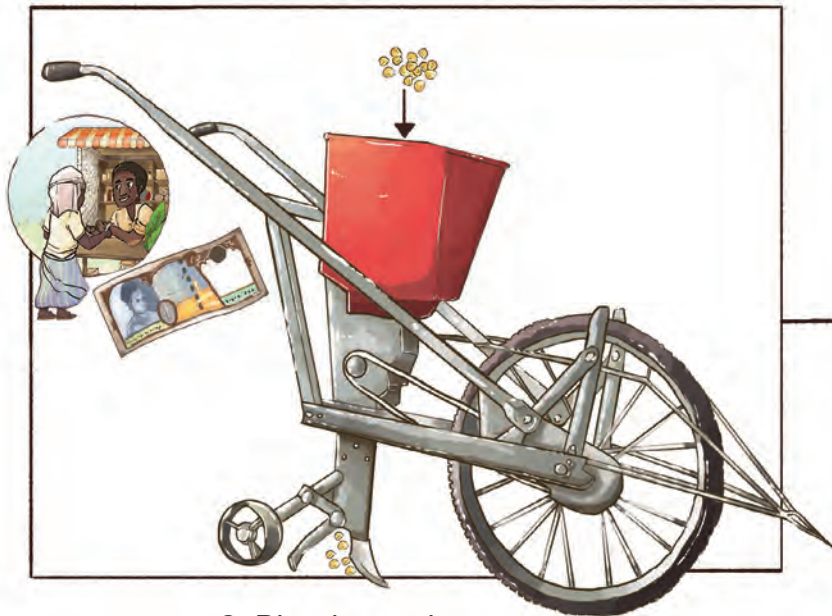
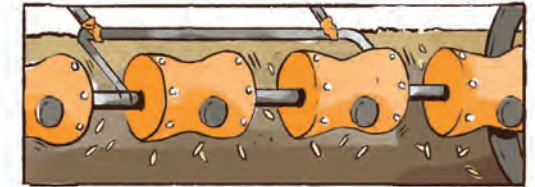
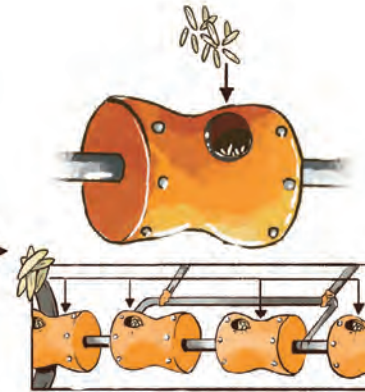
1. Multiple-row cattle seeder (top view)



Lesson: Tools to sow seeds with less labour



1. Four-row wheel seeder for rice

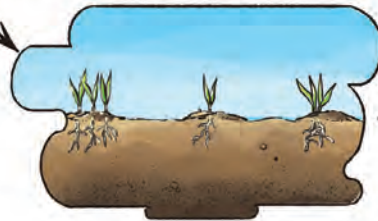
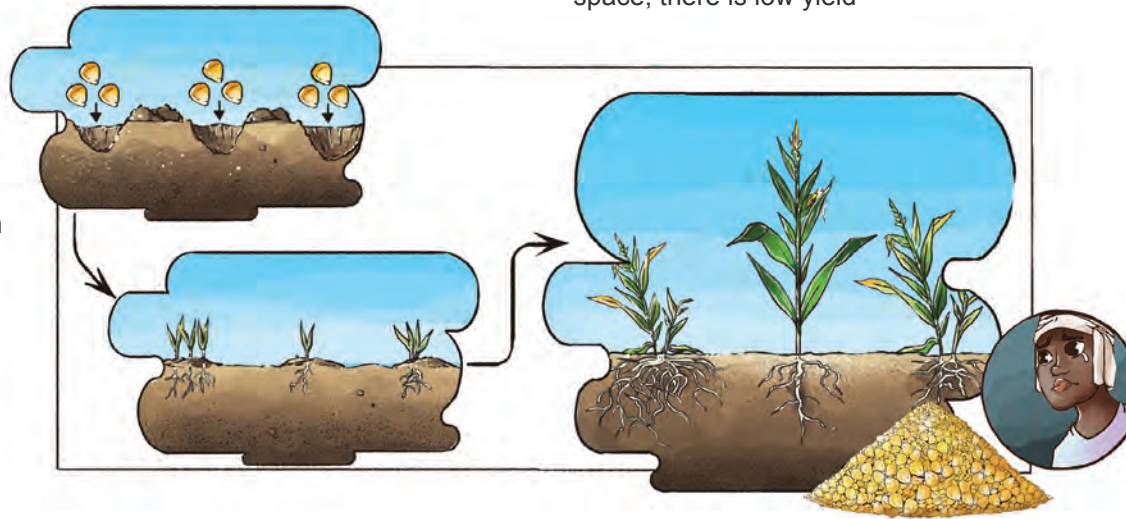


2. Bicycle seeder



Lesson: Thinning seedling number can improve overall yield

1. Traditional practice is to sow 2-3 seeds per hole due to low germination



3. Improved practice: after germination, remove extra plants



4. Overall yield is higher

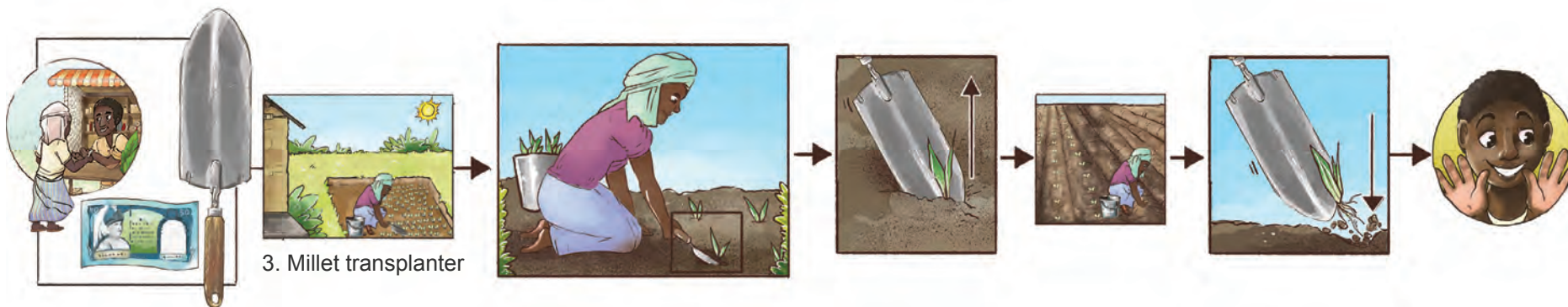


Lesson: Tools to reduce labour required for transplanting seedlings

1. Traditional practice

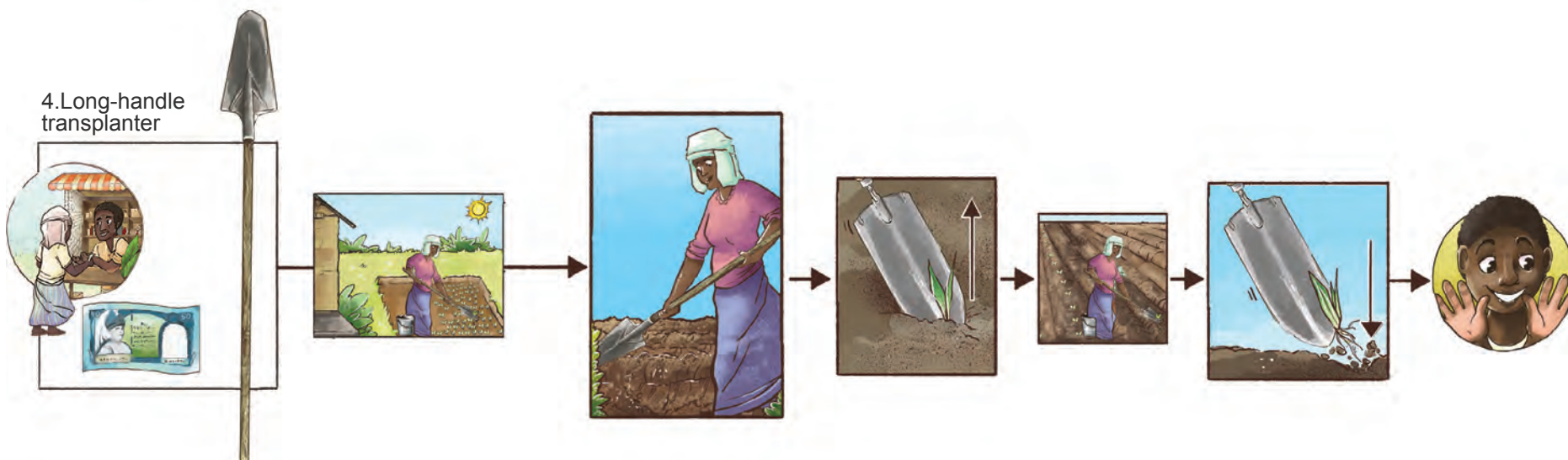


2. New tools: ask local vendor to supply or ask blacksmith to construct



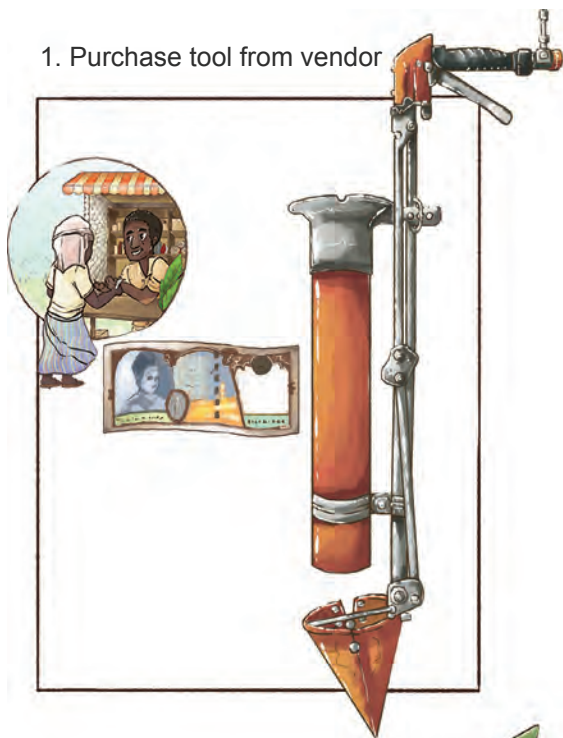
3. Millet transplanter

4. Long-handle transplanter

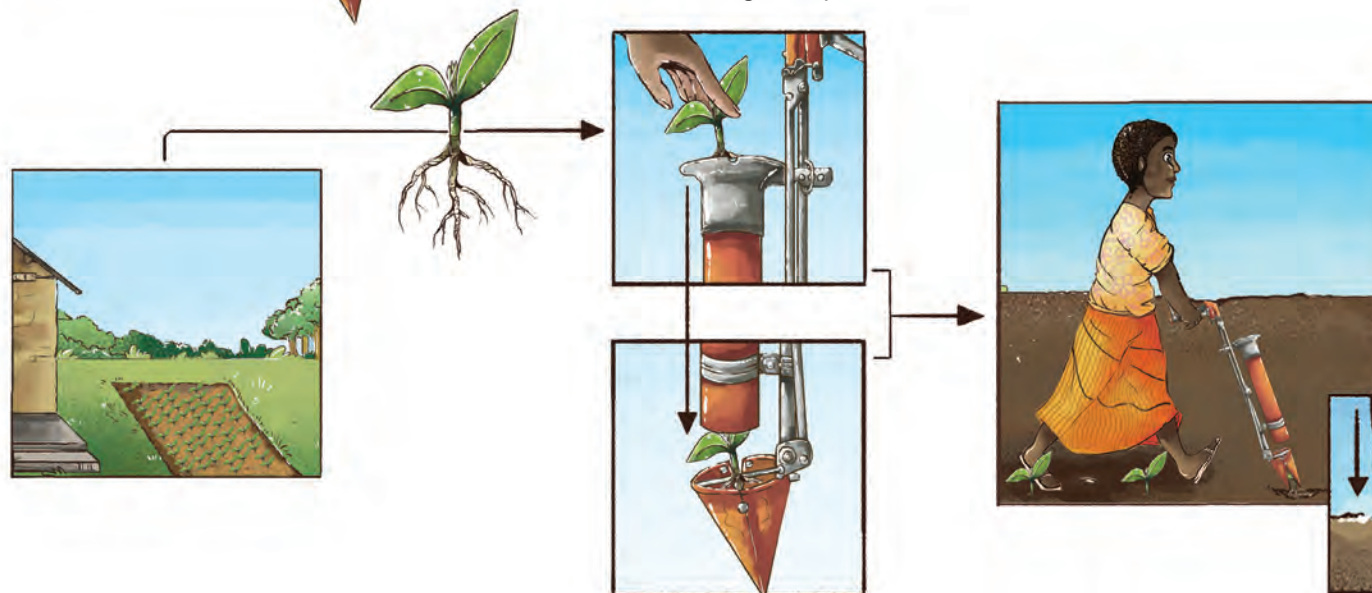


Lesson: Tools to reduce labour required for transplanting vegetable seedlings

1. Purchase tool from vendor



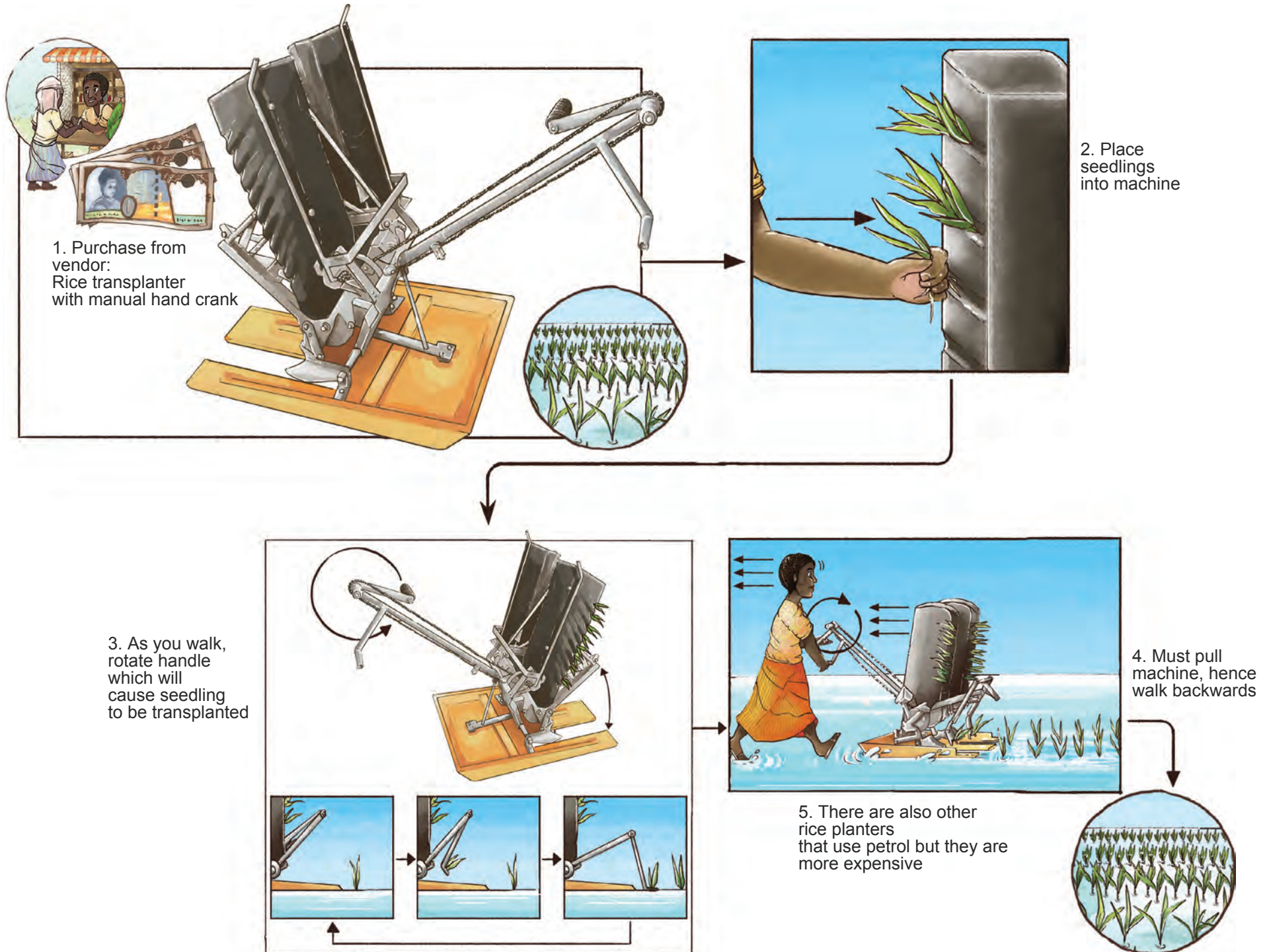
2. Place seedling on top of machine



3. Jab machine into ground, and seedling will be sown

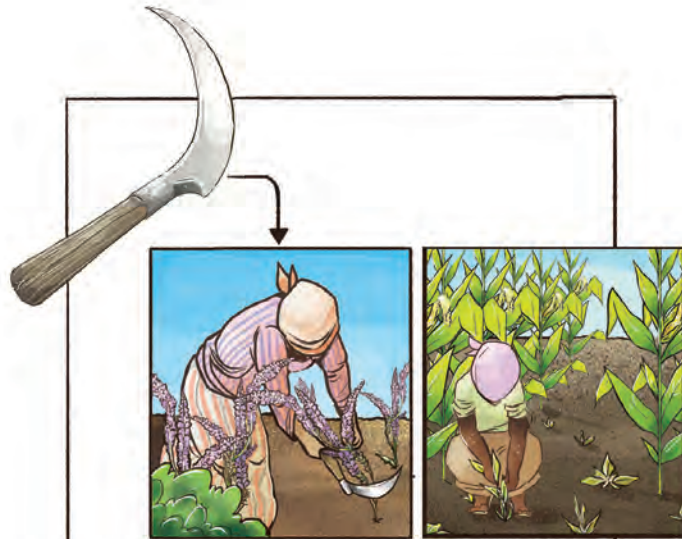


Lesson: Tools to reduce labour required for transplanting paddy rice seedlings

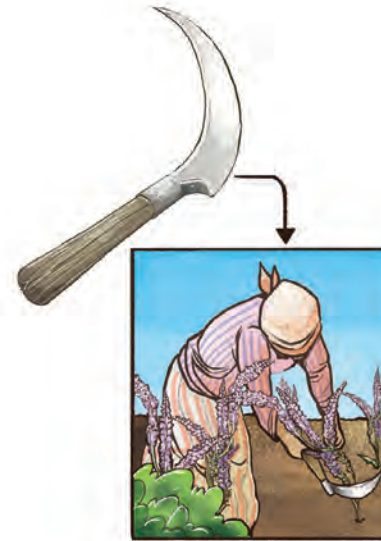
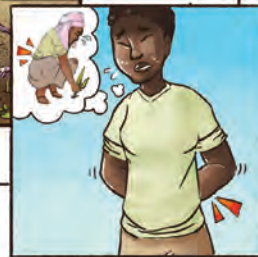


Lesson: A raking tool to help collect weeds, spread manure or other purposes

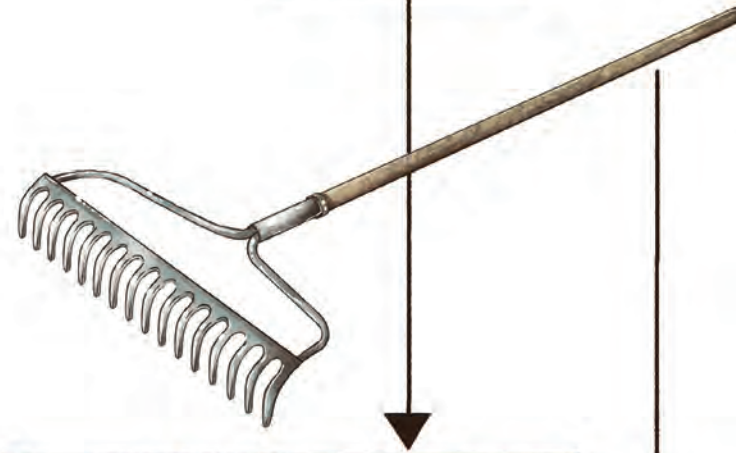
1. Traditional practice



2. Remove cut weeds by hand



3. New tool to remove cut weeds



Lesson: A back support can prevent strain and injury when lifting.

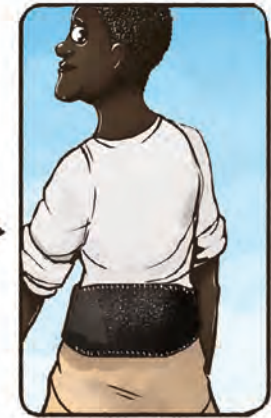
1. Traditional practice



2. Strain to back and pain.



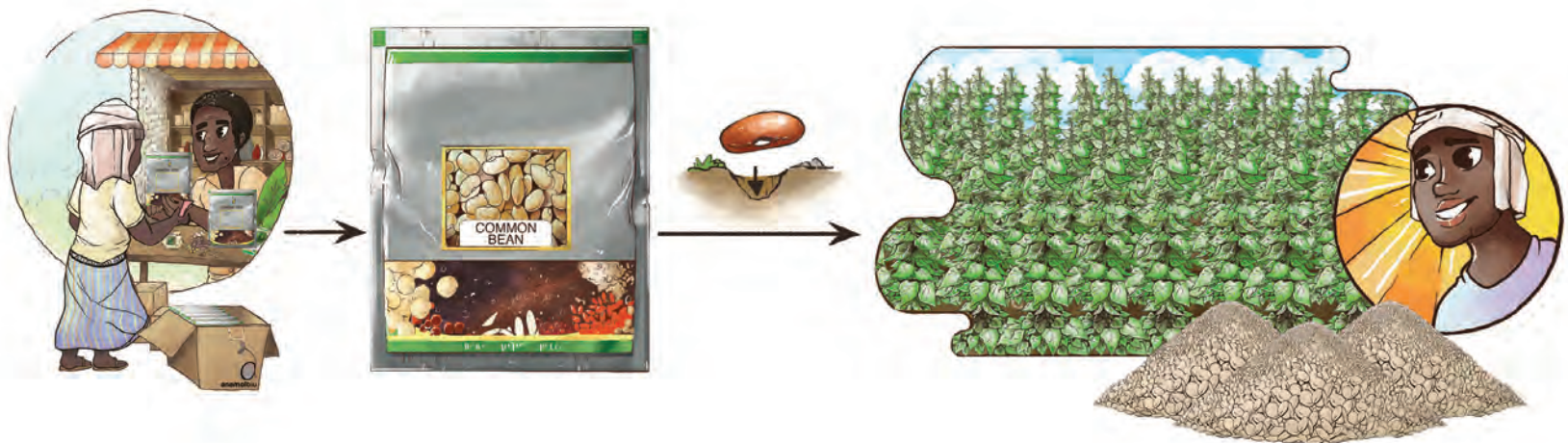
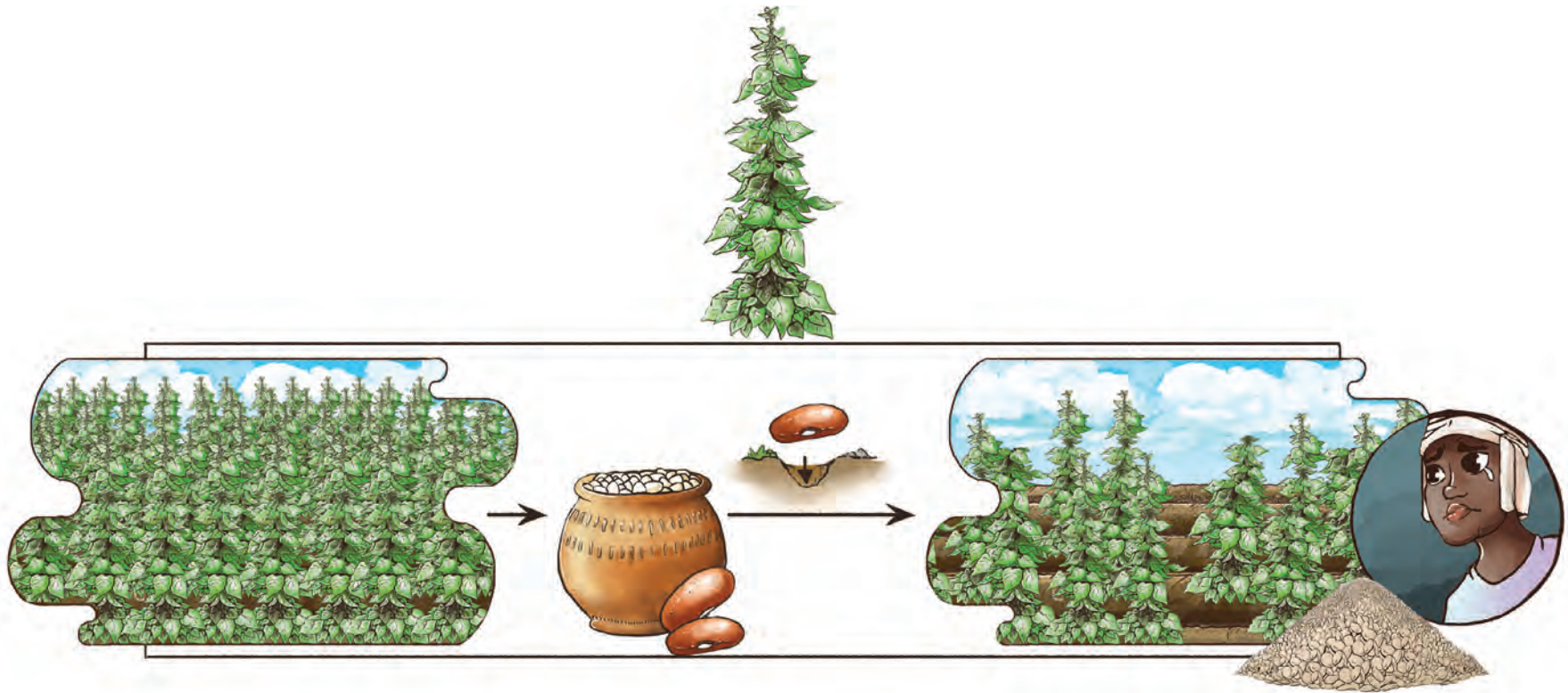
3. Improved practice: purchase a back support from vendor and tie around waist (on top or under clothes)

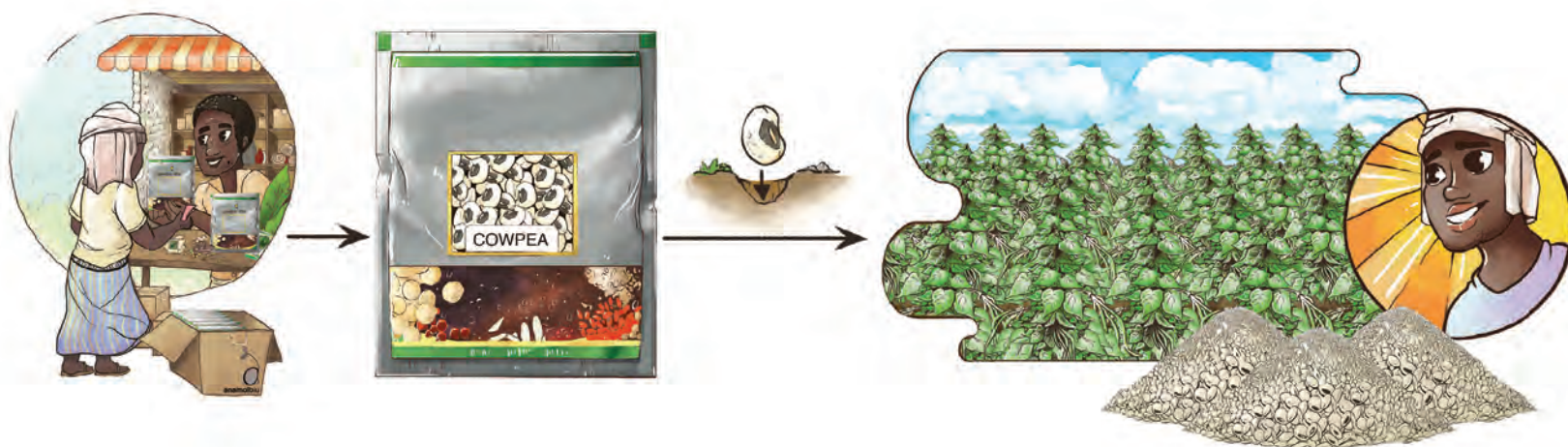
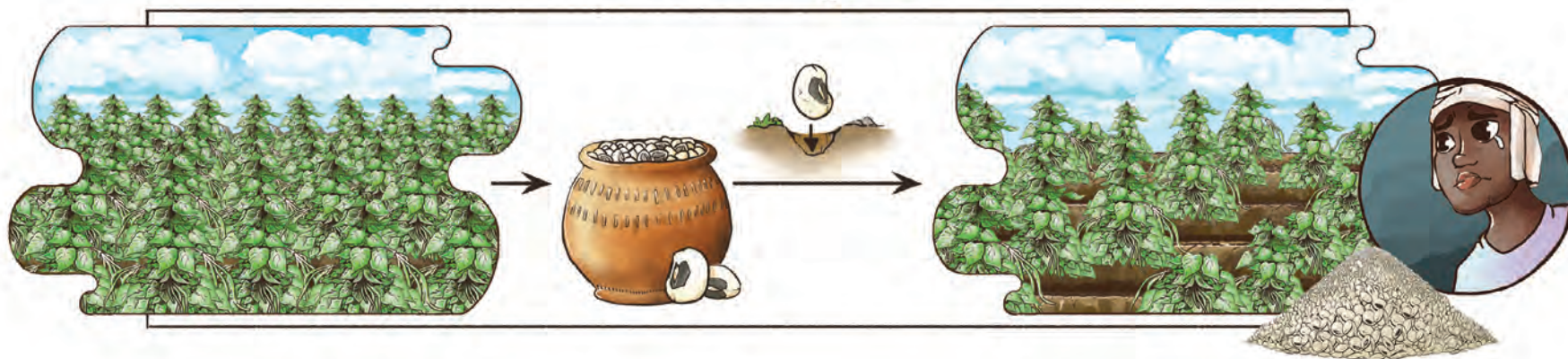


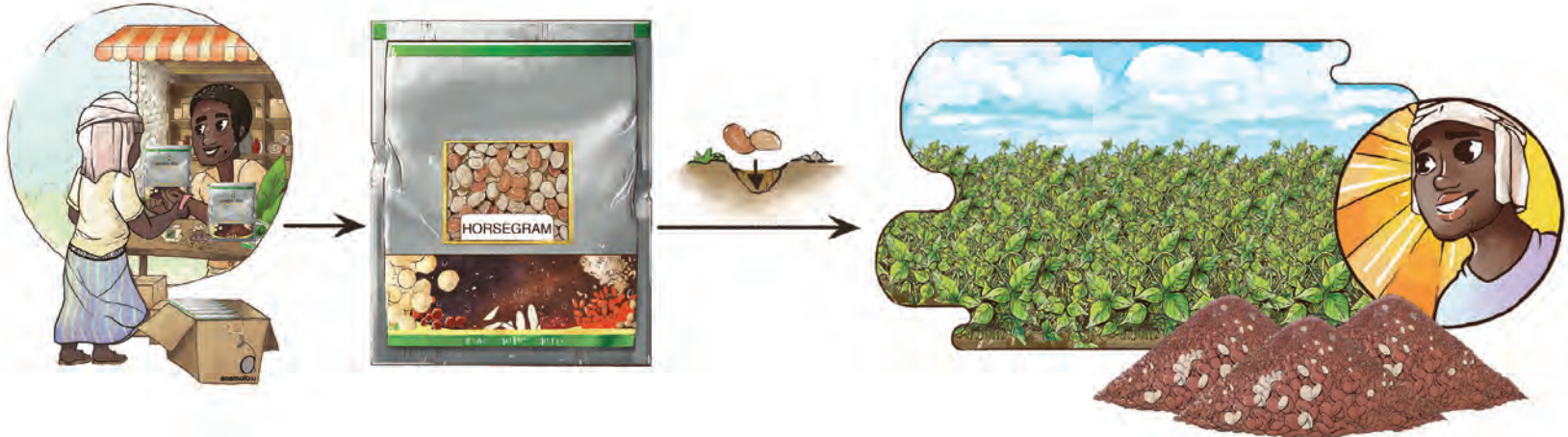
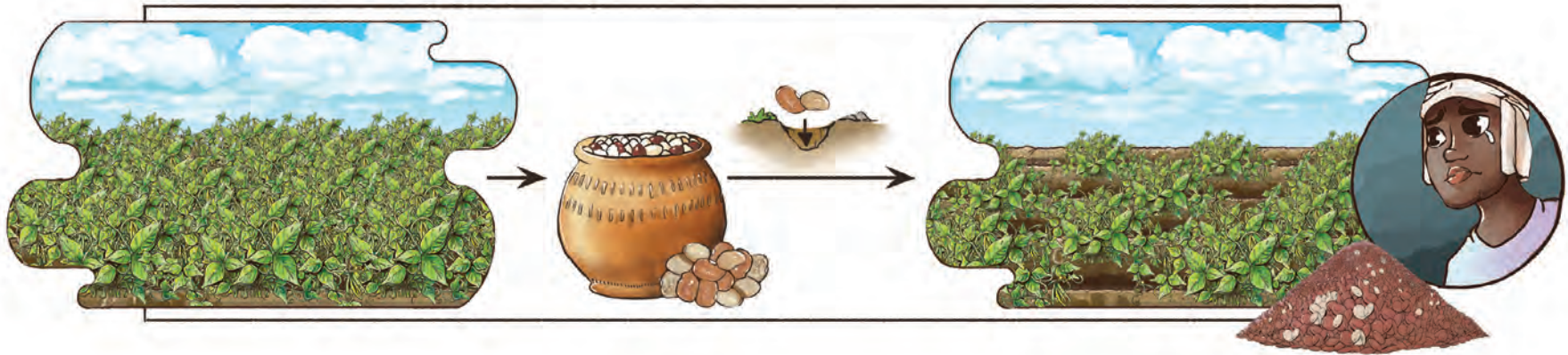
4. Less strain and pain

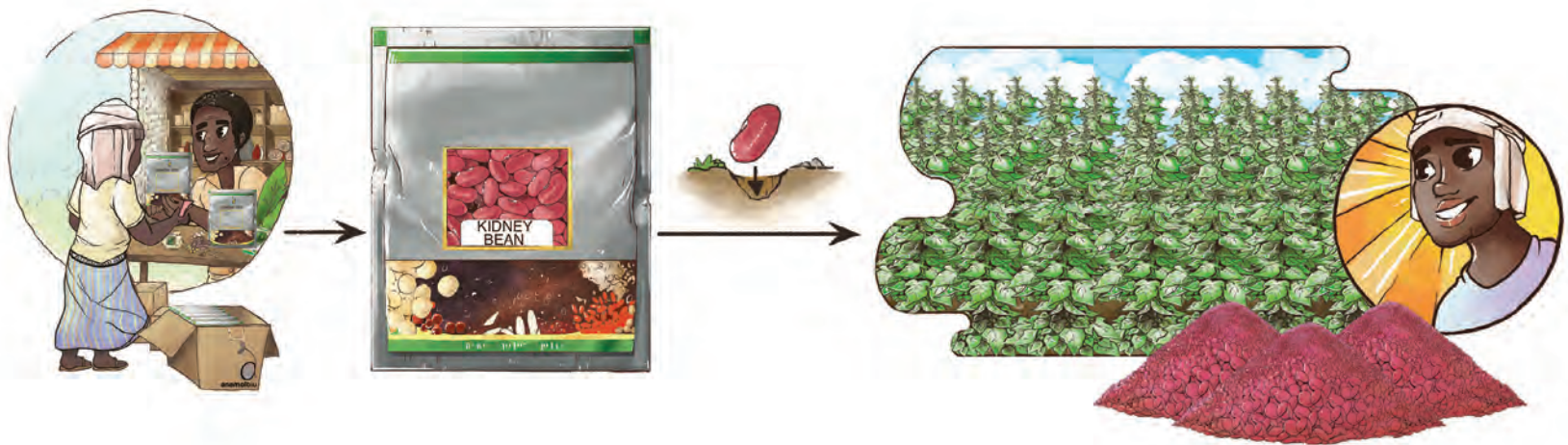
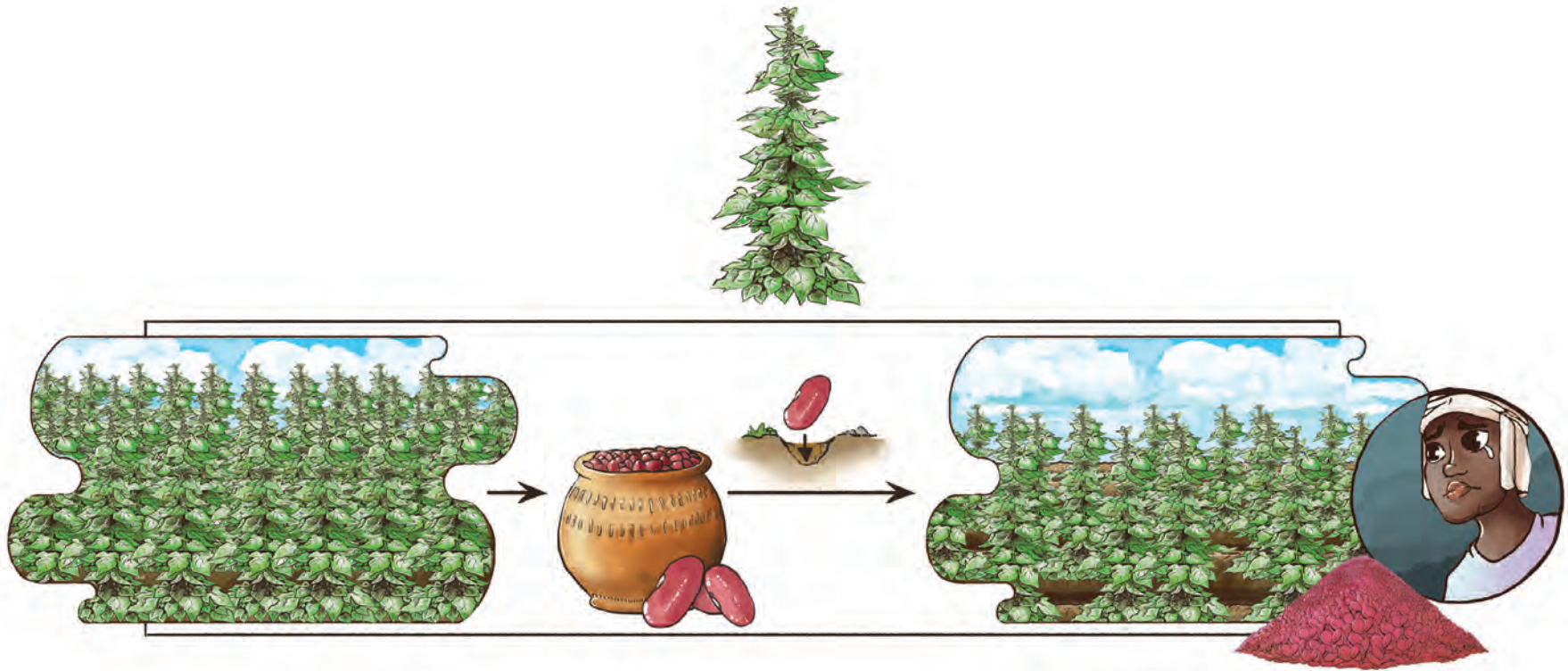


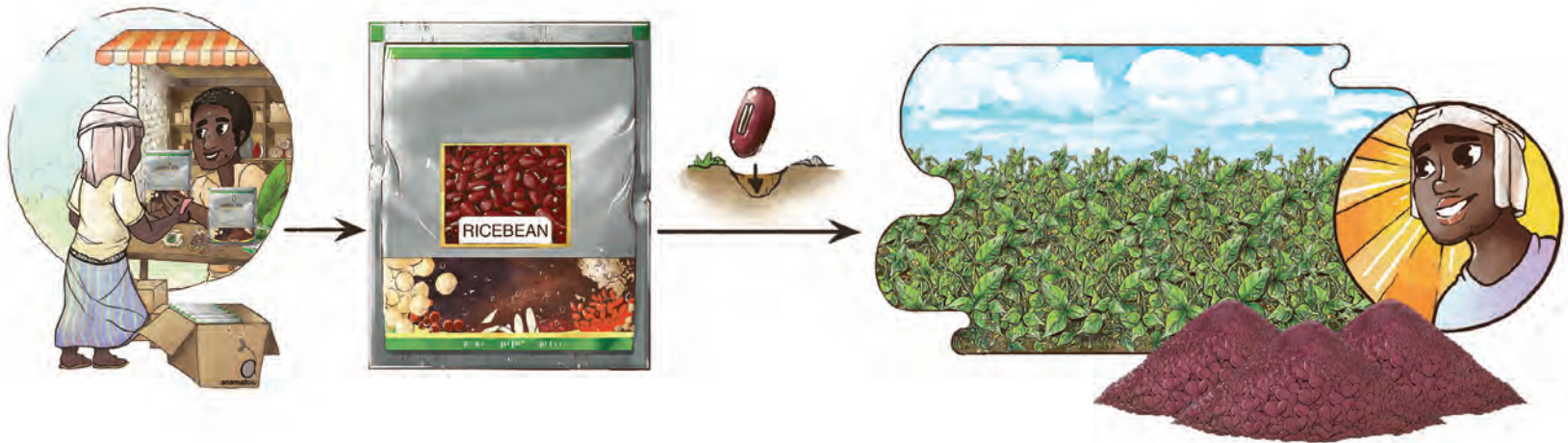
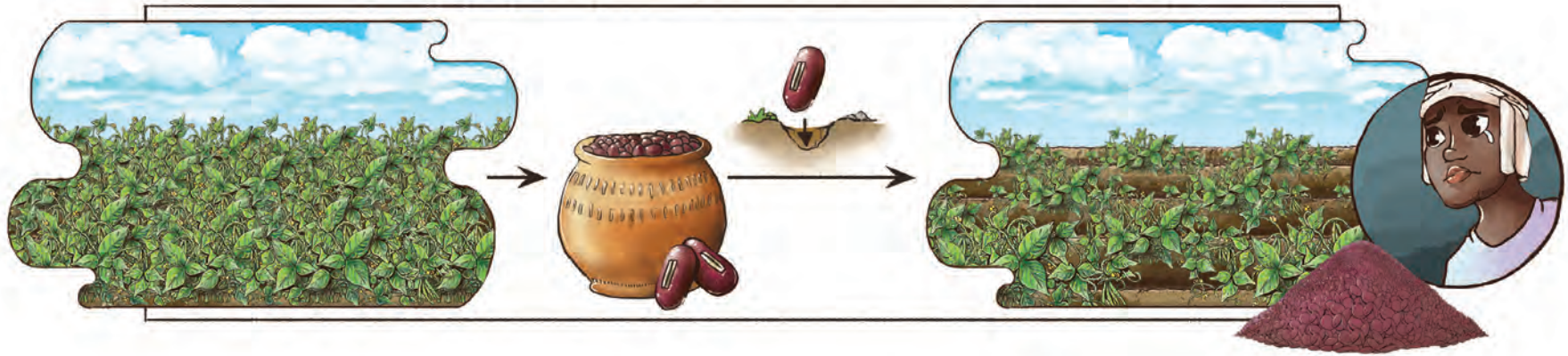
Chapter 3: Crop & Tree Intensification

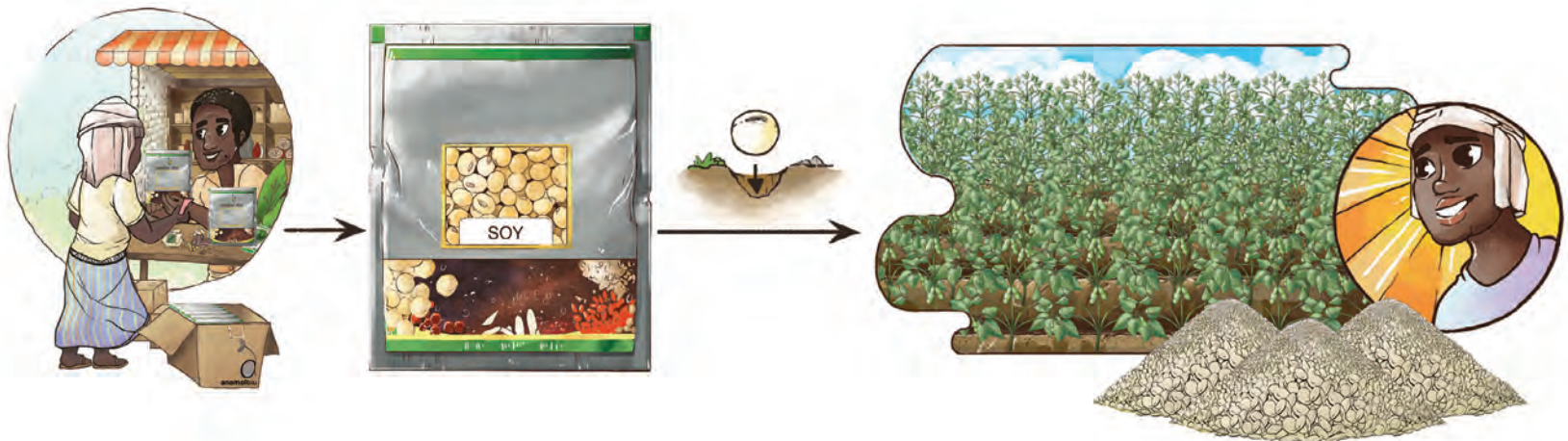
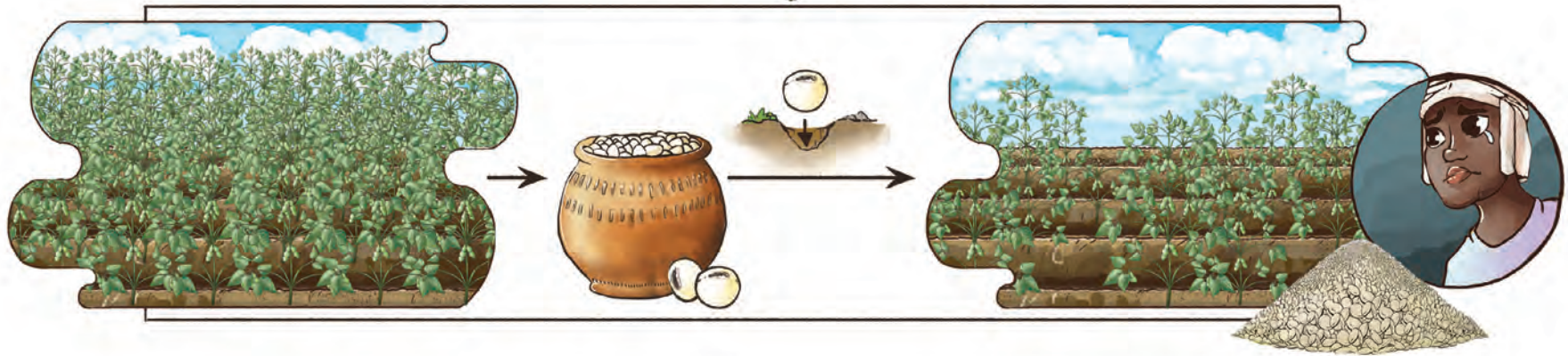






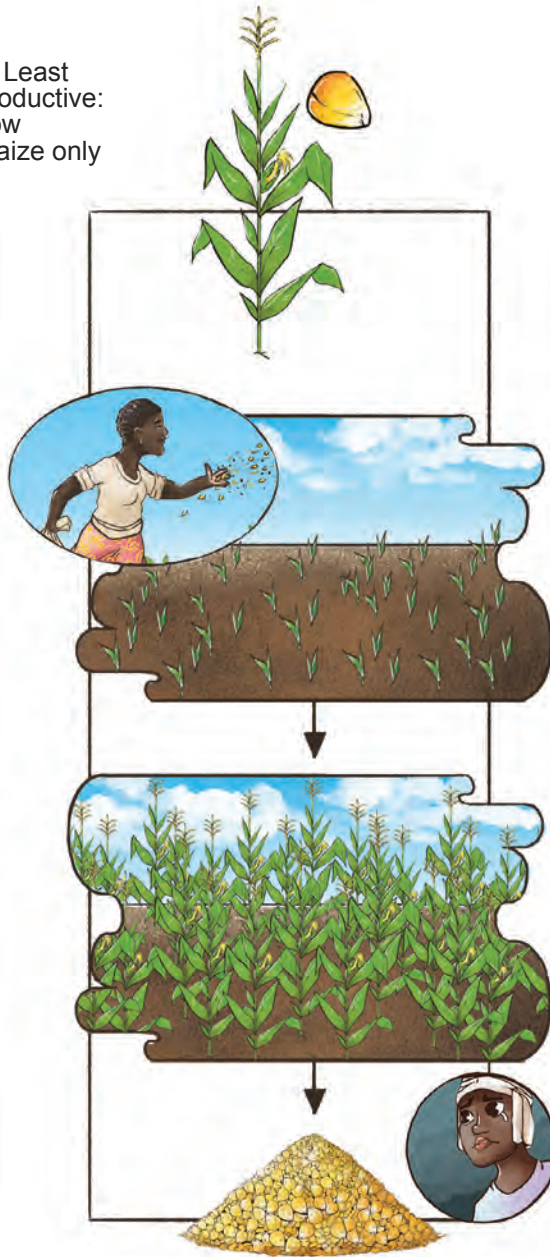




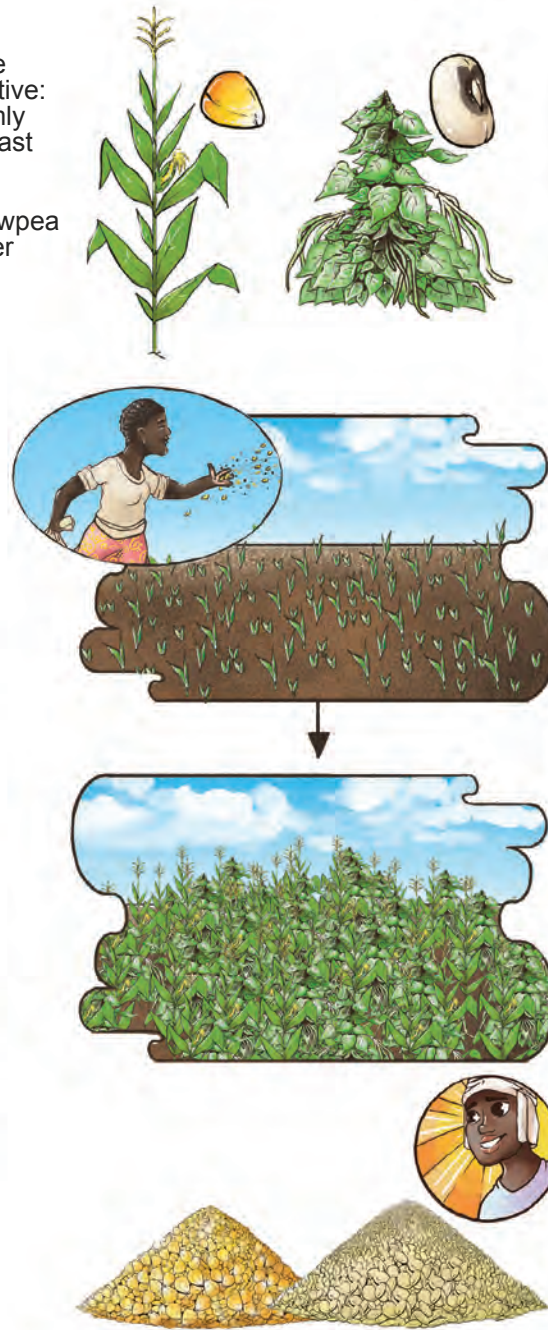


Lesson: Sowing maize together with cowpea will yield more profit than maize only.

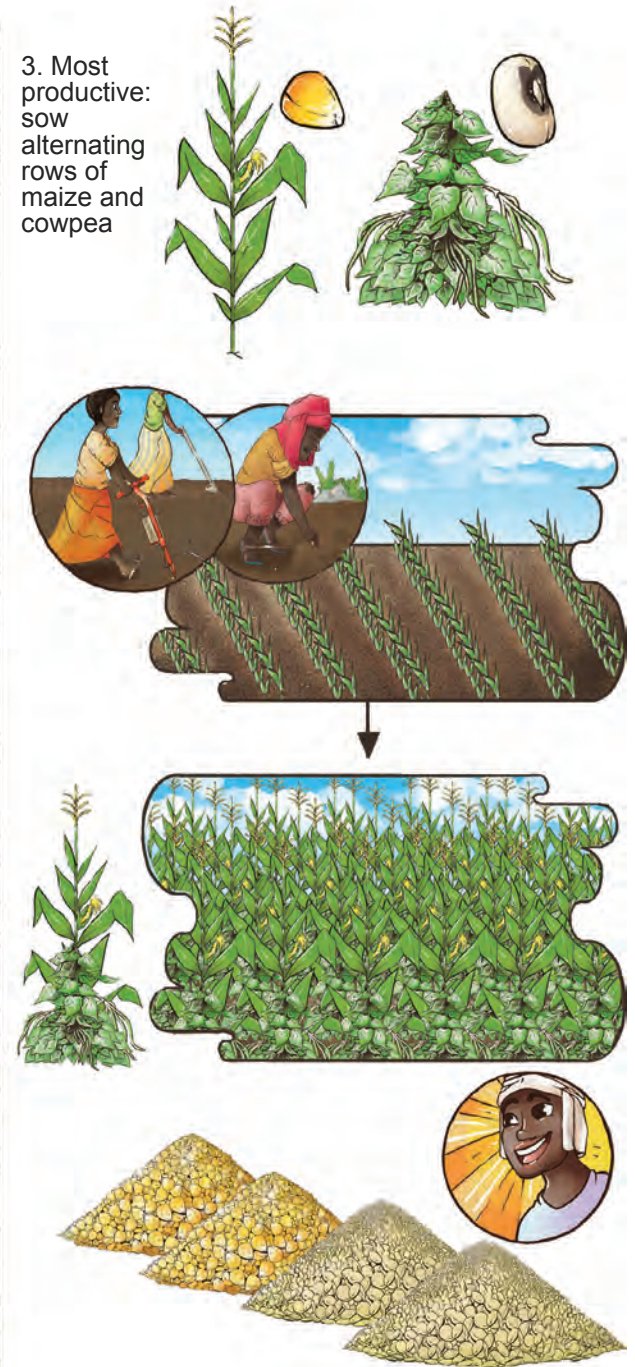
1. Least productive: sow maize only



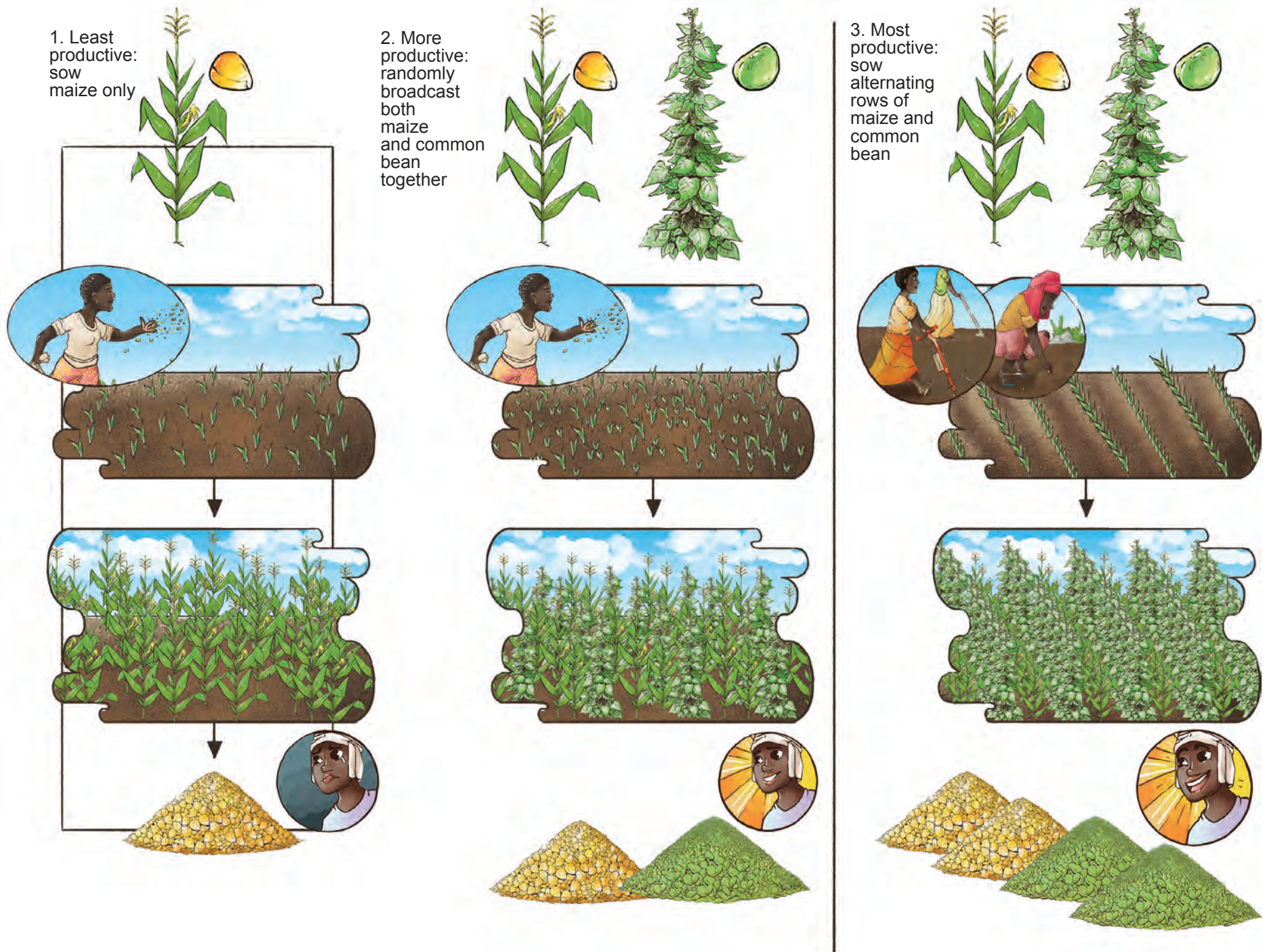
2. More productive: randomly broadcast both maize and cowpea together



3. Most productive: sow alternating rows of maize and cowpea

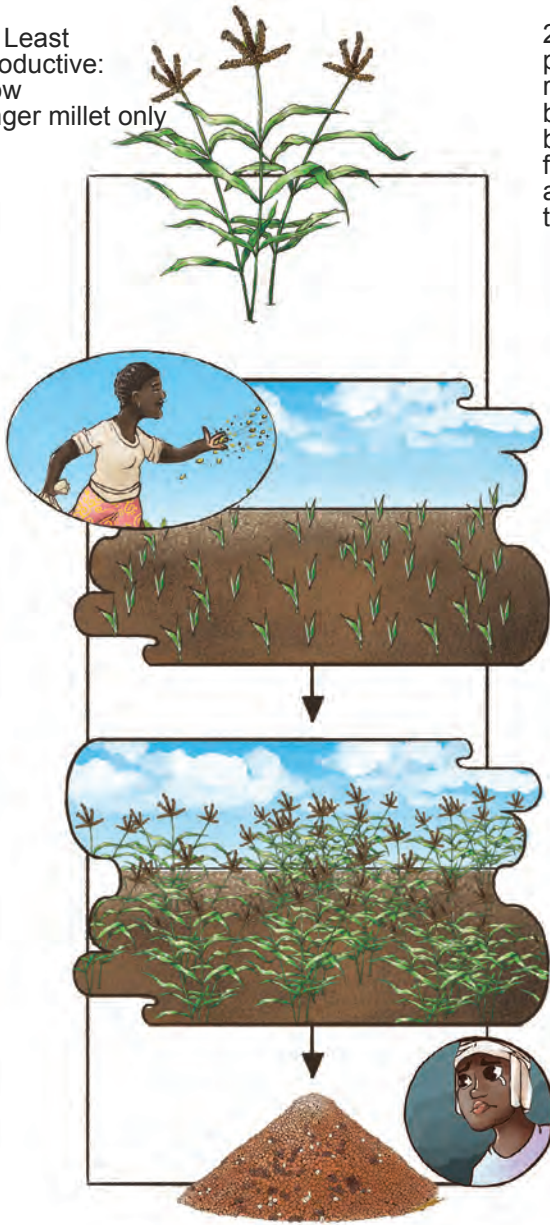


Lesson: Sowing maize together with common bean will yield more profit than maize only.

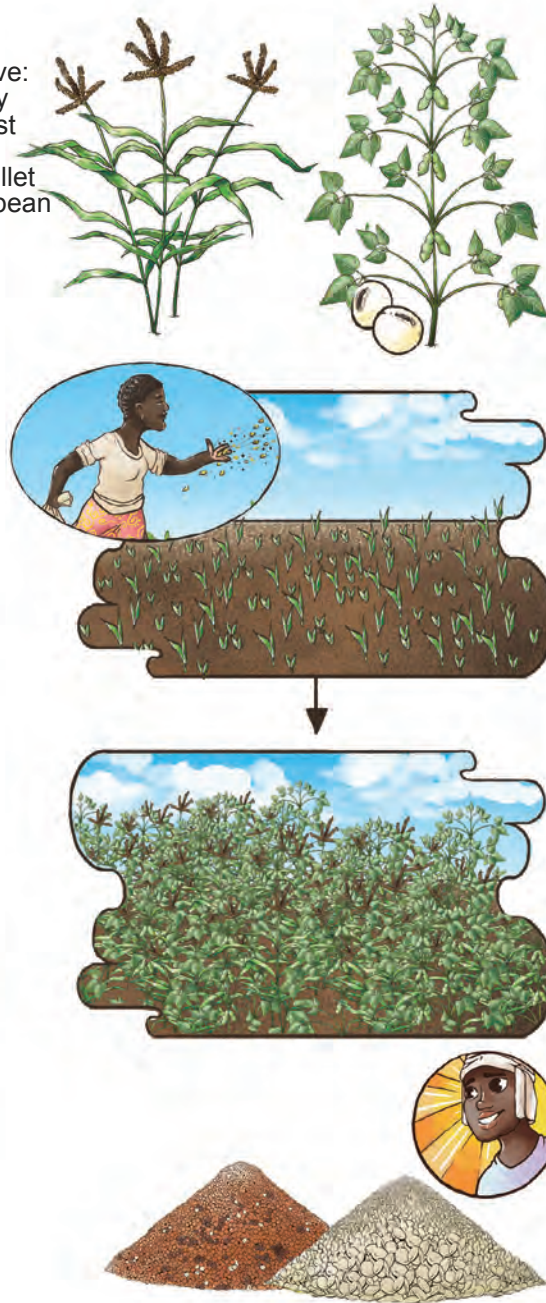


Lesson: Sowing finger millet together with soybean will yield more profit than millet only.

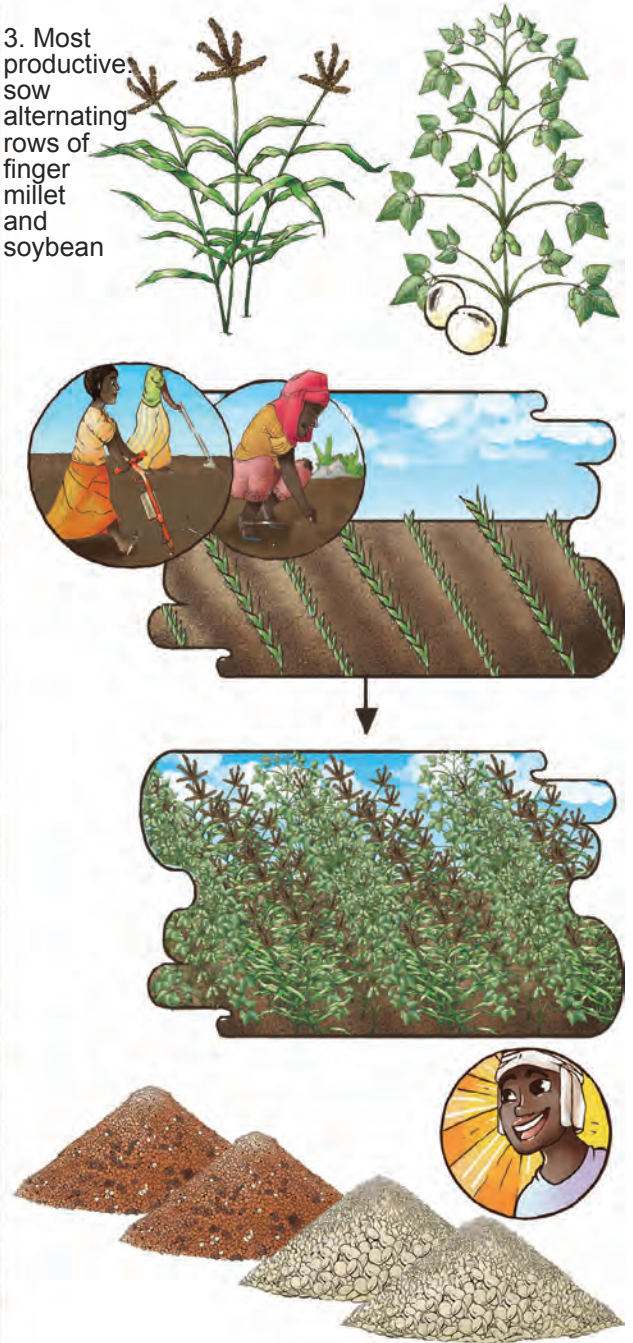
1. Least productive: sow finger millet only



2. More productive: randomly broadcast both finger millet and soybean together

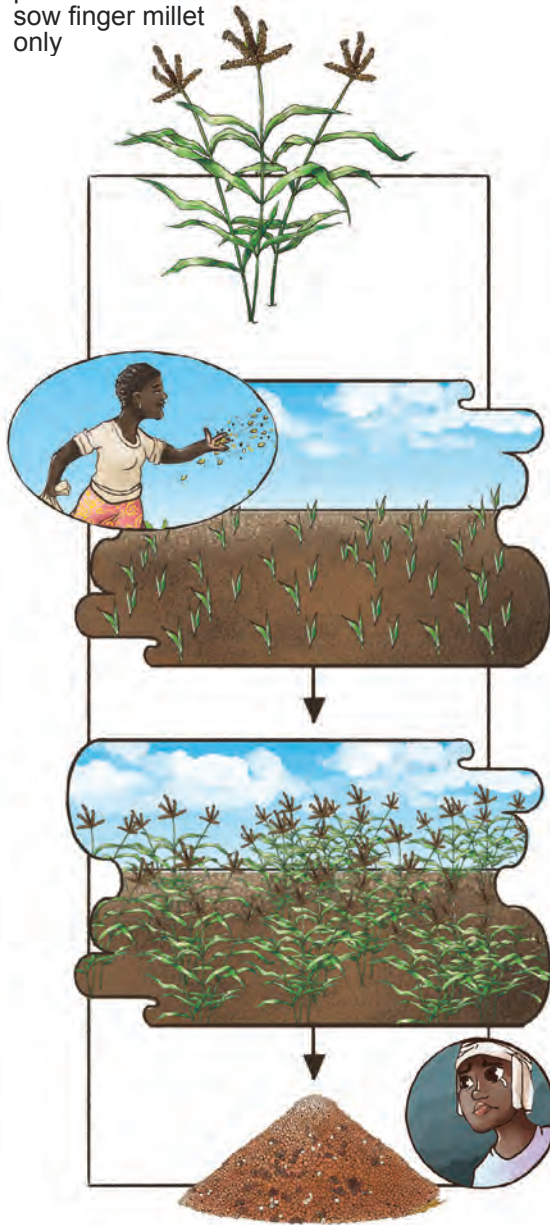


3. Most productive: sow alternating rows of finger millet and soybean

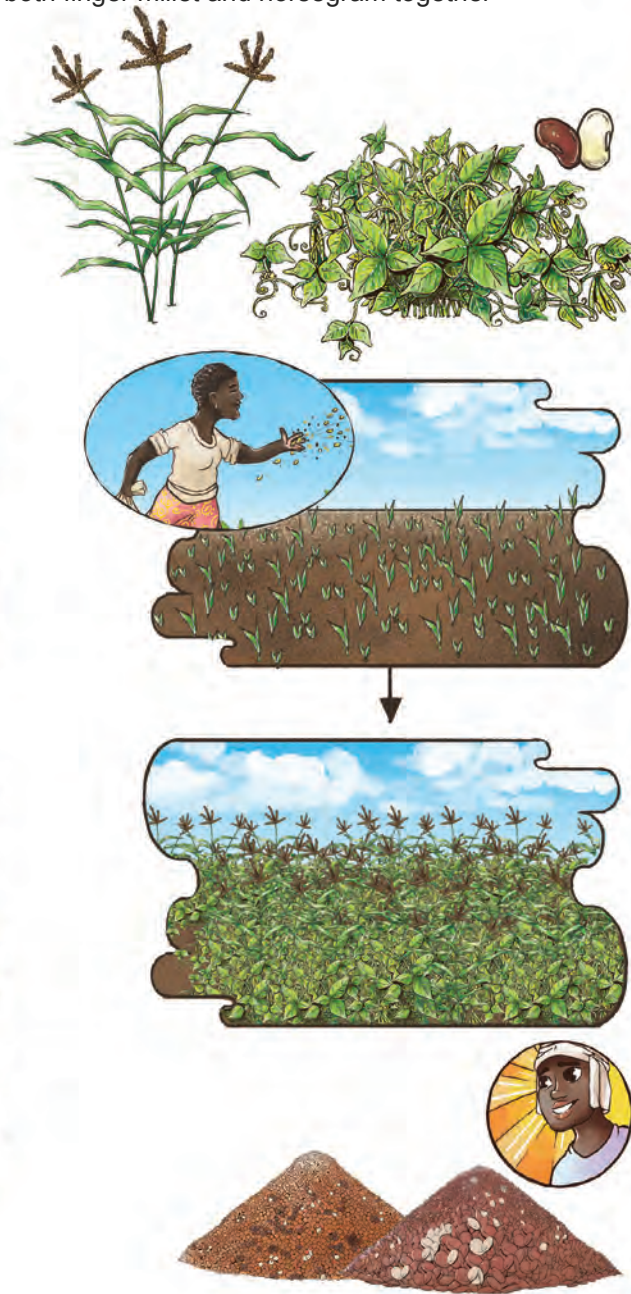


Lesson: Sowing finger millet together with horsegram will yield more profit than millet only.

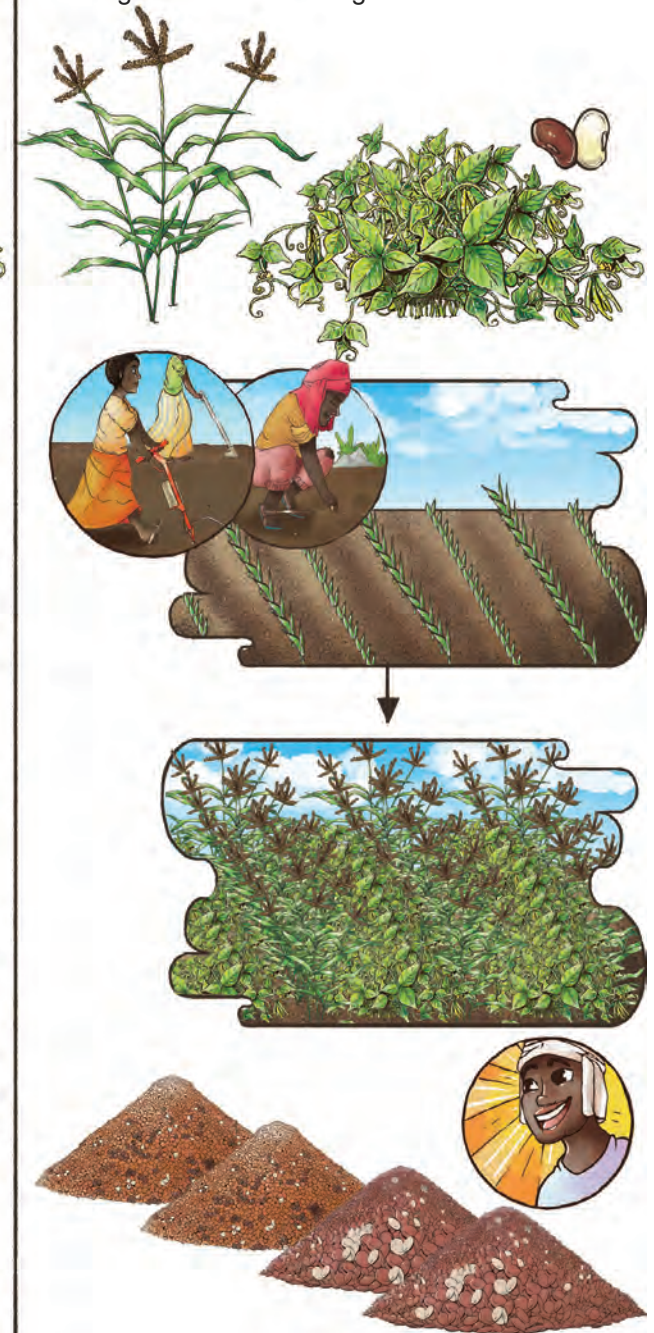
1. Least productive: sow finger millet only



2. More productive: randomly broadcast both finger millet and horsegram together

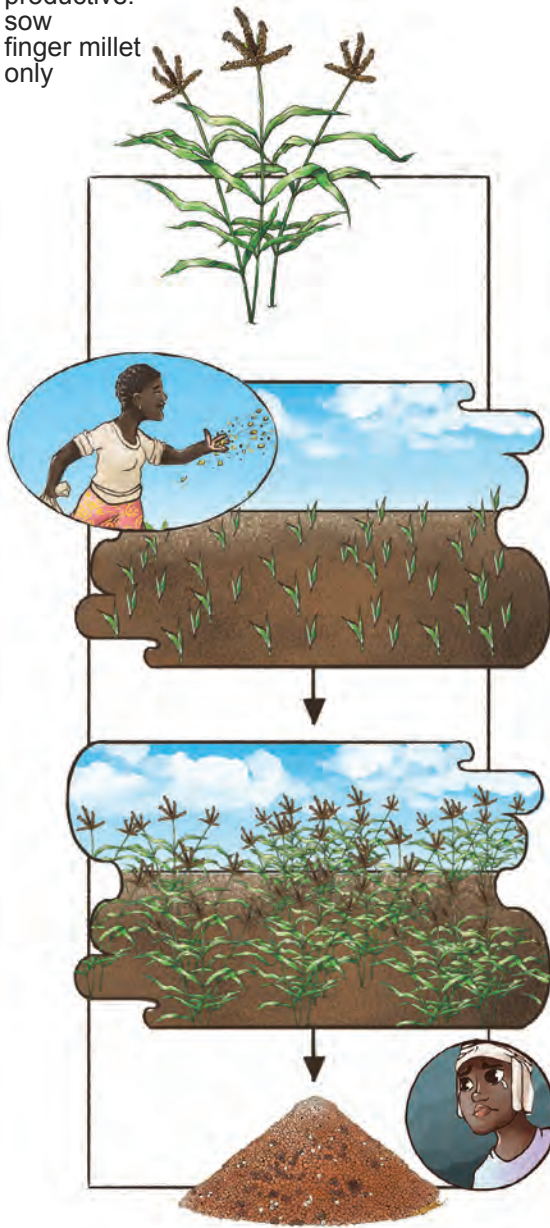


3. Most productive: sow alternating rows of finger millet and horsegram

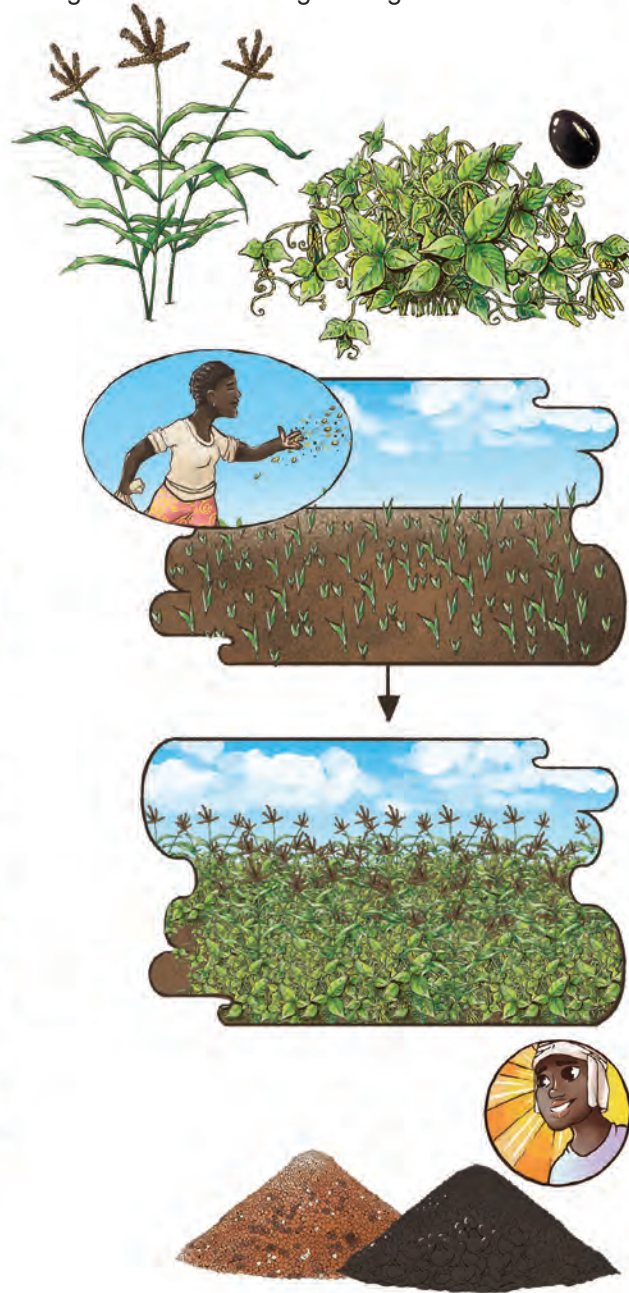


Lesson: Sowing finger millet together with blackgram will yield more profit than millet only.

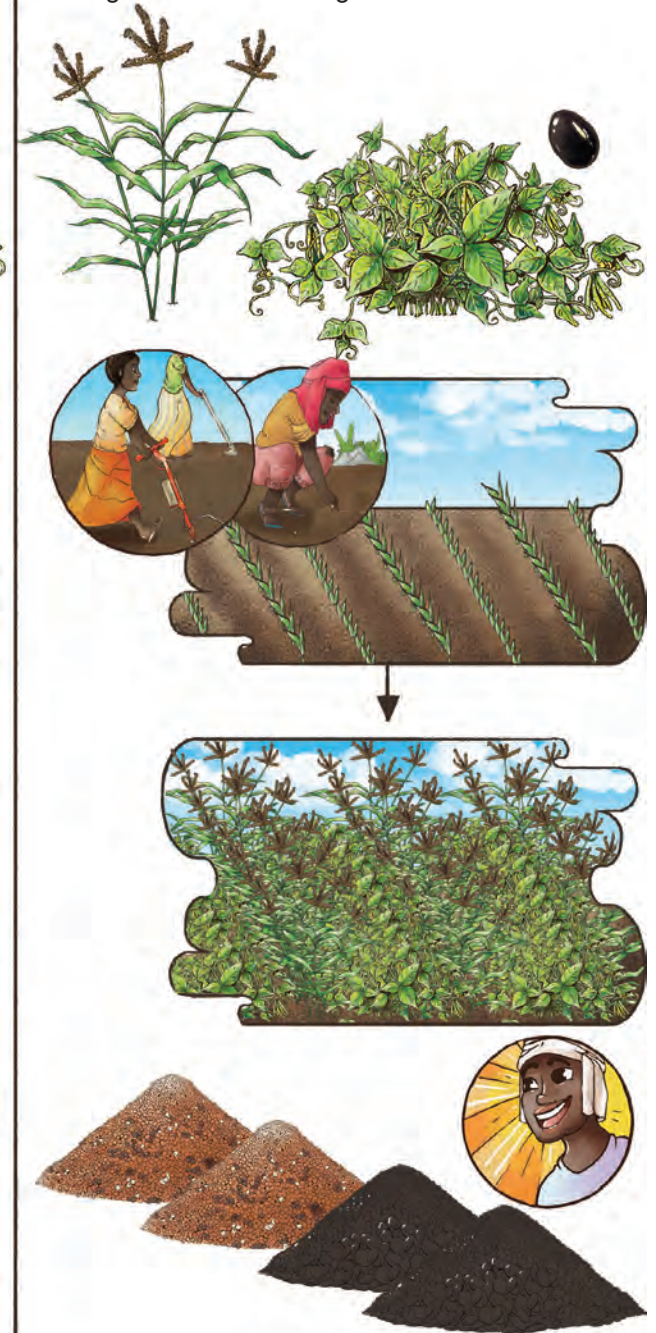
1. Least productive: sow finger millet only



2. More productive: randomly broadcast both finger millet and blackgram together

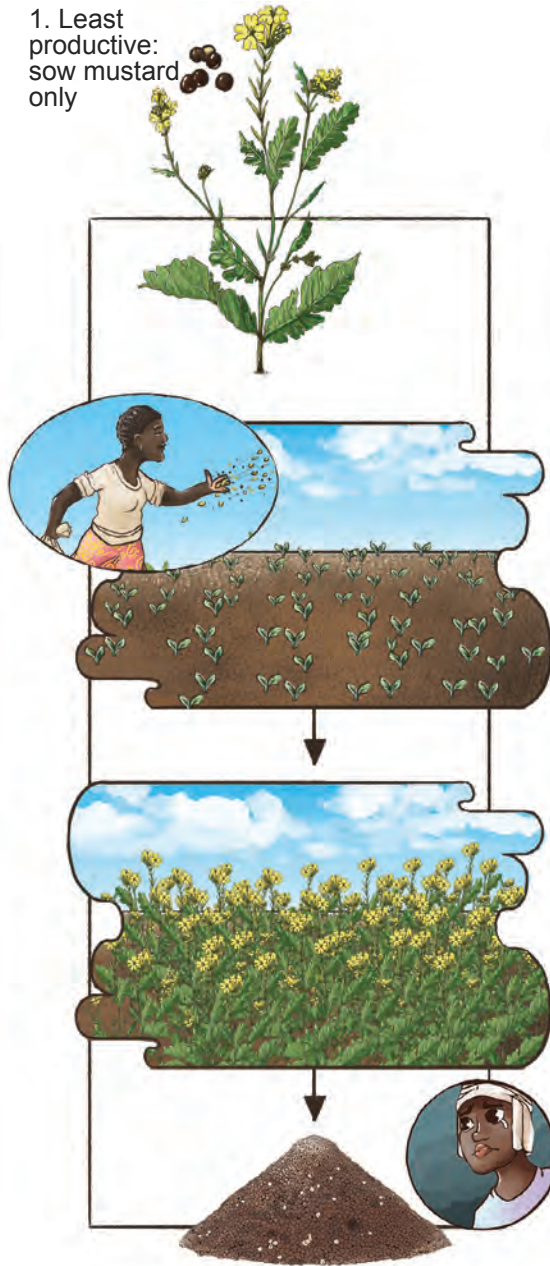


3. Most productive: sow alternating rows of finger millet and blackgram

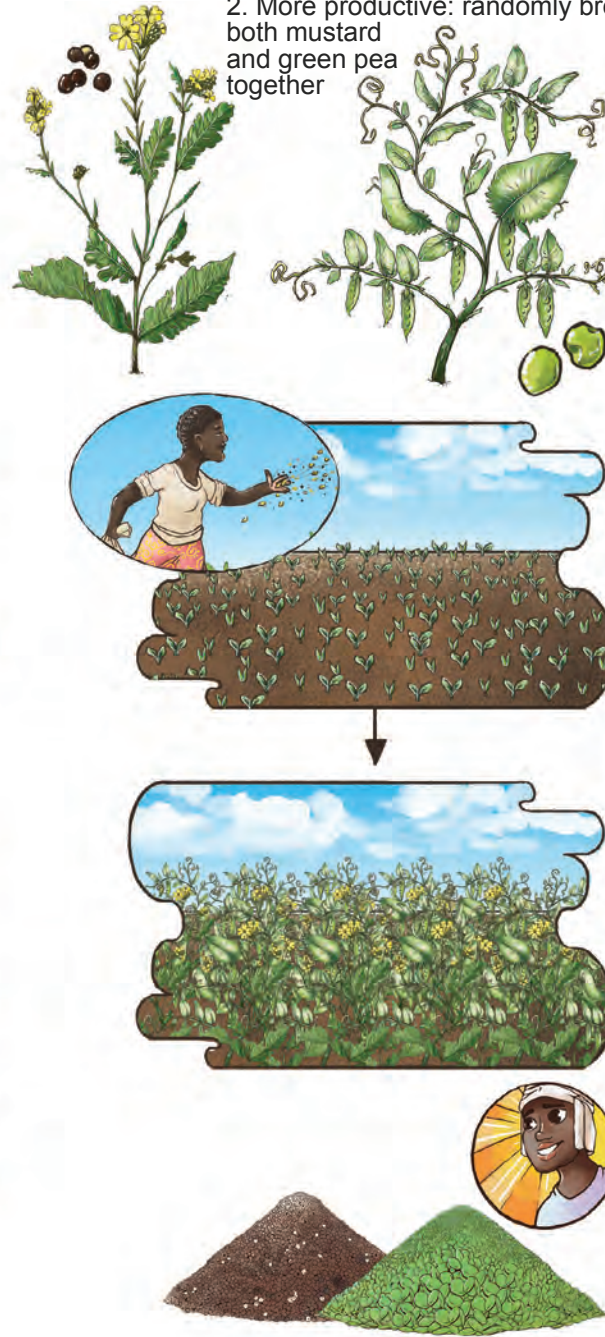


Lesson: Sowing mustard together with green pea (field pea) will yield more profit than mustard only.

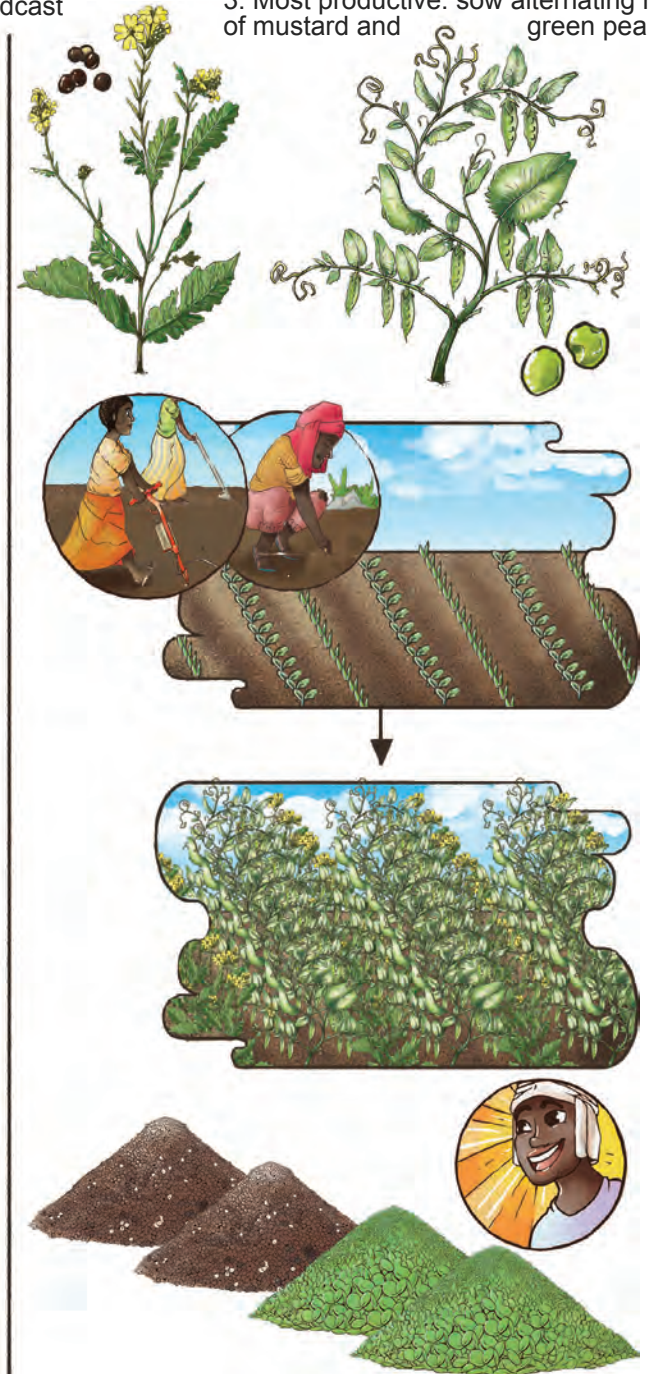
1. Least productive: sow mustard only



2. More productive: randomly broadcast both mustard and green pea together

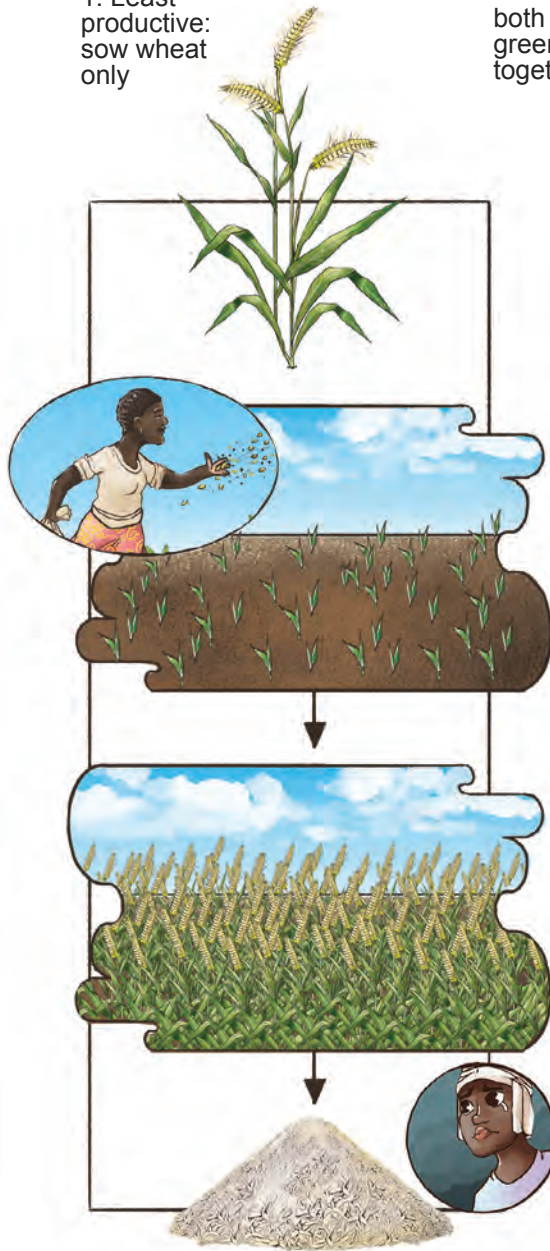


3. Most productive: sow alternating rows of mustard and green pea

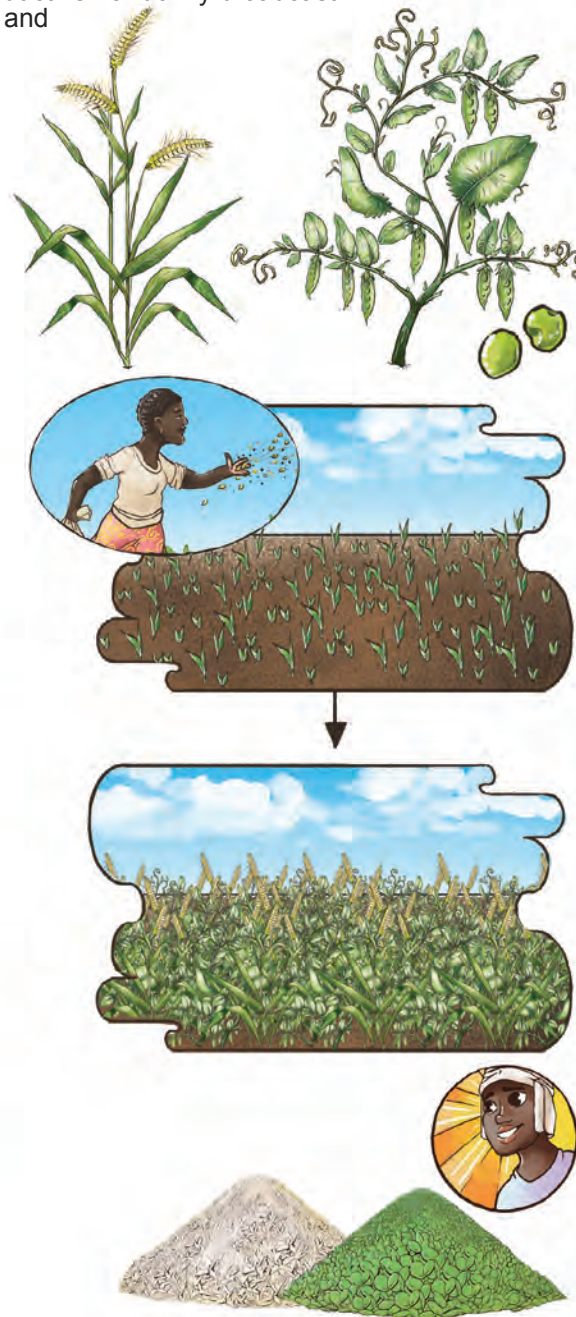


Lesson: Sowing wheat together with green pea (field pea) will yield more profit than wheat only.

