

A Picture Book of Best Practices for Subsistence Farmers: North African version

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Global Affairs
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IDRC
International Development
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développement international

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



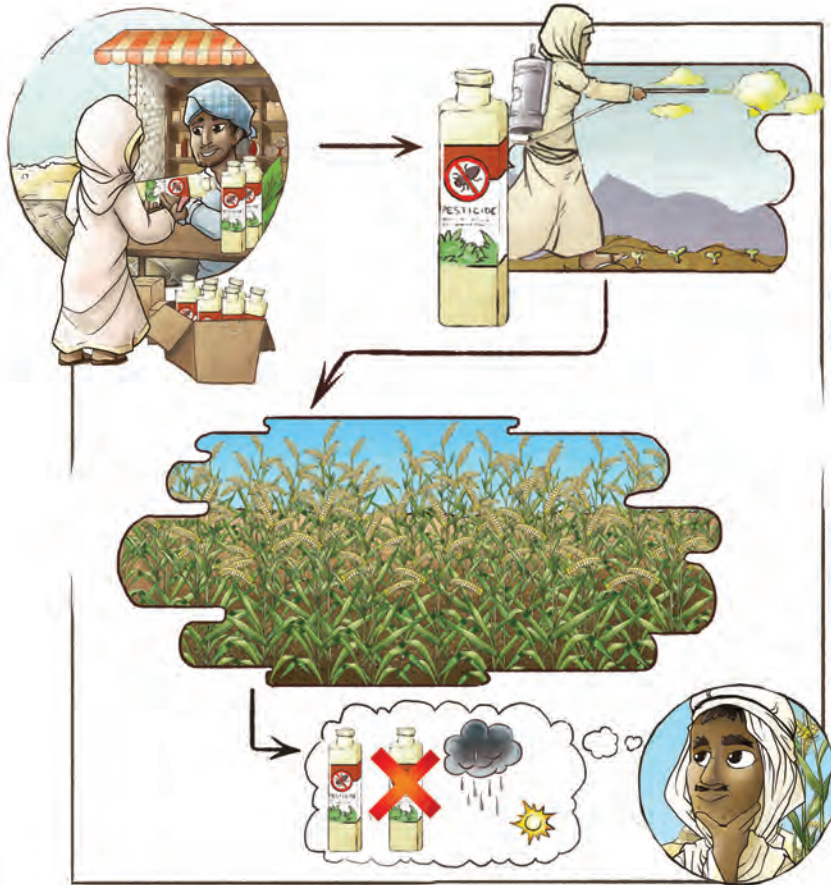
Lisa J. Smith graduated from the Graphic Design Diploma program at Conestoga College in Kitchener, Ontario, Canada in 2014, with her main focus in illustration. In early 2015, Lisa was selected as part of a national competition onto the SAKGlobal team as the illustrator for the picture book along with 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.

Lisa can be contacted by email at smithjaylisa@gmail.com

Chapter 1: Scientific Method

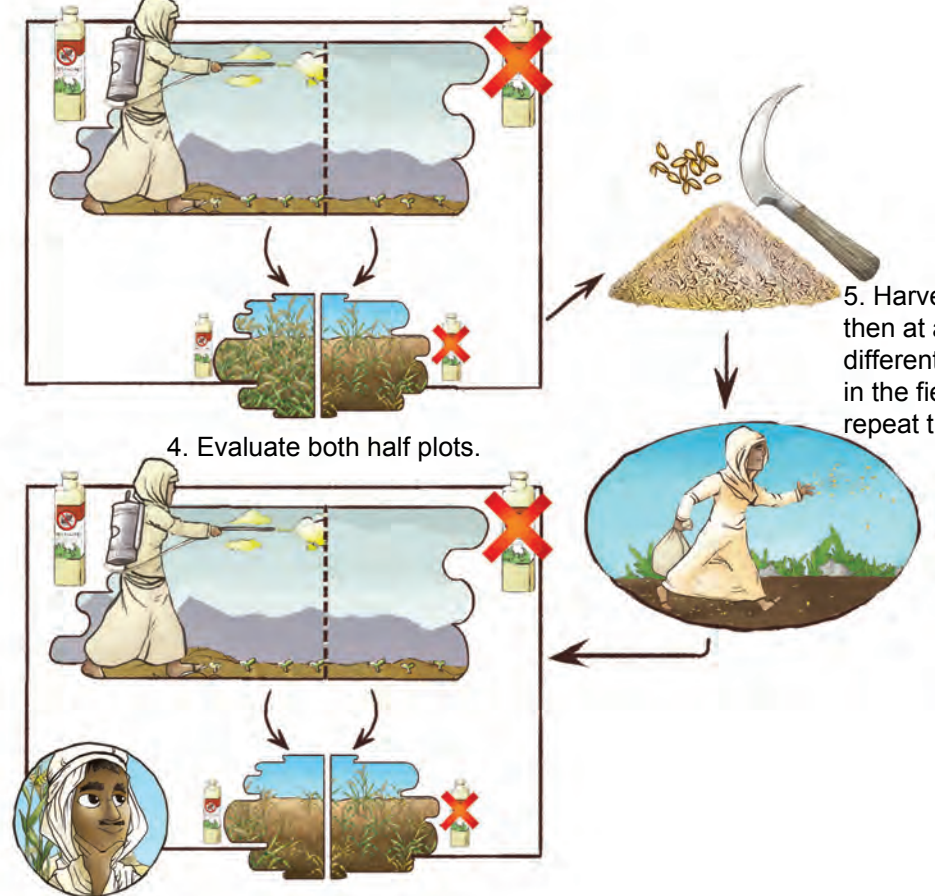
Lesson: Before adopting any new product (e.g. pesticide) or practice, it is important to test it on a small plot using a scientific method.

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.

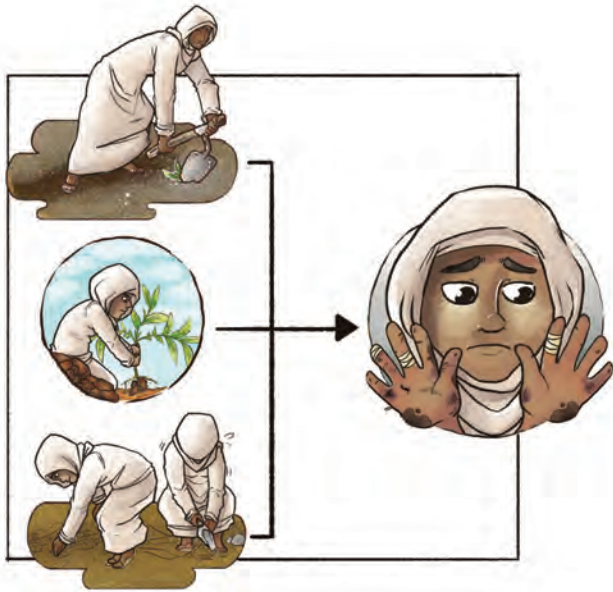
6. Evaluate both half plots (second trial). If the new seed or product resulted in benefits in both years, then it is beneficial.

5. Harvest, sow, then at a different location in the field, repeat the test.

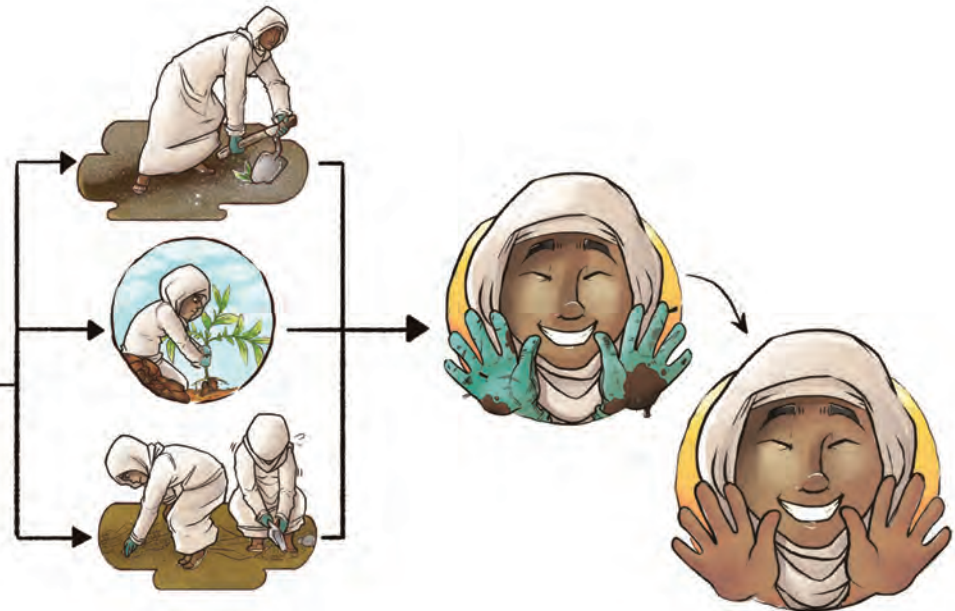
Chapter 2: Land Preparation & Sowing

Lesson: Gloves reduce pain and damage to hands.

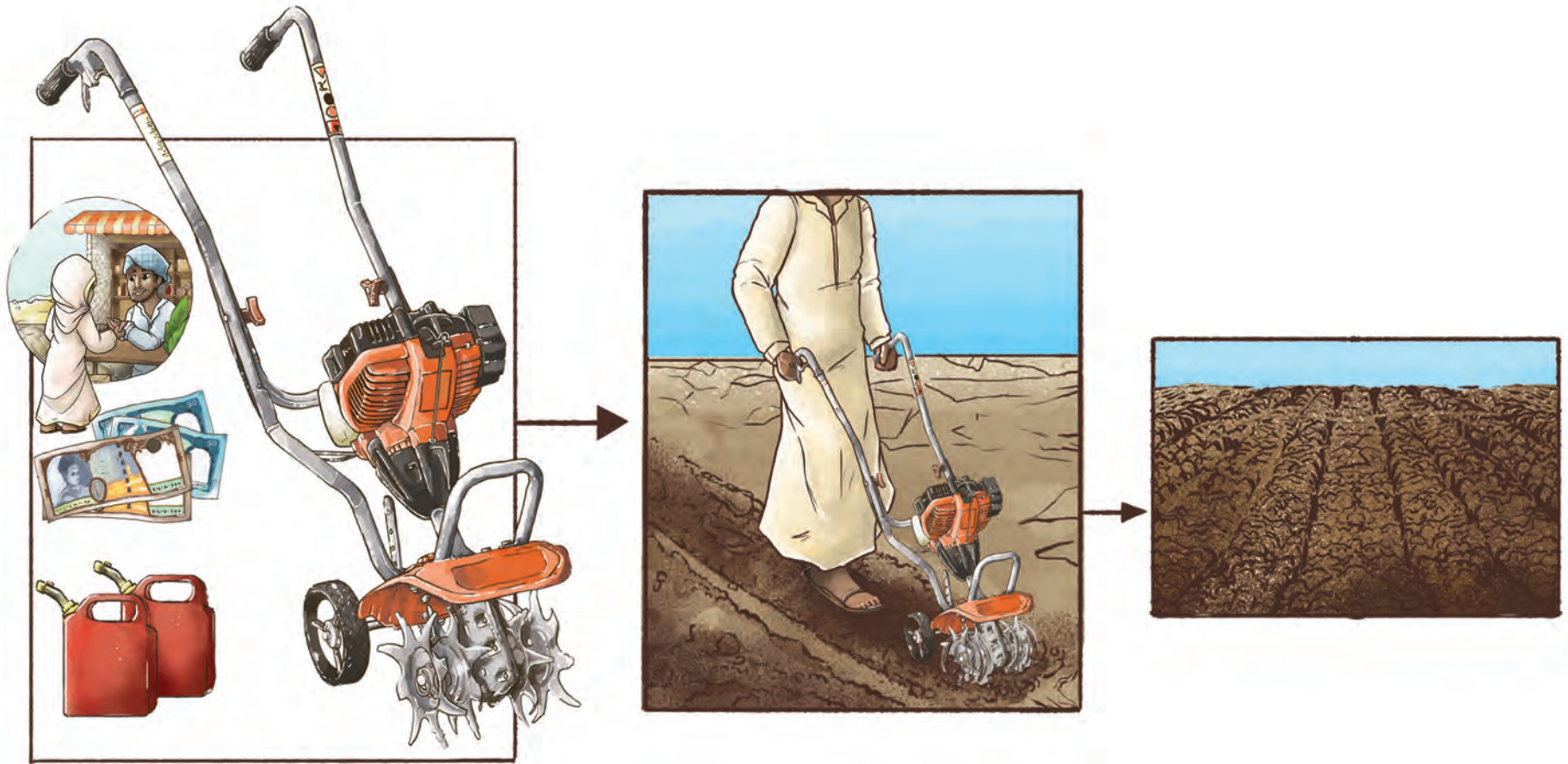
1. Traditional practice



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



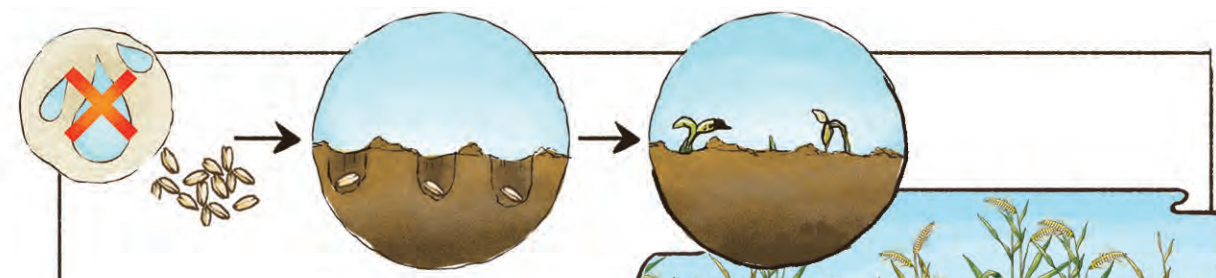
Lesson: New tool to prepare field



1. Petrol mini-tiller

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

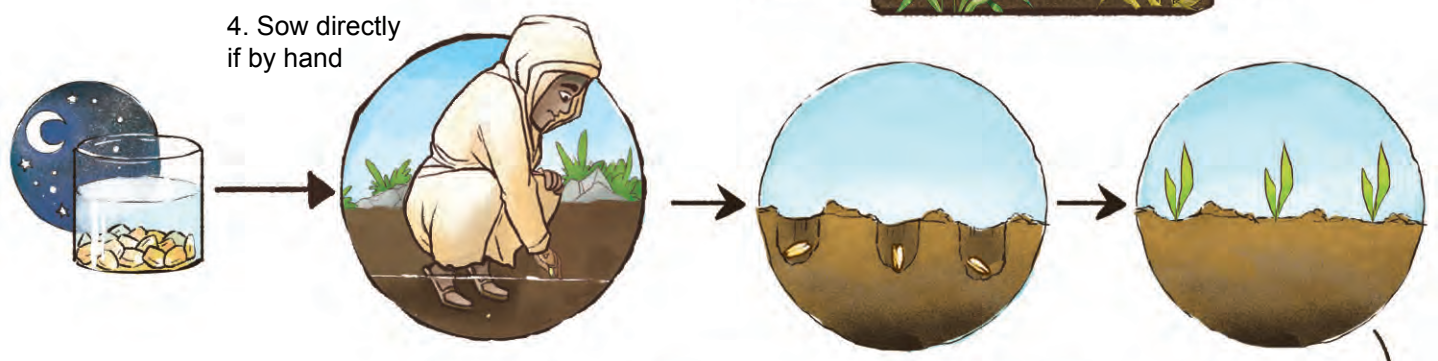
1. Traditional practice is to sow seeds dry



2. Poor germination, sick plants



3. Improved practice is to soak seeds overnight first



4. Sow directly if by hand

5. Improved germination, healthier plants

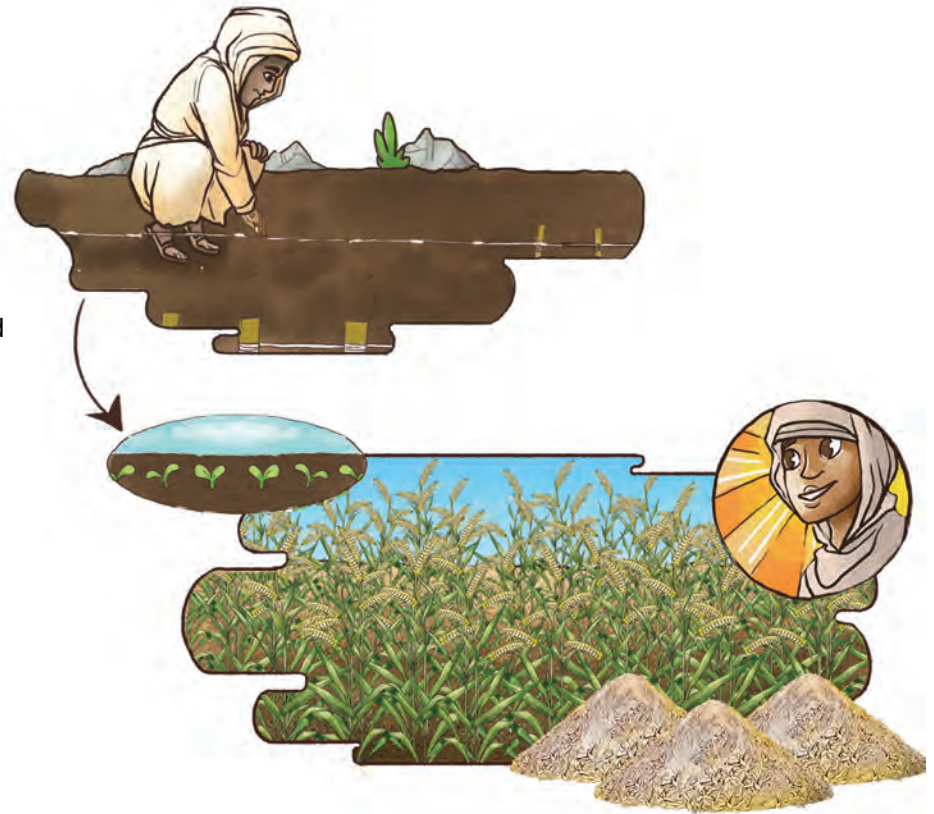


Lesson: Sowing seeds in rows can improve yields compared to broadcasting



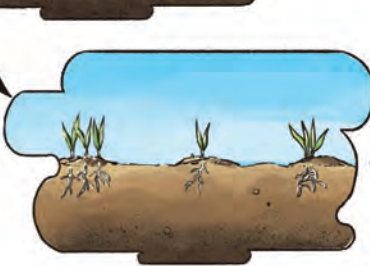
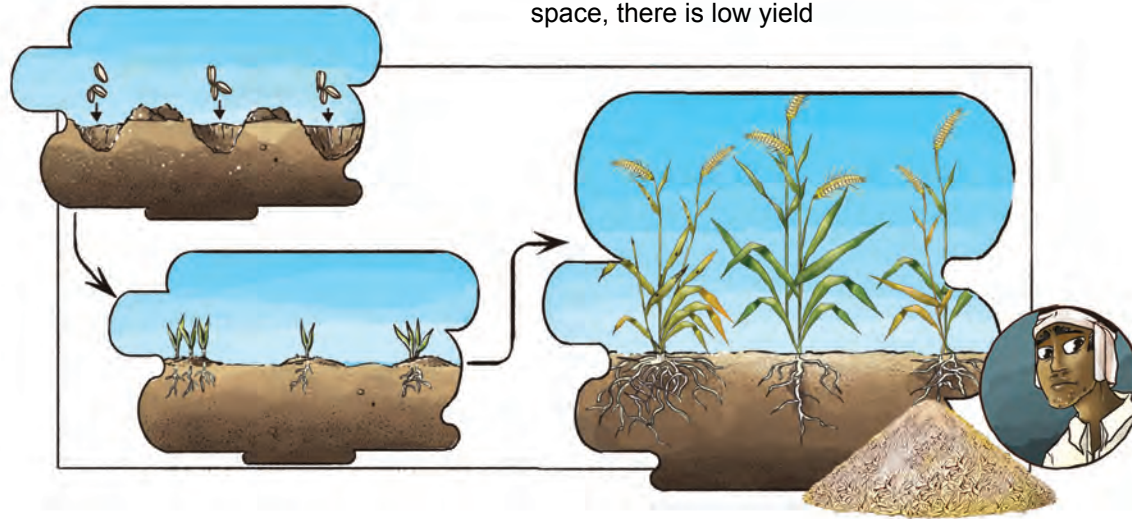
1. Traditional practice: broadcasting

2. Improved practice: line sowing allows each plant to have equal access to sunlight and nutrients, and permits weeding and inspection for disease/pests