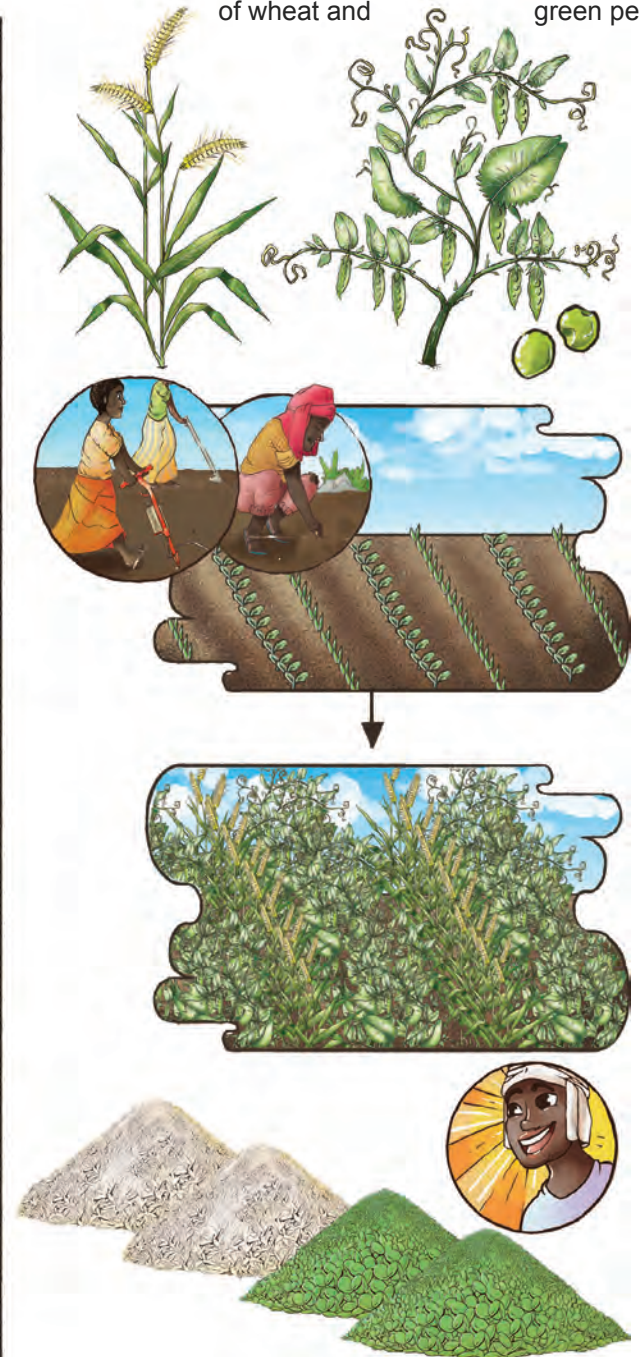
1. Least productive: sow wheat only



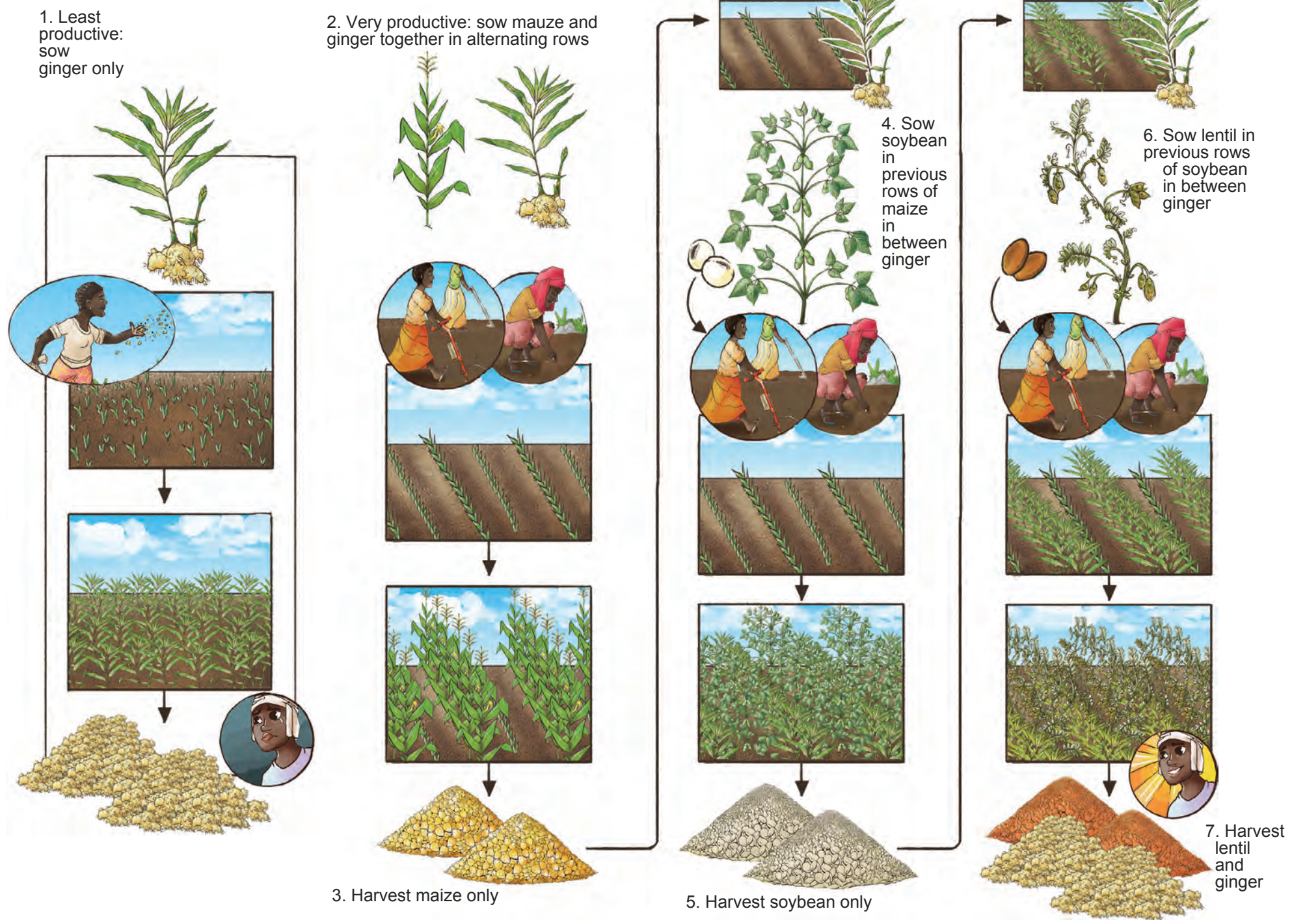
2. More productive: randomly broadcast both wheat and green pea together



3. Most productive: sow alternating rows of wheat and green pea



Lesson: Compared to sowing only ginger, it is more profitable to also sow maize, harvest the maize, then sow soybean, harvest the soy, then sow lentil, and finally harvest both lentil and ginger



Lesson: A kit of seed packages will increase the types of fruits and vegetables in the garden

1. Traditional: only few types of vegetables



2. New practice: purchase packages of different seeds (composite seed package)



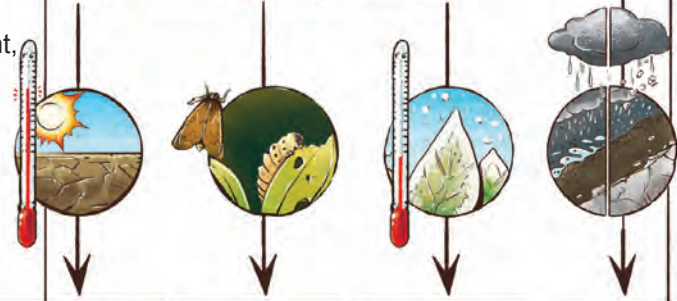
3. Many types of vegetables

Lesson: A greenhouse (plastic tunnel) can improve vegetable production

1. Traditional practice: vegetables uncovered



2. Drought, insects, cold or heavy rain damage crops



3. Low yield

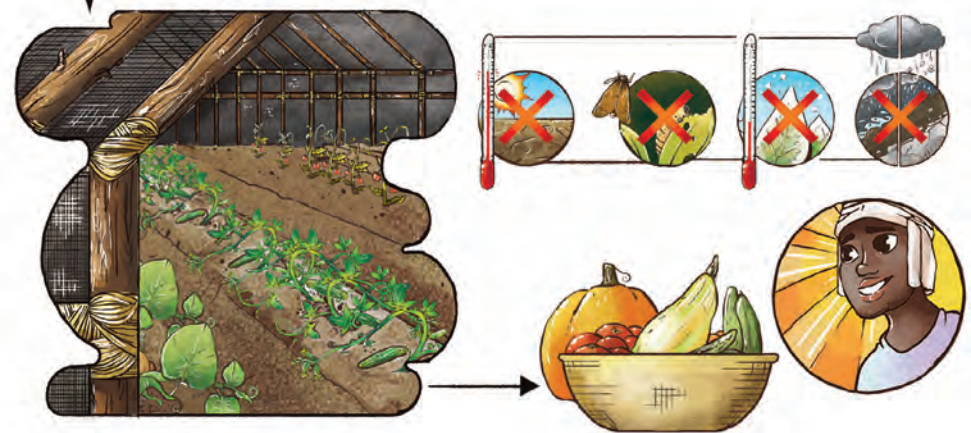


4. New practice: purchase mesh (if hot such as in tropics)



5. Build greenhouse (high tunnel)

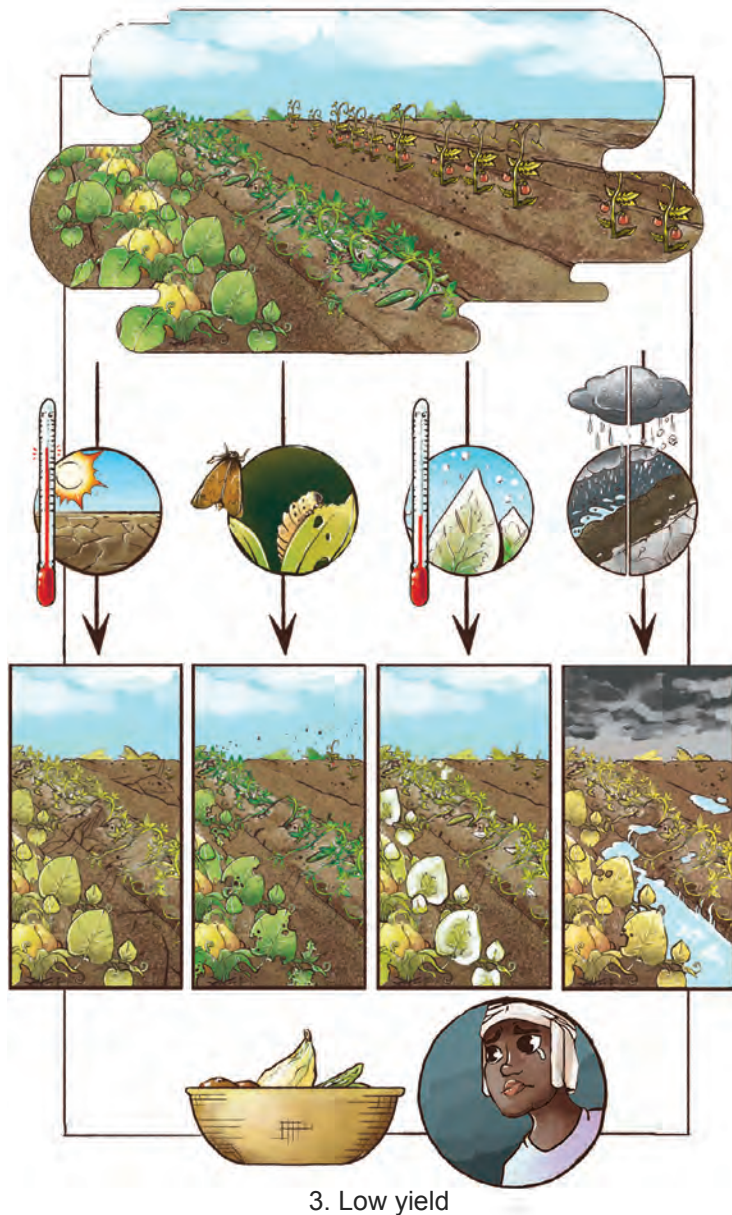
6. Vegetables are protected from drought, insects, cold or heavy rain



7. High yield

Lesson: A greenhouse (plastic tunnel) can improve vegetable production

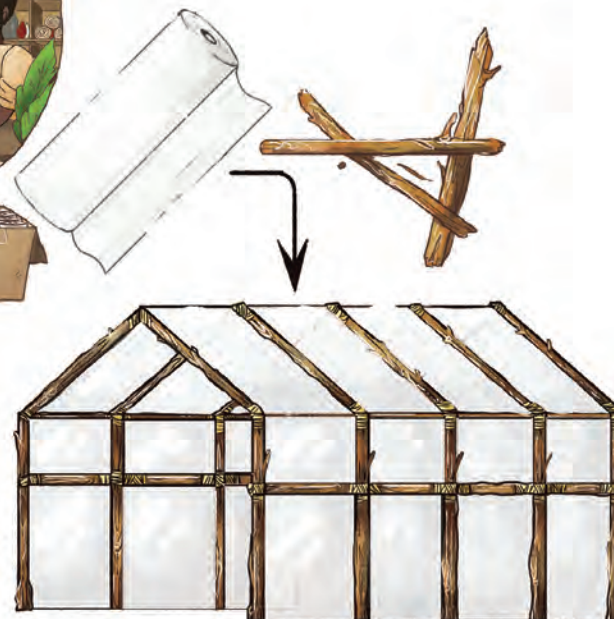
1. Traditional practice: vegetables uncovered



3. Low yield

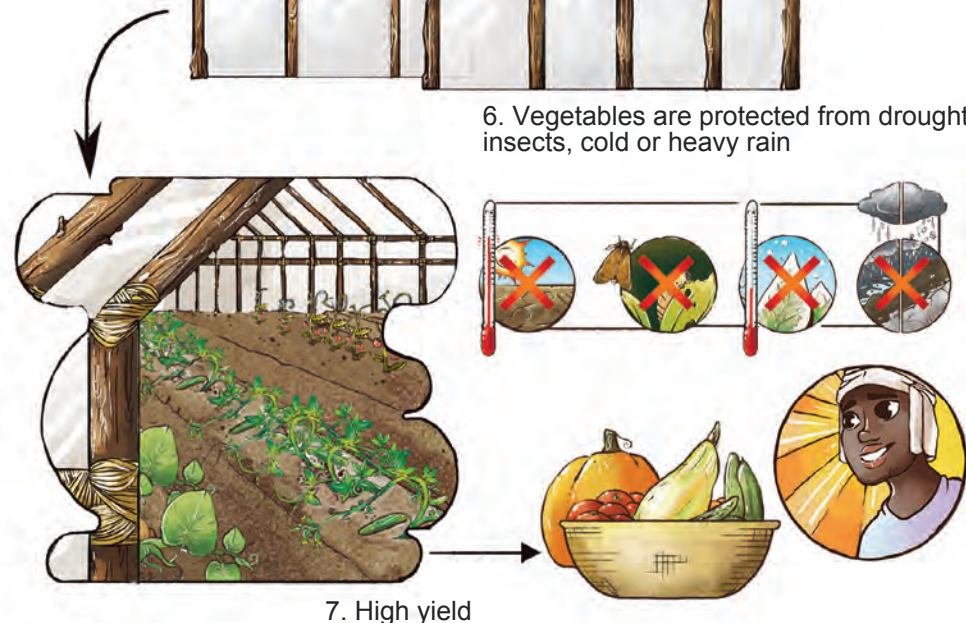


4. Purchase tarpaulin (in colder climate)



5. Build greenhouse (high tunnel)

6. Vegetables are protected from drought, insects, cold or heavy rain



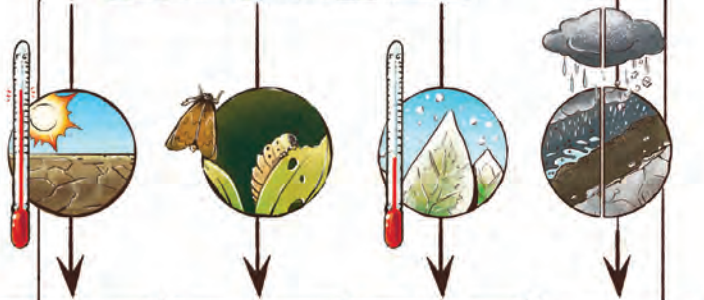
7. High yield

Lesson: Low tunnel covers can help to grow vegetables (should combine with drip irrigation or else use mesh material)

1. Traditional practice: vegetables uncovered



2. Drought, insects, cold or heavy rain damage crops



3. Low yield



4. Purchase clear tarpaulin from vendor



5. Build short tunnels



6. Vegetables are protected from drought, insects, cold or heavy rain

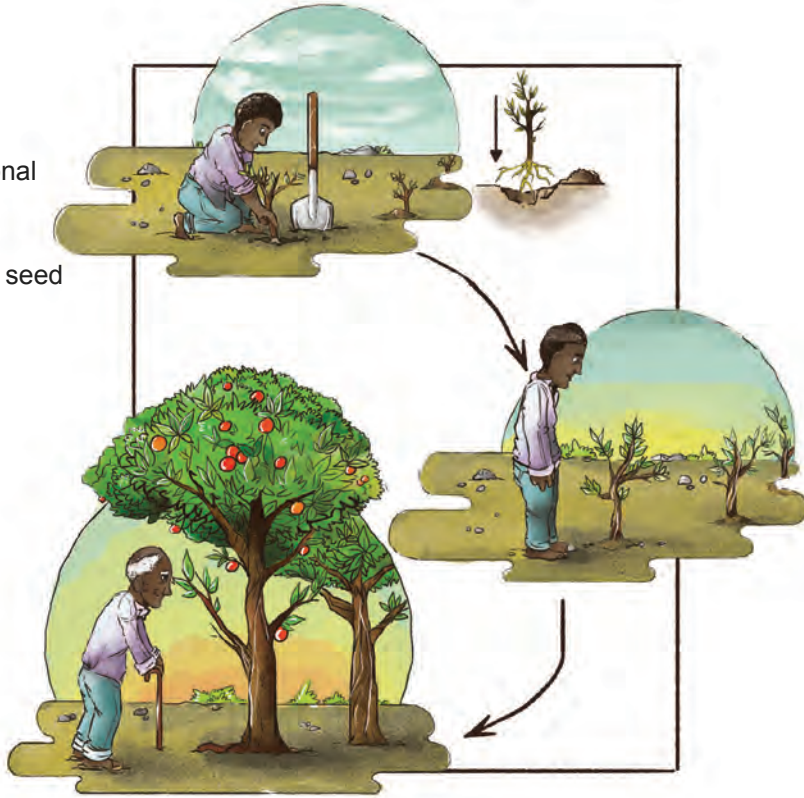


7. High yield

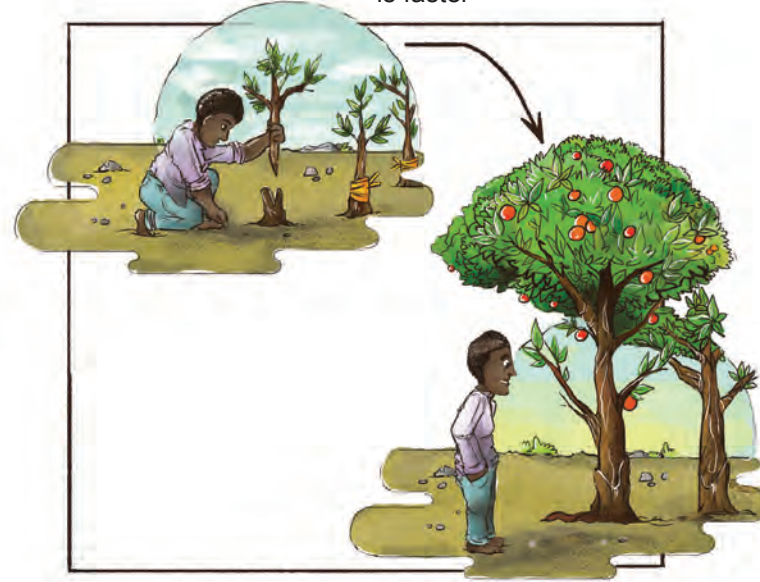


Lesson: Grow a new tree much faster by attaching a young branch onto an old tree stump

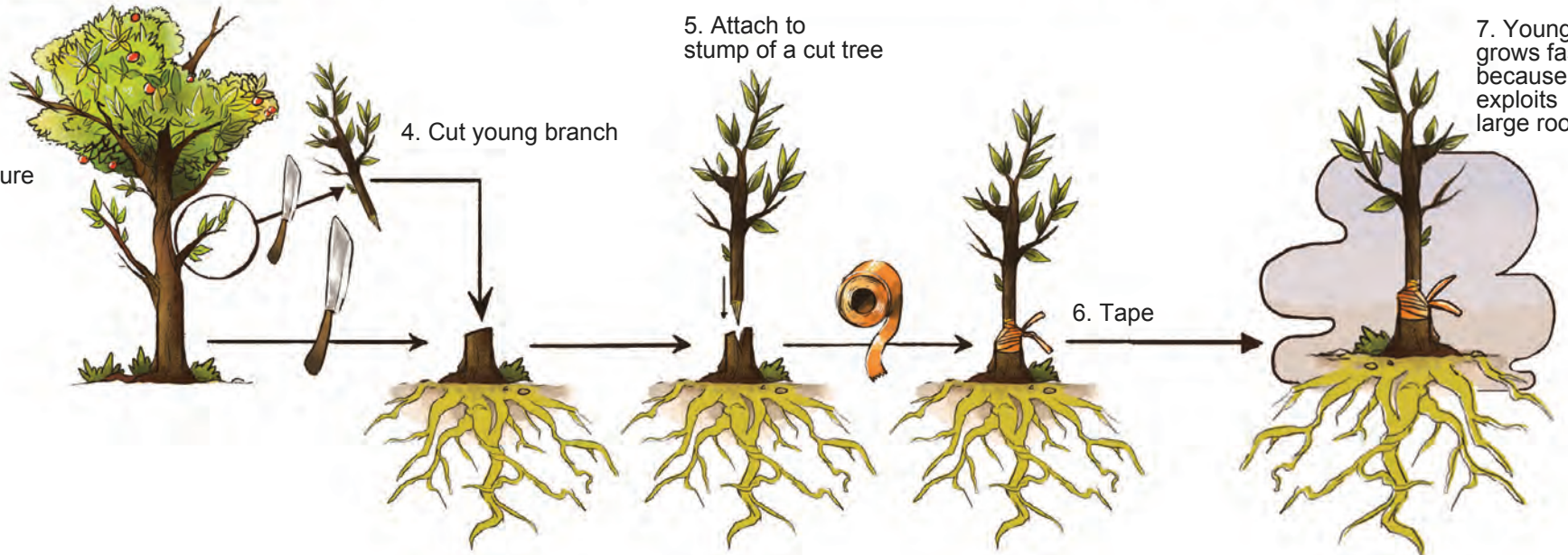
1. Traditional practice: planting tree from sapling or seed is slow



2. New practice: attaching young branch to old tree stump is faster



3. Procedure



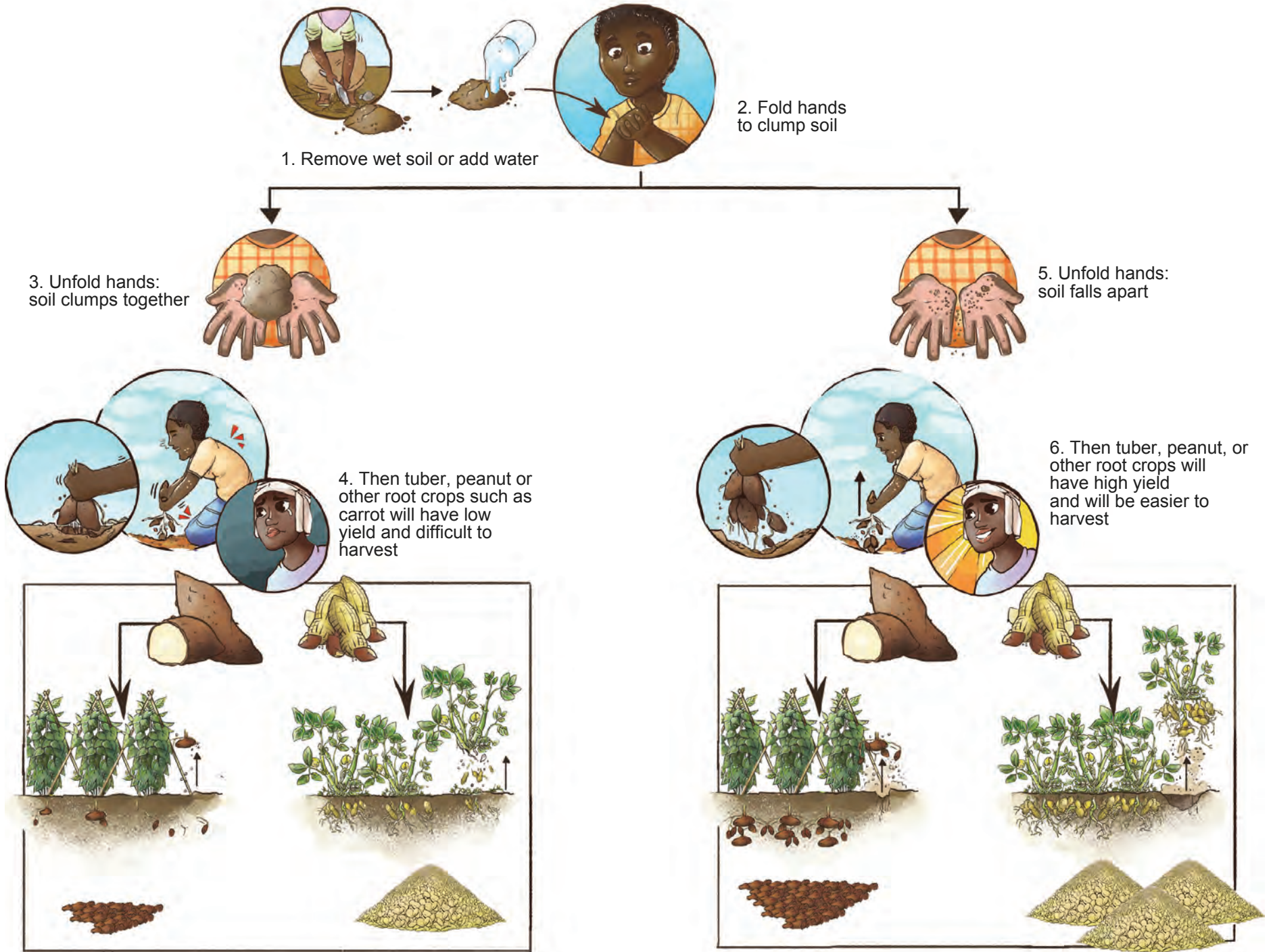
4. Cut young branch

5. Attach to stump of a cut tree

6. Tape

7. Young branch grows fast, because it exploits large roots

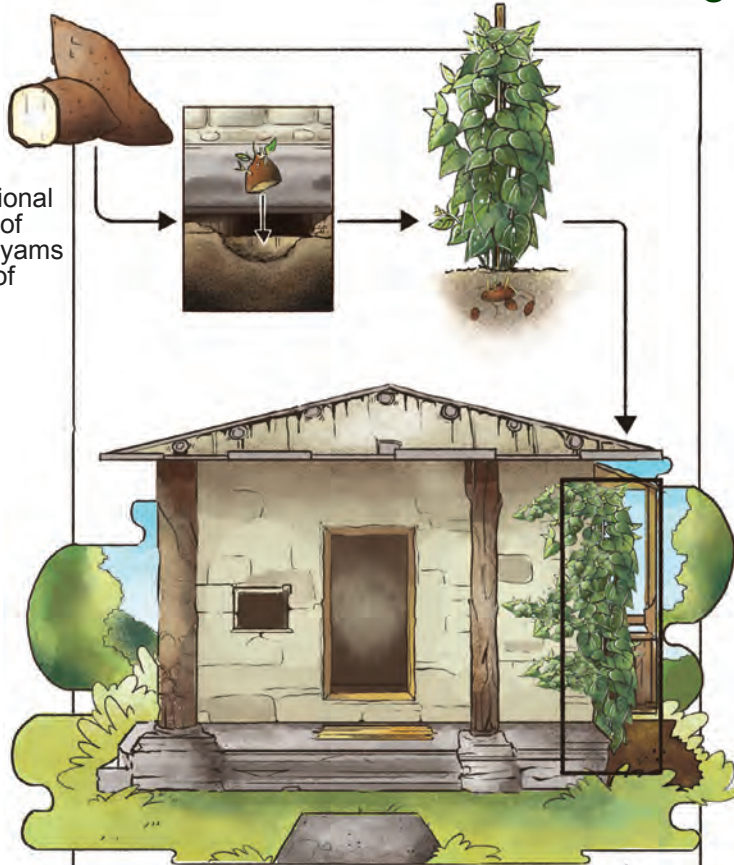
Lesson: A simple soil clumping test can help determine whether root crops can be grown



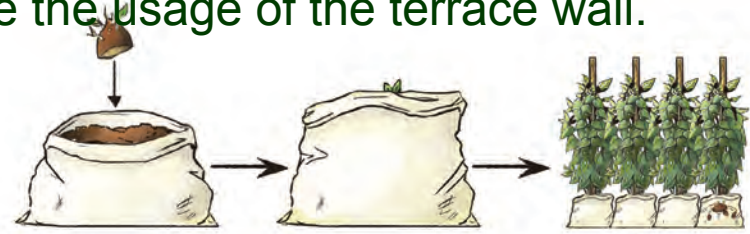
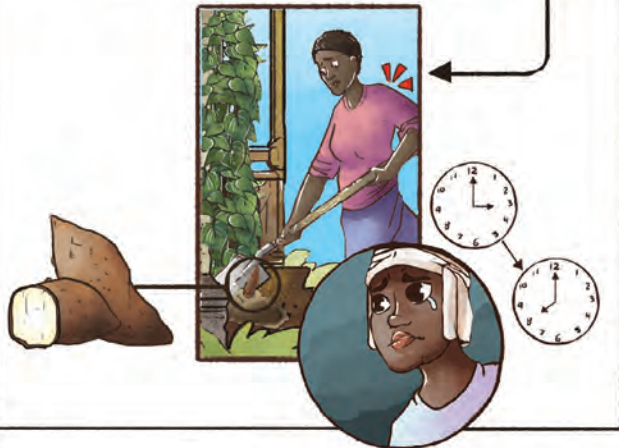
Chapter 4: Terrace Agriculture

Lesson: Yams or tubers planted in sacks at the base of the terrace wall will reduce labour at the time of harvesting and increase the usage of the terrace wall.

1. Traditional practice of growing yams on side of house



2. Difficult to dig to harvest yams/tubers



3. New practice: place yam seed in bag with soil



4. Place bags at bottom of terrace wall

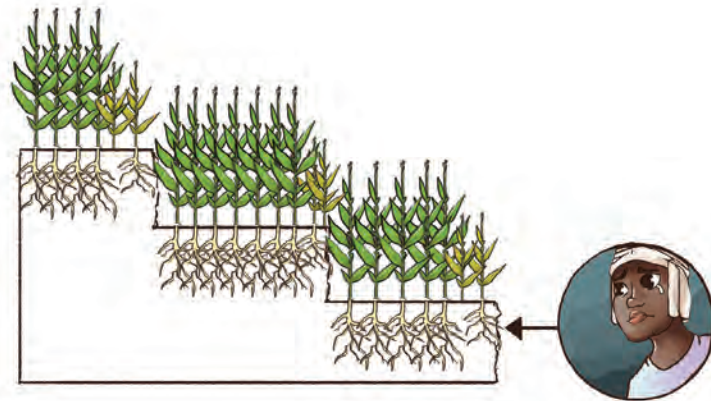
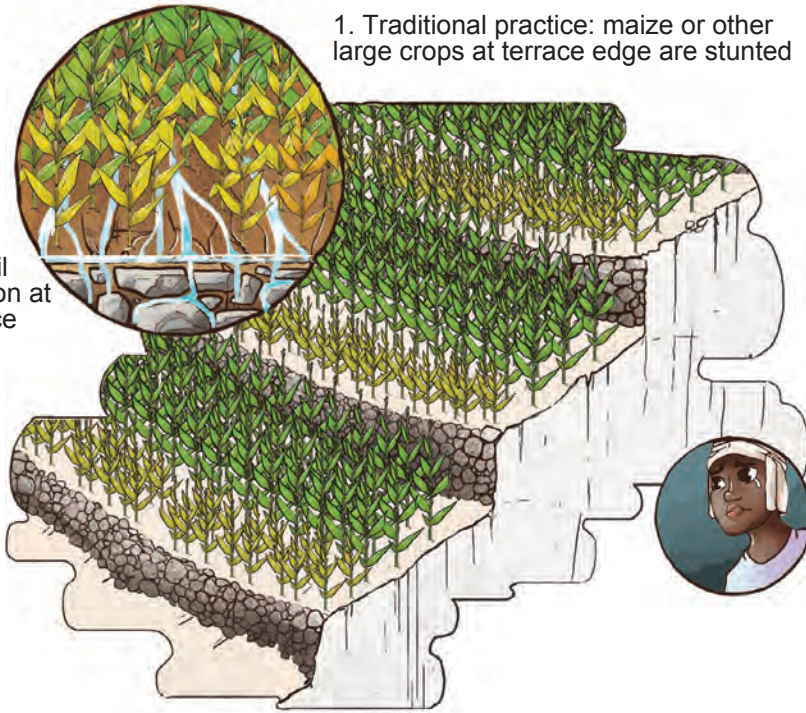
5. Easy to harvest yam from bags



Lesson: Climbing beans can be planted at the base of the terrace wall for growth up the wall to maximize usage of the vertical surface area.

1. Traditional practice: maize or other large crops at terrace edge are stunted

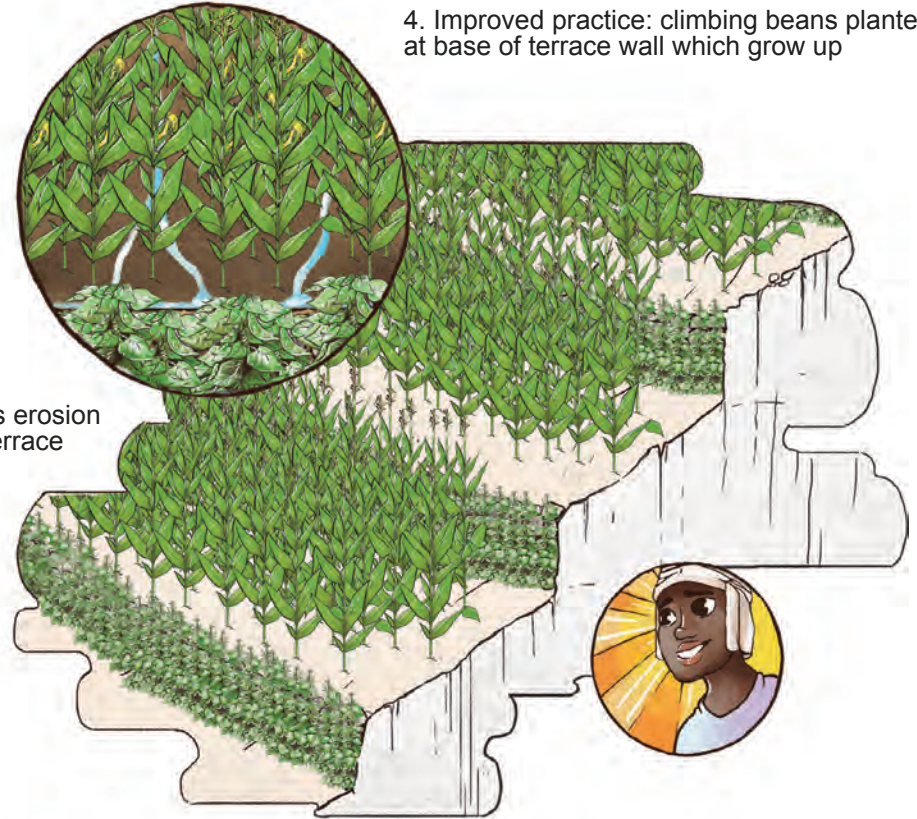
2. Soil erosion at terrace edge



3. Traditionally, low yield near terrace edge

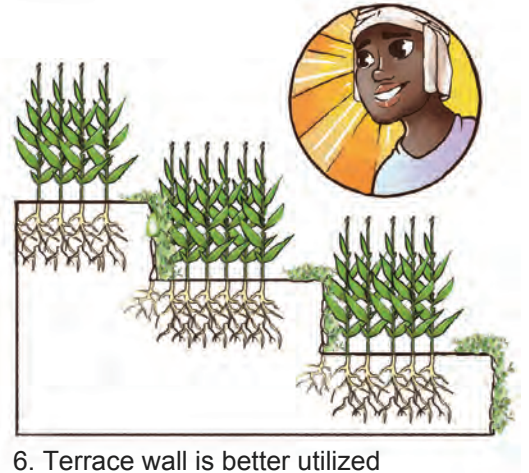
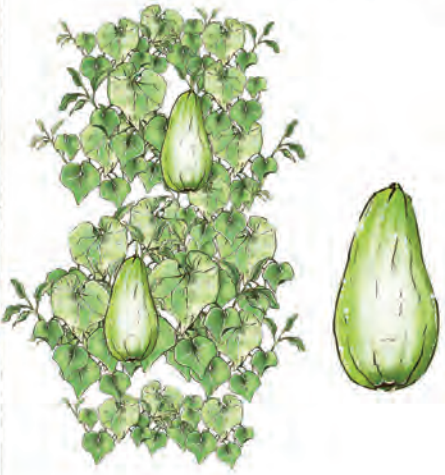
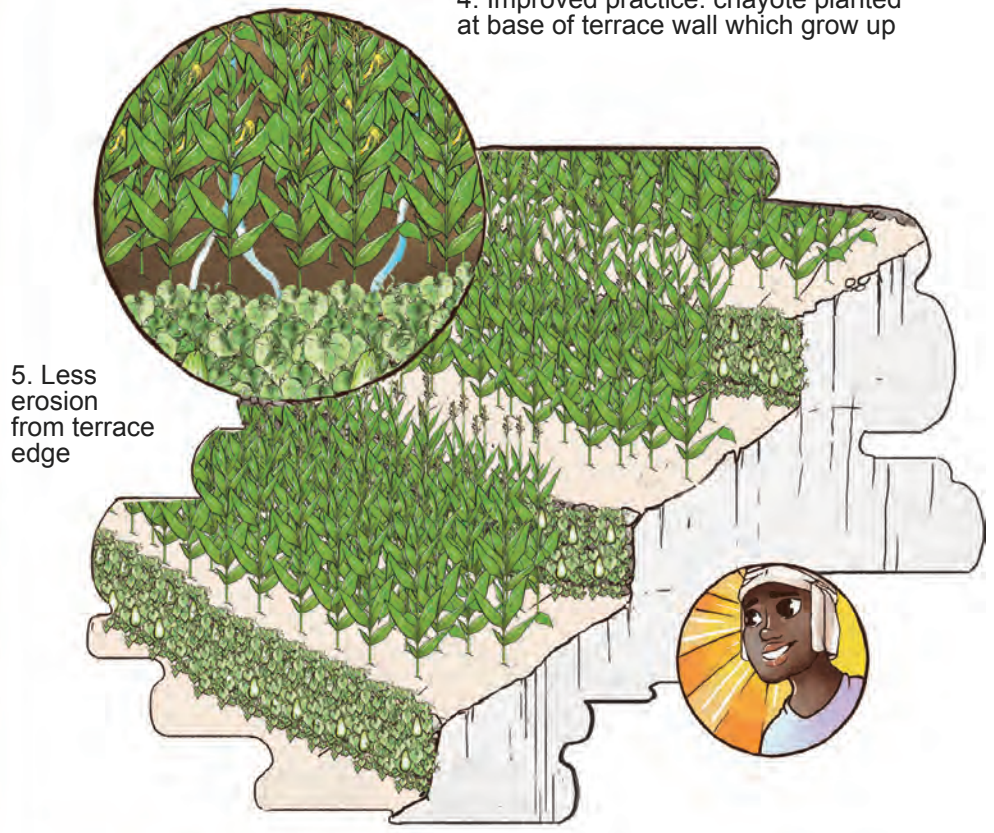
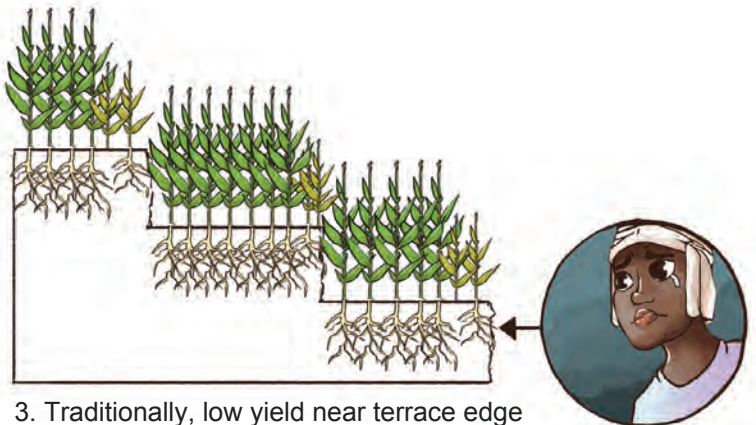
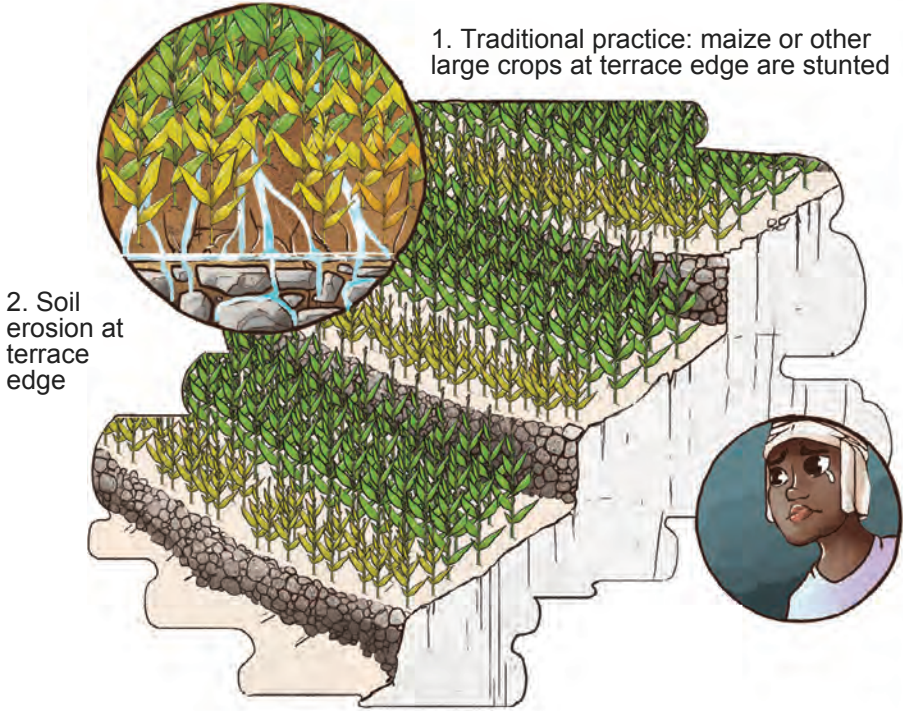
4. Improved practice: climbing beans planted at base of terrace wall which grow up

5. Less erosion from terrace edge



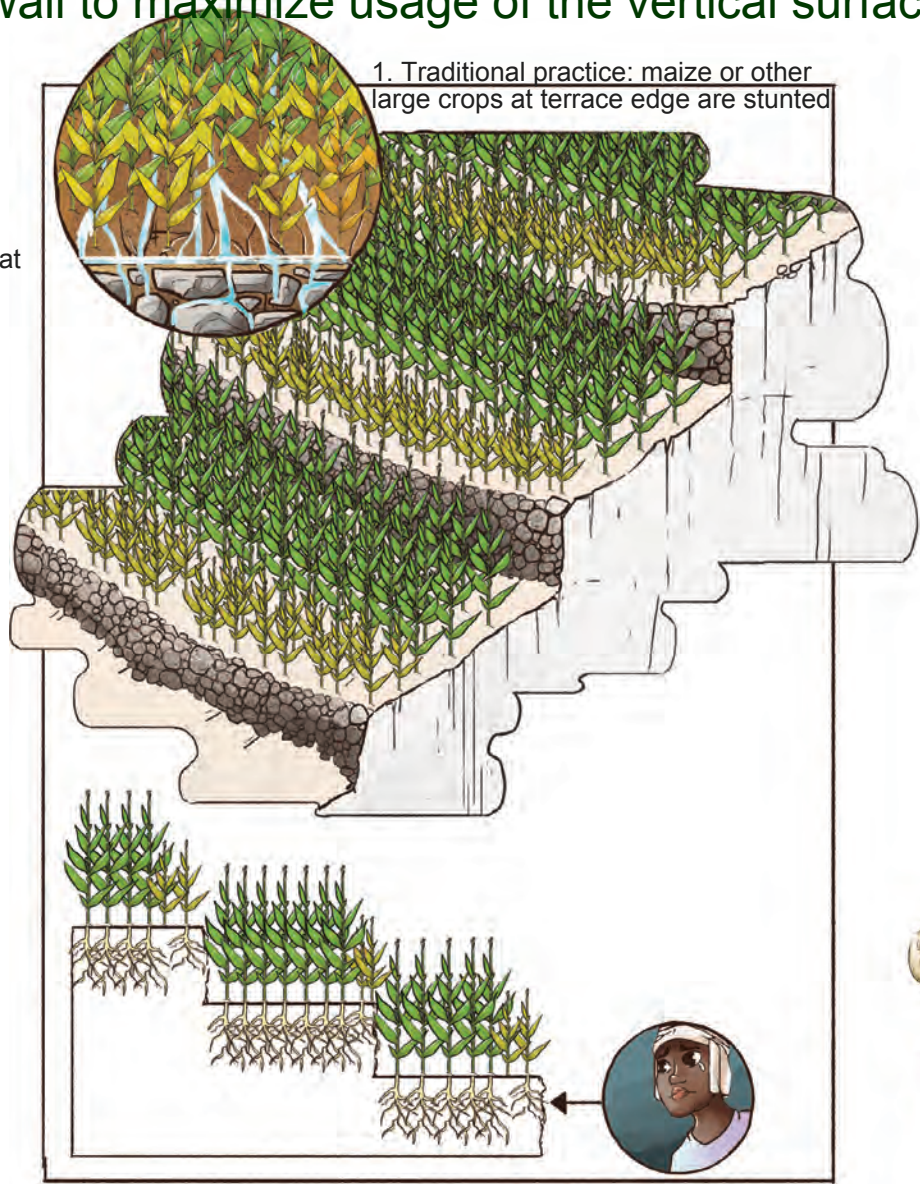
6. Terrace wall is better utilized

Lesson: Climbing chayote squash can be planted at the base of the terrace wall for growth up the wall to maximize usage of the vertical surface area.



Lesson: Waterfall-type legumes can be planted at the top edge of the terrace wall and grow down the wall to maximize usage of the vertical surface area.

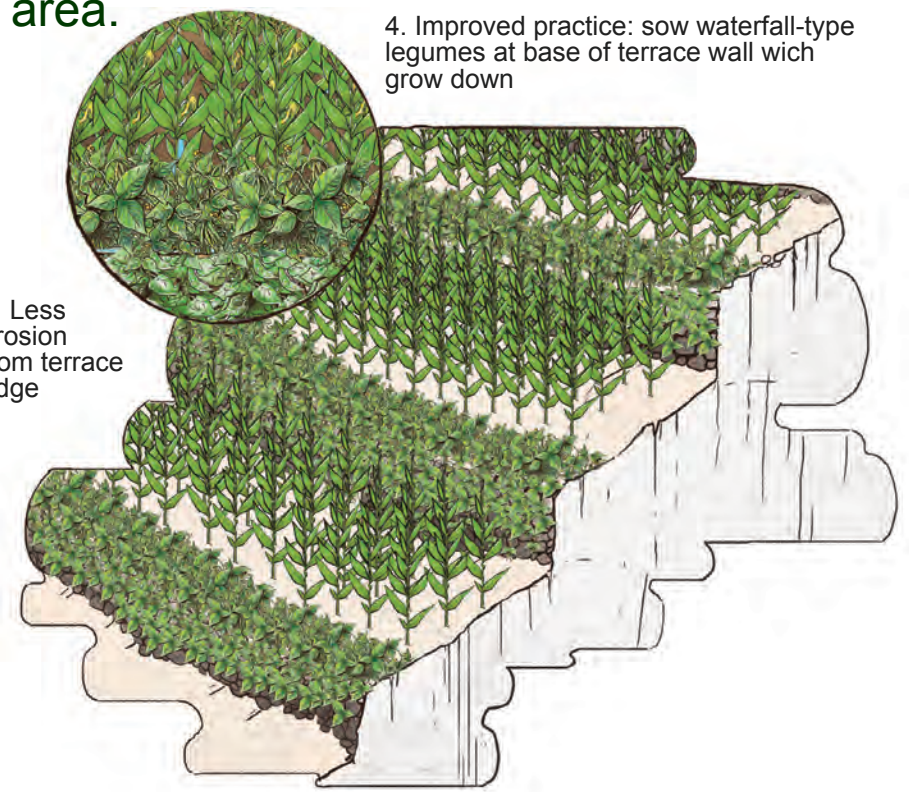
2. Soil erosion at terrace edge



1. Traditional practice: maize or other large crops at terrace edge are stunted

3. Traditionally, low yield near terrace edge

4. Improved practice: sow waterfall-type legumes at base of terrace wall which grow down



5. Less erosion from terrace edge

ricebean



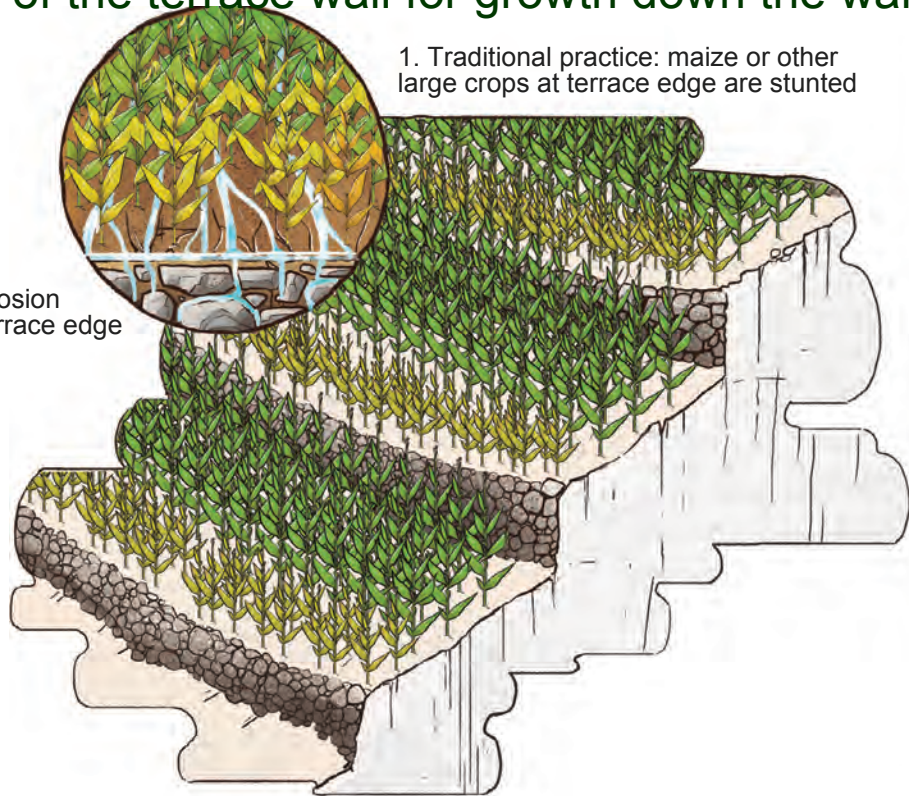
cowpea



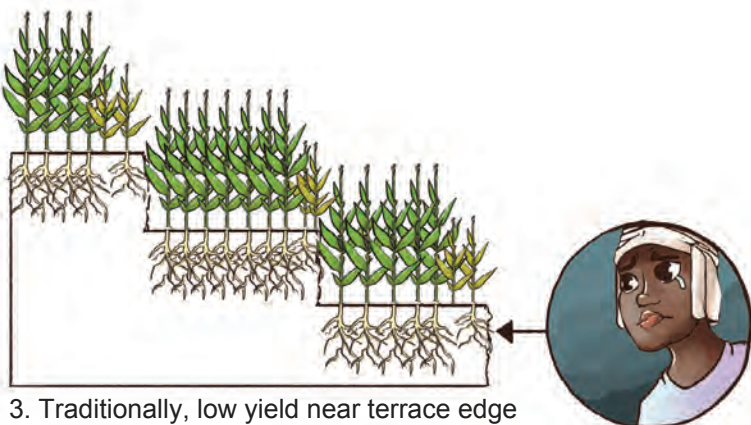
6. Terrace wall and edge are better utilized

Lesson: Waterfall-type cucurbits (pumpkin, cucumber, squash, melon) can be planted at the top edge of the terrace wall for growth down the wall to maximize usage of the vertical surface area.

1. Traditional practice: maize or other large crops at terrace edge are stunted

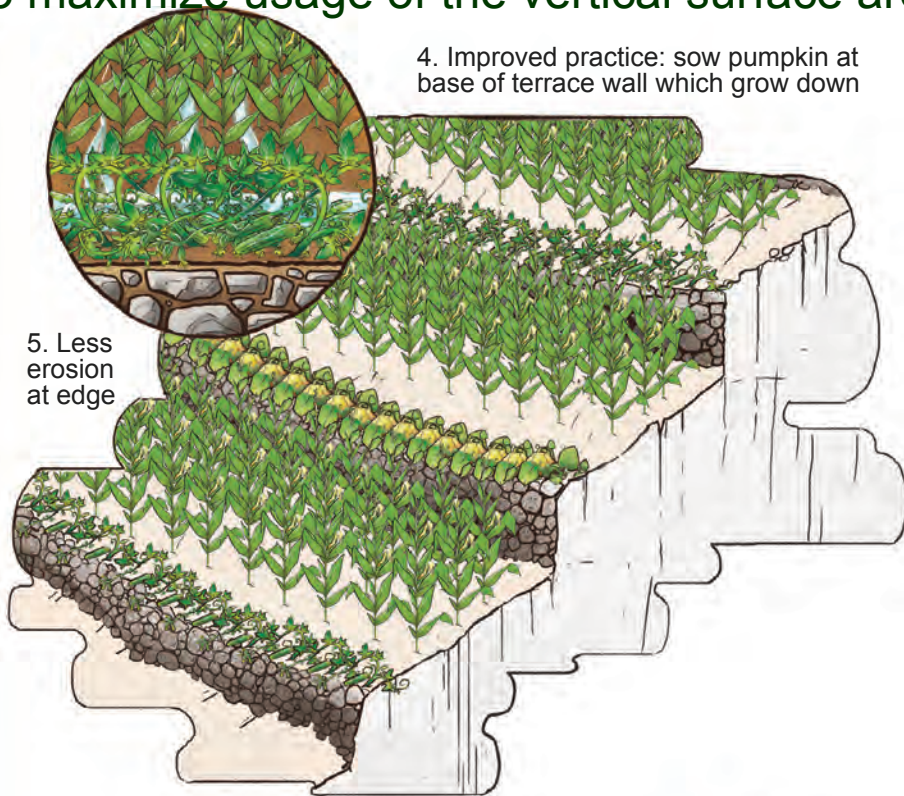


2. erosion at terrace edge



3. Traditionally, low yield near terrace edge

4. Improved practice: sow pumpkin at base of terrace wall which grow down



5. Less erosion at edge

cucumber



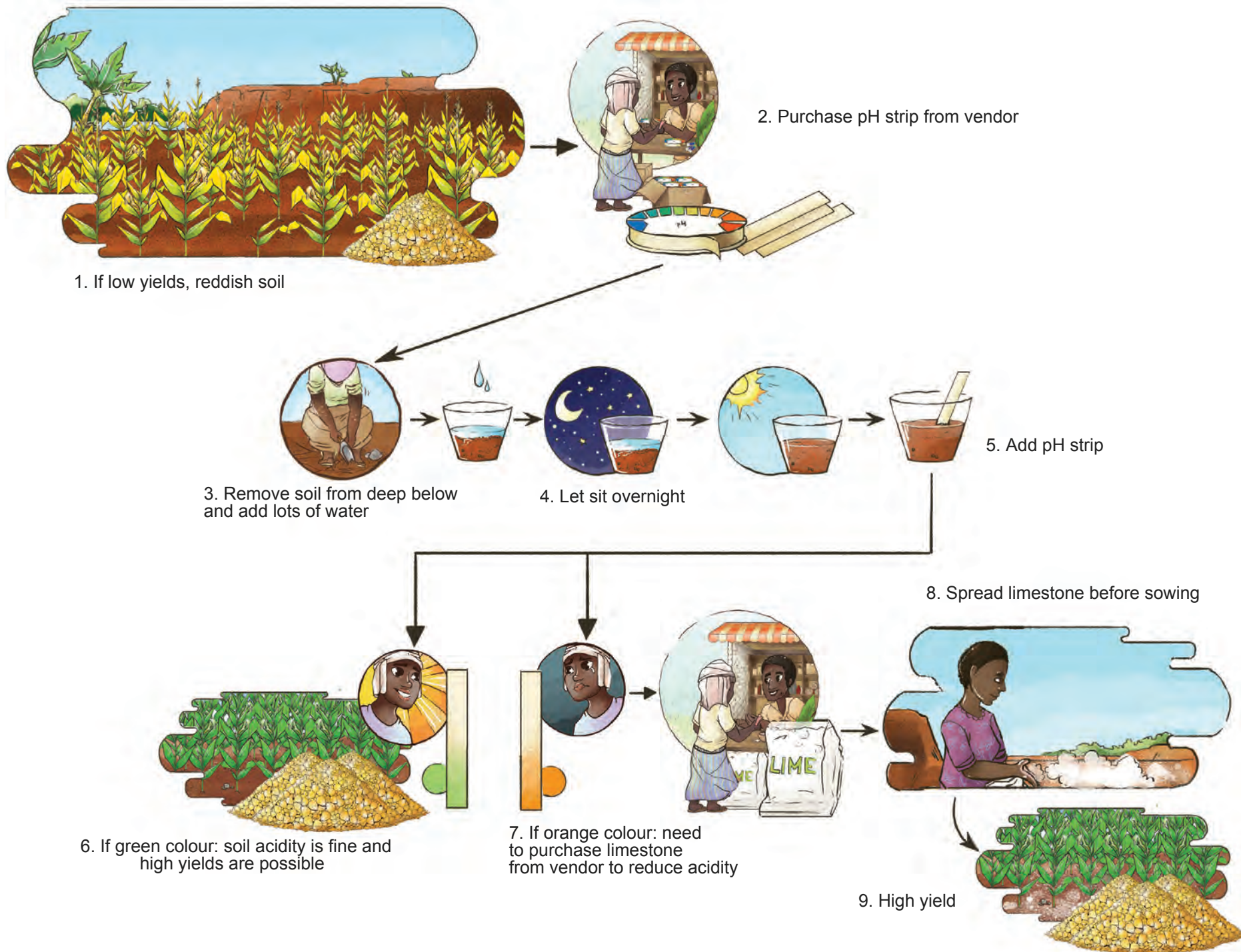
pumpkin



6. Terrace wall and edge are better utilized

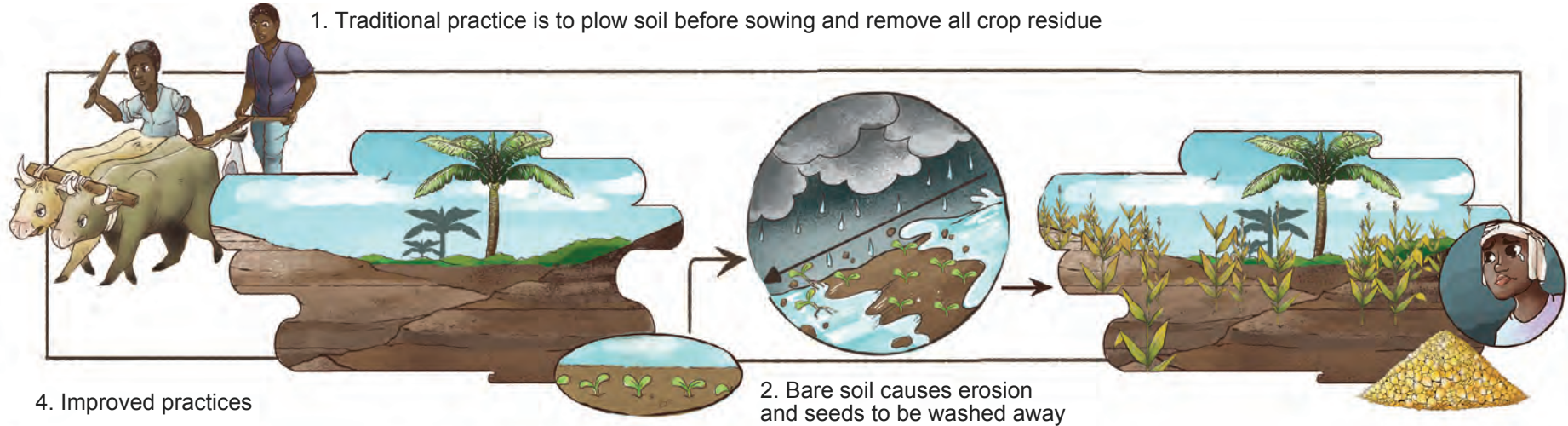
Chapter 5: Soil Health

Lesson: If yields are low and the soil is reddish, soil acidity should be tested



Lesson: Not leaving the soil bare reduces soil erosion and improves yields

1. Traditional practice is to plow soil before sowing and remove all crop residue



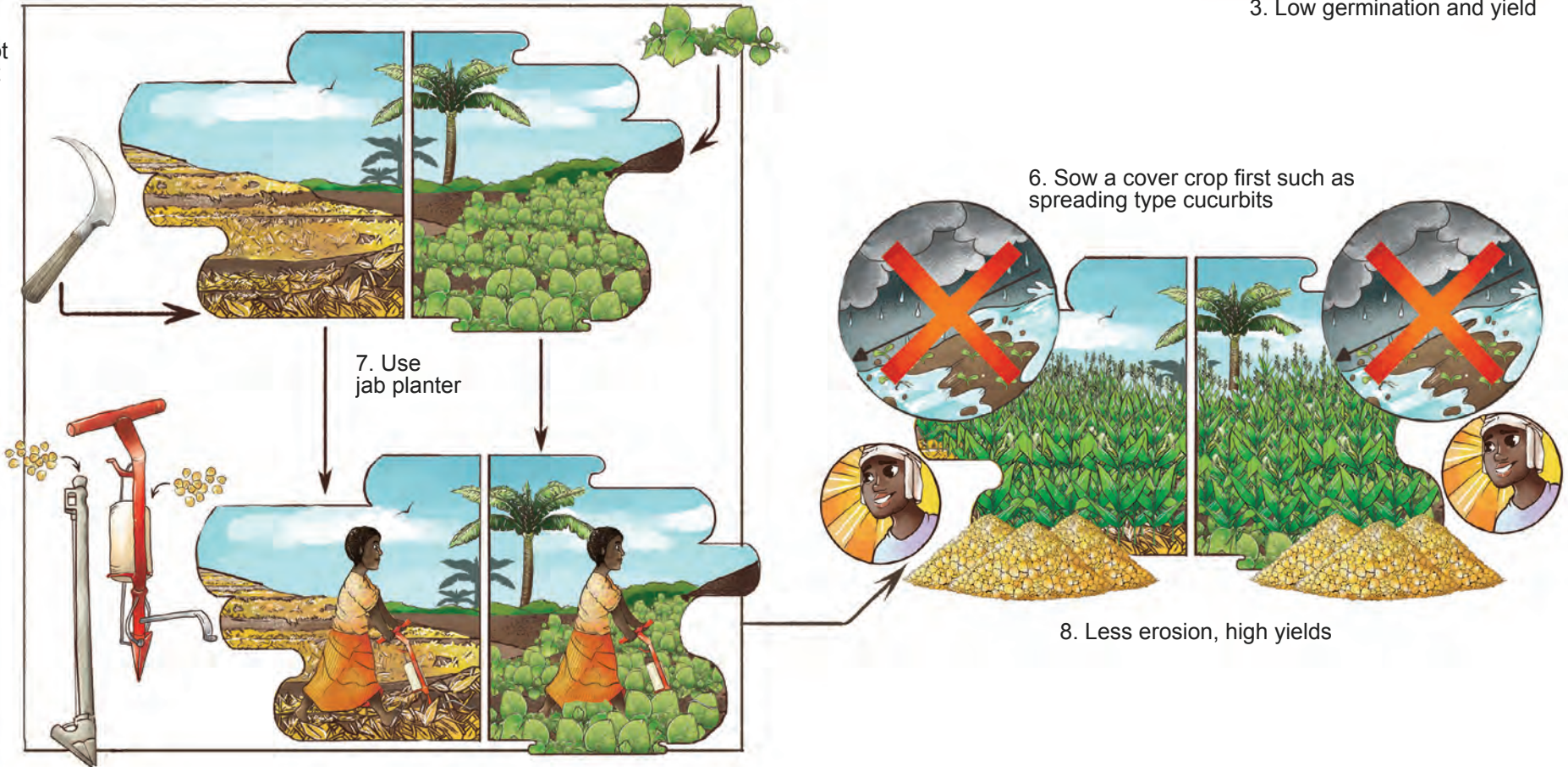
4. Improved practices

2. Bare soil causes erosion and seeds to be washed away

3. Low germination and yield

5. Do not plow but instead leaf dead mulch on field

6. Sow a cover crop first such as spreading type cucurbits



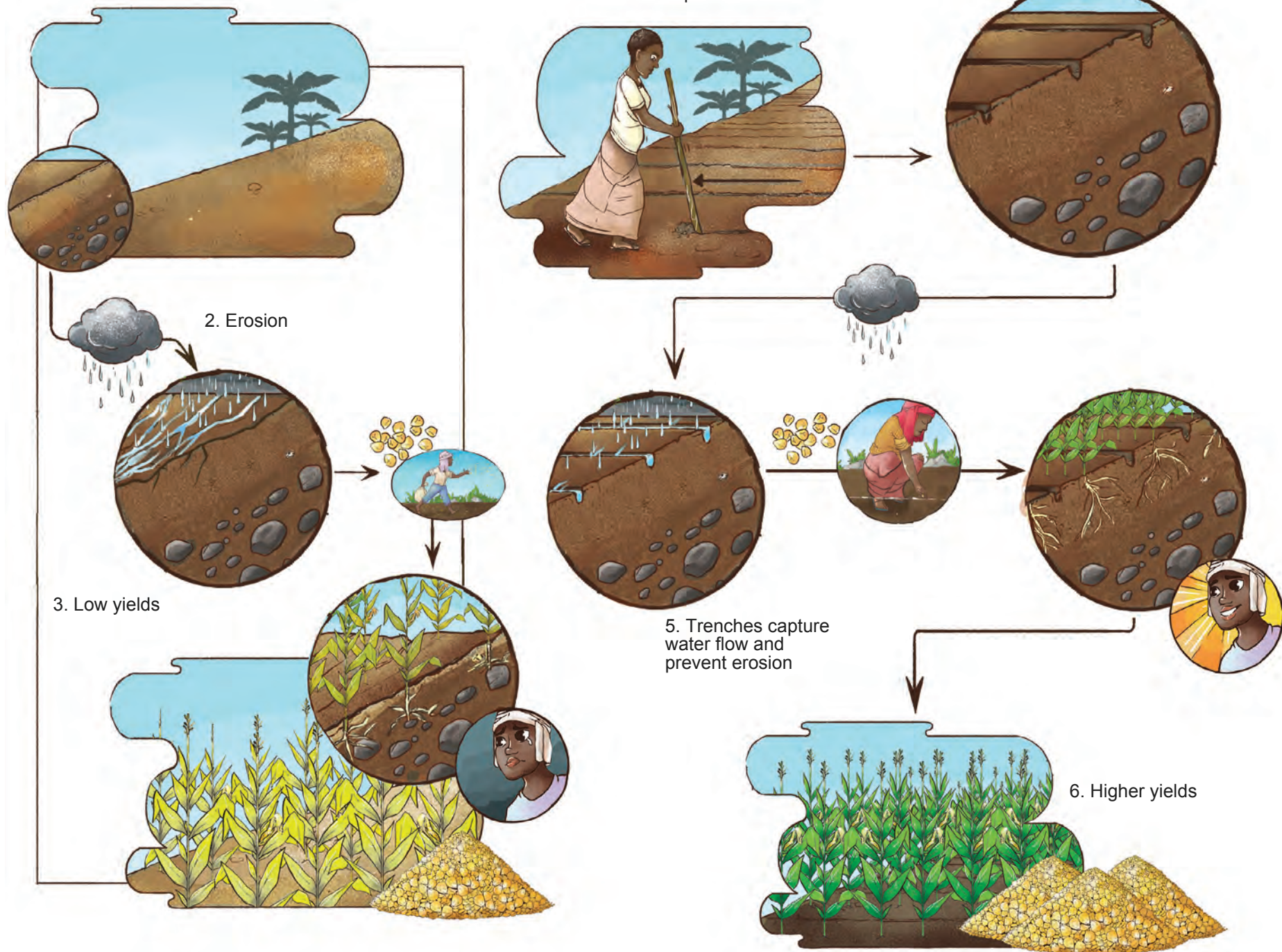
7. Use jab planter

8. Less erosion, high yields

Lesson: Creating shallow trenches with a stick perpendicular to a slope will reduce soil erosion, capture water and increase yields

1. Traditional practice on slope

4. Improved practice: use stick to create shallow trenches perpendicular to slope



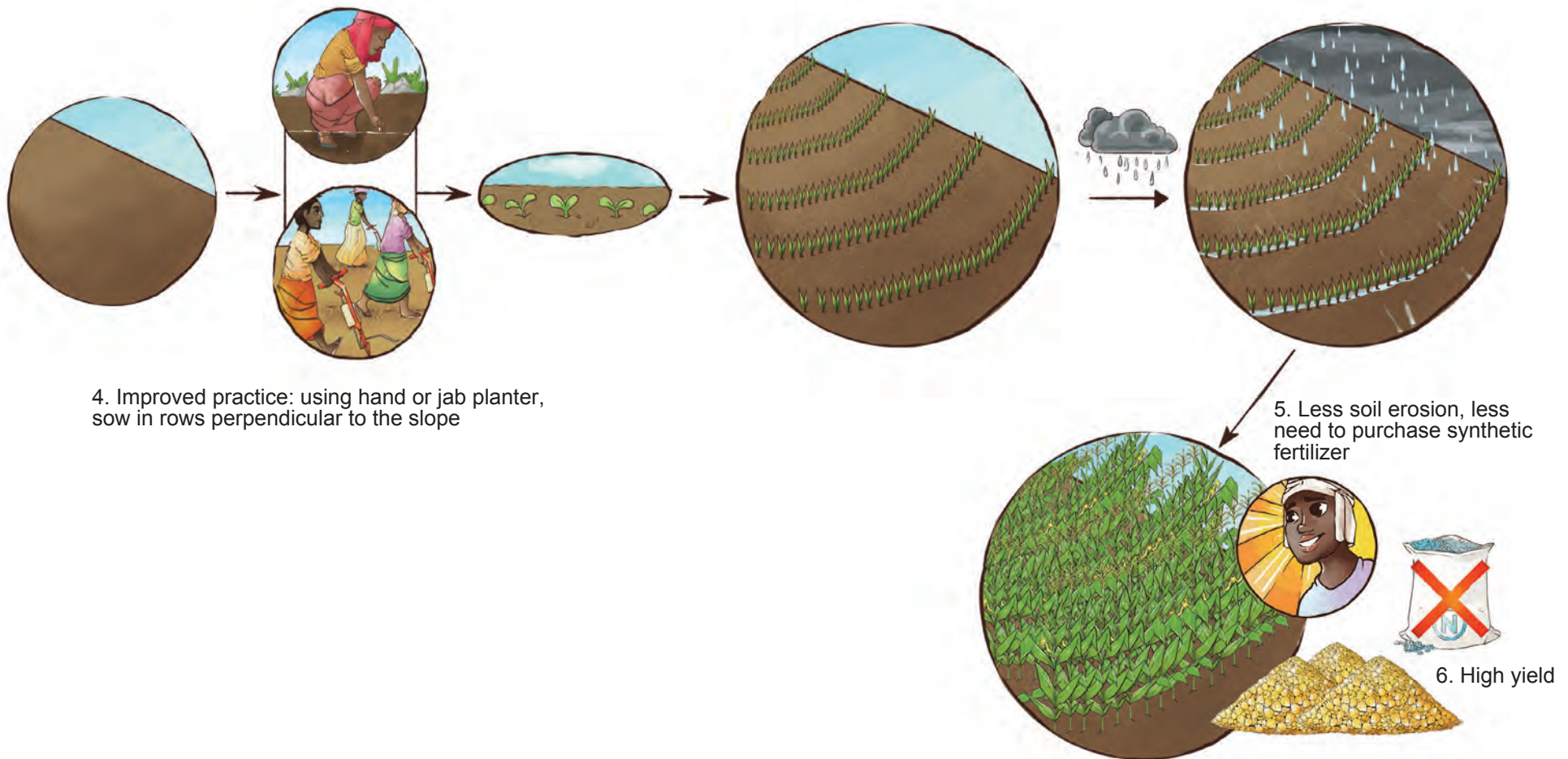
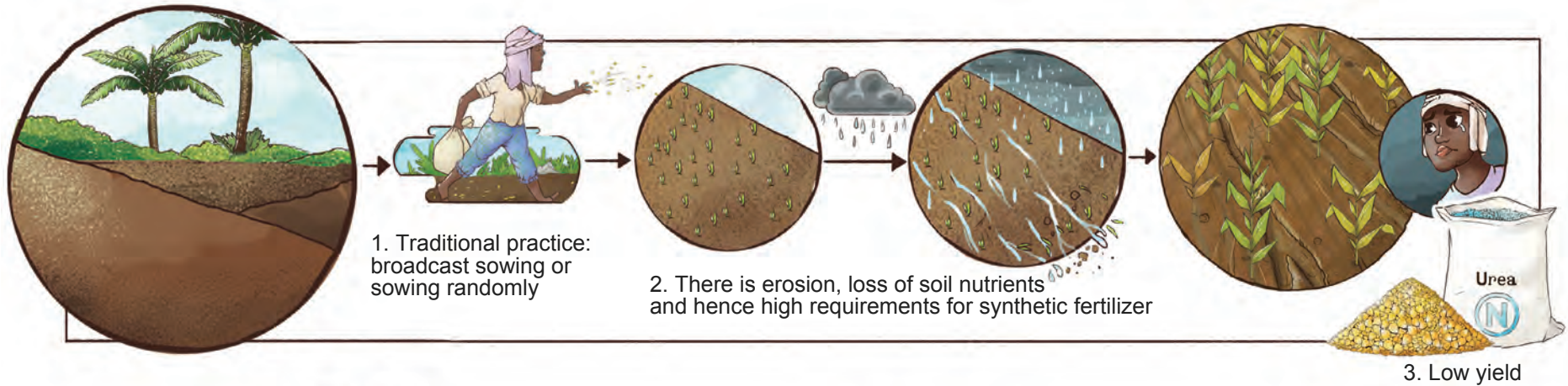
2. Erosion

3. Low yields

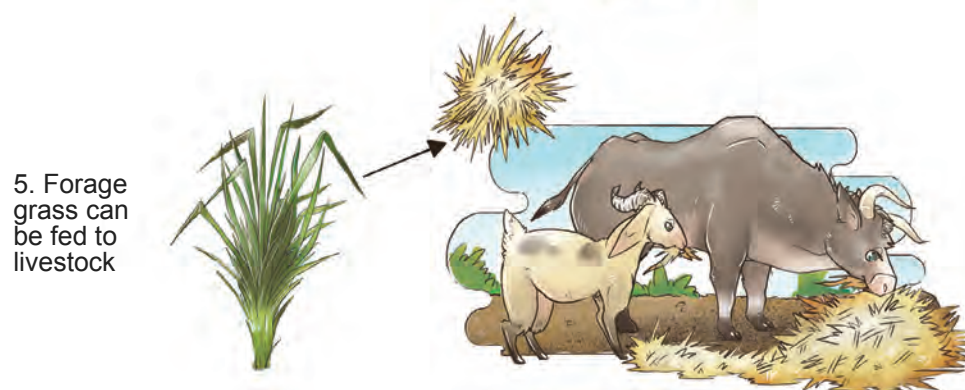
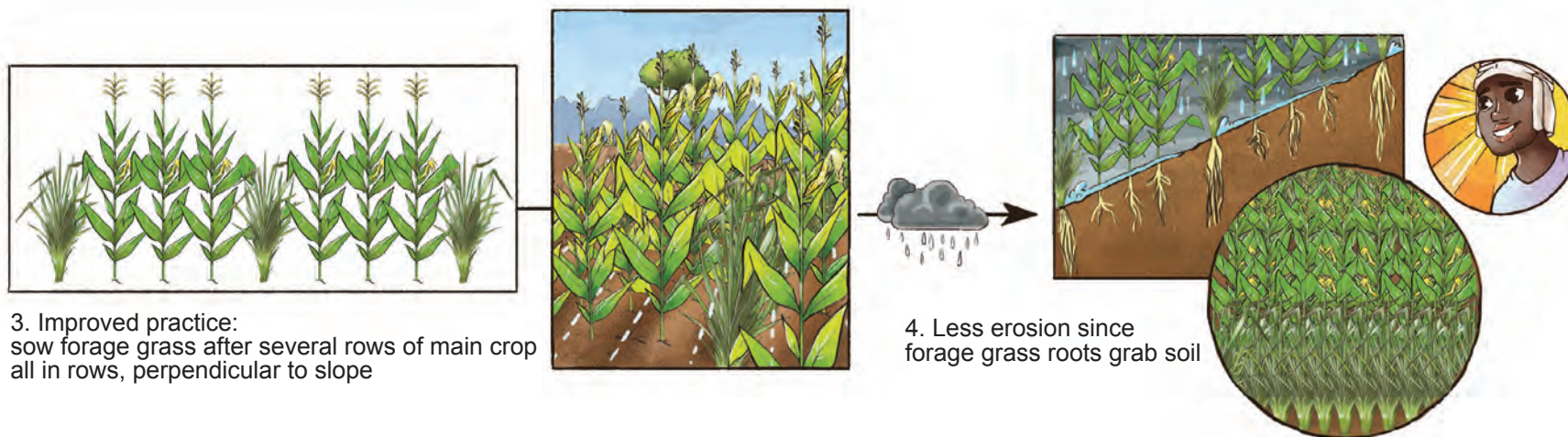
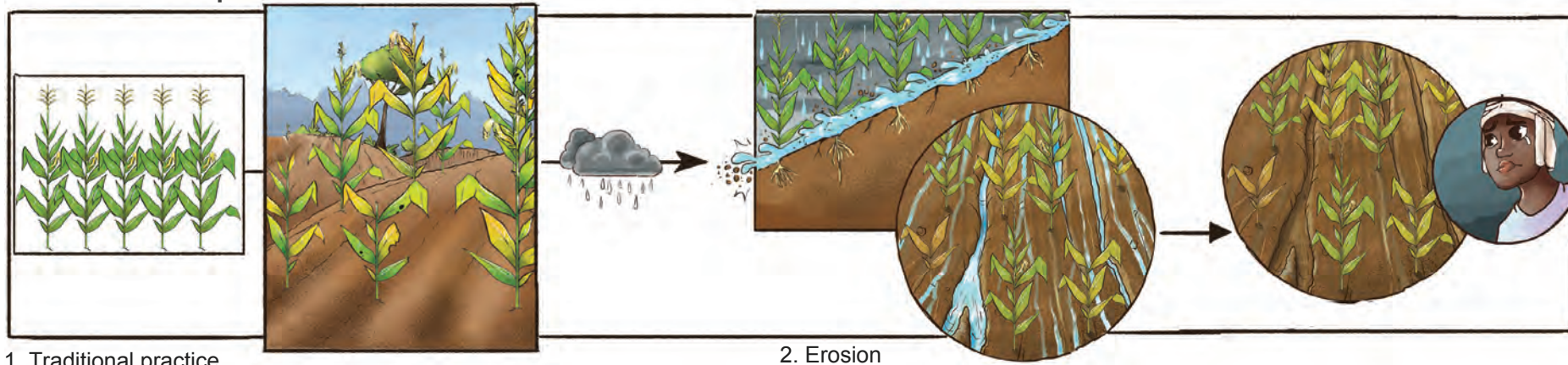
5. Trenches capture water flow and prevent erosion

6. Higher yields

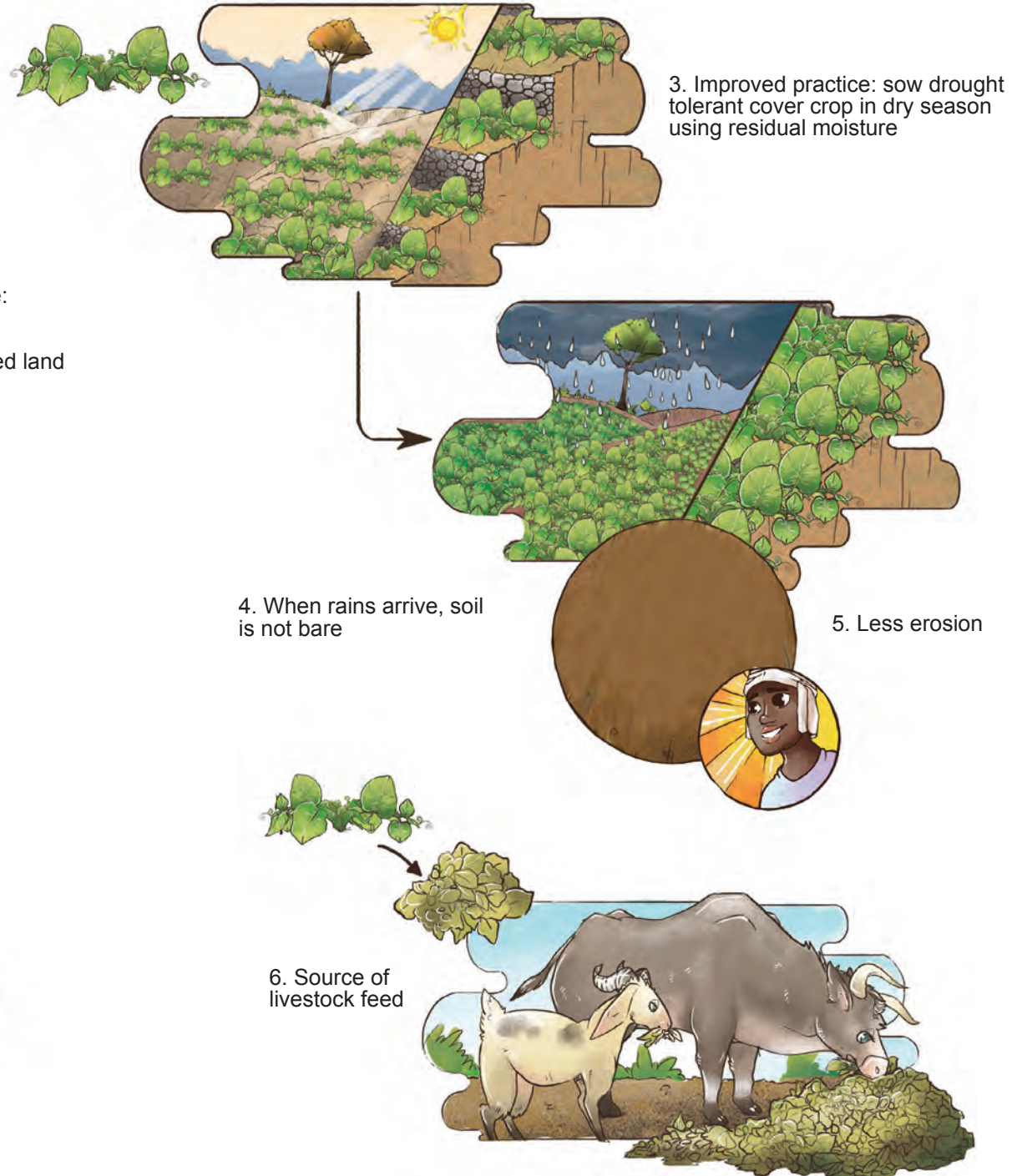
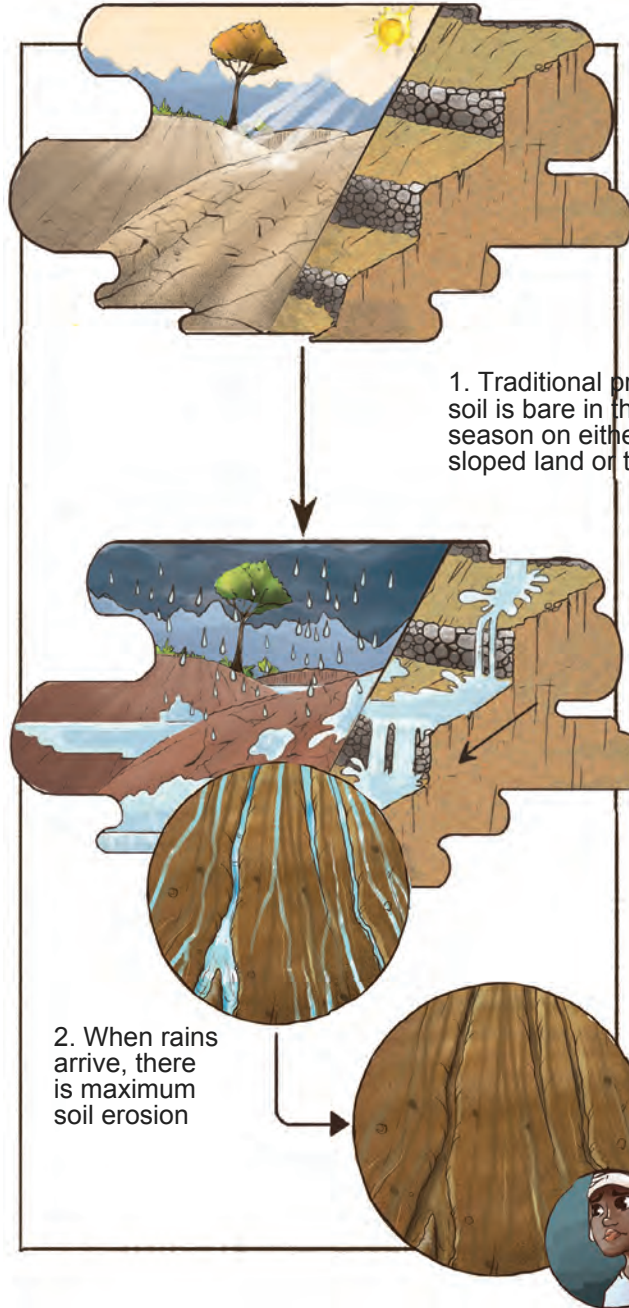
Lesson: On non-terraced, sloped land, sowing crops in rows perpendicular to the slope will reduce soil erosion and reduce fertilizer need



Lesson: On sloped, non-terraced land, sowing vetiver or other forage grasses will reduce erosion and prevent water loss

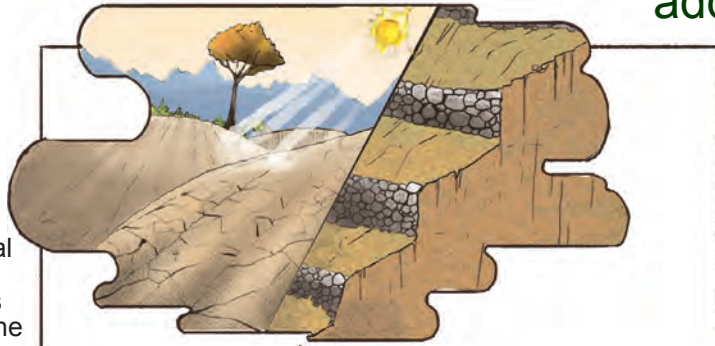


Lesson: Sowing a spreading type cover crop prior to the transition between the dry season and the wet season will reduce soil erosion and provide livestock feed in the dry season

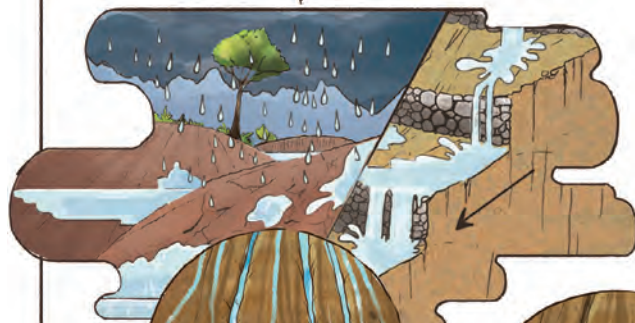


Lesson: Planting vetch in the dry season will reduce soil erosion, provide animal fodder and add nutrients to soil.

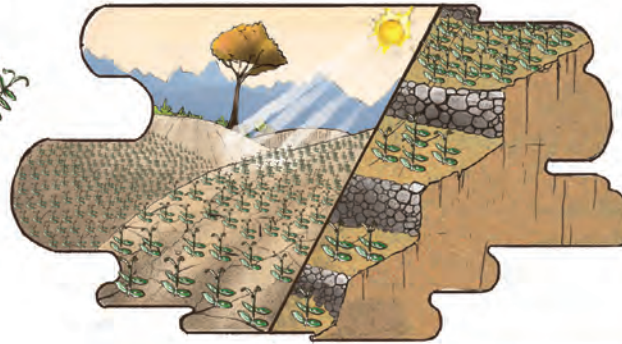
1. Traditional practice: nothing is sown in the dry season



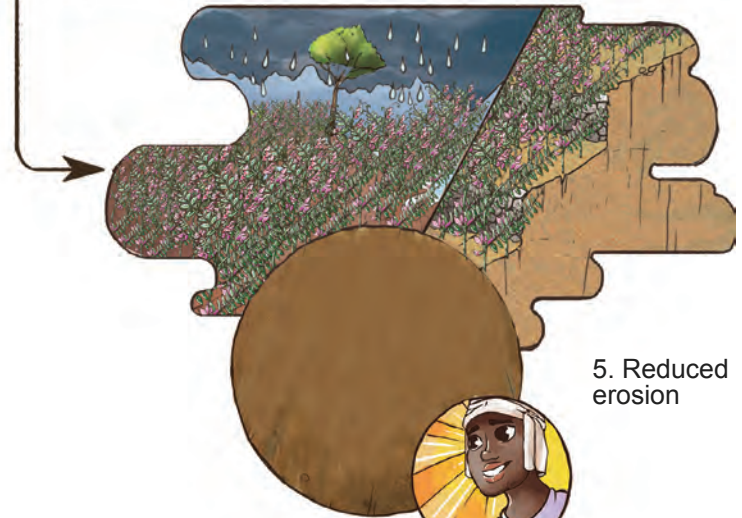
2. Soil erosion when first rain arrives



3. Little animal fodder in the dry season



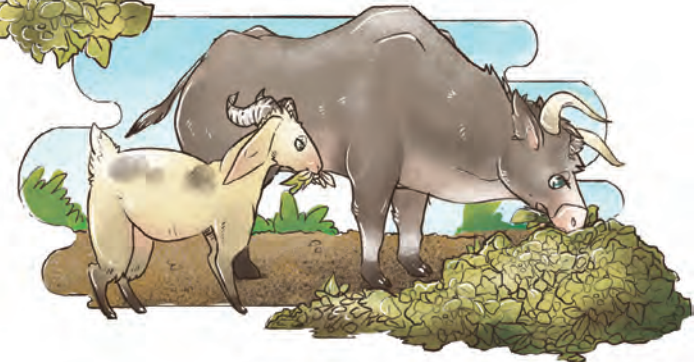
4. Improved practice: sow vetch prior to the beginning of the rainy season



5. Reduced erosion

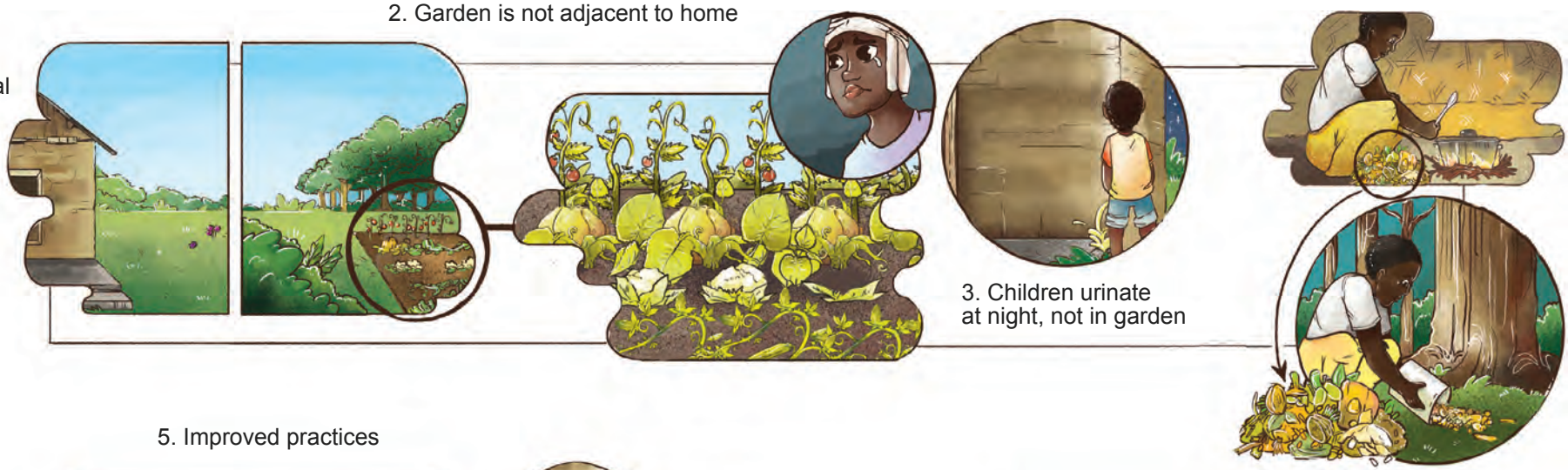


6. Good animal fodder in dry season



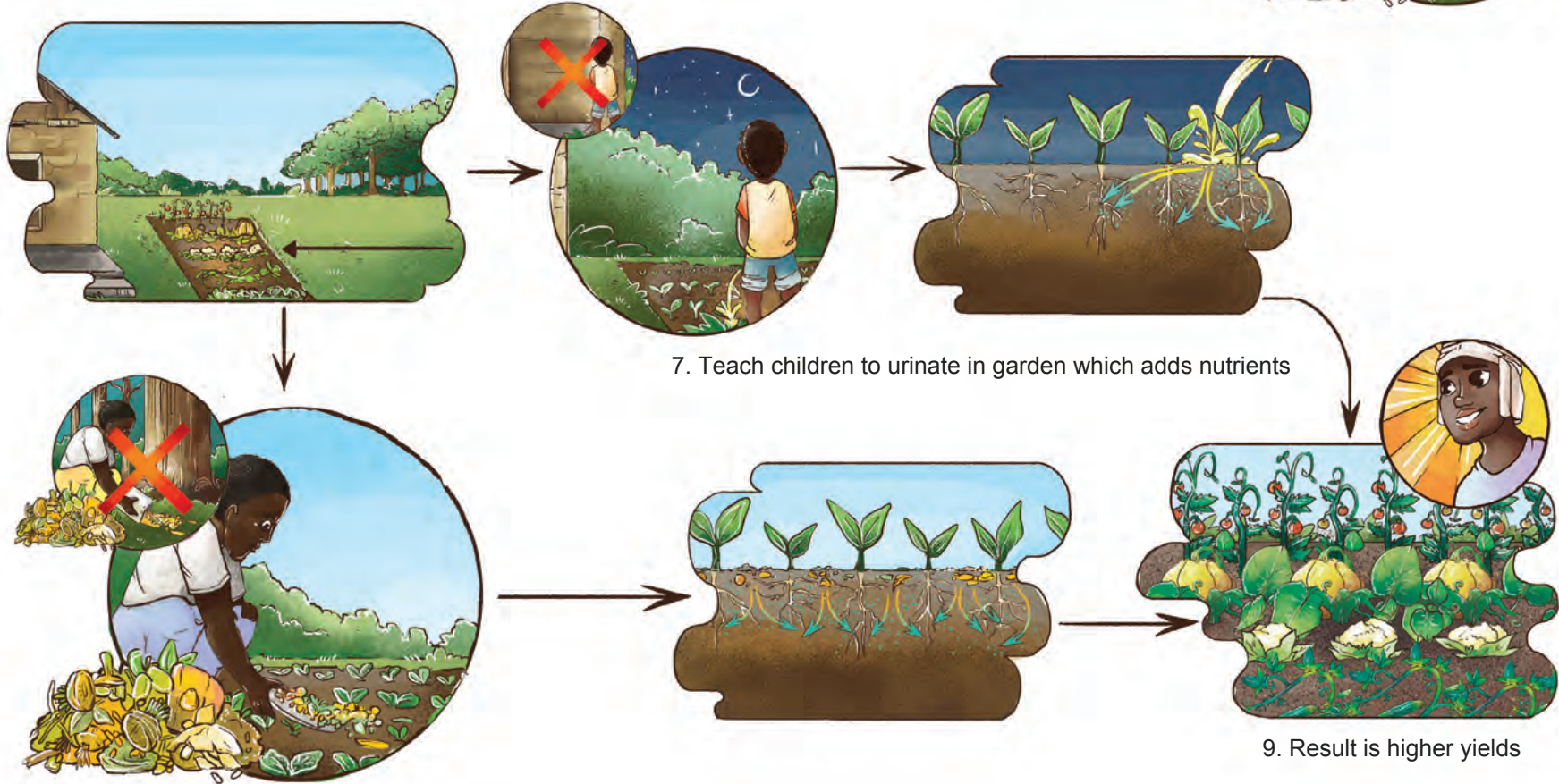
Lesson: Simple practices can improve yields of home gardens

1. Less ideal practices cause low yield



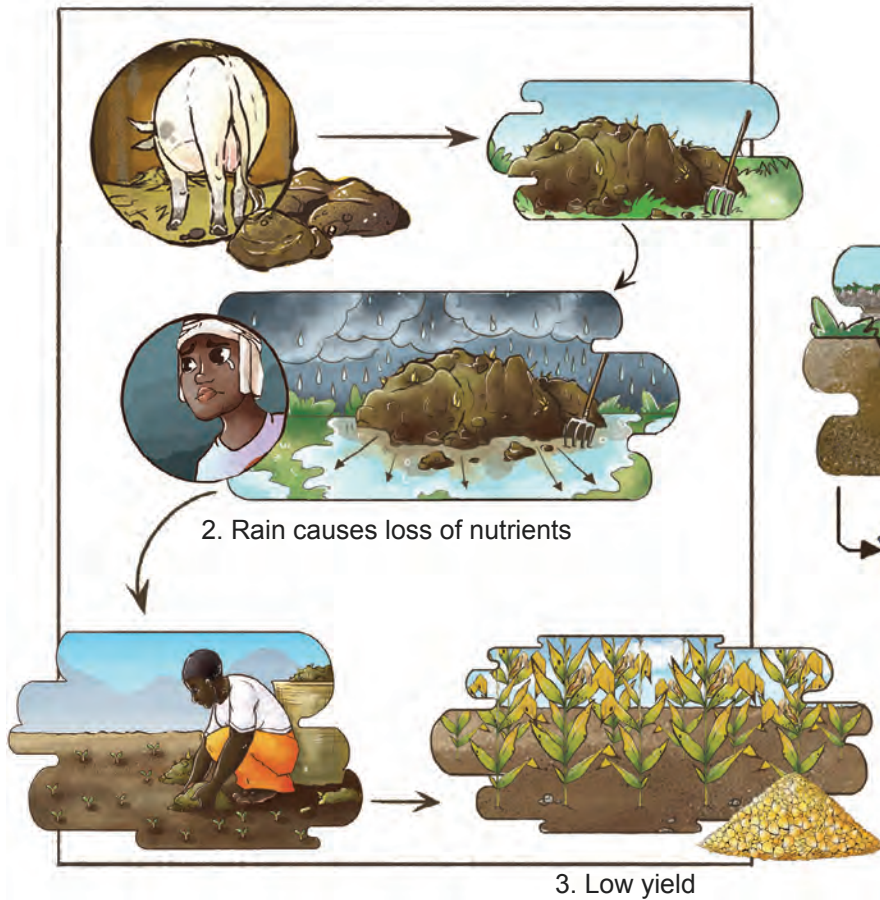
5. Improved practices

6. Shifting garden adjacent to home increases yields

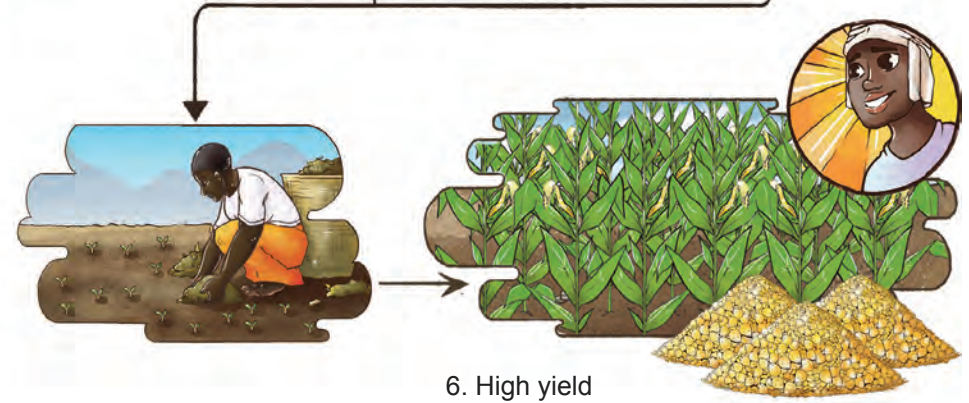
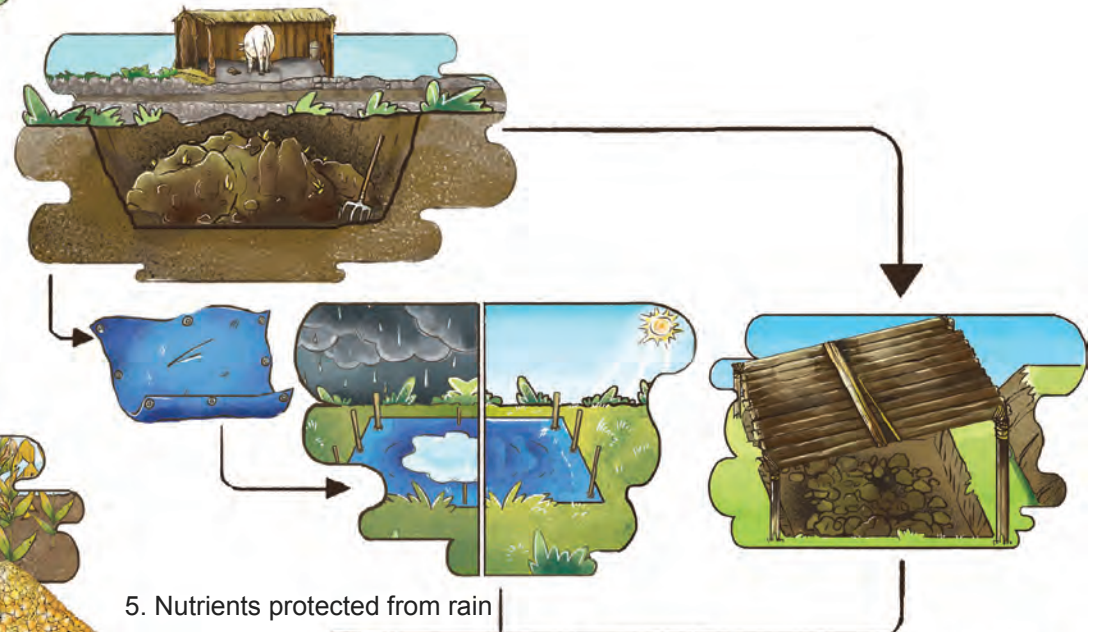


Lesson: Covering manure from rain will prevent loss of its nutrients

1. Traditional practice of storing manure in the open on the ground

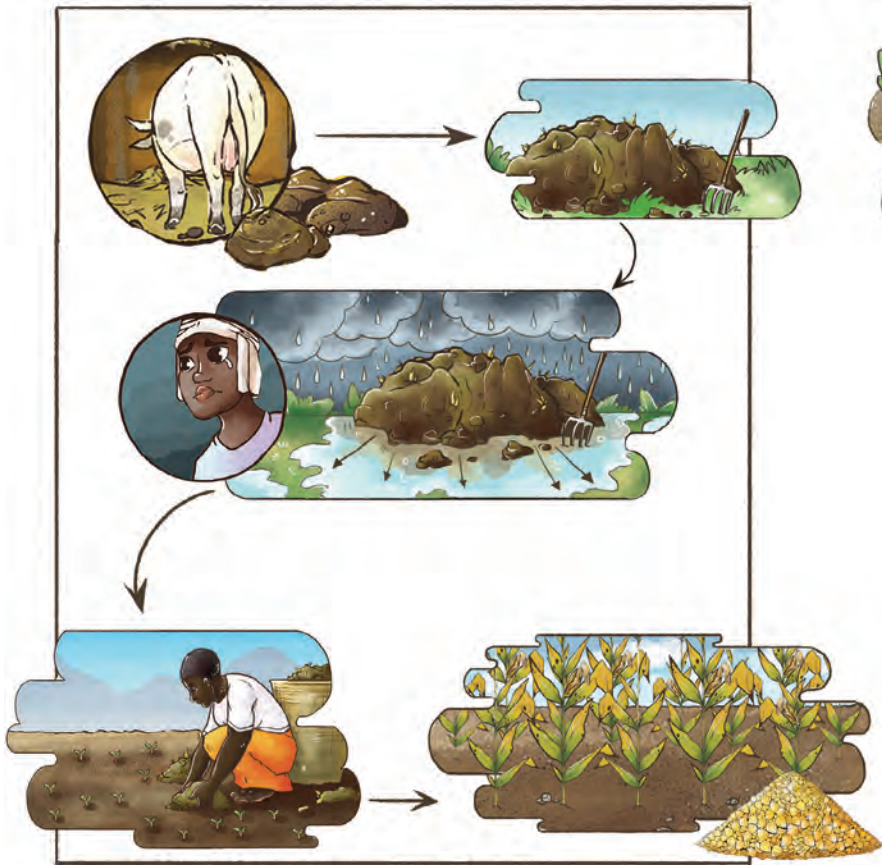


4. Improved practices: store manure in pit or inside mud/stone walls and cover



Lesson: Covering manure from rain will prevent loss of its nutrients

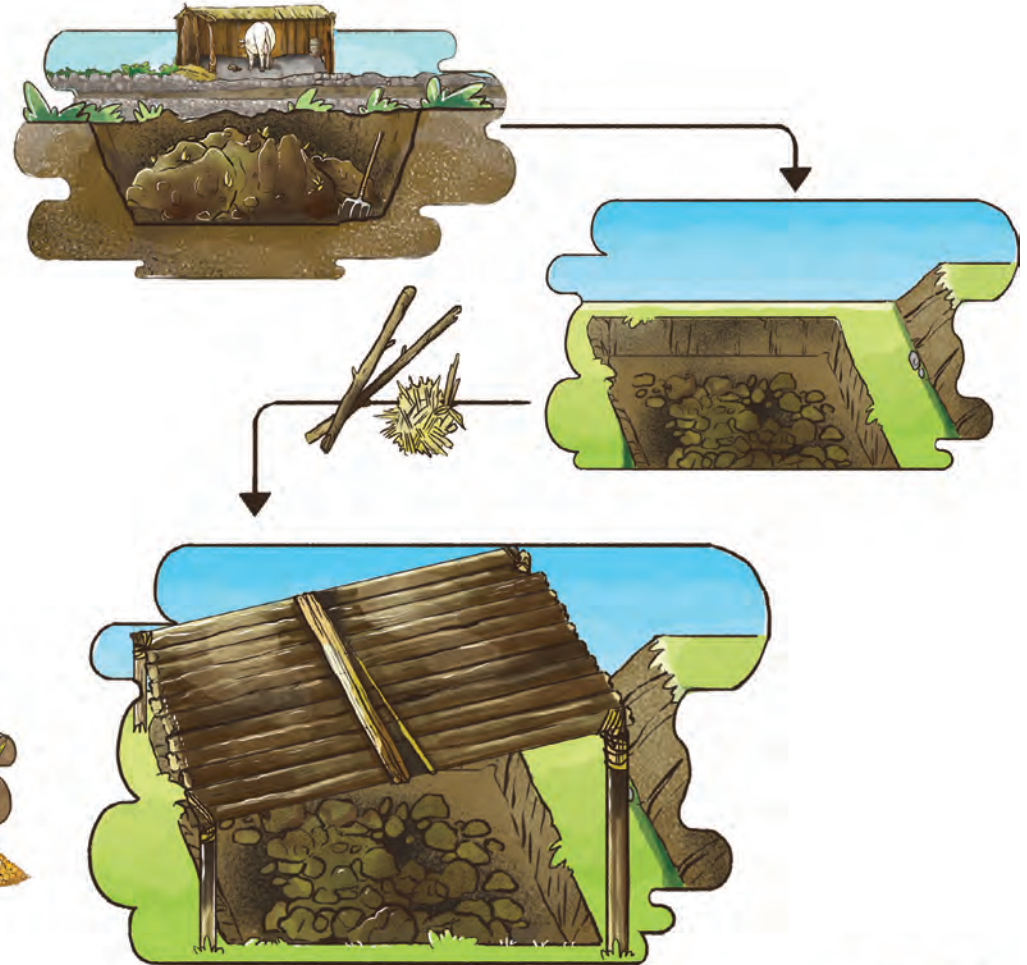
1. Traditional practice of storing manure in the open on the ground



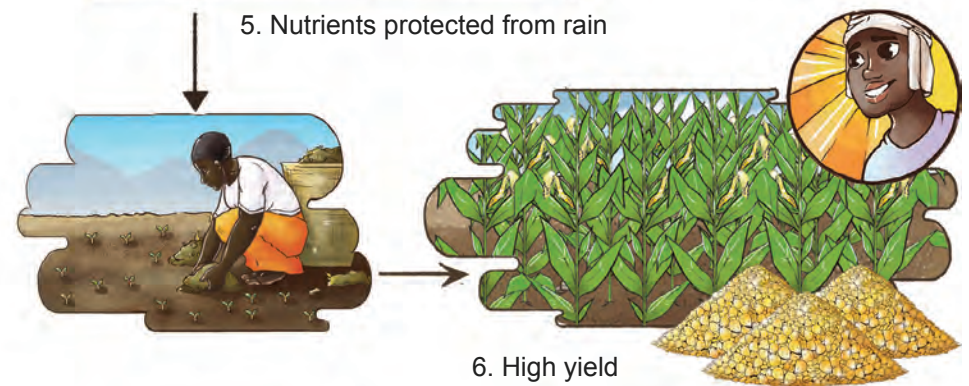
2. Rain causes loss of nutrients

3. Low yield

4. Improved practices: store manure in pit and cover with wood and thatch



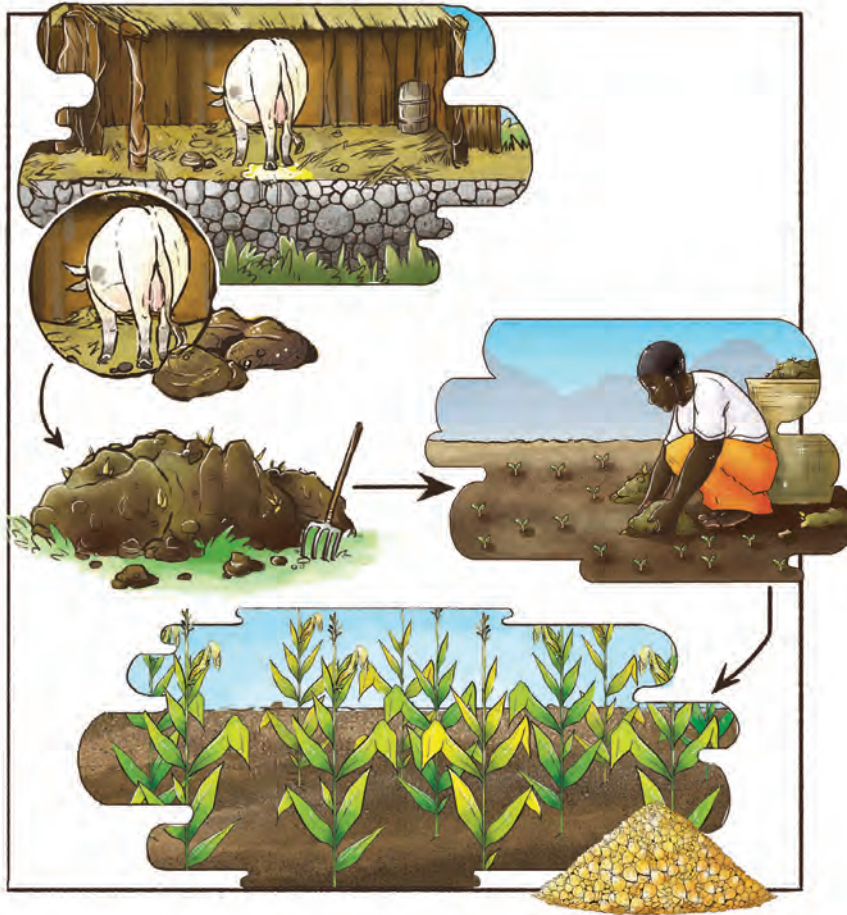
5. Nutrients protected from rain



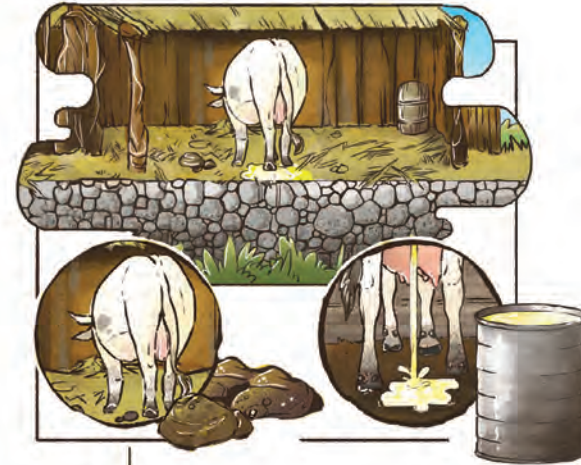
6. High yield

Lesson: There are methods to improve the nutrients of manure (Part 1)

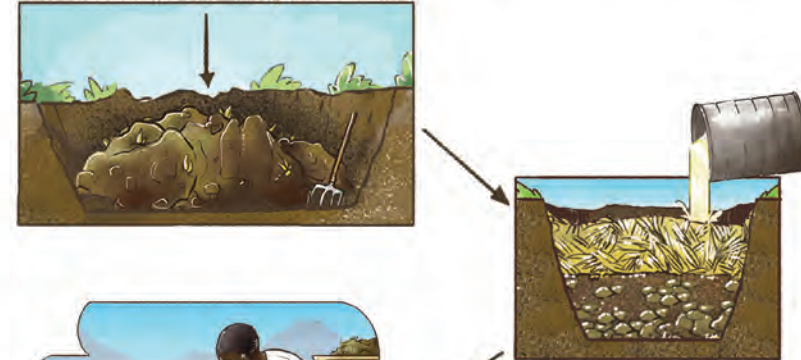
1. Traditional practice: livestock urine is not collected



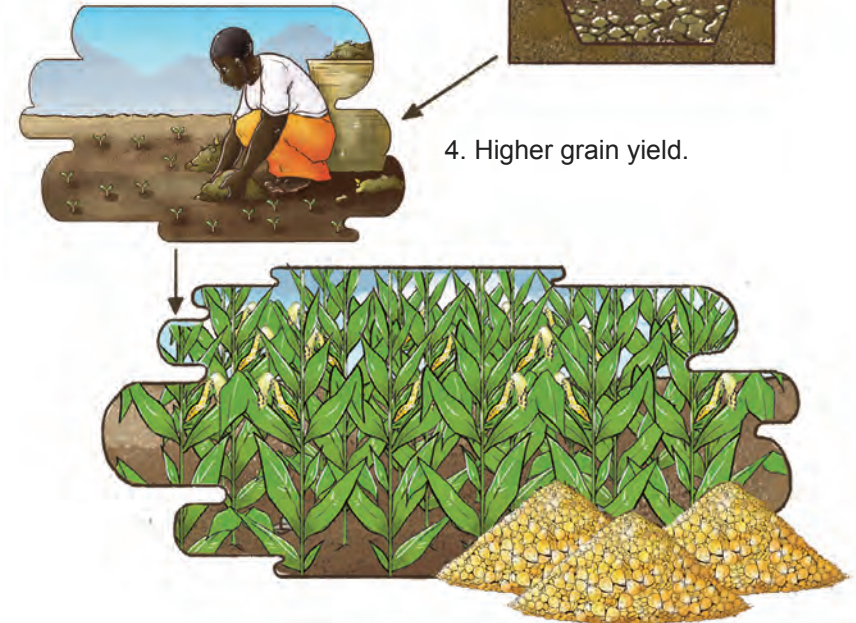
2. Manure gives lower grain yield.



3. New practice: combine urine with manure

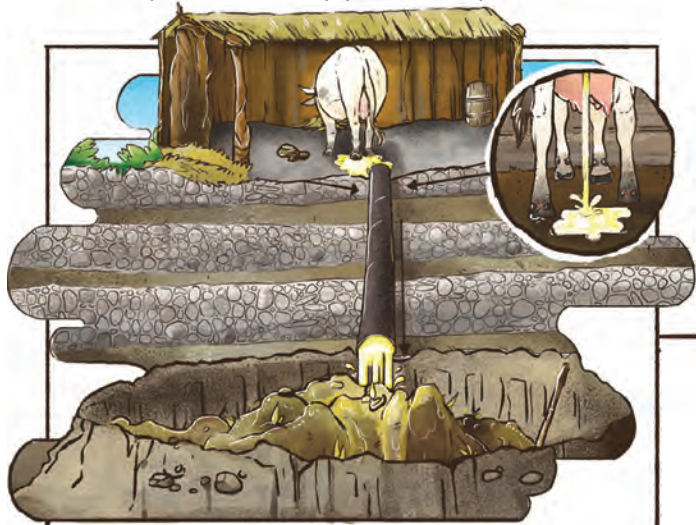


4. Higher grain yield.

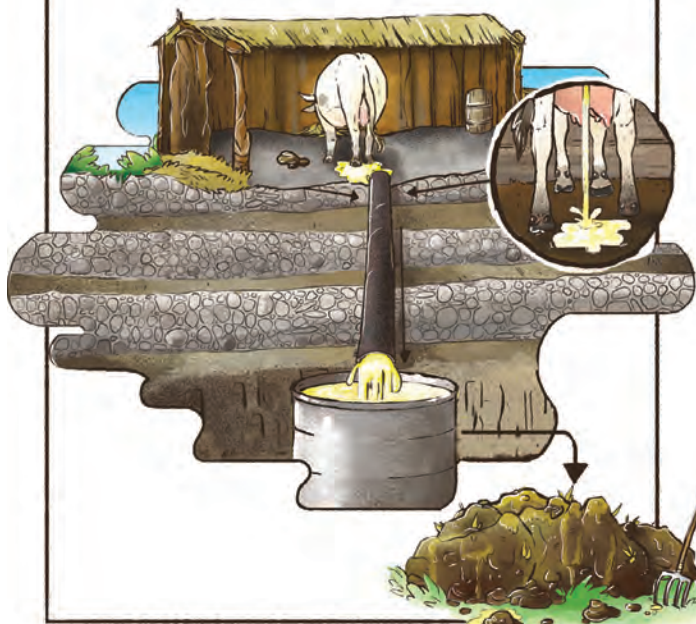


Lesson: There are methods to improve the nutrients of manure (Part 2)

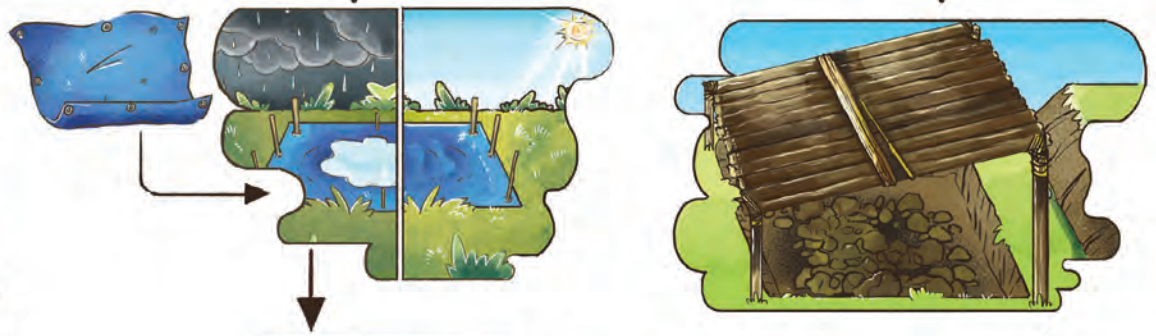
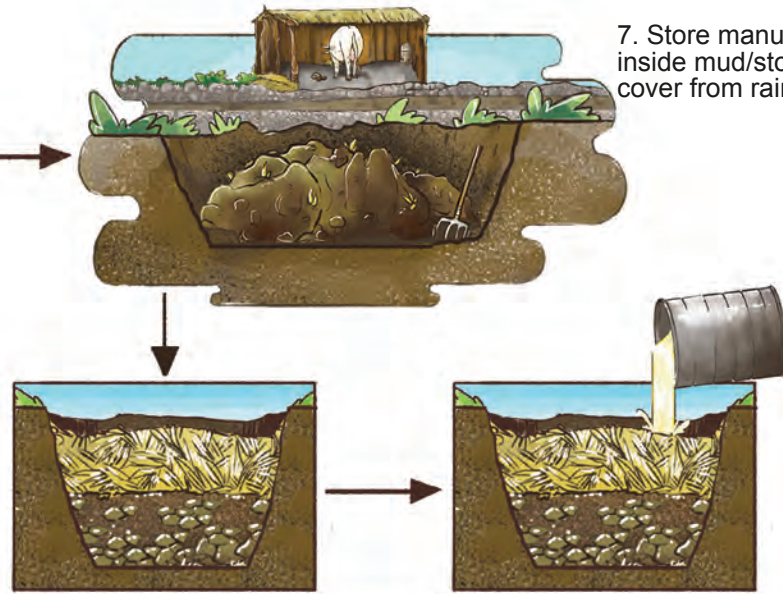
5. Collect urine by using concrete floor that is sloped towards a pipe, and empties into the manure pit.



6. Alternative: urine pipe can go to a drum from which urine can be added to manure

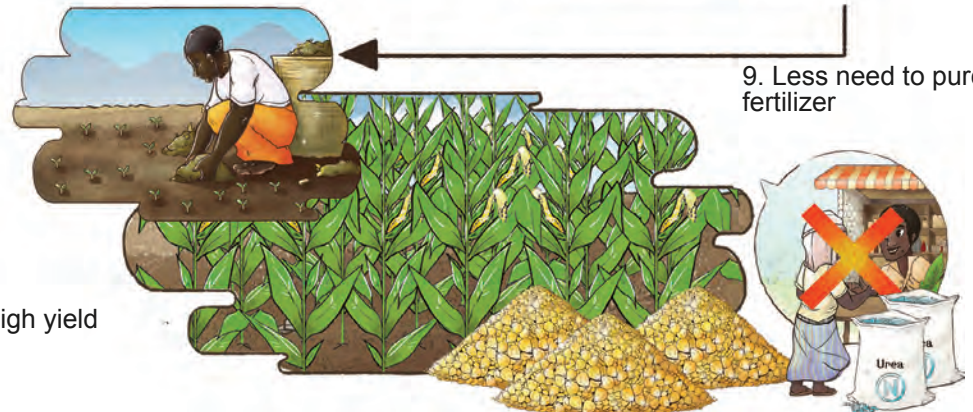


7. Store manure in pit or inside mud/stone walls and cover from rain



9. Less need to purchase fertilizer

8. High yield



Lesson: Adding manure in layers with straw and soil in a container or pit will improve its nutrients

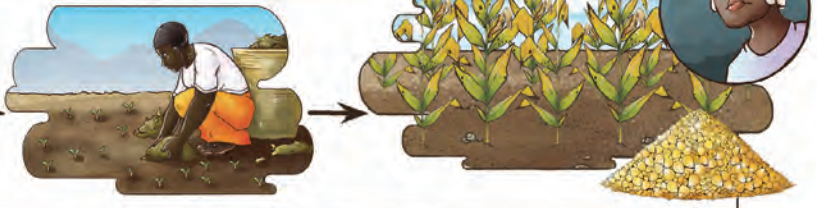
1. Traditional practice is to collect manure and store on ground or in pit



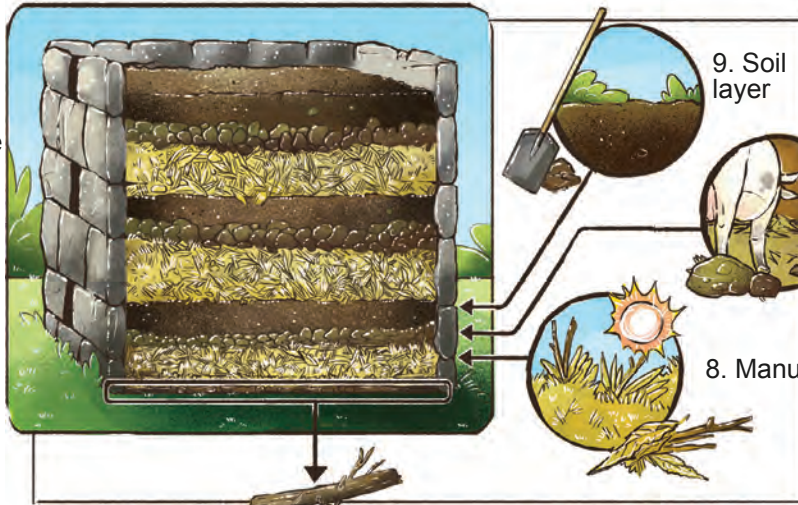
2. Spread manure



3. Low yield



4. Improved practice is to store manure inside walls, elevated, with repeating layers of straw, manure and soil



9. Soil layer

8. Manure layer

7. Layer of straw

5. Create storage structure with sticks, mud or brick

6. Bottom should be sticks to prevent water from soaking up

10. Optional: purchase thermometer at vendor and place in heap



11. If heap was built properly, it should become hotter over a period of weeks.

12. Let compost incubate for several weeks



13. Spread in field

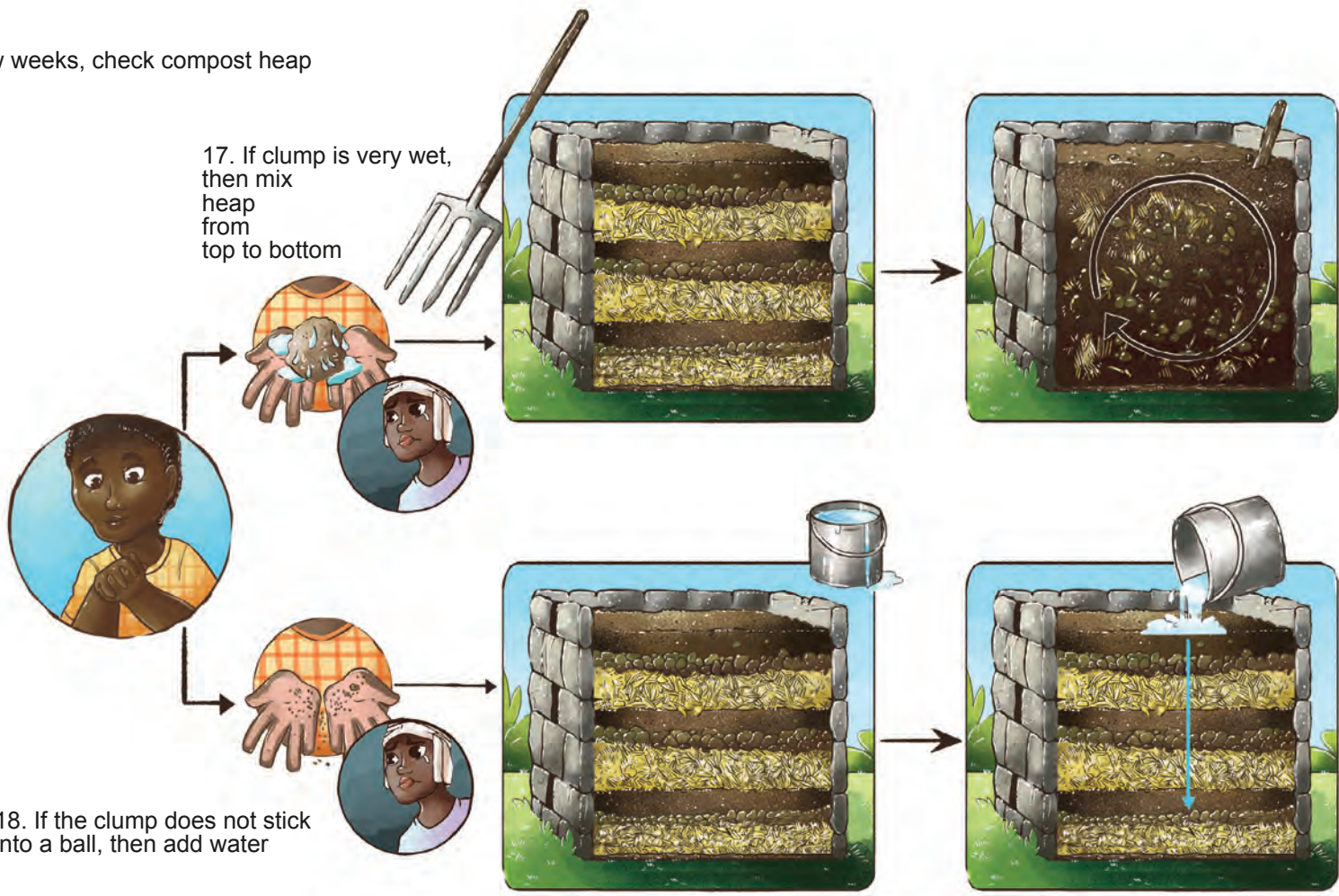


14. Higher yields

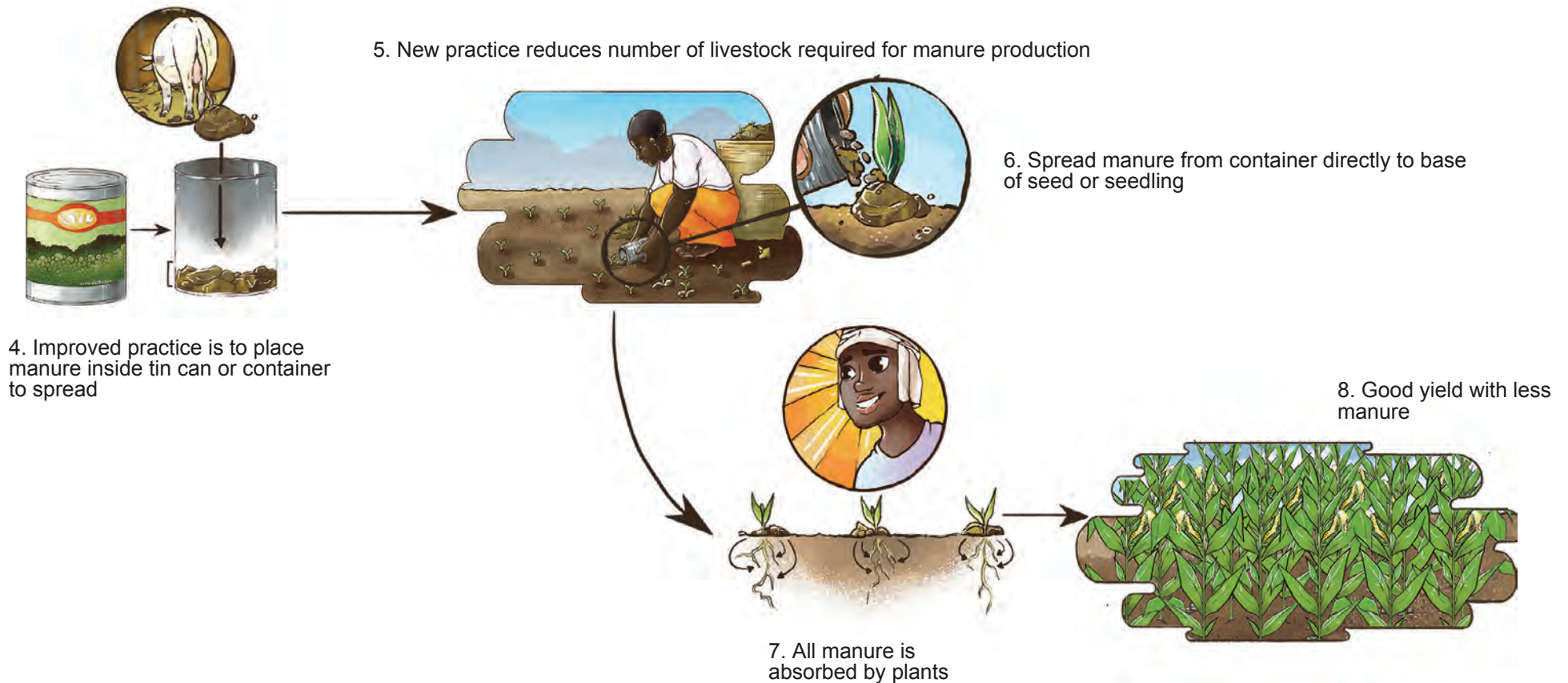
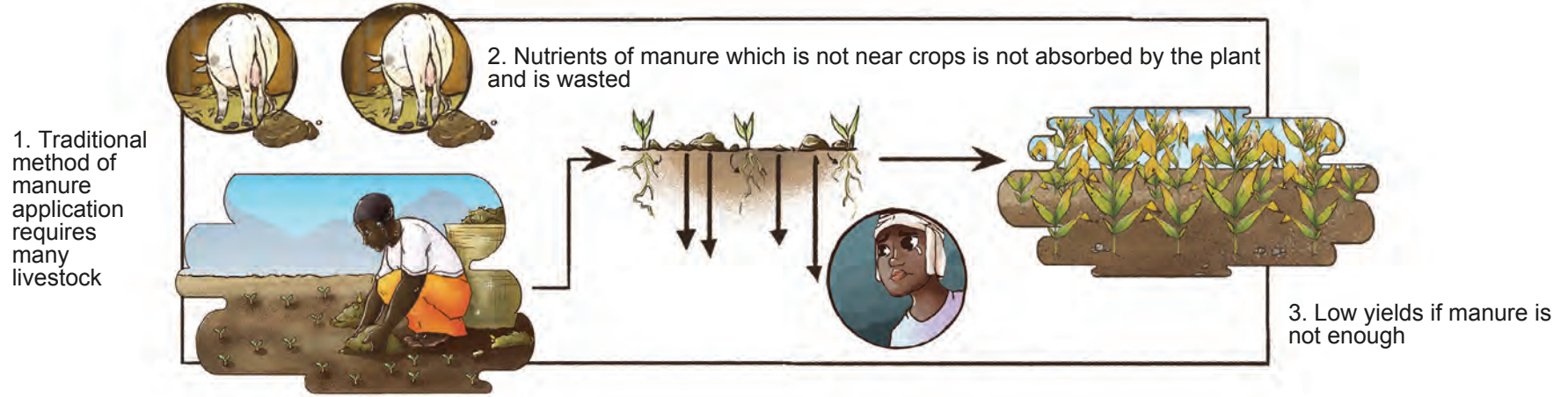


Lesson: Adding manure in layers with straw and soil in a container or pit will improve its nutrients (continued)

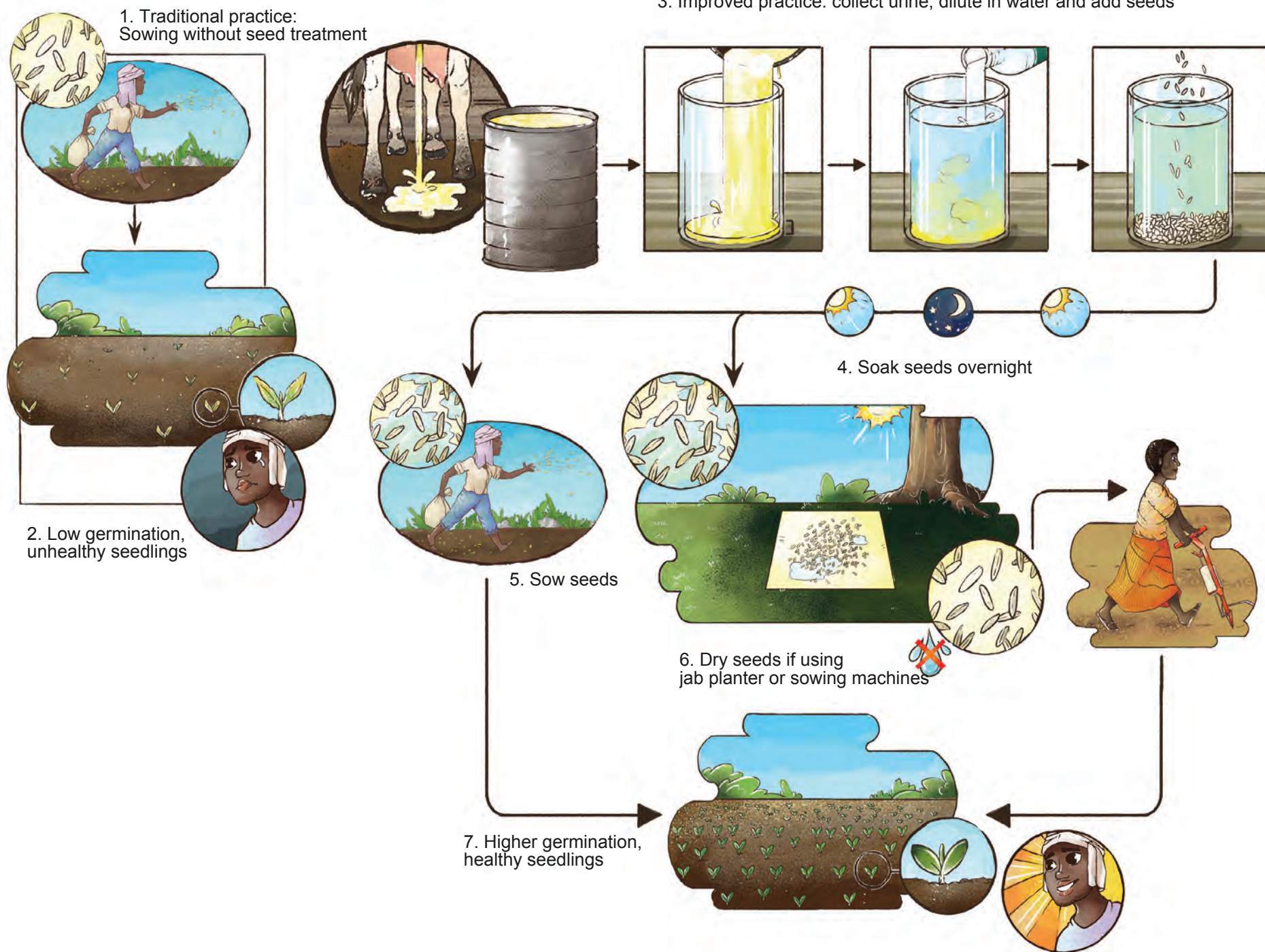
15. Every few weeks, check compost heap



Lesson: Rather than traditional method of spreading manure, adding small amounts of manure directly to each seedling will reduce the total quantity of manure required

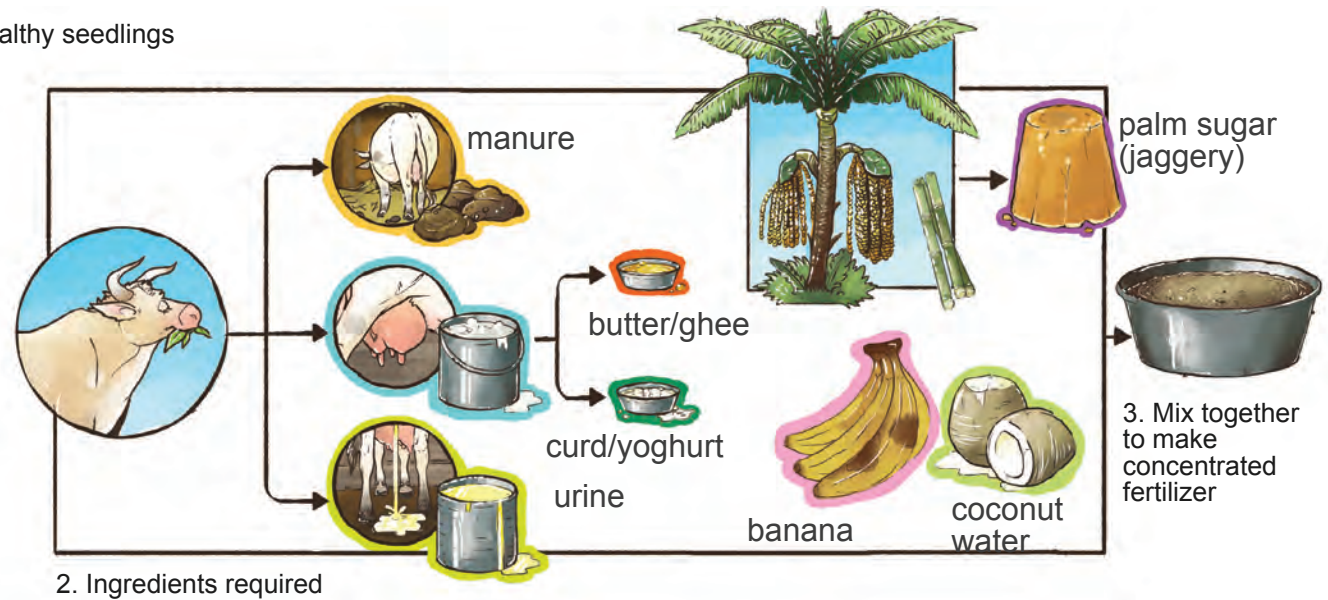
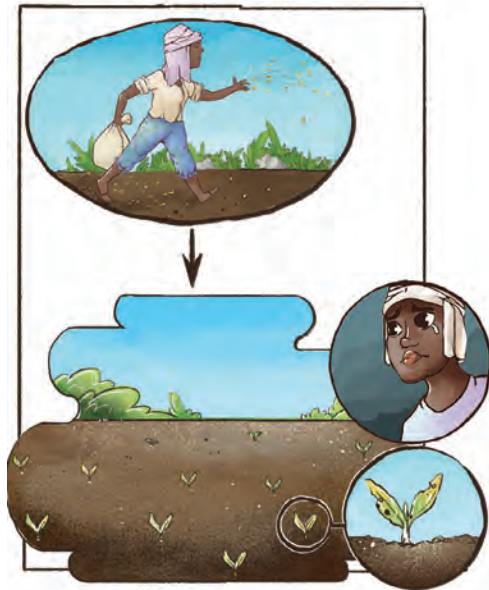


Lesson: Treatment of seeds with livestock urine will improve seed germination and health



Lesson: An indigenous biofertilizer improves germination and improves seedling health (panchakavya) (part I)

1. Traditional practice: Low germination, unhealthy seedlings

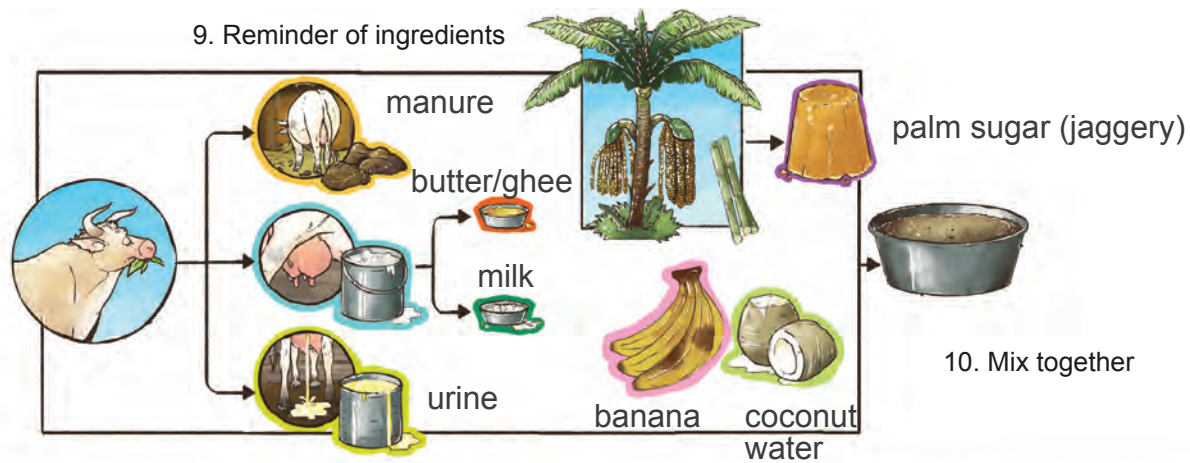


2. Ingredients required



Lesson: An indigenous biofertilizer improves germination and improves seedling health (panchakavya)(part 2)

8. Details of biofertilizer recipe: Mixtures should be kept in shade and kept open but covered with a mosquito net



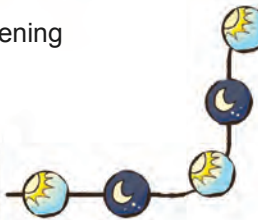
11. Mix 7kg manure and 1kg butter/ghee



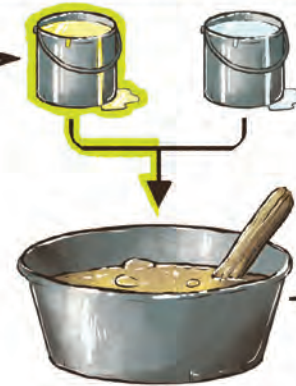
12. Mix morning and evening



13. Keep for 3 days



14. Add 10L cow urine and 10L water



15. Mix each morning and evening for 15 days



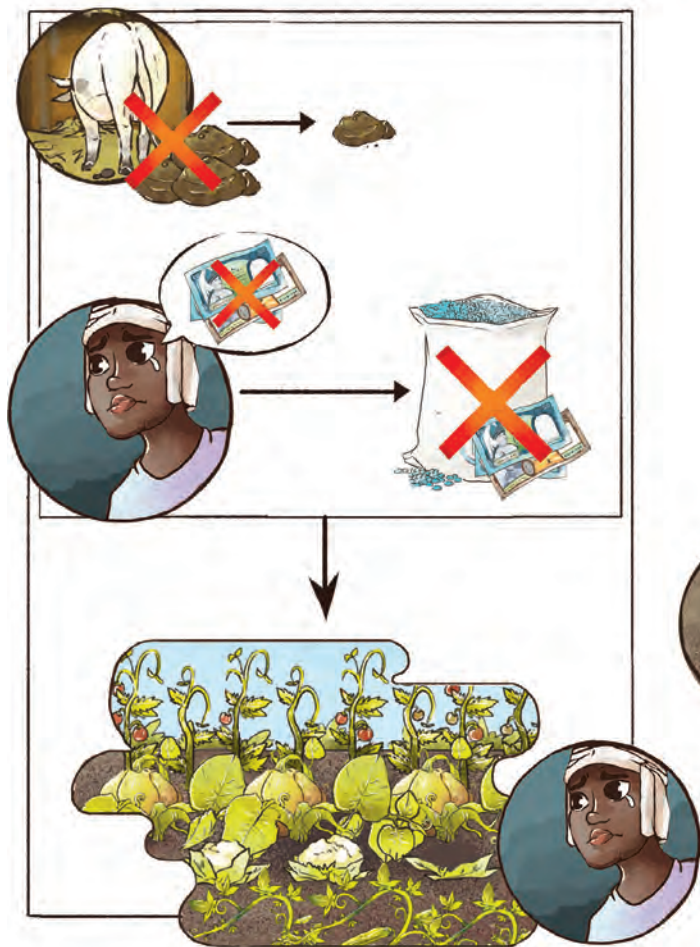
17. Incubate for 15 more days



16. After 15 days, add:
cow milk - 3L
yoghur/curd - 2L
fresh coconut water - 3L
jaggery/palm sugar - 3kg
ripe banana - 12 bananas

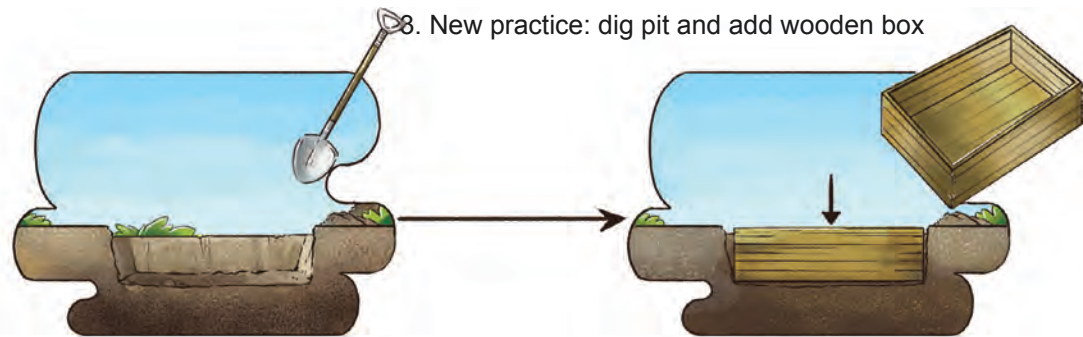
Lesson: Manure made with the help of worms can be an alternative to livestock manure or synthetic fertilizers for home gardens

1. Traditional sources of livestock manure or synthetic fertilizer may not be available or expensive



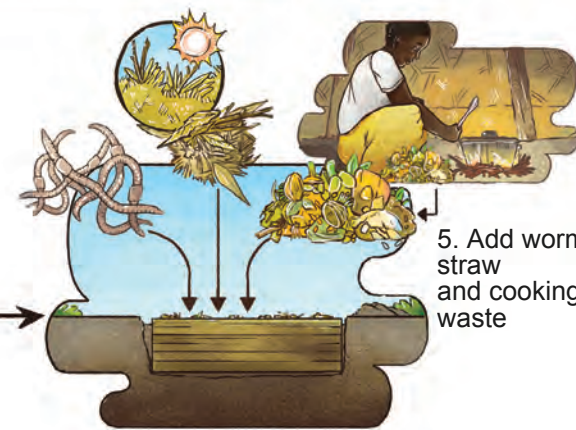
2. Low yields

7. Worms will eat straw and waste and convert to manure



3. New practice: dig pit and add wooden box

4. Collect earthworms after rain



5. Add worms, straw and cooking waste

6. Time passes



8. Add worm manure, high yields

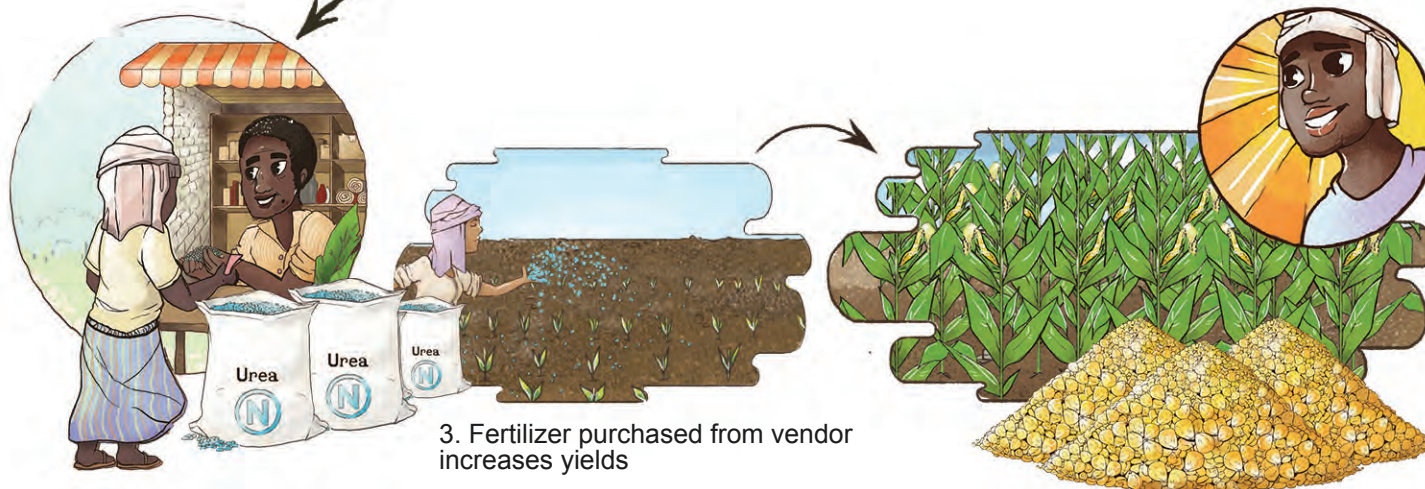
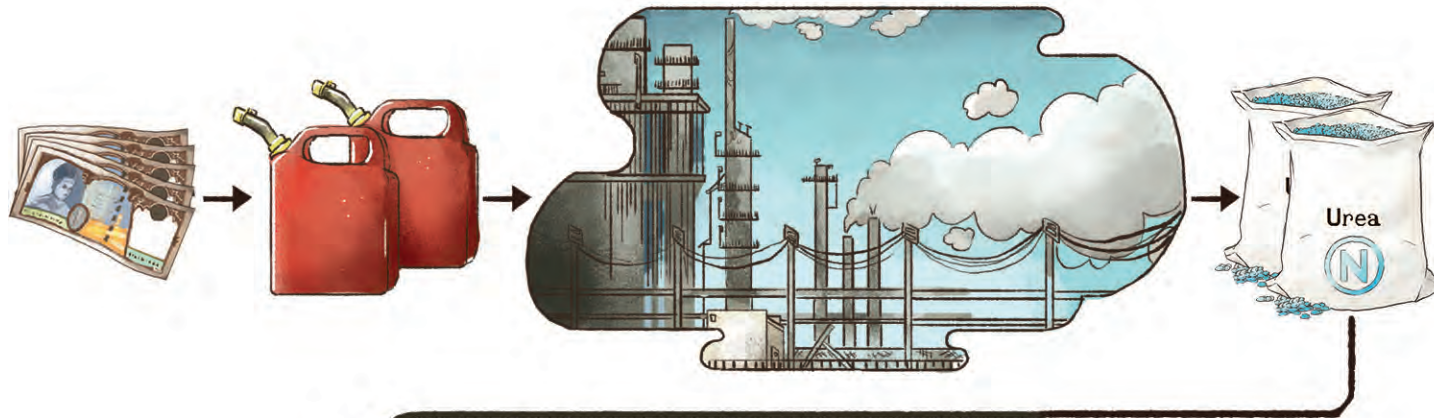


Lesson: Synthetic nitrogen fertilizer raises crop yields

1. If not fertilizer or manure, crop yields are low



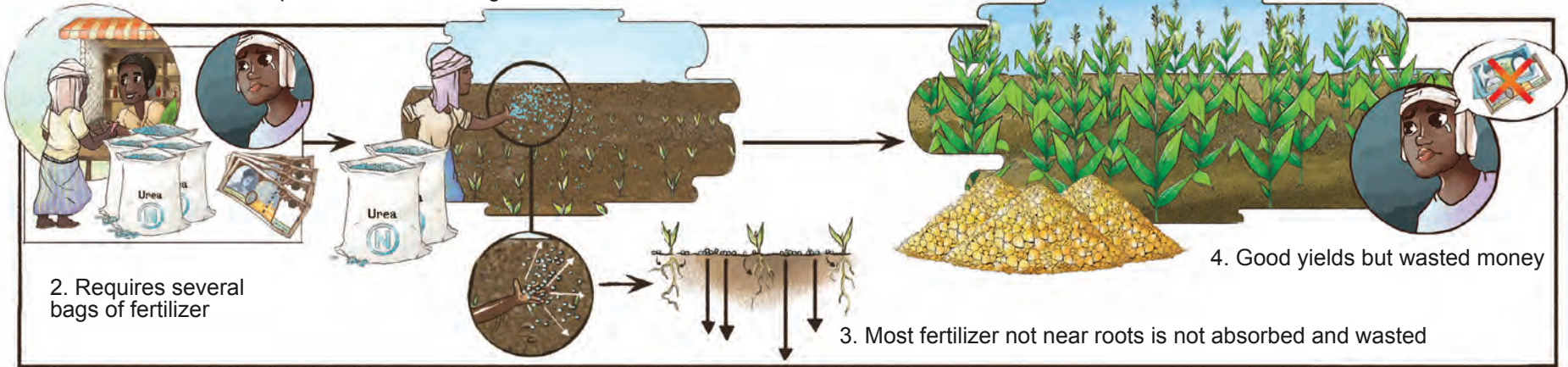
2. Synthetic nitrogen fertilizer is created in factories using natural gas or petrol, hence when petrol prices increase, fertilizer price will increase



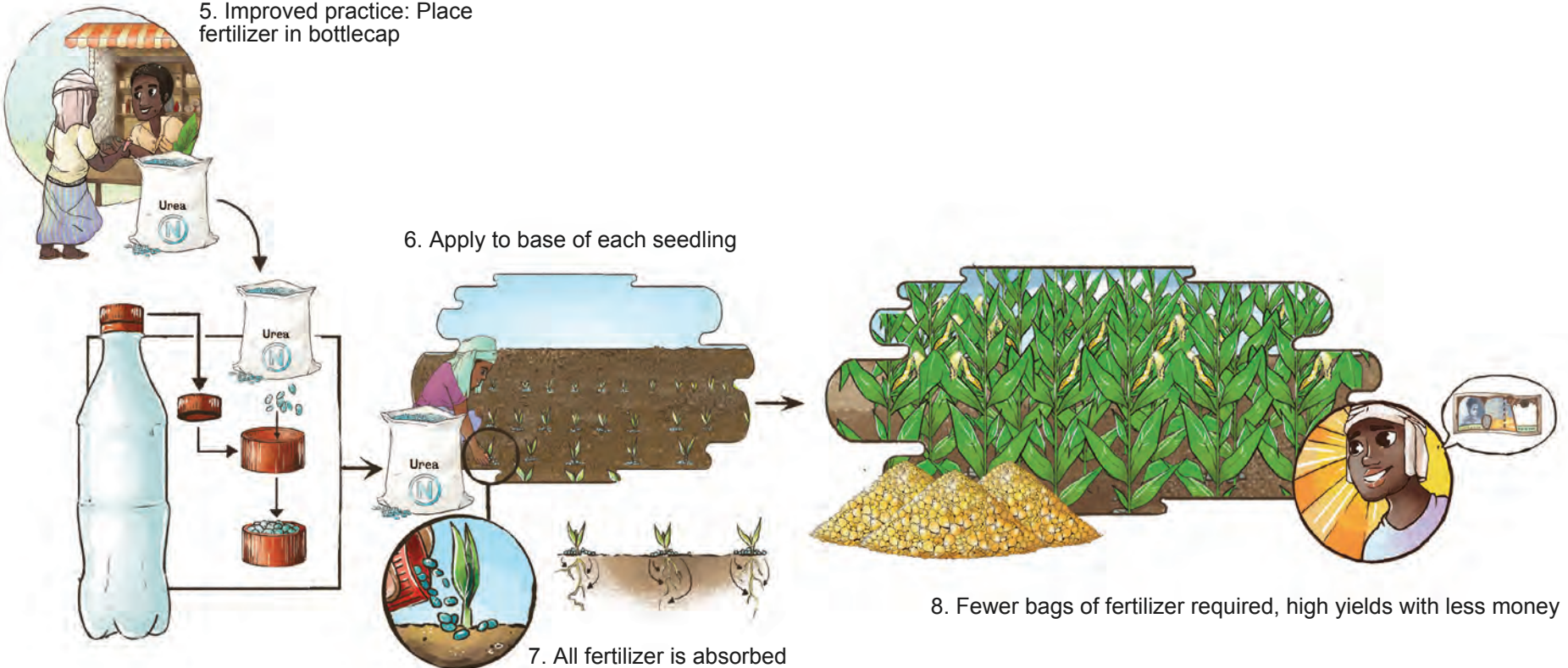
3. Fertilizer purchased from vendor increases yields

Lesson: Rather than random broadcasting of fertilizer, adding small amounts using a bottle cap directly to each seed or seedling reduces the total amount of fertilizer required

1. Traditional practice: broadcasting fertilizer

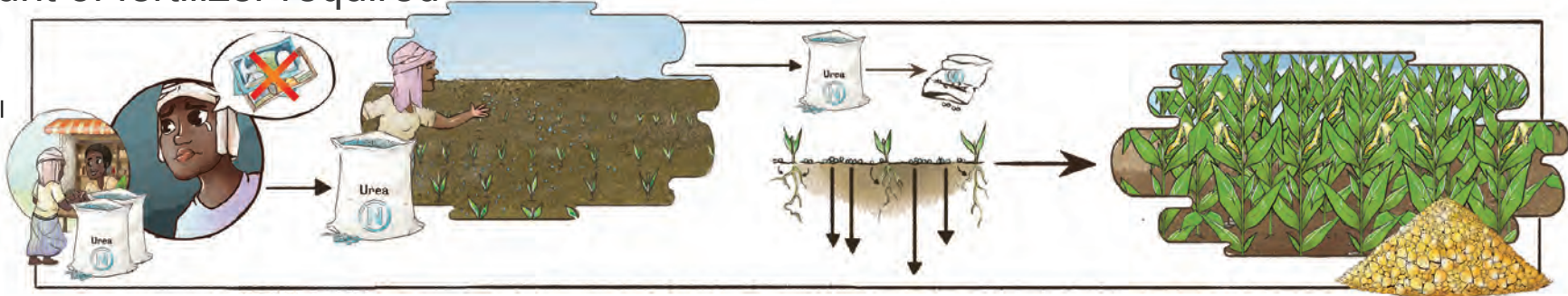


5. Improved practice: Place fertilizer in bottlecap



Lesson: Rather than applying all fertilizer in a single dose, splitting the doses will reduce the amount of fertilizer required

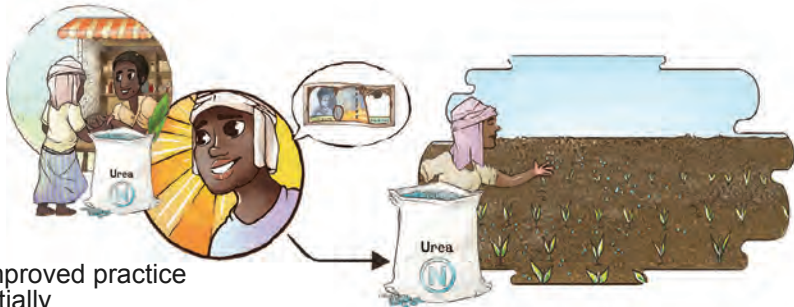
1. Traditional practice of applying fertilizer in a single dose



2. Plants are small and will not absorb fertilizer

3. Money wasted, lower yield

4. Improved practice is initially apply only 1/2 or 1/3 bag of fertilizer



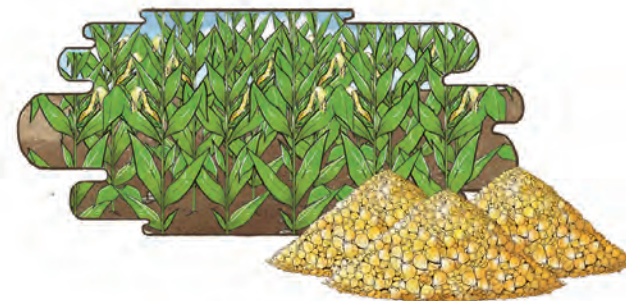
5. At a later stage, apply remaining fertilizer



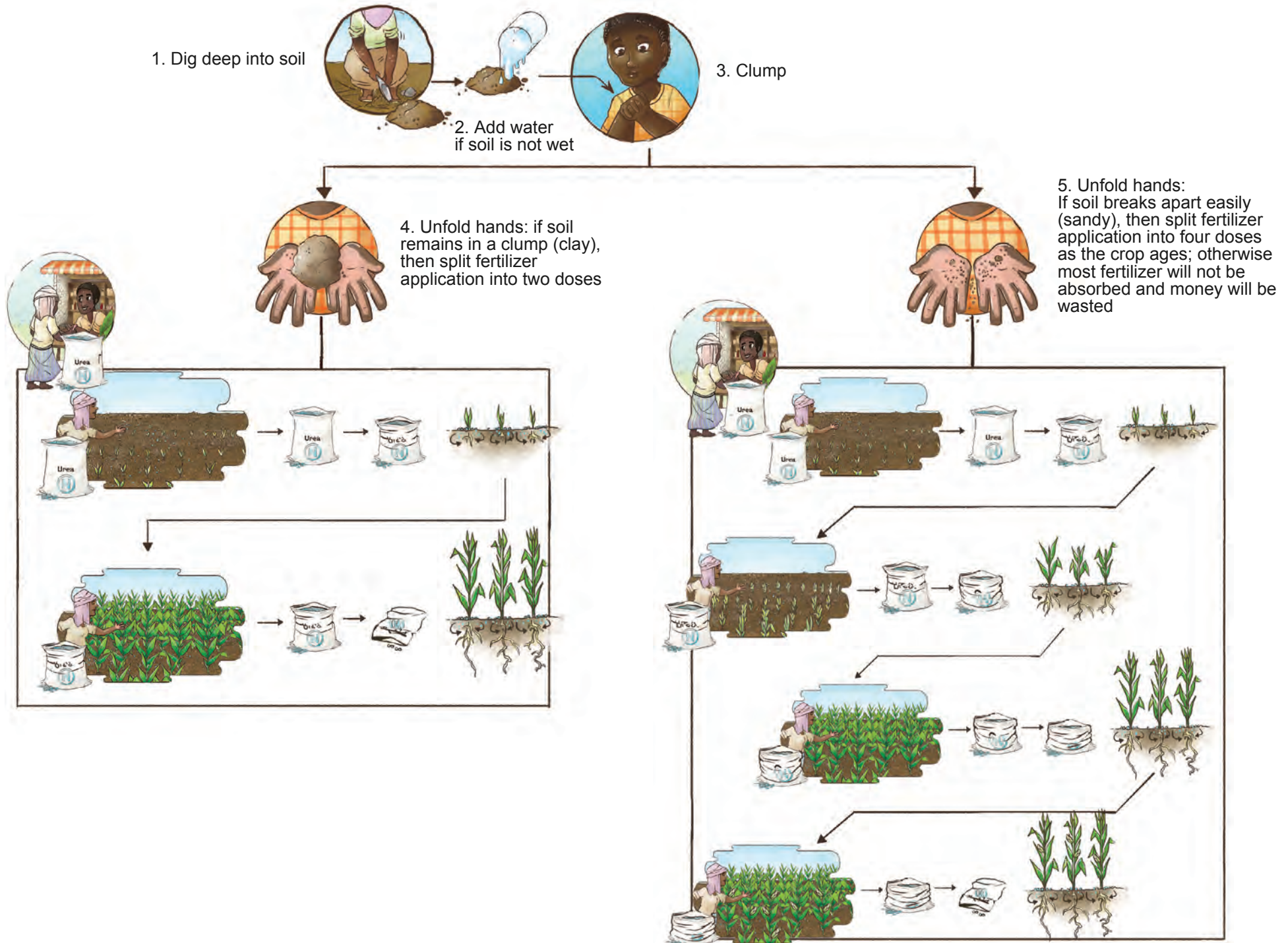
6. All fertilizer is absorbed



7. High yields with less fertilizer and hence less money

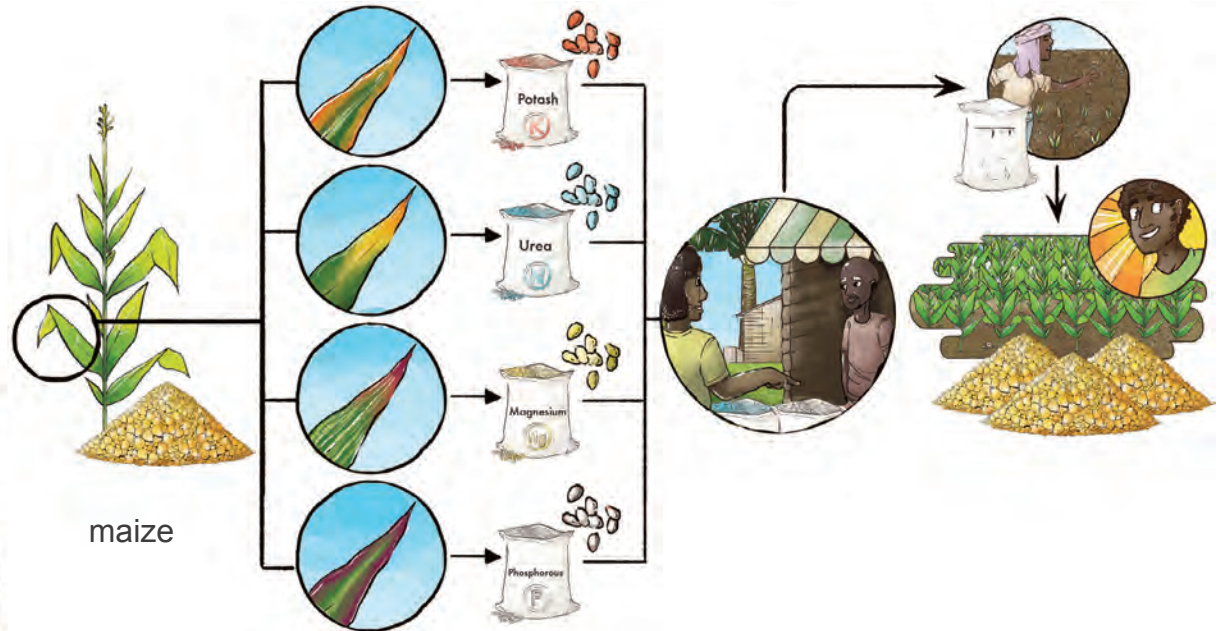


Lesson: Artificial fertilizers should be applied differently on different soil-texture types

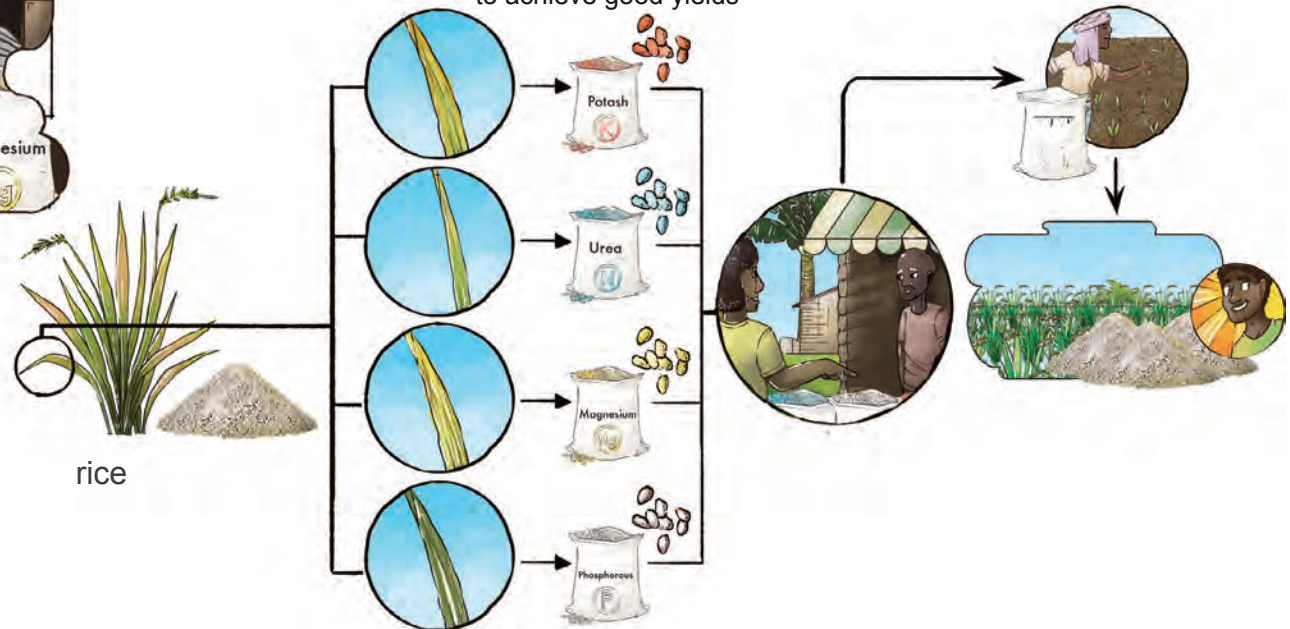


Lesson: A colour change in crop leaves can potentially indicate that one type of fertilizer is lacking

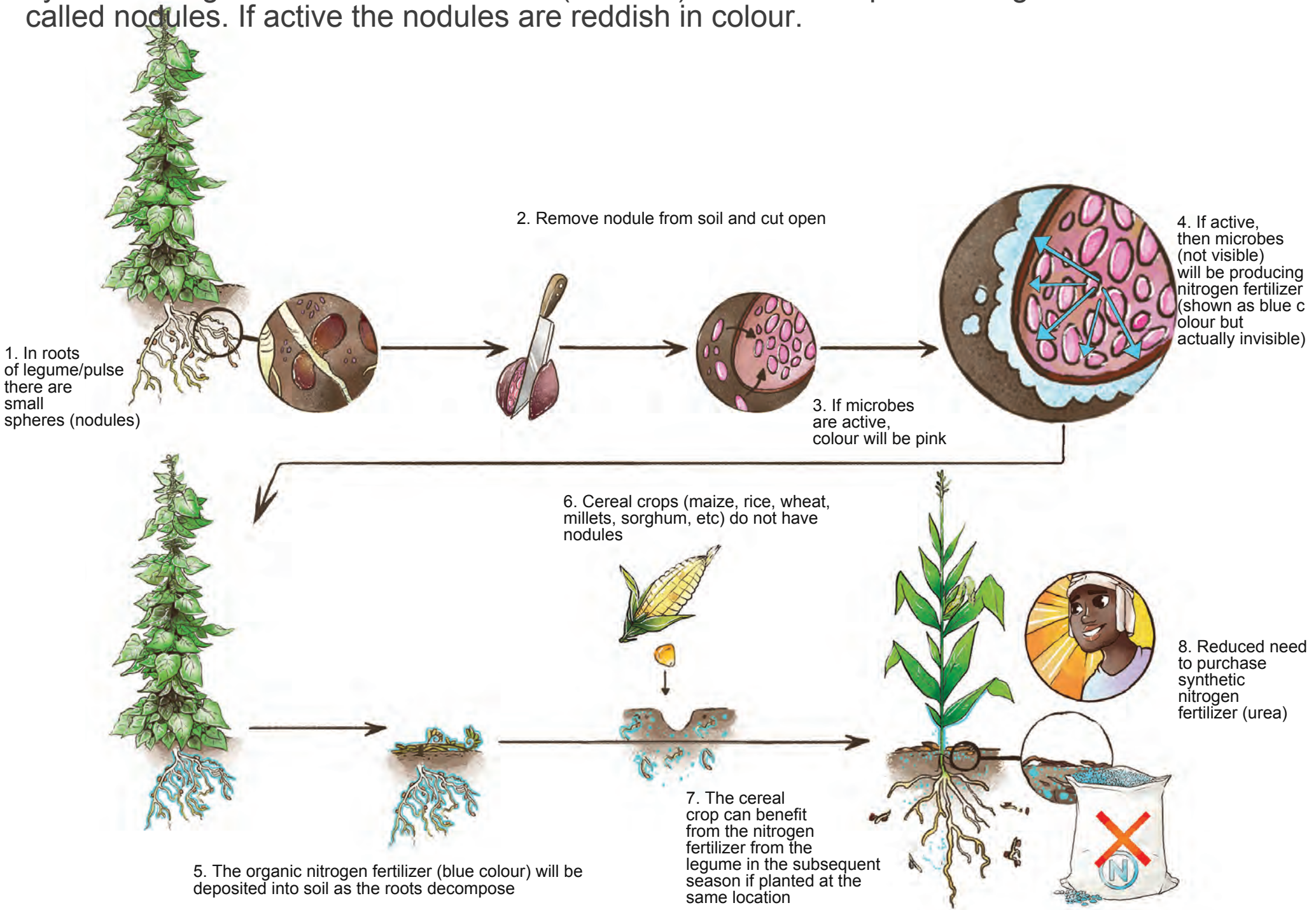
1. Traditional practice: crops are sick but the reason is unknown. To fix, a farmer purchases different fertilizers or pesticides but none may solve the problem.