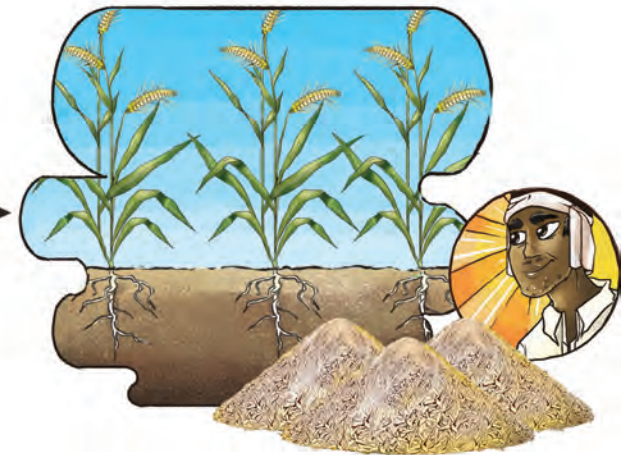


Lesson: Thinning seedling number can improve overall yield

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



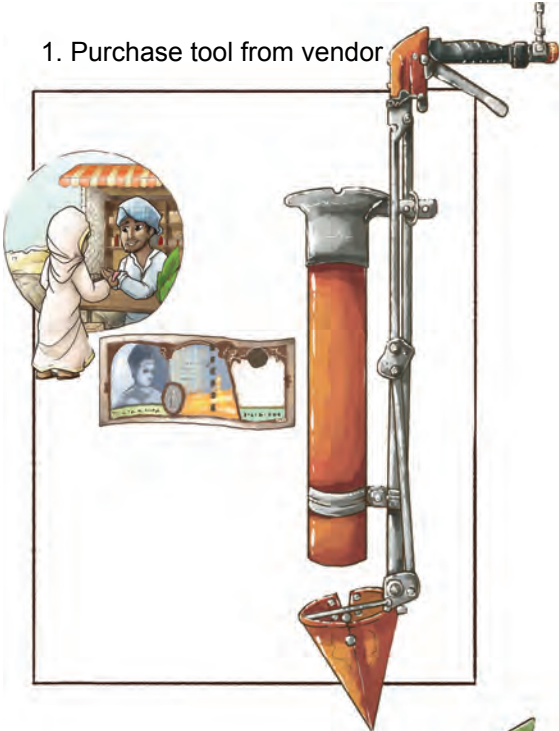
4. Overall yield is higher



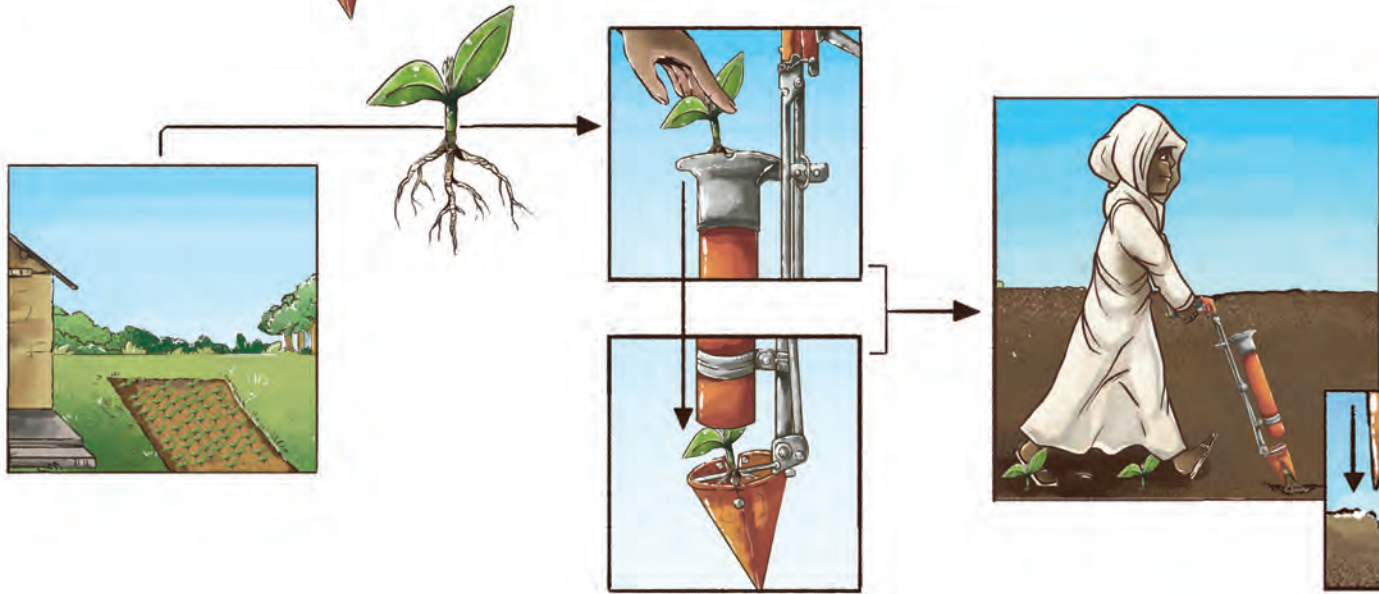
3. Improved practice: after germination, remove extra plants

Lesson: Tools to reduce labour required for transplanting vegetable seedlings

1. Purchase tool from vendor



2. Place seedling on top of machine

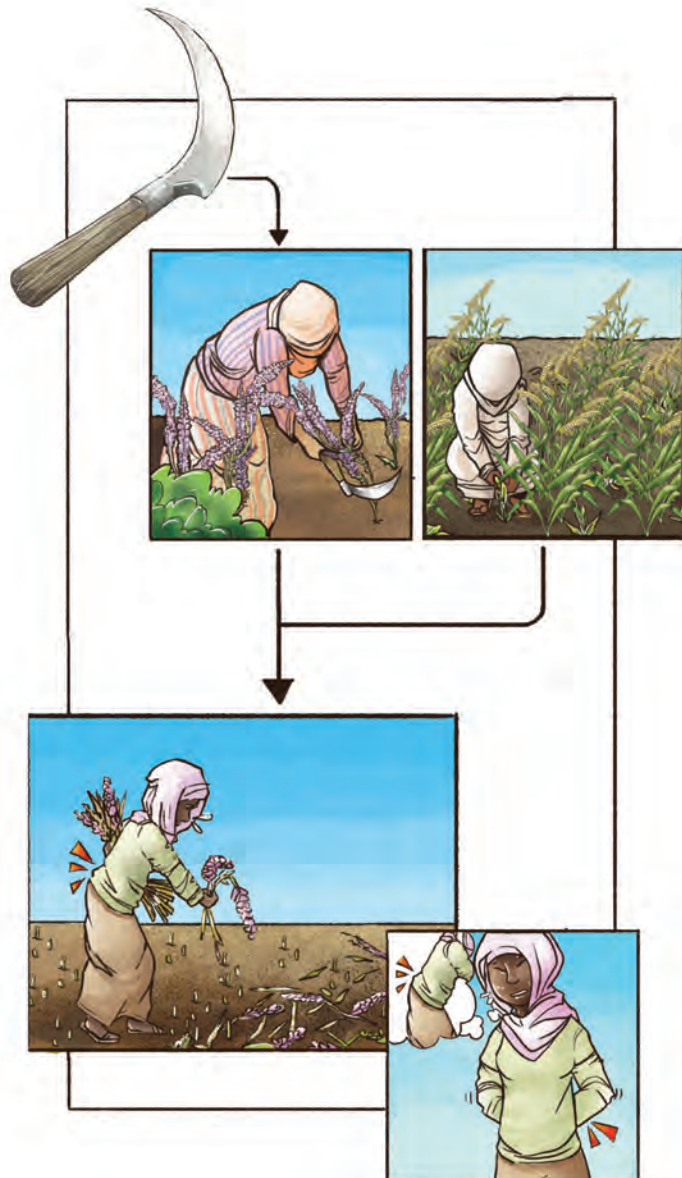


3. Jab machine into ground, and seedling will be sown

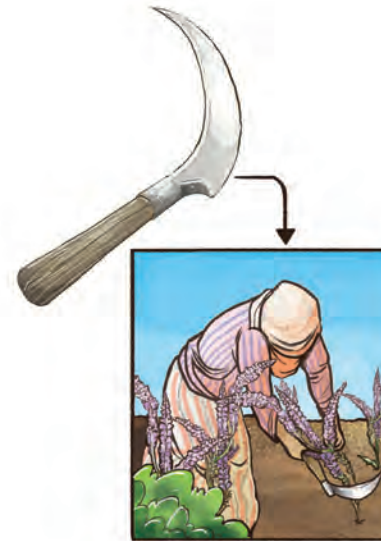


Lesson: A raking tool to help collect weeds, spread manure or other purposes

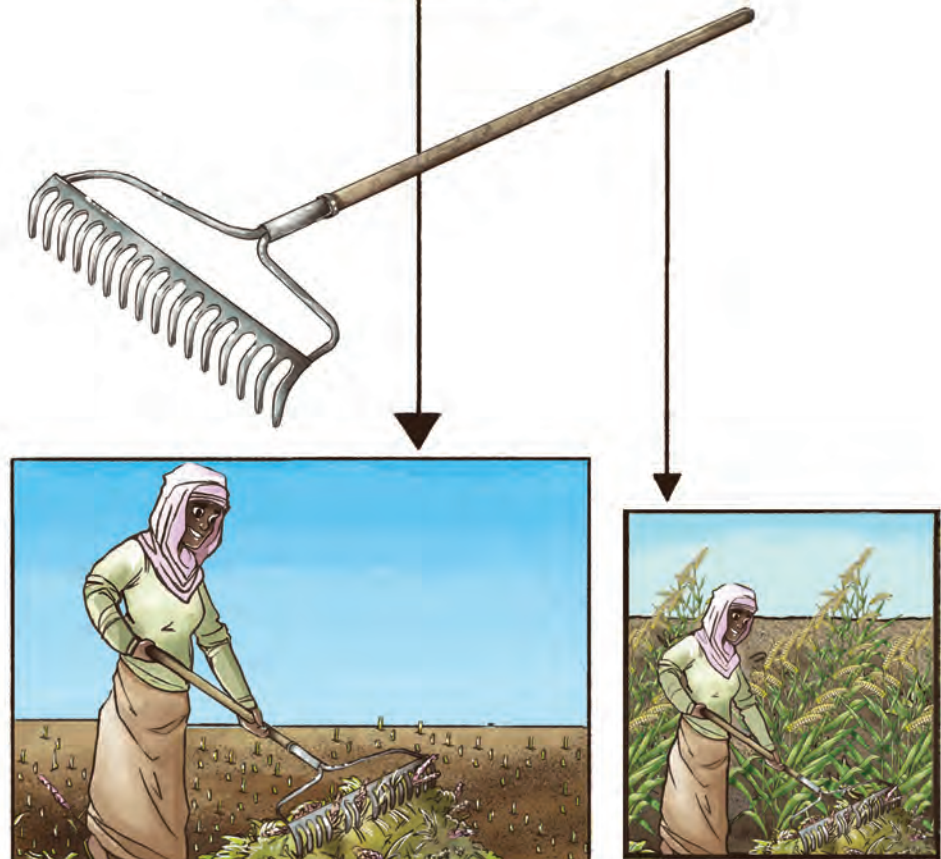
1. Traditional practice



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.



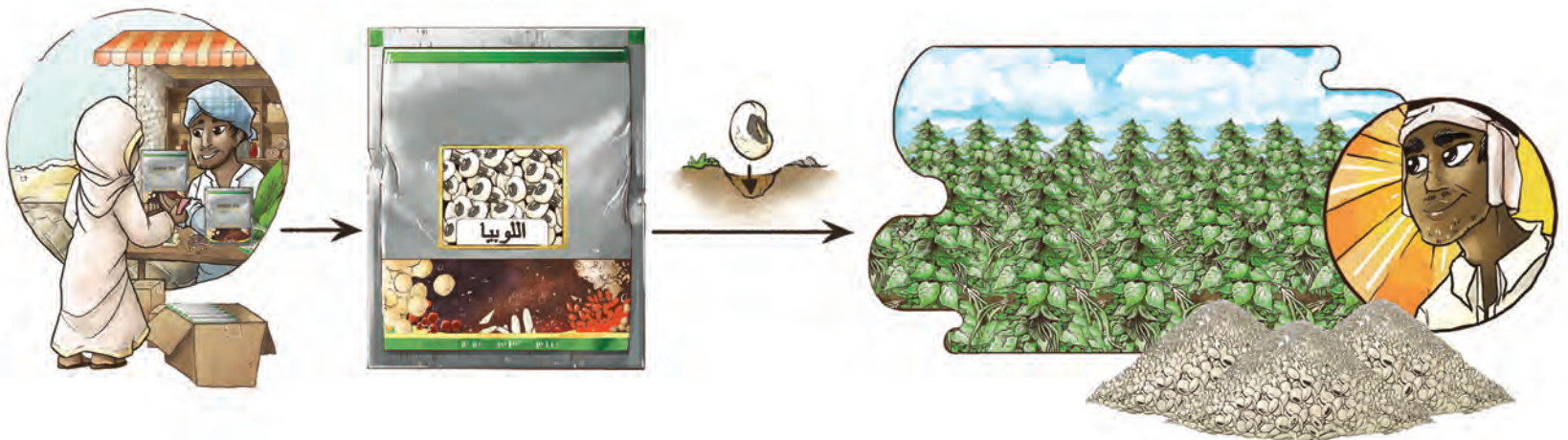
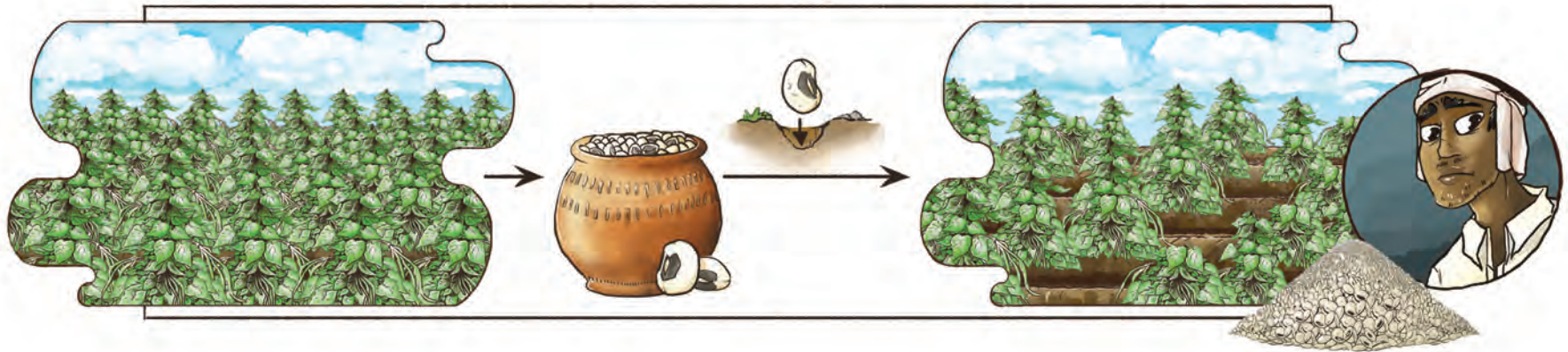
3. Improved practice: purchase a back support from vendor and tie around waist (on top or under clothes)

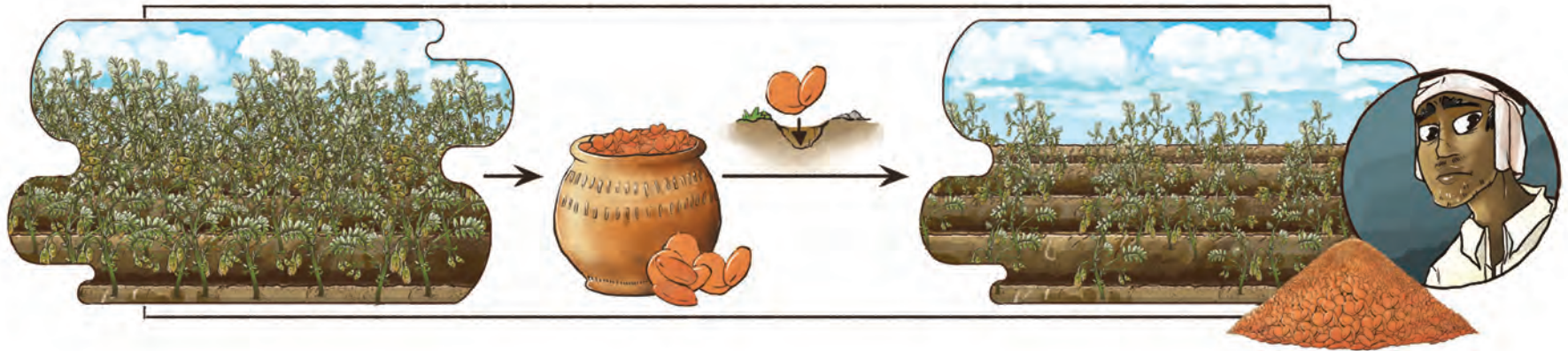


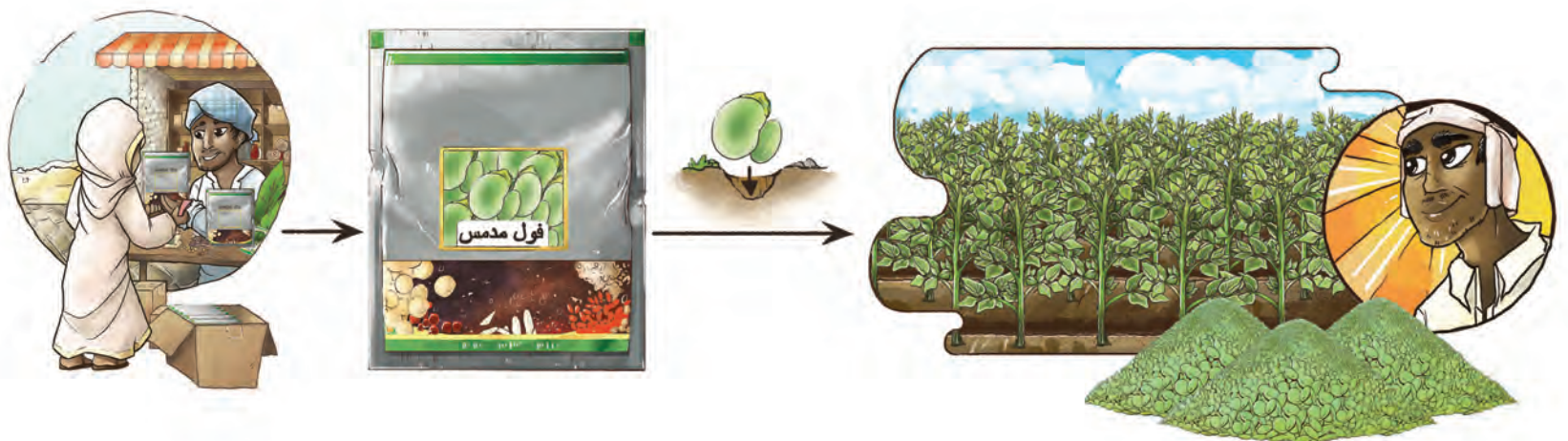
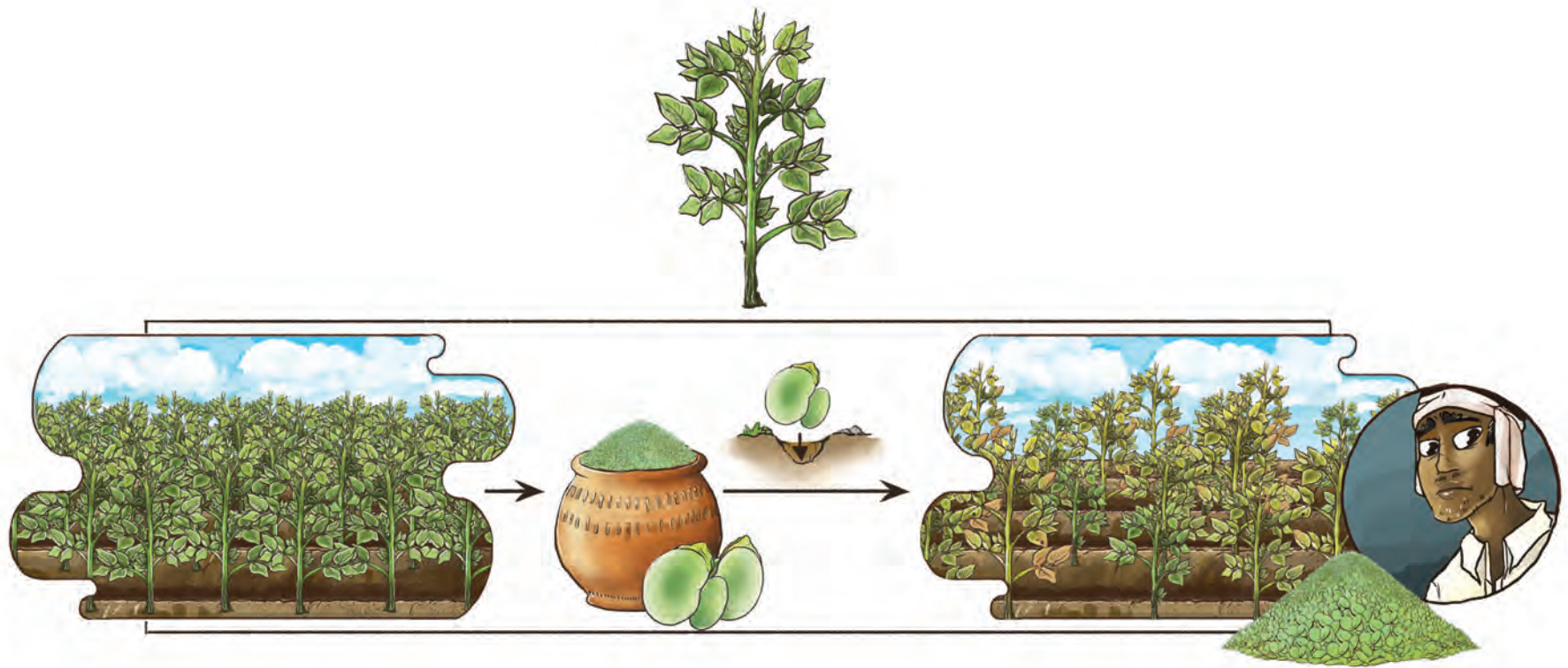
4. Less strain and pain