2. Improved practice is look for a change in the colour and pattern on the leaves, then purchase the appropriate fertilizer if needed to achieve good yields



Background educational lesson: A legume (bean) or pulse can produce organic nitrogen fertilizer by associating with beneficial microbes (rhizobia) that inhabit spherical organs in the roots called nodules. If active the nodules are reddish in colour.

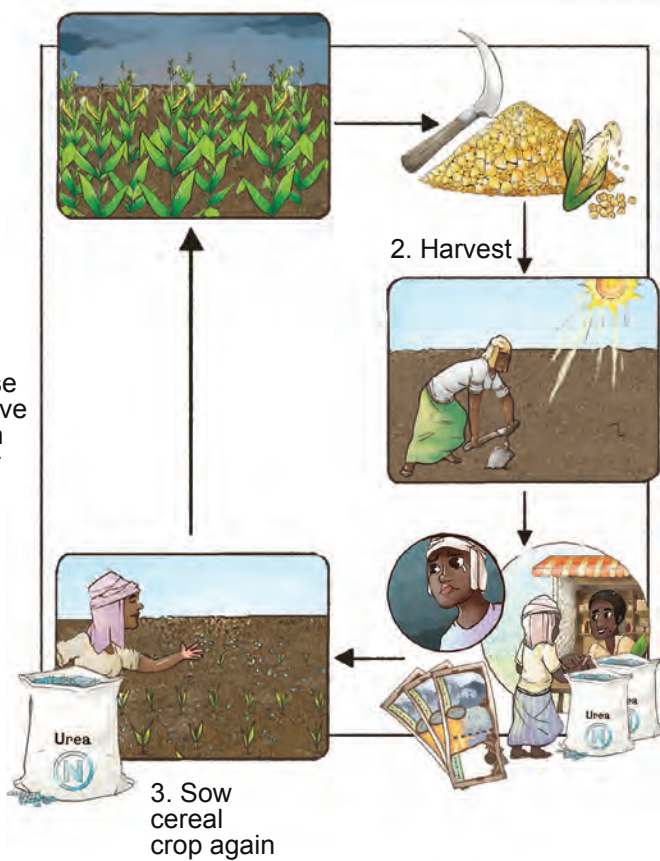


Background educational lesson: The roots of legume and pulses have little spheres in which helpful microbes make natural nitrogen fertilizer to reduce need to purchase artificial fertilizer.

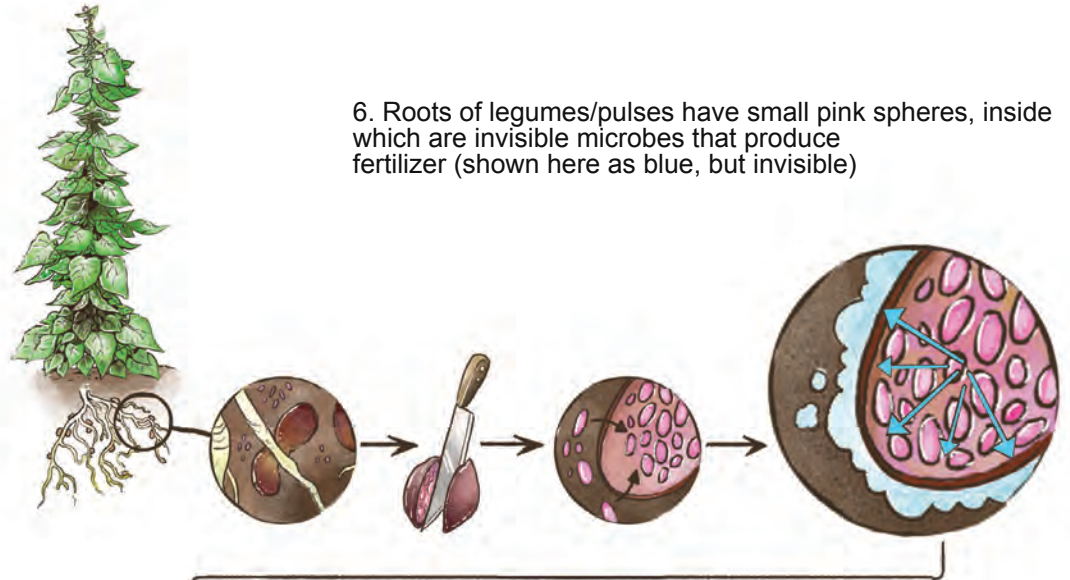
1. Bad practice: plant sole crop of maize wheat, rice, millet in all seasons (no legumes, no pulses)

5. Improved practice: Plant legumes or pulses (e.g. lentil) as intercrop or in next season

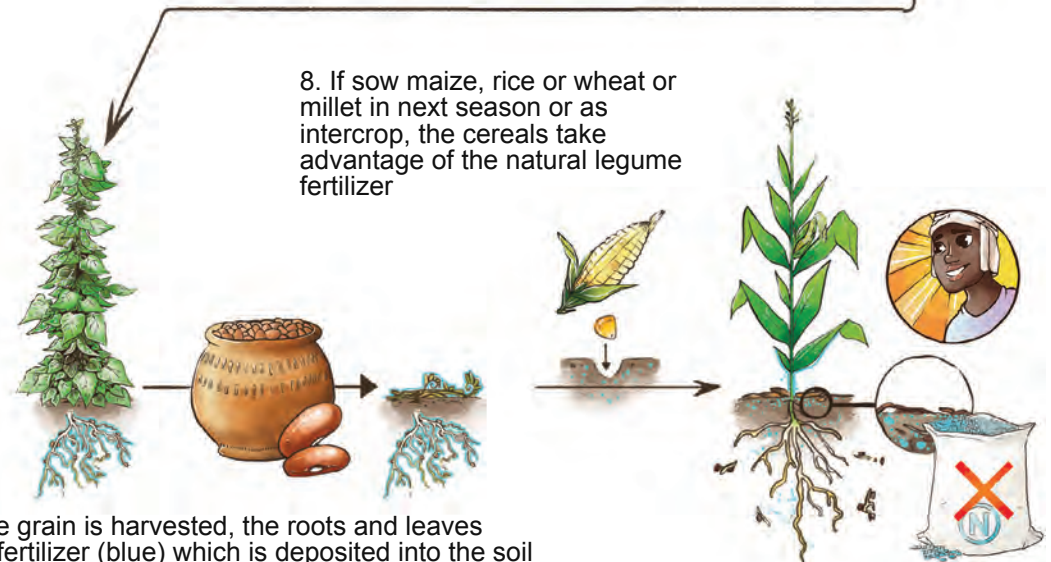
4. Must purchase expensive nitrogen fertilizer



6. Roots of legumes/pulses have small pink spheres, inside which are invisible microbes that produce fertilizer (shown here as blue, but invisible)



8. If sow maize, rice or wheat or millet in next season or as intercrop, the cereals take advantage of the natural legume fertilizer

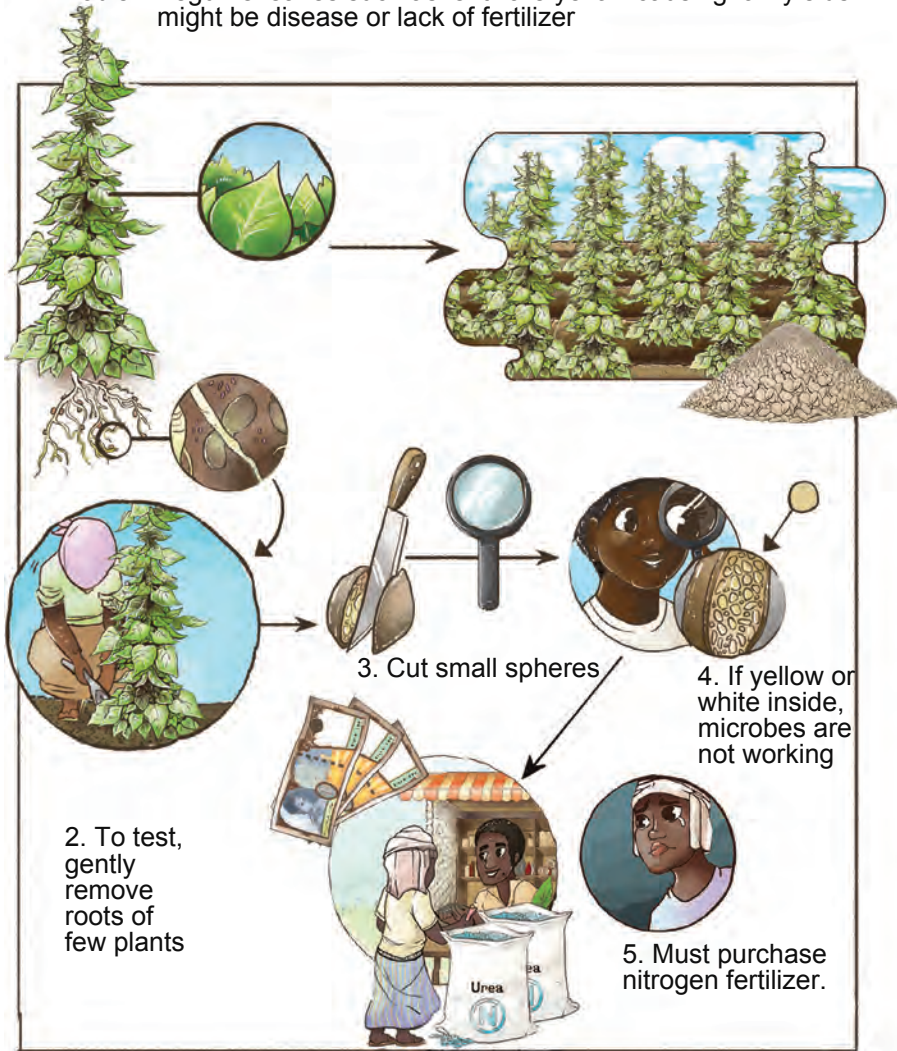


7. After legume grain is harvested, the roots and leaves remain rich in fertilizer (blue) which is deposited into the soil when they decompose

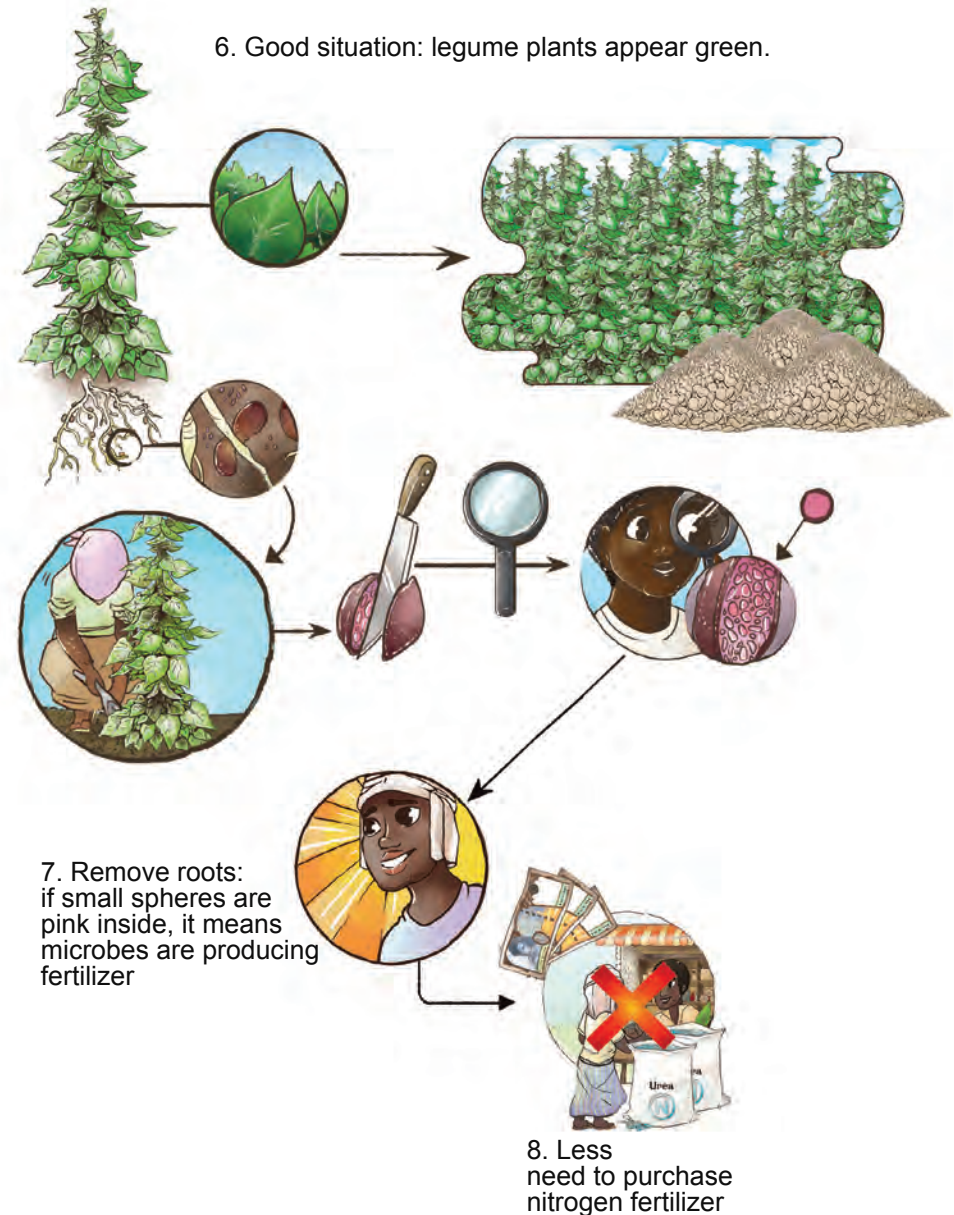
9. Less need to purchase nitrogen fertilizer

Lesson: If small spheres on legume roots are only yellow inside, they do not contain healthy microbes to make natural nitrogen fertilizer, but a pink colour inside means they are producing fertilizer

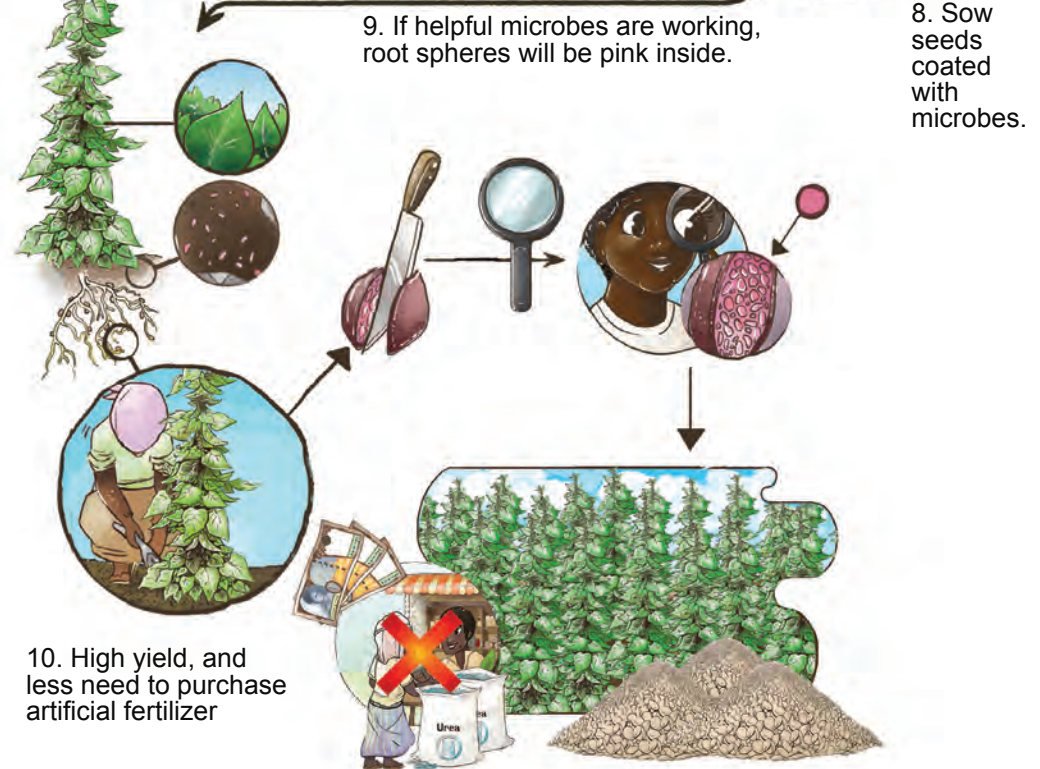
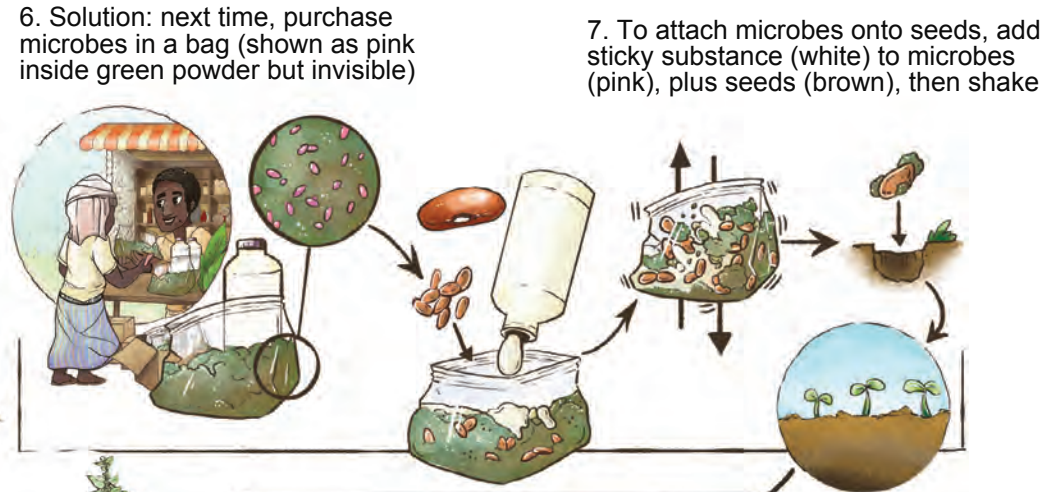
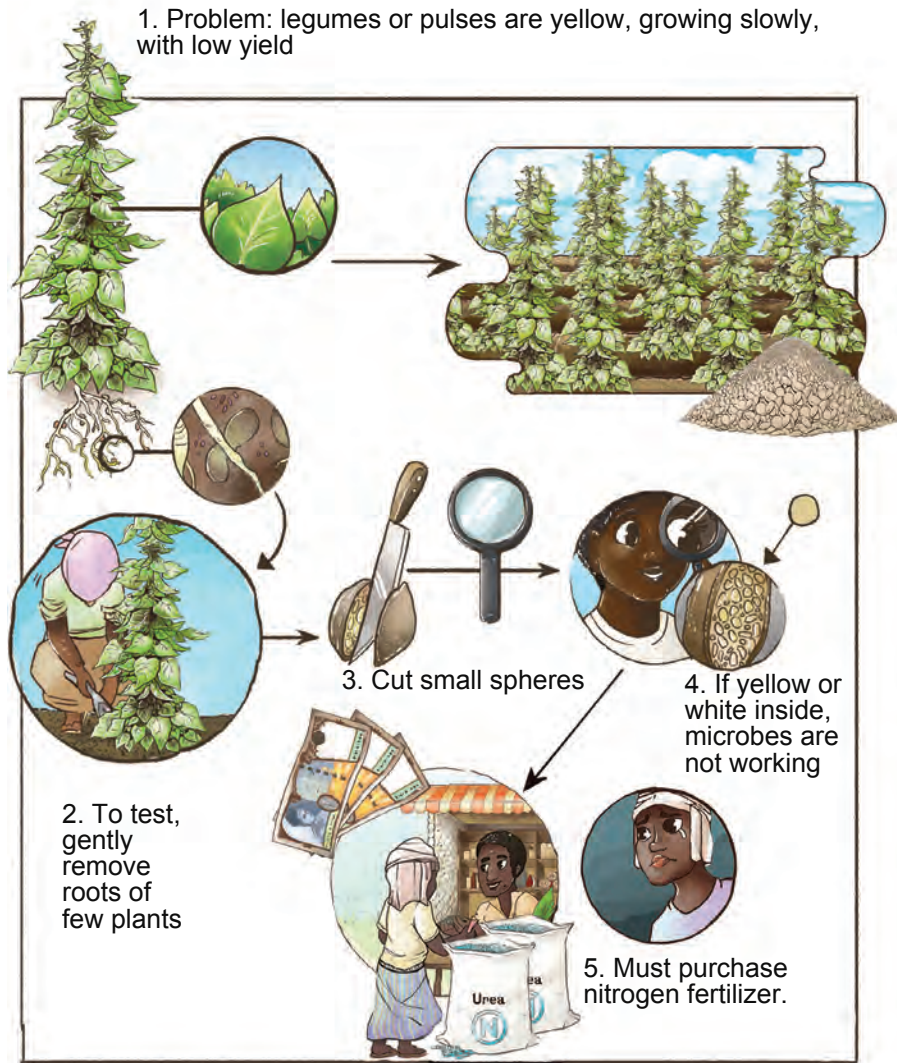
1. Problem: legume leaves such as lentil are yellow causing low yields: might be disease or lack of fertilizer



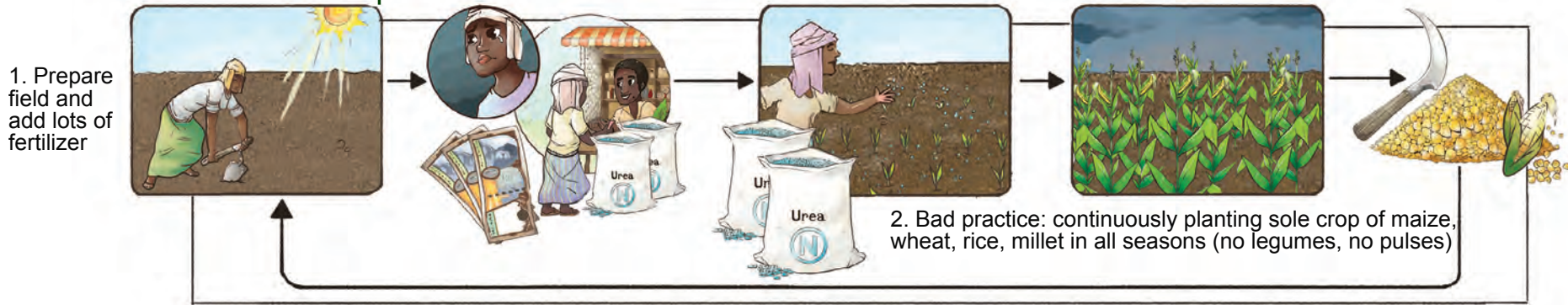
6. Good situation: legume plants appear green.



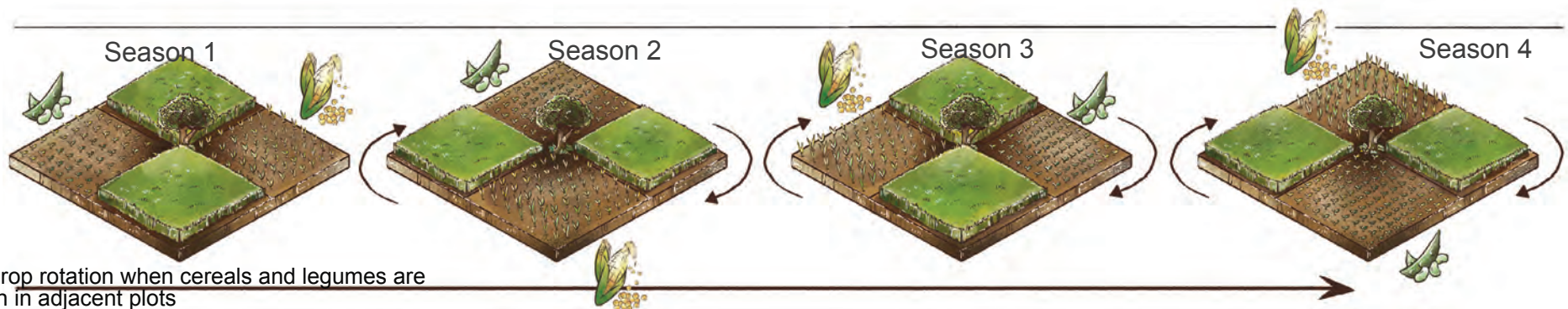
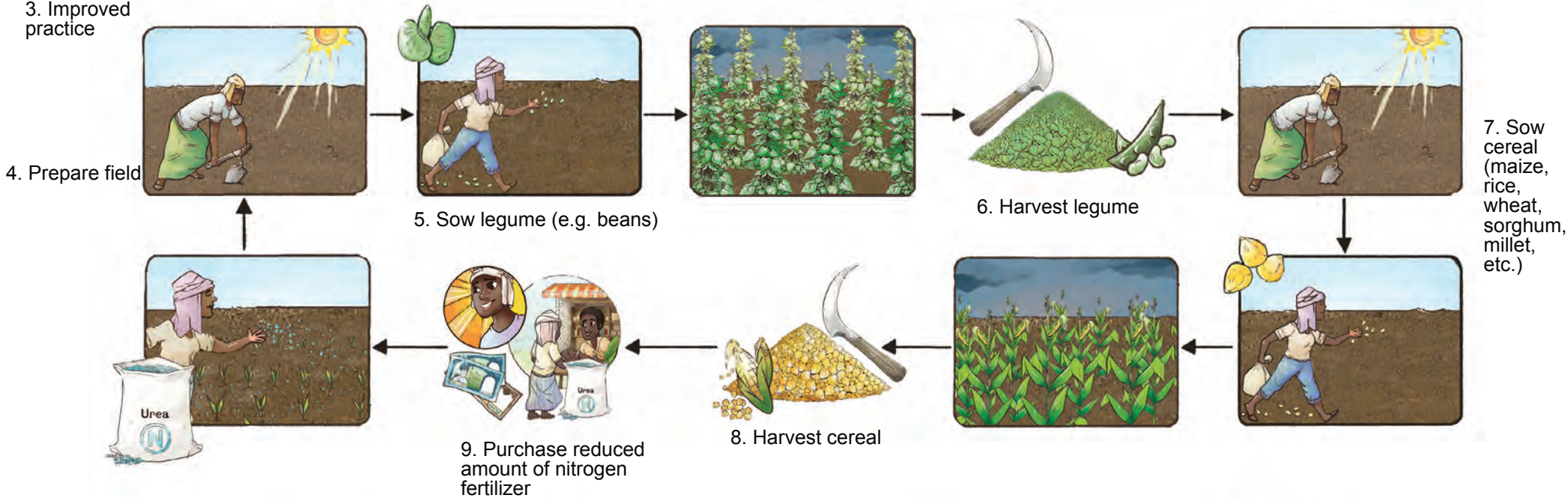
Lesson: If helpful microbe inside small spheres of legume roots are not making natural nitrogen fertilizer, the problem may be fixed in the future by purchasing healthy microbes called rhizobia and coating onto seeds. Seeds may also be purchased already coated with the microbes.



Lesson: Rotating a cereal crop (e.g. maize) with a legume crop (e.g. beans) will reduce need to purchase artificial nitrogen fertilizer and will reduce pests/disease.

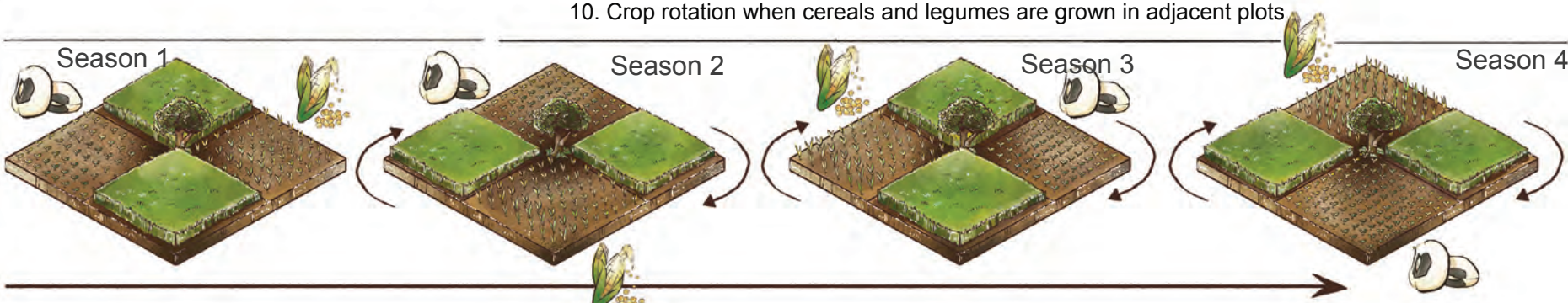
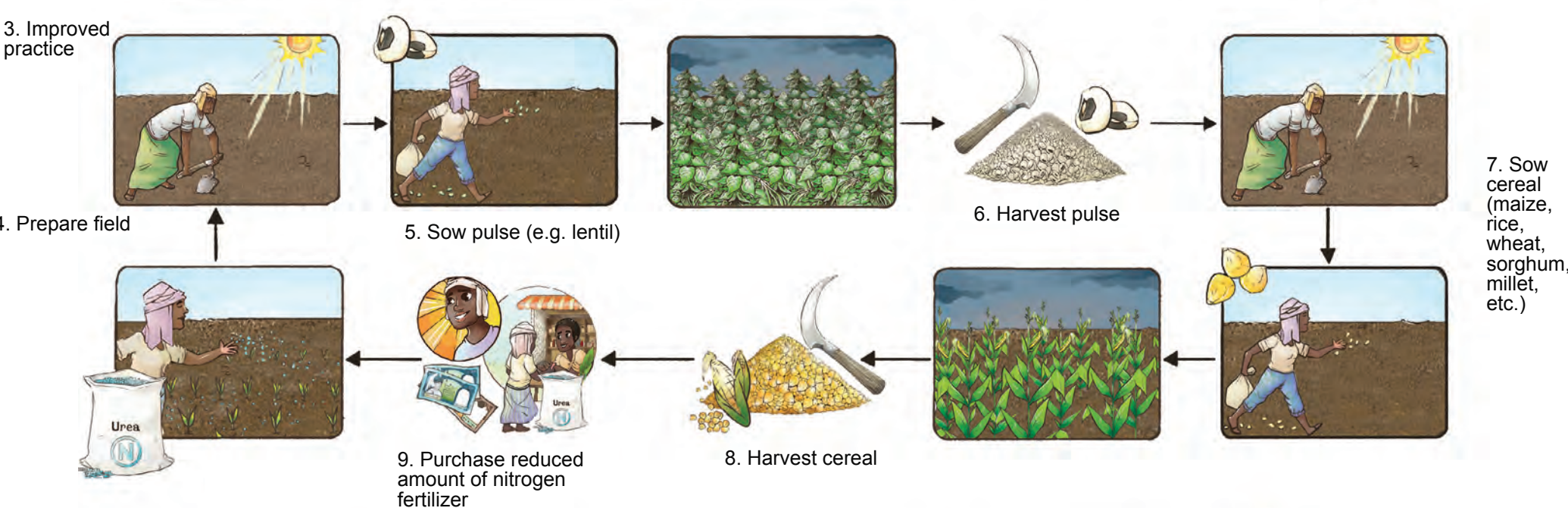
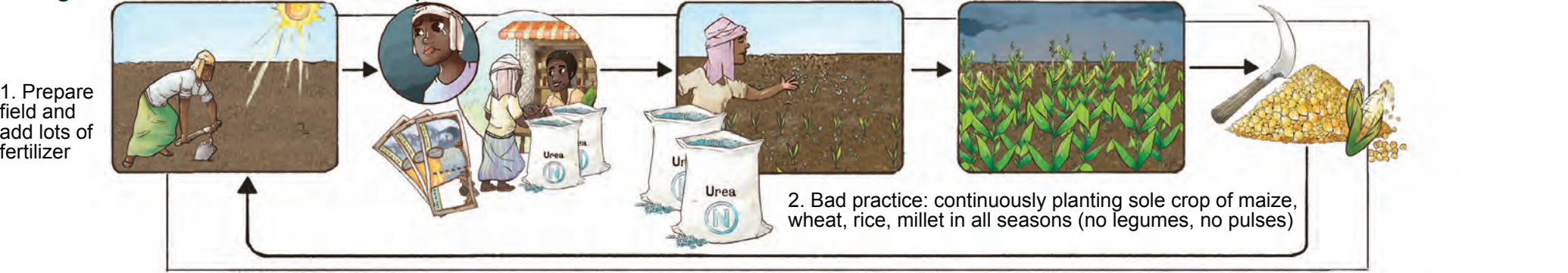


3. Improved practice



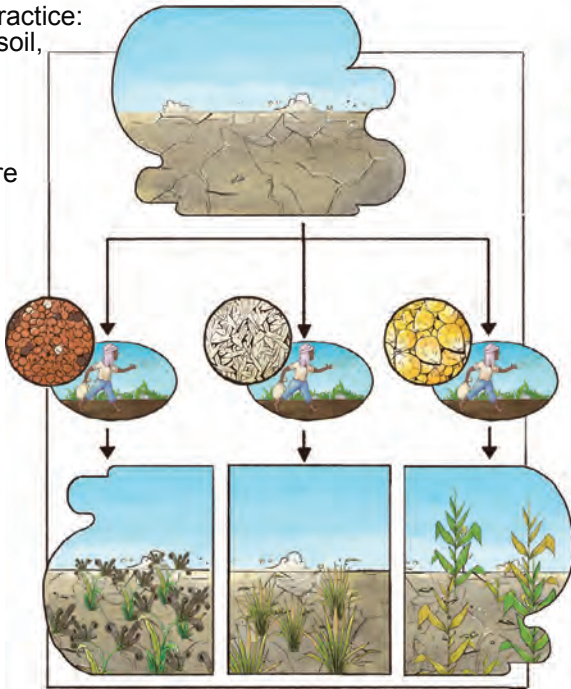
10. Crop rotation when cereals and legumes are grown in adjacent plots

Lesson: Rotating a cereal crop (e.g. maize) with a legume pulse crop (e.g. lentils) will reduce need to purchase artificial nitrogen fertilizer and will reduce pests/disease.



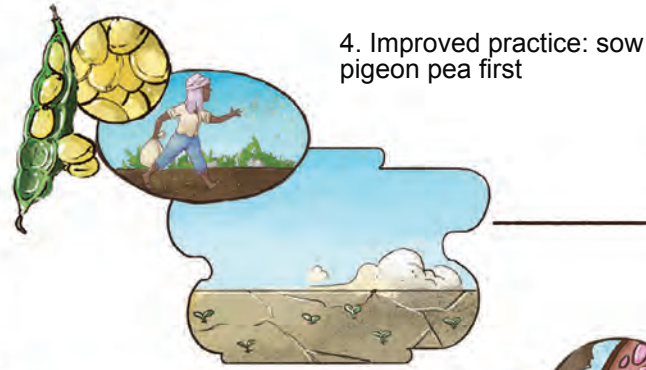
Lesson: When soil is poor, it is better to plant pigeon pea first instead of a cereal crop

1. Bad practice: on poor soil, cereals such as maize, millet or rice are sown

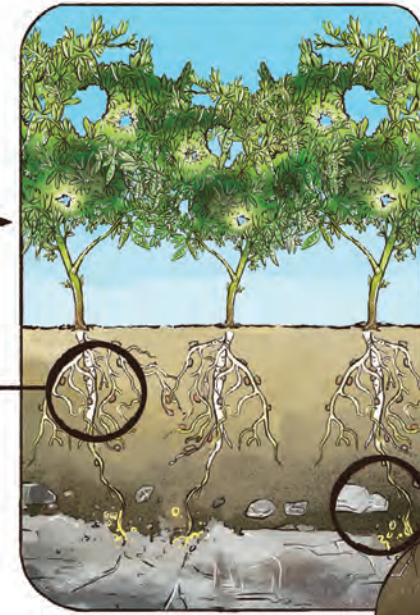


2. Low yields

3. Yields would be higher if synthetic fertilizer was added, but this costs money



4. Improved practice: sow pigeon pea first

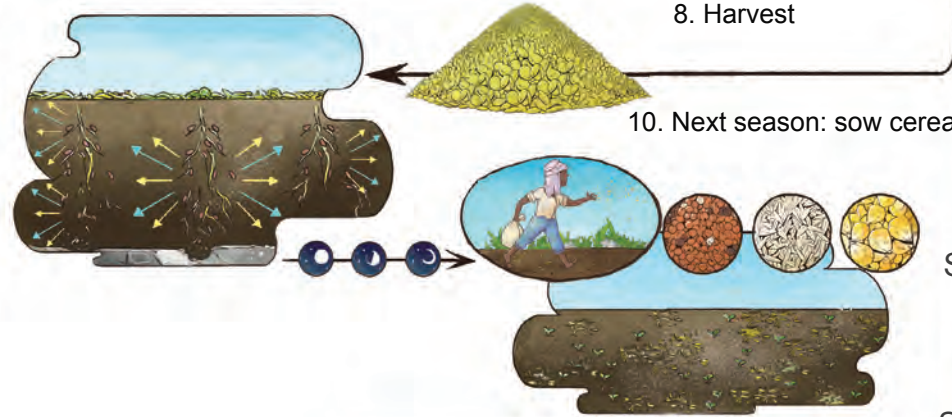


5. Mature pigeon pea

7. Long roots dissolve deep rock phosphorus (yellow colour)

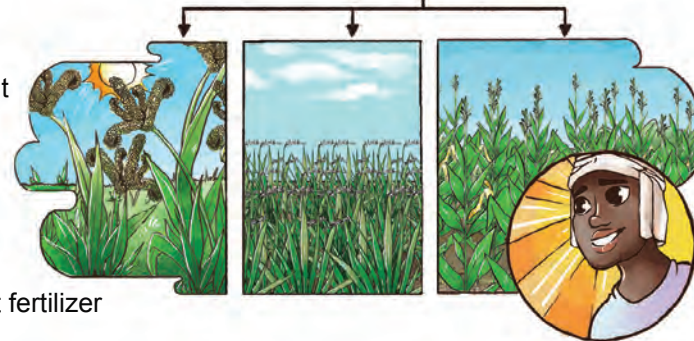
6. Roots have pink spheres which produce natural nitrogen fertilizer (blue colour)

8. Harvest



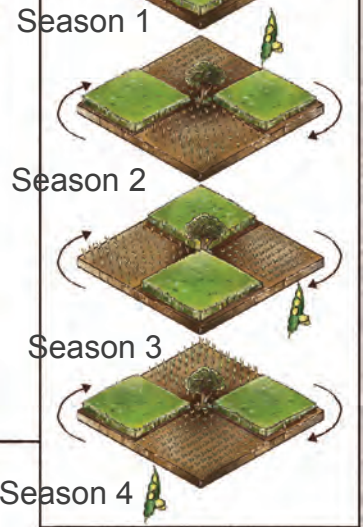
10. Next season: sow cereal

9. Remaining pigeon pea roots decompose and deposit nitrogen (blue) and phosphorus (yellow) into soil

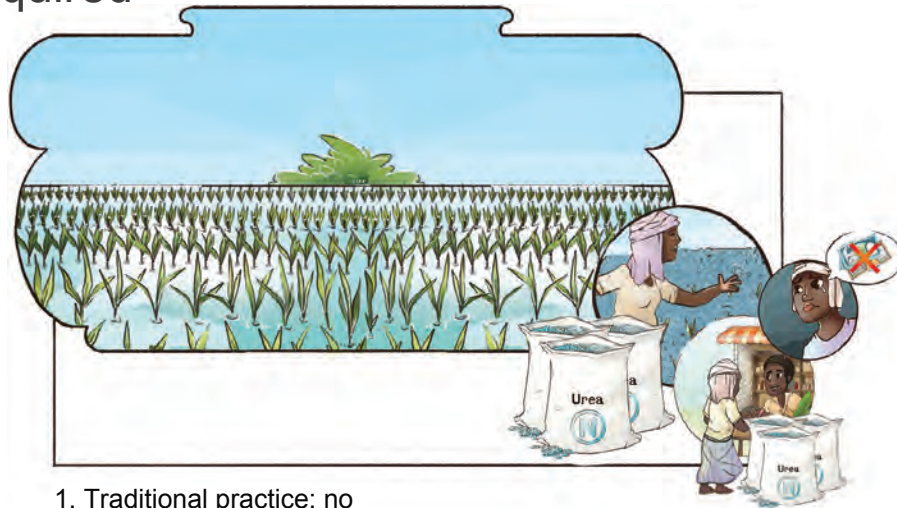


11. Cereal crop will now grow without fertilizer

12. Continue rotation with cereal and legumes

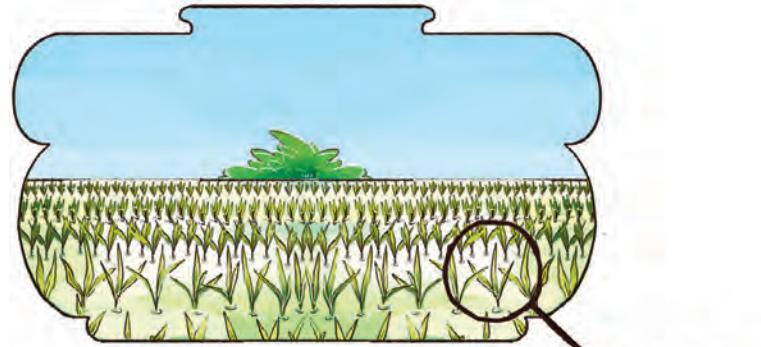


Lesson: In a rice paddy, water algae called Azolla can reduce the amount of nitrogen fertilizer required

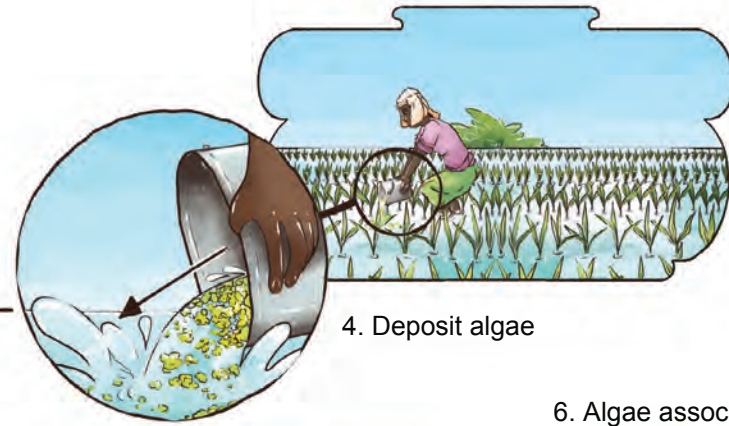


1. Traditional practice: no water algae, and hence many bags of artificial nitrogen fertilizer must be applied

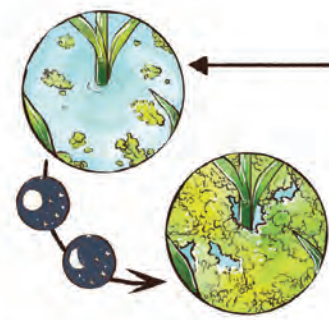
2. Improved practice: go with buckets to rice paddy with green algae



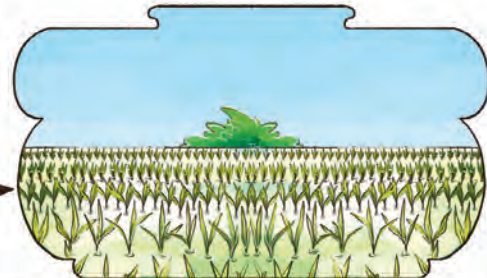
3. Collect algae



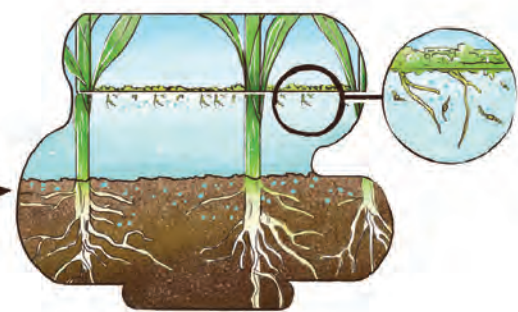
4. Deposit algae



5. Algae will grow



6. Algae associates with microbes to produce natural nitrogen fertilizer



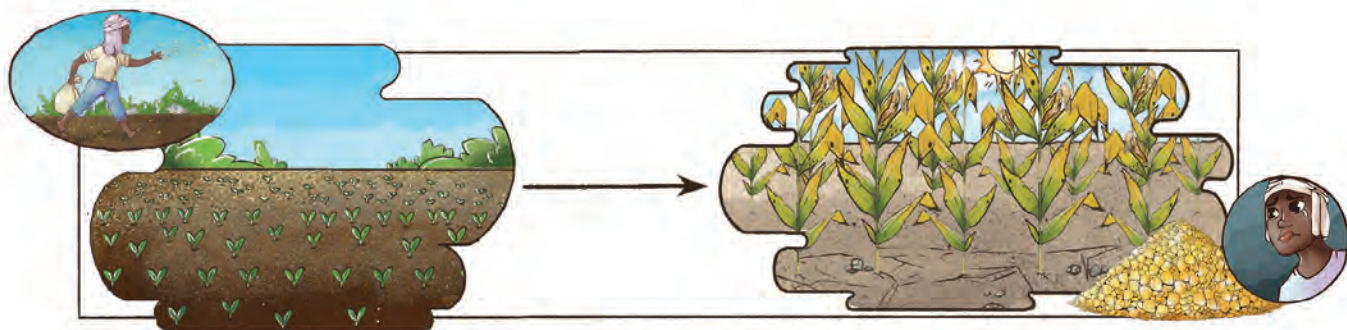
7. Good yield with fewer bags of artificial nitrogen fertilizer needed



Chapter 6: Water

Lesson: If the climate is becoming dryer, then shift from traditional crops such as maize or rice to drought tolerant crops such as finger millet, pearl millet, fava beans or lentils

1. Traditional practice may be to grow maize or rice but yields are low when rain is low



2. Select drought tolerant crops

finger millet



fava bean



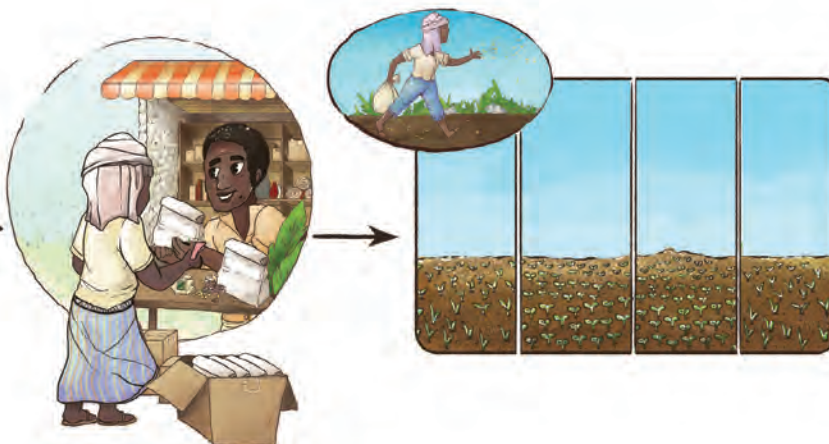
lentil



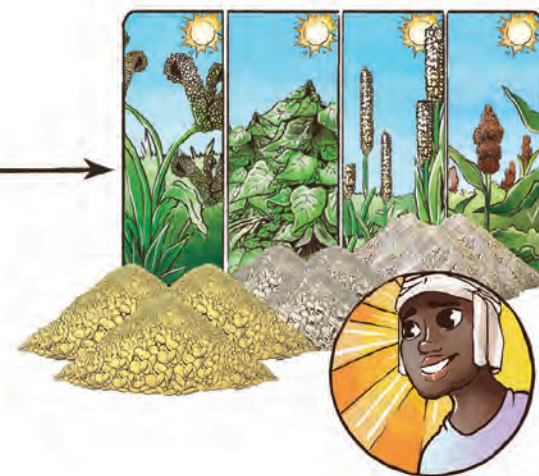
pearl millet



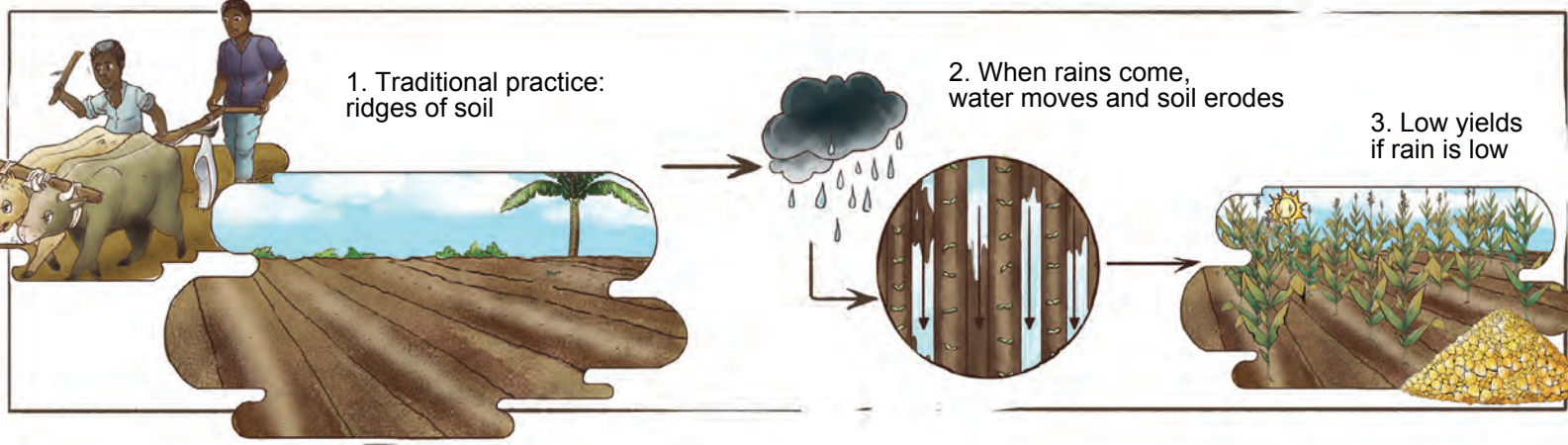
3. Purchase seed from vendor



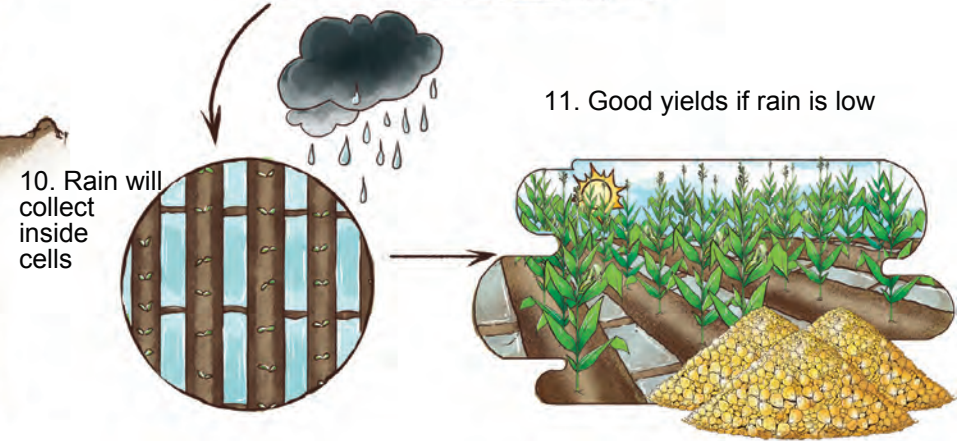
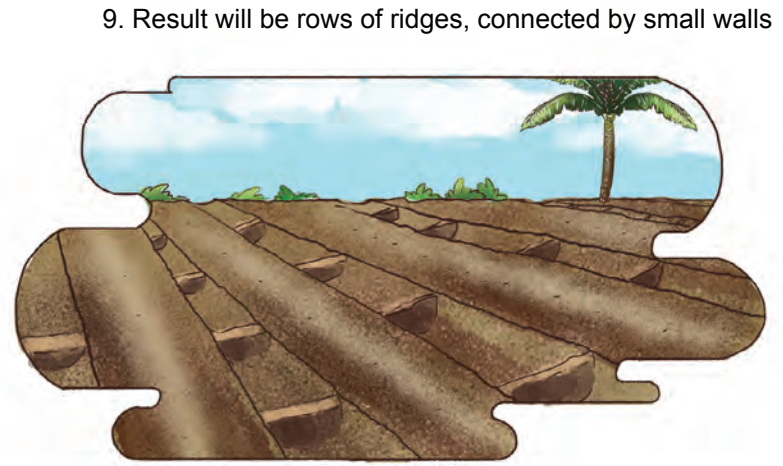
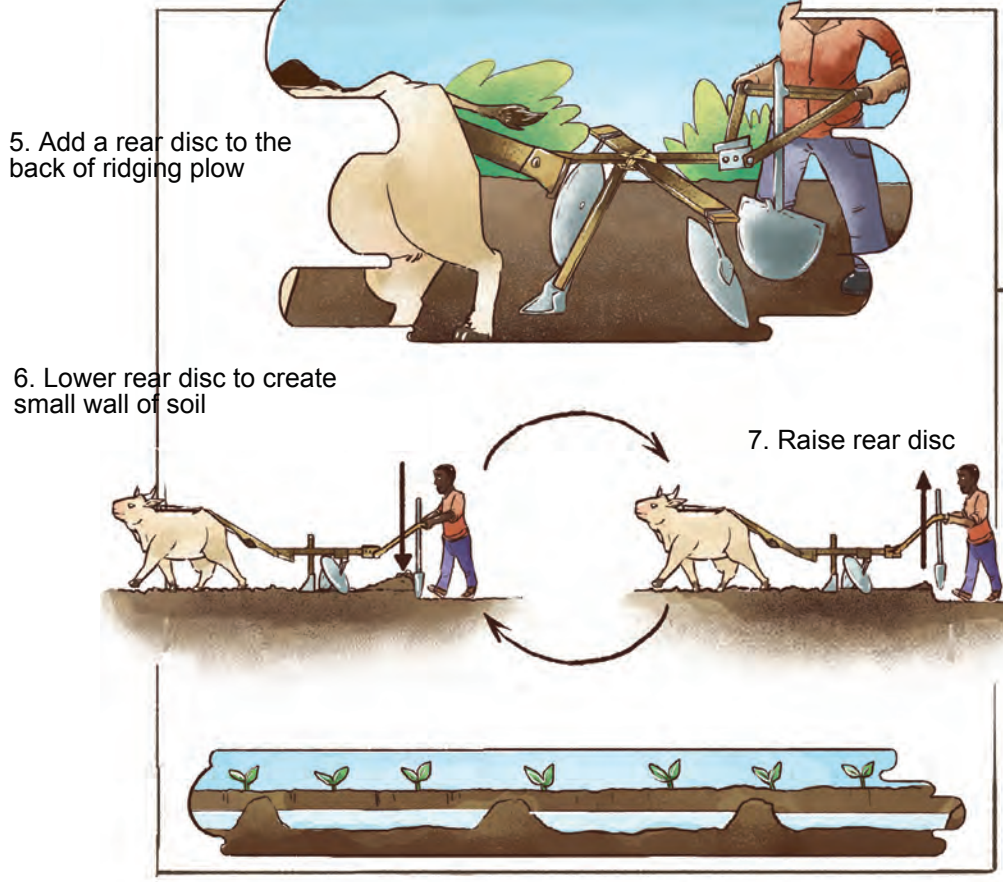
4. Good yields with low rainfall



Lesson: Connecting soil ridges with small walls of soil can conserve rainwater and reduce soil erosion on sloped land



4. Improved practice

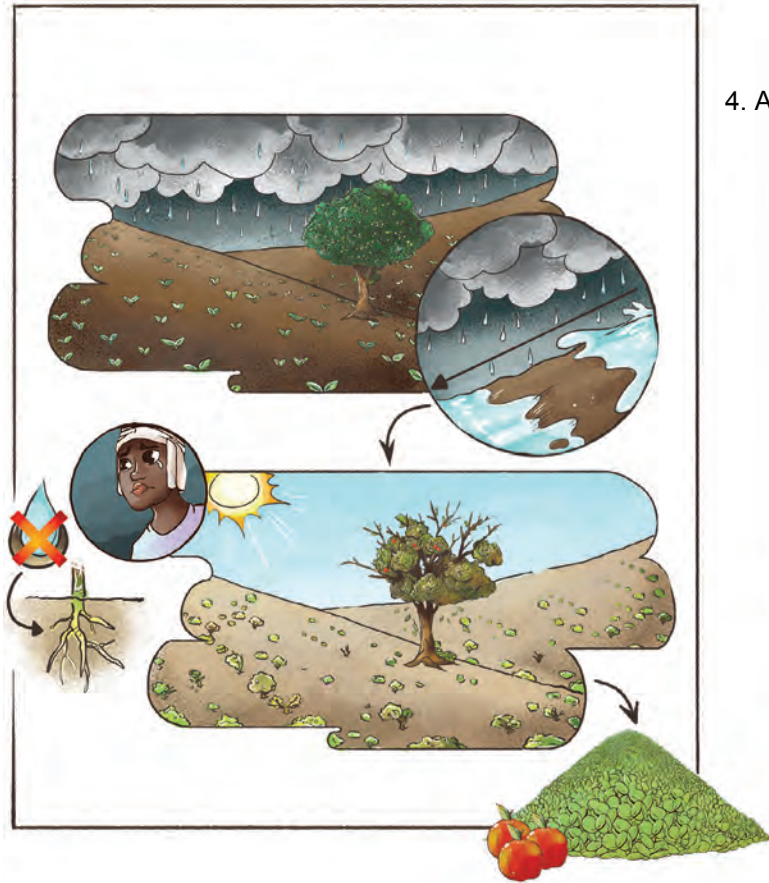


Lesson: There are simple methods to collect rainwater on slightly sloped land for dry season

3. Improved practice: create soil bund that surrounds fruit tree to collect rainwater

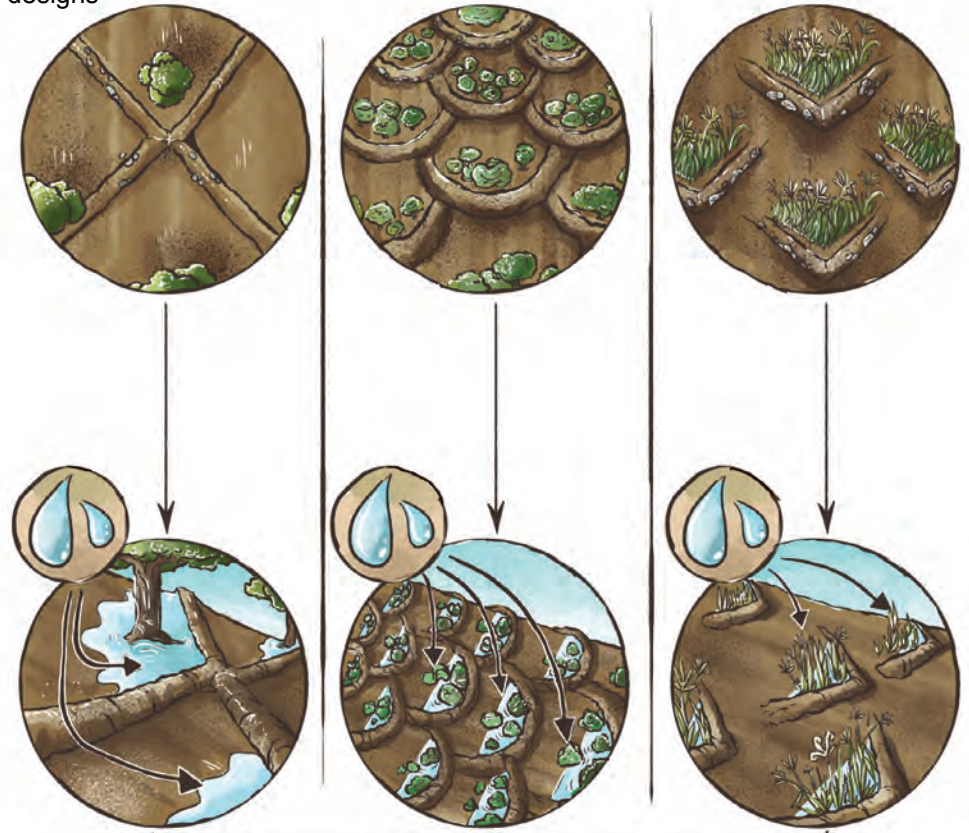


1. Traditional practice: water is lost



2. Low yields when rain is low (e.g. apple)

4. Alternative designs

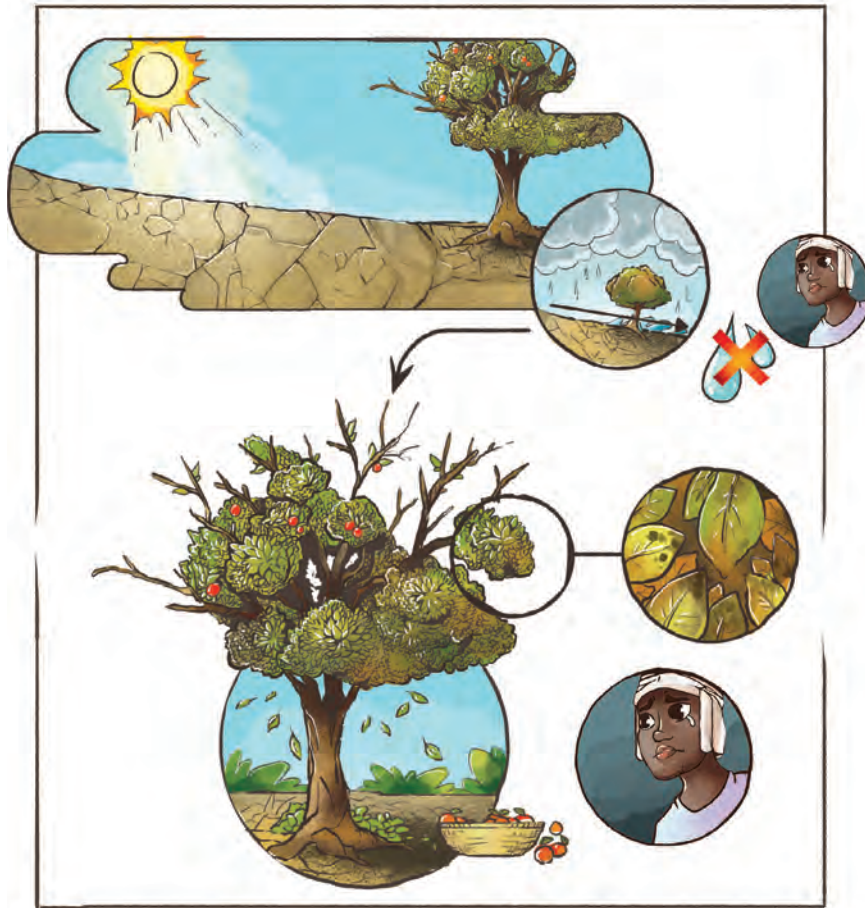


5. Improved yields



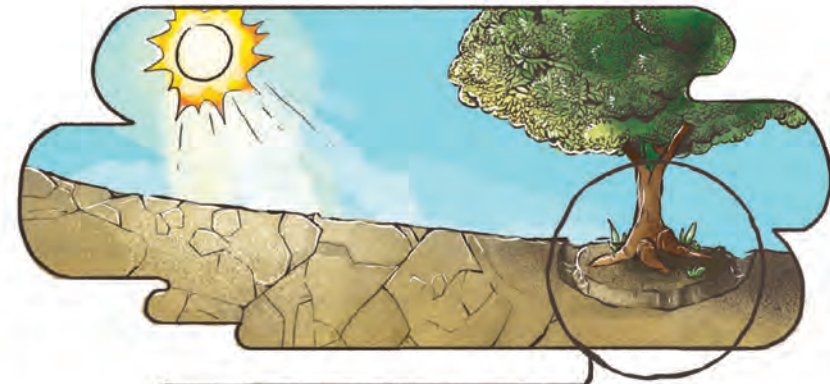
Lesson: Fruit trees can be grown in dry climates by harvesting rainwater around tree using a bund or pit

1. Traditional practice: no water collected

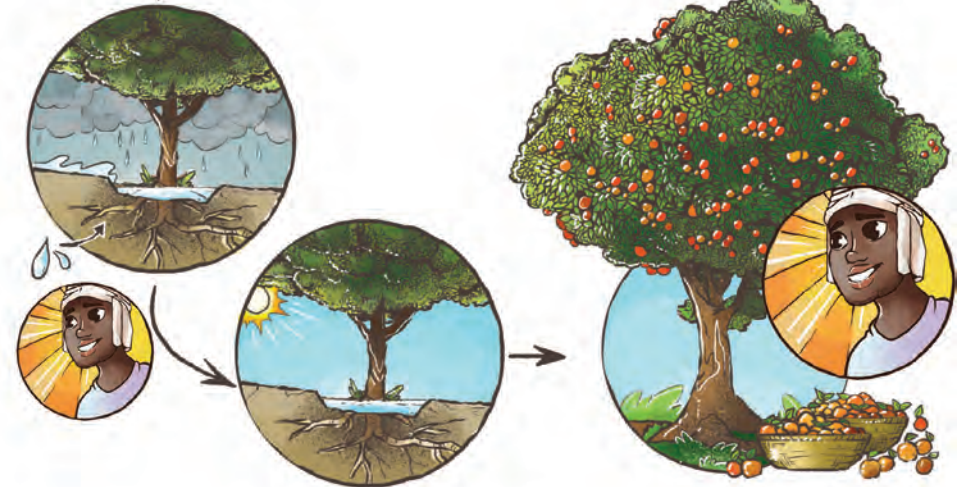


2. Low fruit yield (e.g. apple)

3. Improved practice: create short wall or pit around tree



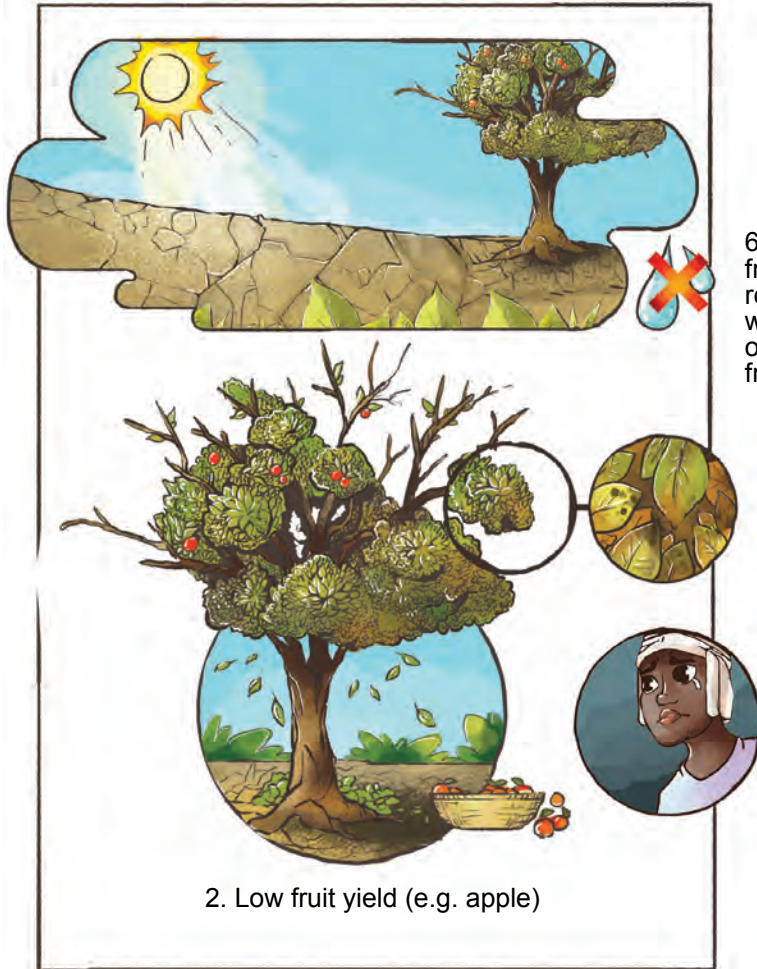
4. Rain collected



5. High fruit yield

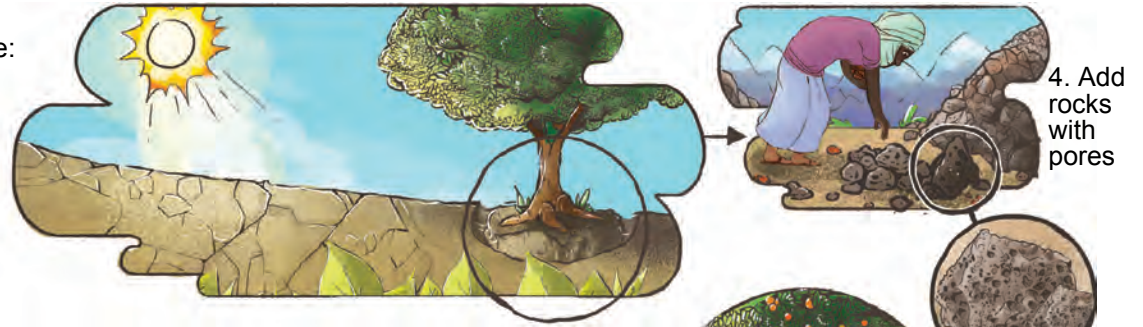
Lesson: Fruit trees can be grown in dry climates by harvesting rainwater around tree using porous rocks

1. Traditional practice: no water collected



2. Low fruit yield (e.g. apple)

3. Improved practice: create short wall or pit around tree

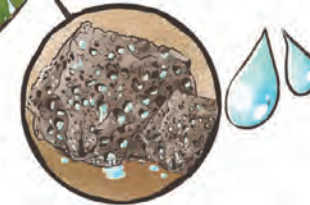


4. Add rocks with pores

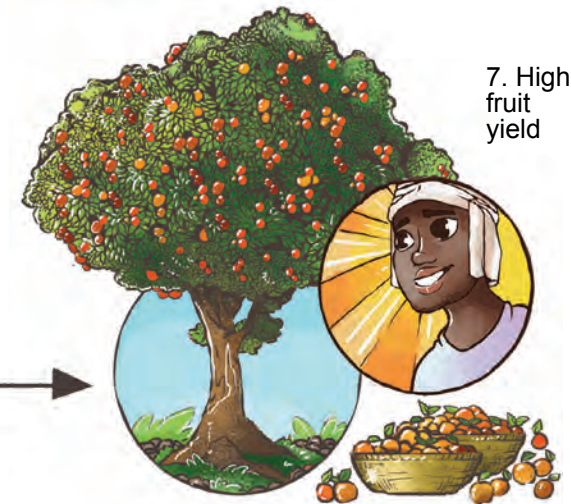
6. Water from rocks will drip onto free roots



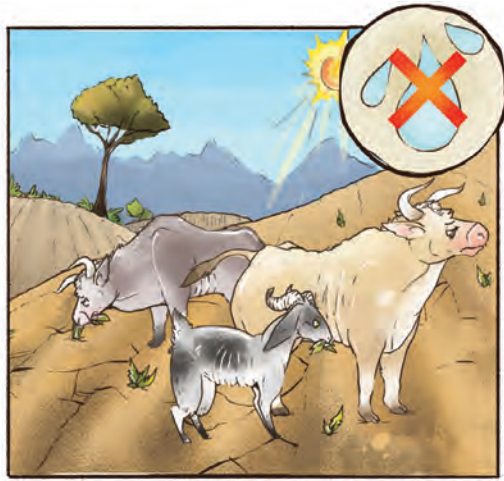
5. Morning dew will collect inside pores



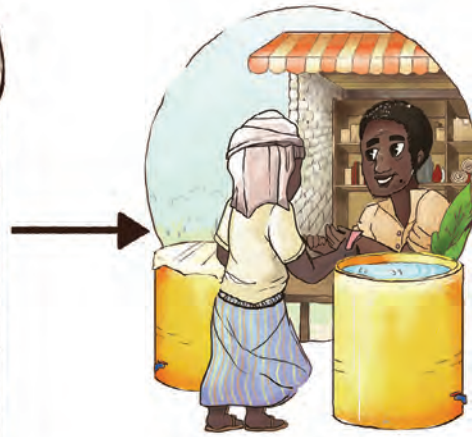
7. High fruit yield



Lesson: Rainwater can be collected



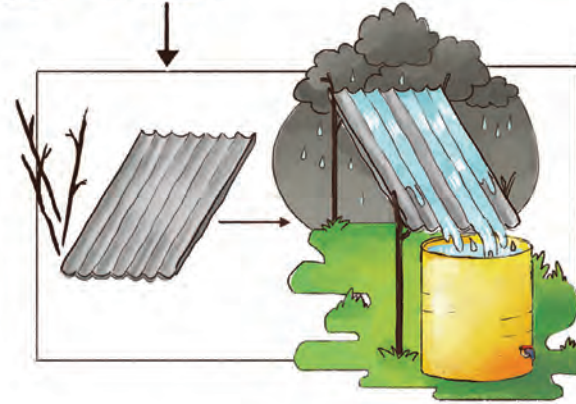
1. Traditionally: no water in dry season



3. Purchase tank from vendor



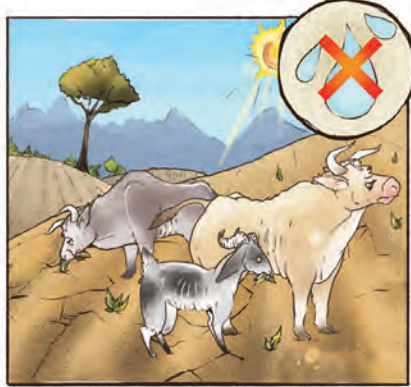
2. New practice: collect rainwater



4. Many uses of rainwater



Lesson: Cheap foldable plastic tanks or tarpaulins can be used to collect rainwater

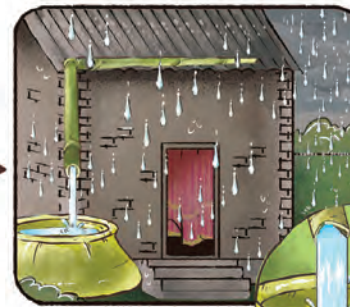


1. Traditional situation: rainfall is lost

2. In dry season, no water



3. New practice is to purchase folding plastic water tank



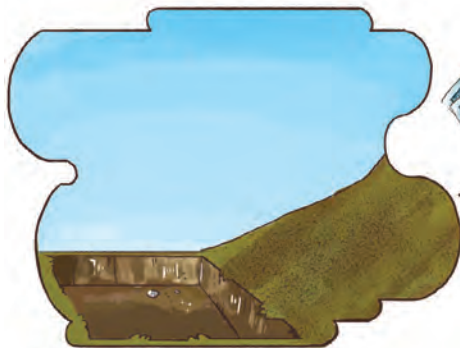
4. Collect rainwater



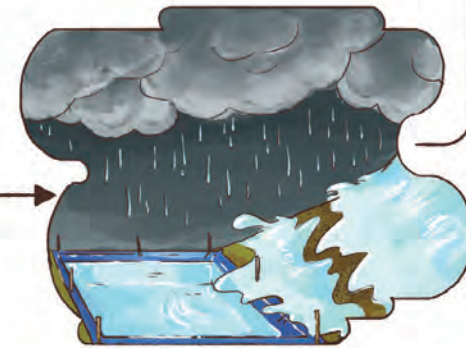
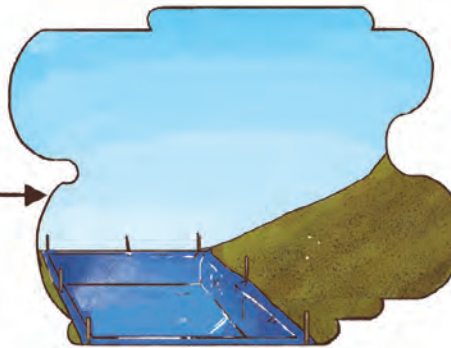
5. Many uses of rainwater



6. Second new practice is to dig pit at bottom of hill.

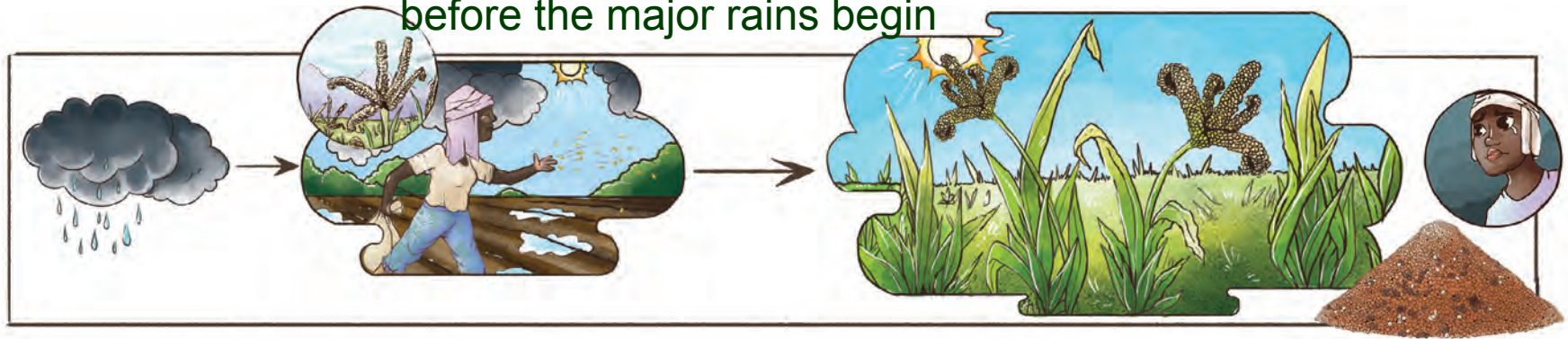


7. Purchase tarpaulin, then line pit



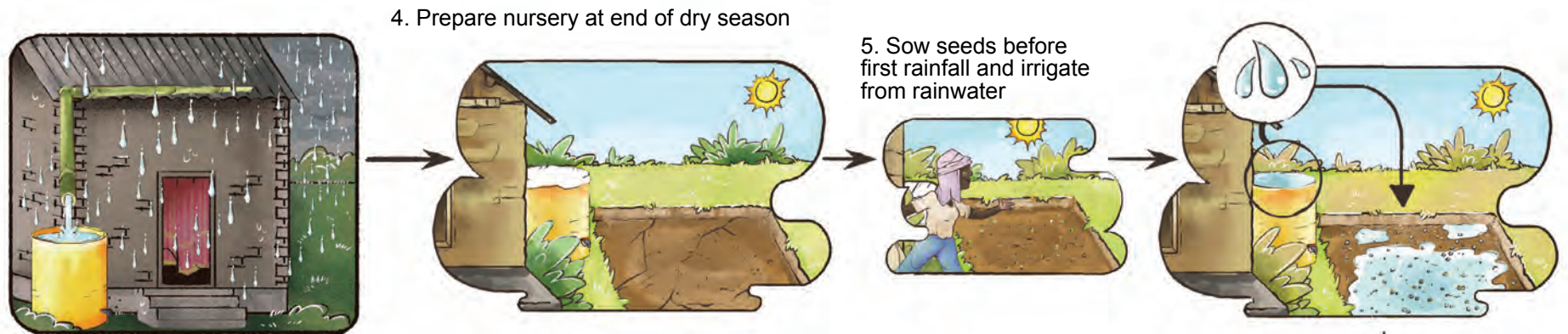
8. Collect rainwater in pit

Lesson: Collected rainwater can be used to irrigate a millet nursery in order to enable sowing before the major rains begin



1. Traditional practice is to sow millet seeds after first rainfall

2. If growing season is short, then yield is low.

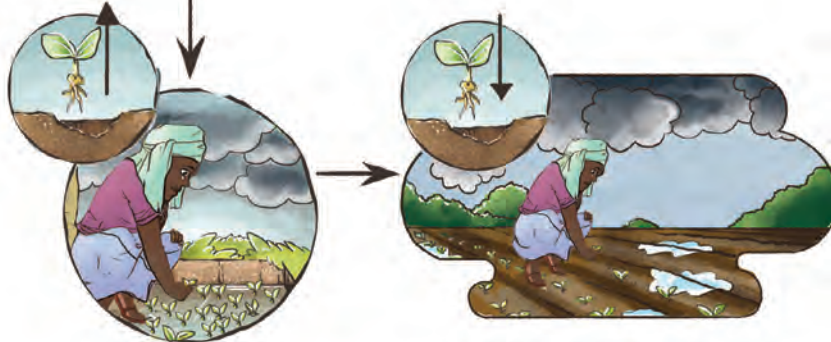


4. Prepare nursery at end of dry season

5. Sow seeds before first rainfall and irrigate from rainwater

3. New practice is to collect rain during rainy season.

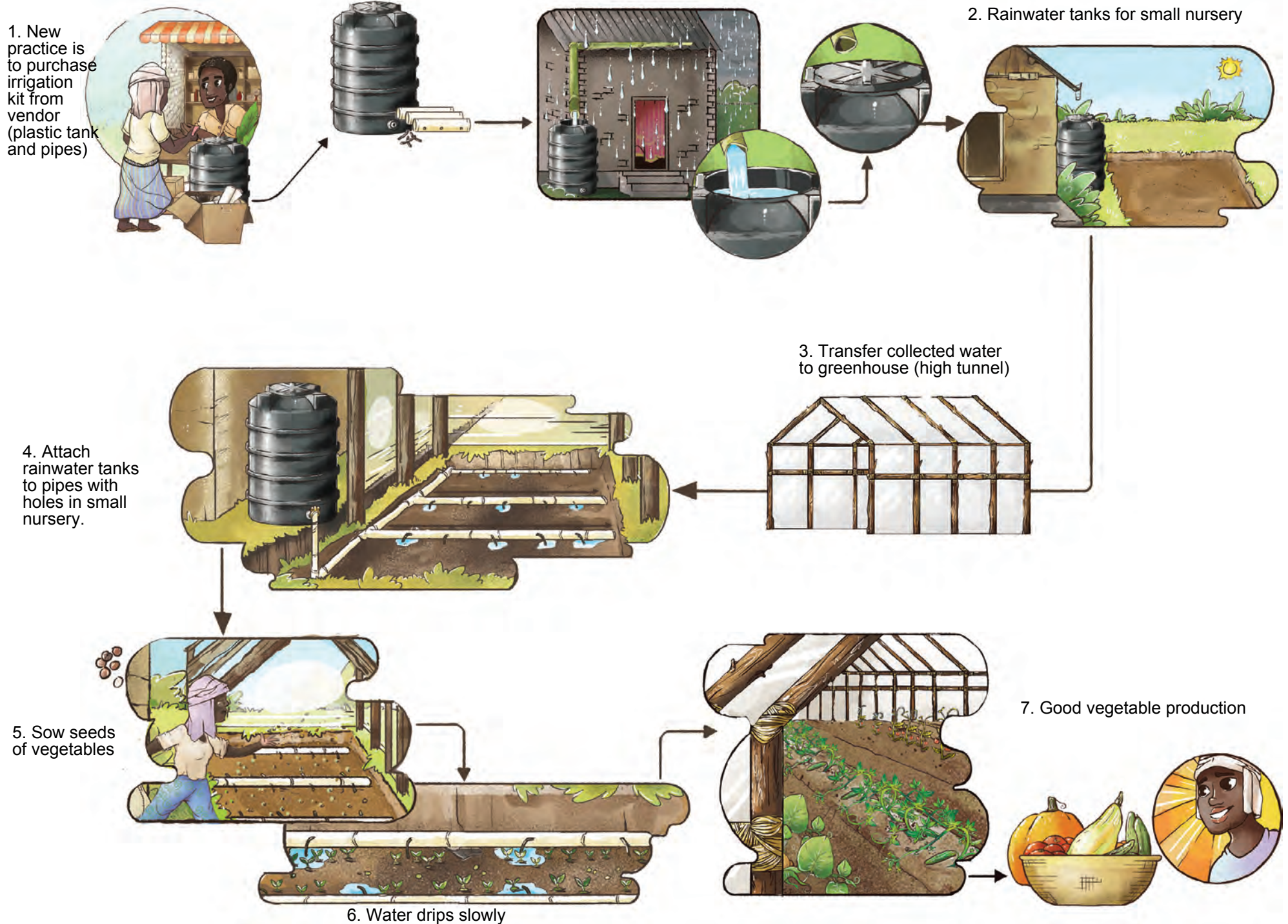
6. When rains arrive, transplant seedlings to the field

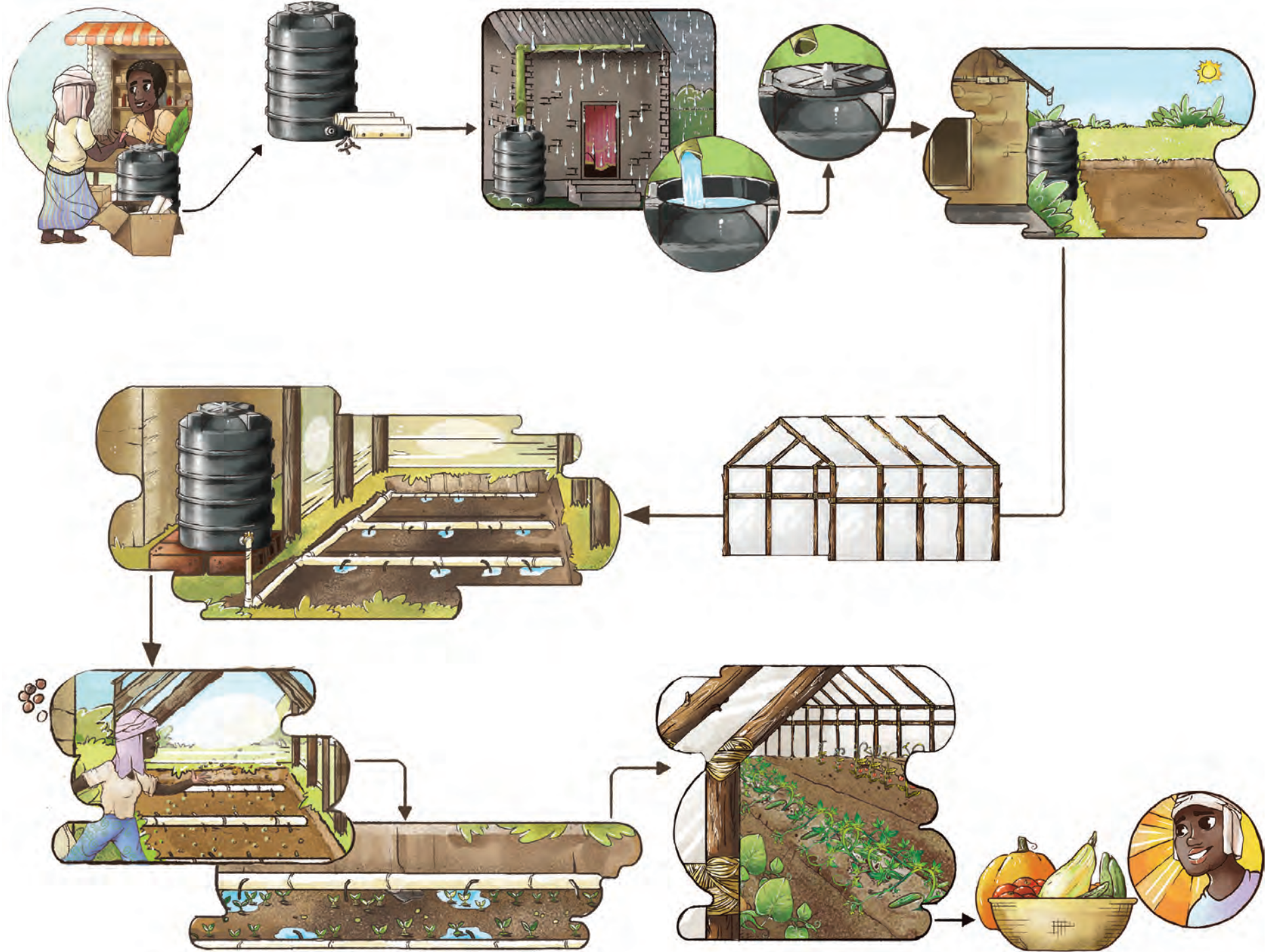


7. Yield is higher because the crop duration was increased



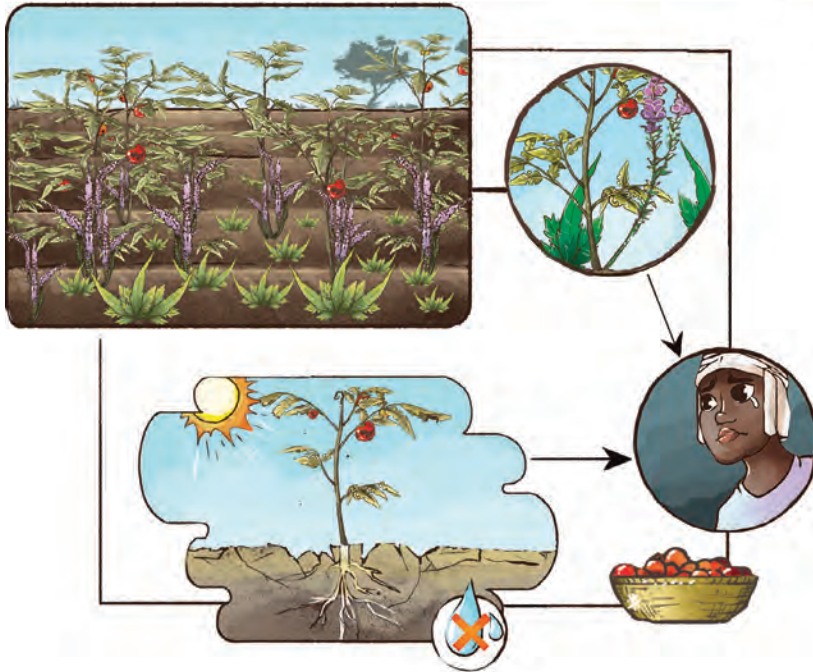
Lesson: Collected rainwater can be connected to pipes with holes to feed water directly to roots





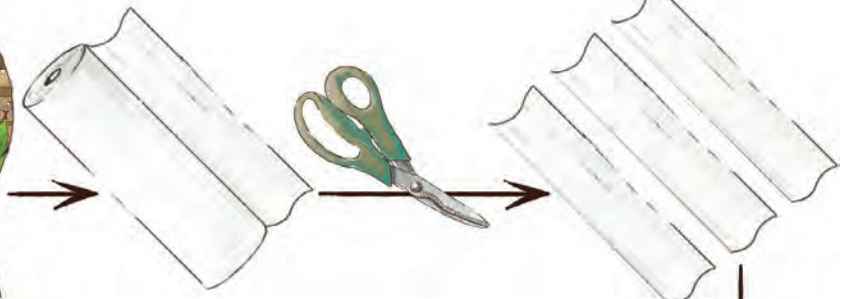
Lesson: Use plastic mulch to suppress weeds in the garden, prevent water loss and keep soil warm.

1. Problem: in garden weeds can grow

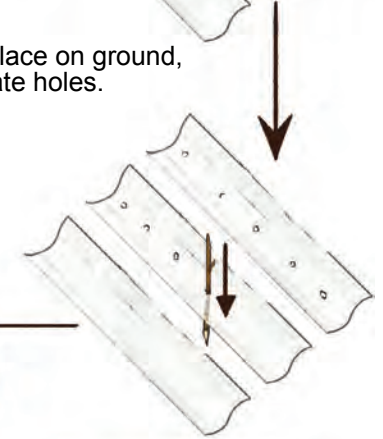


2. Problem: In hot season with low rainfall, crops will not grow.

3. Solution: Purchase rolls of plastic sheets



4. Place on ground, create holes.



5. Sow seeds in holes

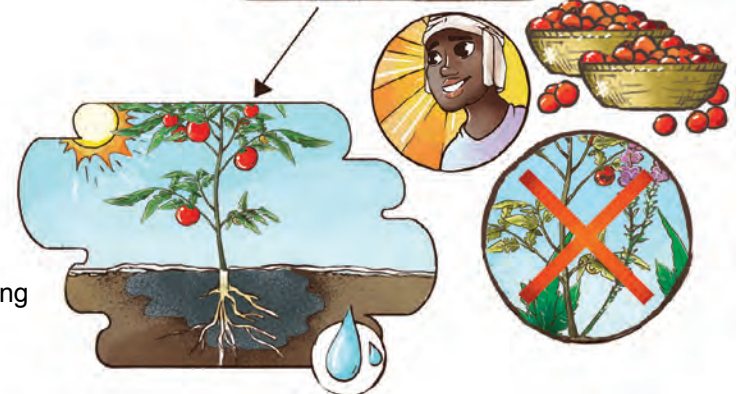


6. Vegetables grow without weeds.



8. High yield

7. Plastic prevents water from evaporating and keeps the soil warm.

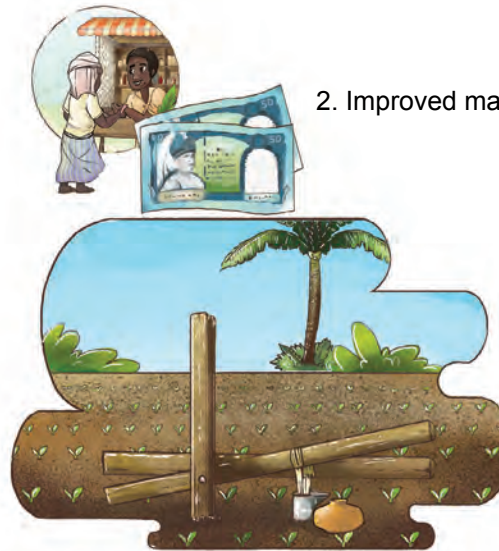


Lesson: There are improved machines to pump water from a well that reduce labour

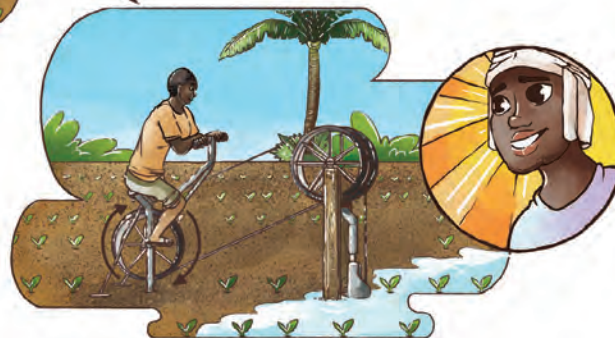
1. Traditional practice



2. Improved machine: foot treddle pump available at vendor



3. Alternative improved machine: bicycle pump available at vendor



Chapter 7: Weeds

Lesson: Kneepads can reduce pain at knees and prevent knees from becoming wet or cold such as during weeding

1. Traditional practice causes cold, pain on knees



2. New practice

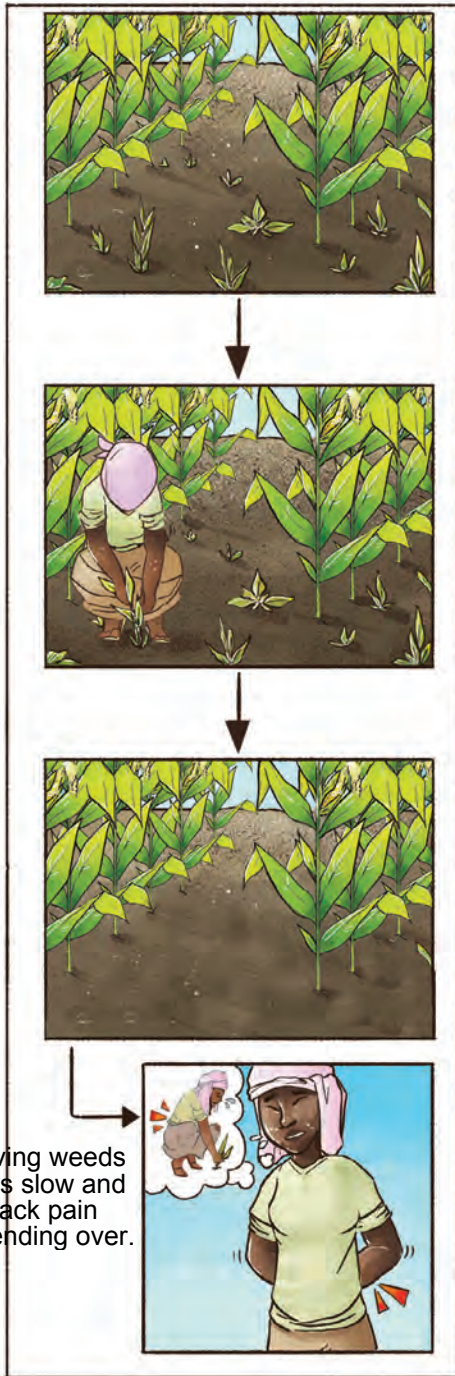


3. Purchase from vendor

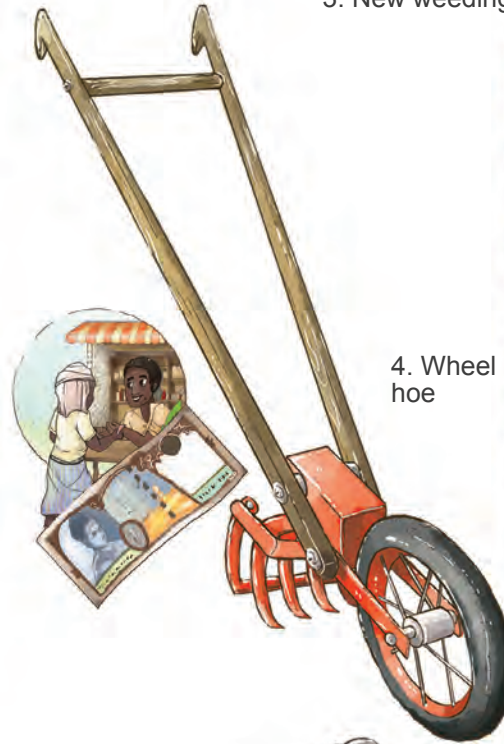


Lesson: New tools to reduce drudgery of hand removal of weeds

1. Traditional practice



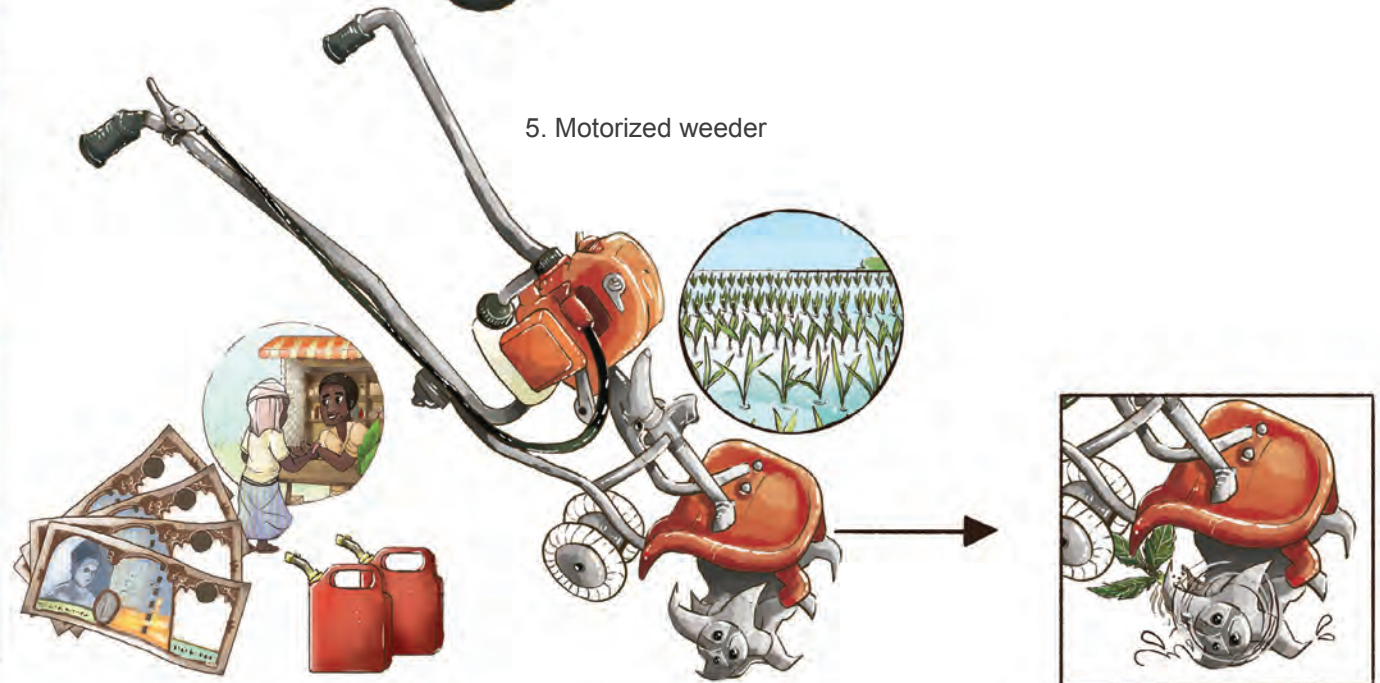
3. New weeding tools: ask nearby vendor to supply or ask local blacksmith to construct



4. Wheel hoe

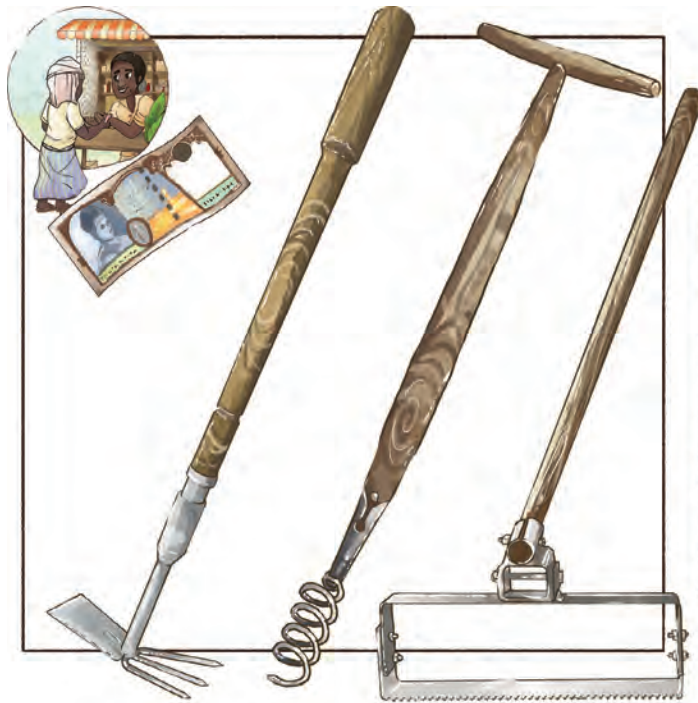


5. Motorized weeder

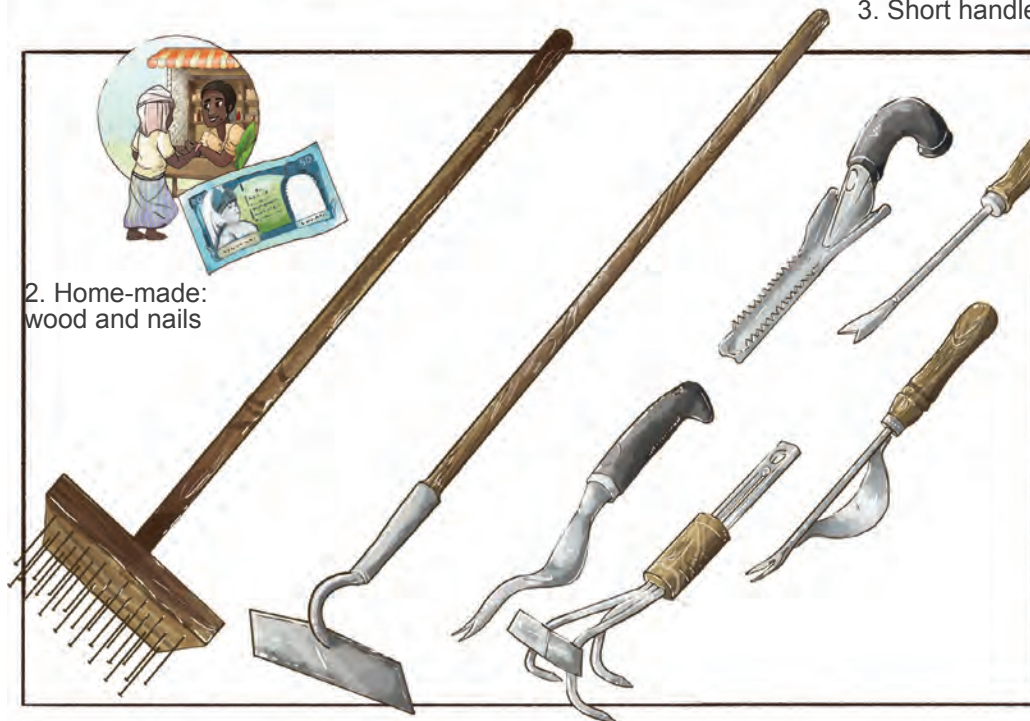
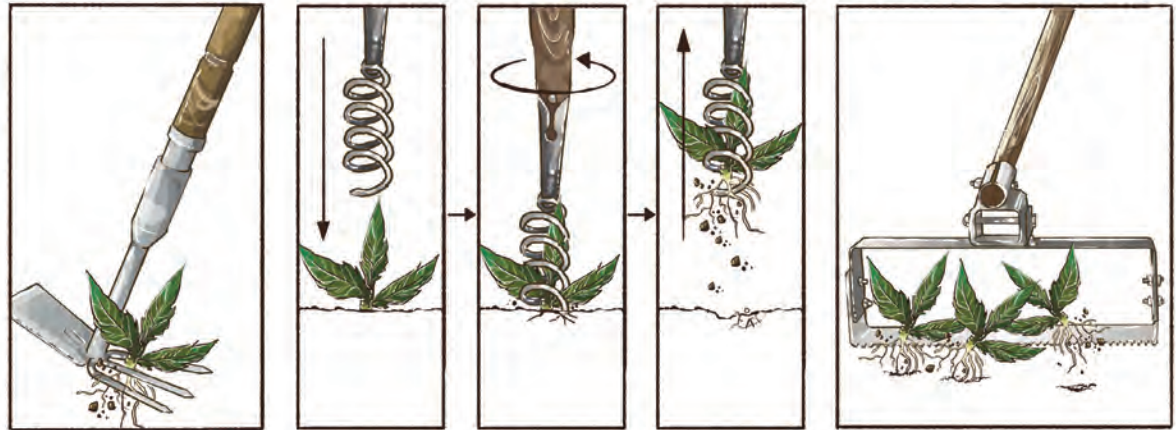


2. Removing weeds by hand is slow and causes back pain due to bending over.

Lesson: New tools to reduce drudgery of hand removal of weeds: Long-handled, medium cost options.



1. Long handled weeders



2. Home-made: wood and nails

3. Short handled weeders

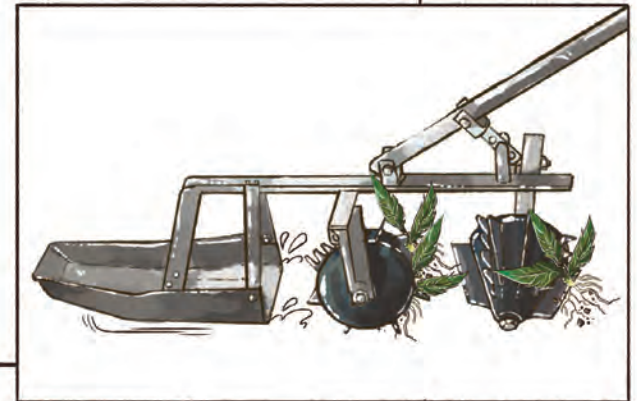
4. How to use



Lesson: New tools to reduce drudgery of hand removal of weeds: Expensive options.

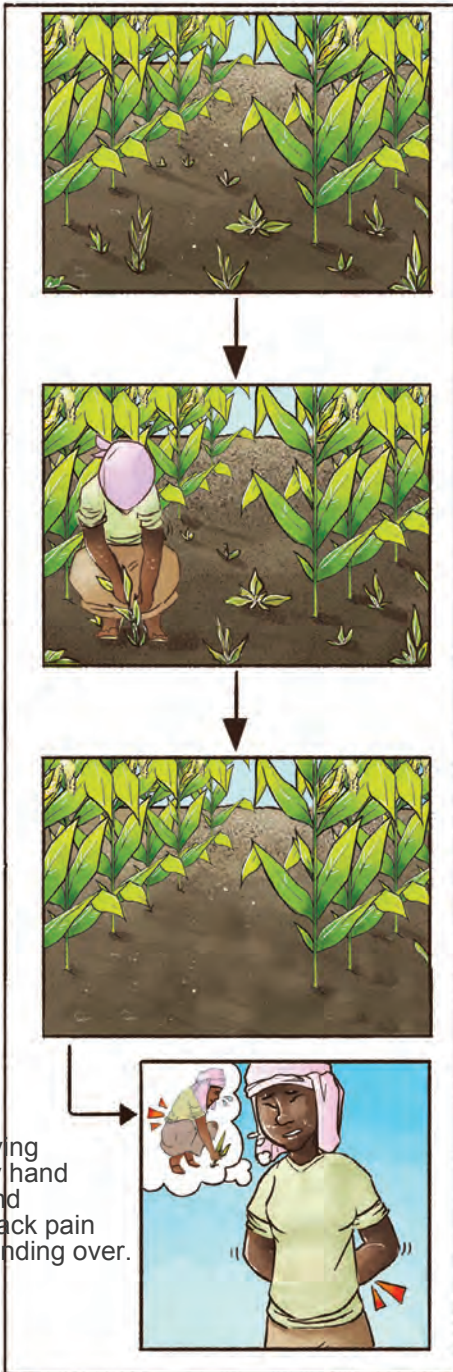


2. Cono-weeder for rice paddy



Lesson: New tool to reduce drudgery of hand removal of weeds: Fork weeder.

1. Traditional practice



3. New tool: fork weeder available at vendor

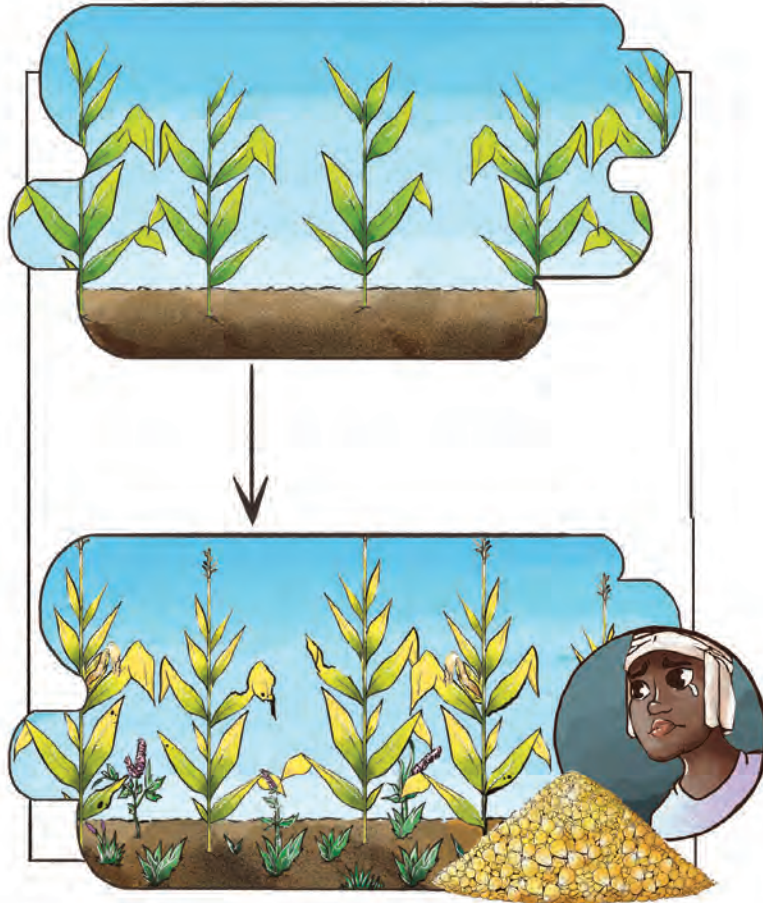


4. Remove weeds easily



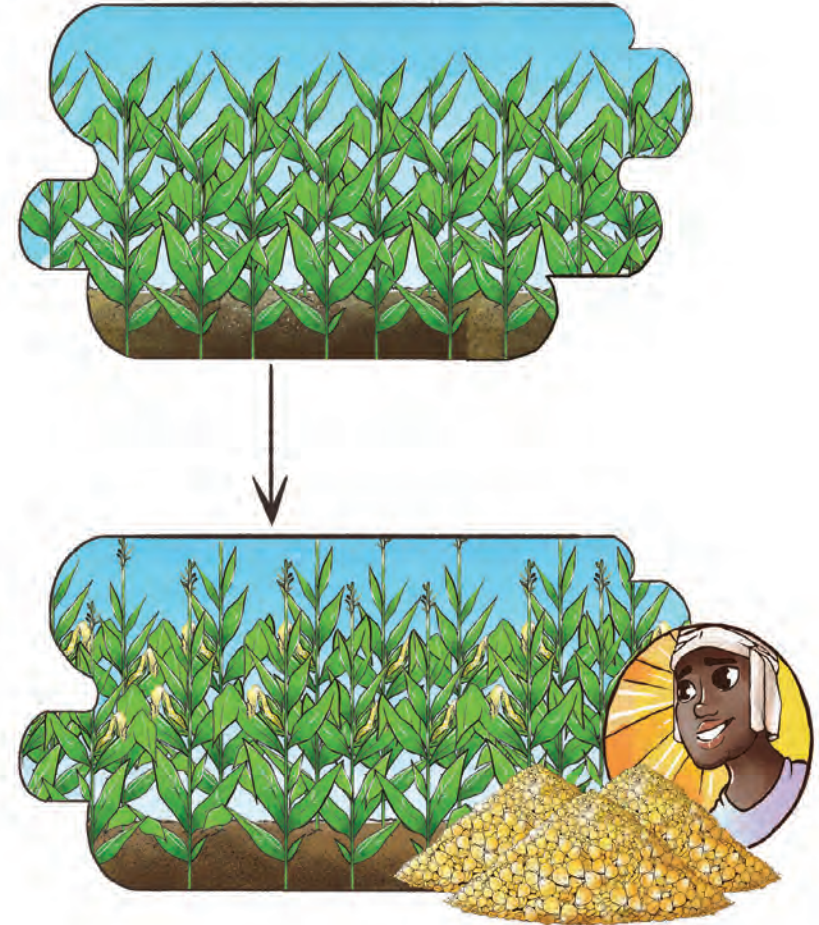
Lesson: Sowing crops at a high density can suppress weeds

1. Traditional practice: sowing crops in rows with wide spacing



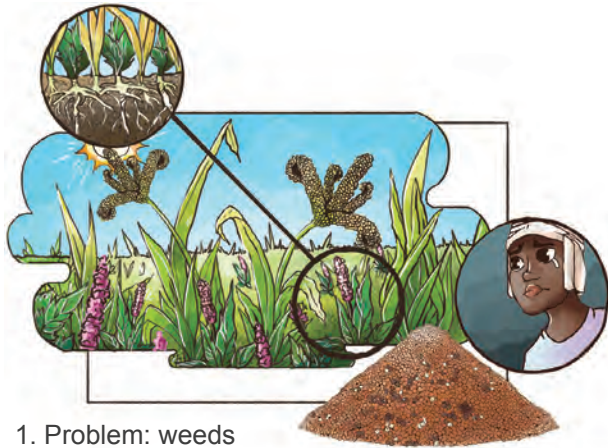
2. Weeds grow, low yields

3. Improved practice: sow crops in rows with very narrow spacing



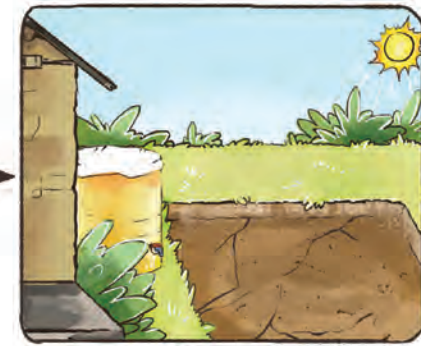
4. Fewer weeds, higher yields

Lesson: Sowing finger millet in a nursery using irrigated water, followed by transplanting, can reduce the weed growth.

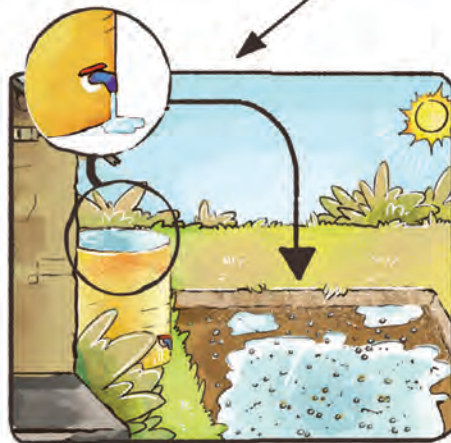


1. Problem: weeds (red flower) reduce yield of millet

2. Improved practice



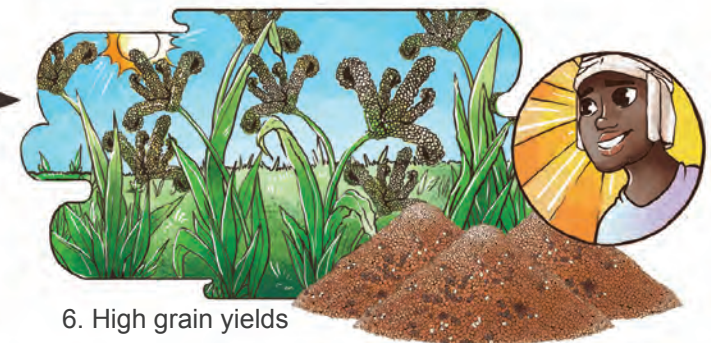
3. Sow millet seedlings at end of dry season in a nursery and use harvested rainwater for irrigation



4. Transplant seedlings to field at start of rainy season



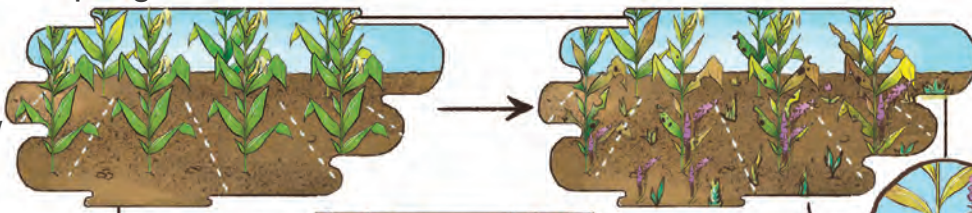
5. Since millet plants are large, they outcompete germinating weeds



6. High grain yields

Lesson: To suppress weeds, sow seeds of a spreading type crop or forage in between rows of the major crop. The weed suppressing crop should permit trampling.

1. Traditional practice is to sow seeds of a sole crop in rows.



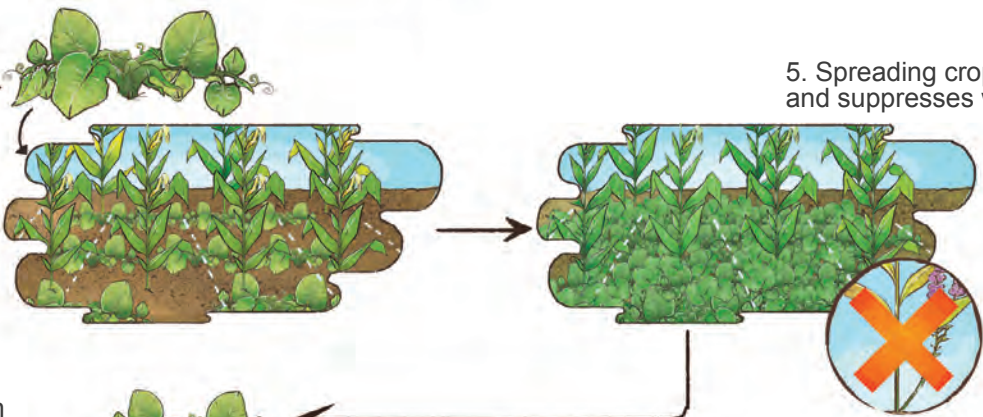
2. Problem: weeds grow in between rows.



3. Drudgery to remove weeds

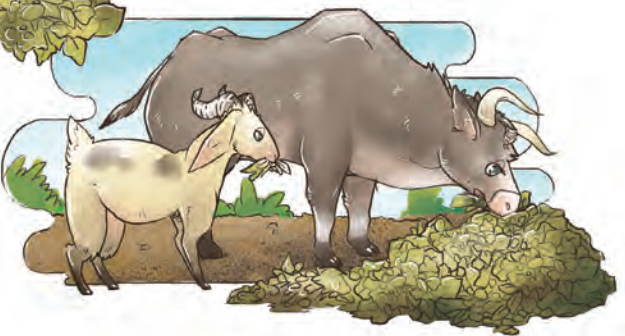


4. Improved practice: in between rows, sow seeds of a spreading type (e.g. cucurbits)



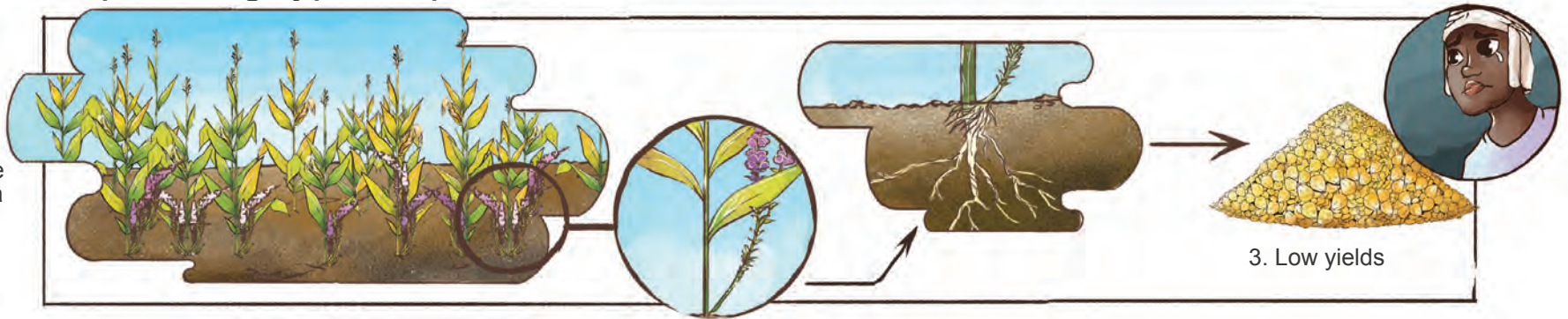
5. Spreading crop covers the ground and suppresses weeds.

6. Cover crop may be harvested and consumed by livestock as an animal feed or by humans.

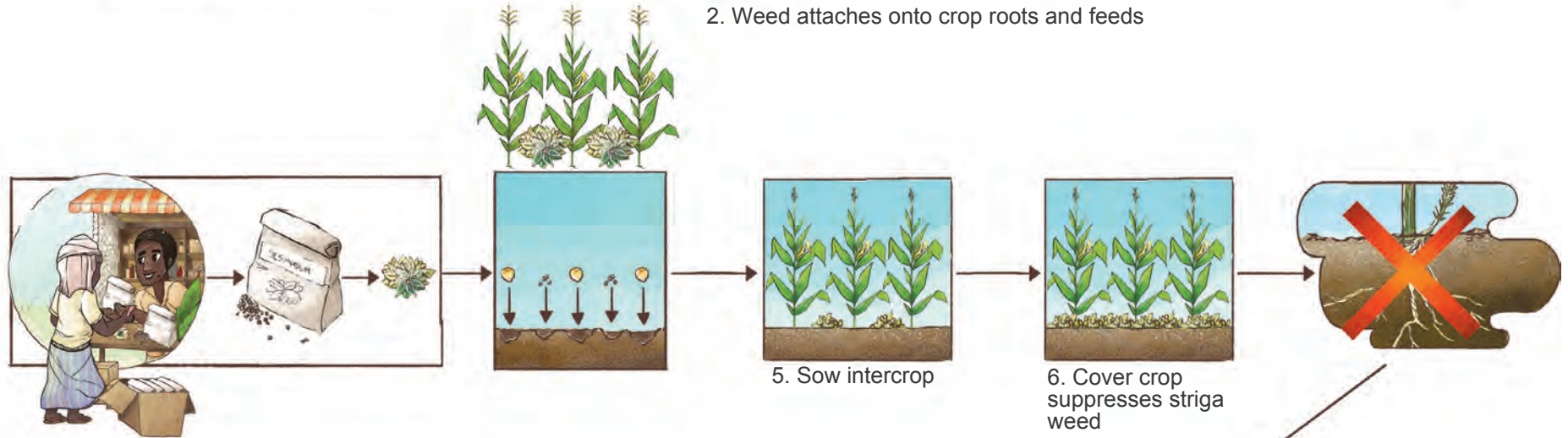


Lesson: Parasitic striga weed can be suppressed by intercropping with Desmodium or other spreading-type crops

1. Traditional practice: no cover crop - purple or white flowered striga weed grows



2. Weed attaches onto crop roots and feeds

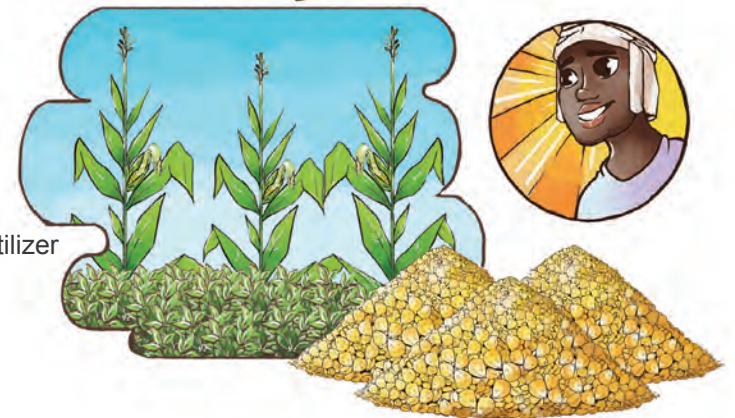


4. Improved practice: purchase Desmodium seed or other spreading-type seed from vendor

5. Sow intercrop

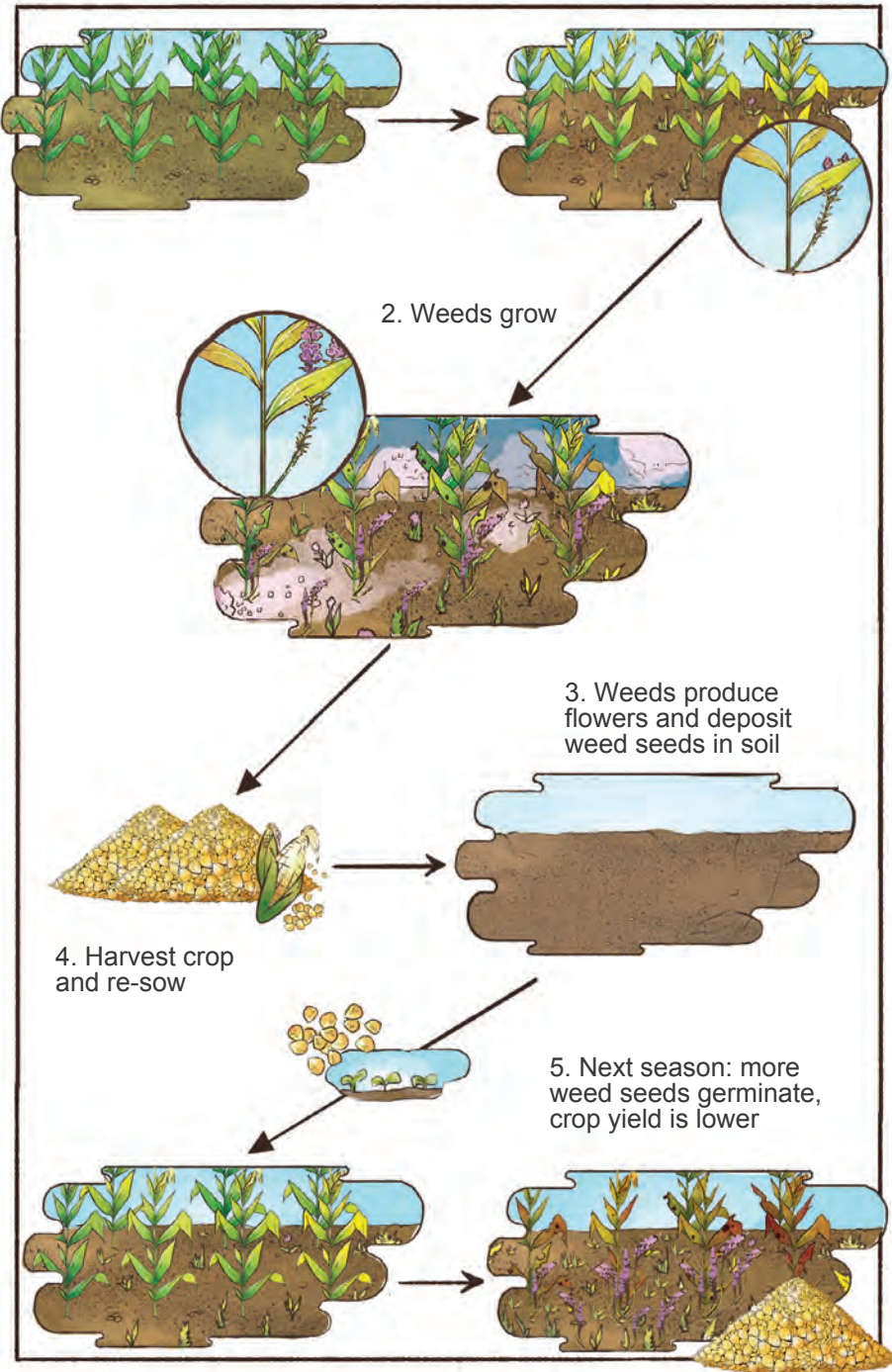
6. Cover crop suppresses striga weed

7. High yields. Desmodium also adds natural nitrogen fertilizer to soil and can be used as livestock feed

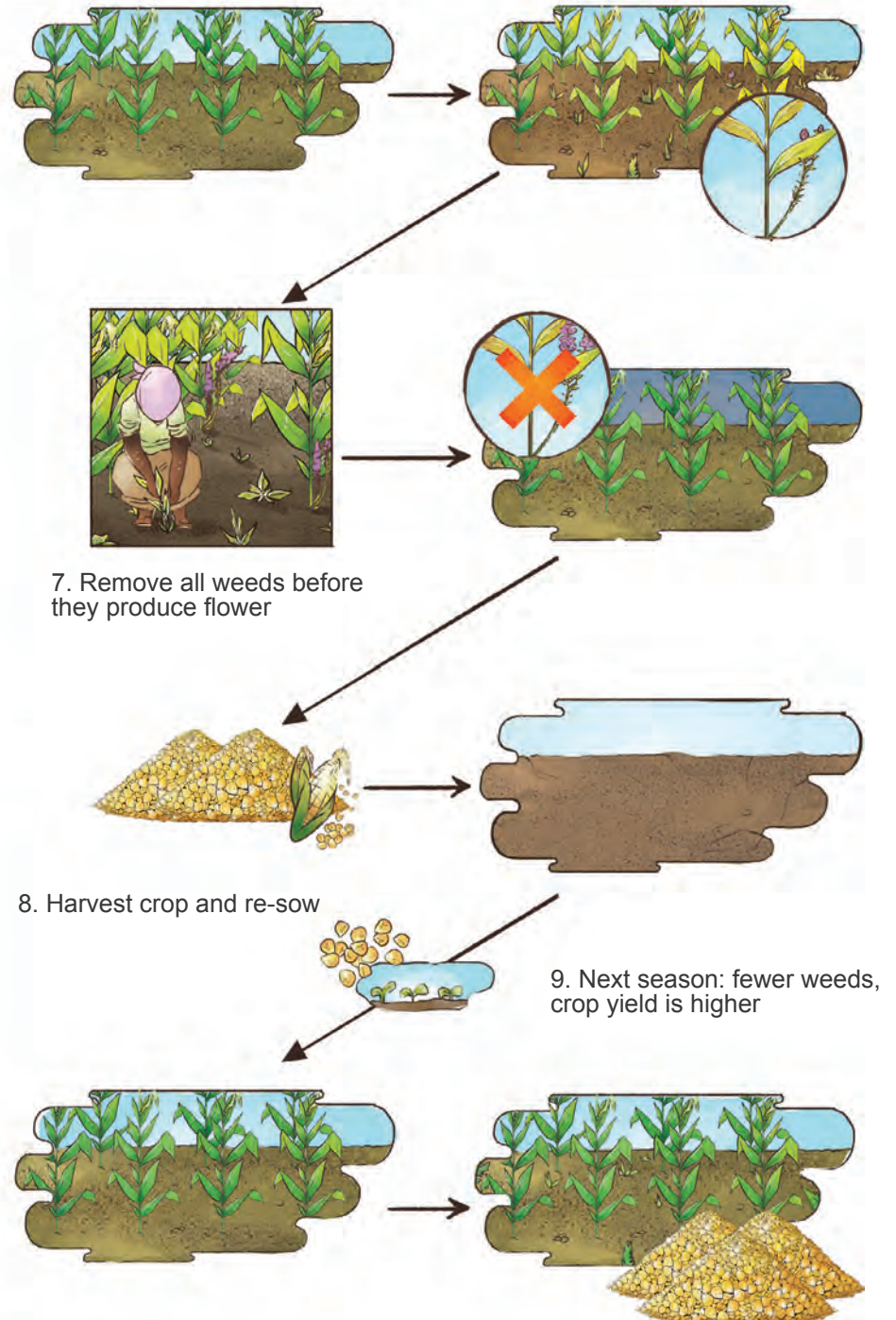


Lesson: Removing weeds before they produce flowers will reduce weeds in future years

1. Traditional practice

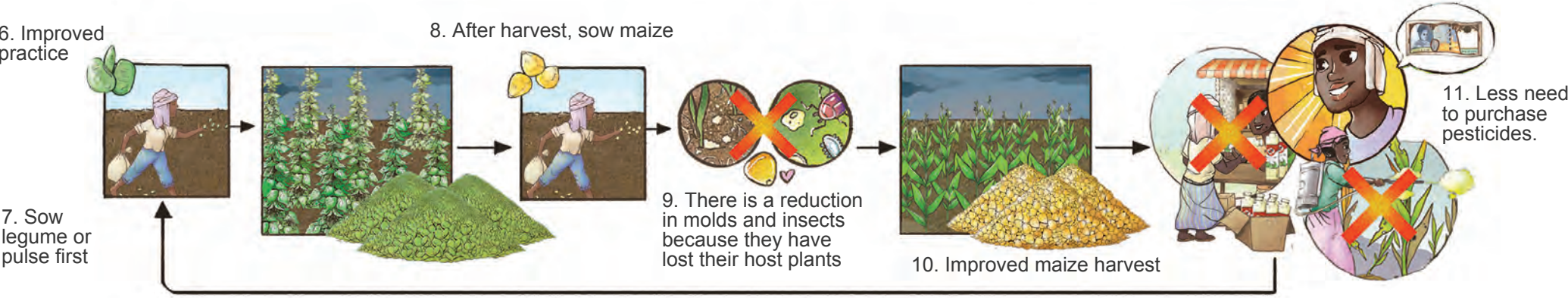
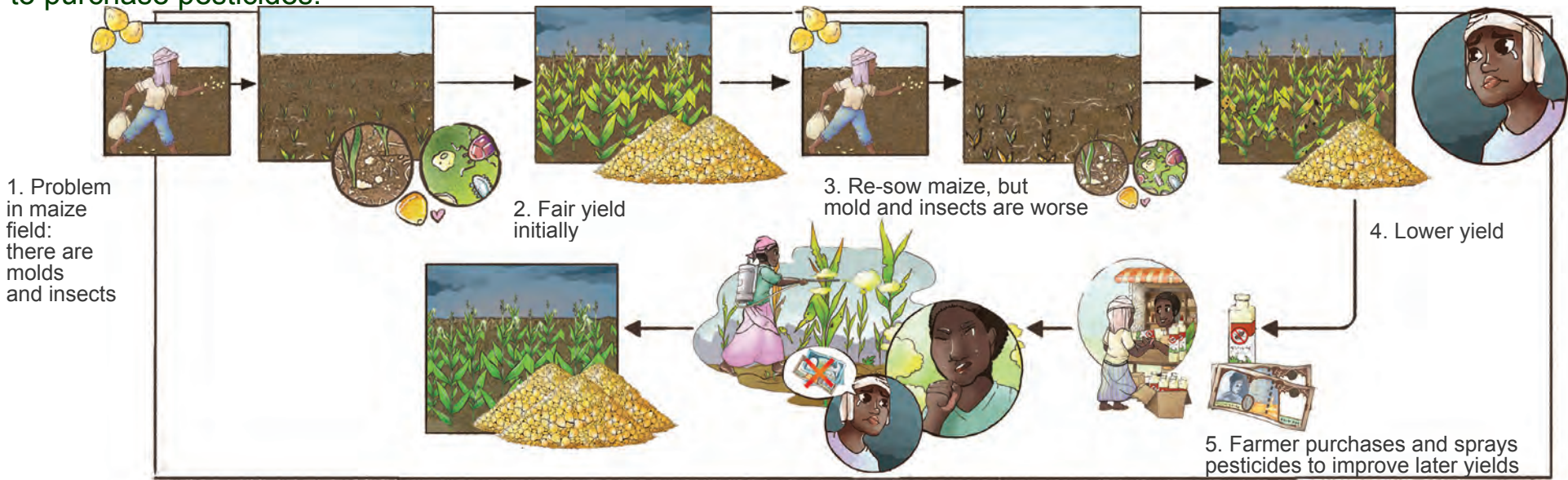


6. Improved practice



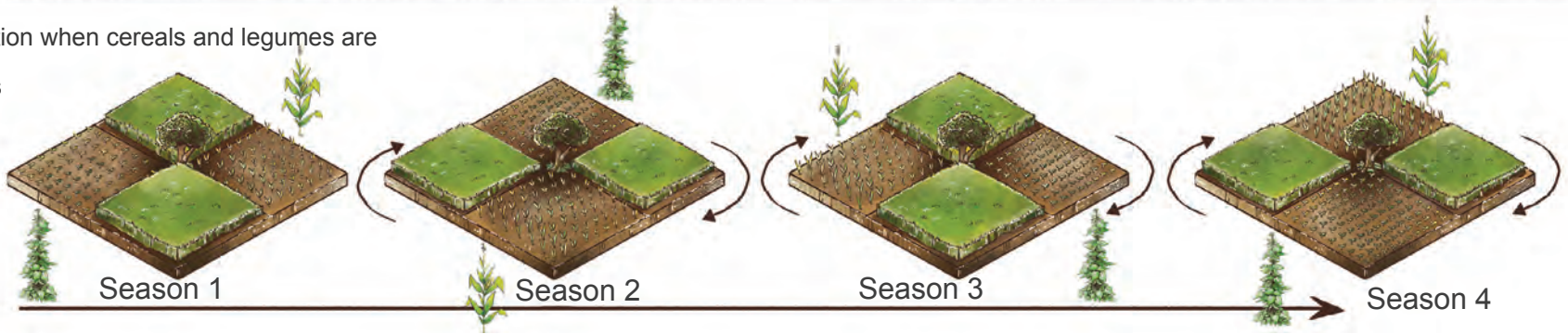
Chapter 8: Pests & Disease

Lesson: Rotating a cereal crop (e.g. maize) with a legume crop (e.g. beans) will reduce pests and diseases and reduce need to purchase pesticides.



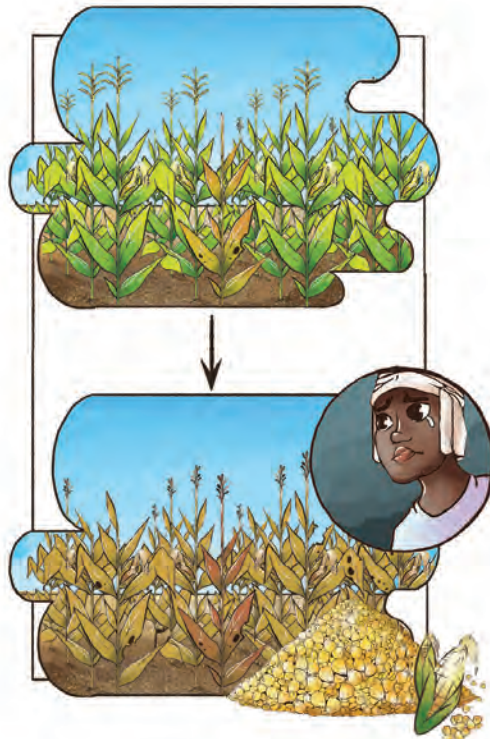
12. Repeat rotation

13. Crop rotation when cereals and legumes are grown in adjacent plots

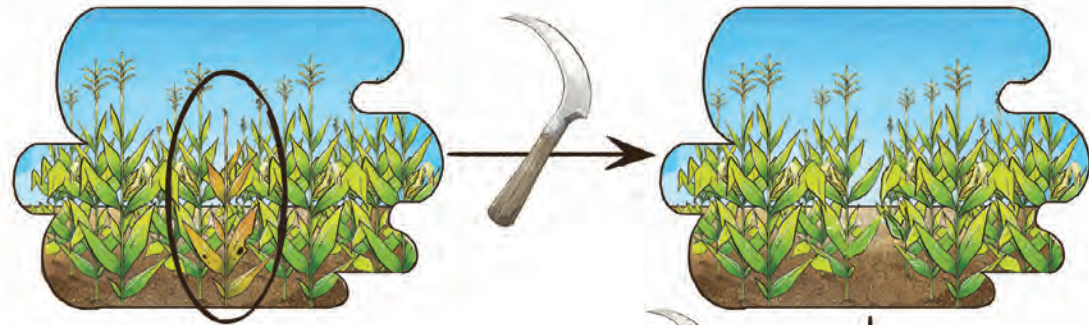


Lesson: Constantly visual inspect fields for sick plants and remove them in order to improve the health of the field

2. Improved practice: remove sick plants immediately to prevent spread of disease or pests



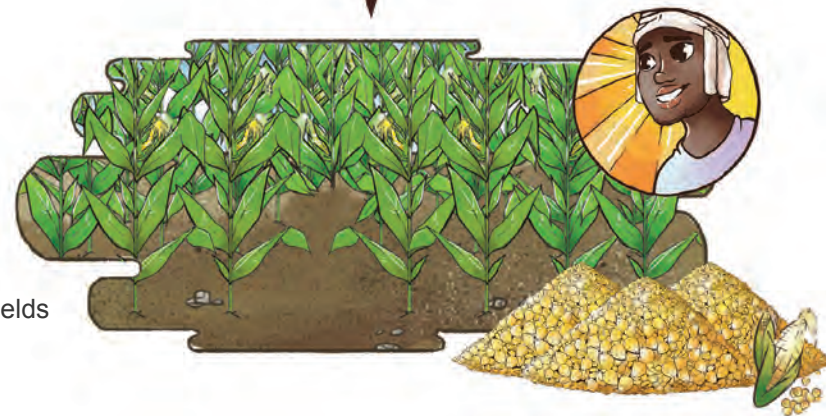
1. Traditional practice: sick plants are allowed to remain in field. Many plants become sick, low yields



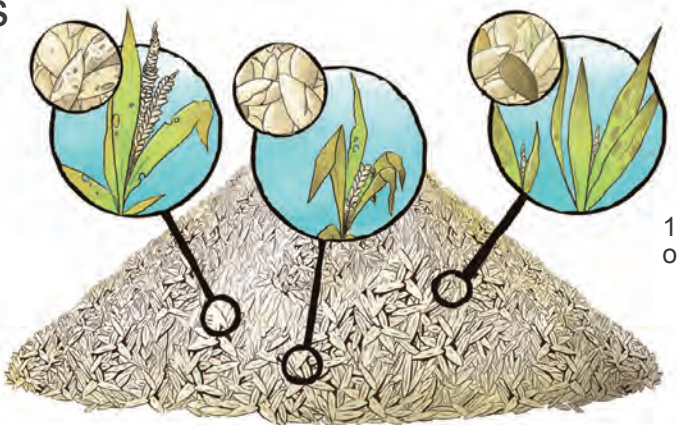
3. Wash the cutting knife as it may be contaminated with disease or pest



4. Field is healthy, high yields



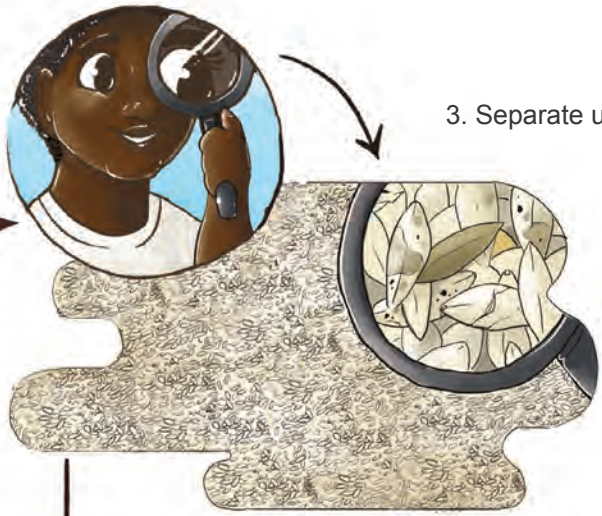
Lesson: Before sowing seeds, use a magnifying glass/sheet to help remove seeds with disease or pests



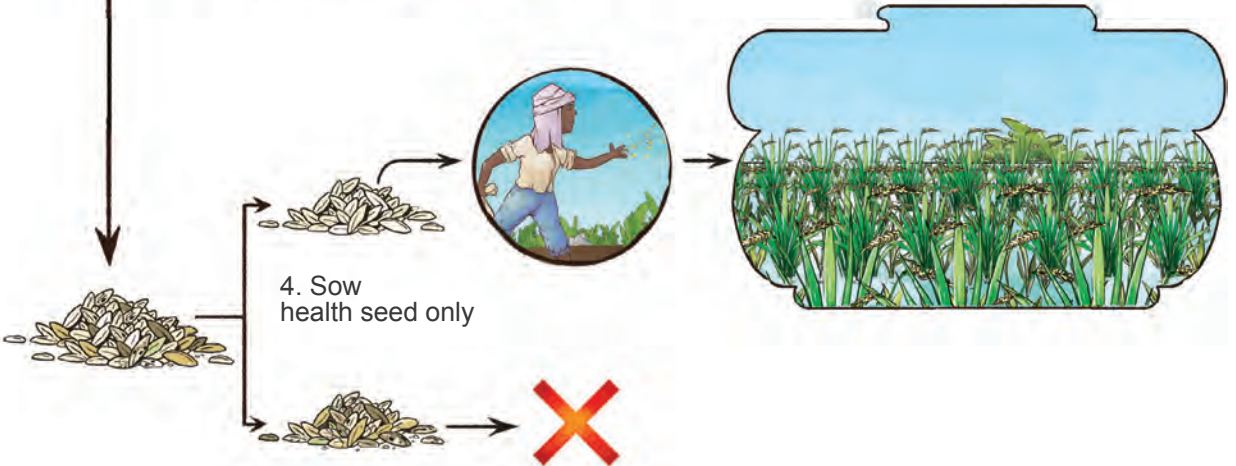
1. Seeds for sowing may have small spots or damage due to insects or mold



2. Purchase magnifying glass/sheet from vendor



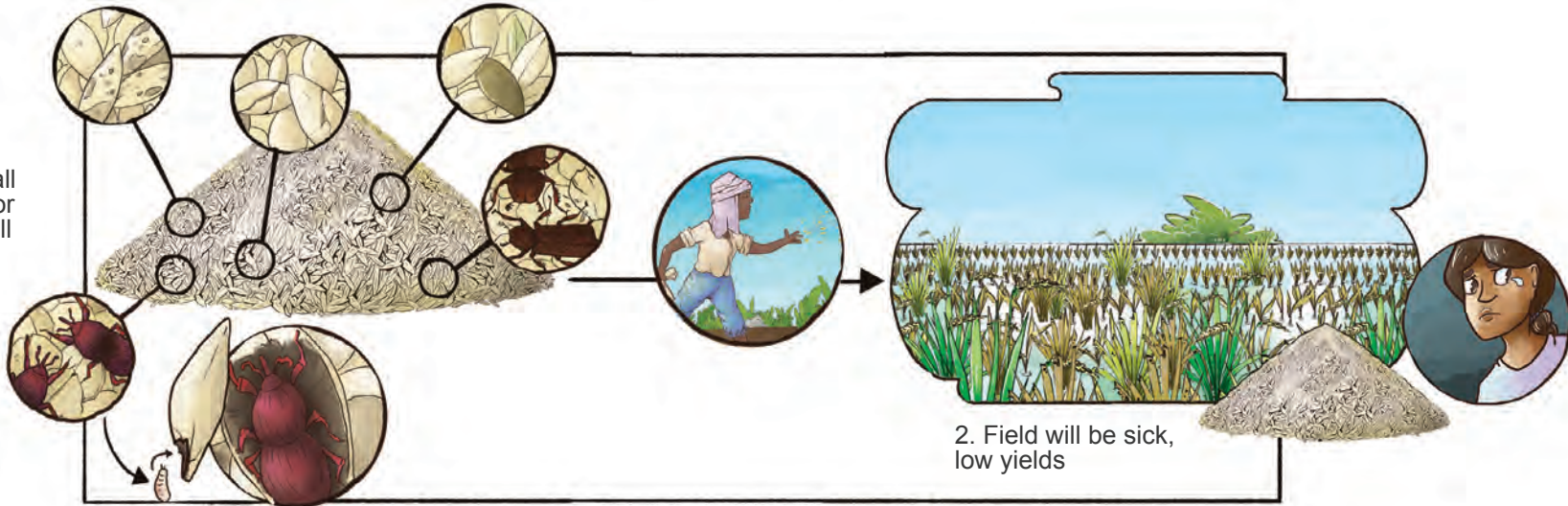
3. Separate unspotted, undamaged seed



4. Sow health seed only

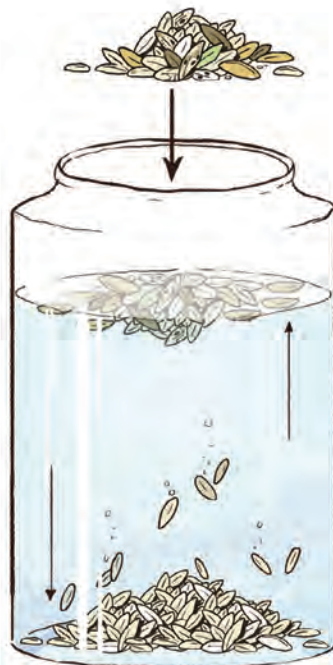
Lesson: Healthy seeds can be easily separated from sick seeds prior to sowing using water floatation

1. Traditional practice: seeds with small disease spots or containing small insects may be missed, and sown in field



2. Field will be sick, low yields

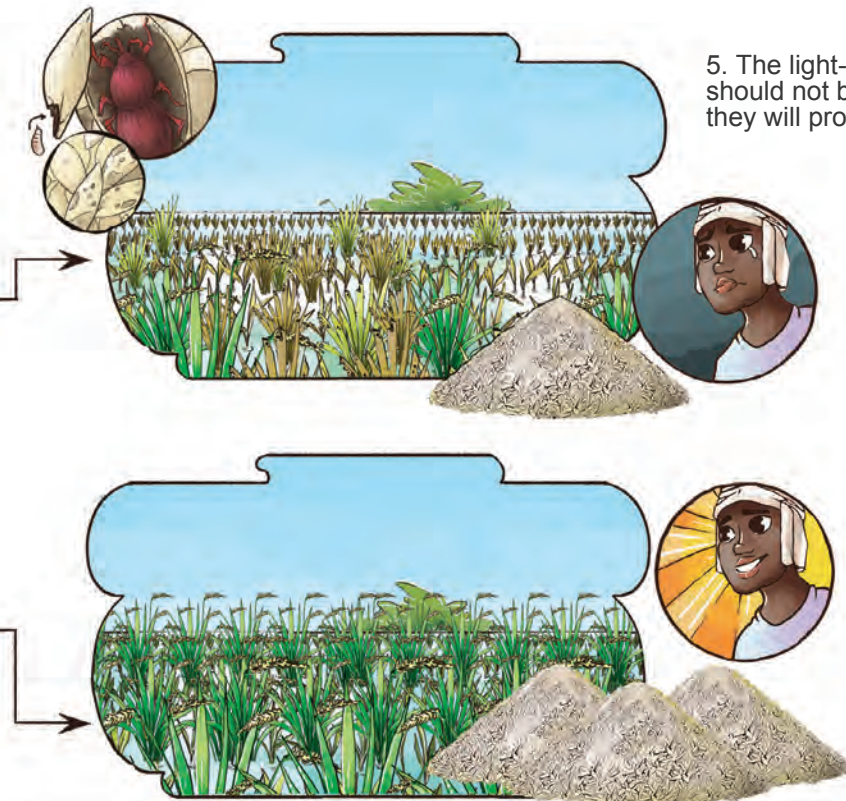
3. Improved practice: Add seeds to water.



4. Sick seeds are light-weight and will float.

6. Healthy seeds are heavy and will sink

7. The heavy seeds will produce a healthy field

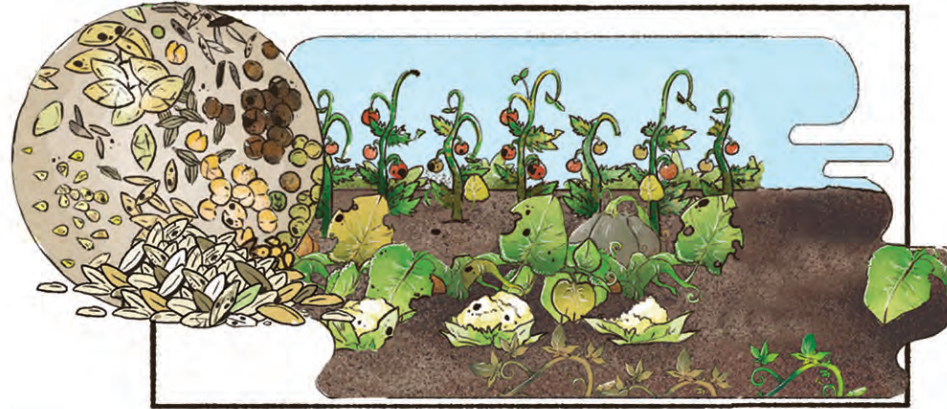


5. The light-weight seeds should not be planted as they will produce a sick field

8. If seed size is large, then salt should be added to jar to better enable seed separation

Lesson: Gently heat treating vegetable seeds prior to sowing can reduce crop disease

1. Traditional practice: seeds may contain disease leading to field diseases



2. Improved practice: Purchase a thermometer from a vendor, then add water pre-heated to 45°C to seeds



3. Incubate for 1 hour. Heat will kill some diseases



5. Be careful: excess temperature or time will kill seeds.



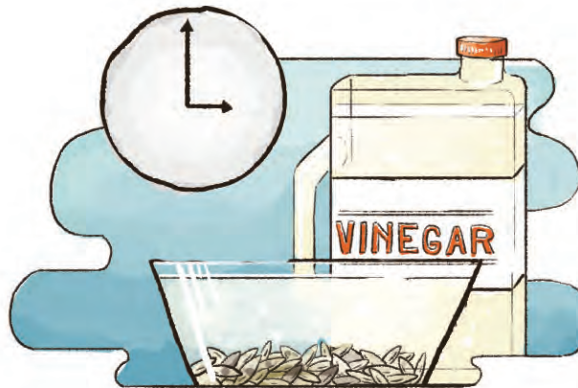
4. Vegetable garden may be healthier but if the water temperature is too high, then seeds will be damaged

Lesson: Instead of spraying chemical pesticide or biopesticide in the field, it is less expensive and less labour to initially remove pests and disease from seeds before sowing, using vinegar.

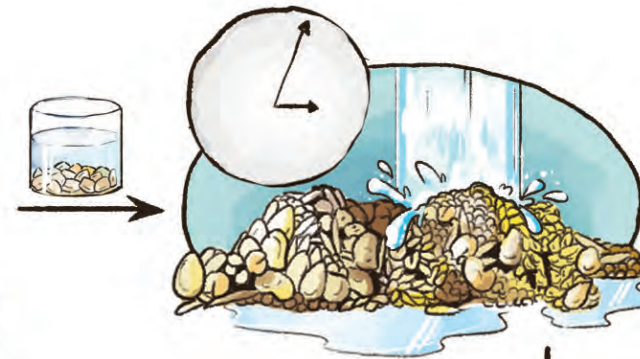
1. Problem: vegetables damaged by pests and disease



2. Partial solution: soak seeds for a few minutes in vinegar

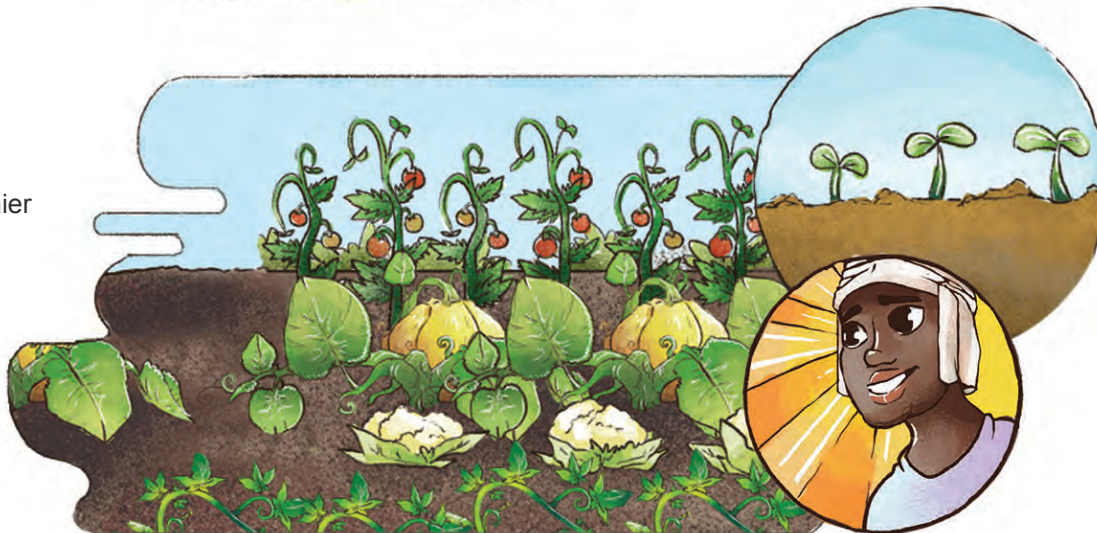


3. Rinse with water



4. Sow seeds

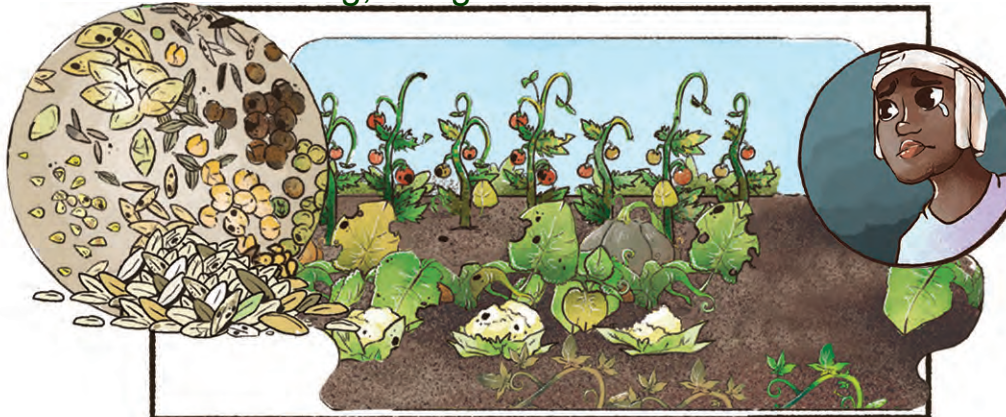
5. Healthier plants



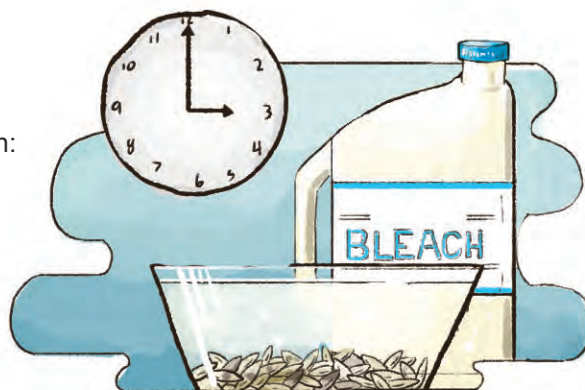
6. Be careful, excess concentration or time of vinegar will kill seeds. It is recommended to try different dilutions and durations of the treatment, and then sow the seeds to ensure germination is not reduced.

Lesson: Instead of spraying chemical pesticide or biopesticide in the field, it is less expensive and less labour to initially remove pests and disease from seeds before sowing, using diluted bleach.

1. Problem: vegetables damaged by pests and disease



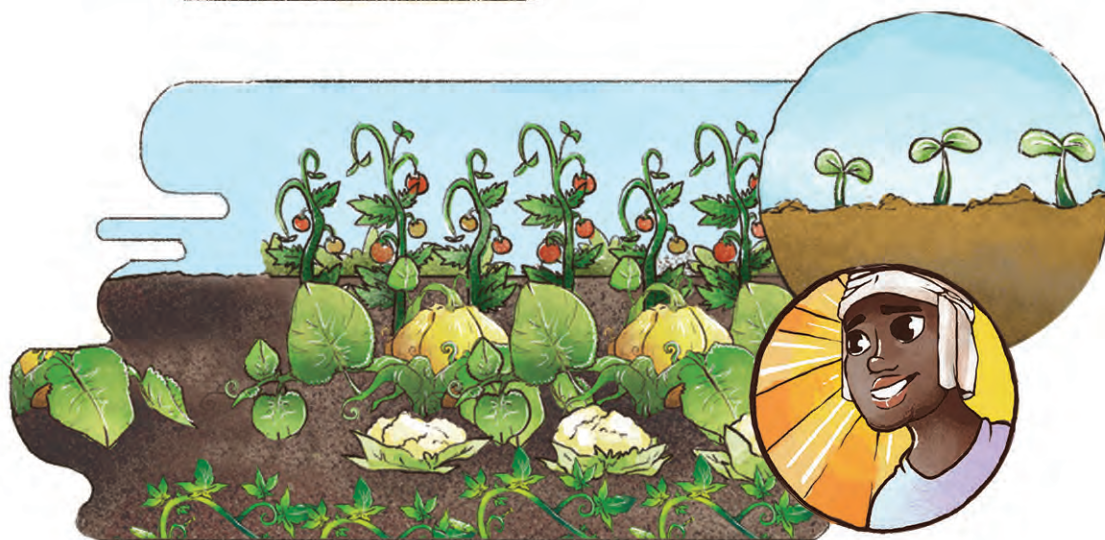
2. Partial solution: soak seeds for a few minutes in diluted bleach



3. Rinse with water



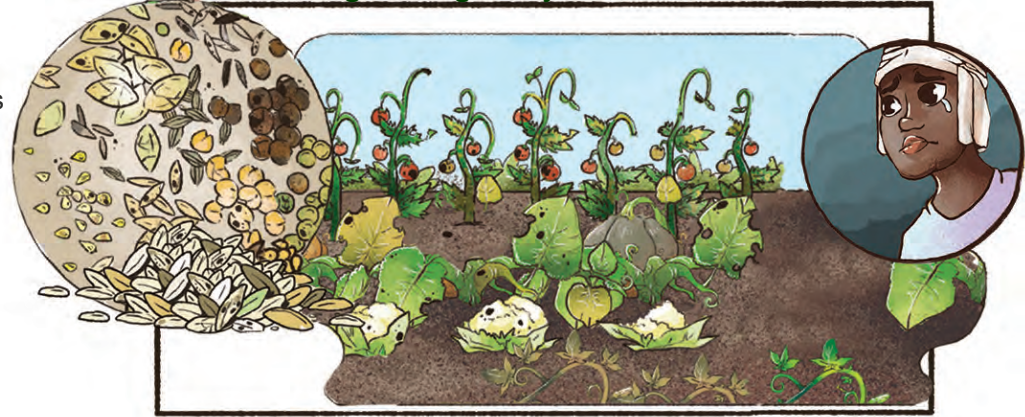
4. Sow seeds



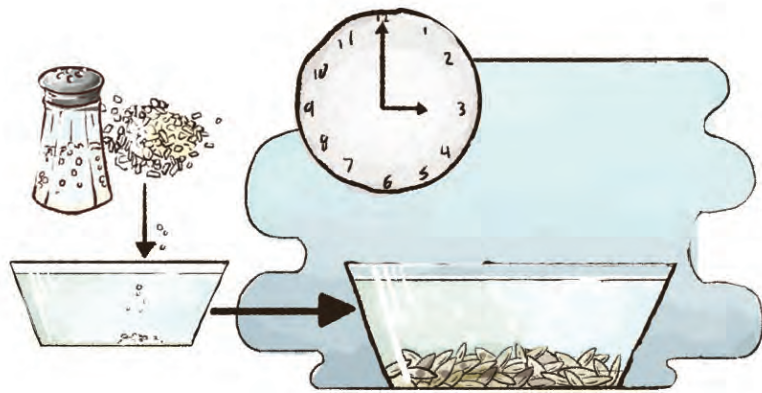
6. Be careful, excess concentration or time of vinegar will kill seeds. It is recommended to try different dilutions and durations of the treatment, and then sow the seeds to ensure germination is not reduced.

Lesson: Instead of spraying chemical pesticide or biopesticide in the field, it is less expensive and less labour to initially remove pests and disease from seeds before sowing, using salty water.

1. Problem: vegetables damaged by pests and disease



2. Partial solution: soak seeds for a few minutes in very salty water

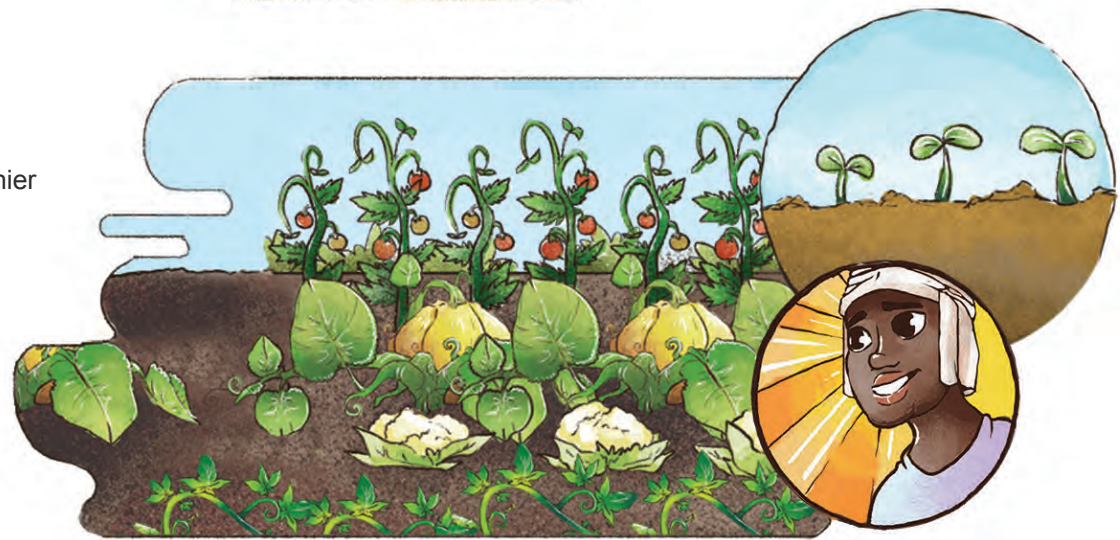


3. Rinse with non-salty water



4. Sow seeds

5. Healthier plants



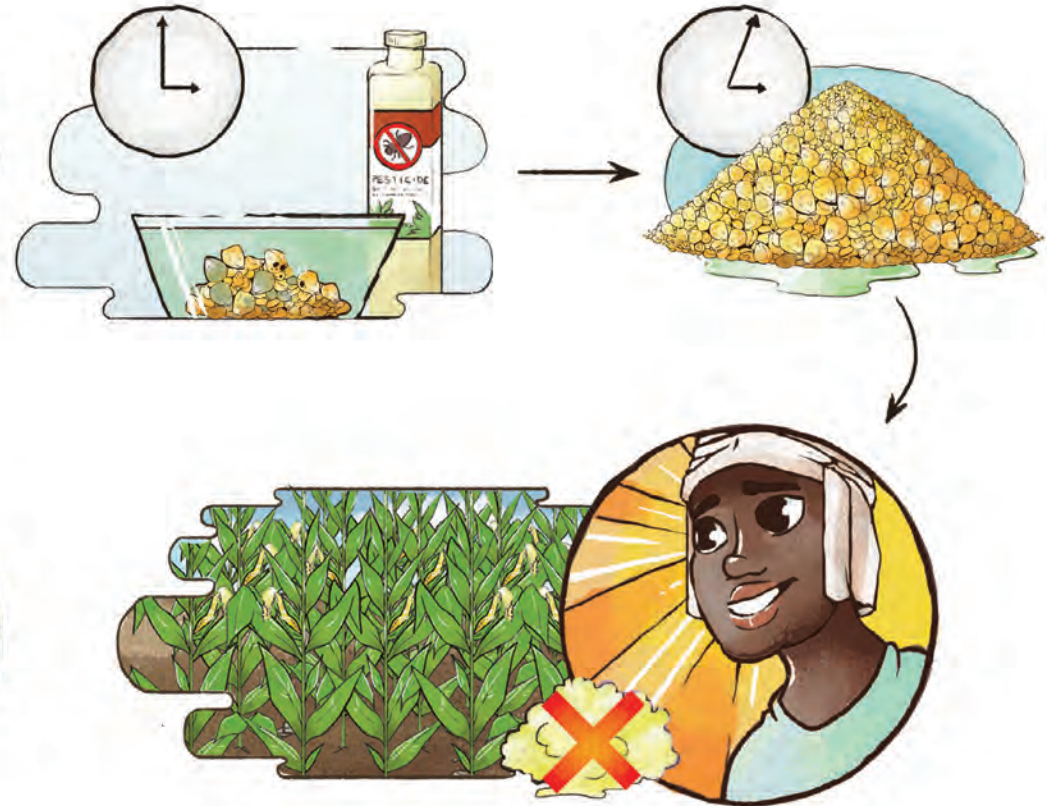
6. Be careful, excess concentration or time of vinegar will kill seeds. It is recommended to try different dilutions and durations of the treatment, and then sow the seeds to ensure germination is not reduced.

Lesson: Instead of spraying chemical pesticide or biopesticide in the field, it is less expensive and less labour to coat seeds with these chemicals before sowing

1. Traditional practice



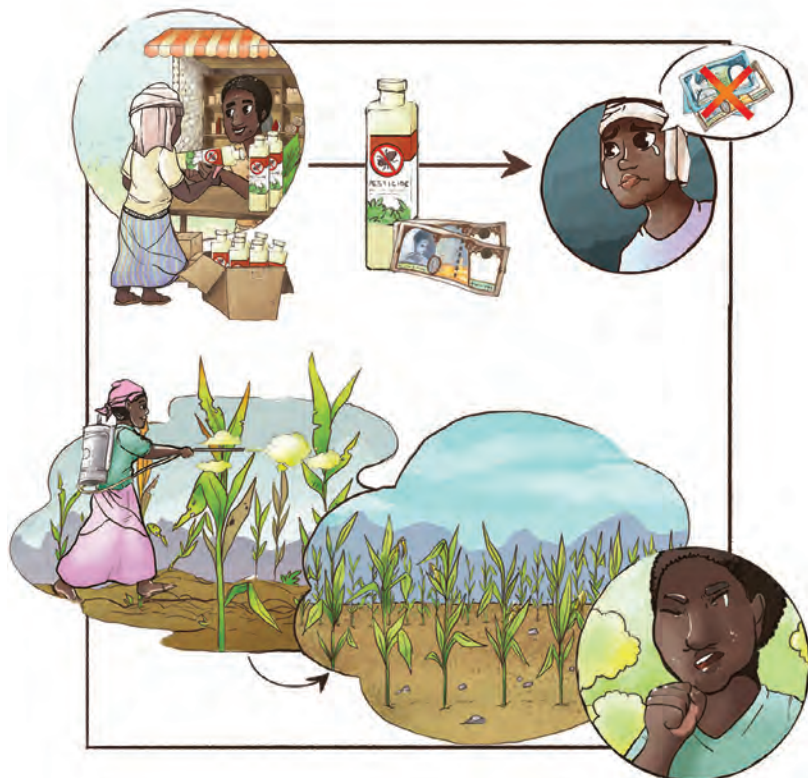
2. Improved practice: soak seeds in pesticide prior to sowing



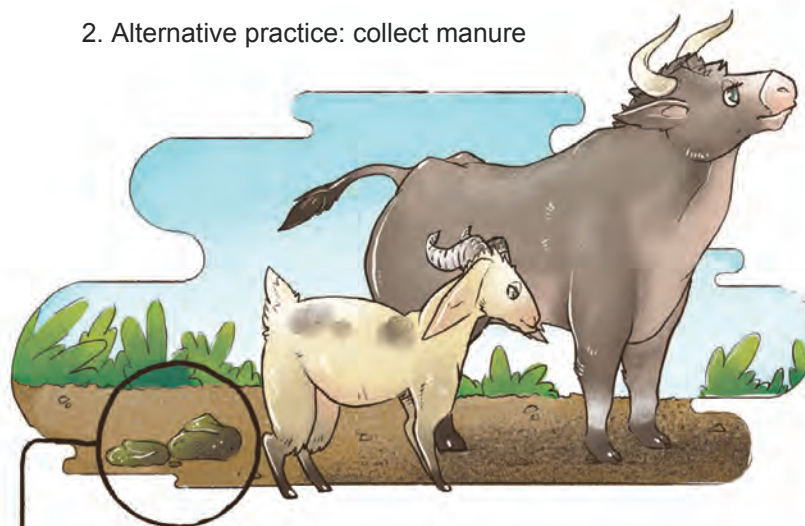
3. Less spraying in the field

Lesson: Manure that is soaked in water can be sprayed onto crops to fight crop disease

1. Traditional practice: purchase pesticides and spray onto field



2. Alternative practice: collect manure



3. Dry manure in sun for many days to kill harmful microbes



4. Add manure to water



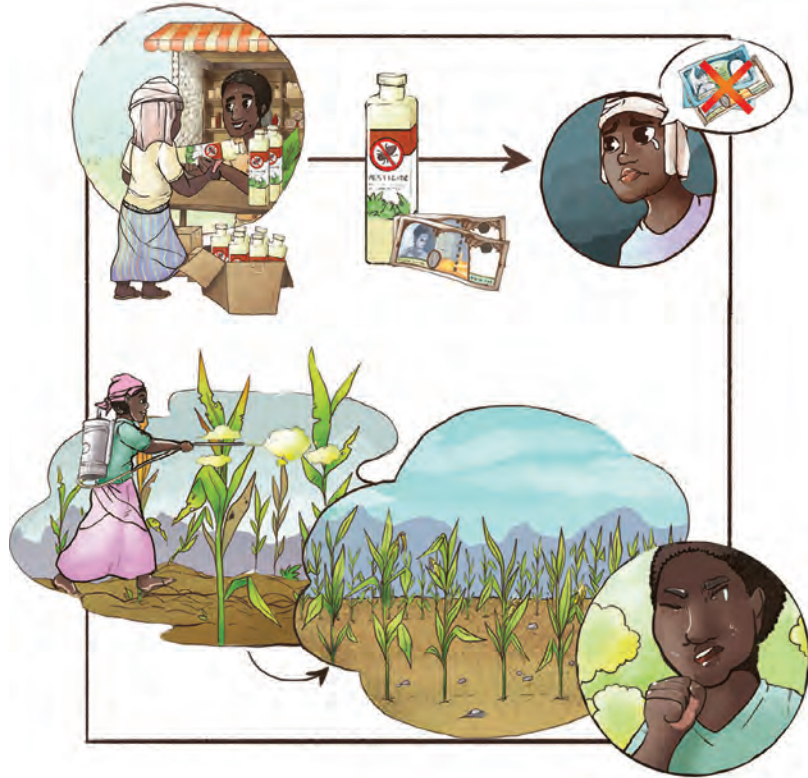
5. Spray manure liquid onto field. Healthy microbes in manure will fight microbes that damage crops.