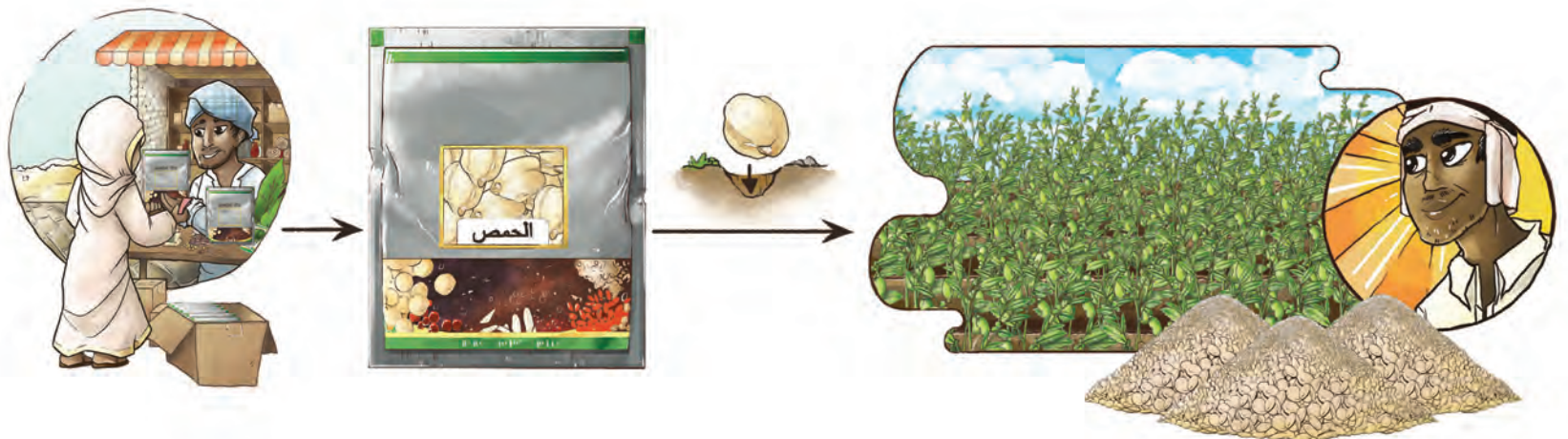
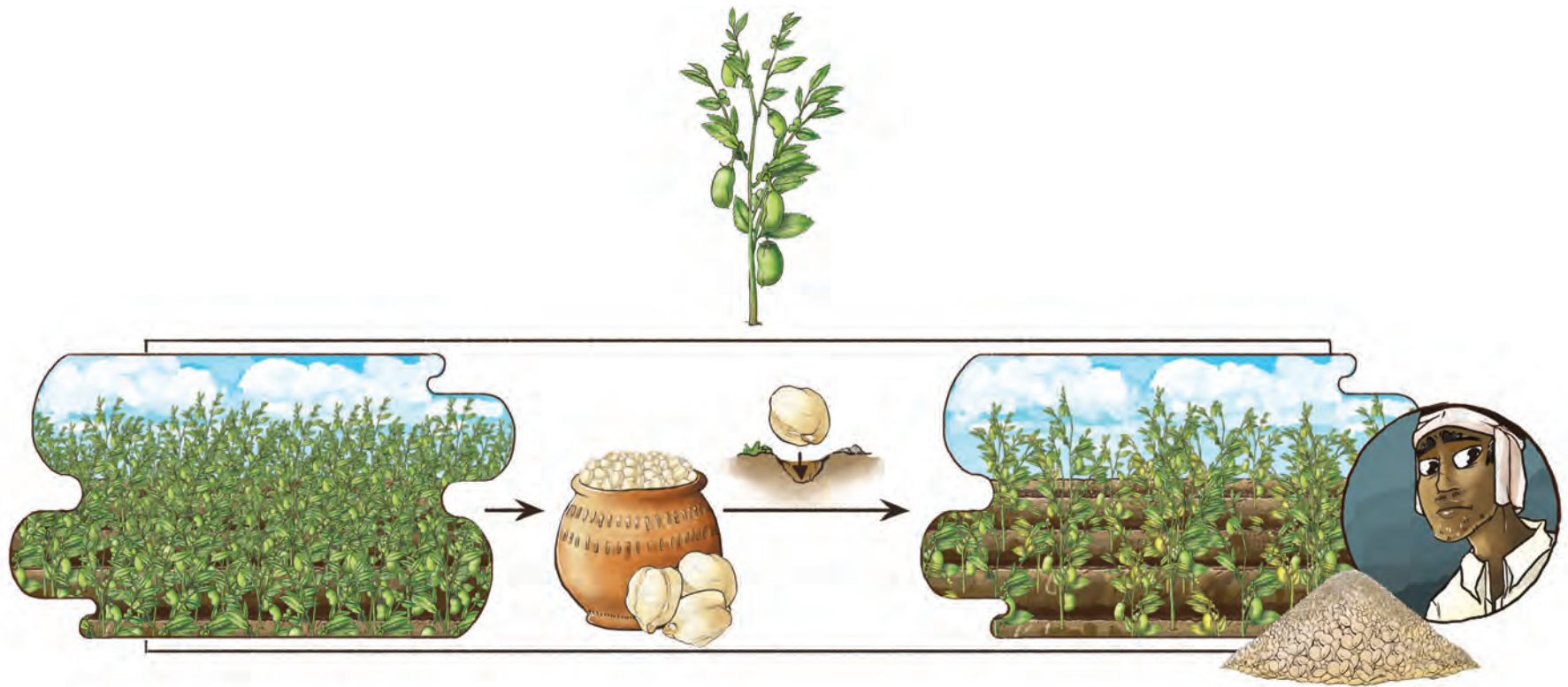


Chapter 3: Crop & Tree Intensification



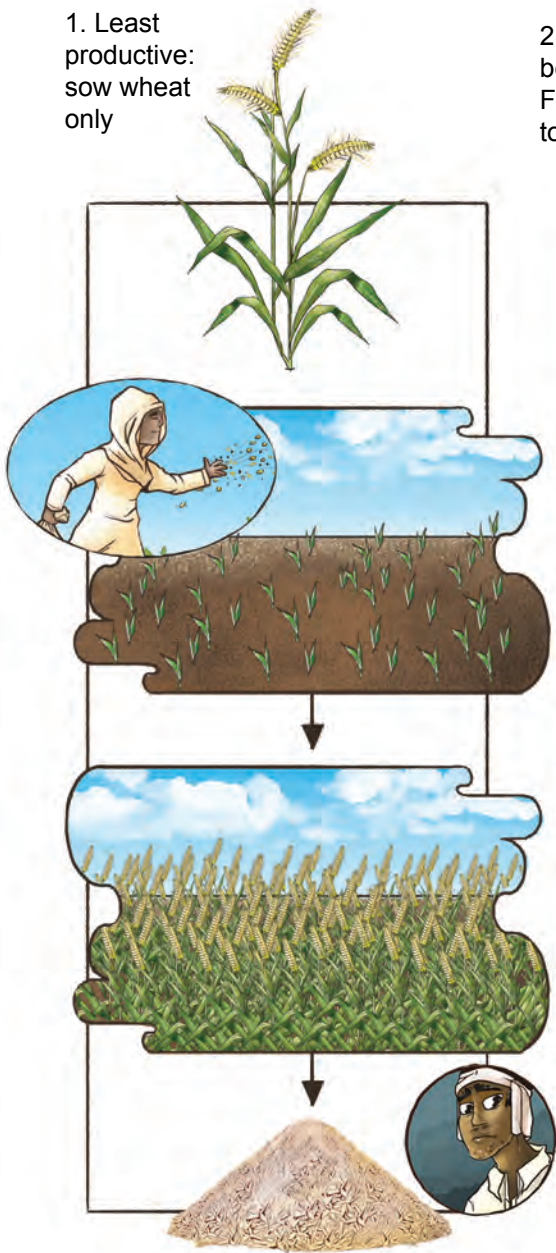




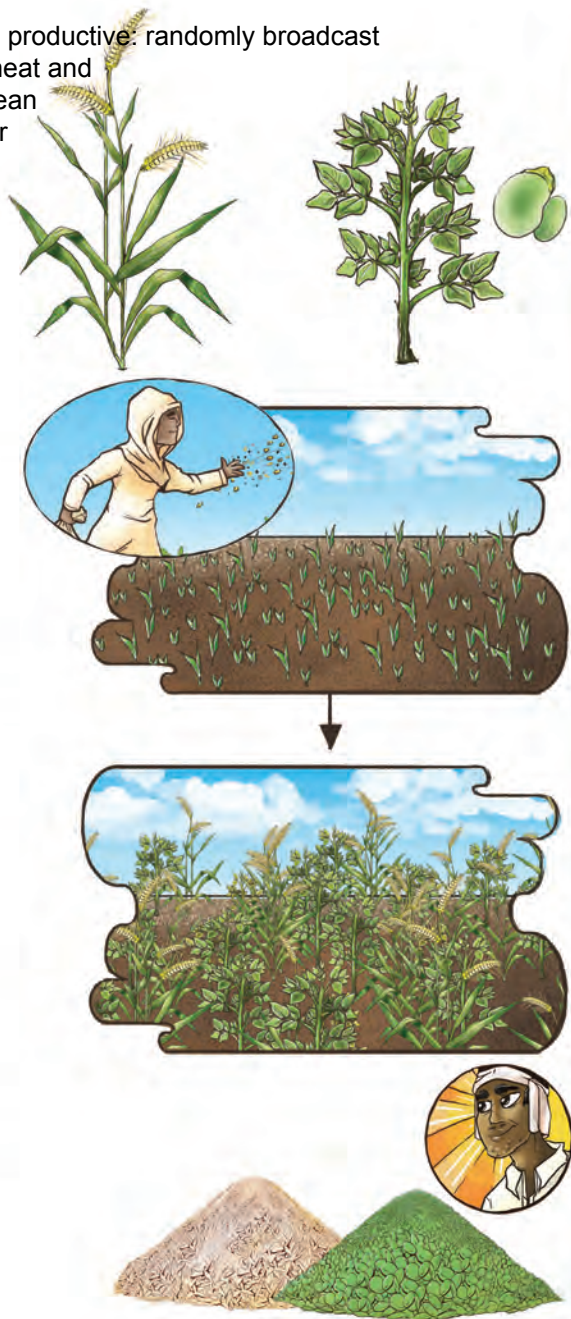


Lesson: Sowing wheat together with Faba bean will yield more profit than wheat only.

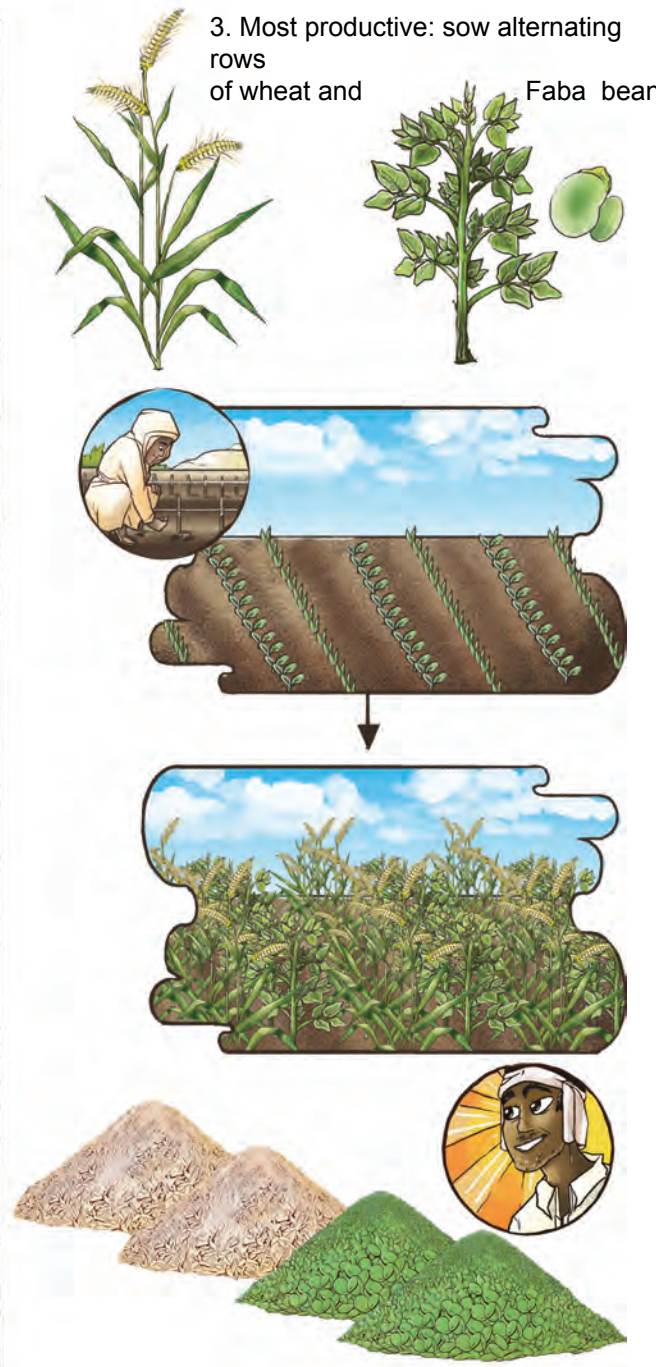
1. Least productive: sow wheat only



2. More productive: randomly broadcast both wheat and Faba bean together



3. Most productive: sow alternating rows of wheat and Faba bean

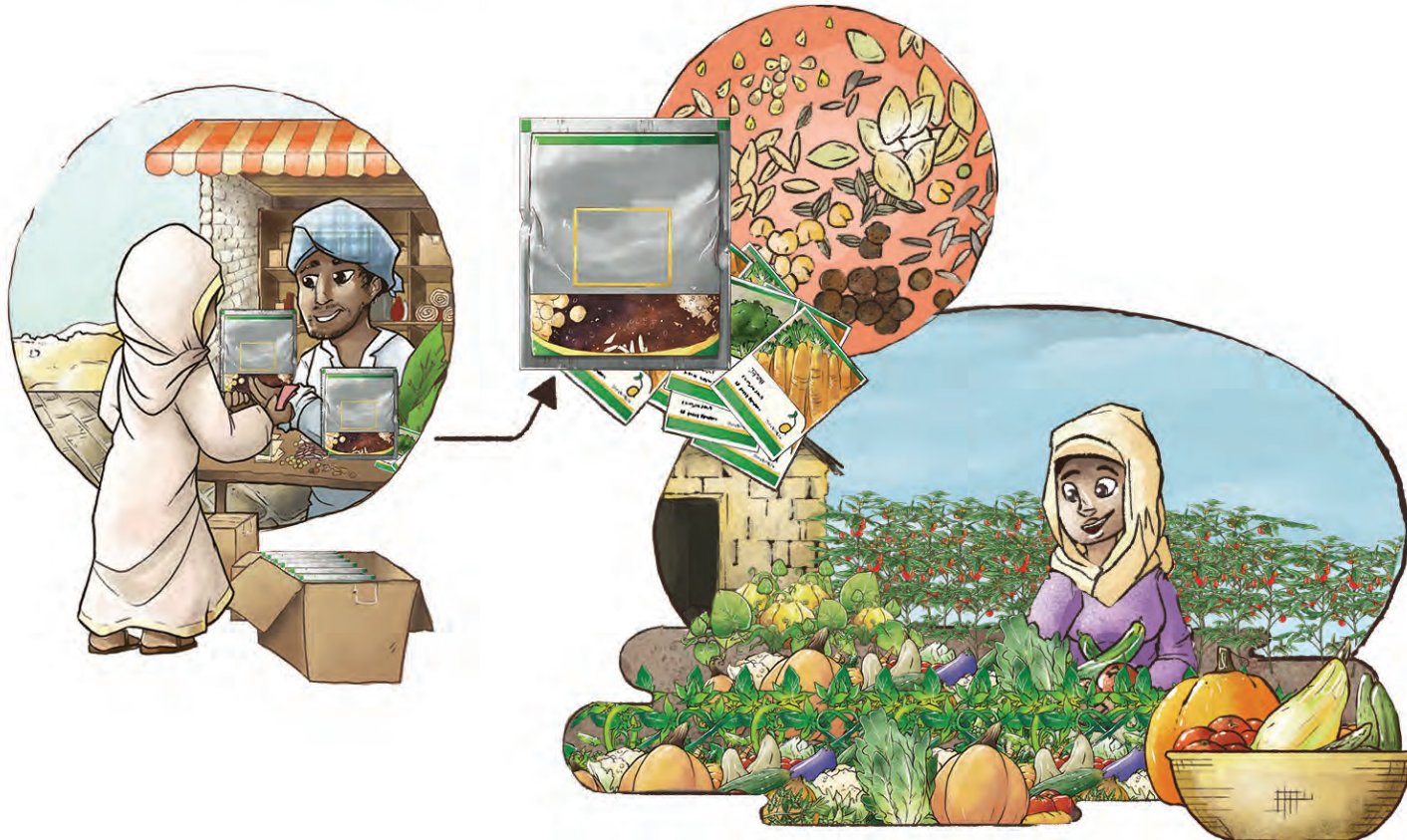


Lesson: A kit of seed packages will increase the types of fruits and vegetables in the garden

1. Traditional: only few types of vegetables



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



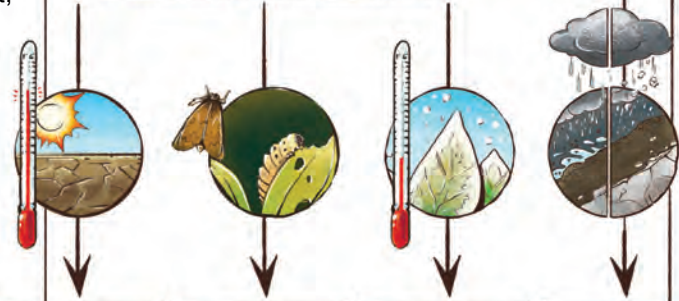
3. Many types of vegetables

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

1. Traditional practice: vegetables uncovered

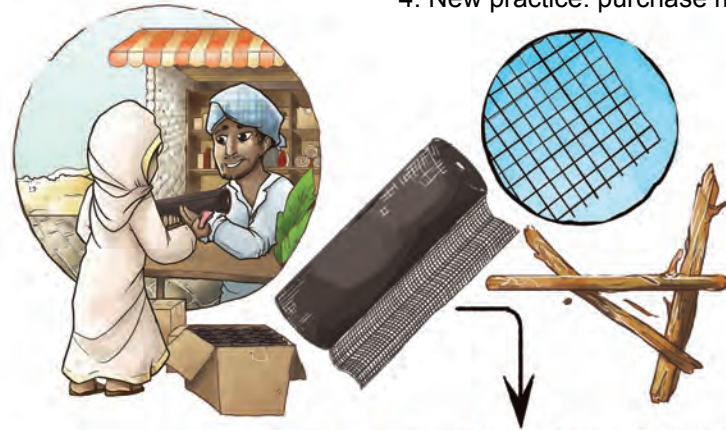


2. Drought, insects, cold or heavy rain damage crops



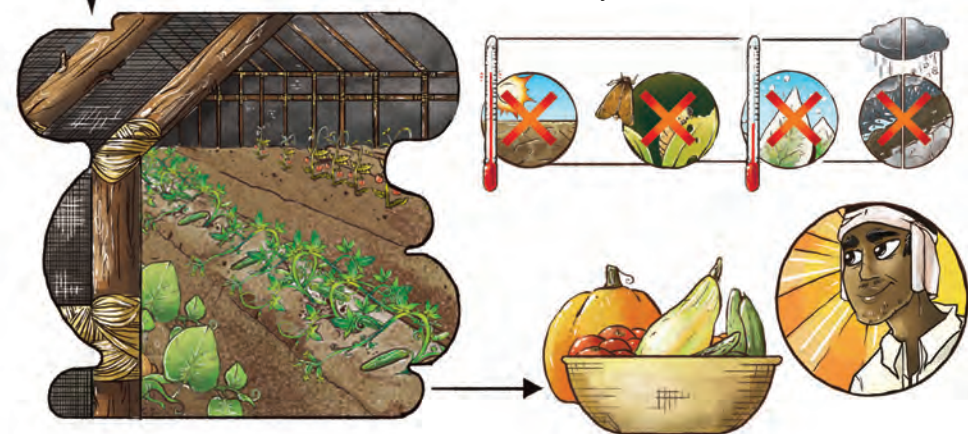
3. Low yield

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



5. Build greenhouse (high tunnel)

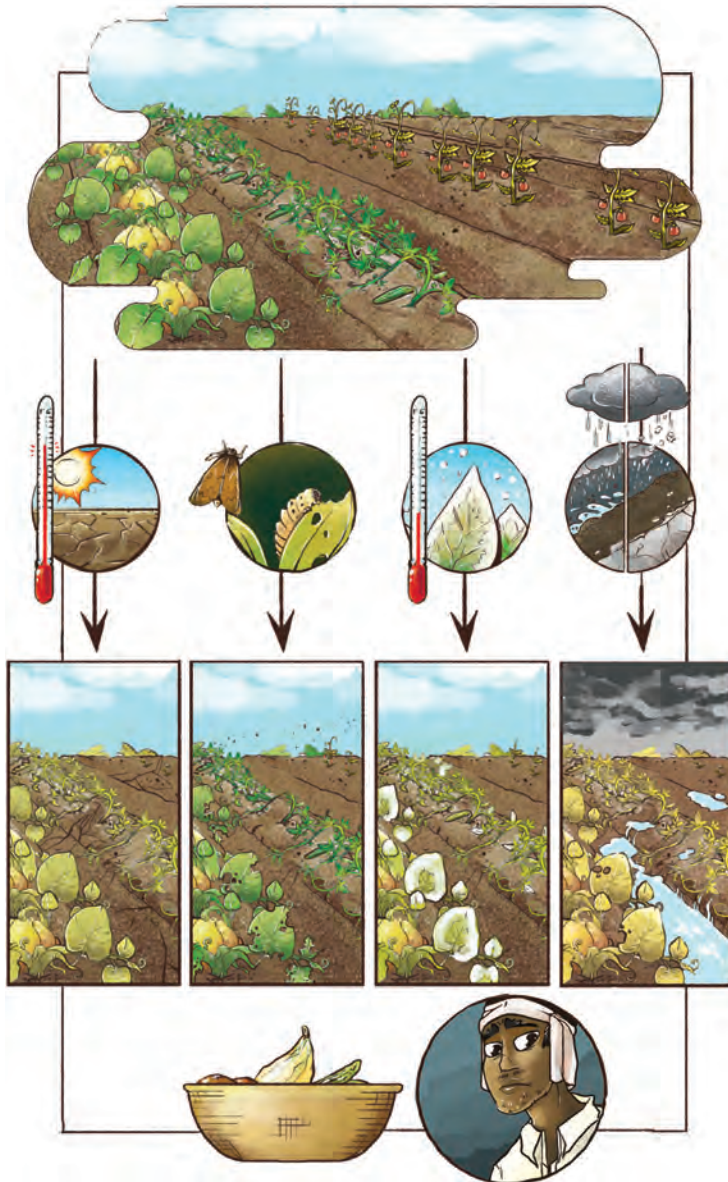
6. Vegetables are protected from drought, insects, cold or heavy rain