6. Less need to purchase pesticides.

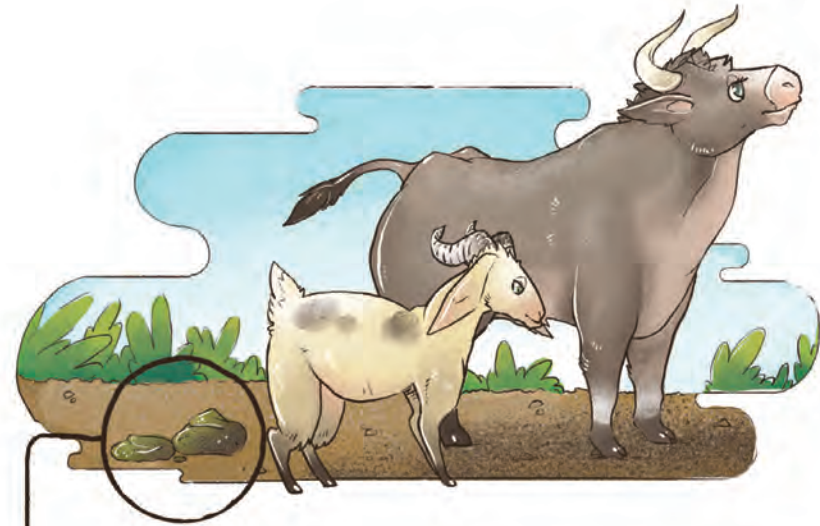


Lesson: Manure soaked in water can be added to seeds before sowing to fight crop disease

1. Traditional practice: purchase pesticides and spray onto field



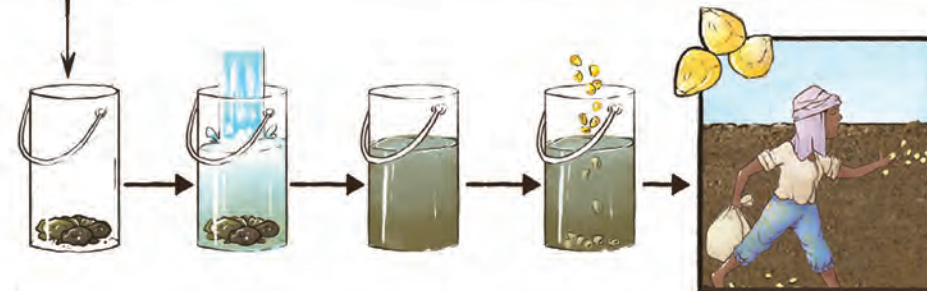
2. Alternative practice: collect manure



3. Dry manure in sun for many days to kill harmful microbes



4. Add manure to water

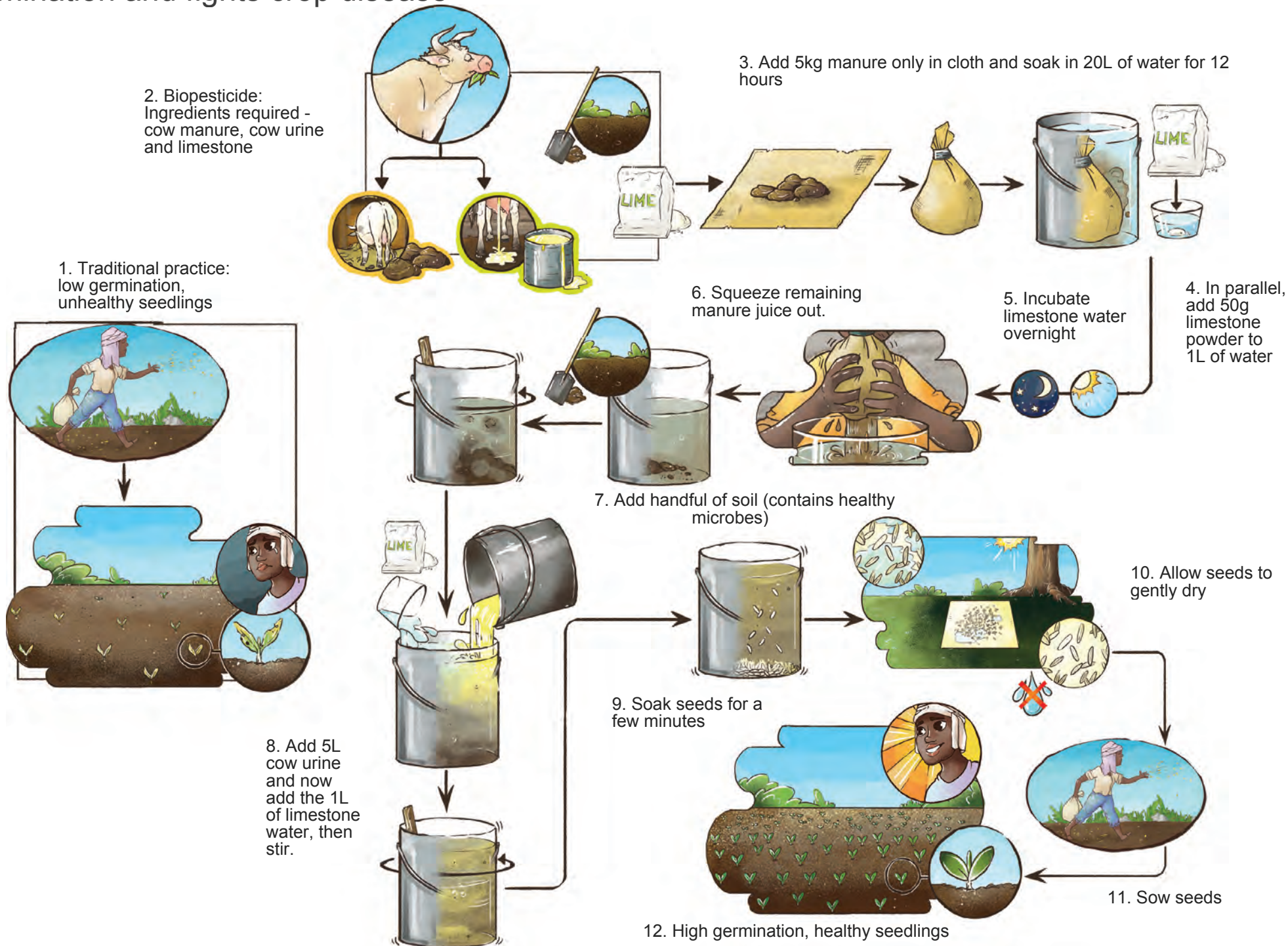


5. Soak seeds in the diluted manure. Healthy microbes in manure will fight microbes that damage crops.

6. Less need to purchase pesticides.

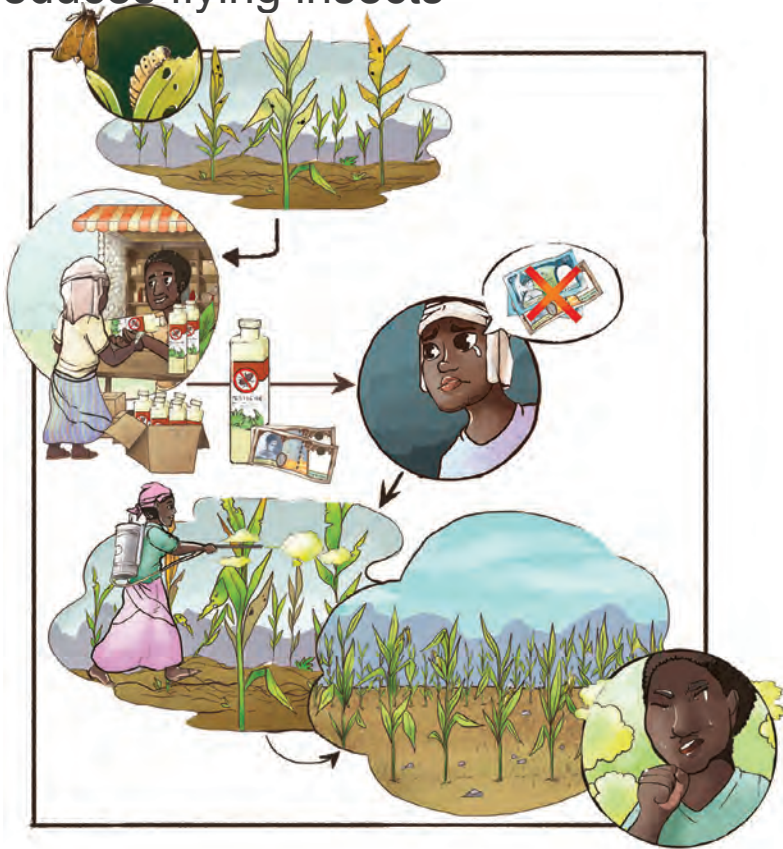


Lesson: An indigenous bio-pesticide (Bijamrita) added to seeds before sowing improves germination and fights crop disease



Lesson: Intercropping with Desmodium cover crop and Napier grass as a border crop reduces flying insects

2. Improved practice: purchase Desmodium and Napier grass seed from vendor



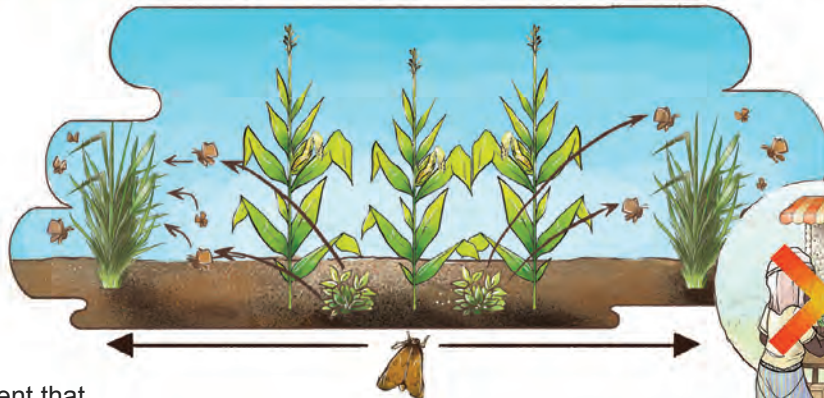
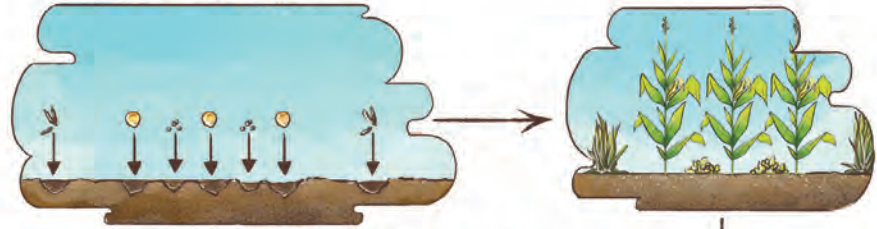
1. Traditional practice: expensive pesticides are purchased from vendor and sprayed



3. Intercrop with Desmodium



4. Border row of Napier grass



6. Less need to purchase pesticides

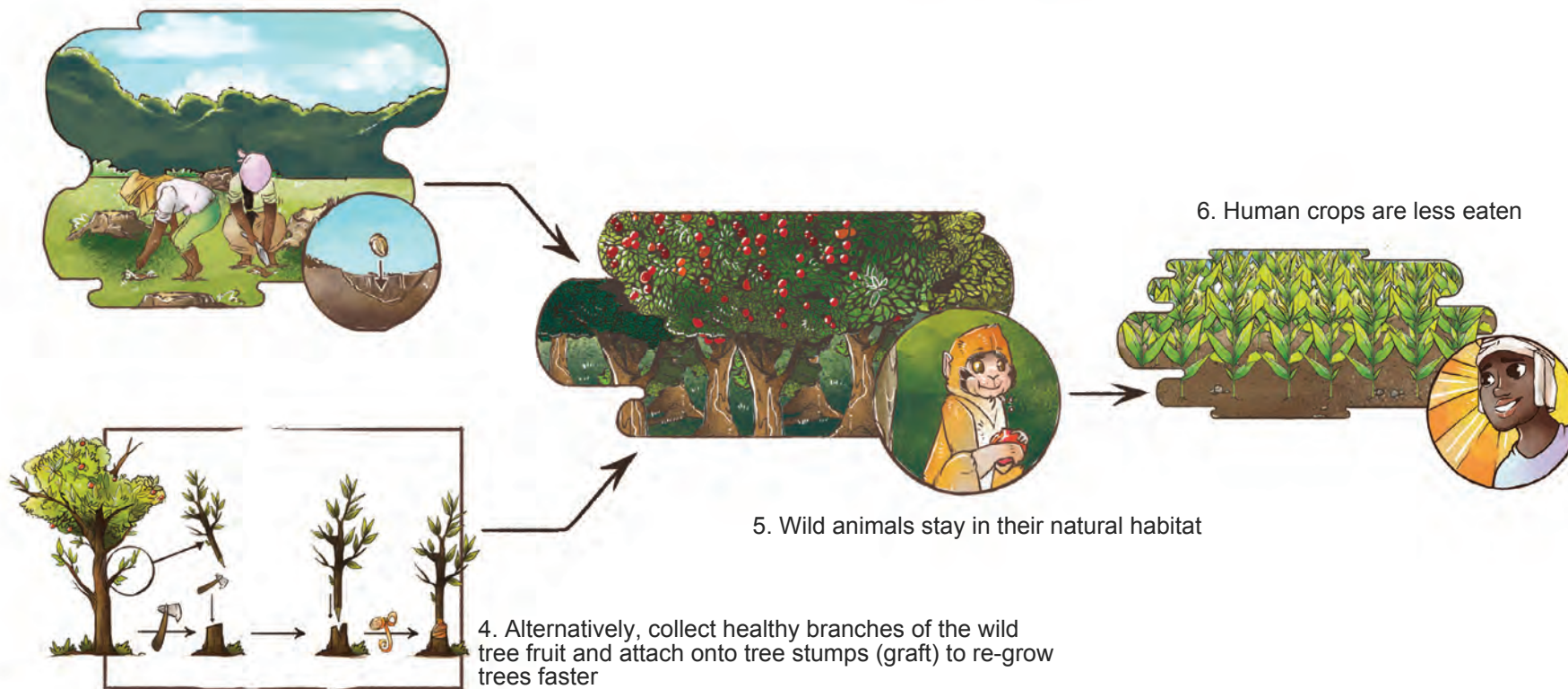
5. Desmodium produces a gas scent that pushes insect moths away from field. Napier grass produces a gas scent that attracts moths to lay their eggs and hence pulls them out of field.

7. Desmodium also enriches soil. Desmodium and Napier are also livestock feeds.

Lesson: Replenishing the natural foods of wild animals may prevent them from attacking human crops



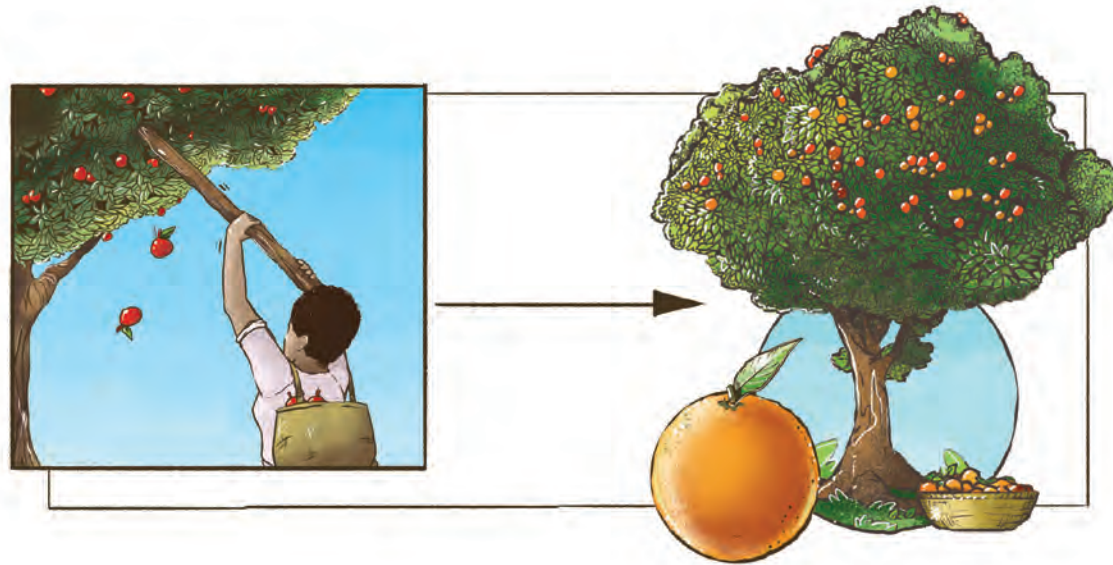
3. Improved practice: Collect seeds to grow the tree fruits of the wild animals



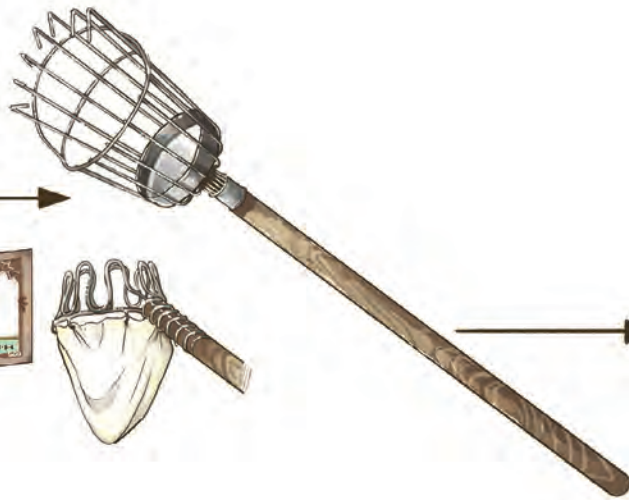
Chapter 9: Post-Harvest

Lesson: New tool to harvest tree fruits without climbing trees

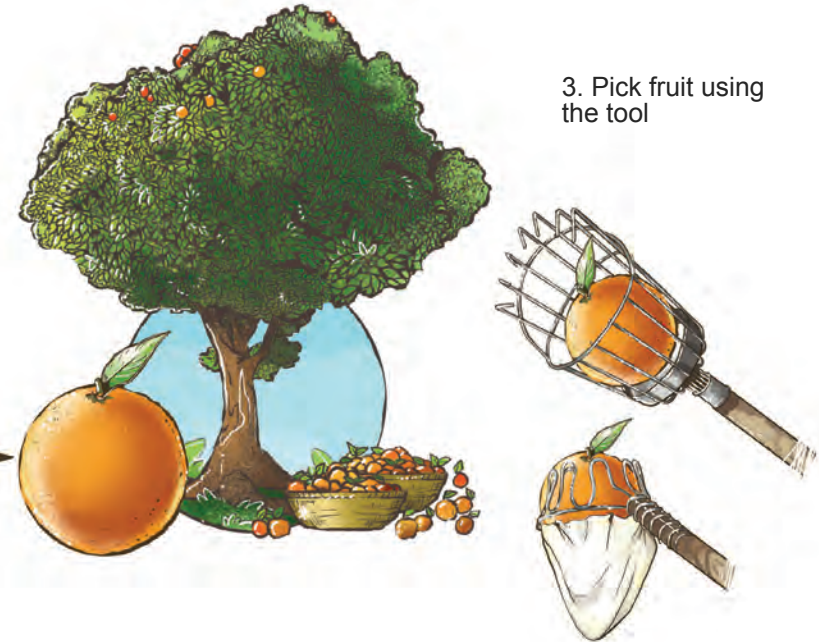
1. Traditional practice



2. New practice: purchase tool from vendor

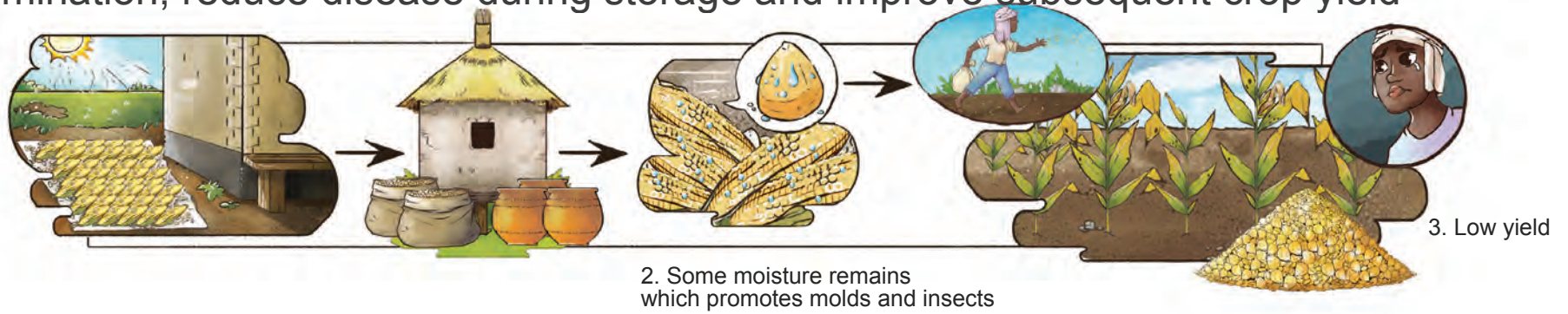


3. Pick fruit using the tool



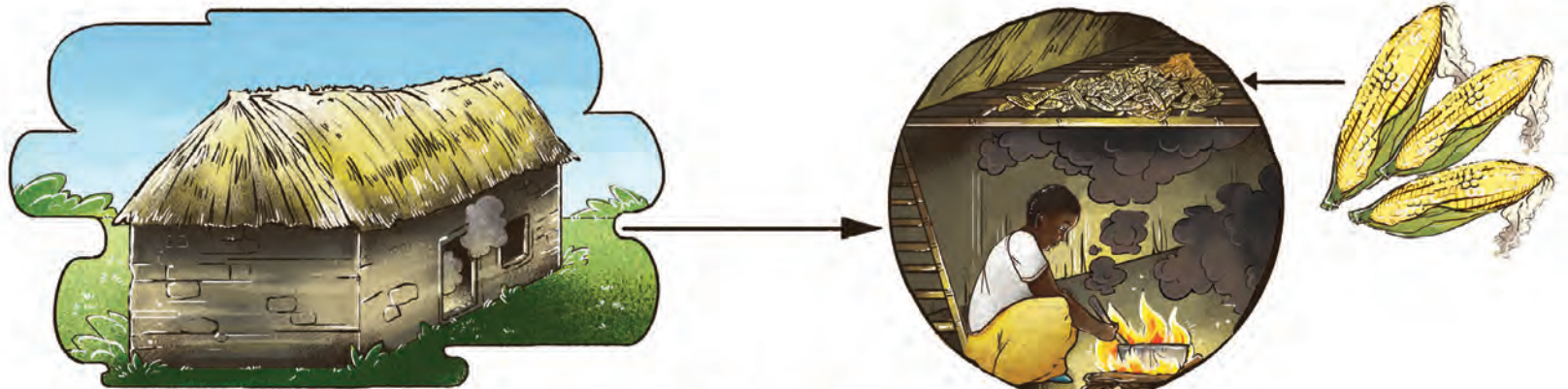
Lesson: Drying seeds prior to storage above the cooking fire will improve subsequent germination, reduce disease during storage and improve subsequent crop yield

1. Traditional practice is to sun dry only prior to storage

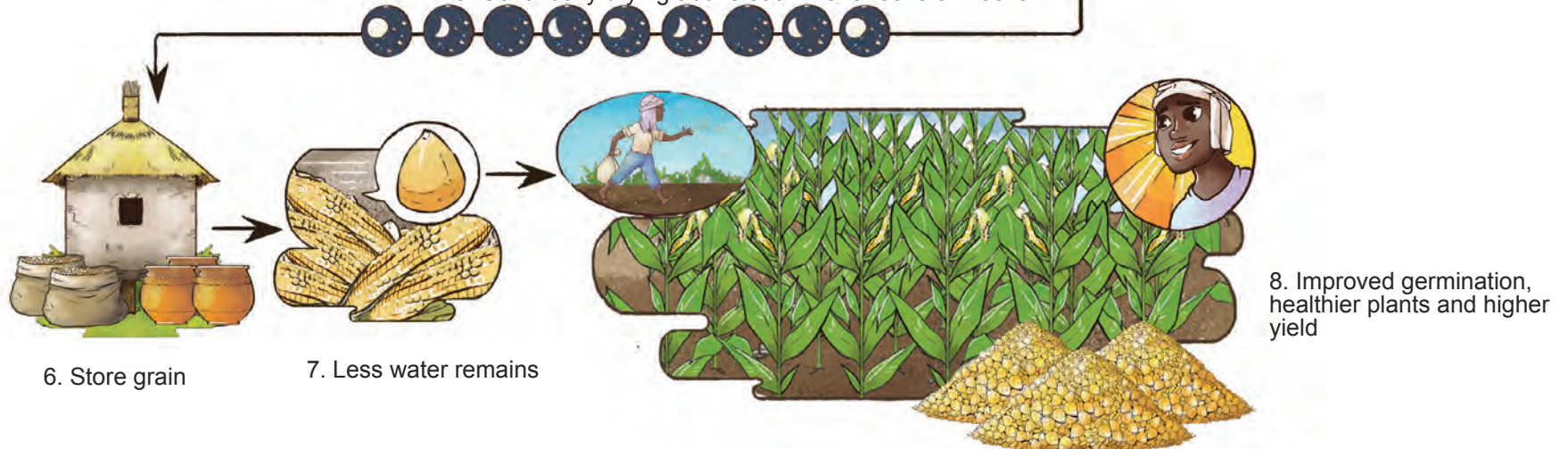


2. Some moisture remains which promotes molds and insects

4. Improved practice is to additionally dry seeds above cooking fire



5. Continually drying above cook fire for several weeks



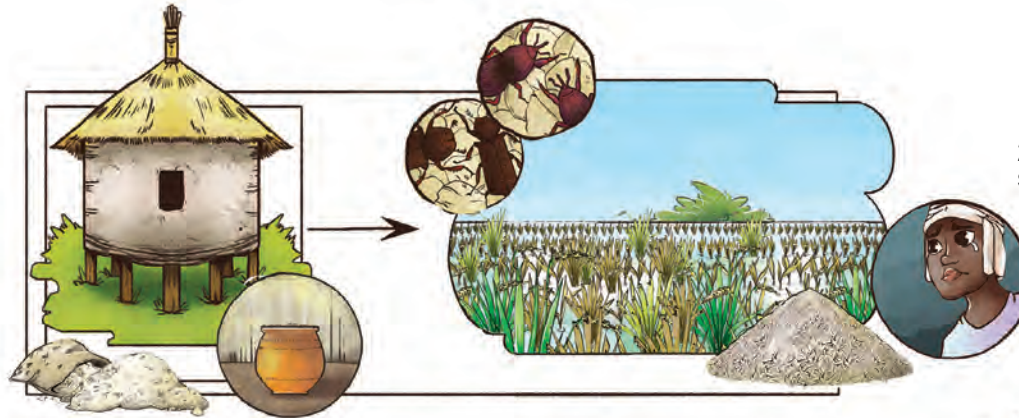
6. Store grain

7. Less water remains

8. Improved germination, healthier plants and higher yield

Lesson: Neem tree leaves fight pests during grain storage

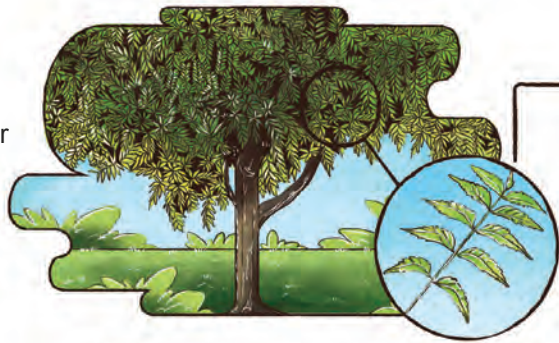
1. Traditional problem: stored grain is damaged by insects during storage.



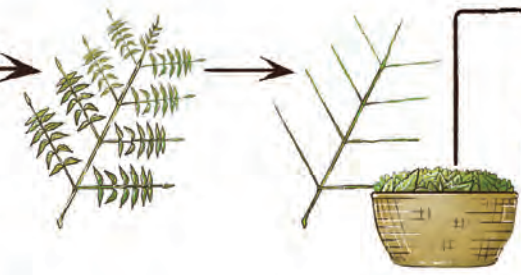
2. When sown, the damaged seeds produce low yields

3. Improved practice

4. Grow or find neem trees



5. Collect neem leaves



6. Add leaves to granary as a layer



7. Add newspaper layer



8. Add grain layer



9. Repeat newspaper



10. Repeat neem leaves



11. Repeat newspaper



12. Repeat grain



13. Repeat newspaper



14. Repeat layering until granary is full



15. Store grain



16. Less insect damage



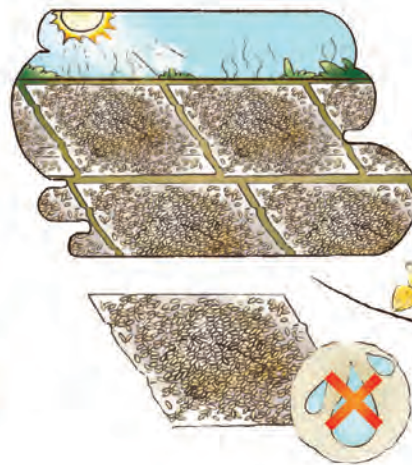
Lesson: Special bags can be used to store grain which reduce oxygen inside bag which prevents insects and fungal molds from surviving, which also reduces toxins.

1. Traditional practice: stored grain is damaged by insects and mold. The mold can produce toxins in the grain.

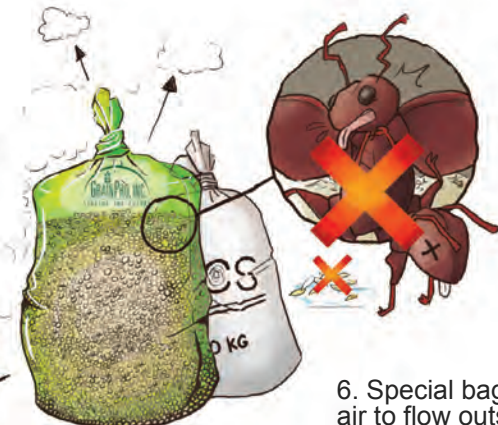


2. New practice

3. Dry grain completely

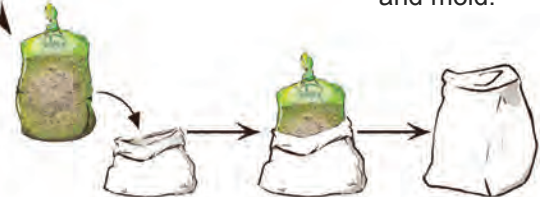


4. Purchase bag from vendor. Put grain in bag, remove air and tie.



6. Special bag causes air to flow outside, causing death to insects and mold.

5. Put bag inside a jute bag. Elevate from ground if possible to prevent rodents.

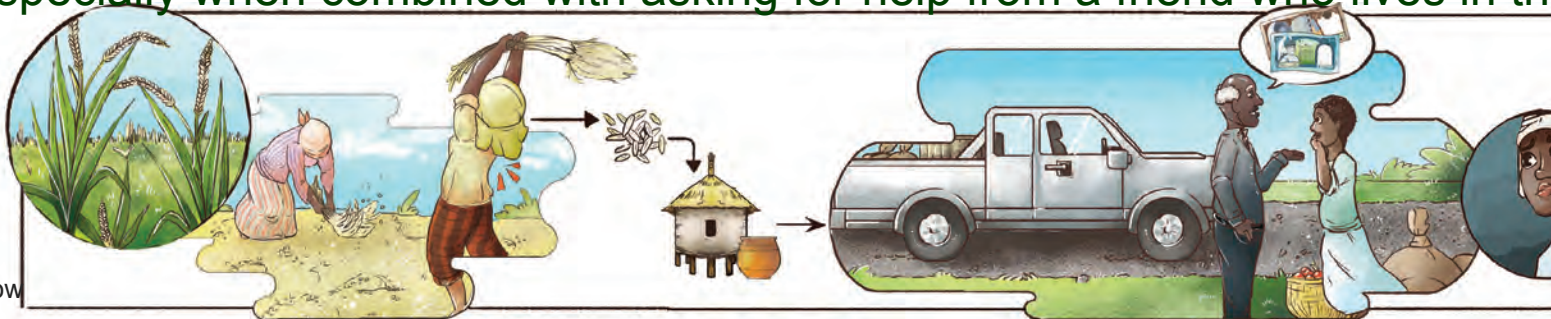


7. High yield if sown and less toxins in food.

8. Re-use bag many times.

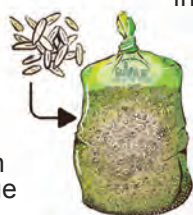
Lesson: Improved storage of grain permits selling of grain when prices are higher, especially when combined with asking for help from a friend who lives in the nearby city

1. Traditional practice: everyone harvests and sells grain at same time to middleman and hence sales price is low



2. Farmer gets little money for grain

3. Improved practice: improved storage of grain such as in Grainpro or Purdue storage bags



4. Farmer should call friend in city



5. Friend should speak to merchant in city to inquire about grain price



6. If price is low, city friend should call farmer and tell her to wait



7. Farmer should not sell grain to middleman when price is low

8. Time passes



9. Friend should again speak to city merchant in city to inquire about grain price



10. If price is low, farmer should not sell



11. When price is high farmer should sell

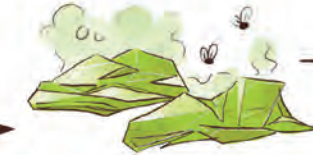
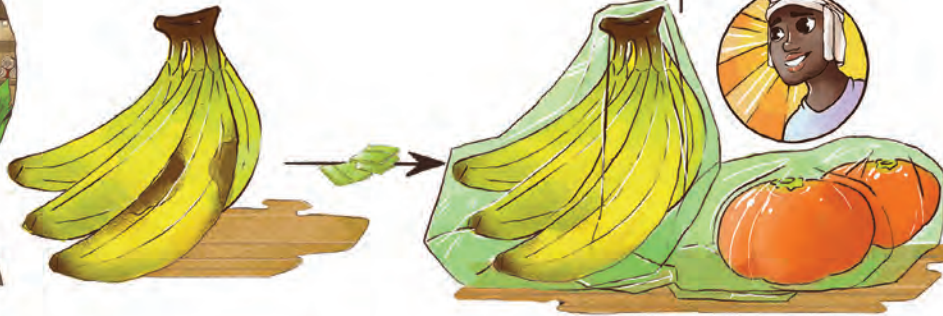


Lesson: Special small green bags may prevent fruits and vegetables from spoiling/ripening too fast

1. Traditionally, fruits/vegetables spoil quickly: when one fruit/vegetable starts to ripen, it releases a gas which causes nearby fruits/vegetables to ripen



2. New practice: purchase an anti-ripening bag from vendor. The bag stops the gas that promotes ripening, preserving the fruits/vegetables for a few more days.



3. Bags are dirty after use

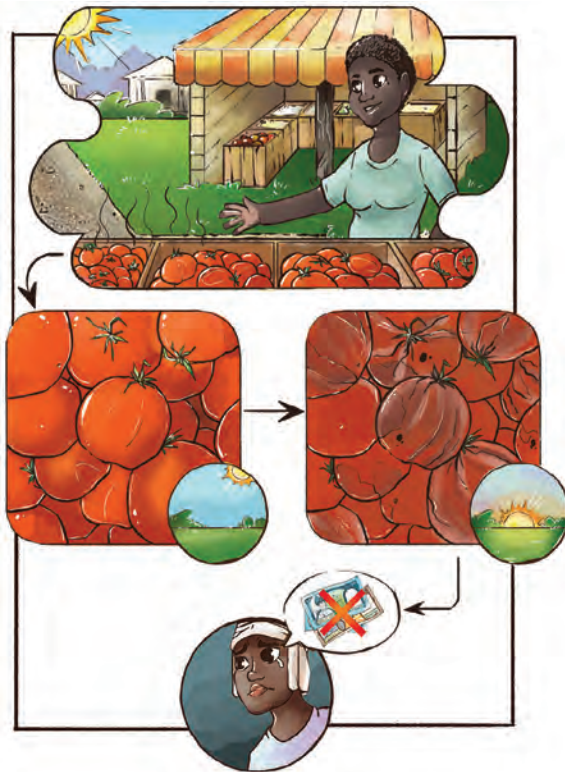


4. Wash in water



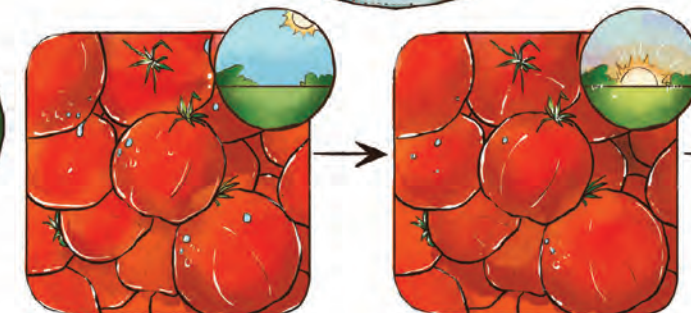
5. Re-use many times

Lesson: To prevent spoilage of fruits and vegetables, a simple clay cooler may be built.



1. Problem: Farmer tries to sell vegetables such as tomatoes in the market but they spoil quickly, causing loss of income

10. Less spoilage



11. Higher income

2. Improved practice



3. Materials needed:
1 large clay pot, 1 smaller clay pot,
sand, water and a cloth

4. Place sand
in large pot



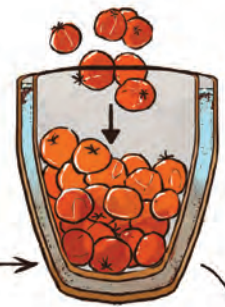
5. Insert small pot in
large pot and add
sand to outside of
small pot



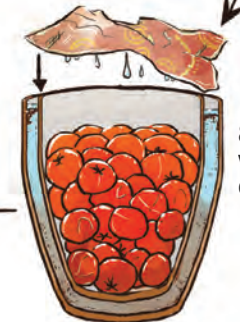
6. Add water
to sand



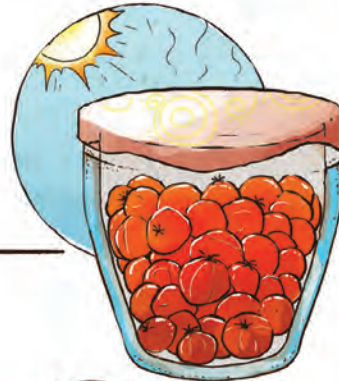
7. Add fruits/vegetables
into small pot



8. Cover
with wet
cloth

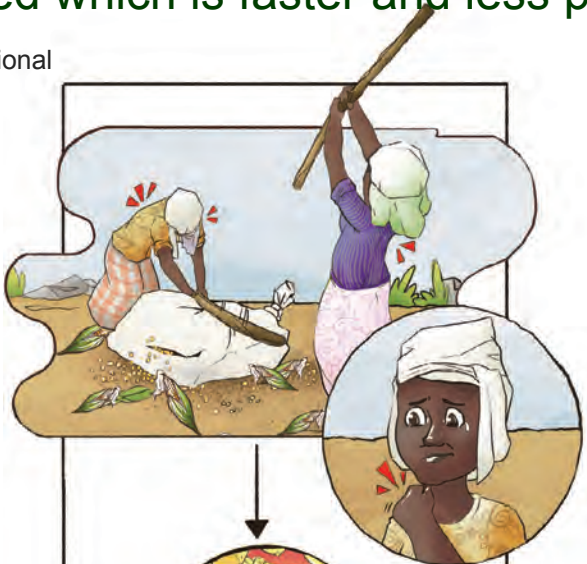


9. When exposed to heat,
water in sand evaporates,
which will cool inner pot

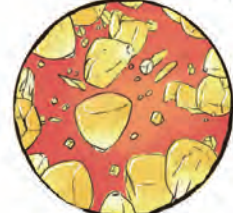


Lesson: Instead of removing grains of maize by beating sacks with a stick, a hand tool can be used which is faster and less painful, and results in seeds which are healthier with fewer toxins

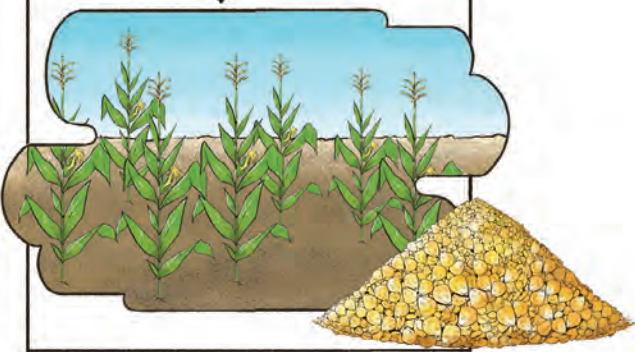
1. Traditional practice



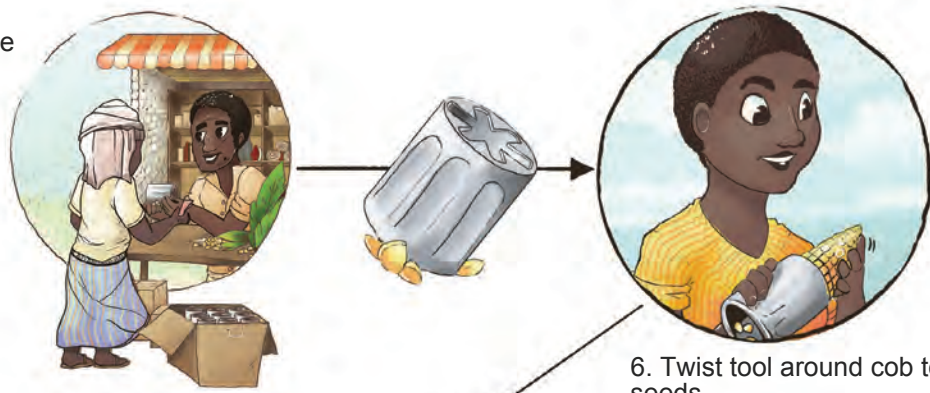
3. Damages seed and cobs which allows more disease during seed storage which can produce toxins. Also, if these seeds are sown, germination may be low



2. Painful

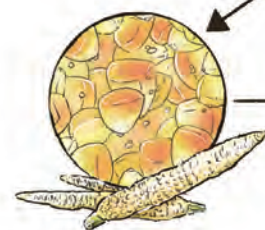


4. New practice

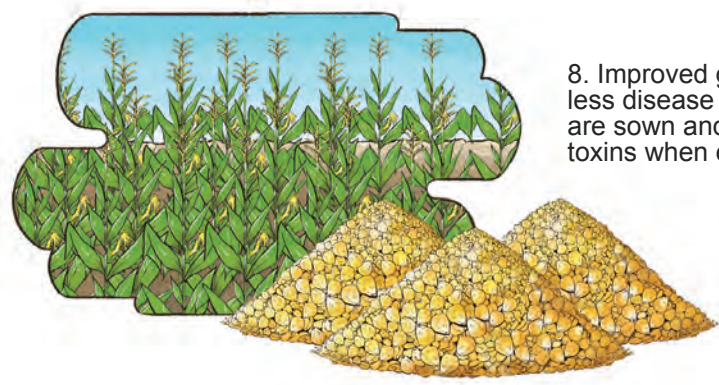


5. Purchase hand tool from vendor

7. Fast, less pain and less breakage of seeds and cob



6. Twist tool around cob to remove seeds



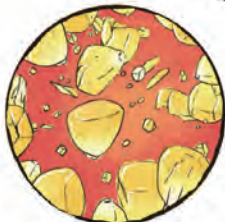
8. Improved germination, less disease when these seeds are sown and fewer toxins when eaten

Lesson: Instead of removing grains of maize by beating sacks with a stick, a hand tool can be made from a tin can which is faster and less painful and results in less toxin in the grain.

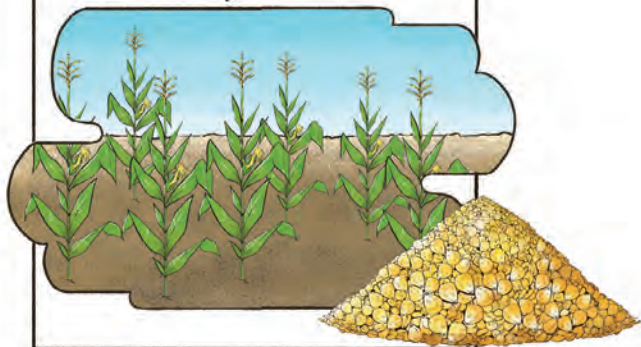
1. Traditional practice



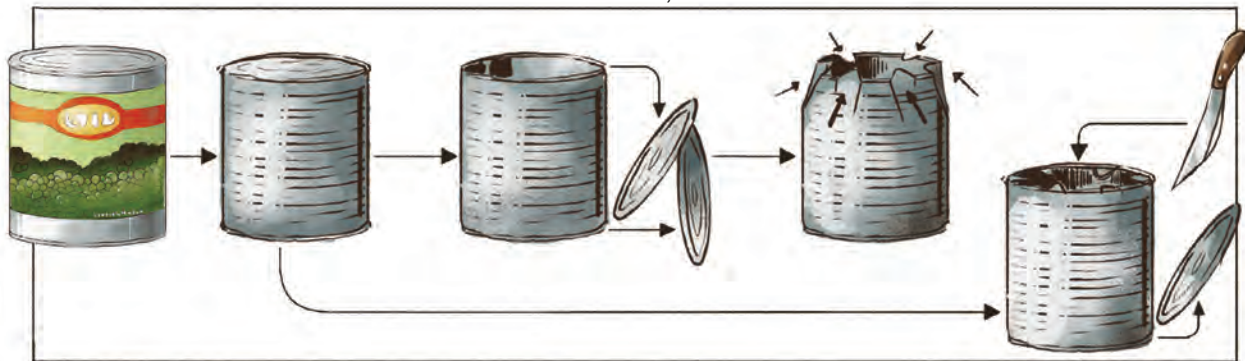
2. Painful



3. Damages seed and cobs which allows more disease during seed storage which can produce toxins. Also, if these seeds are sown, germination may be low



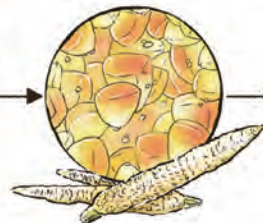
4. New tool: hand maize sheller: remove lid from can, then make cuts with a knife and fold inward



5. Insert cob in tool and rotate cob



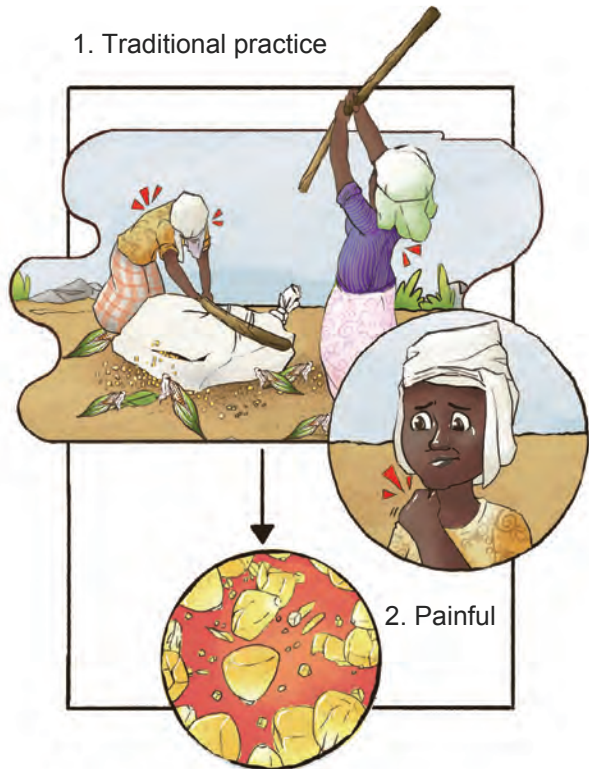
6. Seeds and cobs do not break. Less human pain



7. Improved germination, less disease when these seeds are sown and fewer toxins when eaten

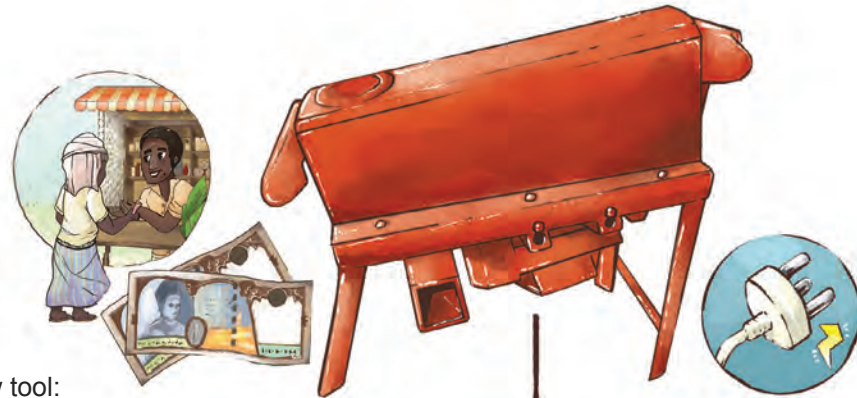


Lesson: New tools from vendor to remove maize seeds from cob



3. Damages seed and cobs which allows more disease during seed storage which can produce toxins. Also, if these seeds are sown, germination may be low

4. New tool: electric or petrol maize sheller from vendor

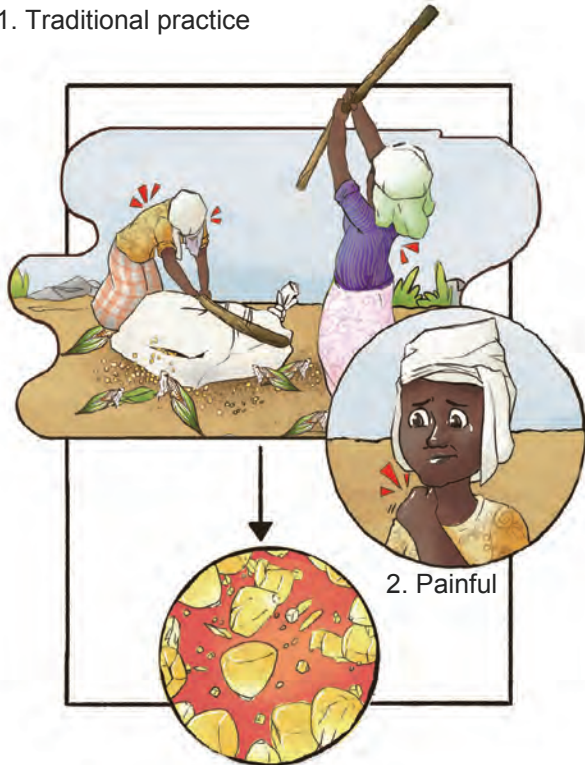


7. Owner can rent machine or offer service for a fee as a small business opportunity



Lesson: New tools from vendor to remove maize seeds from cob

1. Traditional practice

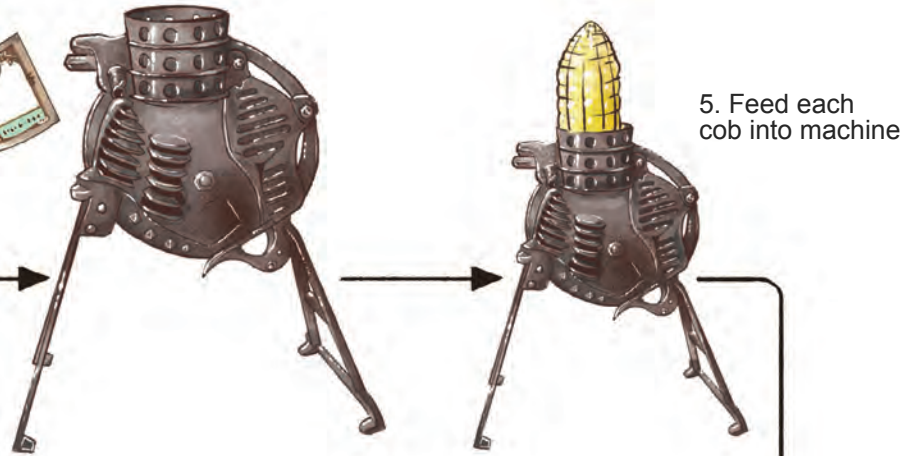


2. Painful

3. Damages seed and cobs which allows more disease during seed storage which can produce toxins. Also, if these seeds are sown, germination may be low

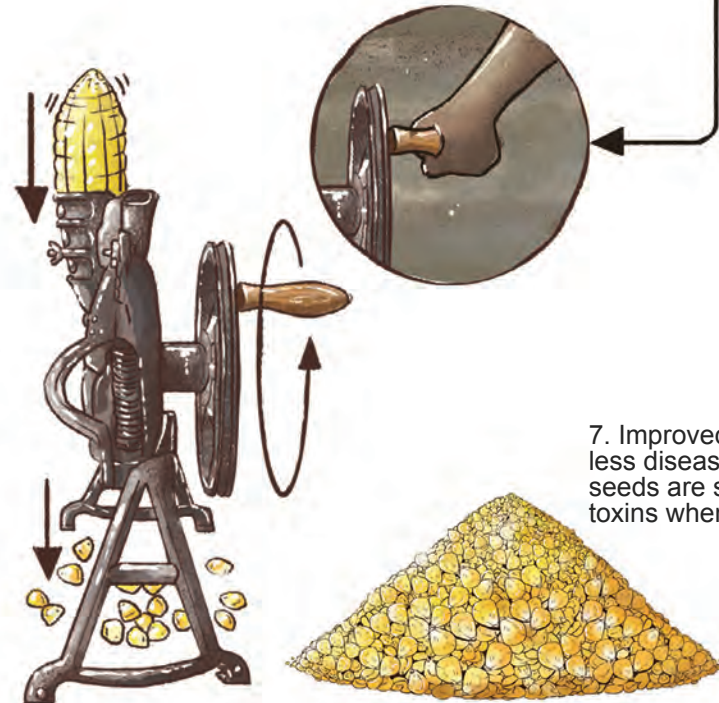


4. New tool:
Hand operated
maize sheller



5. Feed each
cob into machine

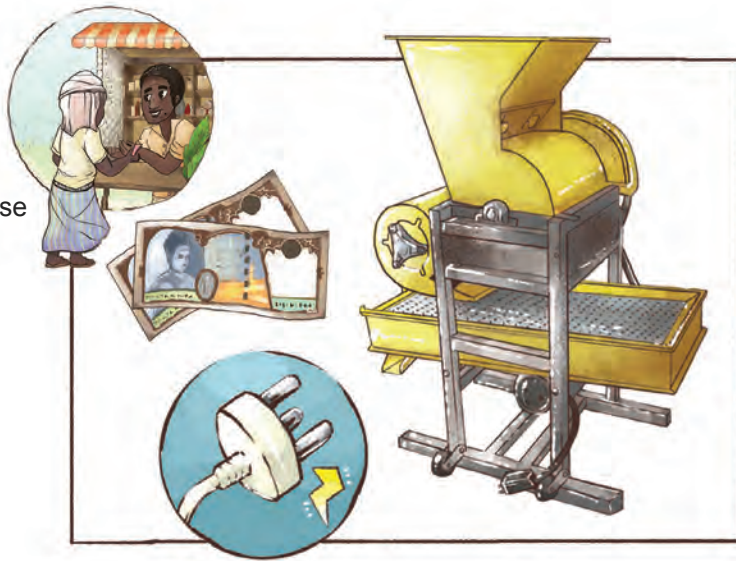
6. Turn
cranl



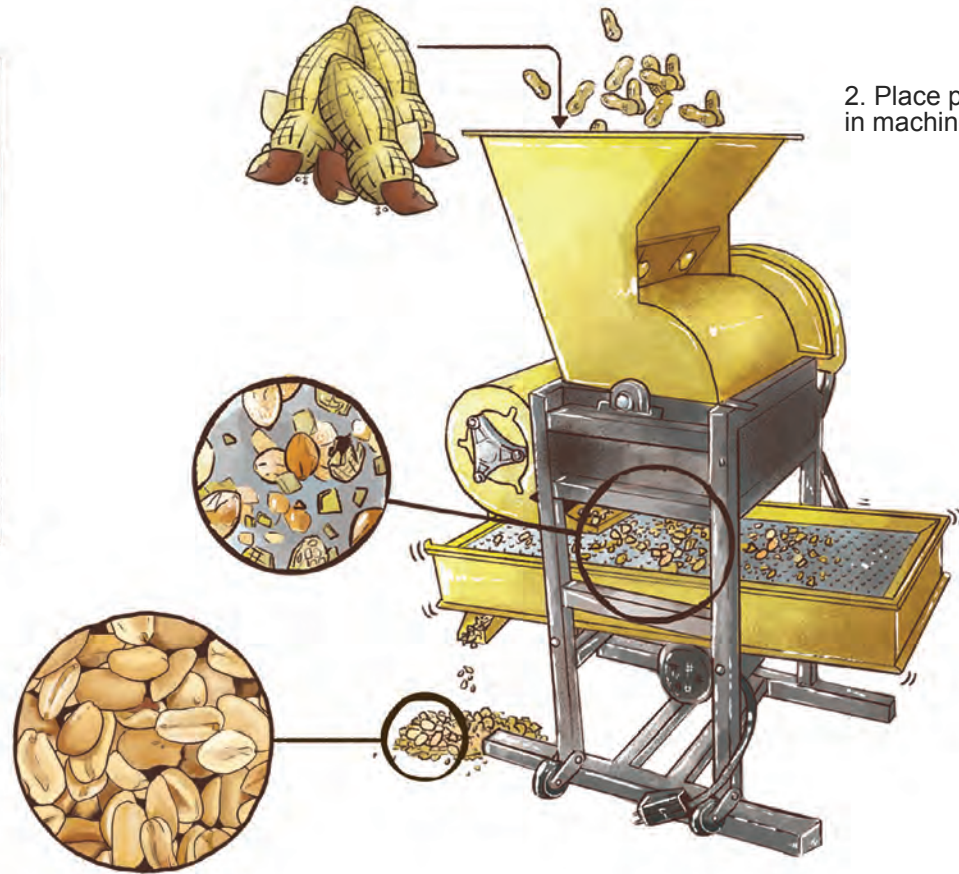
7. Improved germination,
less disease when these
seeds are sown and fewer
toxins when eaten

Lesson: New machine from vendor to remove shell from peanuts

1. Purchase from vendor, electric or petrol powered



2. Place peanuts in machine



3. Owner can rent machine or offer service for a fee as a small business opportunity



Lesson: Instead of manual threshing of grain, grain may be placed on a road to reduce labour

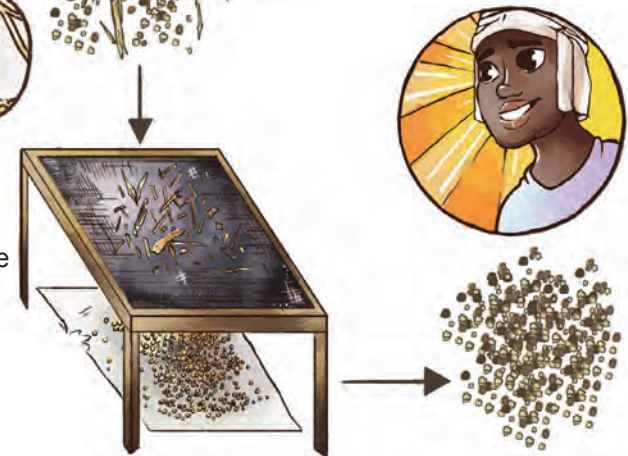
1. Traditional practice



2. Improved practice using car trampling

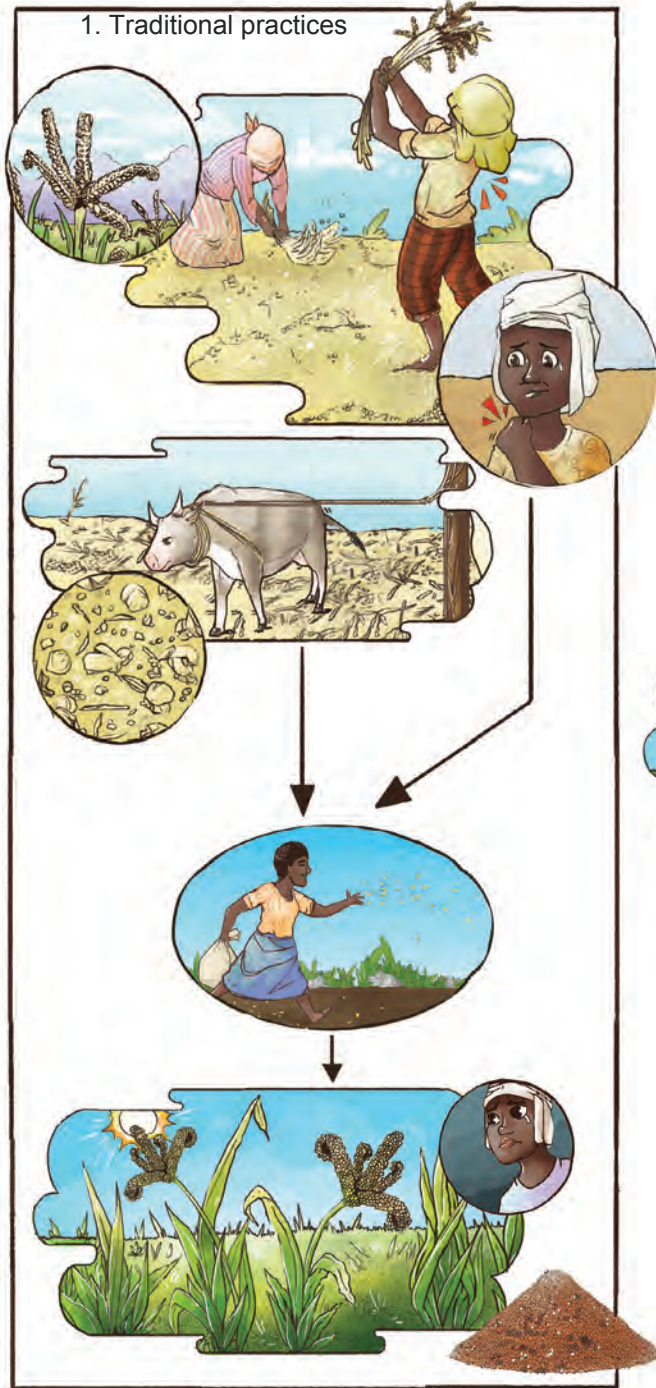


3. Also use sieve



Lesson: Instead of threshing millet grain manually, a machine can be used.

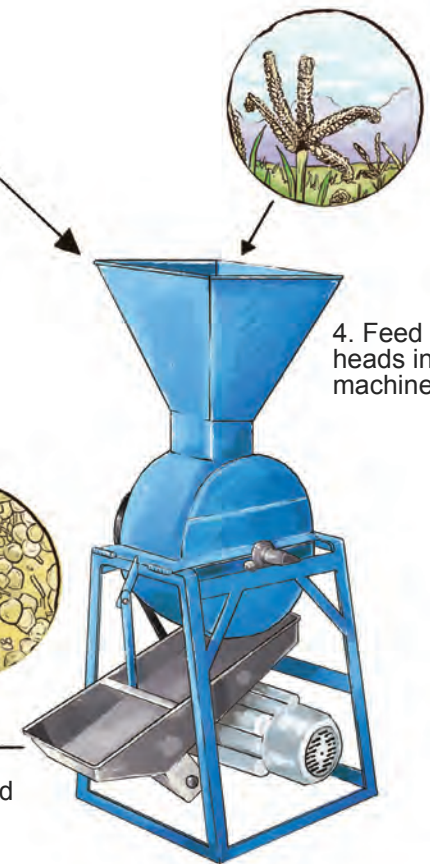
2. Lower yield when sown due to seed damage



3. Purchase electric or petrol threshing machine from vendor



4. Feed grain heads into machine

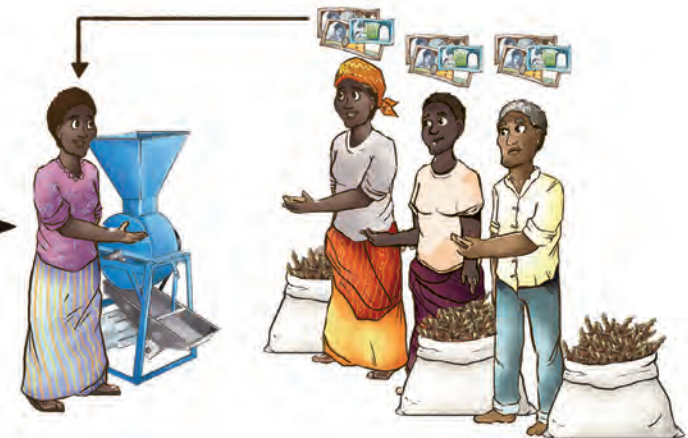


5. Threshed grain



6. Higher yield when sown due to less seed damage

7. Owner can rent machine or offer service for a fee as a small business opportunity

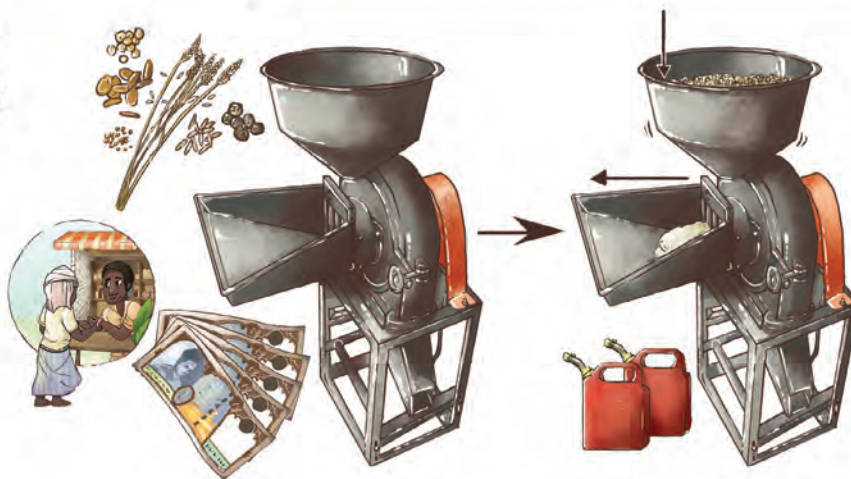


Lesson: To make flour, instead of pounding grain with a stick, there are new machines available

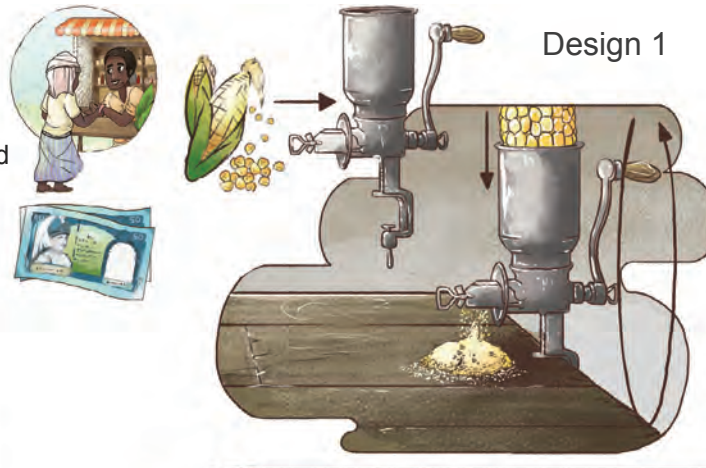
1. Traditional practice



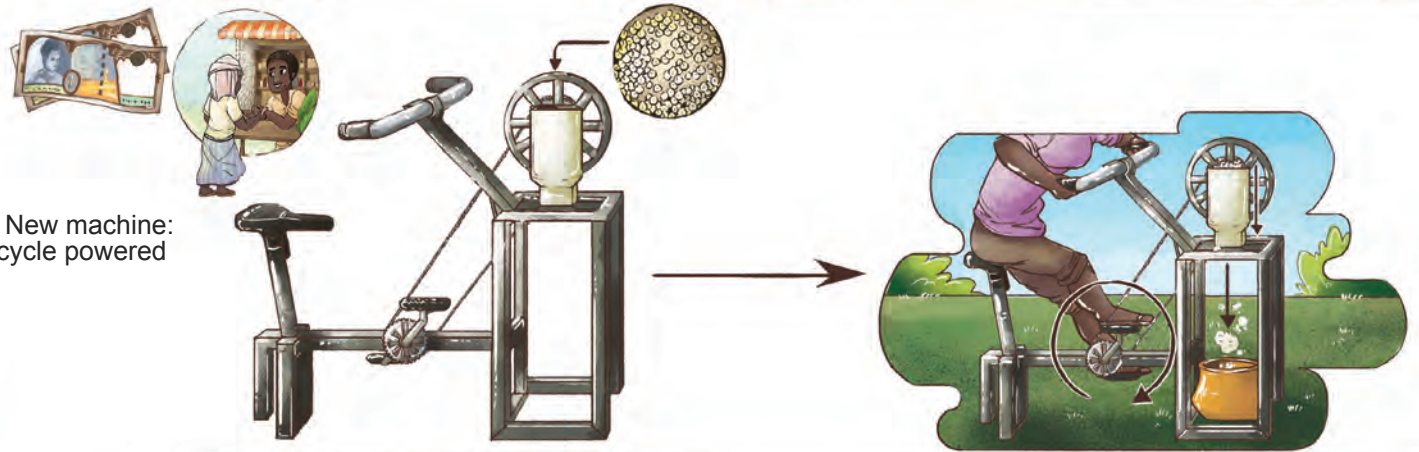
4. New machine: electric/gas



2. New tool: hand crank



3. New machine: bicycle powered

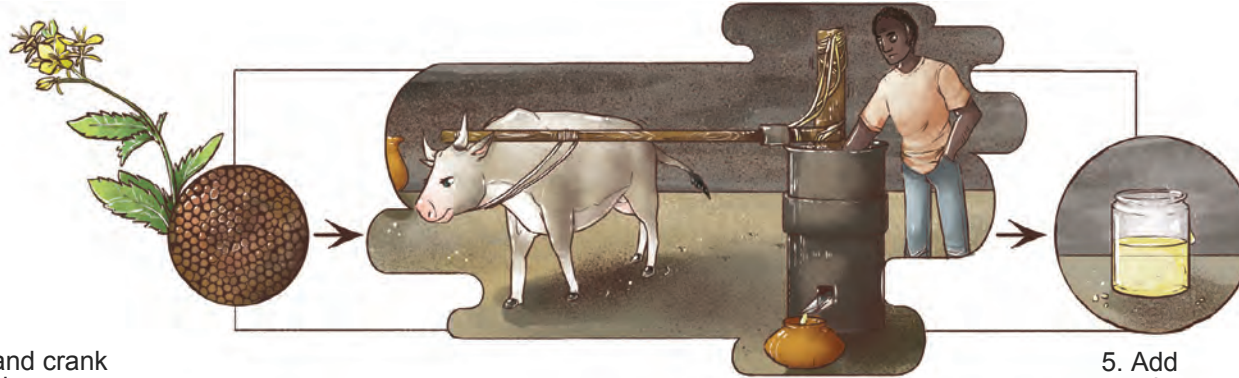


5. Owner can rent machine or service for money

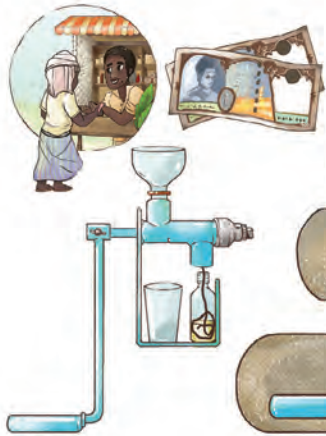


Lesson: New machines may be used to extract cooking oil from seeds

1. Traditional practice



2. New machine: hand crank
Purchase from vendor



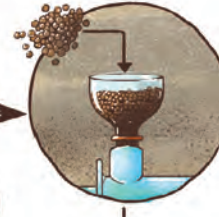
3. Light flame in kerosene



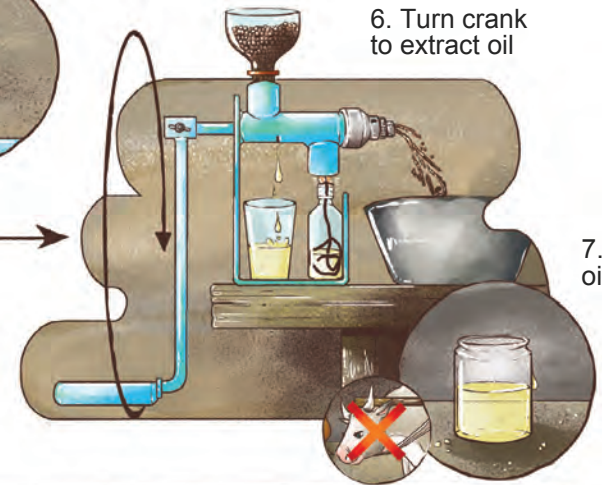
4. Wait 5 min



5. Add seed

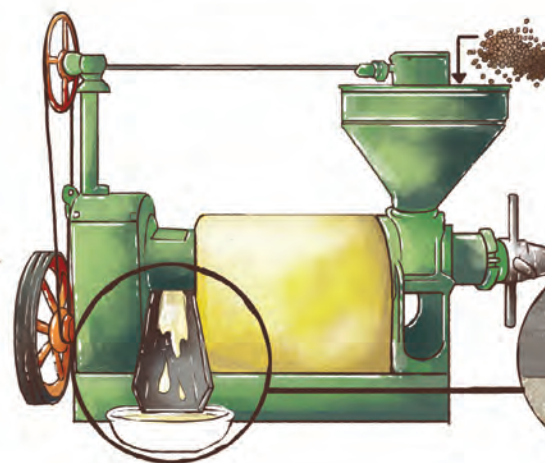


6. Turn crank to extract oil



7. Final oil

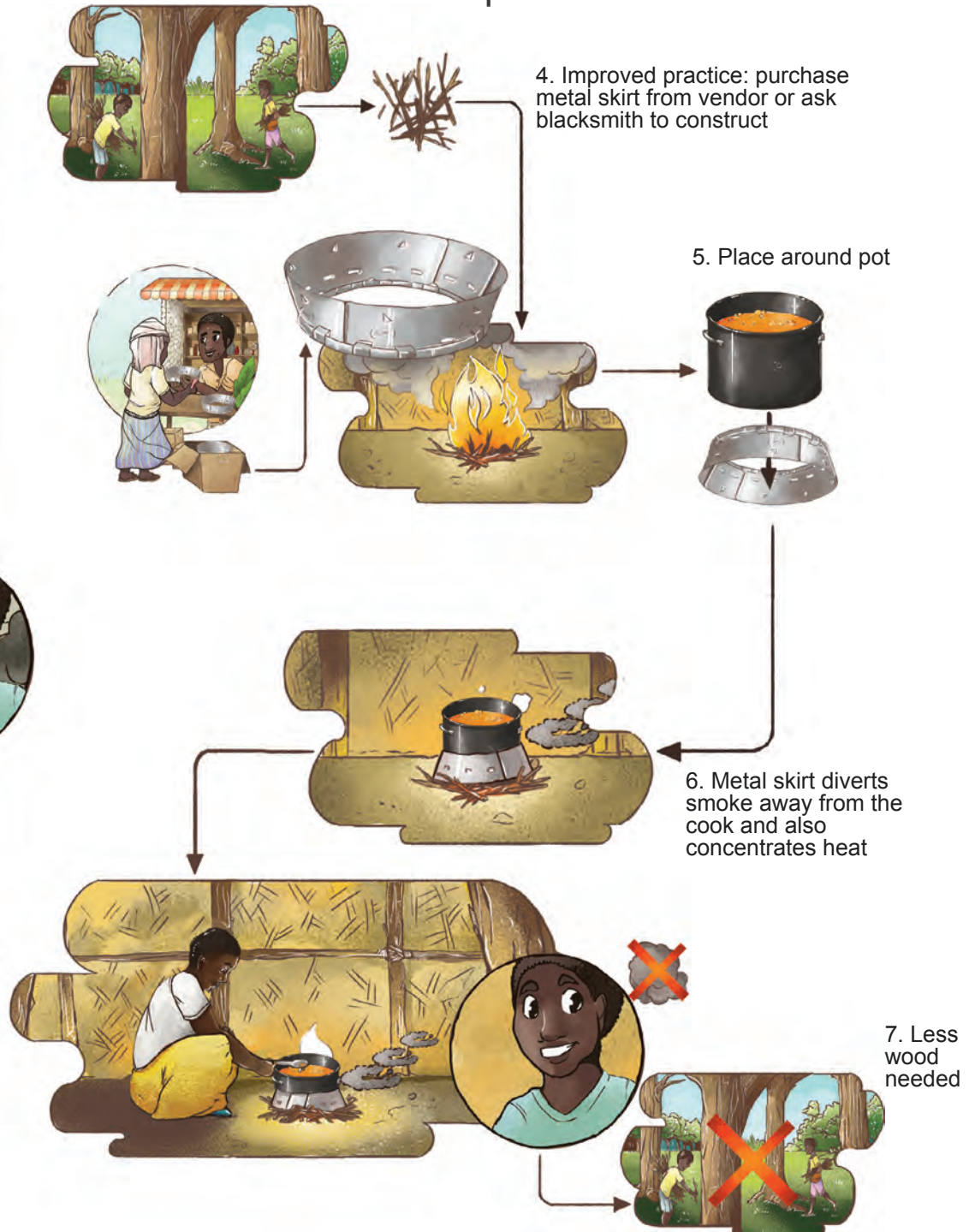
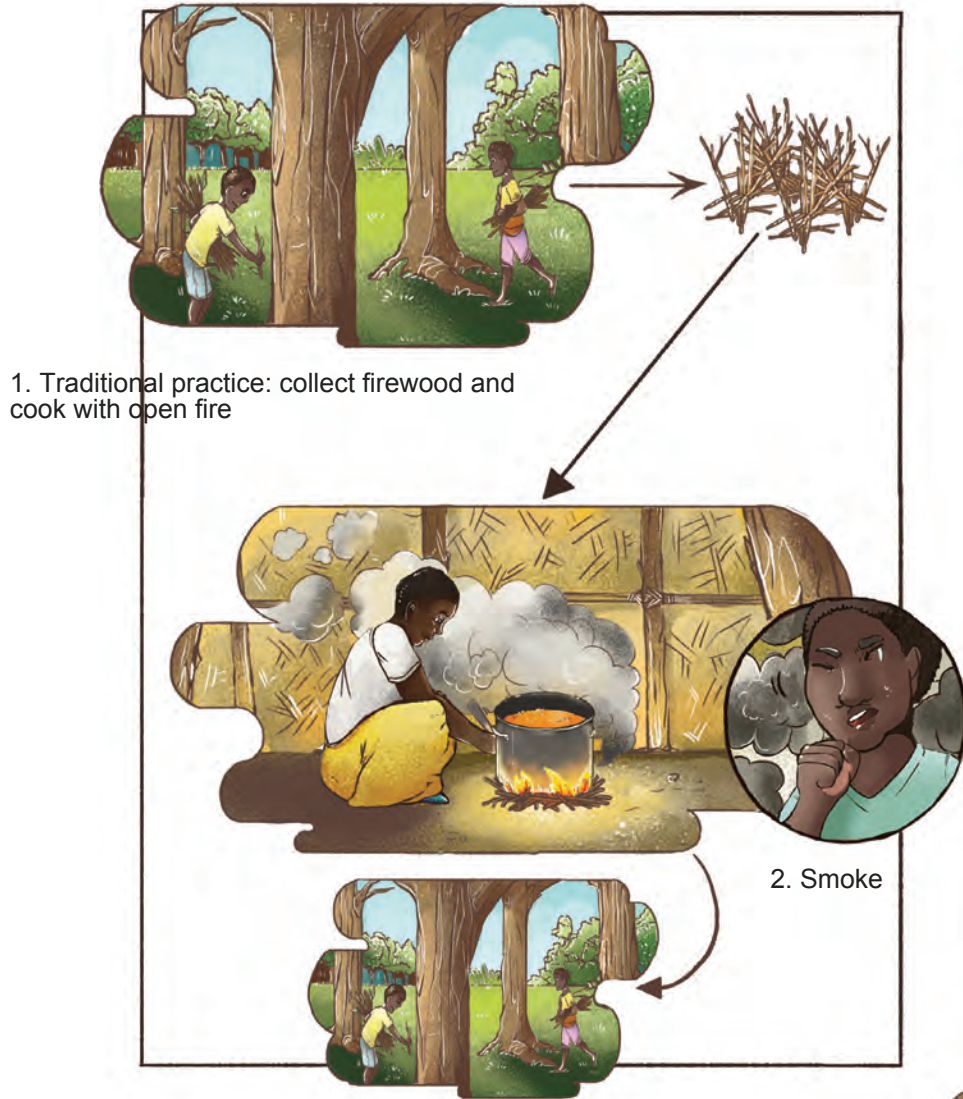
8. New machine: diesel powered or electric



9. Owner can rent machine or offer service for a fee as a small business opportunity

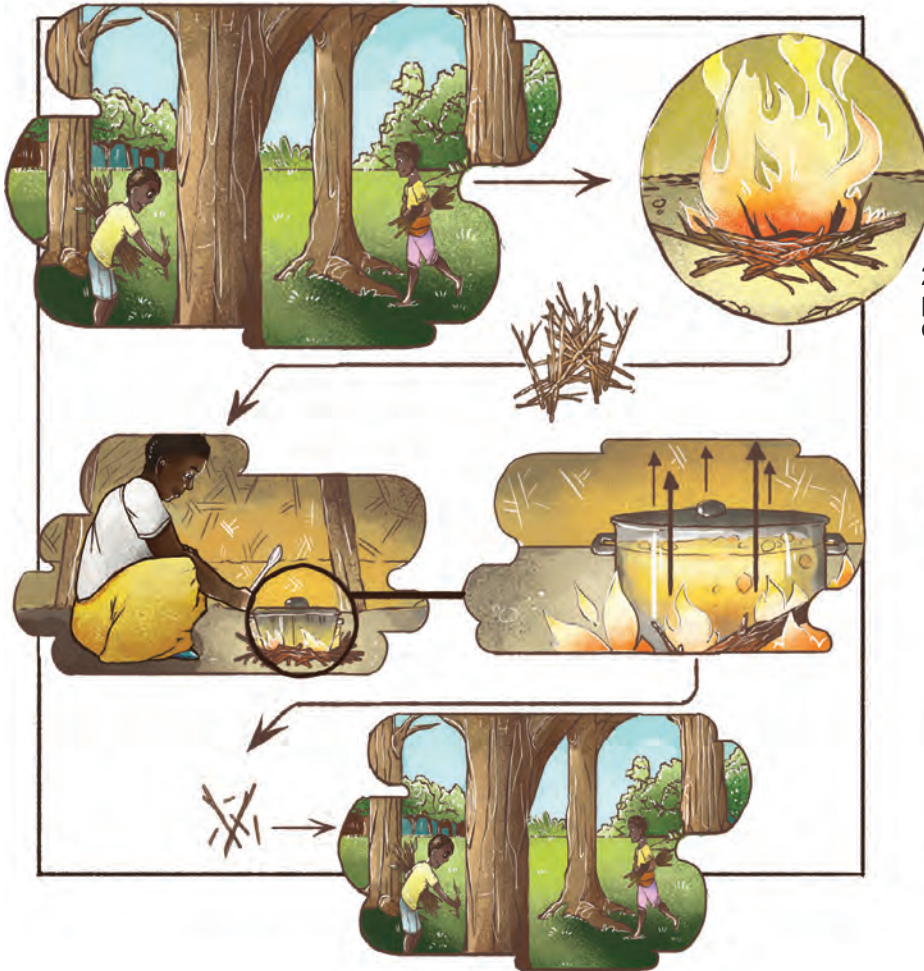


Lesson: Use of a metal skirt around the cooking fire can reduce smoke and raise the heat, which reduces the cooking time and amount of wood or charcoal required



Lesson: Use of a pressure cooker can raise the heat to reduce the cooking time, and the amount of wood or charcoal required especially in high altitudes

1. Traditional practice: collect firewood and cook using a regular pot which cooks at a low temperature and loses heat. Cooking time is slow and consumes firewood so more must be collected. Cooking time is even slower at high altitudes.



2. Improved practice: purchase pressure cooker from vendor

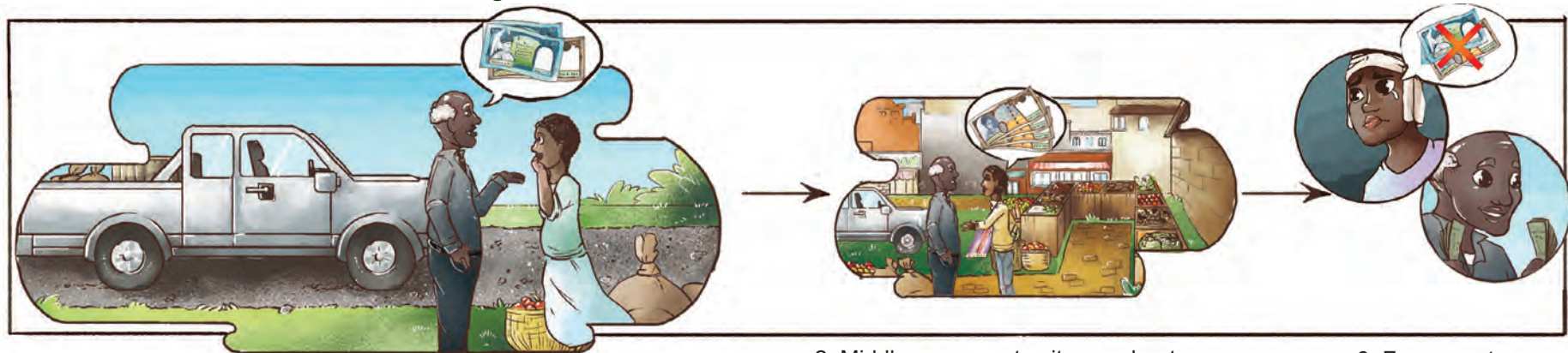


3. Pot is sealed, so pressure builds, heat does not escape, and temperature is raised above boiling



4. Cooking time is faster, consume less firewood or charcoal, so less wood needs to be collected

Lesson: It is better to obtain the selling price for farm harvest products from a friend or family member in the city rather than from a middleman who comes to the village.



1. Traditional practice: middleman comes to the village and offers a low price for the farm harvest

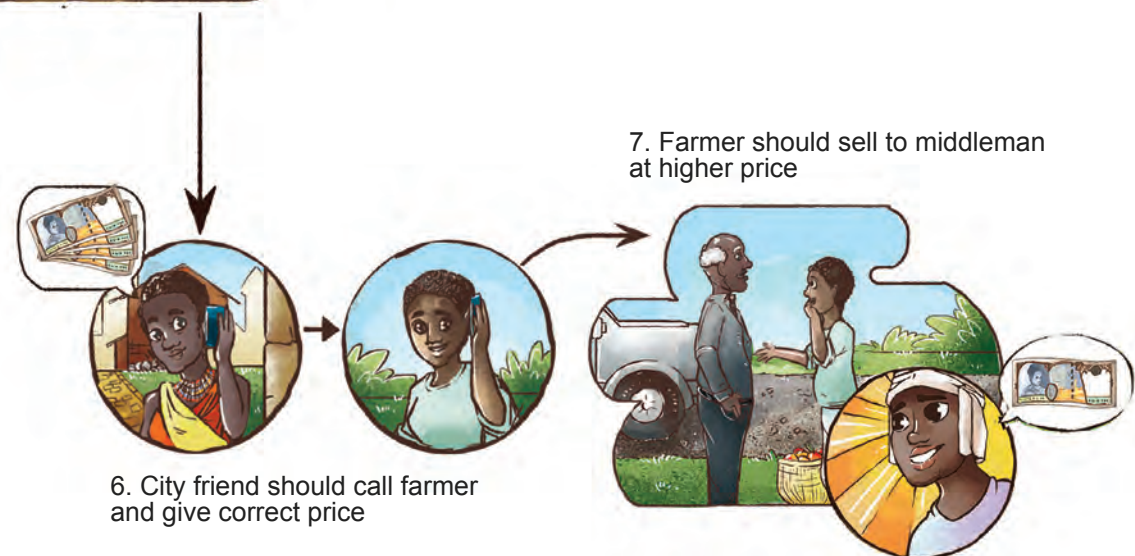
2. Middleman goes to city merchant and sells for a higher price

3. Farmer gets little money, but middleman gets more money



4. Improved practice: farmer should phone friend or relative in the city

5. Friend should speak to merchant in city to inquire about grain price



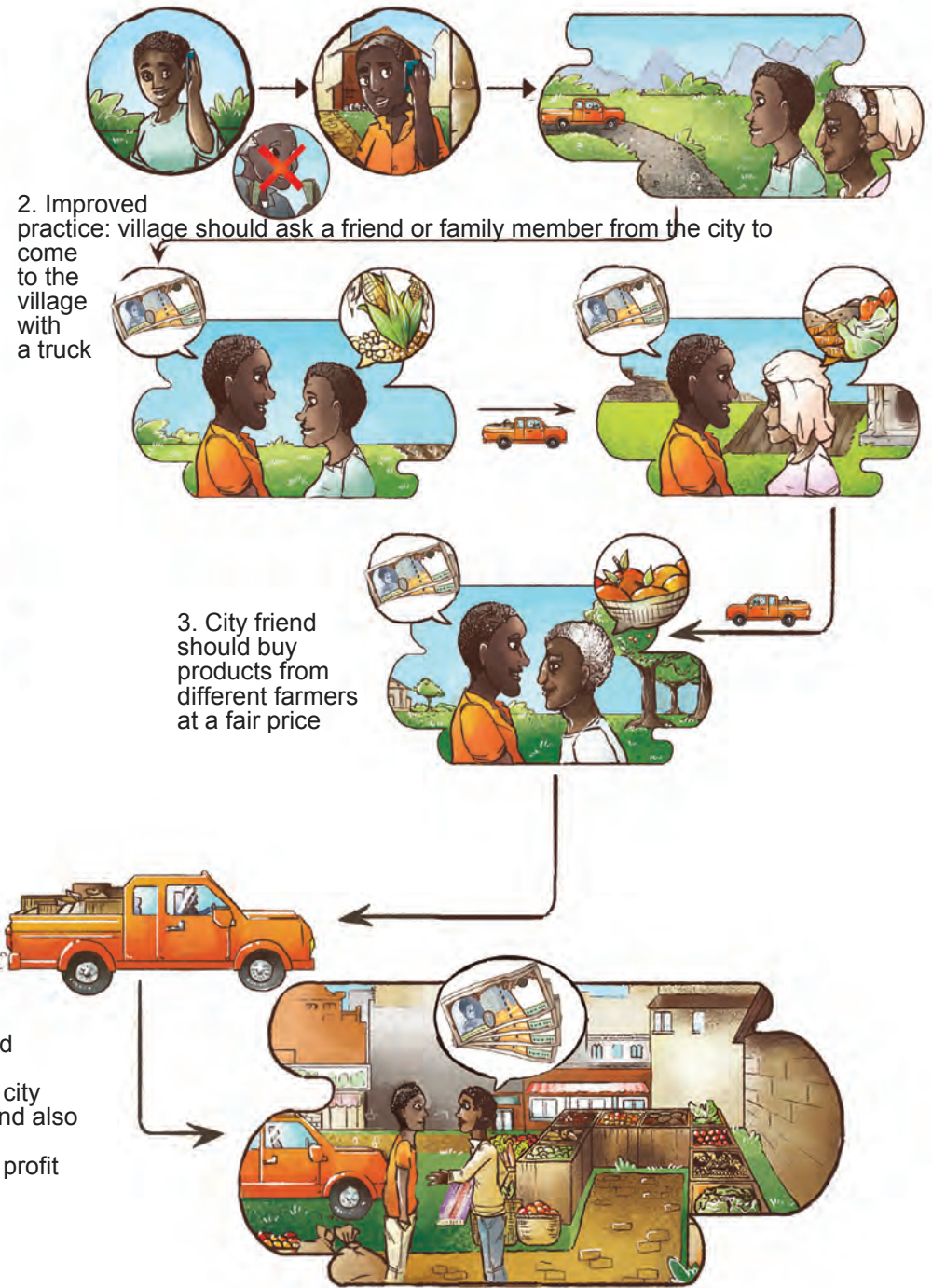
7. Farmer should sell to middleman at higher price

6. City friend should call farmer and give correct price

Lesson: It is better to sell farm harvest products directly to a friend or family member who lives in the city rather than to a middleman who comes to the village.



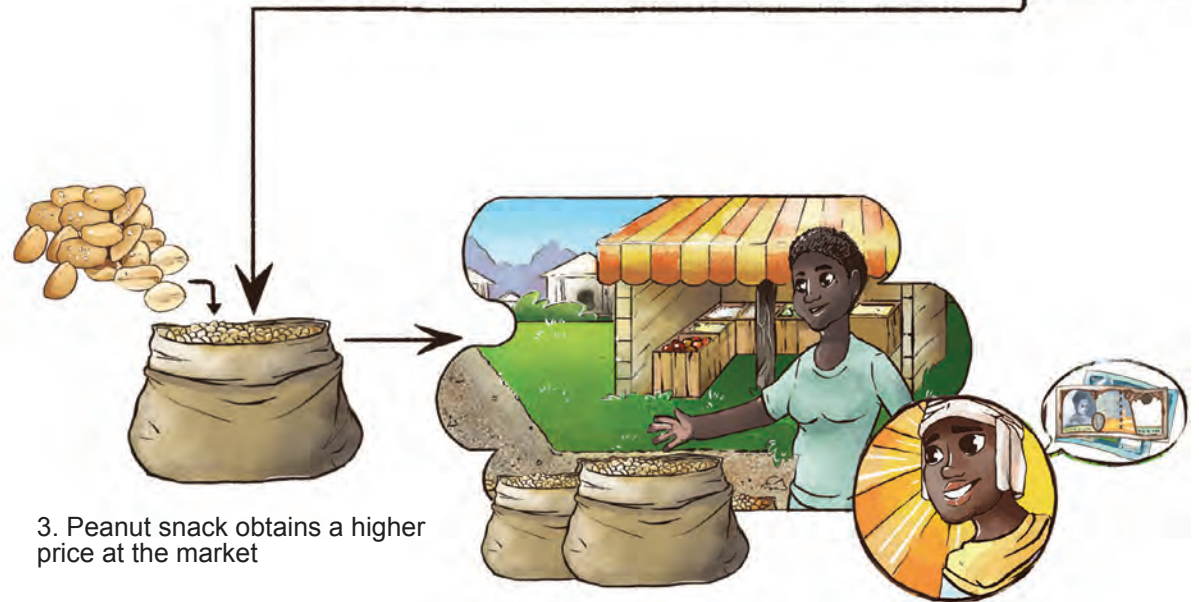
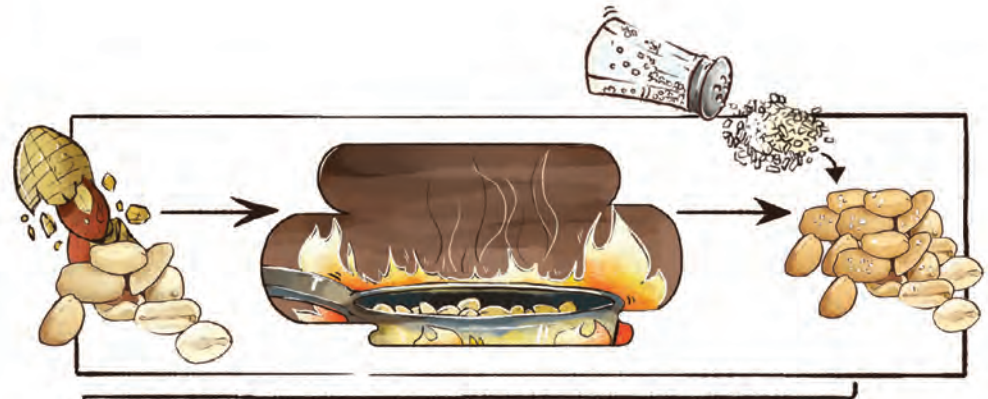
1. Traditional practice: middleman comes to the village and offers a low price for the farm harvest, then middleman goes to city merchant and sells for a higher price.