7. High yield

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

1. Traditional practice: vegetables uncovered



3. Low yield

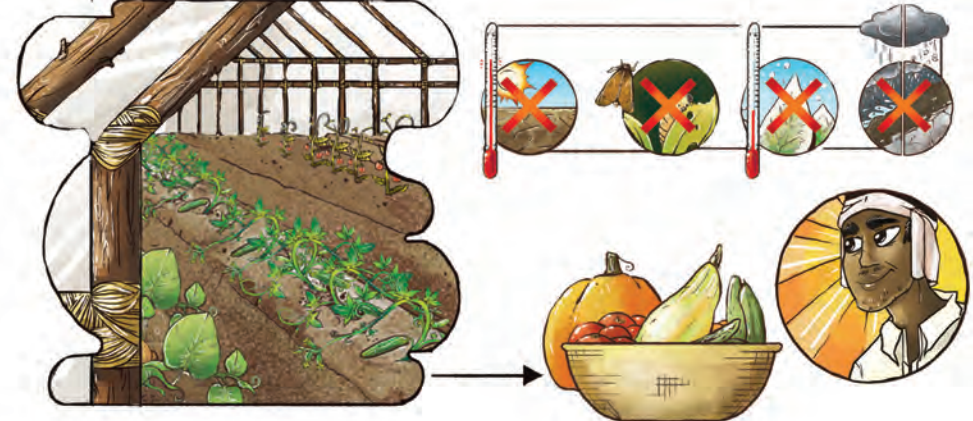
4. Purchase tarpaulin (in colder climate)



5. Build greenhouse (high tunnel)



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



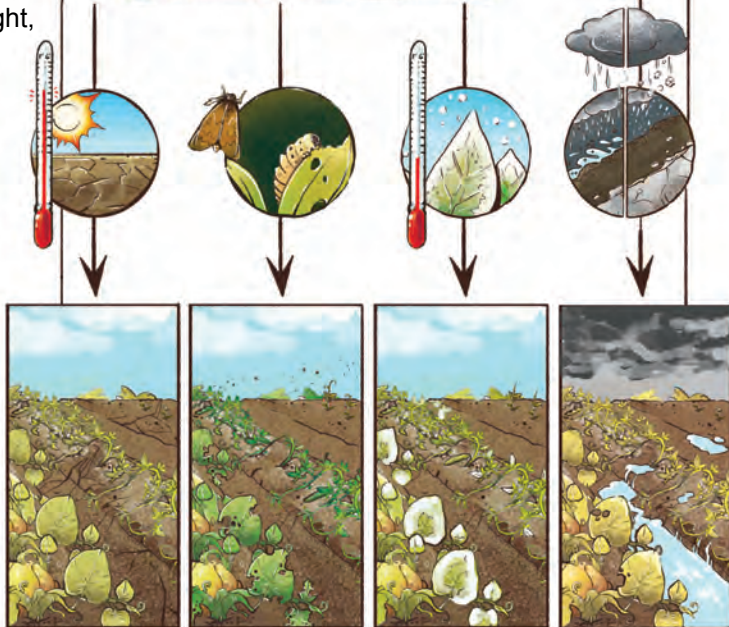
7. High yield

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



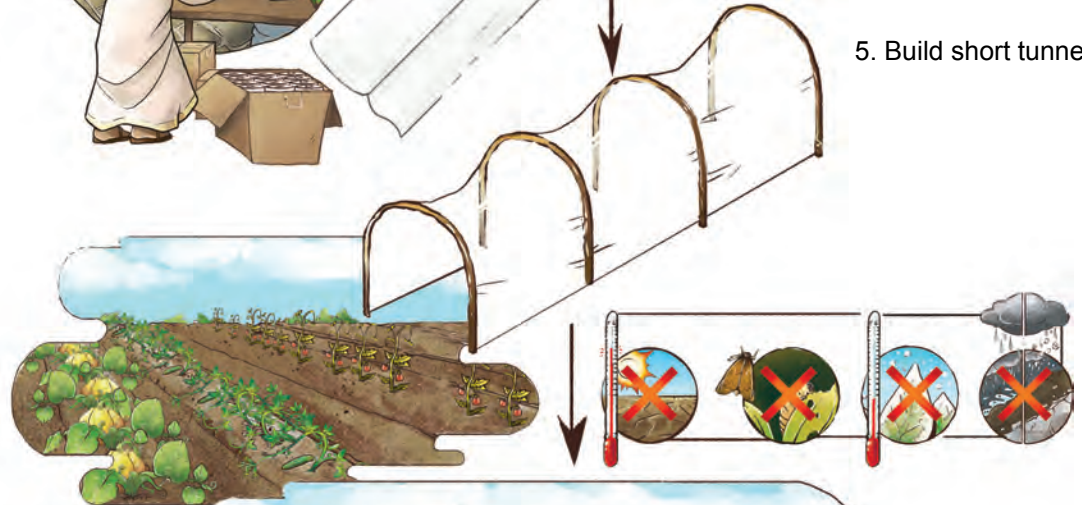
3. Low yield



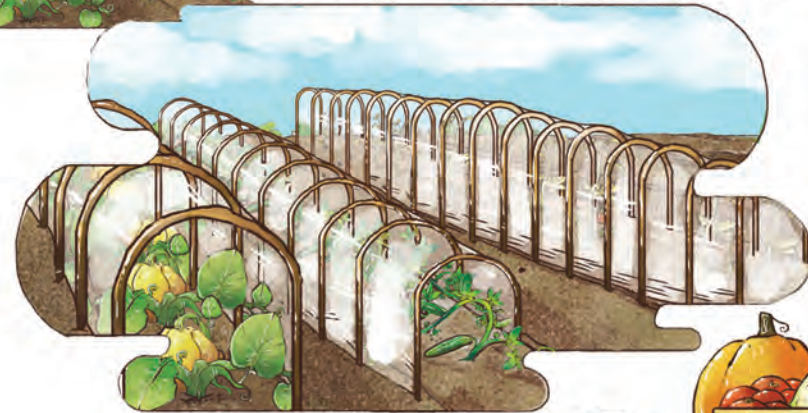
4. Purchase clear tarpaulin from vendor



5. Build short tunnels



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

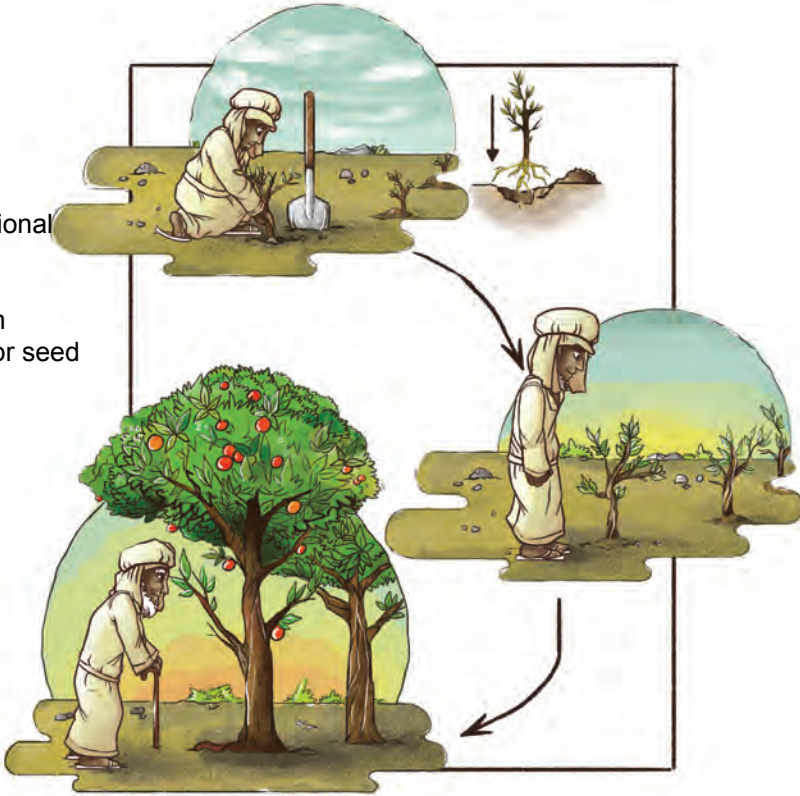


7. High yield

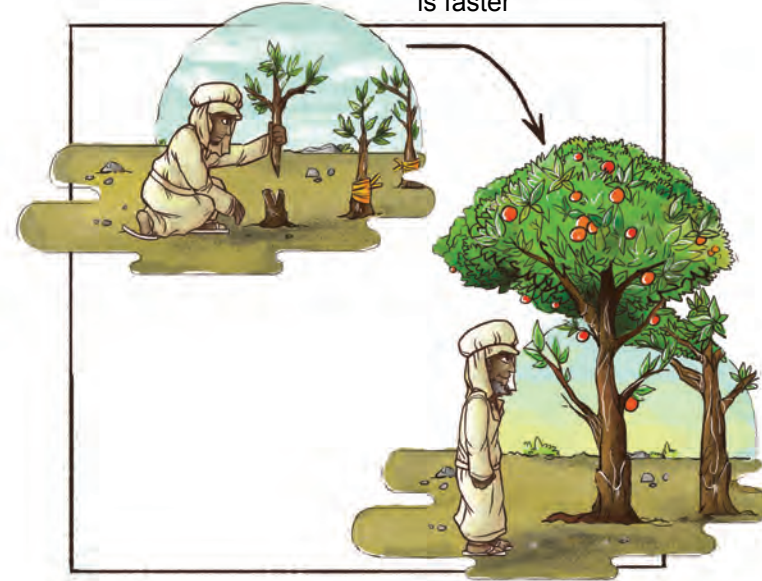


Lesson: Grow a new tree much faster by attaching a young branch onto an old tree stump

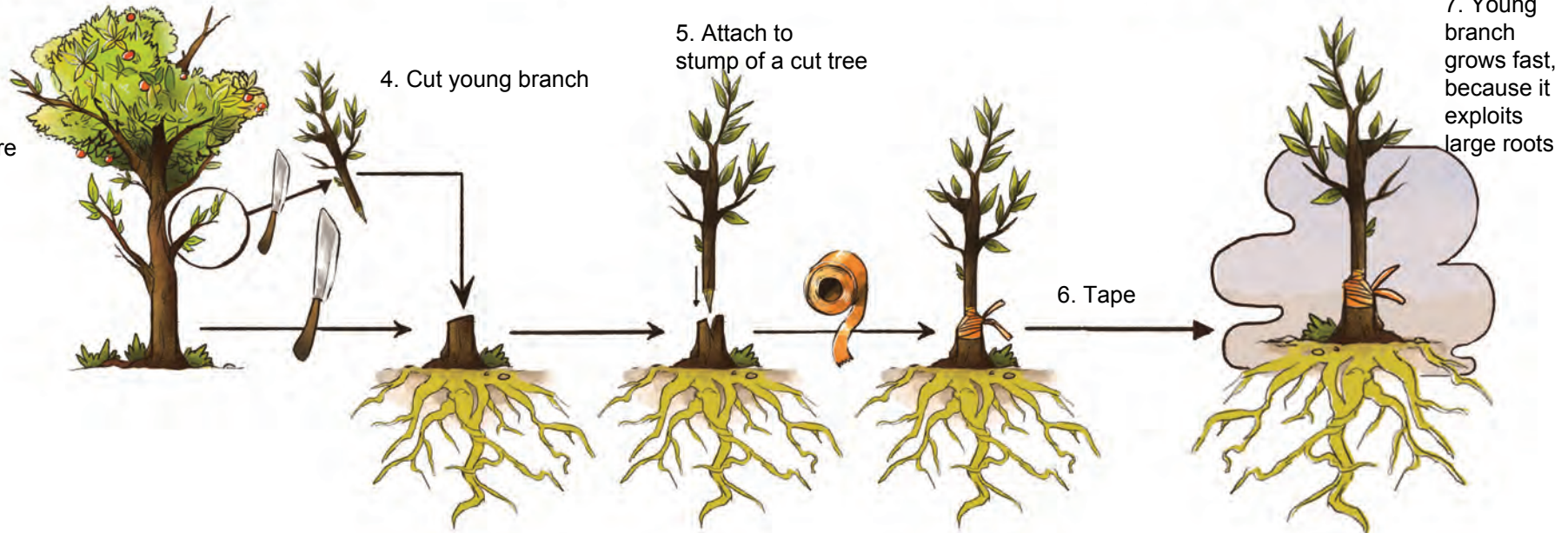
1. Traditional practice: planting tree from sapling or seed is slow



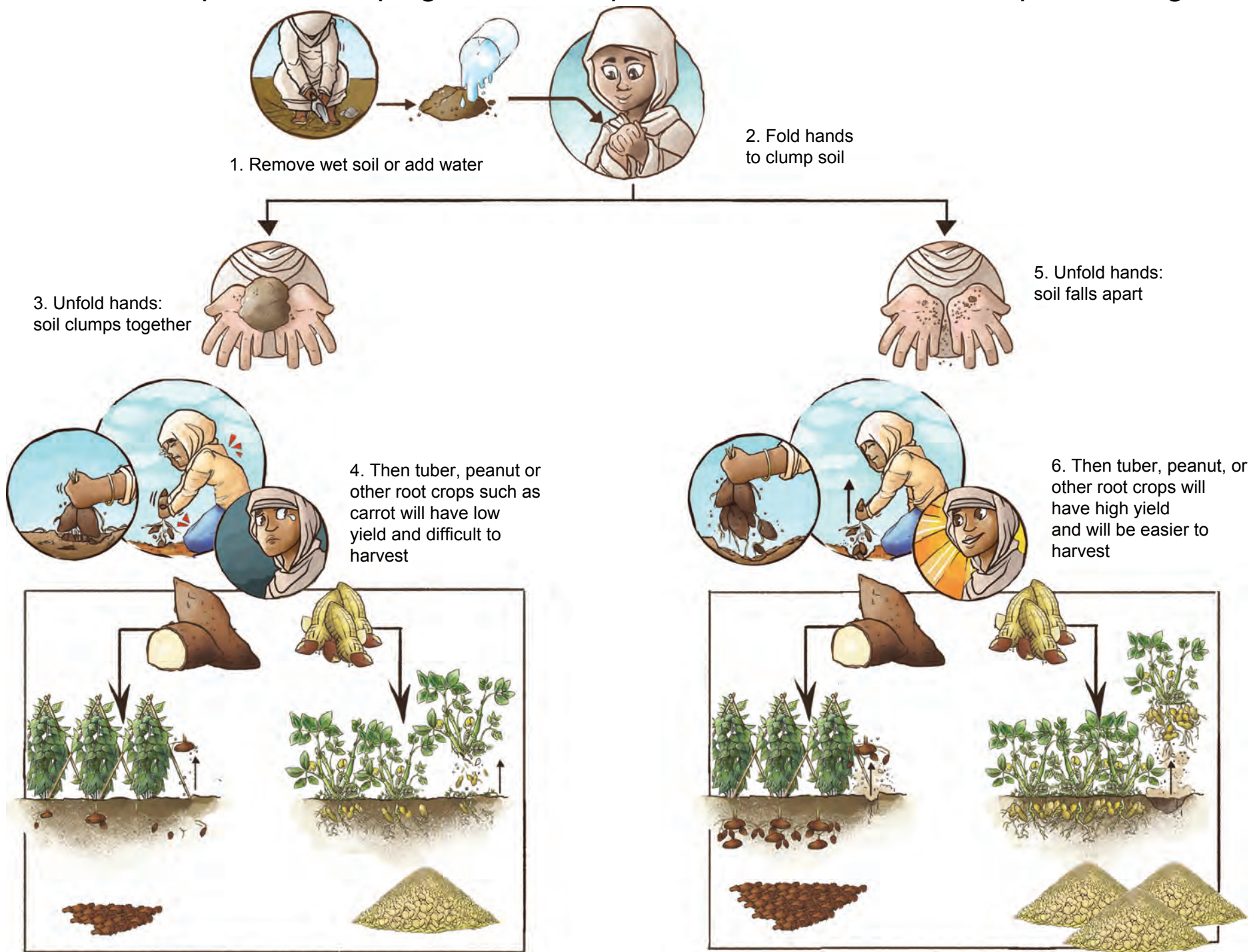
2. New practice: attaching young branch to old tree stump is faster



3. Procedure

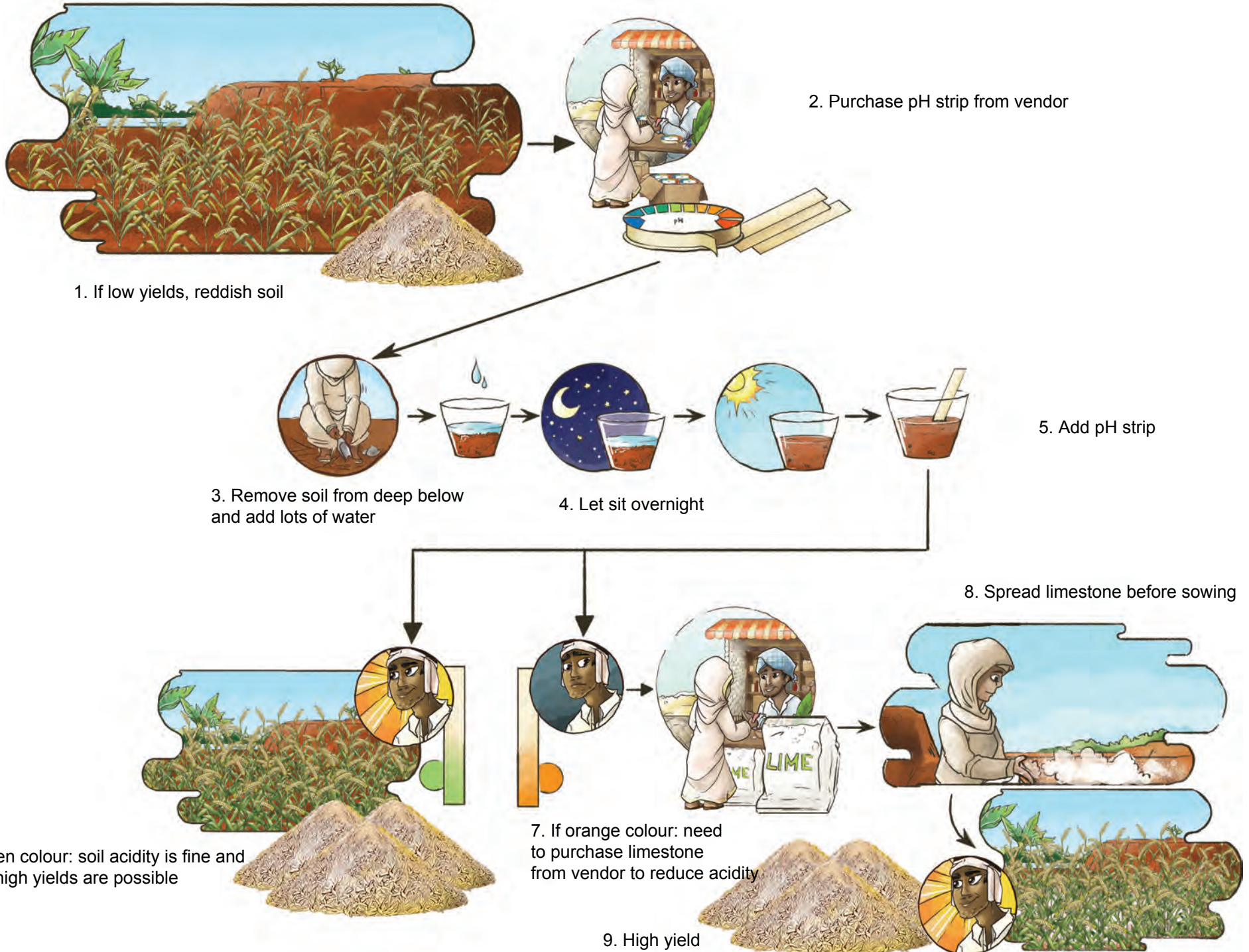


Lesson: A simple soil clumping test can help determine whether root crops can be grown



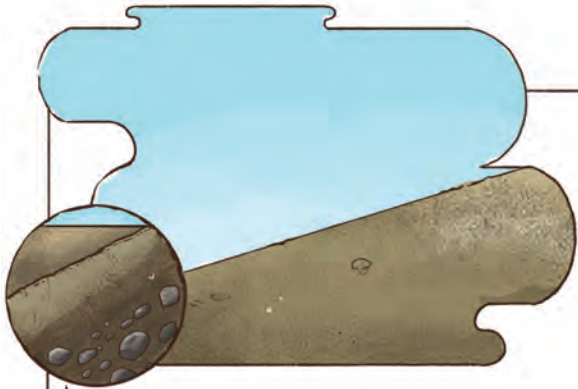
Chapter 4: Soil Health

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

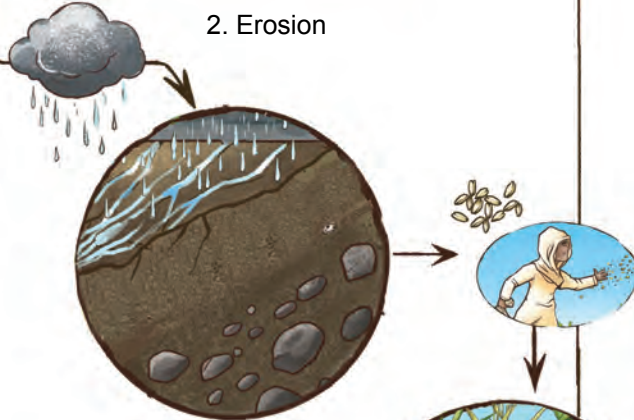


Lesson: Creating shallow trenches with a stick perpendicular to a slope will reduce soil erosion, capture water and increase yields

1. Traditional practice on slope



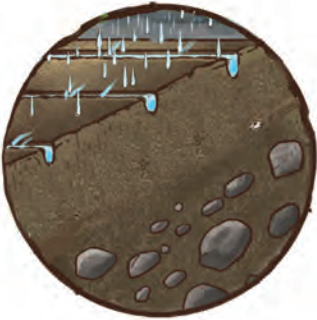
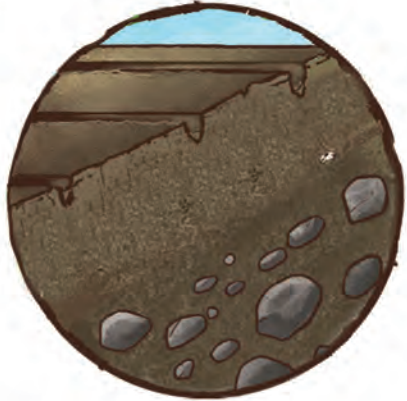
2. Erosion



3. Low yields



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



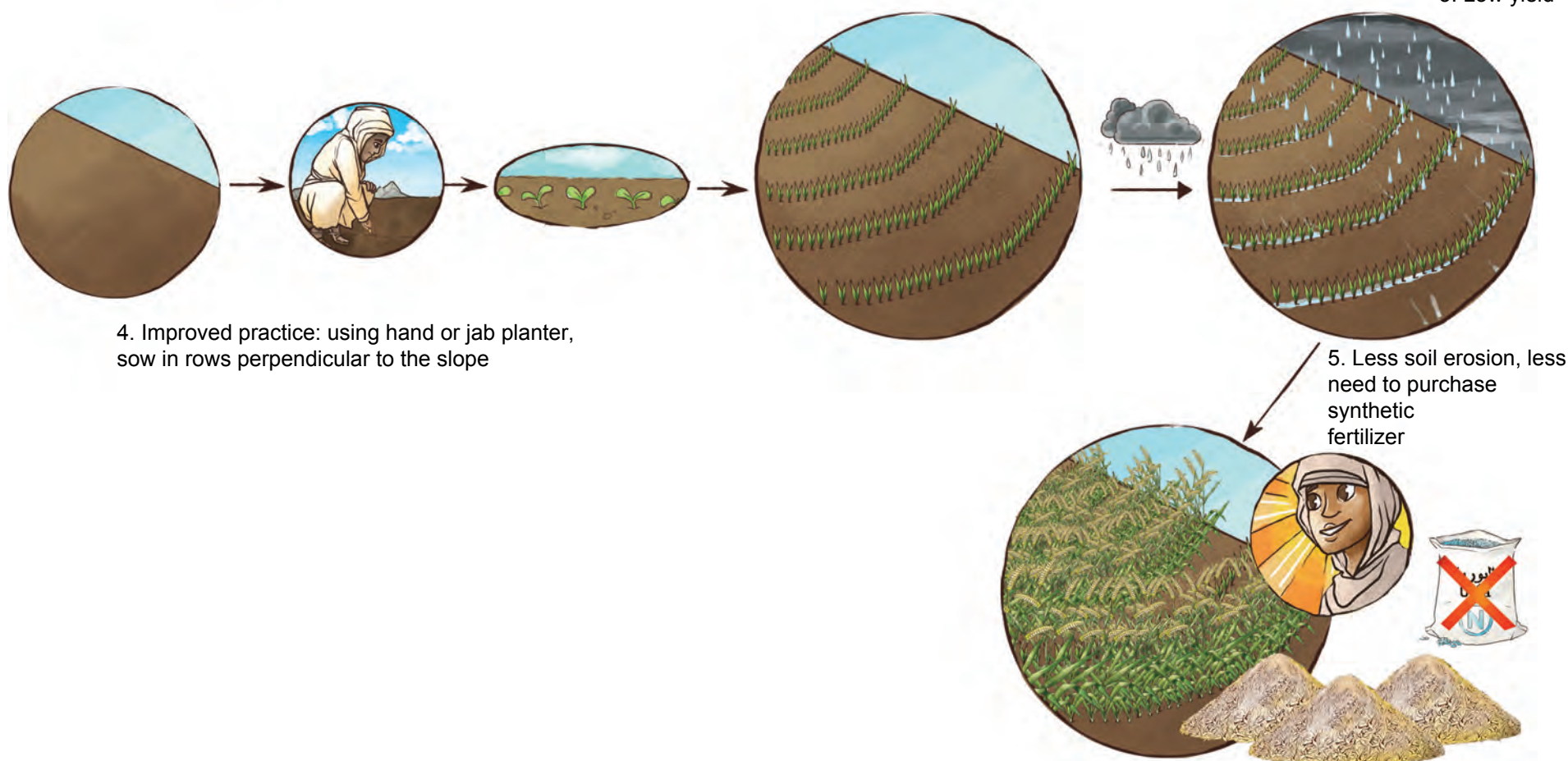
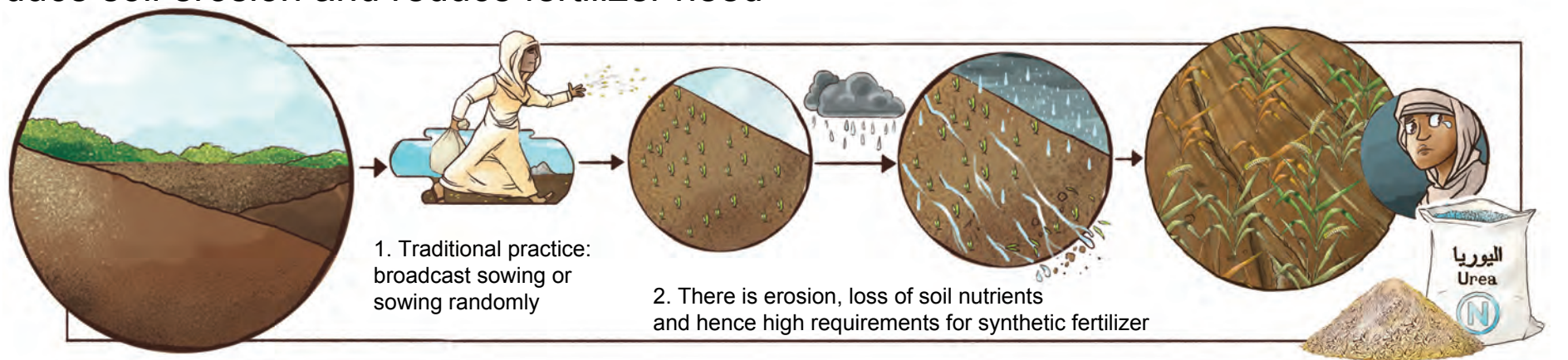
5. Trenches capture water flow and prevent erosion



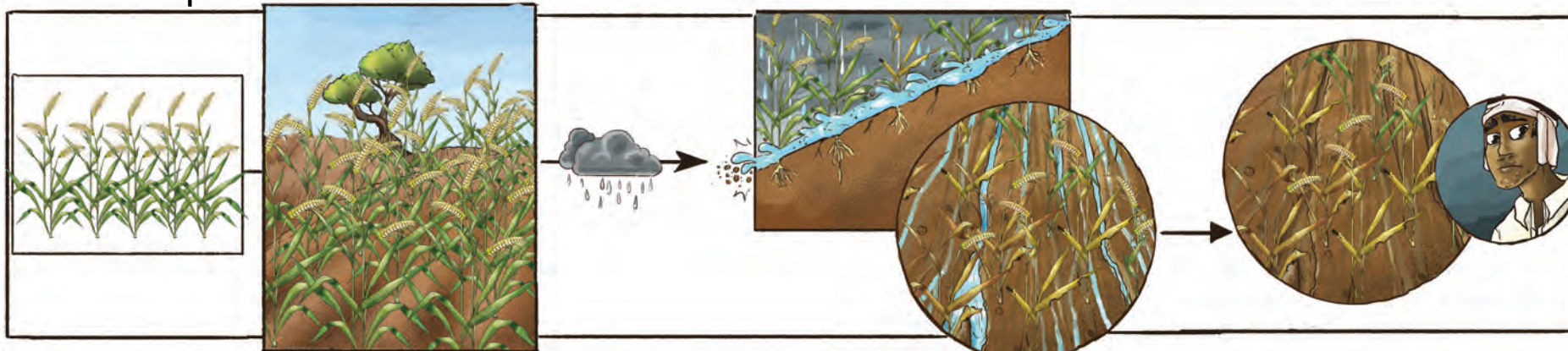
6. Higher yields



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

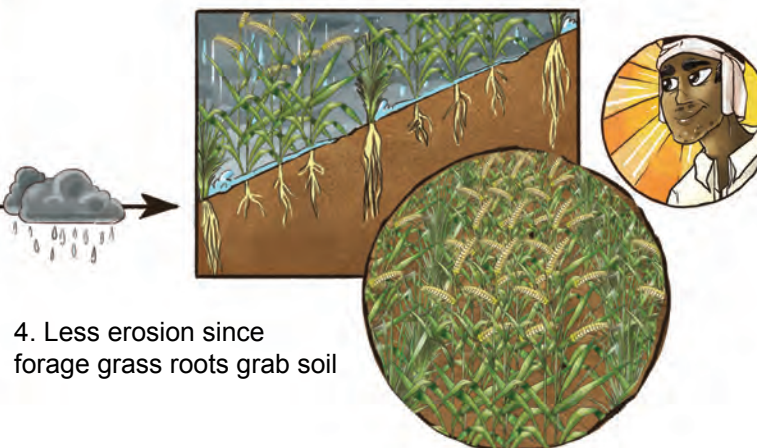


1. Traditional practice

2. Erosion

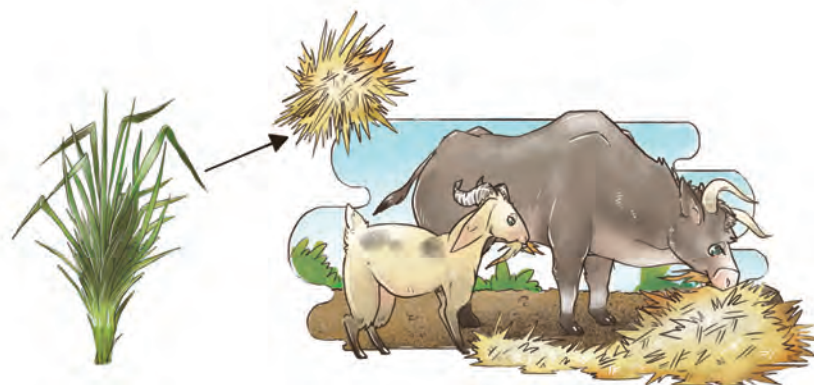


3. Improved practice:
sow forage grass after several rows of main crop
all in rows, perpendicular to slope

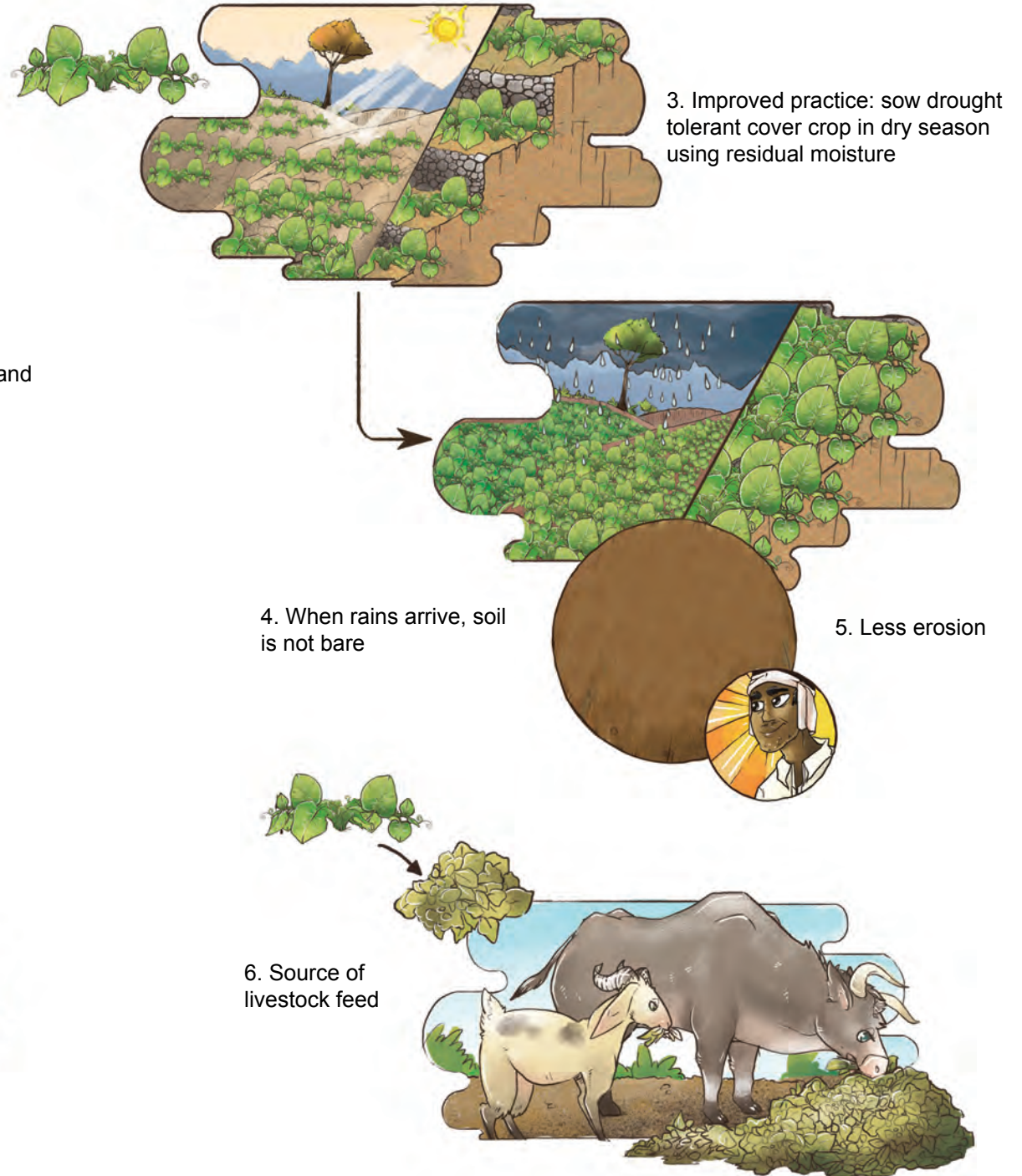
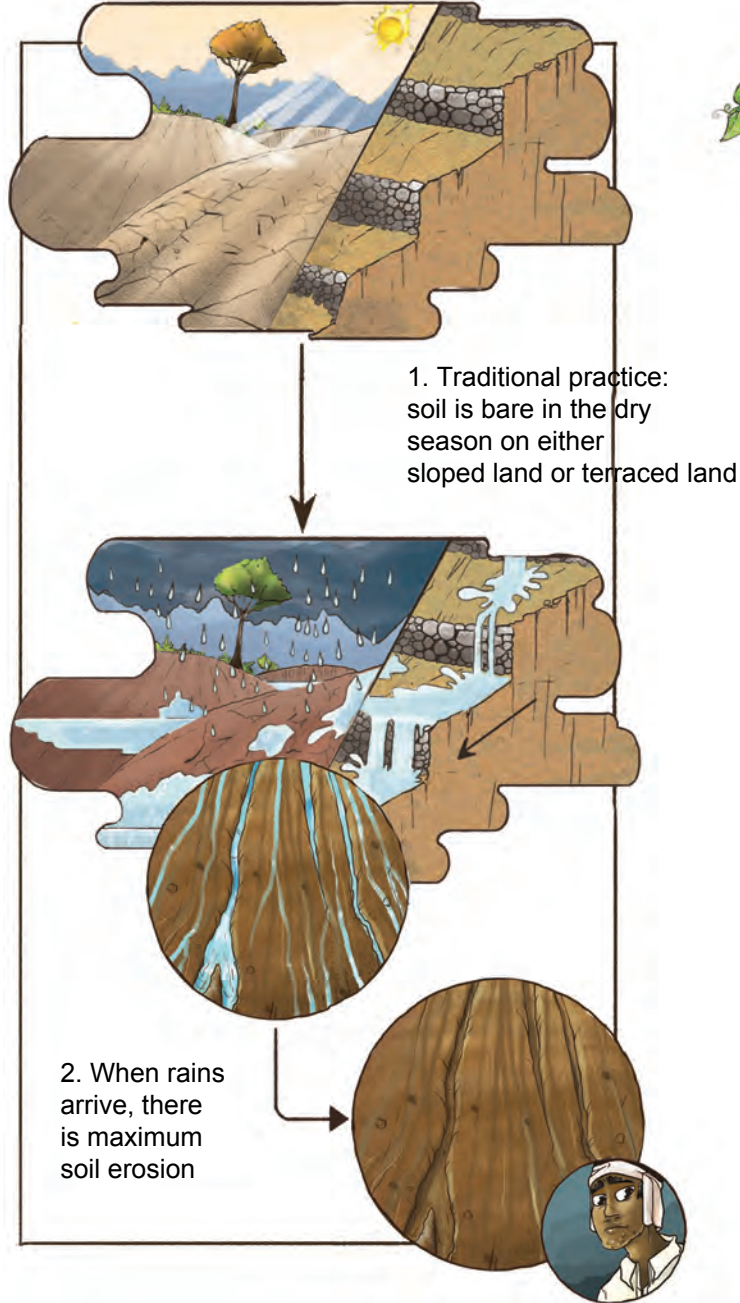


4. Less erosion since
forage grass roots grab soil

5. Forage
grass can
be fed to
livestock

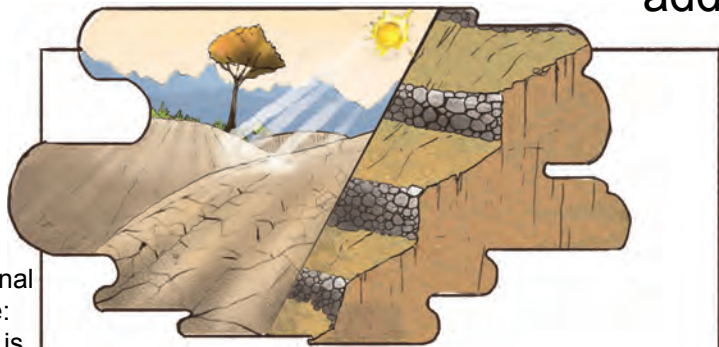


Lesson: Sowing a spreading type cover crop prior to the transition between the dry season and the wet season will reduce soil erosion and provide livestock feed in the dry season

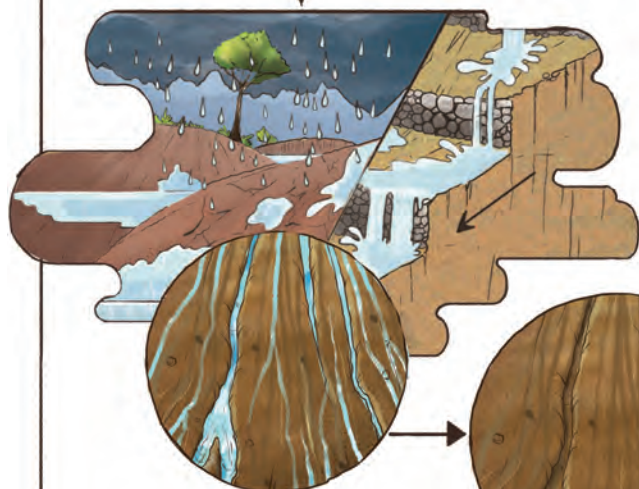


Lesson: Planting vetch in the dry season will reduce soil erosion, provide animal fodder and add nutrients to soil.