Lesson: Rather than selling raw harvested products, it is more profitable to sell cooked and tasty snacks



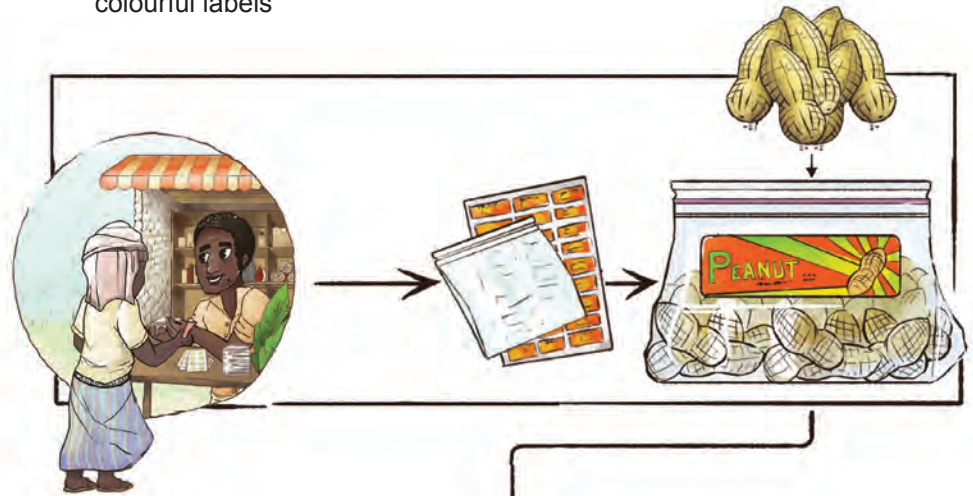
2. Improved practice: remove peanuts from shell, roast it, then add salt and spice.



Lesson: Rather than selling harvested products in bulk, it is more profitable to package them beautifully



2. Improved practice: place peanuts in packages with beautiful, colourful labels



3. Packaged peanuts obtain a higher price at the market



Chapter 10: Human Nutrition

Lesson: Not drinking coffee/tea at the same time as meals, and adding lemon/lime to food, will make people feel more energetic due to improved iron absorption, especially women.

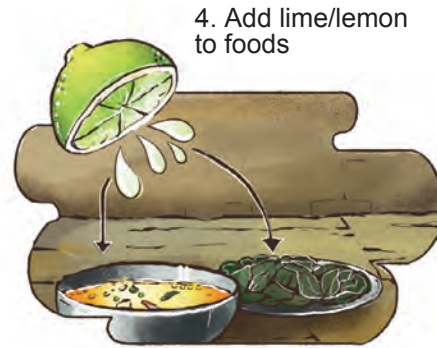


1. Traditional practice: drinking coffee/tea at same time as meal

2. Result: fatigue, less energy for farm labour



3. Improved practices



4. Add lime/lemon to foods



5. Do not drink tea/coffee at same time as meal. Drink other beverages such as juice or water.

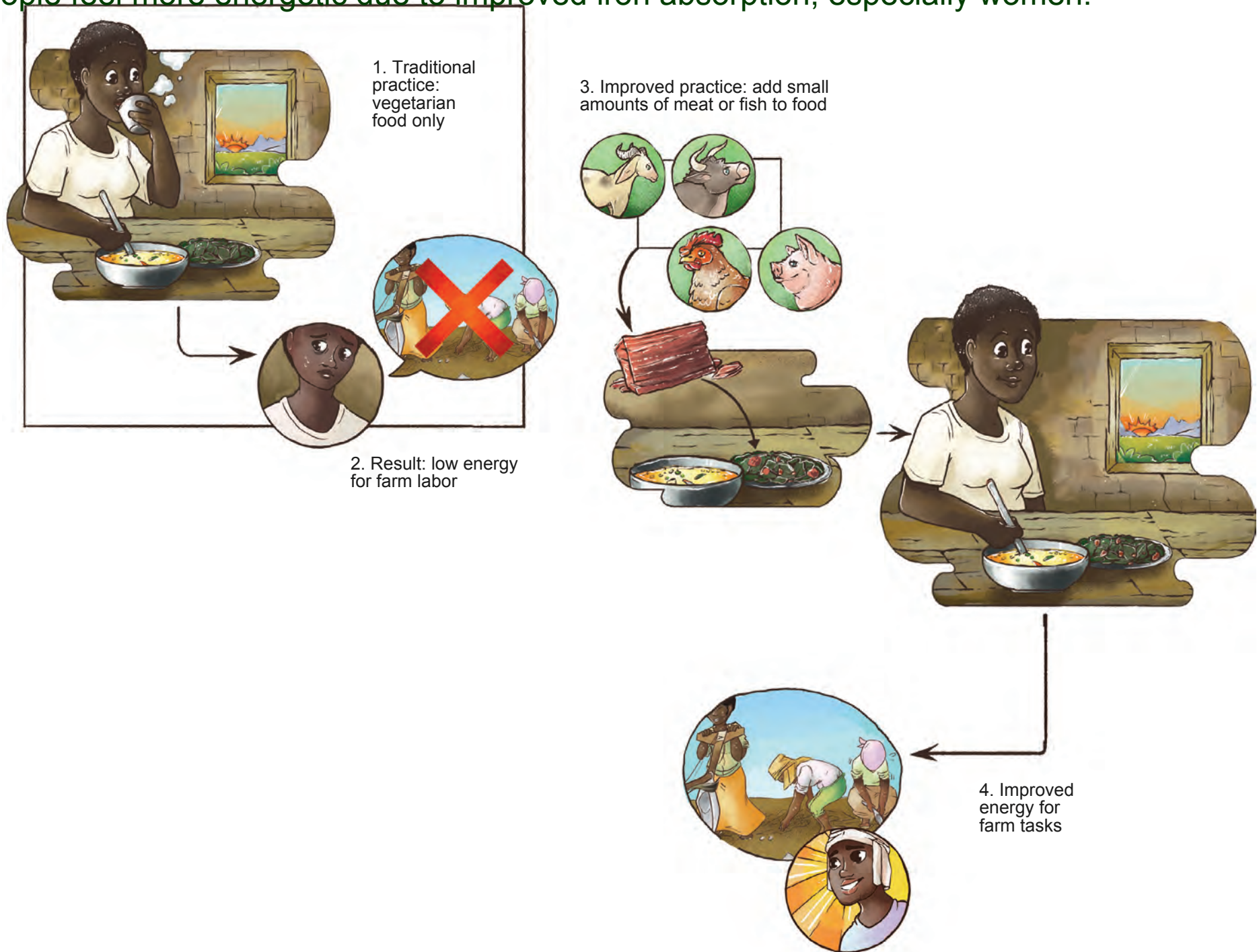


6. Drink tea/coffee at a later time.



7. Improved energy for farm tasks.

Lesson: Adding small amounts of meat or fish to vegetarian food (if beliefs permit) will make people feel more energetic due to improved iron absorption, especially women.



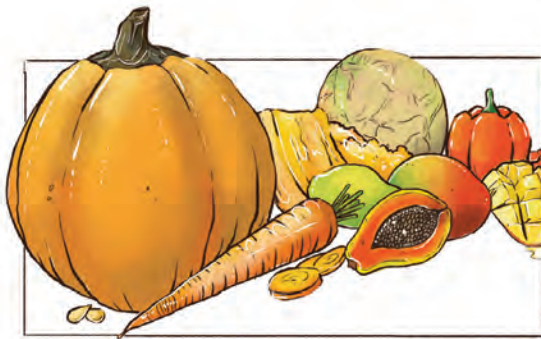
Lesson: Eating a diversity of colourful foods will prevent people from catching diseases

1. Less recommended: Blue-shirt child eats maize, rice, or tubers only



2. Blue shirt child has contact with yellow shirt child who is sick

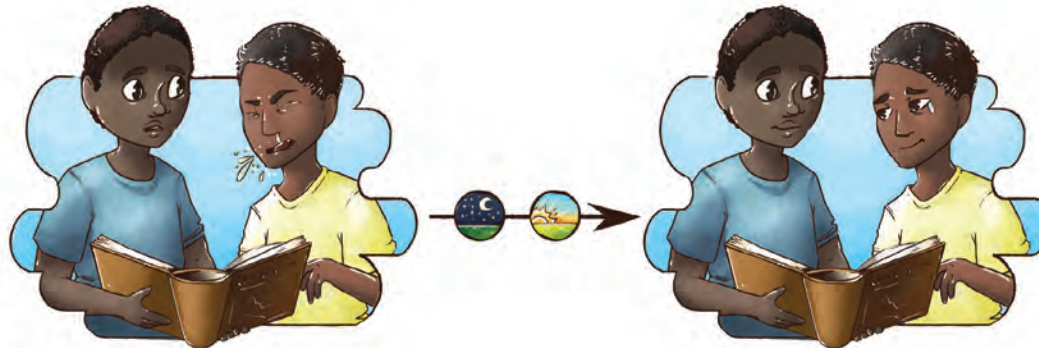
3. Blue shirt child is more likely to catch disease due to poor nutrition



4. Solution: eat a diversity of colourful foods which help to fight diseases.



5. Blue shirt child eats colourful foods

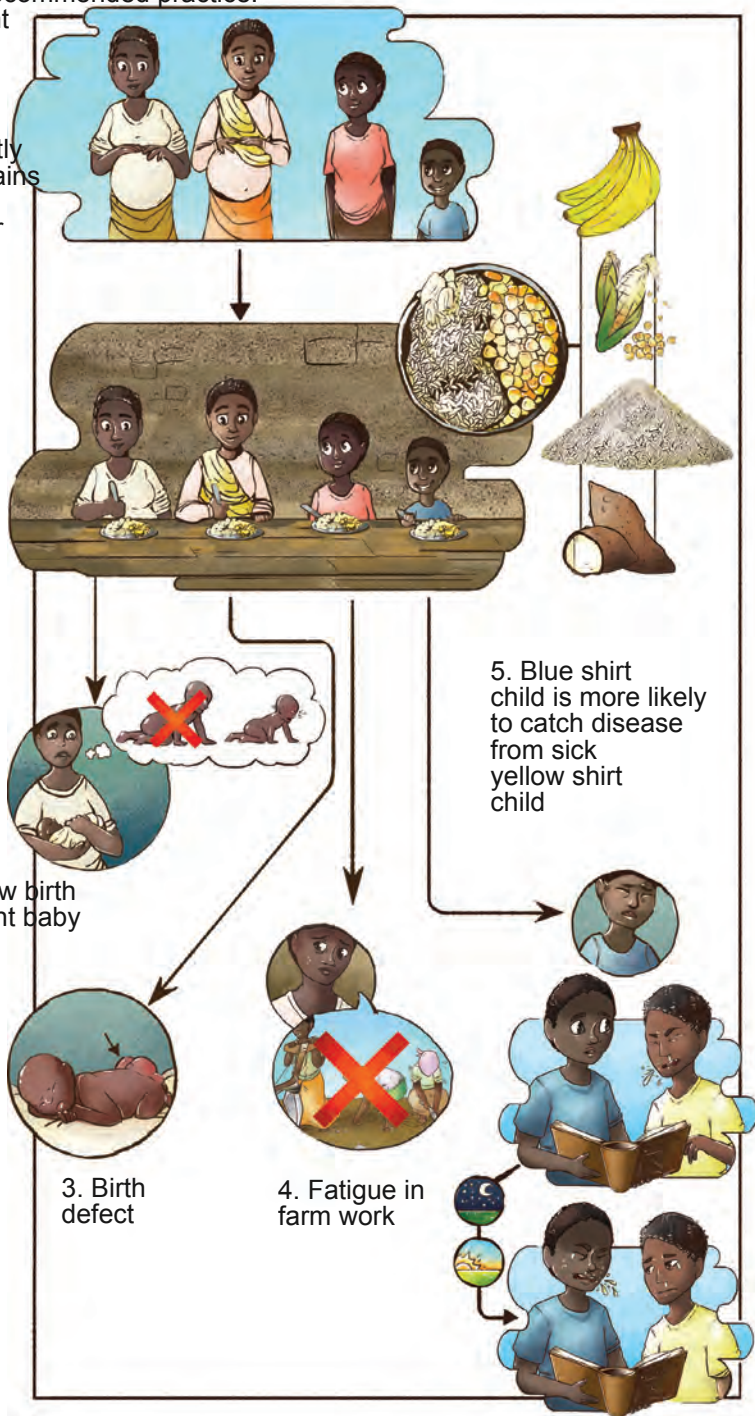


6. Blue shirt child less likely to become sick after contact with sick yellow shirt child

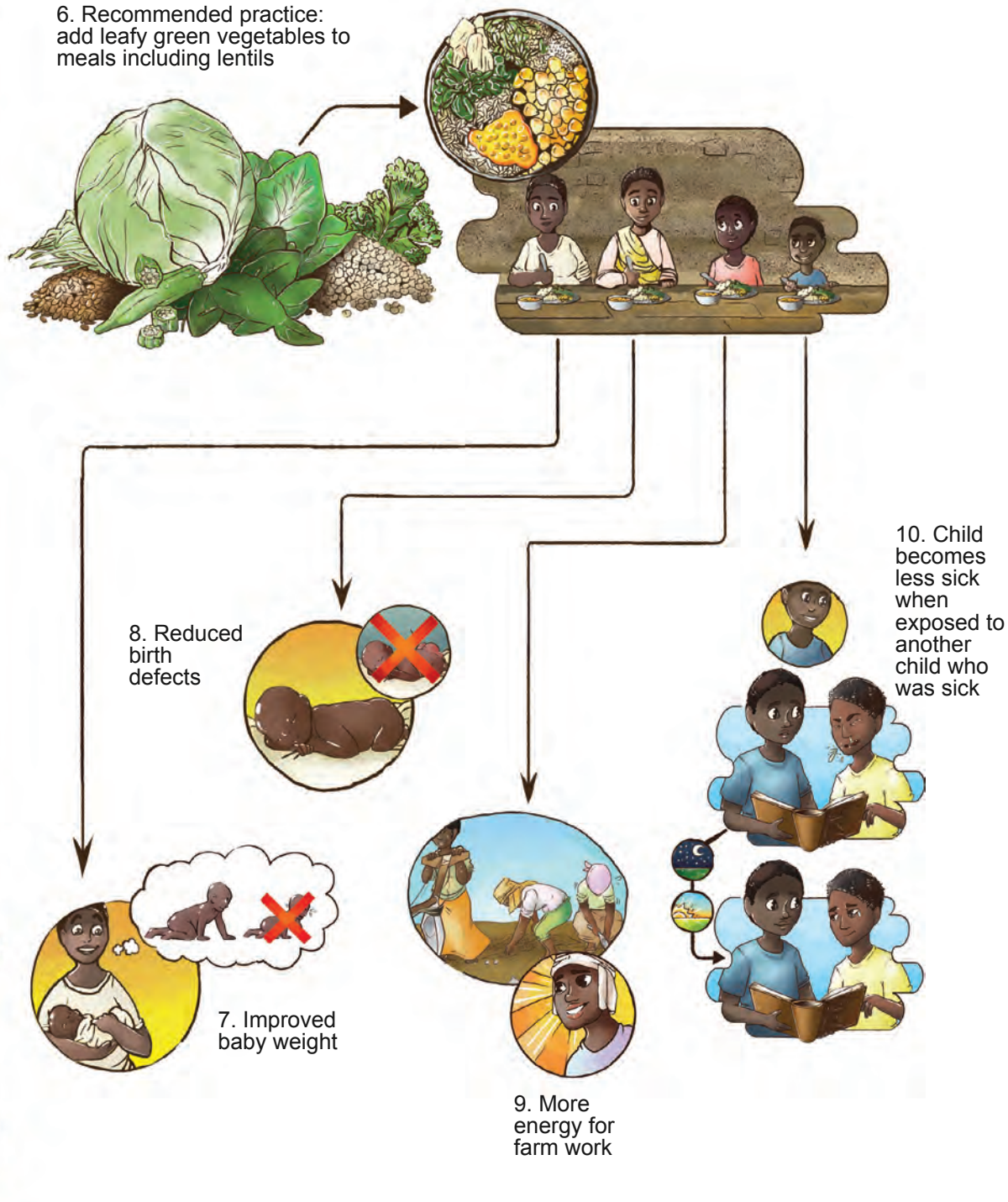
Lesson: Pregnant women and children should eat leafy green vegetables

1. Not recommended practice:

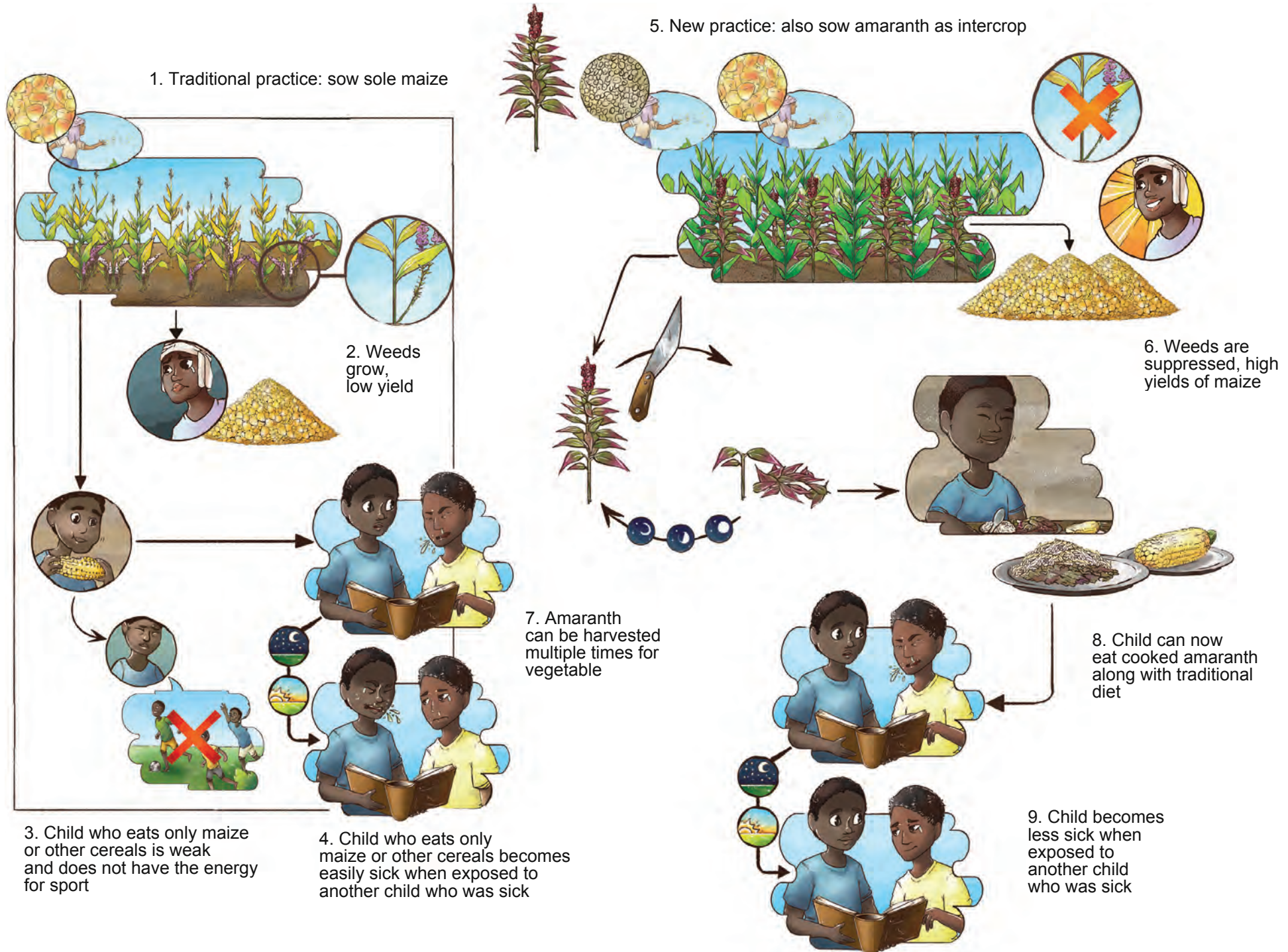
Pregnant women, teenage girls or children eat mostly large grains such as maize or rice or tubers such as cassava



6. Recommended practice: add leafy green vegetables to meals including lentils

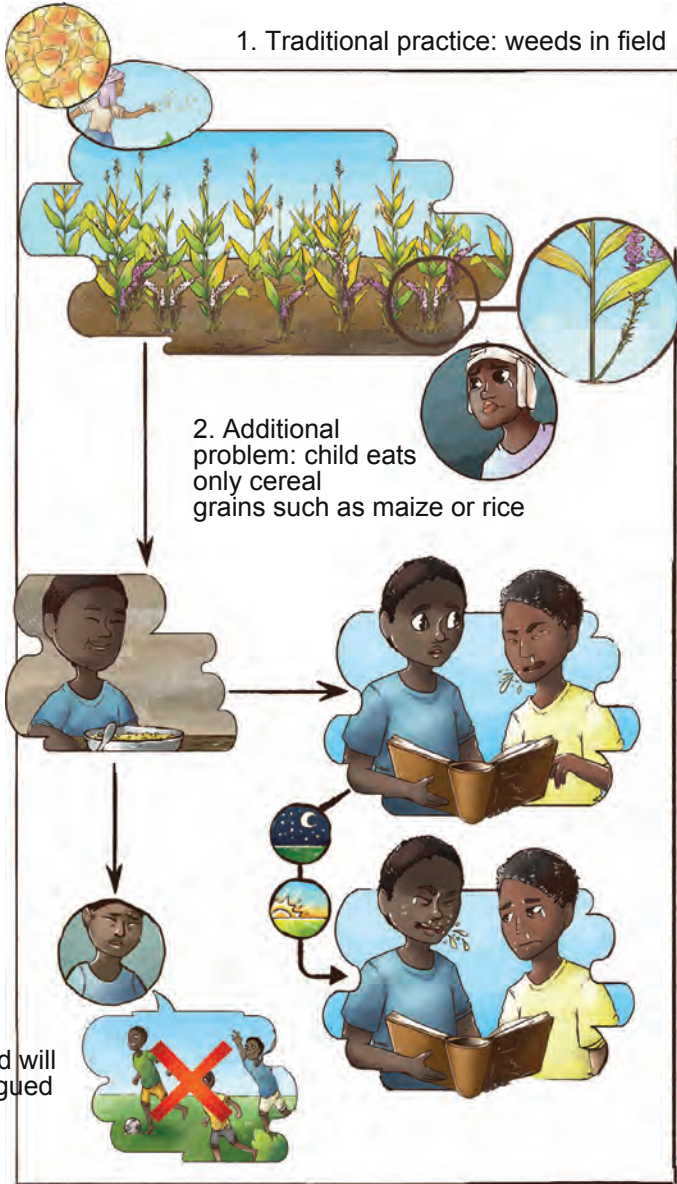


Lesson: Amaranth is fast, easy to grow, can suppress weeds and adds nutrients to human diets

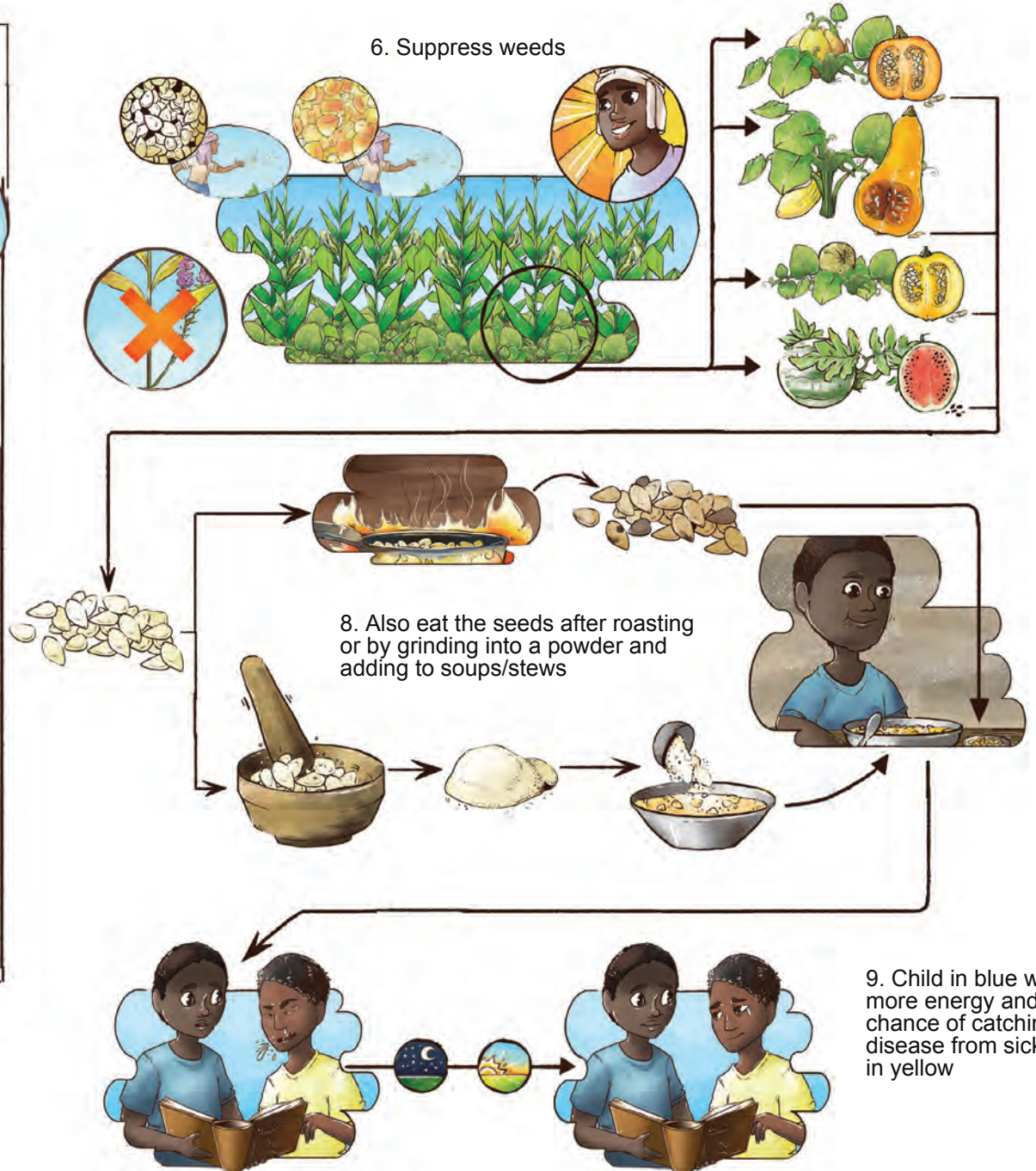


Lesson: Cucurbit intercrops suppress weeds and provide nutrients to reduce disease in people

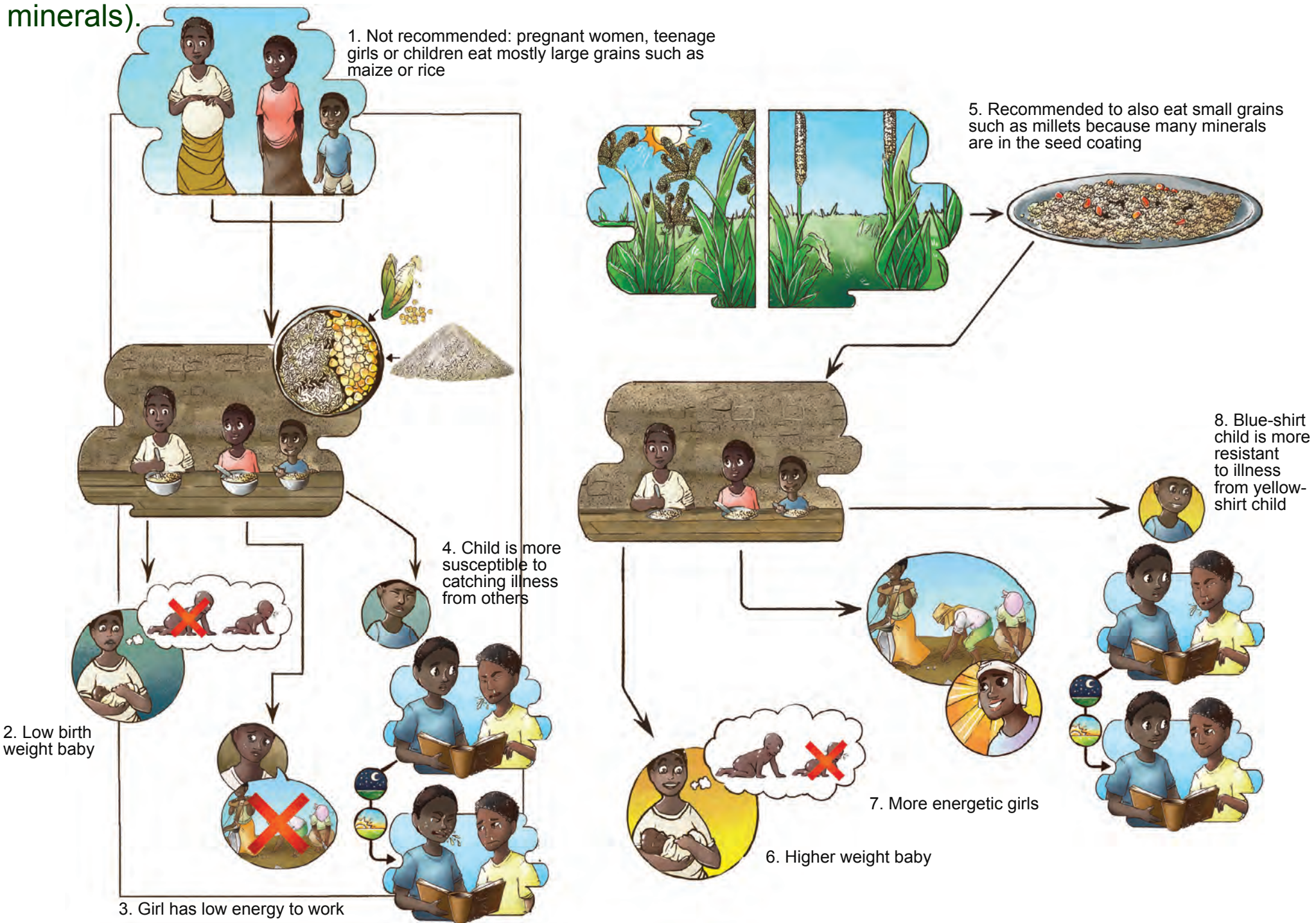
1. Traditional practice: weeds in field



5. Improved practice: sow spreading type cucurbits as an intercrop

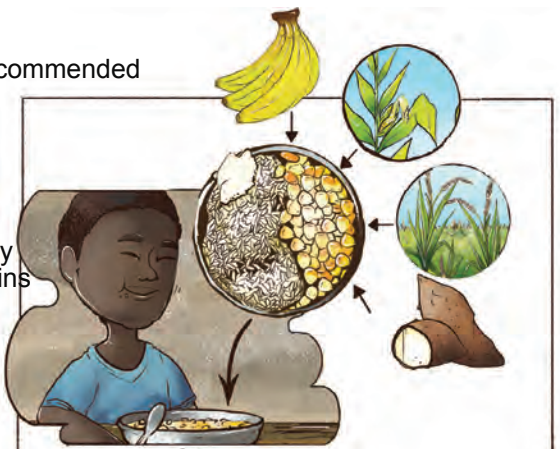


Lesson: Pregnant women and children should eat whole small grains to be healthier (folate and minerals).

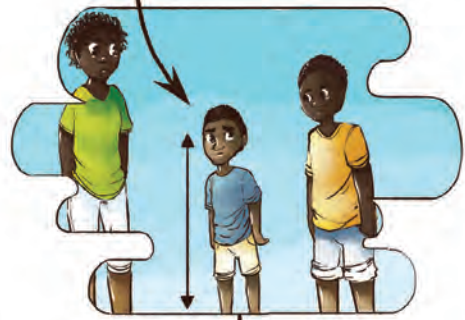


Lesson: People especially pregnant women and children should eat legumes/pulses

1. Not recommended practice: pregnant women, teenage girls or children eat mostly large grains such as maize or rice or tubers such as cassava



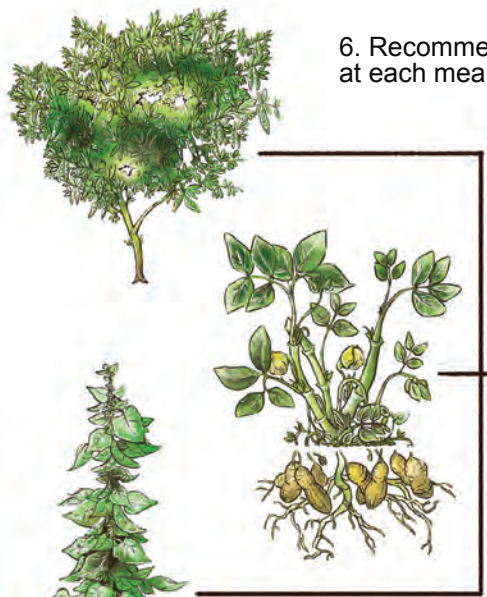
2. Child will be stunted



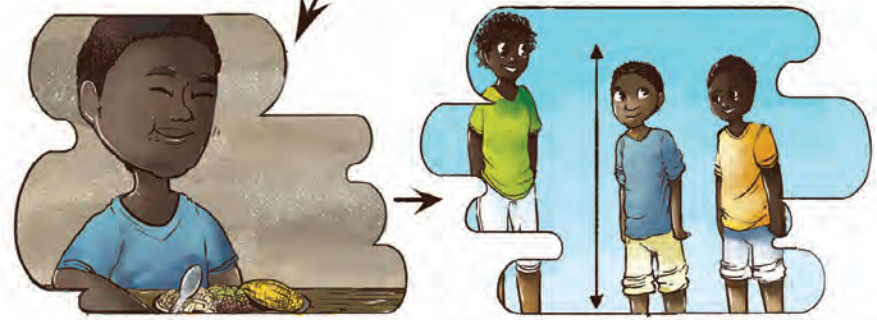
3. Extended belly 4. Skin cracking 5. Hair discoloured or falling out



6. Recommended practice: add legumes, pulses, lentils, beans at each meal



7. Normal child growth

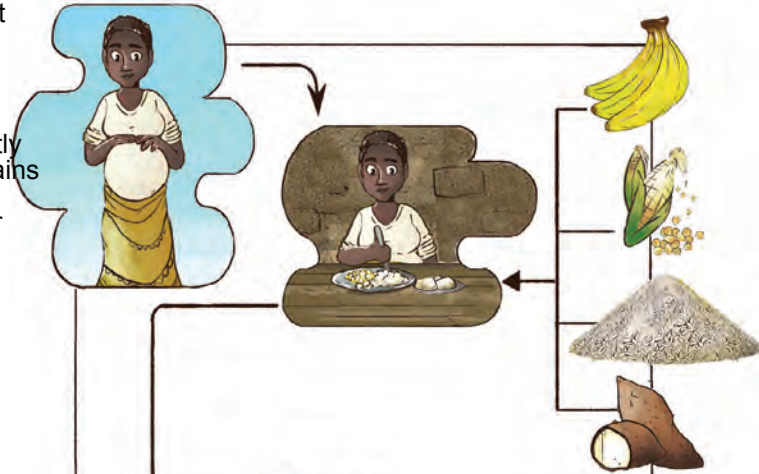


8. Normal belly 9. Normal skin 10. Normal hair



Lesson: Pregnant women and children should eat colourful foods, leafy green vegetables, legumes/pulses and small whole grains

1. Not recommended: pregnant women, teenage girls or children eat mostly large grains such as maize or rice or tubers such as cassava



2. Low birth weight baby



3. Stunted child



4. Night blindness

colourful fruits and vegetables and cooked cucurbit seeds



5. Recommended foods to eat

leafy greens



small grain legumes/pulses



small grain cereals (e.g. millet)



6. High birth weight baby



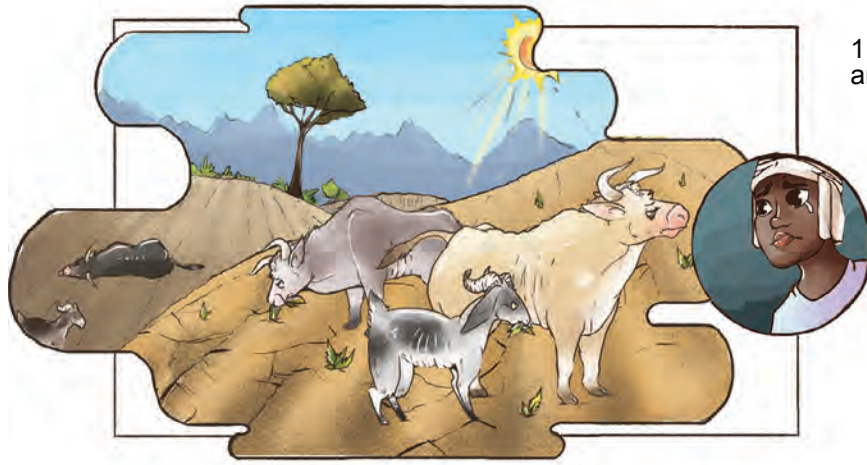
7. Normal growth



8. Proper eyesight at night

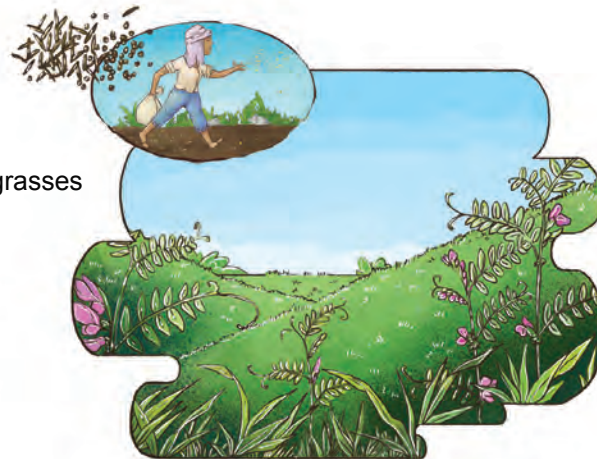
Chapter 11: Animals

Lesson: In the dry season, vetch can grow and provide fodder for livestock

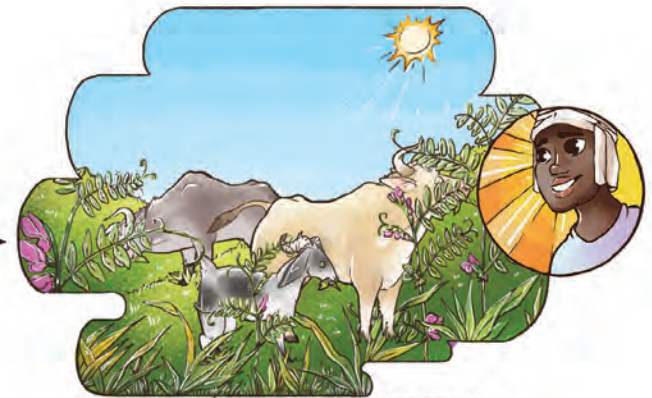


1. Traditional problem is lack of feed for animals in dry season

2. Improved practice:
Sow vetch seeds and grasses
before dry season



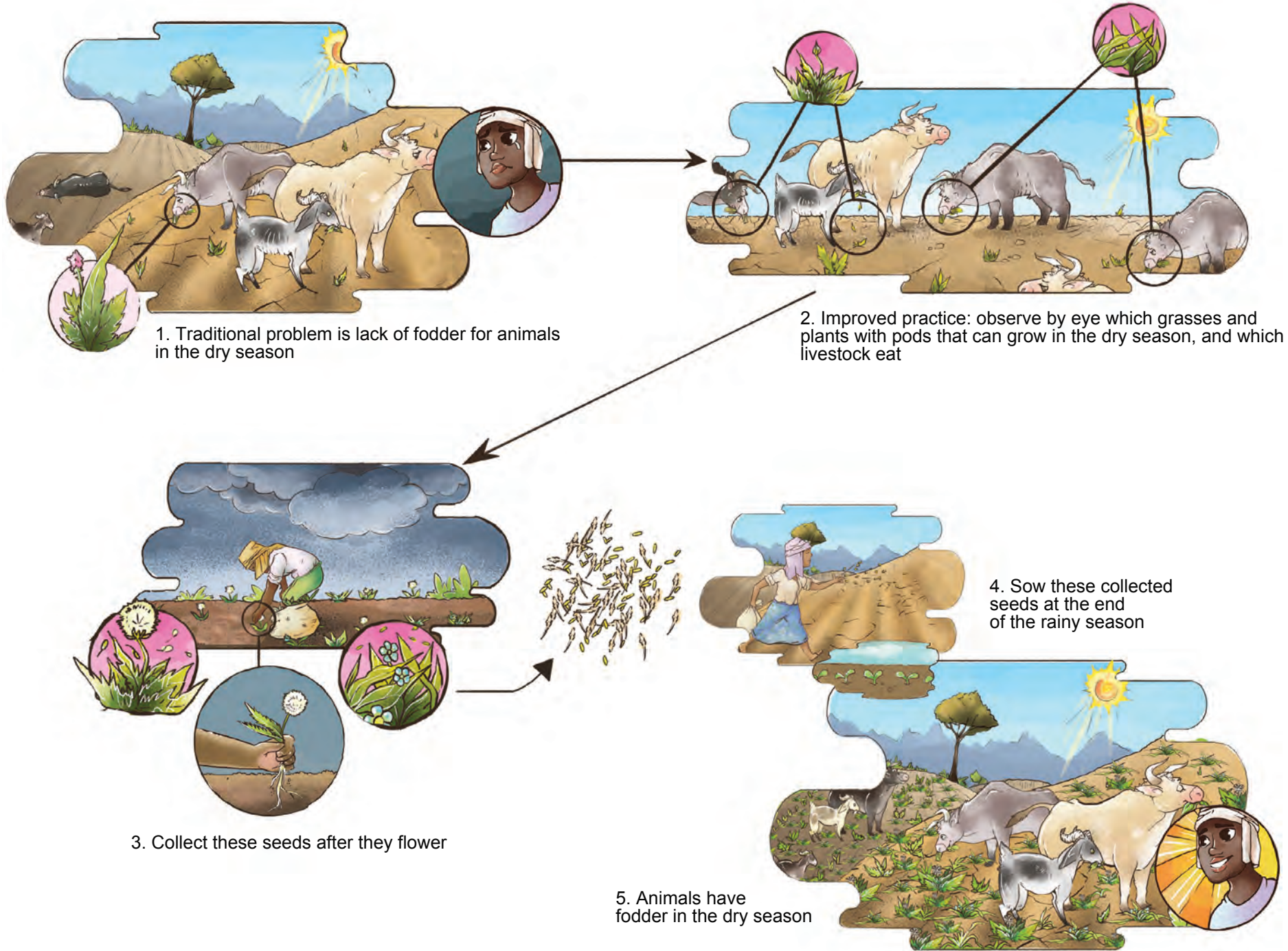
3. Animals have feed in dry season



4. Roots of vetch have
pink spheres
which produce
natural fertilizer
which feeds next
season crop



Lesson: Observe which plants grow in the dry season, then deliberately grow them, to provide livestock fodder



1. Traditional problem is lack of fodder for animals in the dry season

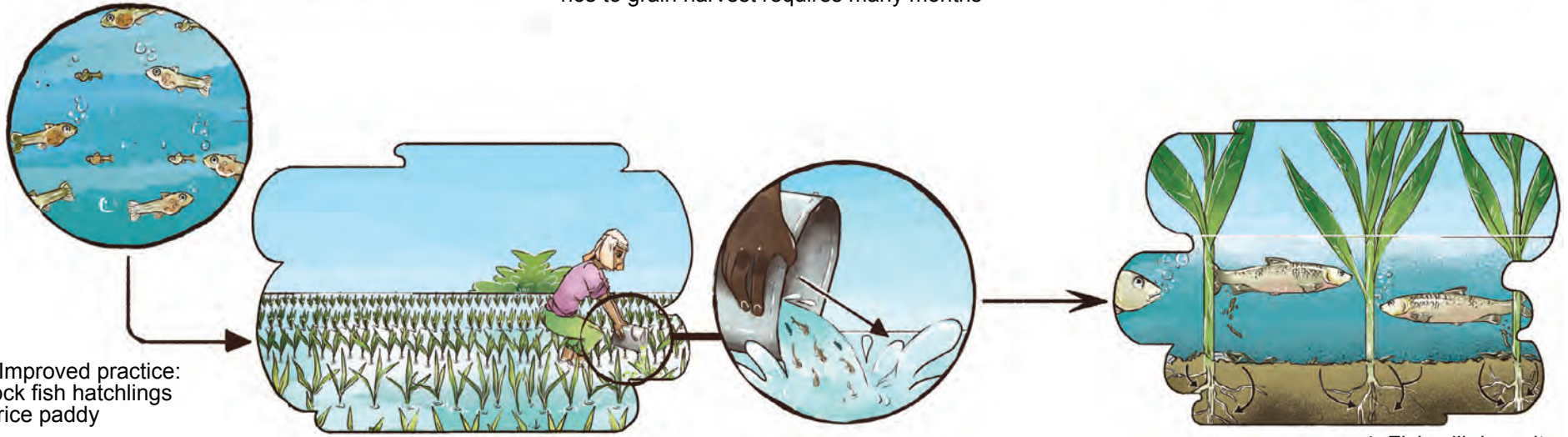
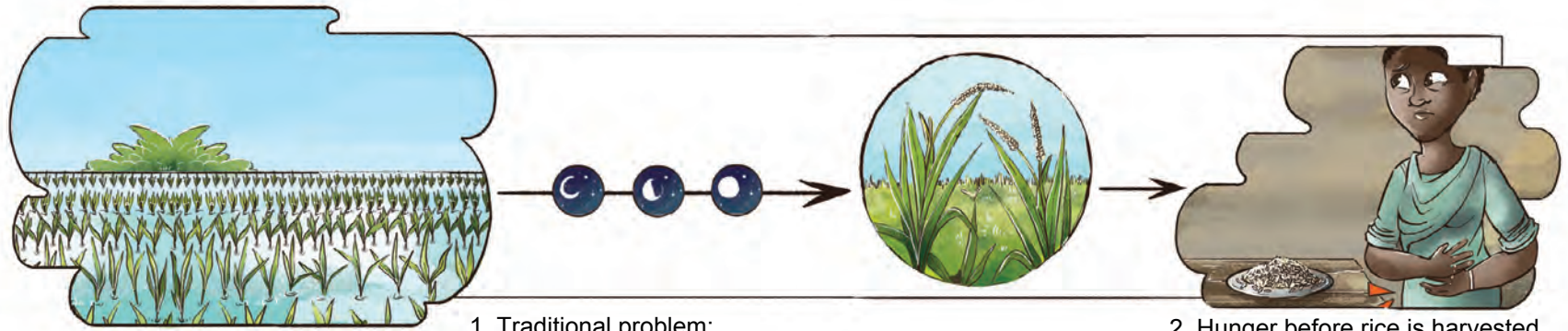
2. Improved practice: observe by eye which grasses and plants with pods that can grow in the dry season, and which livestock eat

3. Collect these seeds after they flower

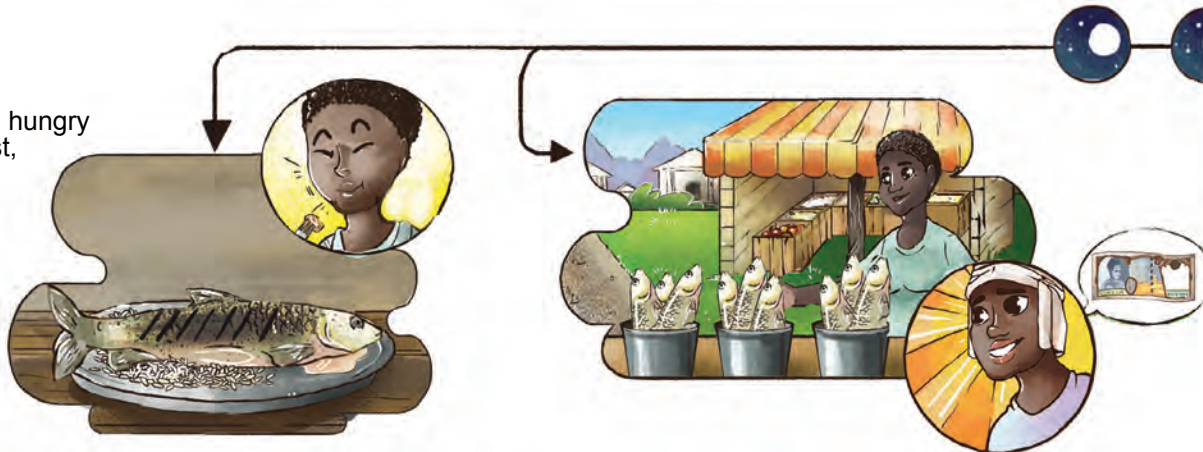
4. Sow these collected seeds at the end of the rainy season

5. Animals have fodder in the dry season

Lesson: Rather than being hungry before the rice harvest, grow fish in the rice paddies and eat them.



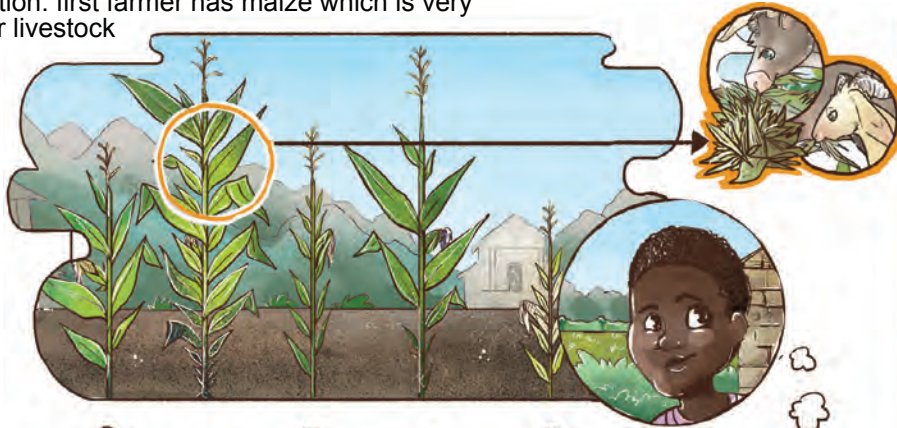
5. Instead of being hungry prior to rice harvest, catch and eat fish



Chapter 12: Crop Breeding

Lesson: Exchanging seeds with farmers from other villages can be beneficial.

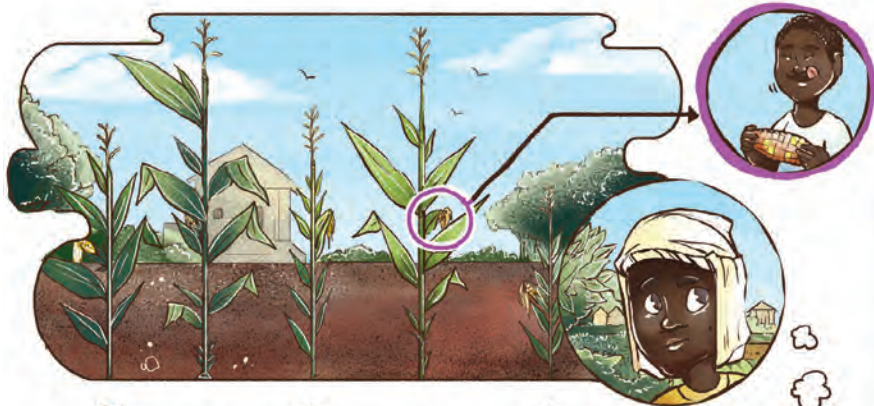
1. Situation: first farmer has maize which is very good for livestock



2. First farmer wants maize which is tastier or healthier for humans



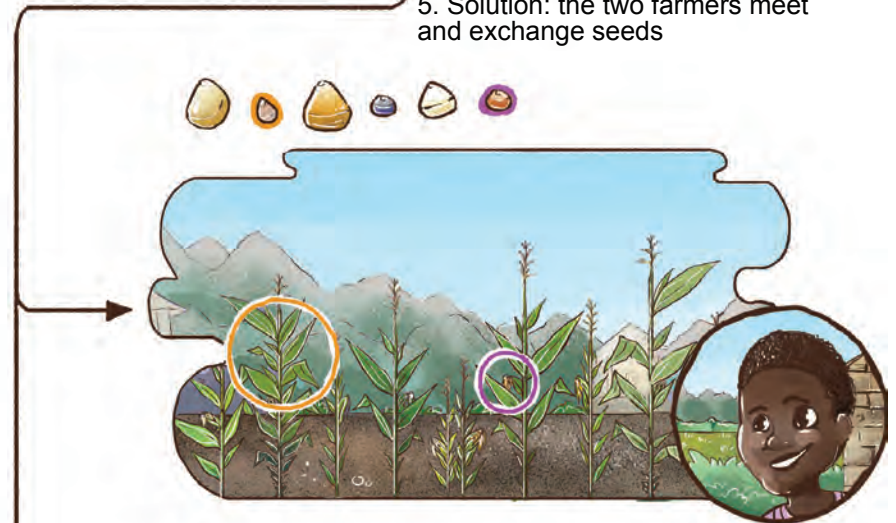
3. Second farmer in nearby village has maize which is tastier for humans



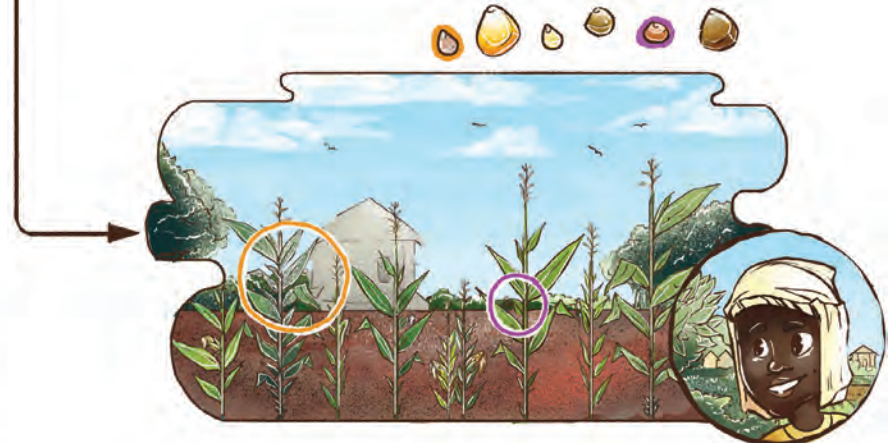
4. Second farmer wants maize which is very good for livestock



5. Solution: the two farmers meet and exchange seeds

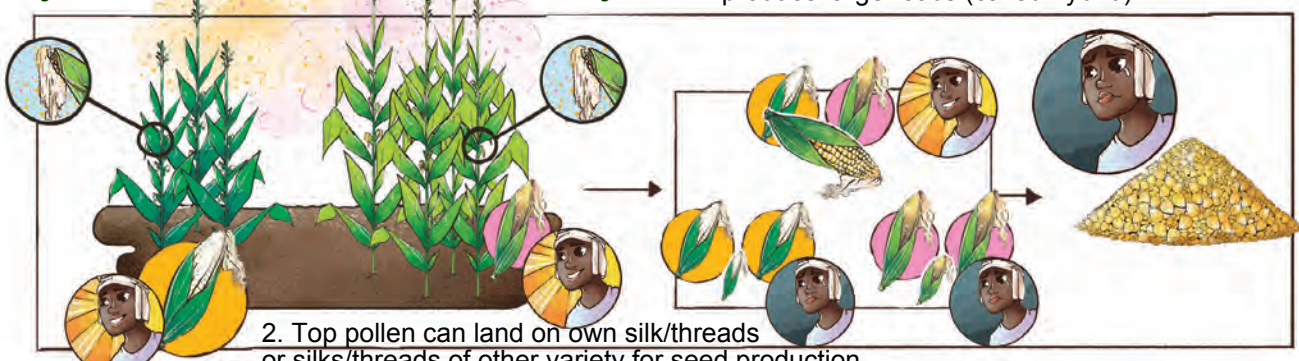


6. Now both farmers have best maize for all purposes



Lesson: Instead of purchasing expensive hybrid maize seed, it is possible to produce one's own higher producing hybrid seed less expensively.

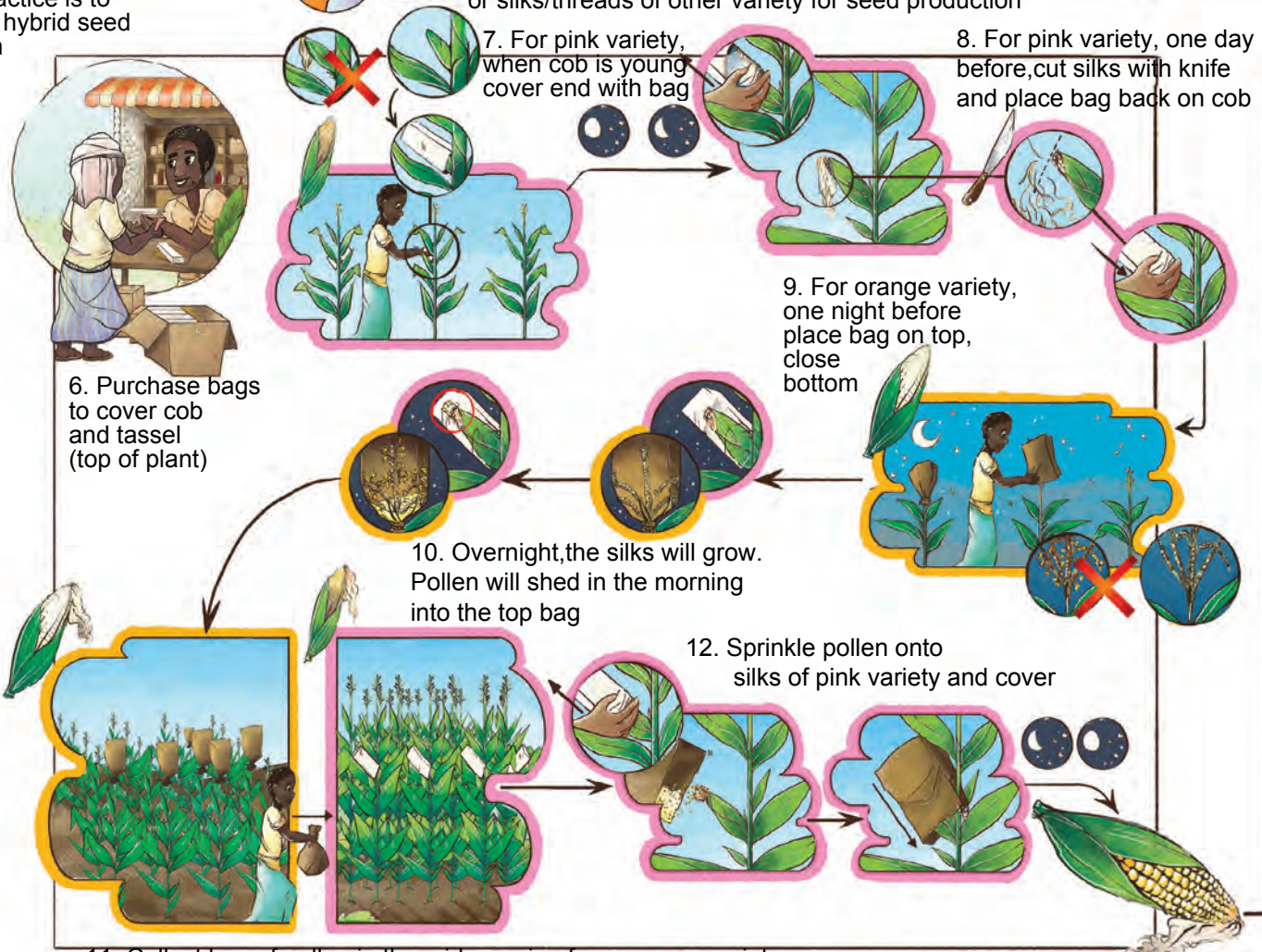
1. Traditional practice: two or more maize varieties (orange, pink) grow



3. Pollen from one variety that randomly lands on silks of the second variety may produce larger cobs (called hybrid)

4. However, most cobs are small from such random, open pollination

5. New practice is to deliberate hybrid seed production



2. Top pollen can land on own silk/threads or silks/threads of other variety for seed production

7. For pink variety, when cob is young cover end with bag

8. For pink variety, one day before, cut silks with knife and place bag back on cob

9. For orange variety, one night before place bag on top, close bottom

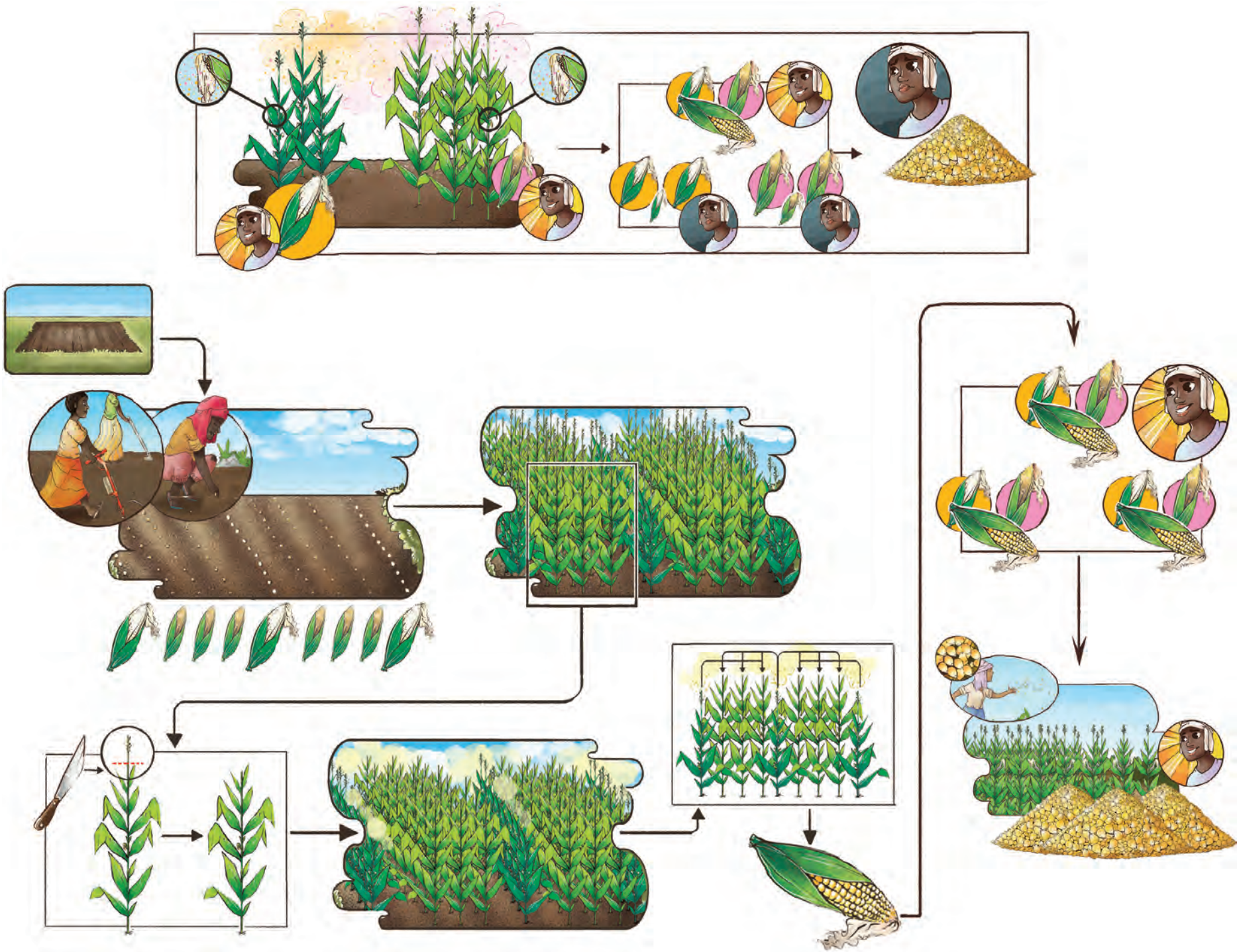
10. Overnight, the silks will grow. Pollen will shed in the morning into the top bag

12. Sprinkle pollen onto silks of pink variety and cover

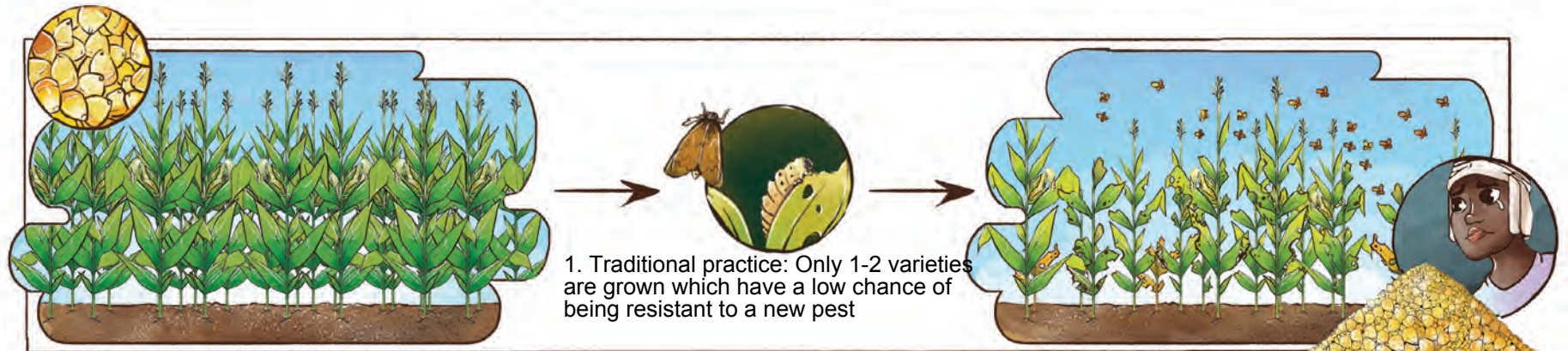
11. Collect bag of pollen in the mid-morning from orange variety

13. All seeds are a hybrid of the two varieties. They may look the same colour, shape and size if the parents were pure (inbred) or different if the parents were not pure

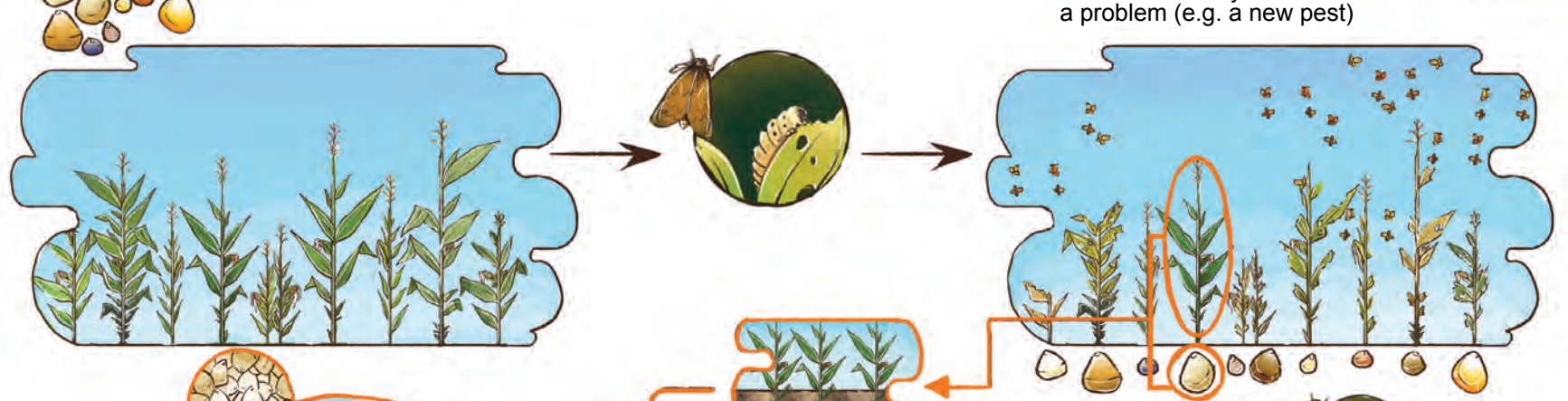
14. Potential for higher yield



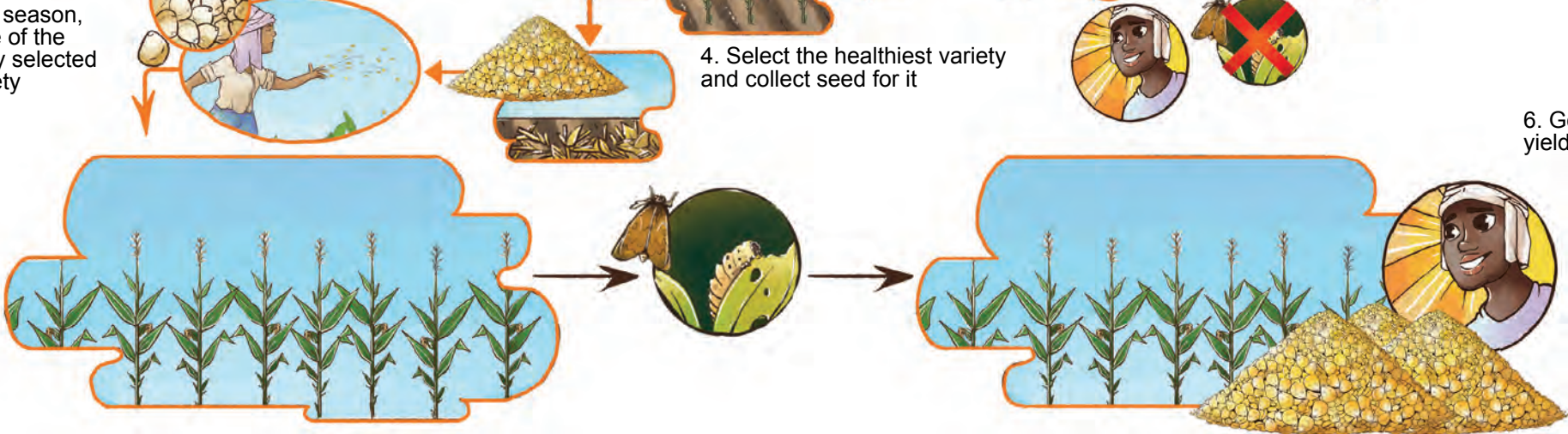
Lesson: It is useful to maintain multiple varieties of each crop in order to test whether a particular variety may overcome a new problem (e.g. a new pest).



2. Improved practice: grow a few plants from many collected varieties each year

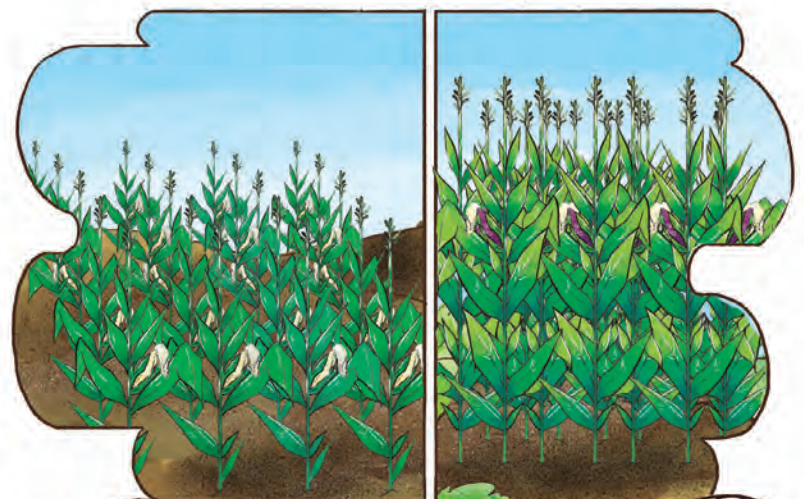


5. In next season, sow more of the previously selected crop variety

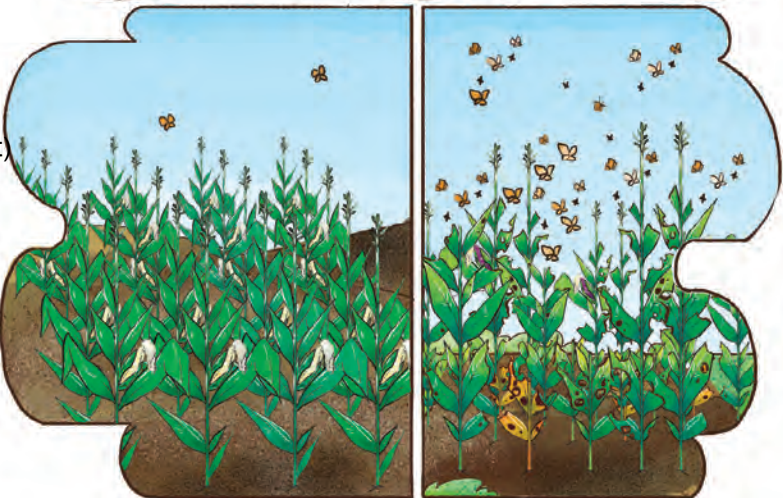


Lesson: It may be possible to combine the best aspects of two crop varieties into a single new variety (part 1).

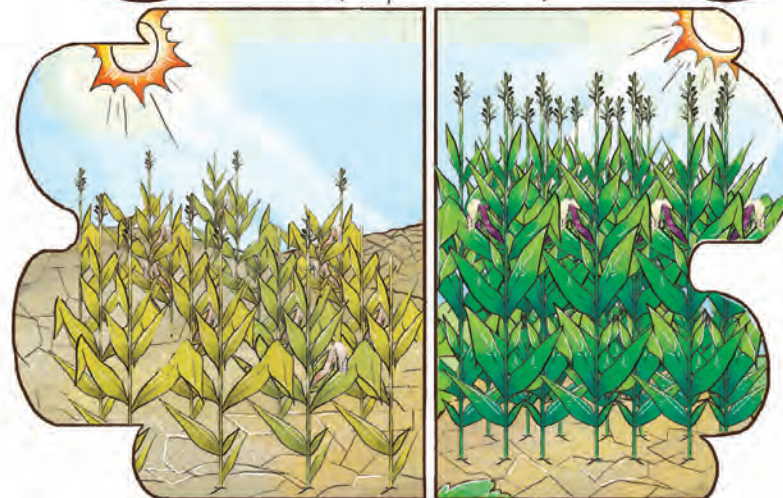
1. Example: Imagine two varieties of maize (white, purple)



2. Imagine the the white maize variety (left) is tolerant to insects but not the purple maize variety (right)



3. Imagine that the purple maize variety (right) is resistant to drought but not the white maize variety (left)

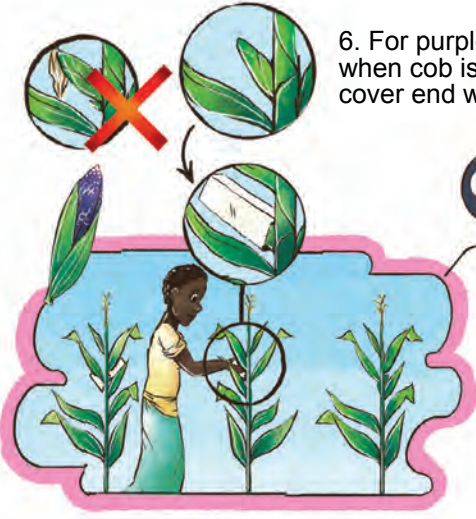


Lesson: It may be possible to combine the best aspects of two crop varieties into a single new variety (part 2).

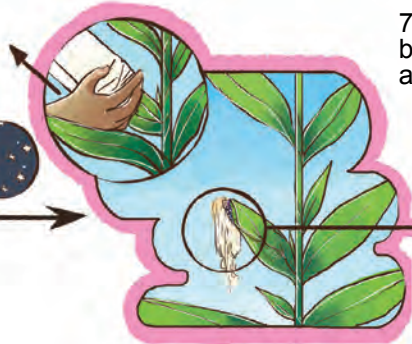
4. It may be possible to create a new maize variety which has the desired traits (e.g. insect resistance and drought resistance) from two varieties: like two parents creating a child



5. Purchase bags to cover cob and tassel (top of plant)



6. For purple variety, when cob is young, cover end with bag



7. For purple variety, one day before, cut silks with knife and place bag back on cob

8. For white maize variety one night before, place bag on top, close bottom



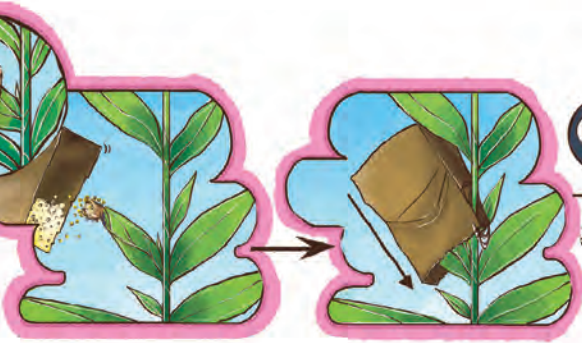
9. Overnight, the silks will grow. Pollen will shed in the morning into the top bag



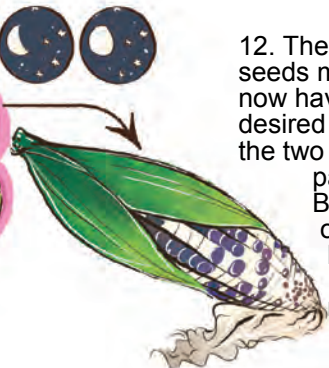
10. Collect bag of pollen in the mid-morning from white variety.



11. Sprinkle pollen onto silks of purple variety and cover

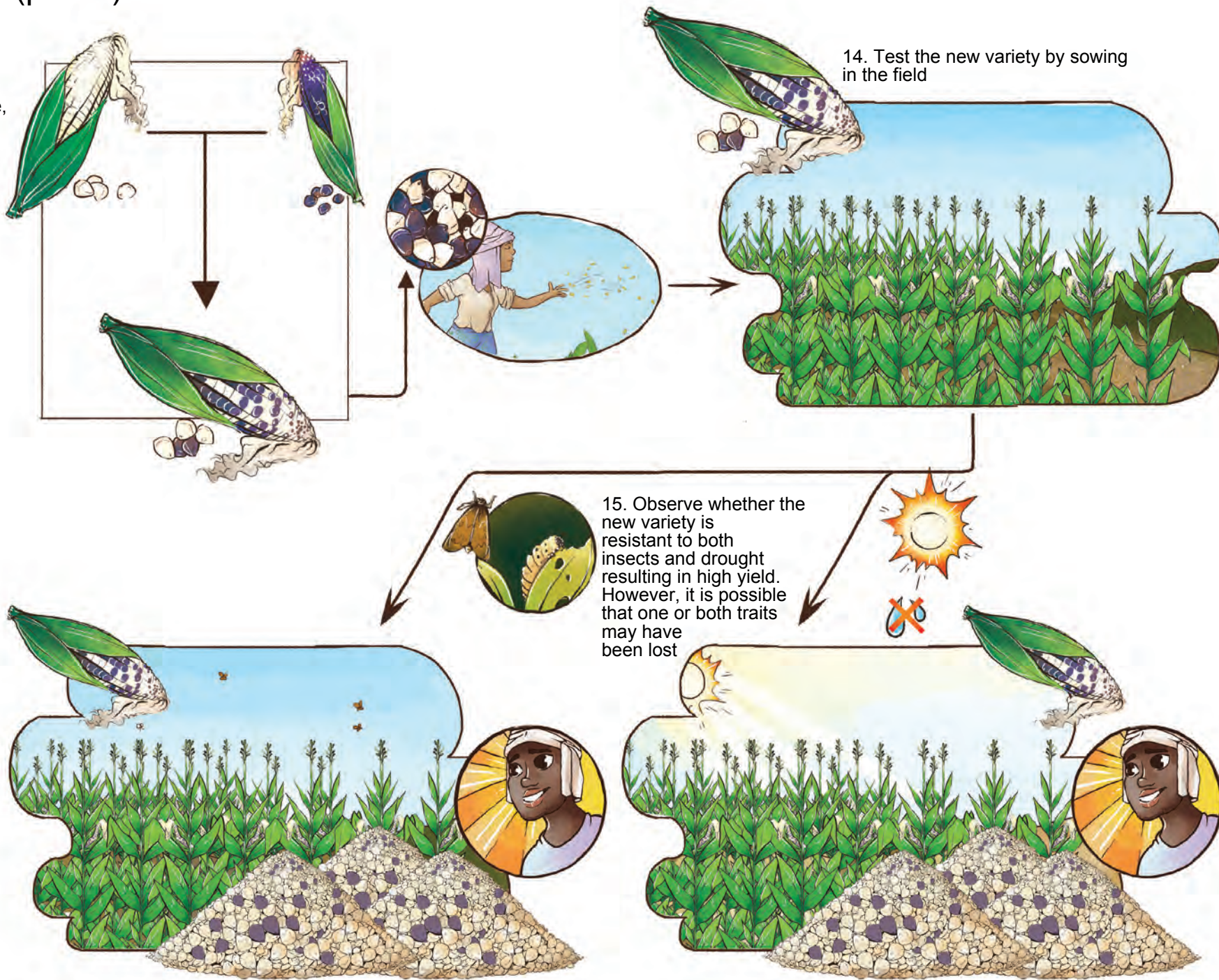


12. The final seeds may now have the desired traits from the two original parents. But also one or both traits may be lost



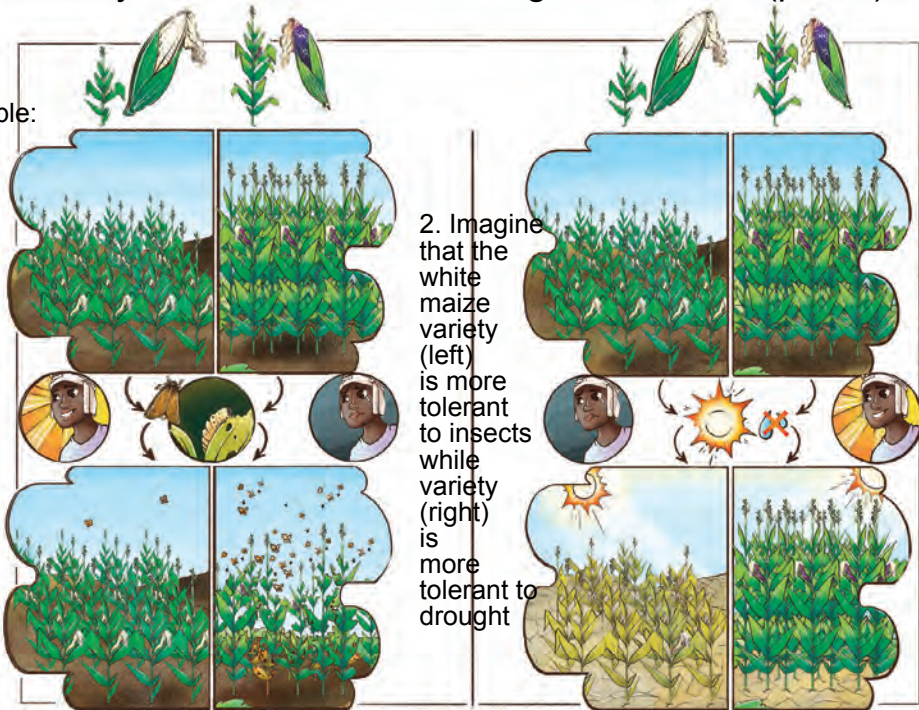
Lesson: It may be possible to combine the best aspects of two crop varieties into a single new variety (part 3).

13. To review, as an example, the white maize variety (resistant to insect) and purple maize variety (resistant to drought) were used to create a new child with the hope that the child would have both good traits.

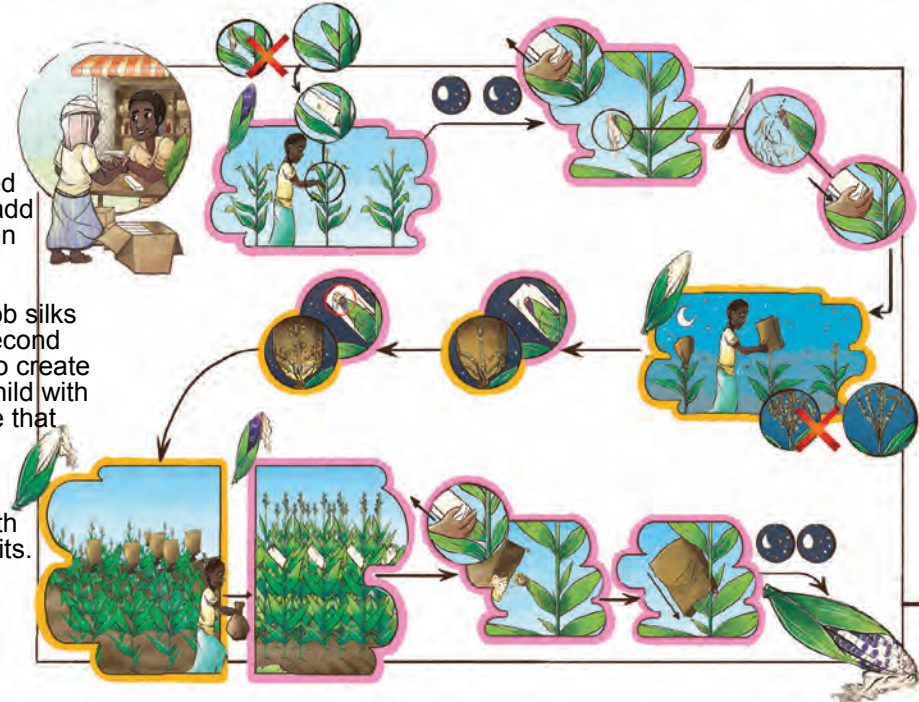


Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original varieties (part 1)

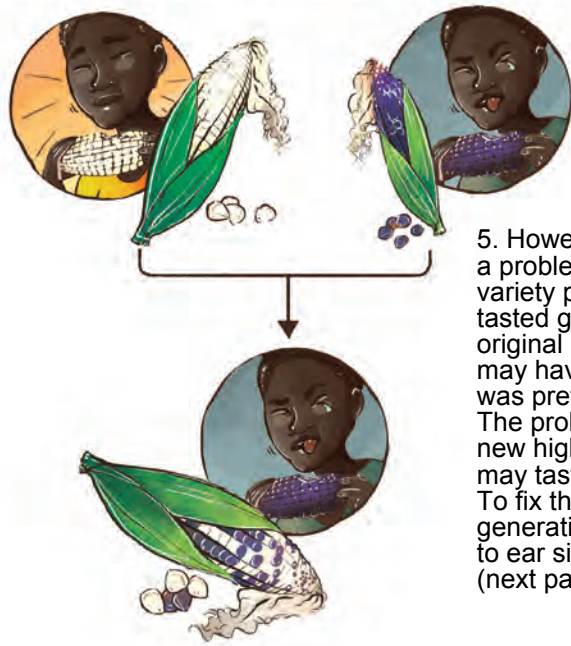
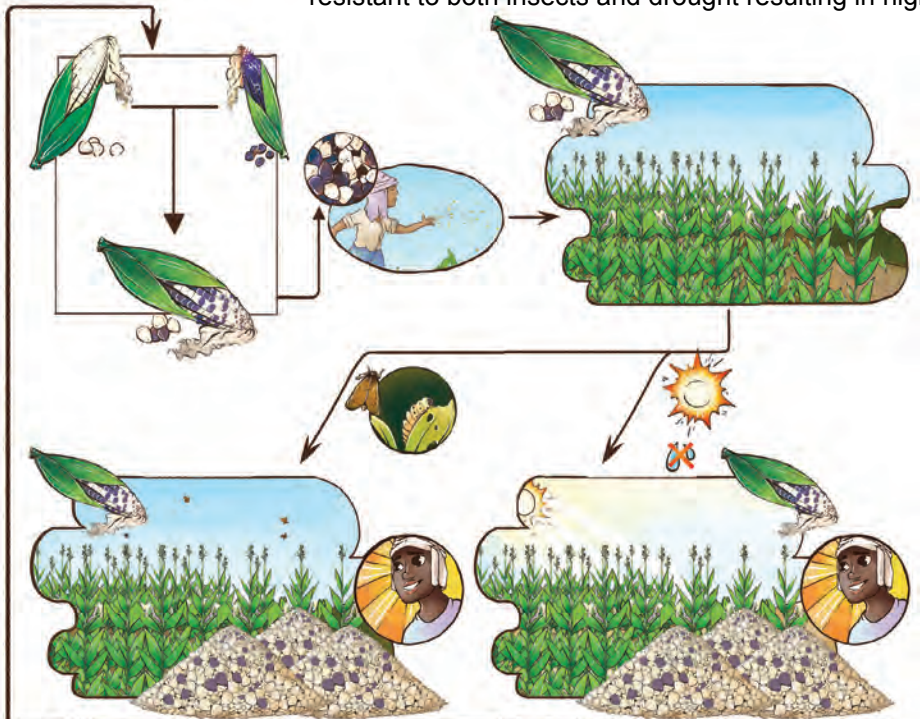
1. Example: Imagine two varieties of maize (white, purple)



3. As described earlier, add the pollen of one variety to the cob silks of the second variety to create a new child with the hope that the child variety would have both good traits.