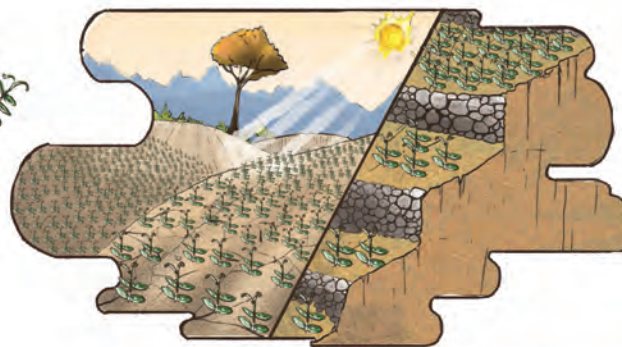
1. Traditional practice: nothing is sown in the dry season



2. Soil erosion when first rain arrives



3. Little animal fodder in the dry season



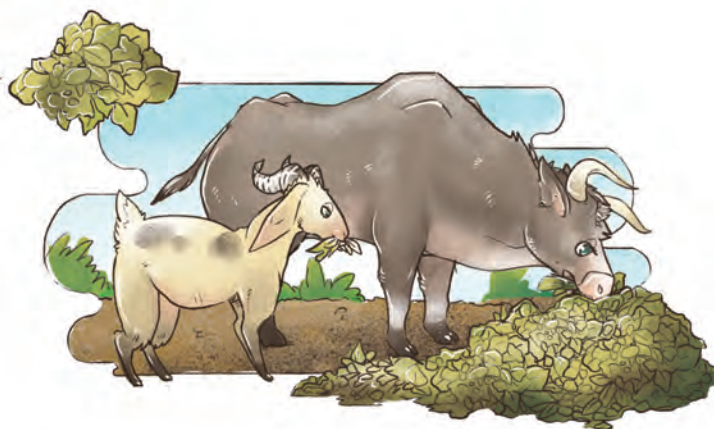
4. Improved practice: sow vetch prior to the beginning of the rainy season



5. Reduced erosion

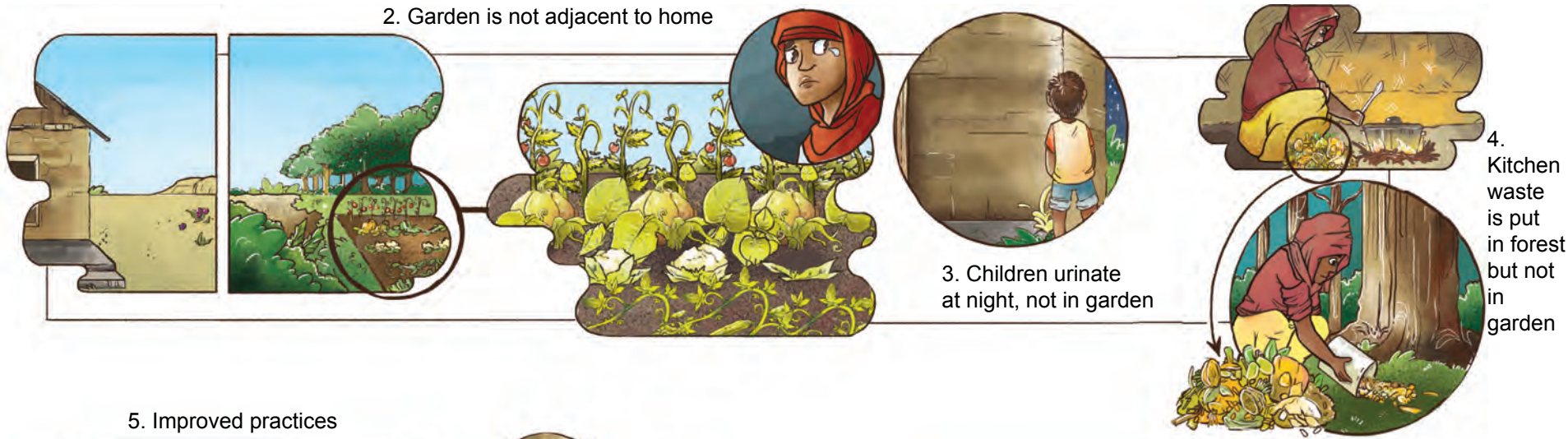


6. Good animal fodder in dry season



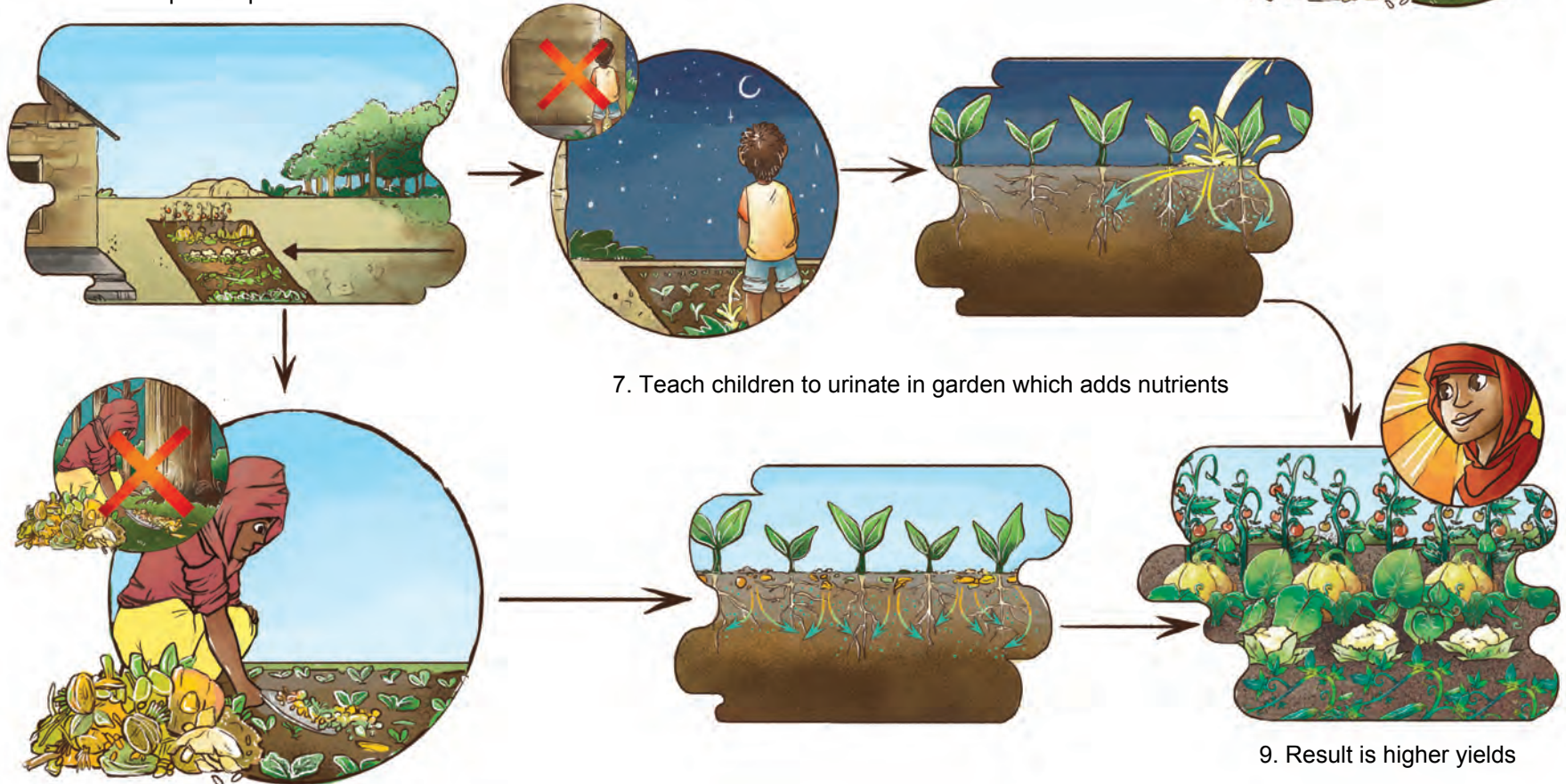
Lesson: Simple practices can improve yields of home gardens

1. Less ideal practices cause low yield



5. Improved practices

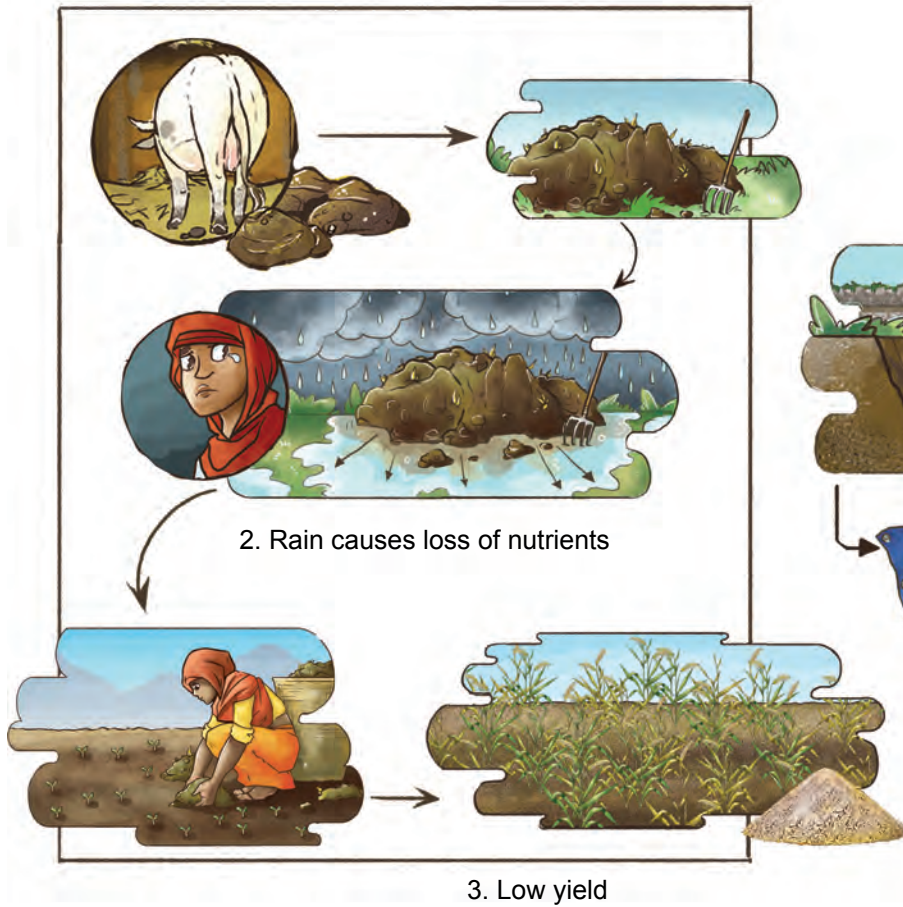
6. Shifting garden adjacent to home increases yields



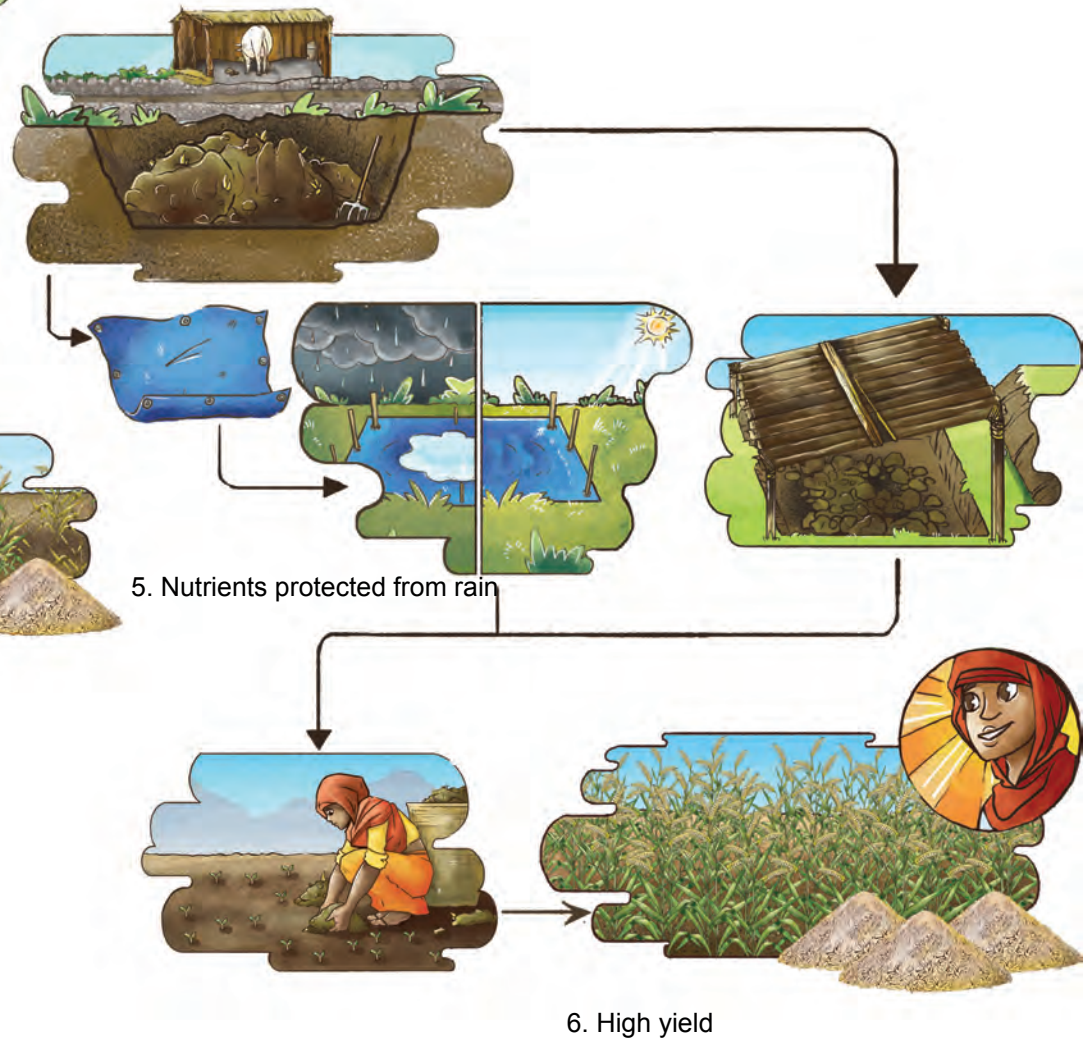
8. Add kitchen waste to garden which adds nutrients as it decomposes

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

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

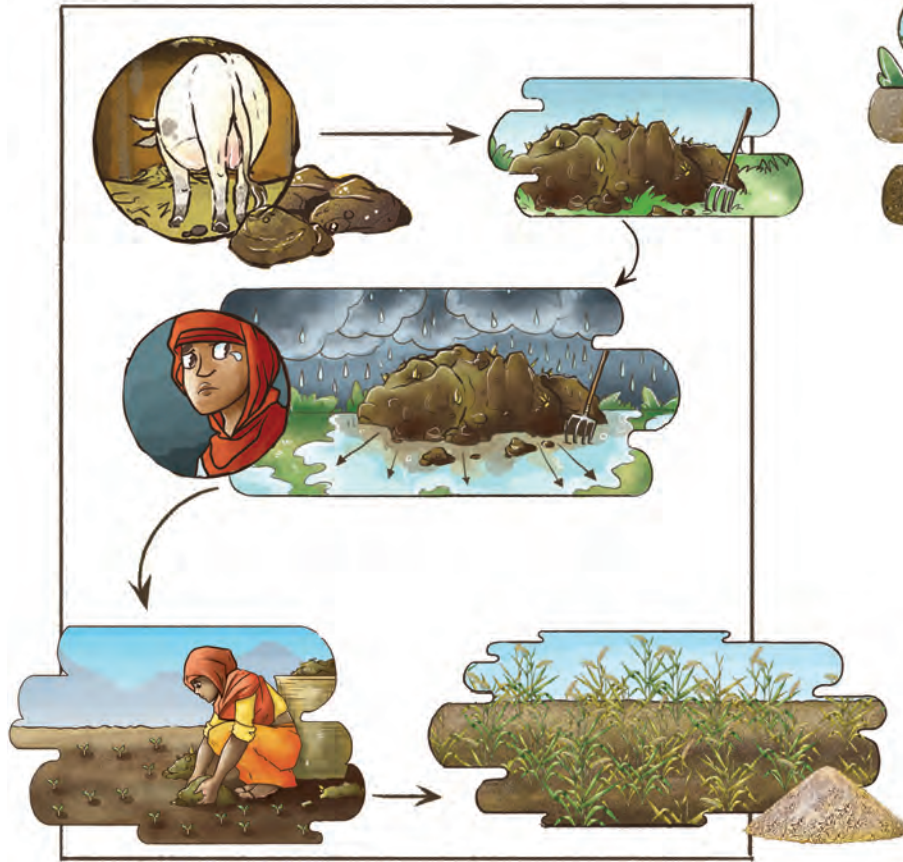


4. Improved practices: store manure in pit or inside mud/stone walls and cover



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

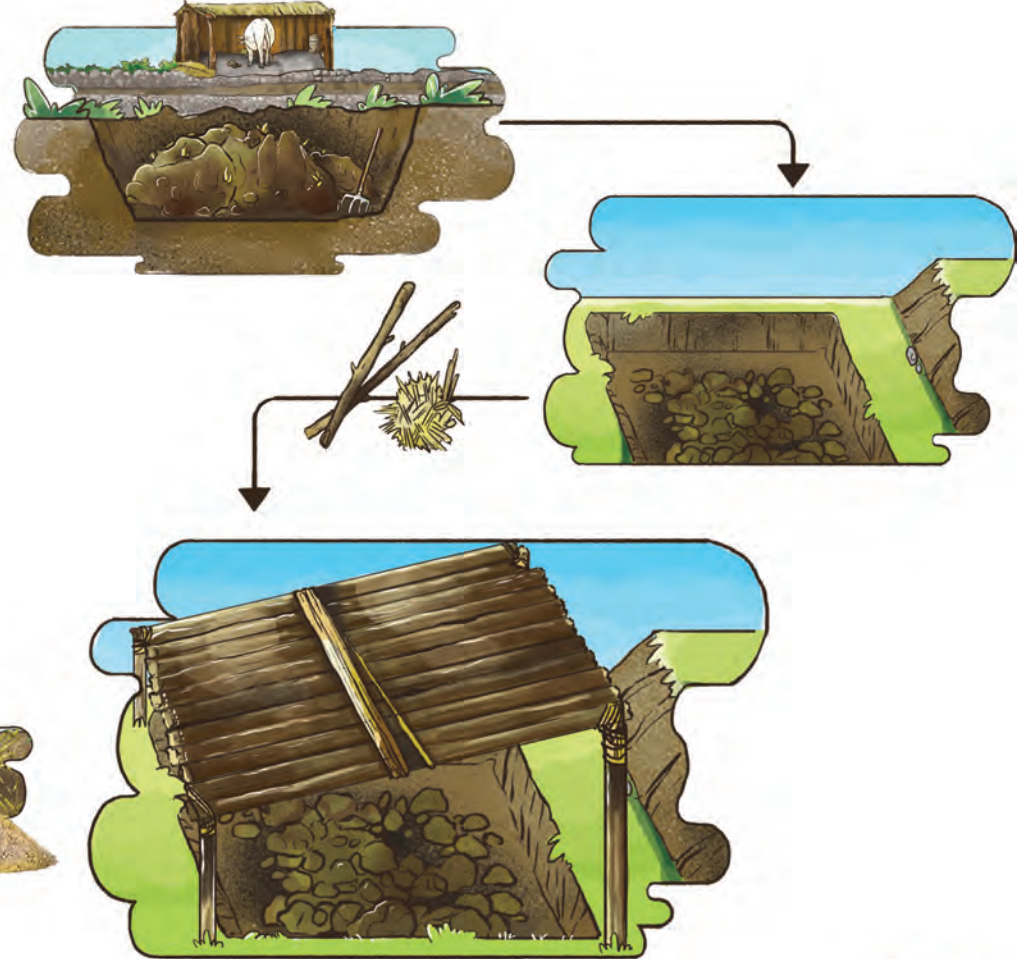
1. Traditional practice of storing manure in the open on the ground



2. Rain causes loss of nutrients

3. Low yield

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

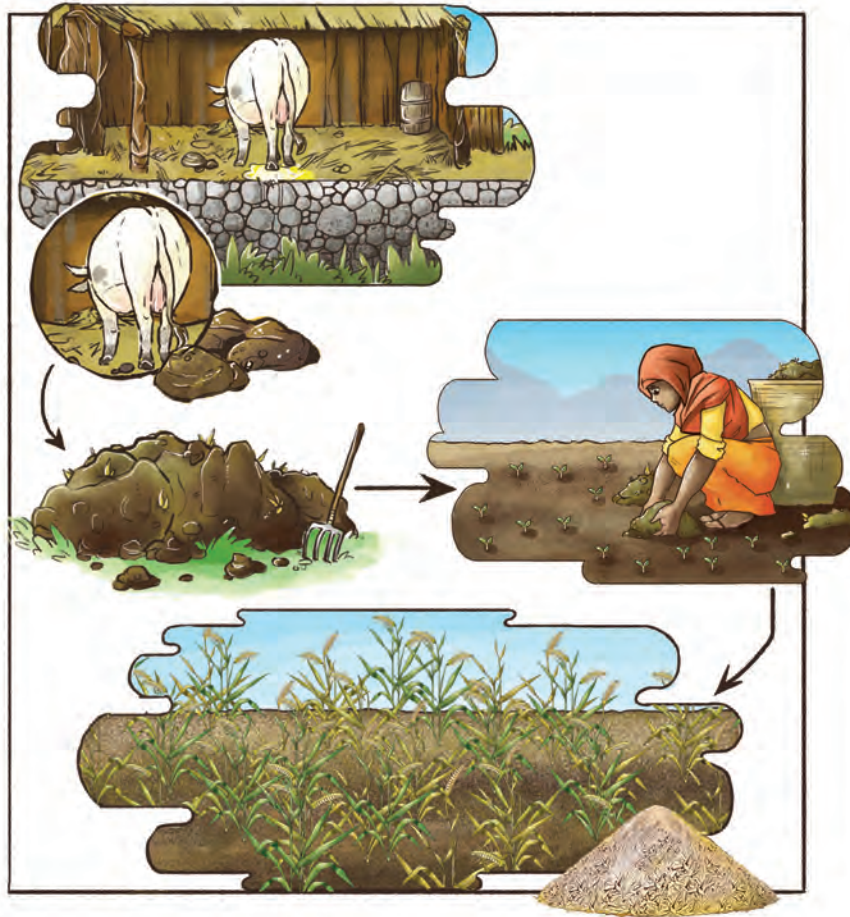


5. Nutrients protected from rain

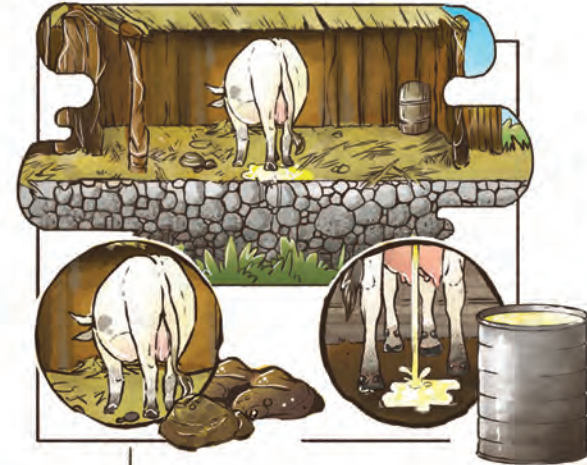
6. High yield

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

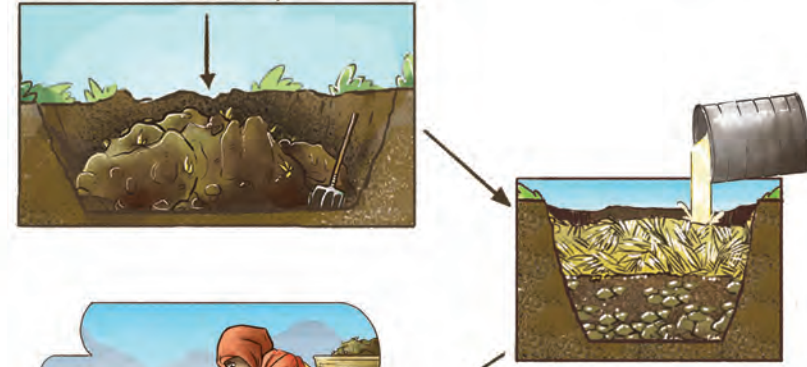
1. Traditional practice: livestock urine is not collected



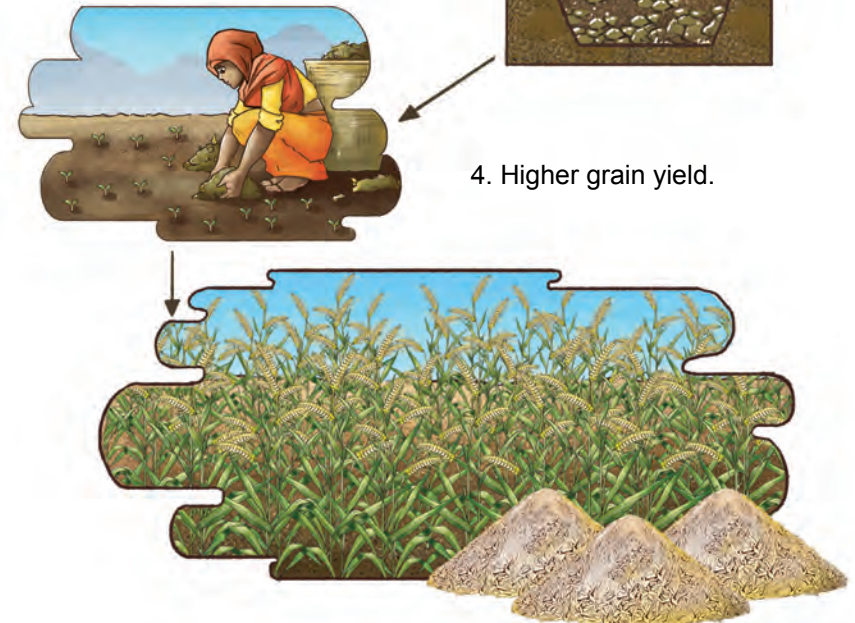
2. Manure gives lower grain yield.



3. New practice: combine urine with manure

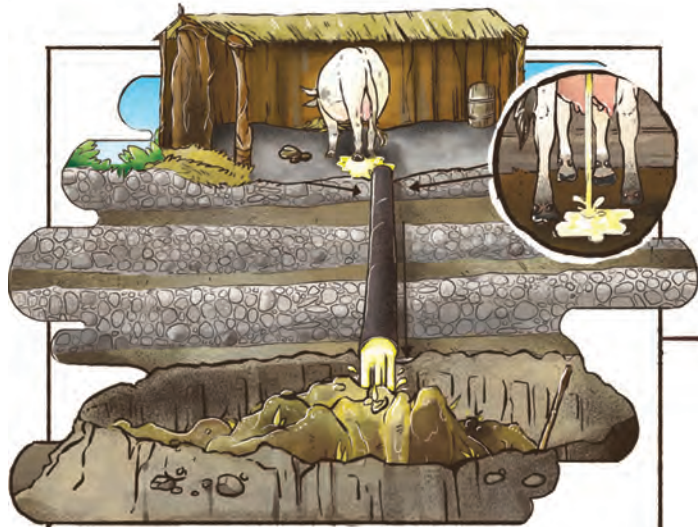


4. Higher grain yield.

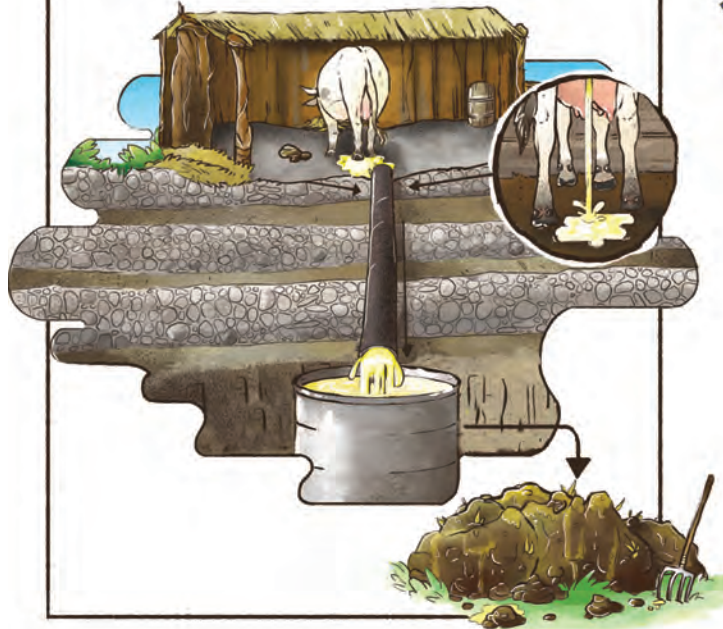


Lesson: There are methods to improve the nutrients of manure (Part 2)

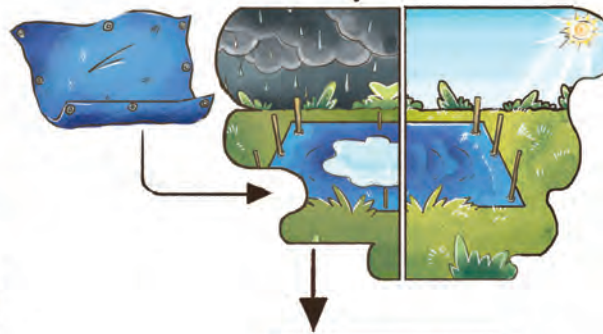
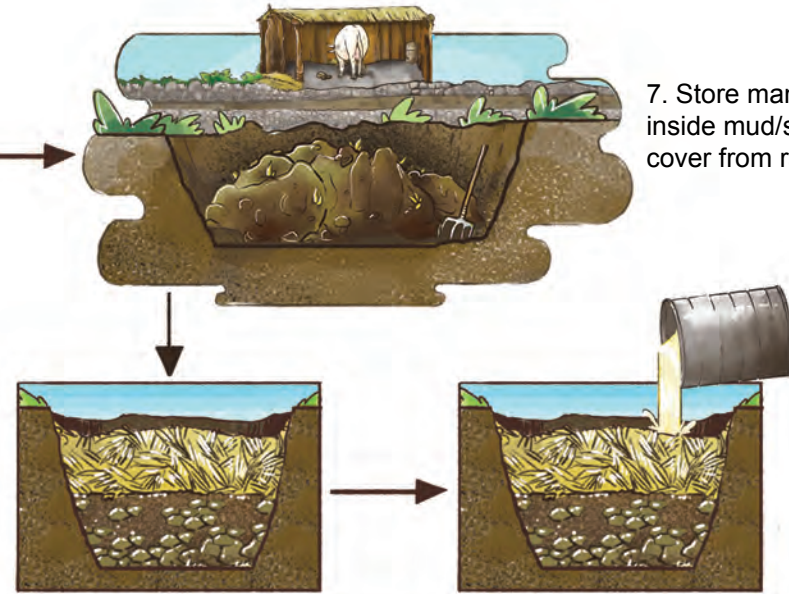
5. Collect urine by using concrete floor that is sloped towards a pipe, and empties into the manure pit.



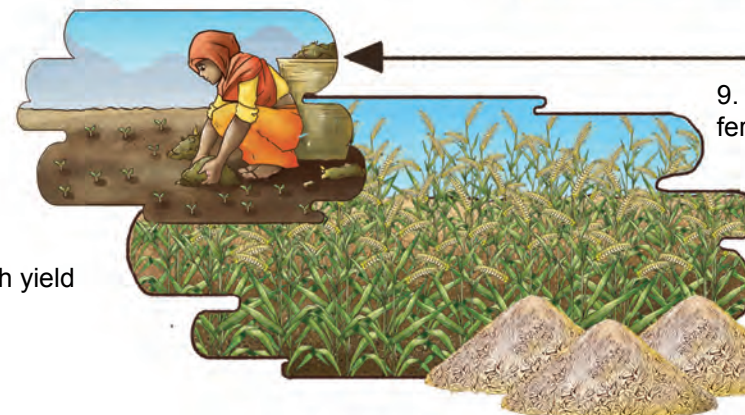
6. Alternative: urine pipe can go to a drum from which urine can be added to manure



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



8. High yield



9. Less need to purchase fertilizer



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

5. Create storage structure with sticks, mud or brick



9. Soil layer

8. Manure layer

7. Layer of straw

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

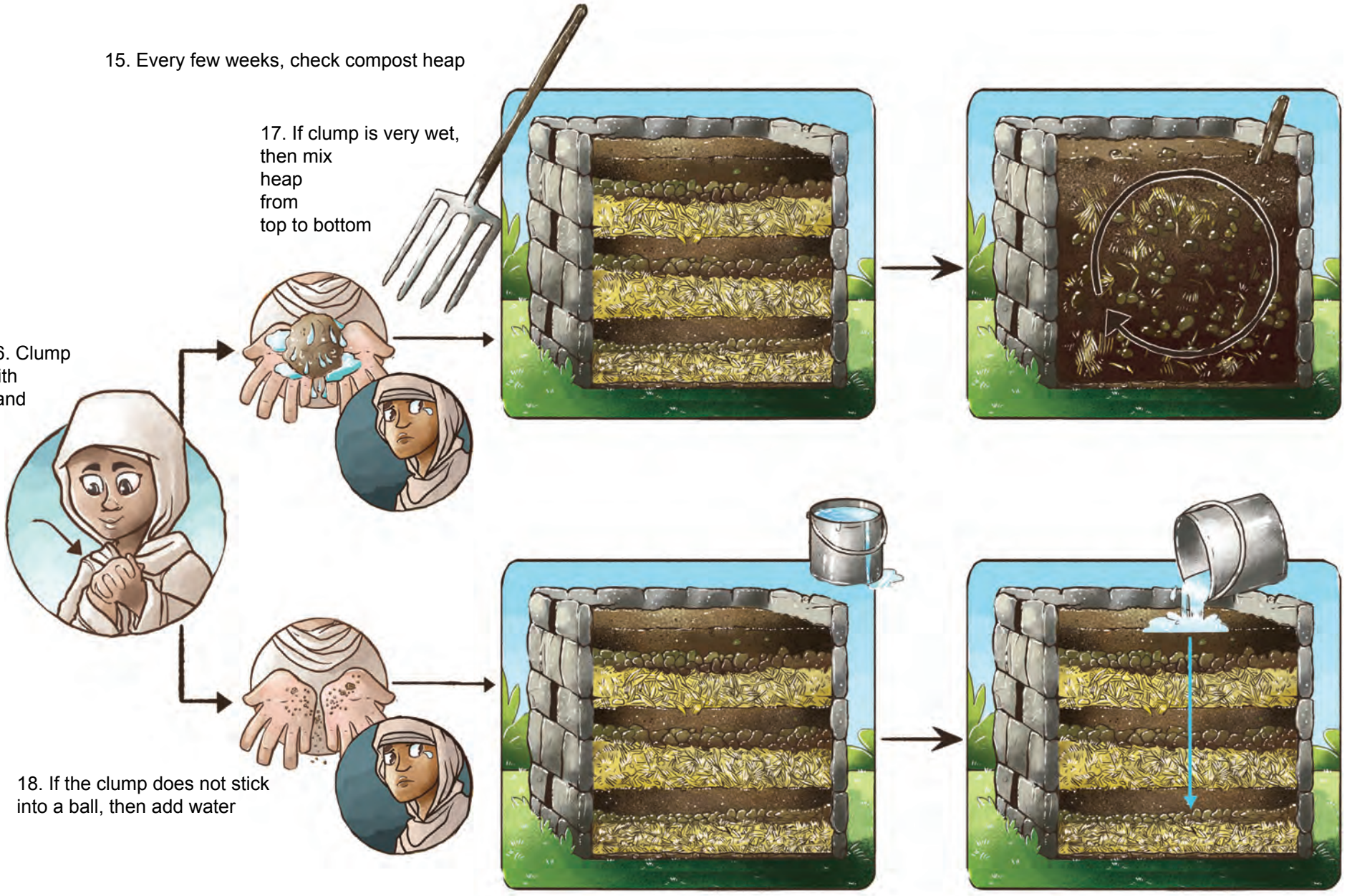
Lesson: Adding manure in layers with straw and soil in a container or pit will improve its nutrients (continued)

15. Every few weeks, check compost heap

17. If clump is very wet, then mix heap from top to bottom

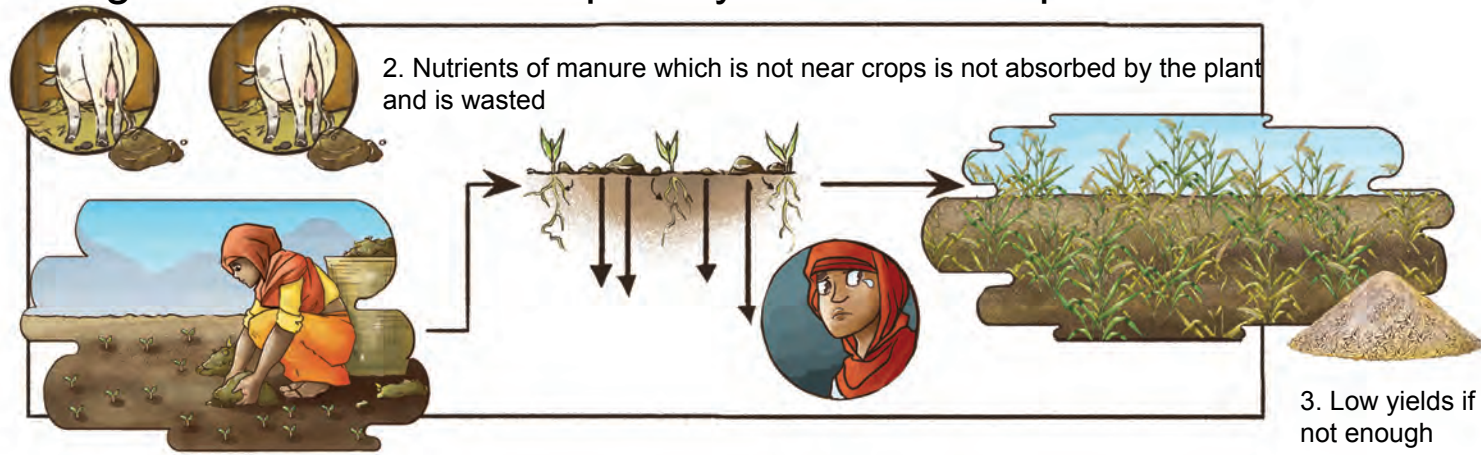
16. Clump with hand

18. If the clump does not stick into a ball, then add water

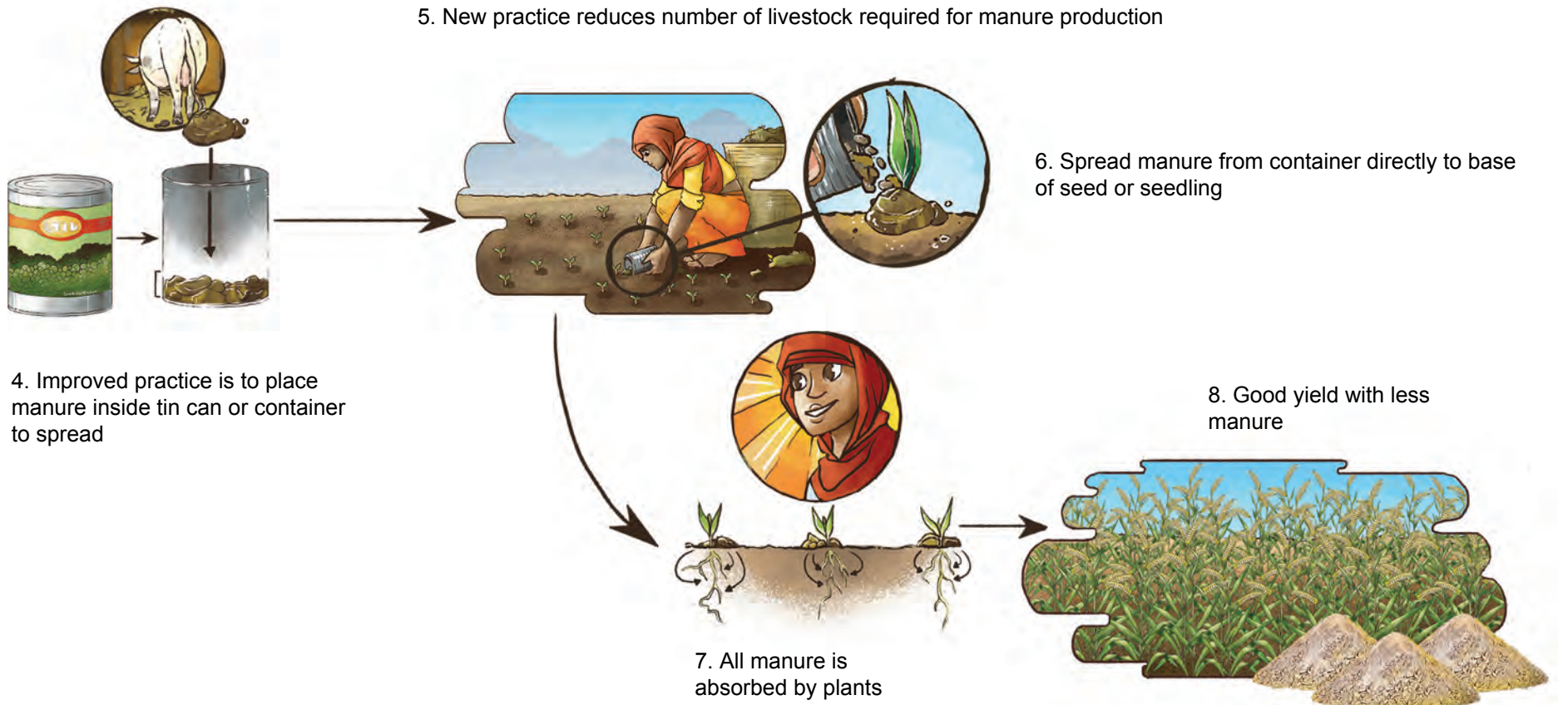


Lesson: Rather than traditional method of spreading manure, adding small amounts of manure directly to each seedling will reduce the total quantity of manure required