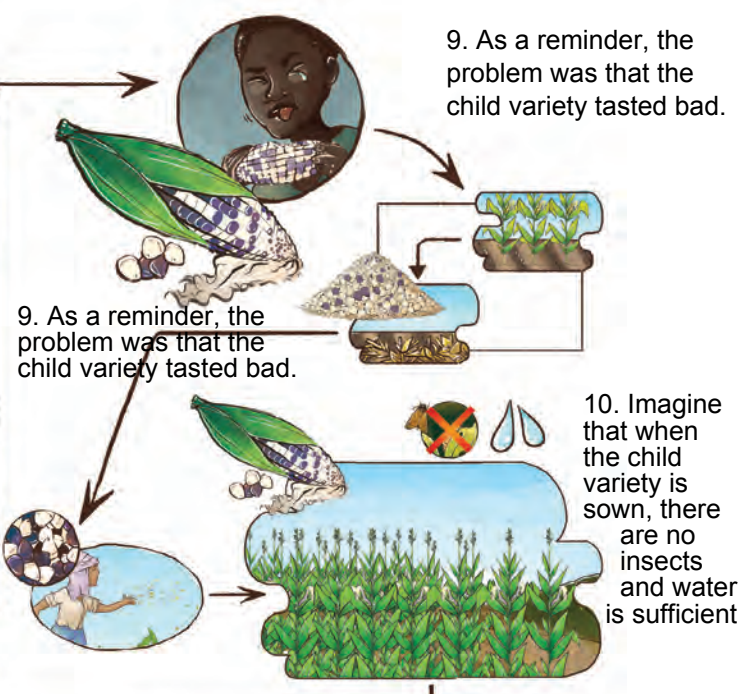
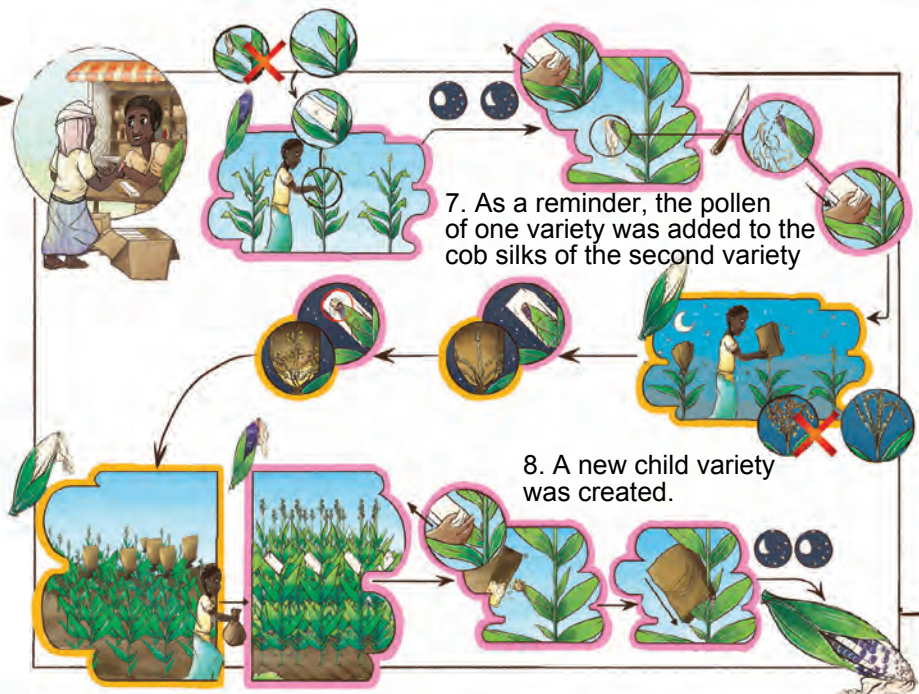
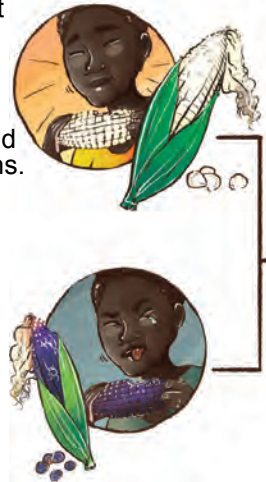
4. As described earlier, it is hoped that the new variety will be resistant to both insects and drought resulting in high yield



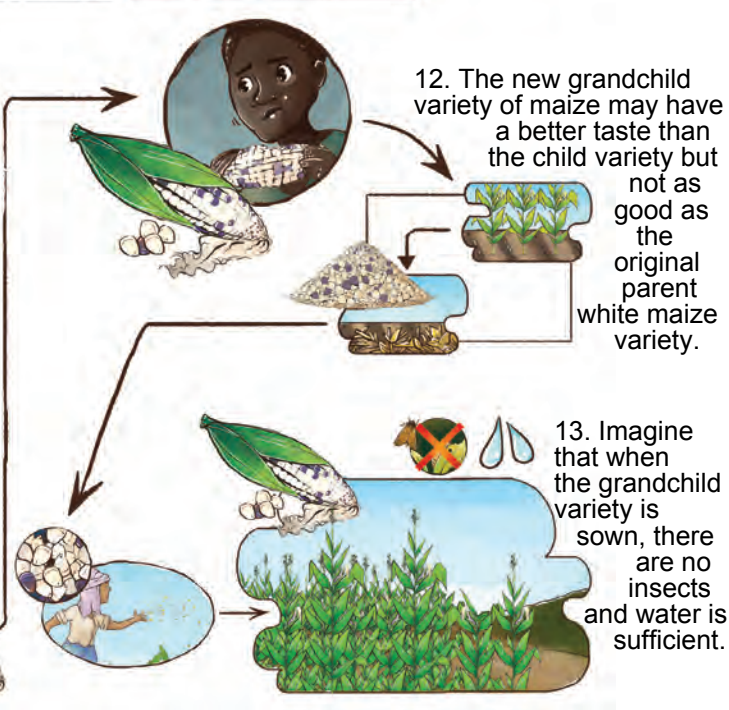
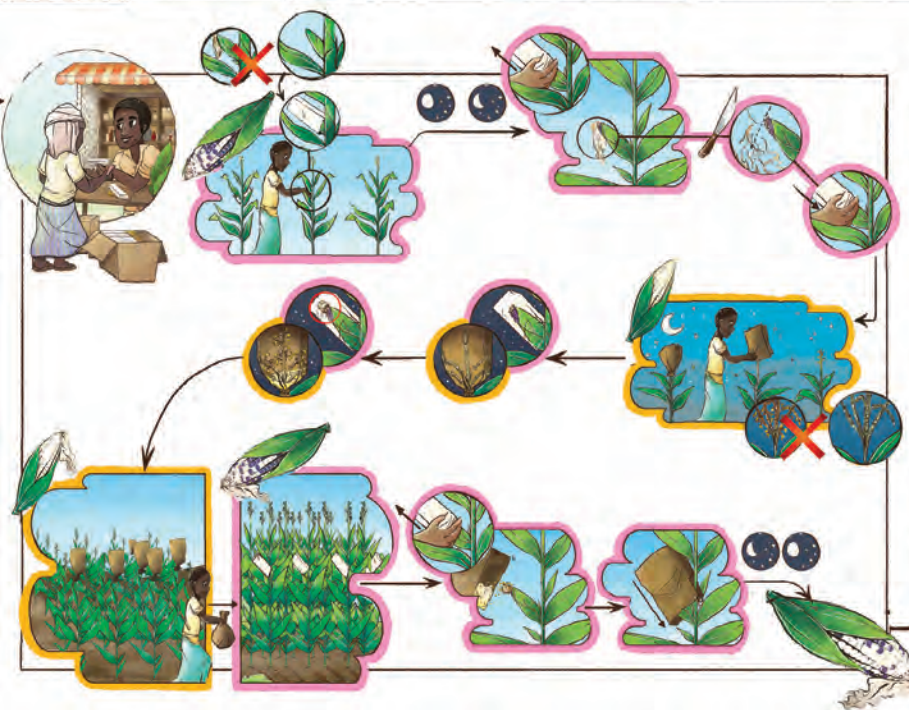
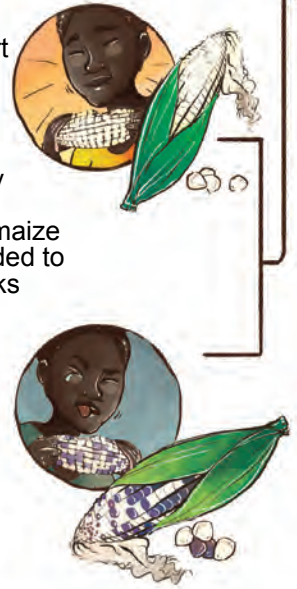
5. However, there may be a problem: the original white variety parent may have tasted good, while the original purple parent variety may have tasted bad (but was preferred by chickens). The problem is that the new high-yielding child variety may taste bad to humans. To fix the problem, multiple generations of adding pollen to ear silks will be required (next page).

Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original varieties (part 2)

6. As a reminder, the white parent variety of maize tastes good, but the purple variety of maize tastes bad to humans.

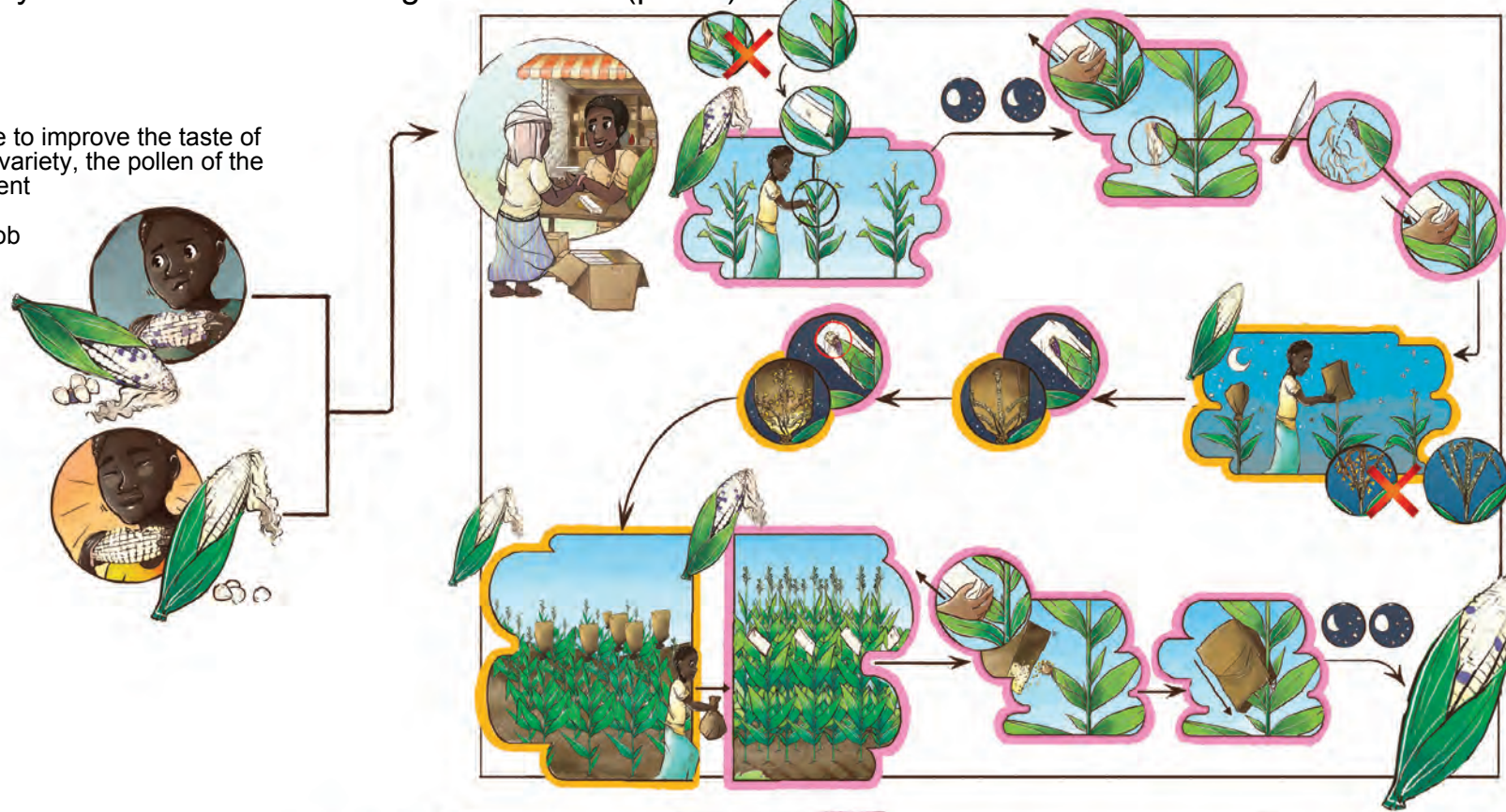


11. To start to fix the taste problem, the pollen of the tasty white variety of maize can be added to the cob silks of the new child variety to create a grandchild variety.



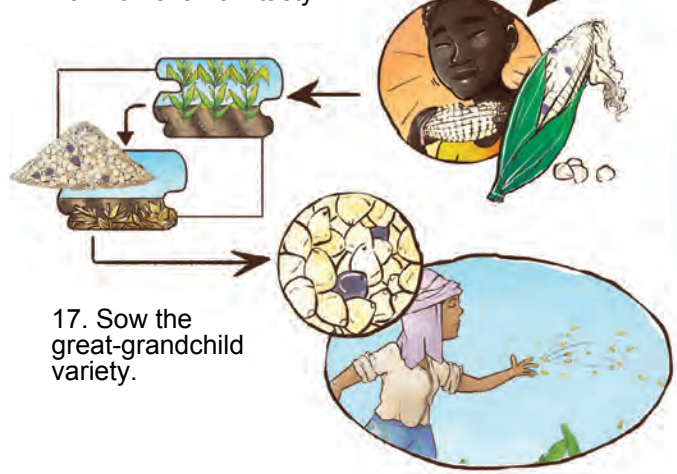
Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original varieties (part 3)

14. To continue to improve the taste of the grandchild variety, the pollen of the tasty white parent variety can be added to the cob silks of the grandchild variety.



15. The new great grandchild variety will more resemble the original white parent variety

16. The great-grandchild variety of maize is now tasty.



17. Sow the great-grandchild variety.

18. Imagine that when the great-grandchild variety is sown, there are no insects and water is sufficient.

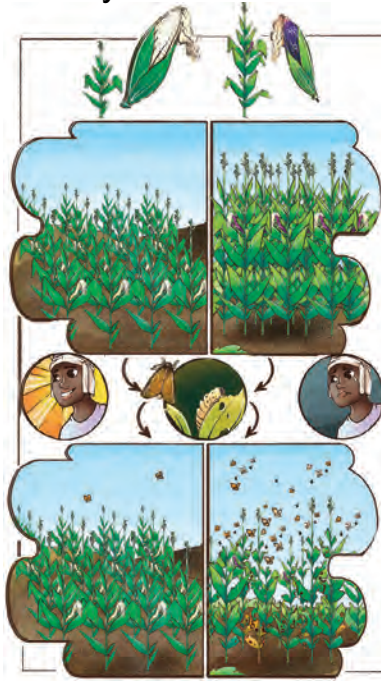


19. It is not clear whether the great-grandchild variety has kept its resistance to both insects and drought.

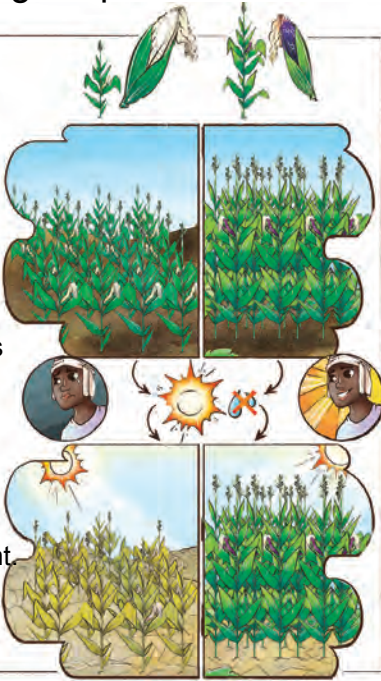


Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original parent varieties but to maintain the benefits of both varieties (part 1)

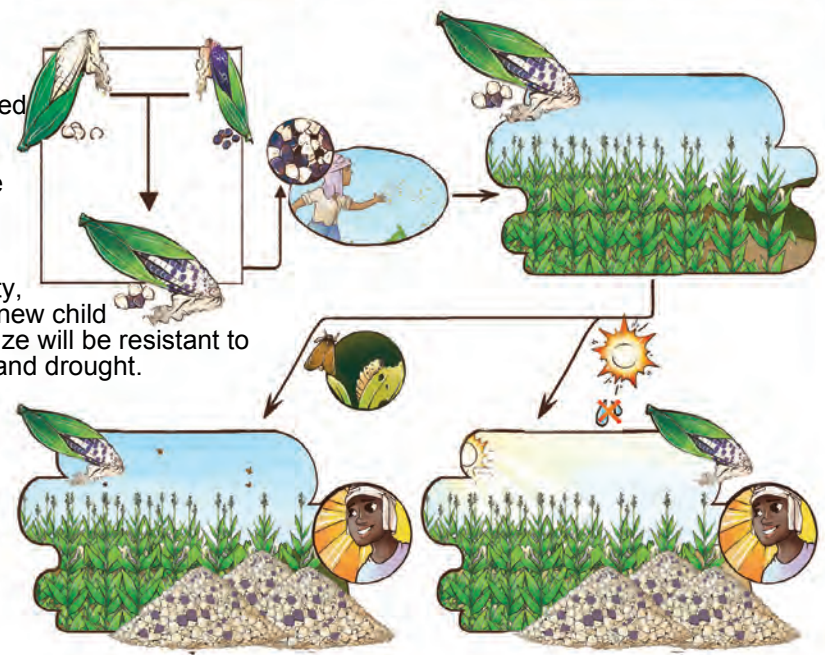
1. As a reminder, imagine two varieties of maize (white, purple)



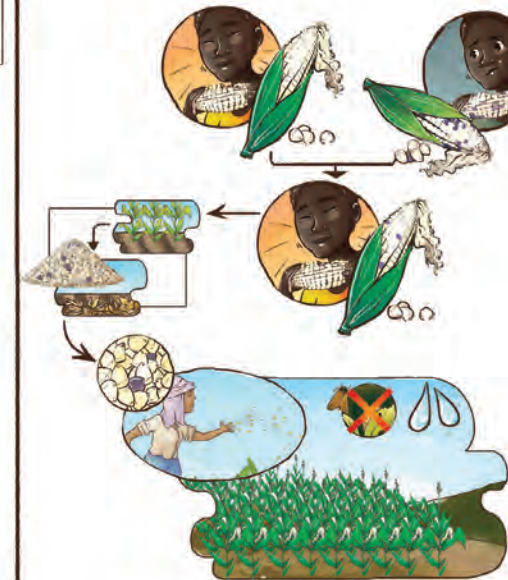
2. Again, imagine that the white maize variety (left) is more tolerant to insects while the white variety (right) is more tolerant to drought.



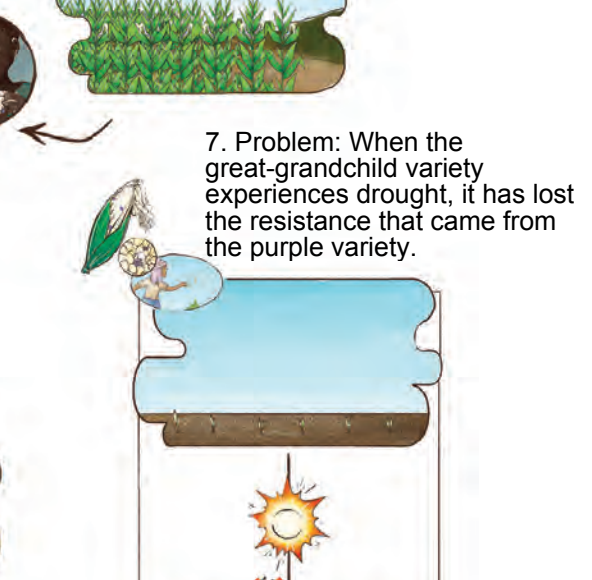
3. As described earlier, it is hoped that by adding the pollen of one variety to the silks of the second variety, the resulting new child variety of maize will be resistant to both insects and drought.



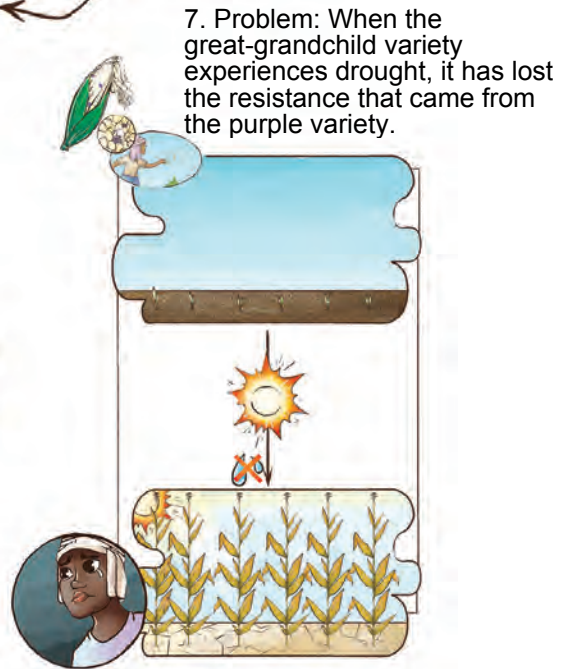
4. As a reminder, the child variety tastes bad. When it is sown, there happens to be no insects or drought.



5. As a reminder, to improve the taste of the child variety, the pollen of the tasty white parent variety can be added to the cob silks of the child variety to create a grandchild variety. When it is sown, there happens to be no insects or drought.

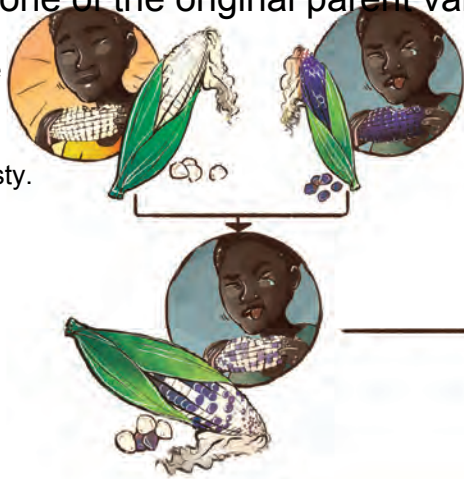


6. As a reminder, to continue to improve the taste of the grandchild variety, the pollen of the tasty white parent variety can be added to the cob silks of the grandchild variety to create a great-grandchild variety. When it is sown, there happens to be no insects or drought.



Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original parent varieties but to maintain the benefits of both varieties (part 2)

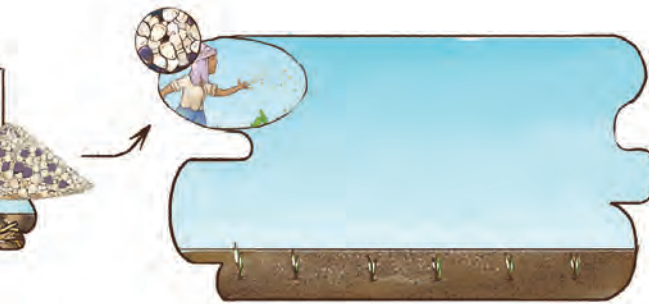
8. There is a method to maintain the benefits of both the white variety and purple variety, but at the same time have the variety resemble the most desired white variety that is tasty.



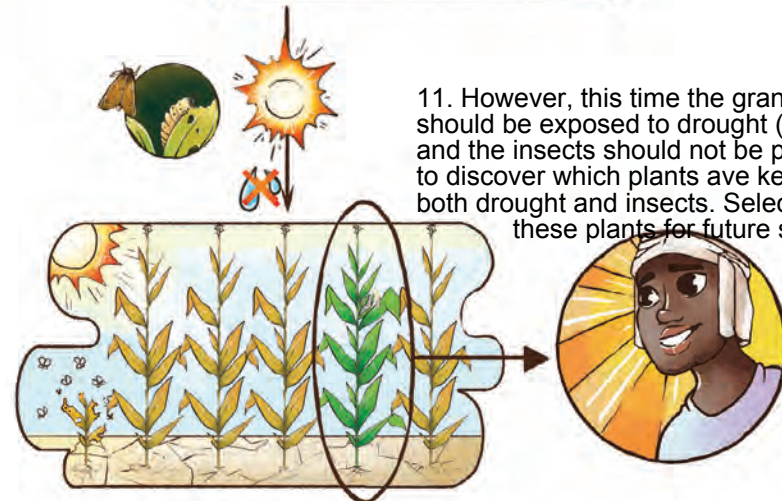
9. After creating the child variety from the white and purple parent maize varieties, sow the child variety.



10. As before, to improve the taste of the child variety, the pollen of the tasty white parent variety can be added to the cob silks of the child variety to create a grandchild variety.



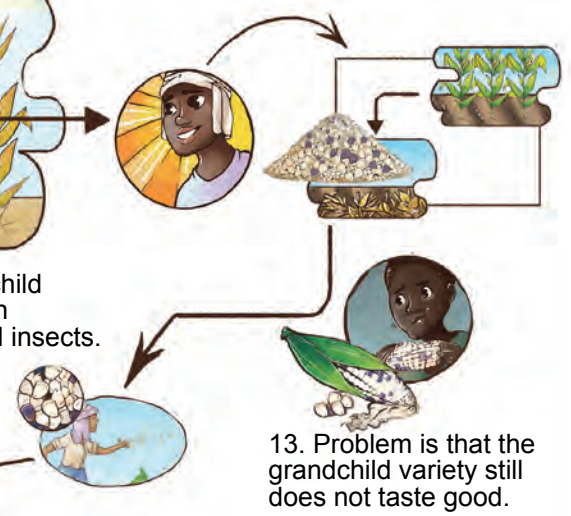
11. However, this time the grandchild variety should be exposed to drought (no irrigation) and the insects should not be prevented, in order to discover which plants have kept resistance to both drought and insects. Select the seeds of only these plants for future sowing.



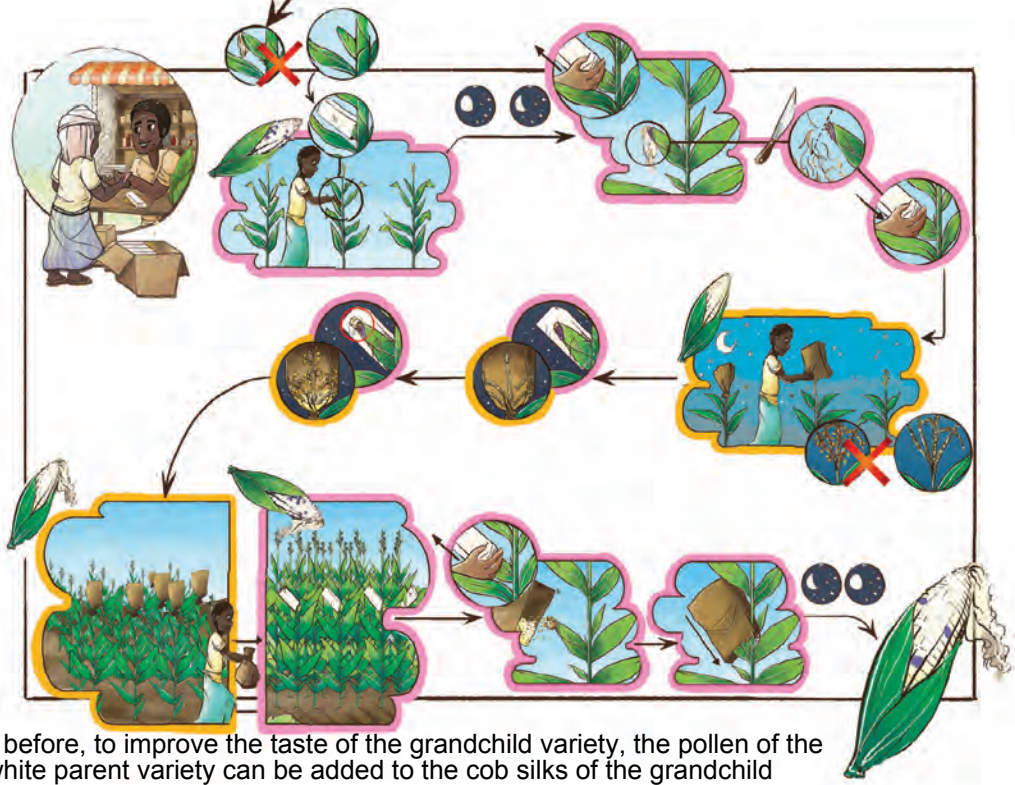
Lesson: After the best benefits of two crop varieties have been combined into a single variety, it is possible to have the new variety closely resemble one of the original parent varieties but to maintain the benefits of both varieties (part 3)



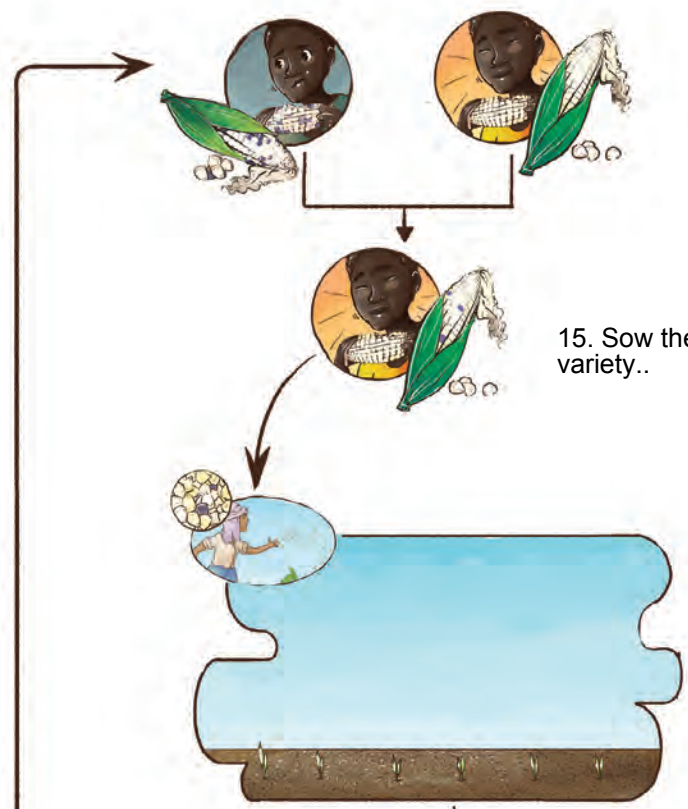
12. To repeat, sow the seeds of the grandchild plants which have resistance similar to both parent varieties, in this case to drought and insects.



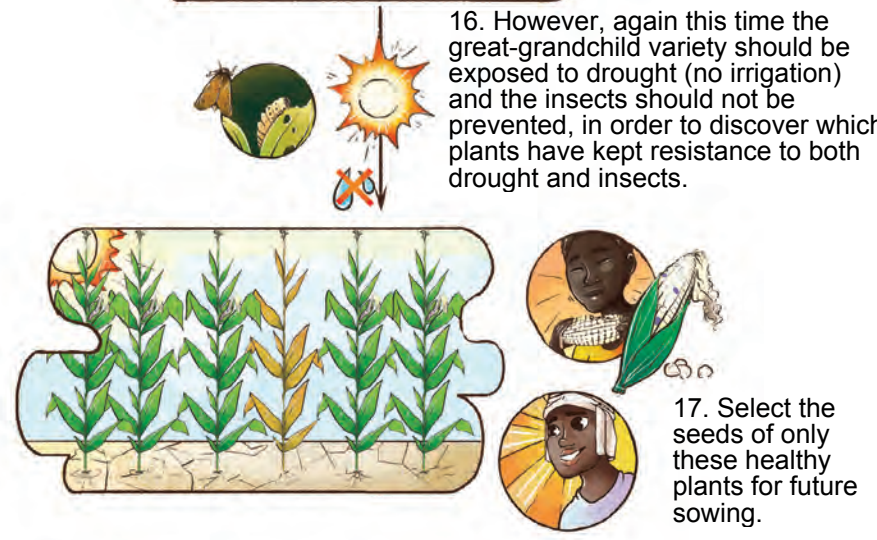
13. Problem is that the grandchild variety still does not taste good.



14. As before, to improve the taste of the grandchild variety, the pollen of the tasty white parent variety can be added to the cob silks of the grandchild variety to create a great-grandchild variety.



15. Sow the great-grandchild variety..



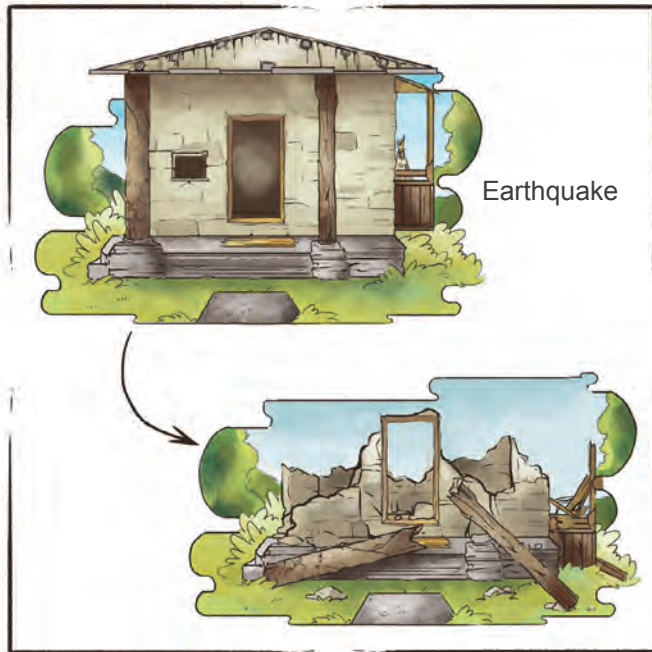
16. However, again this time the great-grandchild variety should be exposed to drought (no irrigation) and the insects should not be prevented, in order to discover which plants have kept resistance to both drought and insects.



17. Select the seeds of only these healthy plants for future sowing.

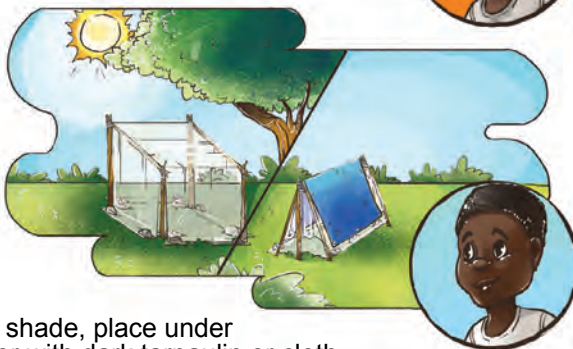
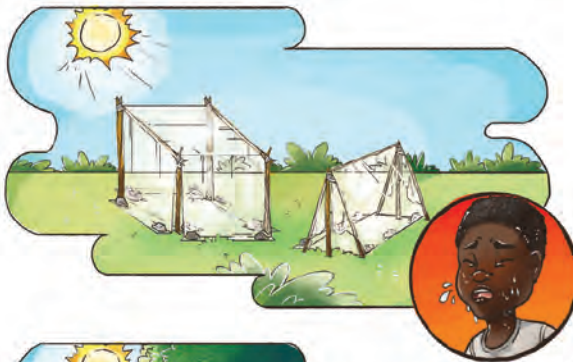
Chapter 13: Disaster Relief

Lesson: How to build shelter from a roll of tarpaulin or plastic sheets

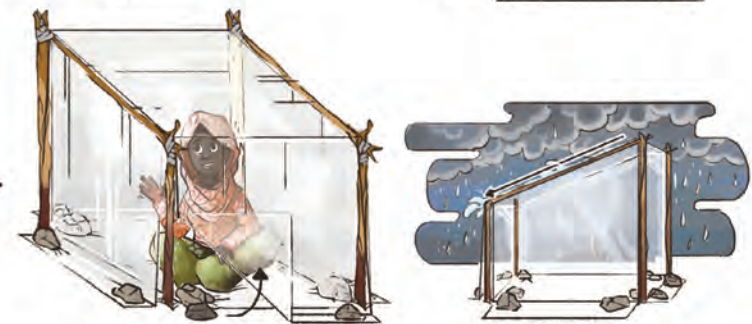


1. Wood frame tied with rope or duct tape (water proof)

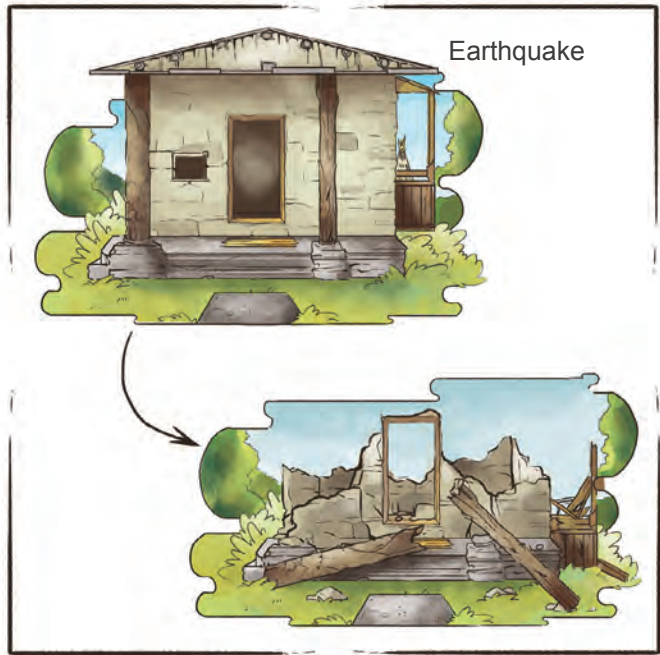
2. Roll of tarpaulin or plastic



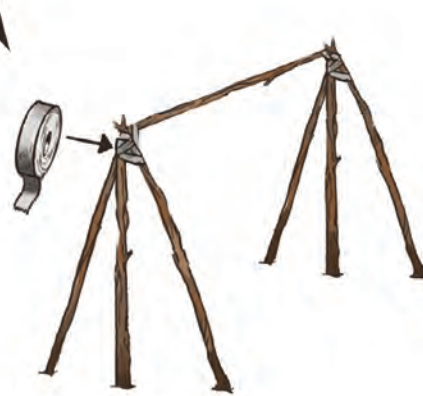
3. For shade, place under trees or with dark tarpaulin or cloth



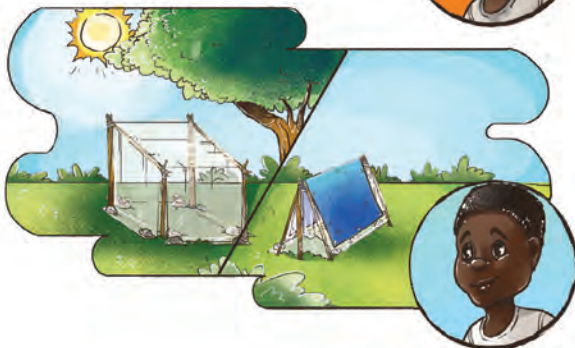
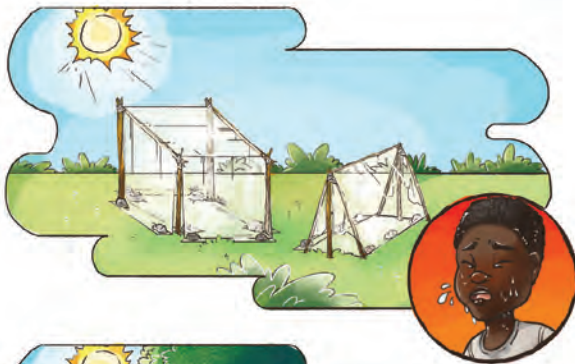
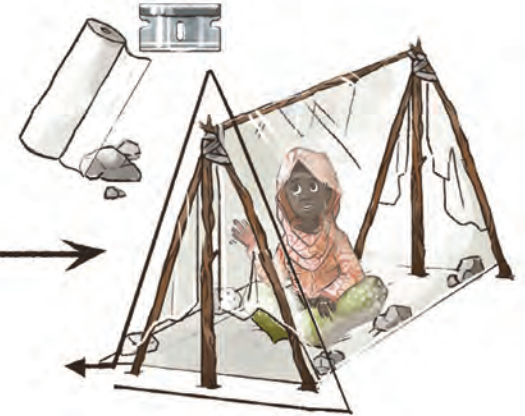
Lesson: How to build shelter from a roll of tarpaulin or plastic sheets



1. Wood frame tied with rope or duct tape (water proof)



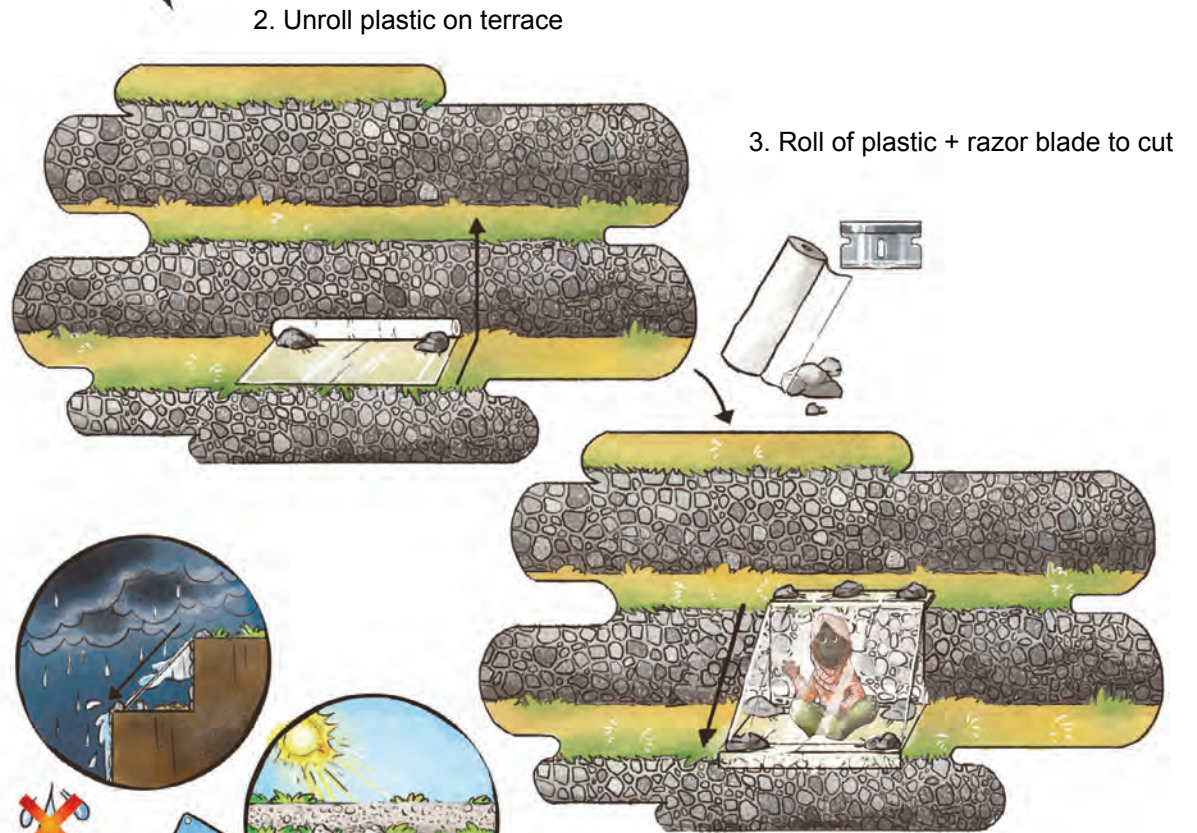
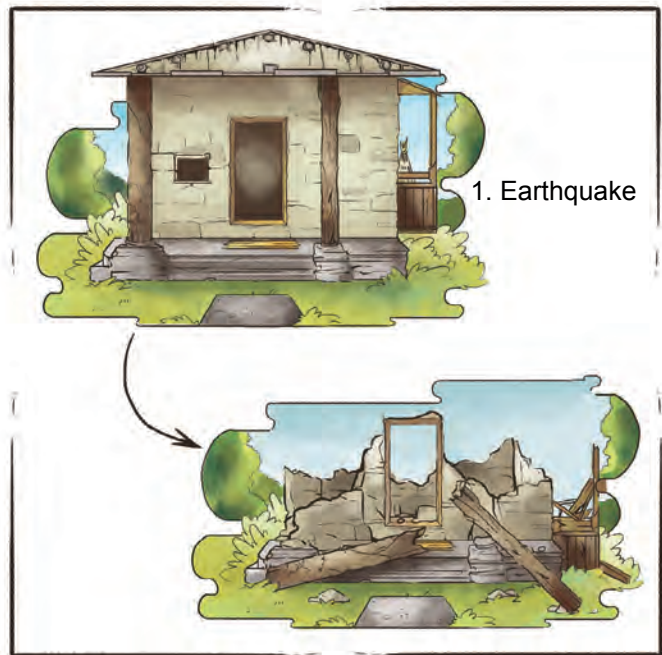
2. Roll of tarpaulin or plastic



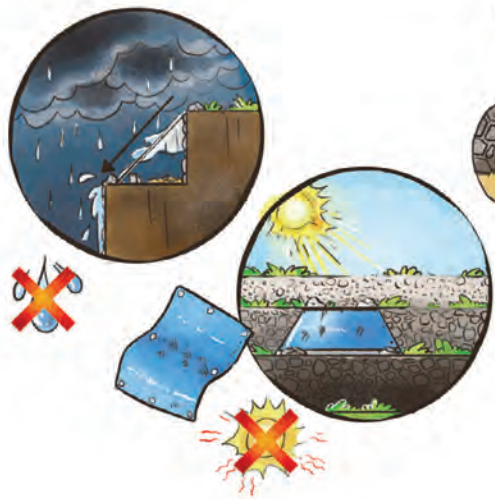
3. Can use tree branch

4. For shade, place under trees or with dark tarpaulin or cloth.

Lesson: How to build a shelter from a roll of tarpaulin or plastic sheets, rapidly, without using wood by using the terrace wall

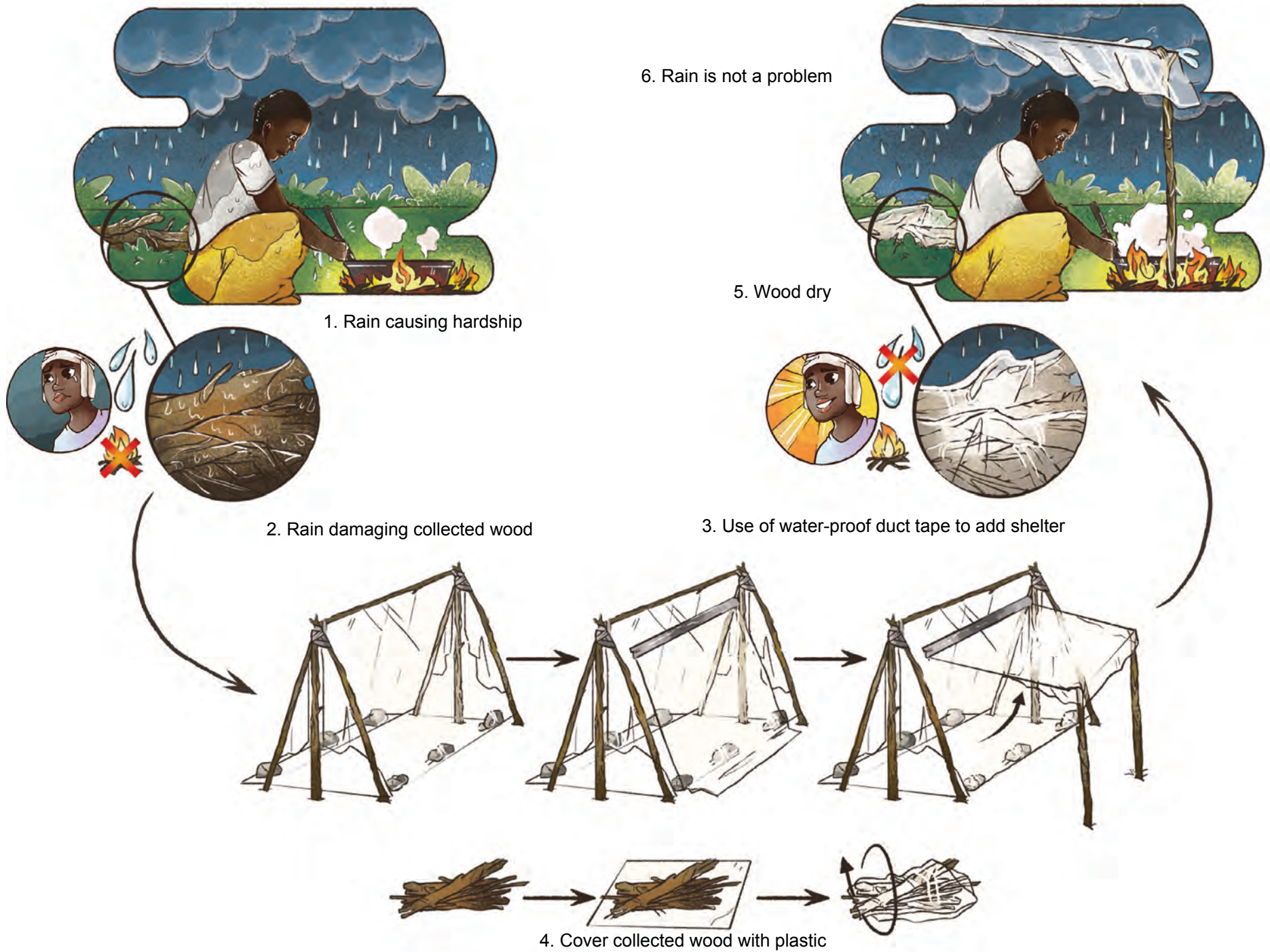


4. Place in area with low water flow



5. For shade, cover with dark tarpaulin or dark cloth

Lesson: Roll of plastic or tarpaulin can be used to create a shelter for cooking and to keep collected wood dry

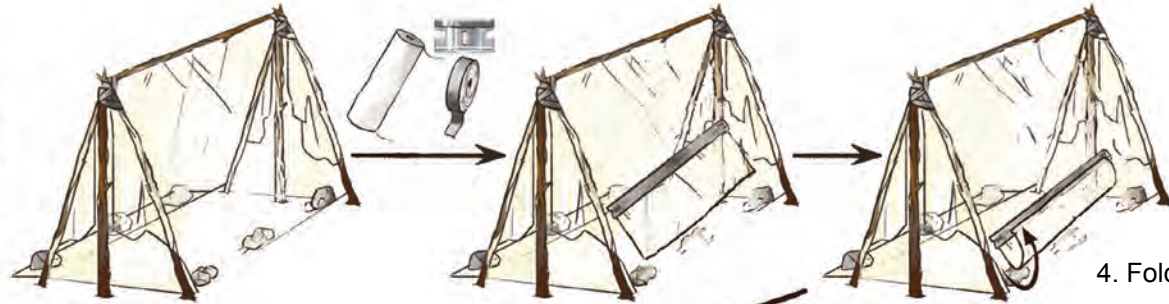


Lesson: A roll of plastic or tarpaulin may be used to collect clean drinking water from rainfall (water harvesting)



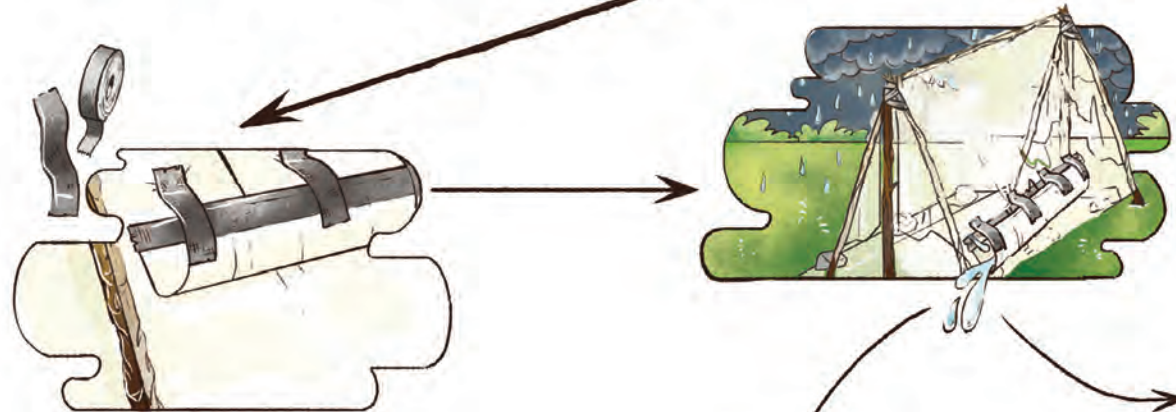
1. Thirsty

2. Roll of plastic, razor blade and water-proof duct tape



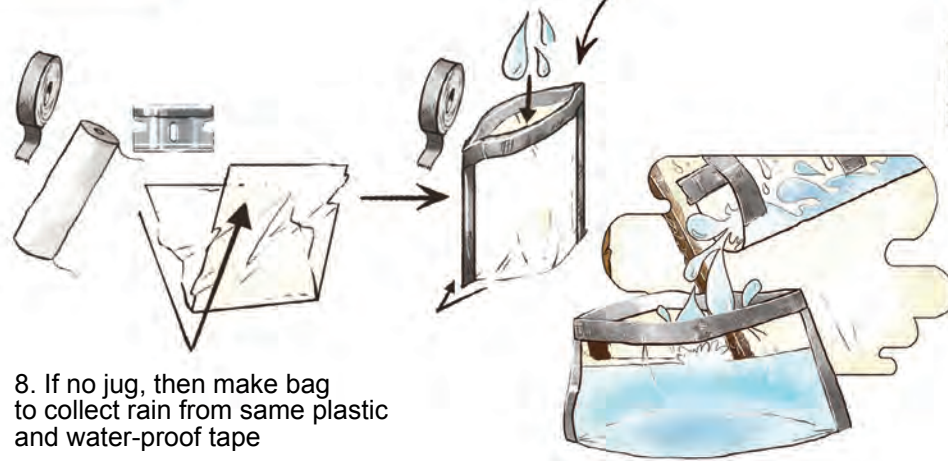
4. Fold up

3. Tape plastic at a sloping angle



6. Collect rain

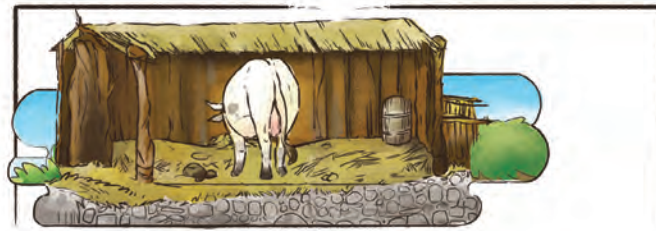
5. Add tape



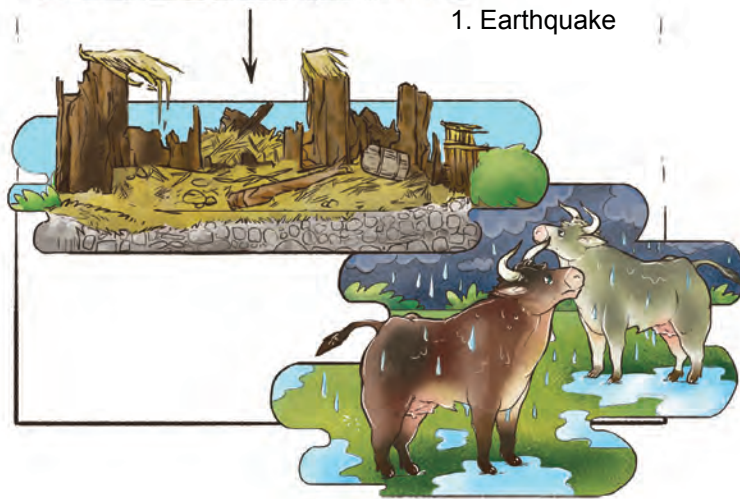
7. Use jug or container to collect rain

8. If no jug, then make bag to collect rain from same plastic and water-proof tape

Lesson: A shelter can be made for animals using a roll of plastic or tarpaulin



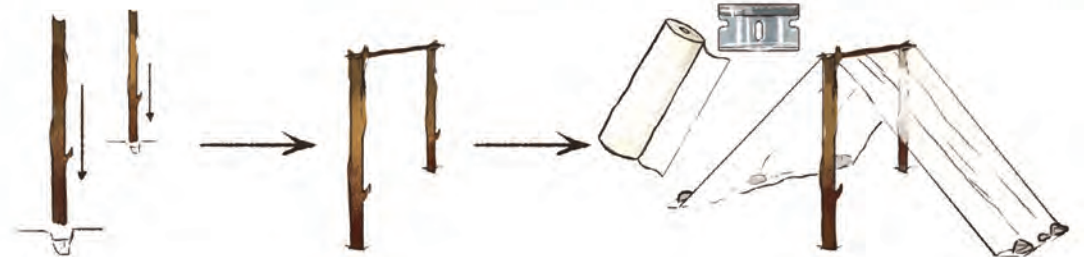
1. Earthquake



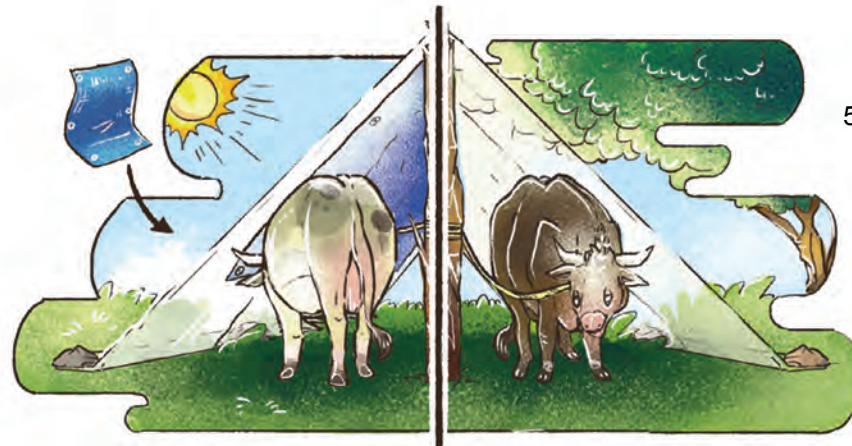
2. Roll of plastic or tarpaulin



3. Razor blade for cutting



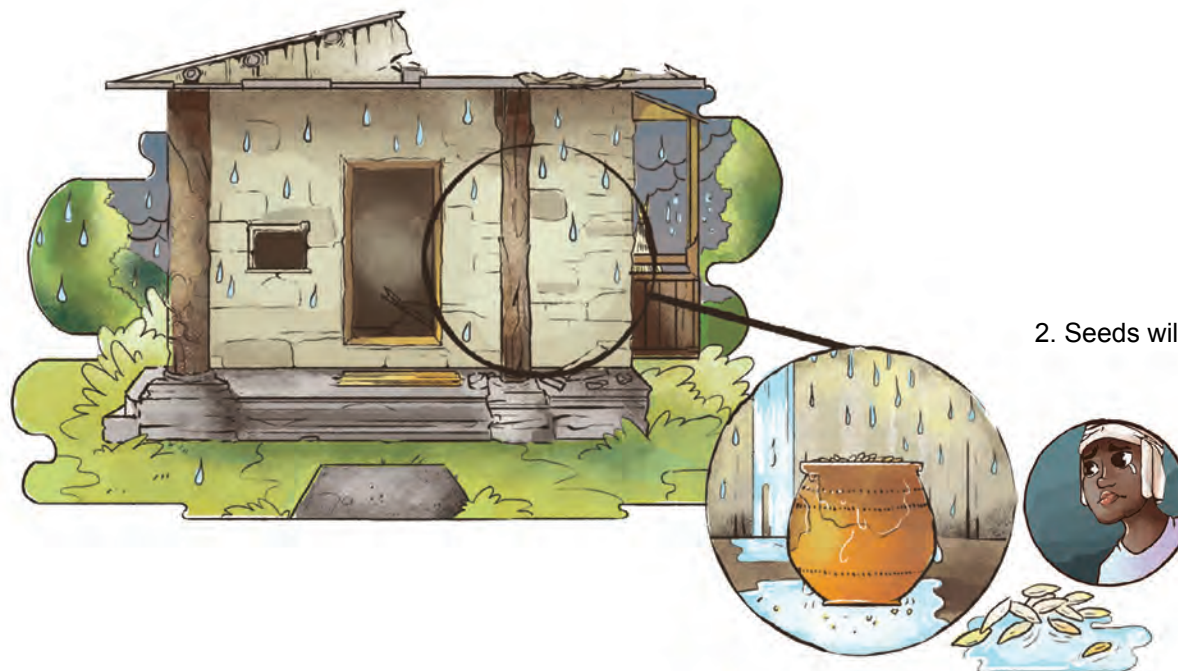
4. For shade, add dark tarpaulin or dark cloth



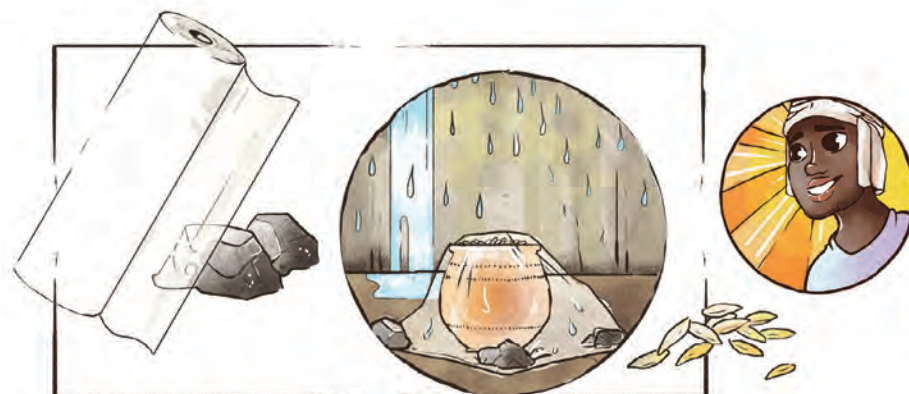
5. For shade, use trees

Lesson: A roll of plastic or tarpaulin, or a bag may be used to protect seeds or food from rainfall

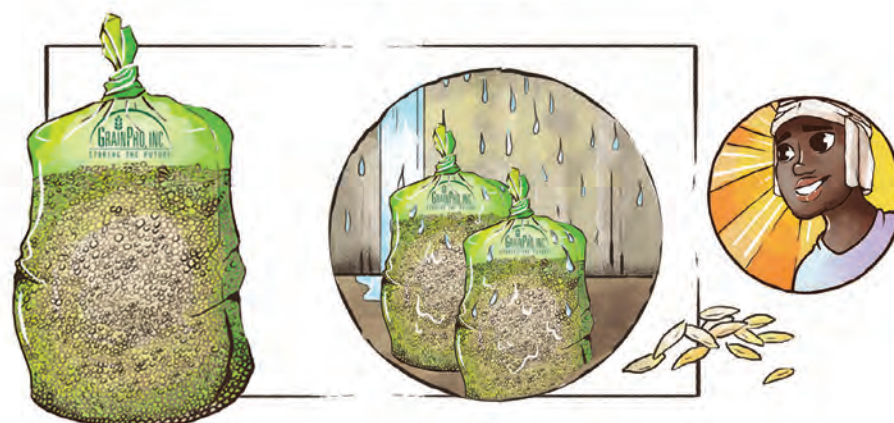
1. Earthquake causing damage to home or granary



2. Seeds will be damaged by rain



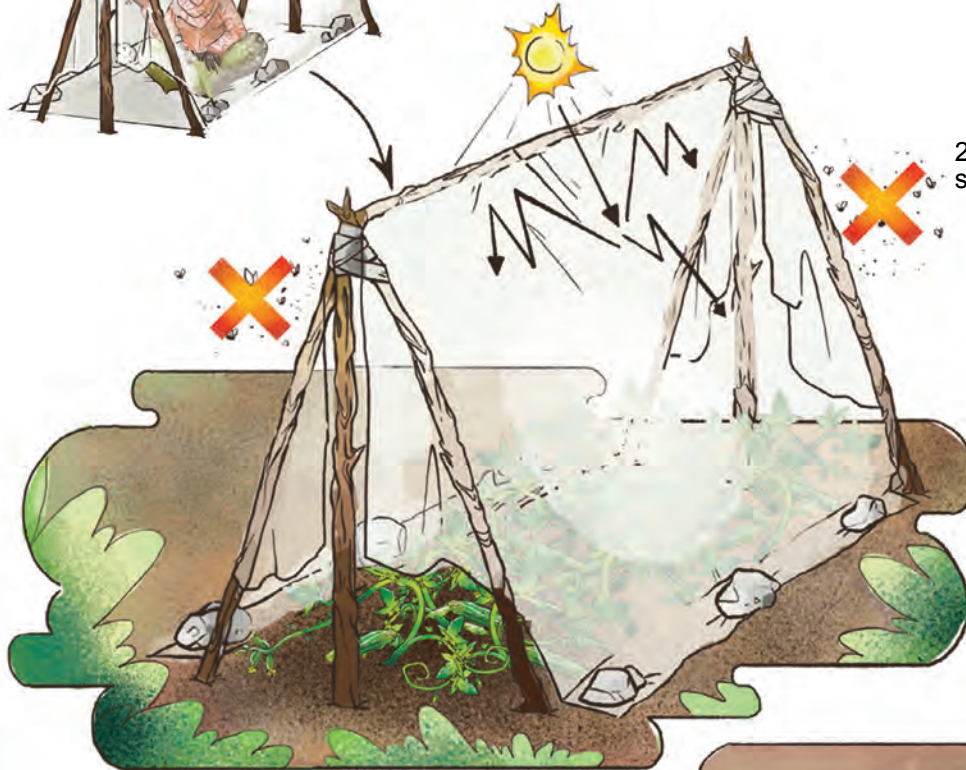
3. Roll of plastic or tarpaulin will protect seeds



4. Plastic bag will protect seeds from rain. A special bag from Grainpro will also protect seeds from insects and mold

Lesson: A tent shelter can be re-purposed later into a greenhouse or shade house for plants

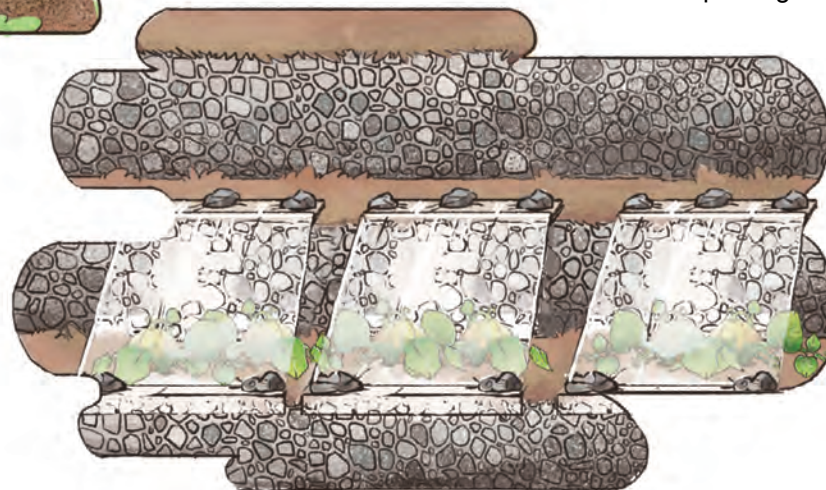
1. Tent



2. If clear plastic, then use as a greenhouse in the winter season, or to protect against insects.

3. If dark plastic, then open sides of tent and use as a shade house to assist young vegetable seedlings to grow.

4. Example of greenhouse on terrace



Lesson: Tarpaulin or plastic used for tent shelters can be re-purposed to prevent weeds in home gardens

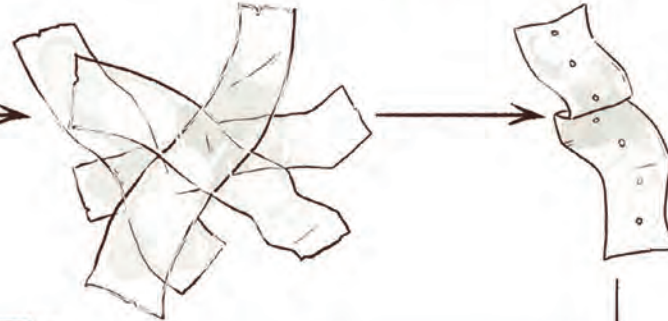
1. Vegetable garden with weeds



2. Tent



3. Cut



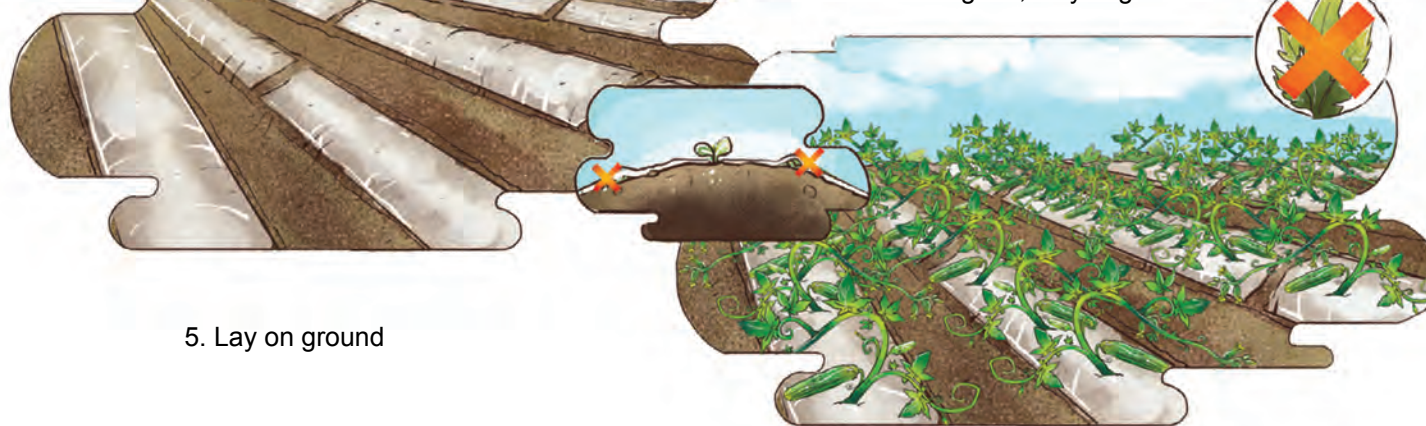
4. Create holes to insert vegetable seeds

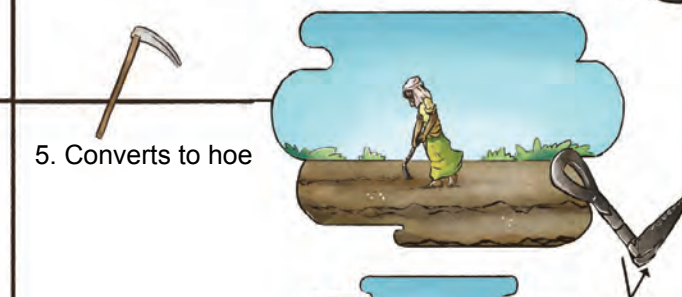
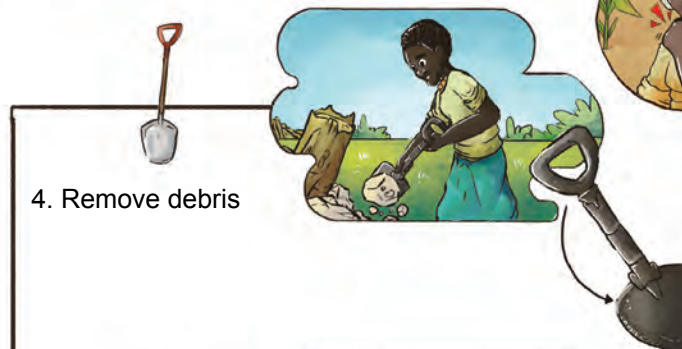
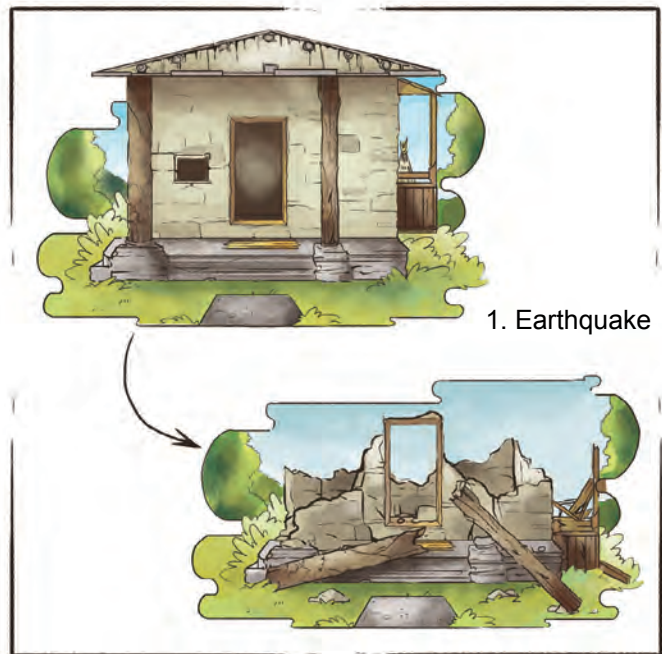


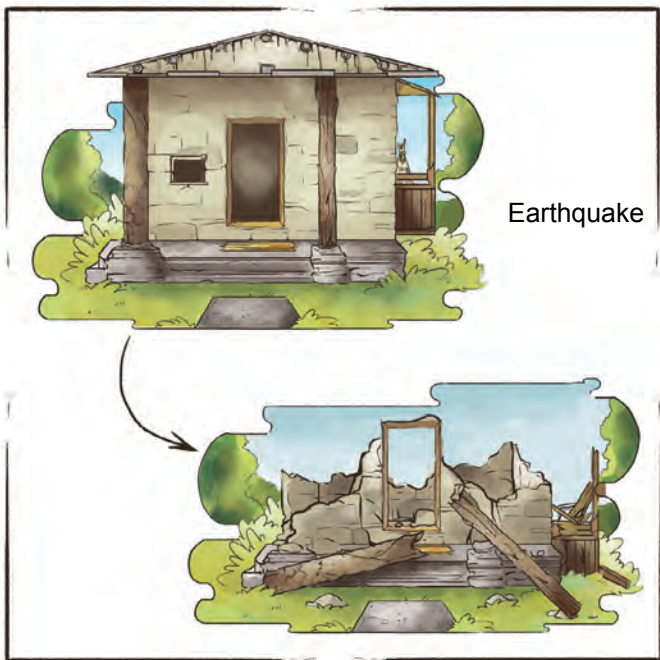
6. Weeds cannot grow, only vegetables



5. Lay on ground







2. Gloves protect hands

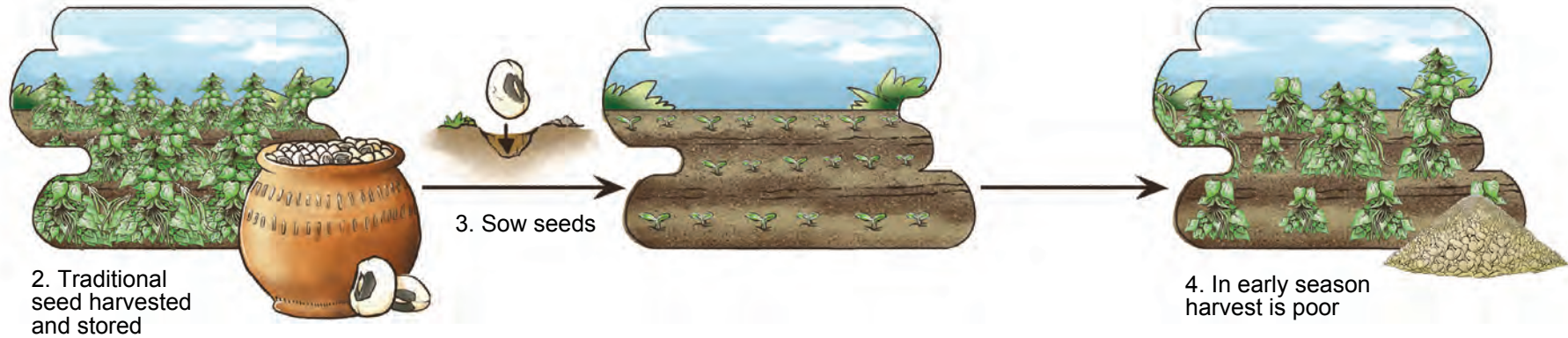


3. Re-use gloves during farming

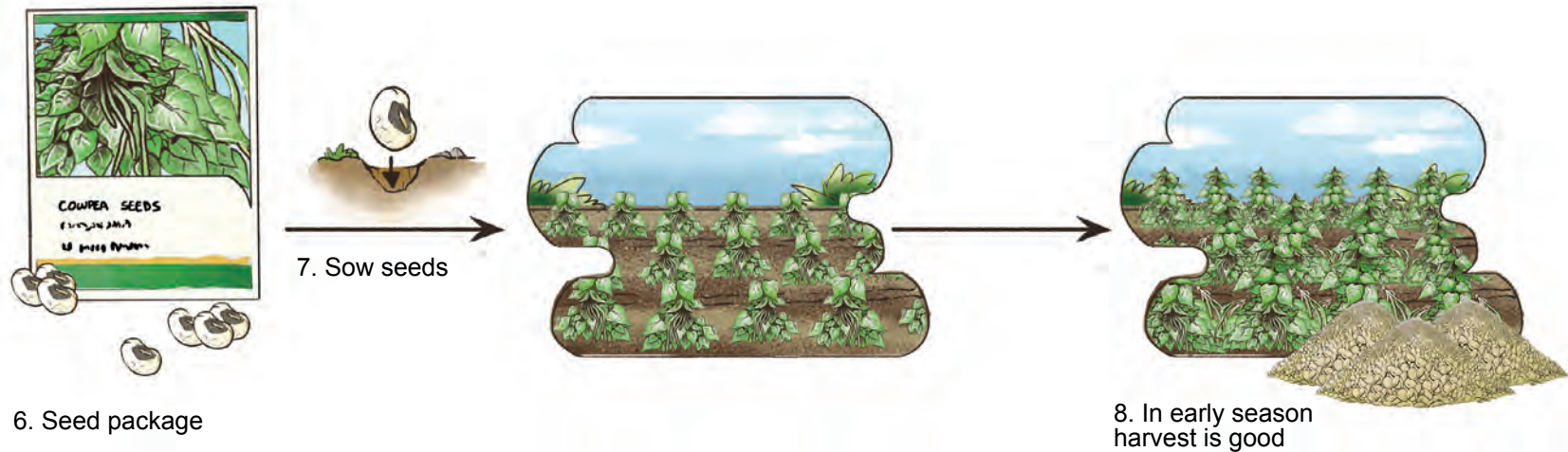


Lesson: Seed package contains an early maturing variety to produce food early

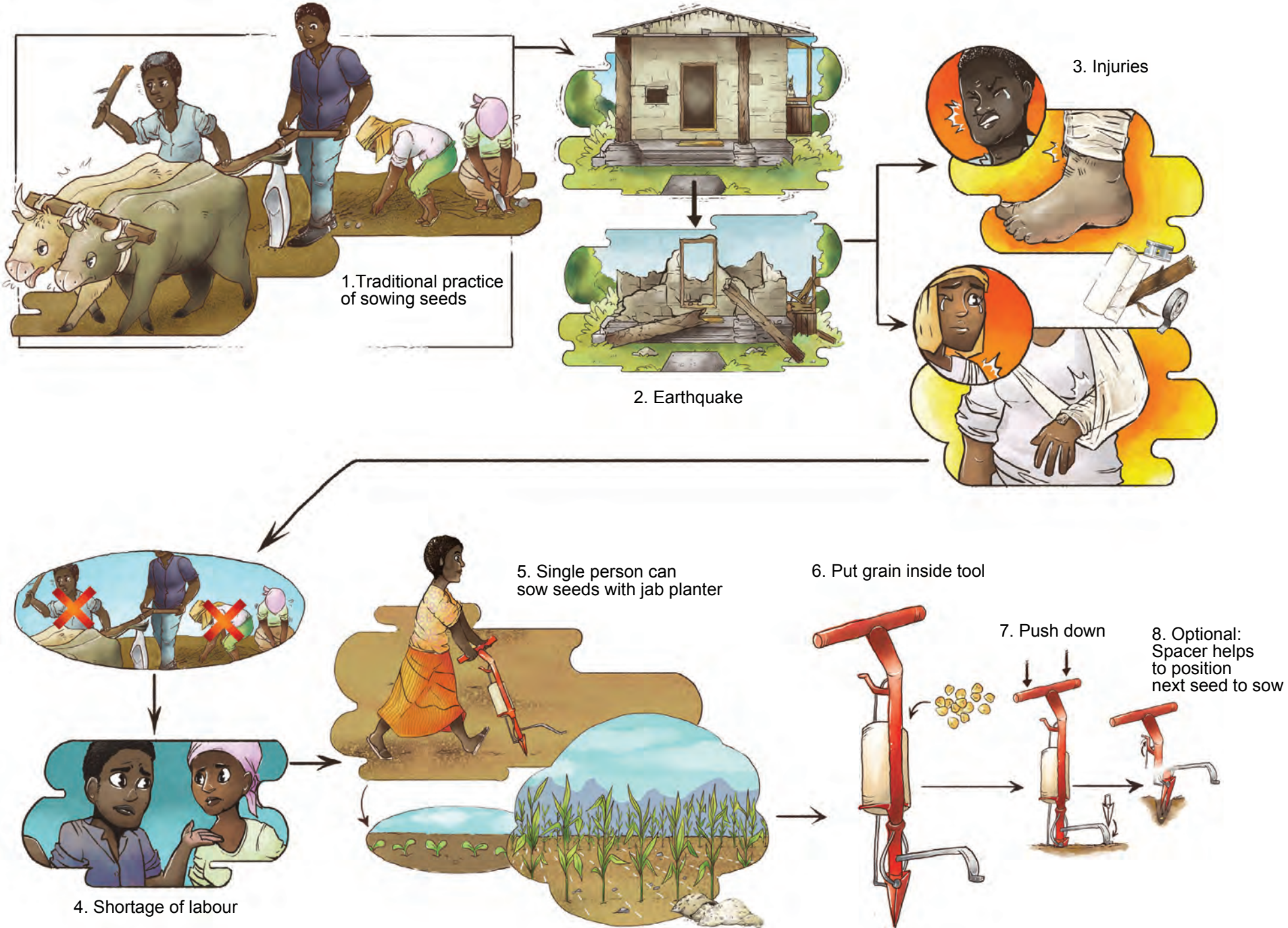
1. Traditional seed variety



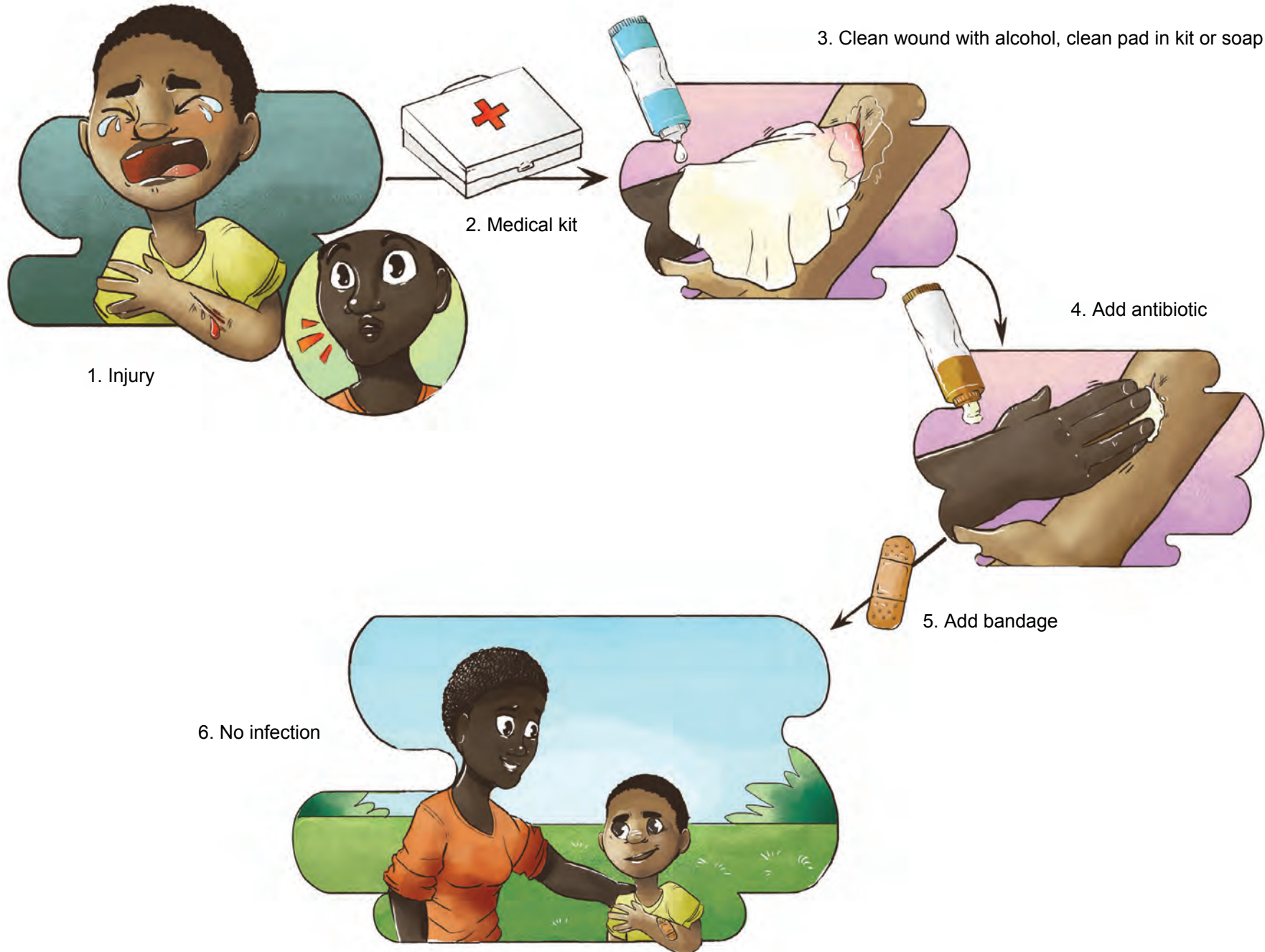
5. Early maturing seed variety



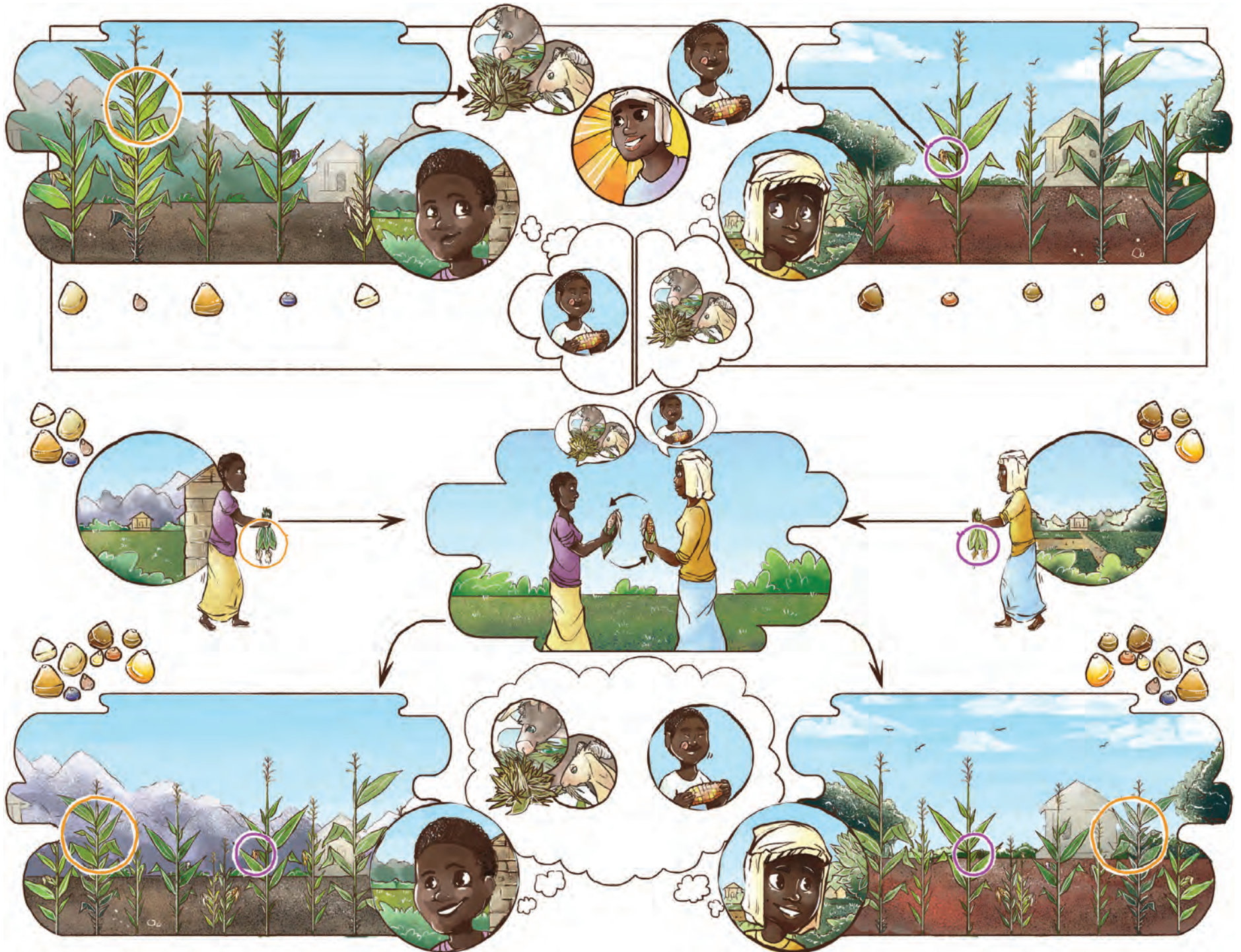
Lesson: A job planter reduces labour required to sow seeds



Lesson: After a cut, clean wound, then apply antibiotic to the wound, before adding a bandage to prevent infection



Bonus Chapter: *Alternate Versions*



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