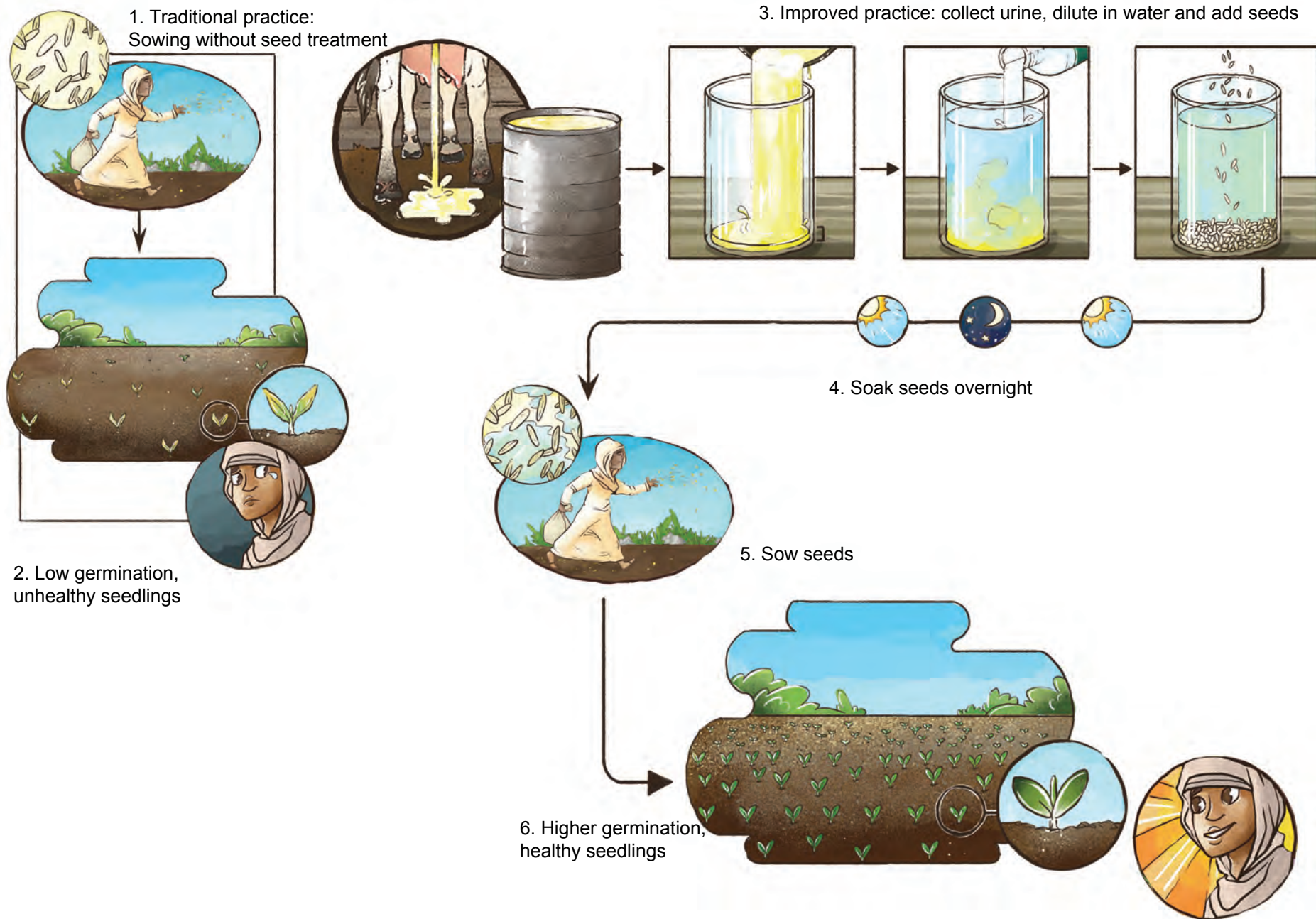
1. Traditional method of manure application requires many livestock



5. New practice reduces number of livestock required for manure production

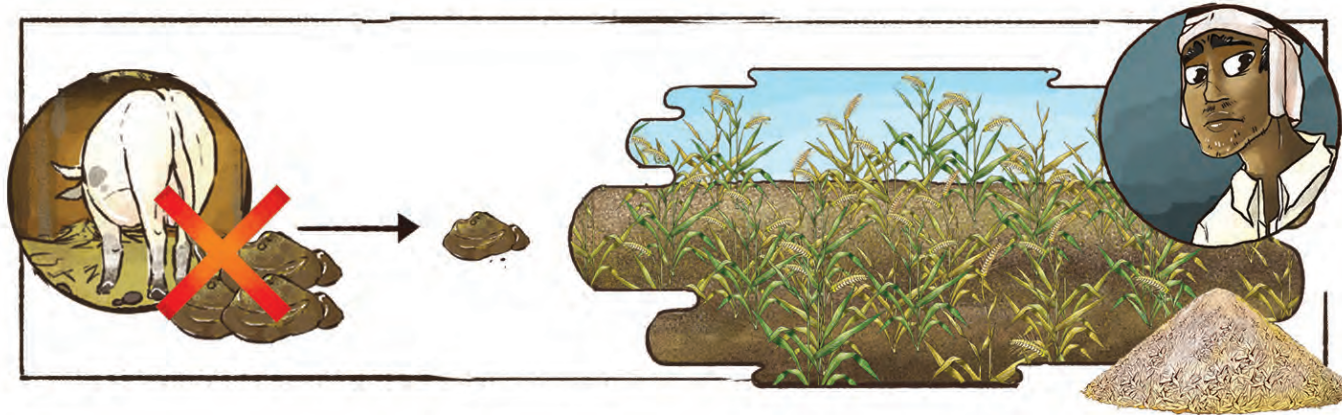


Lesson: Treatment of seeds with livestock urine will improve seed germination and health

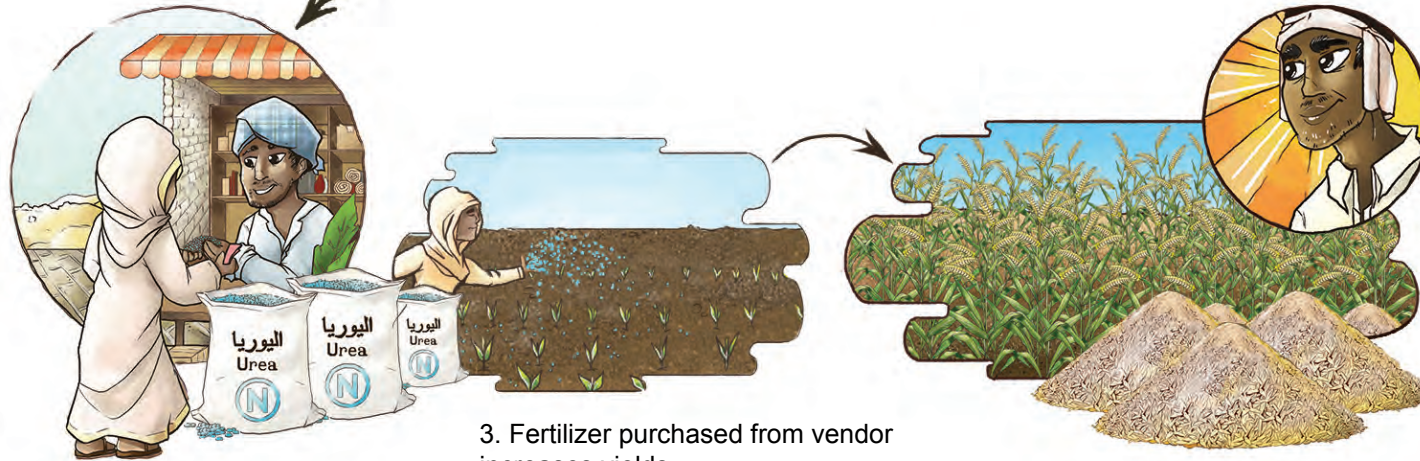
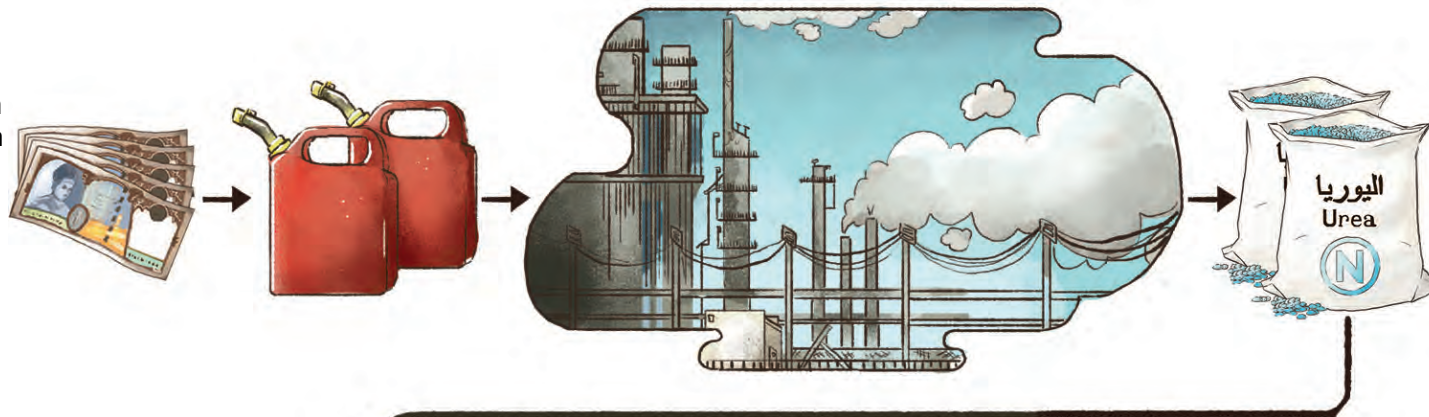


Lesson: Synthetic nitrogen fertilizer raises crop yields

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



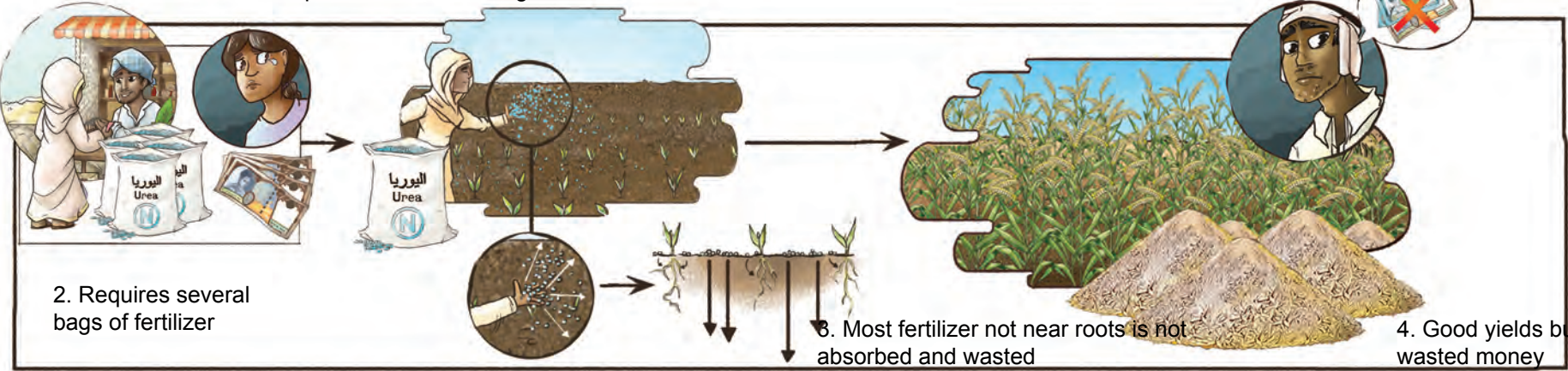
2. Synthetic nitrogen fertilizer is created in factories using natural gas or petrol, hence when petrol prices increase, fertilizer price will increase



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

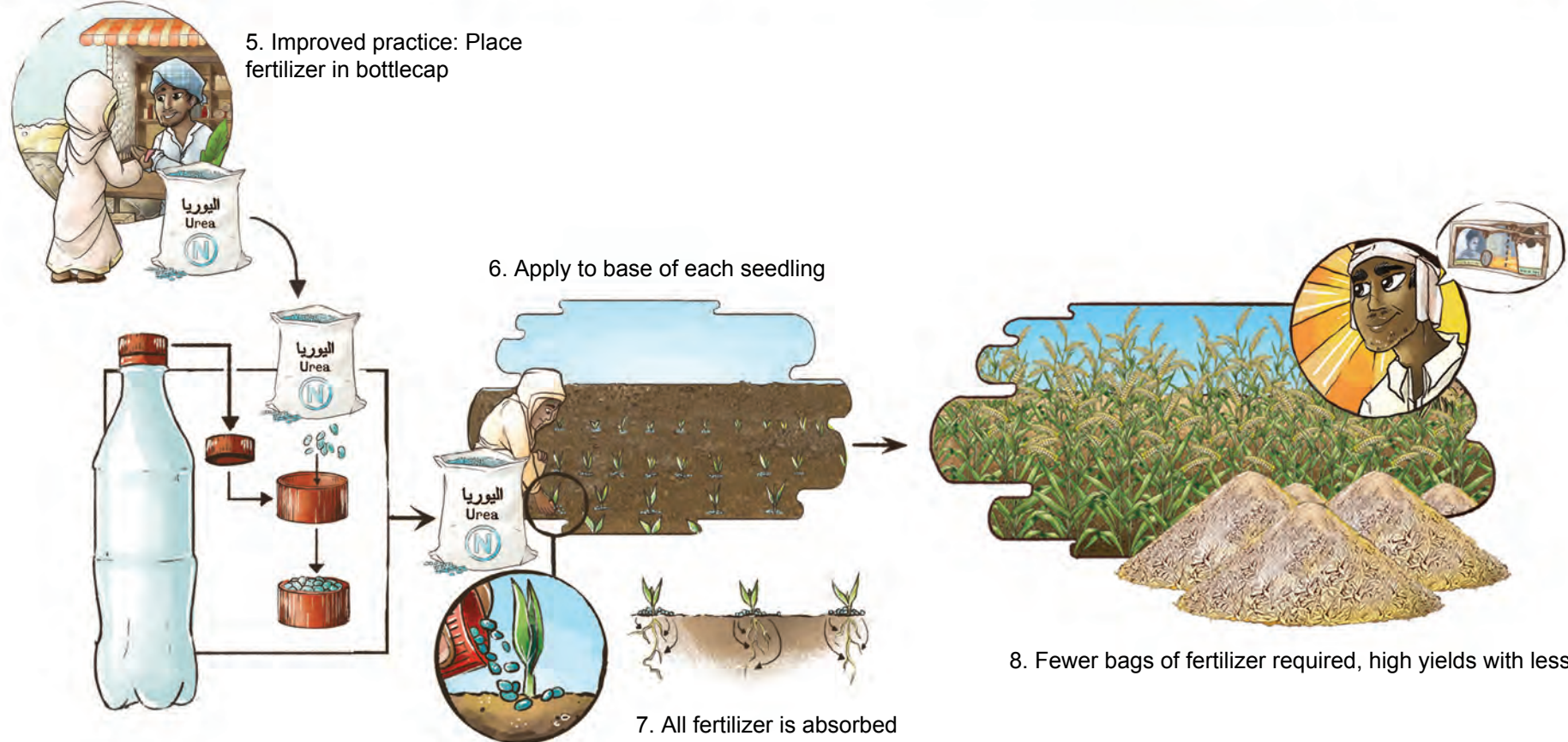


2. Requires several bags of fertilizer

3. Most fertilizer not near roots is not absorbed and wasted

4. Good yields but wasted money

5. Improved practice: Place fertilizer in bottlecap



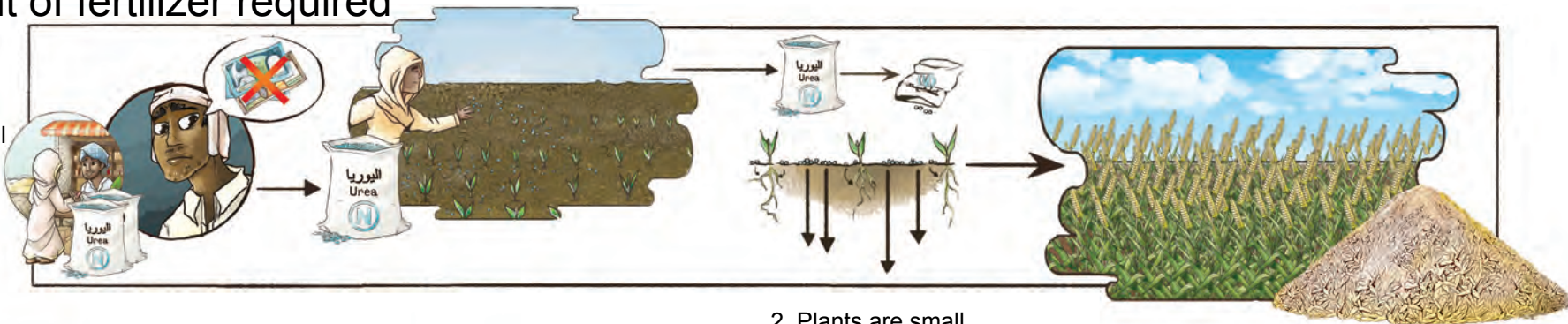
6. Apply to base of each seedling

7. All fertilizer is absorbed

8. Fewer bags of fertilizer required, high yields with less money

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

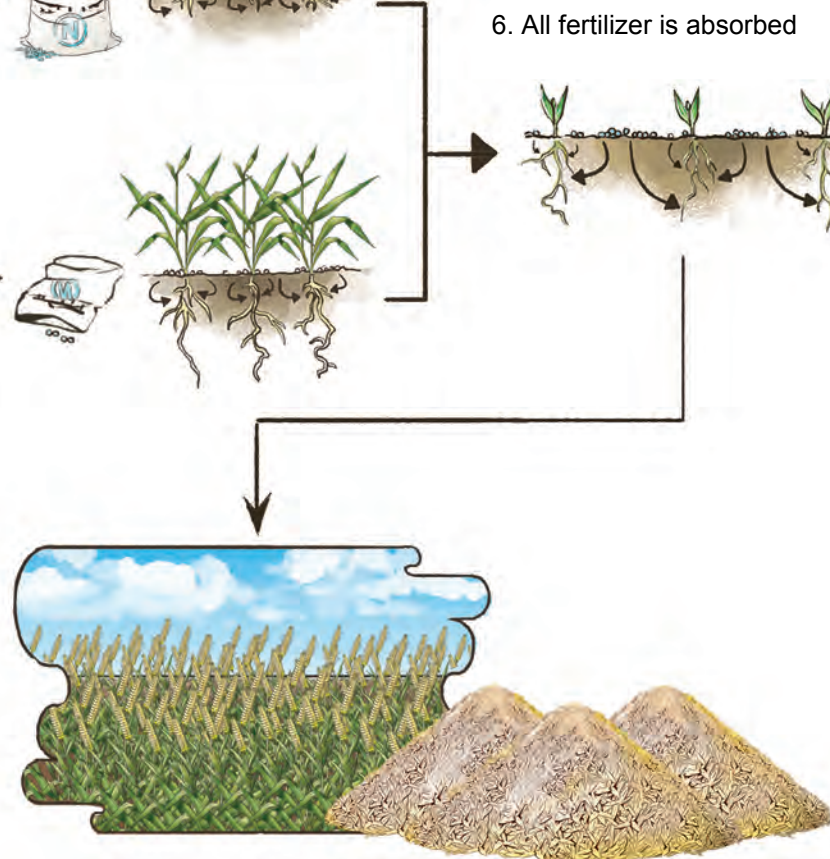
3. Money wasted, lower yield

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



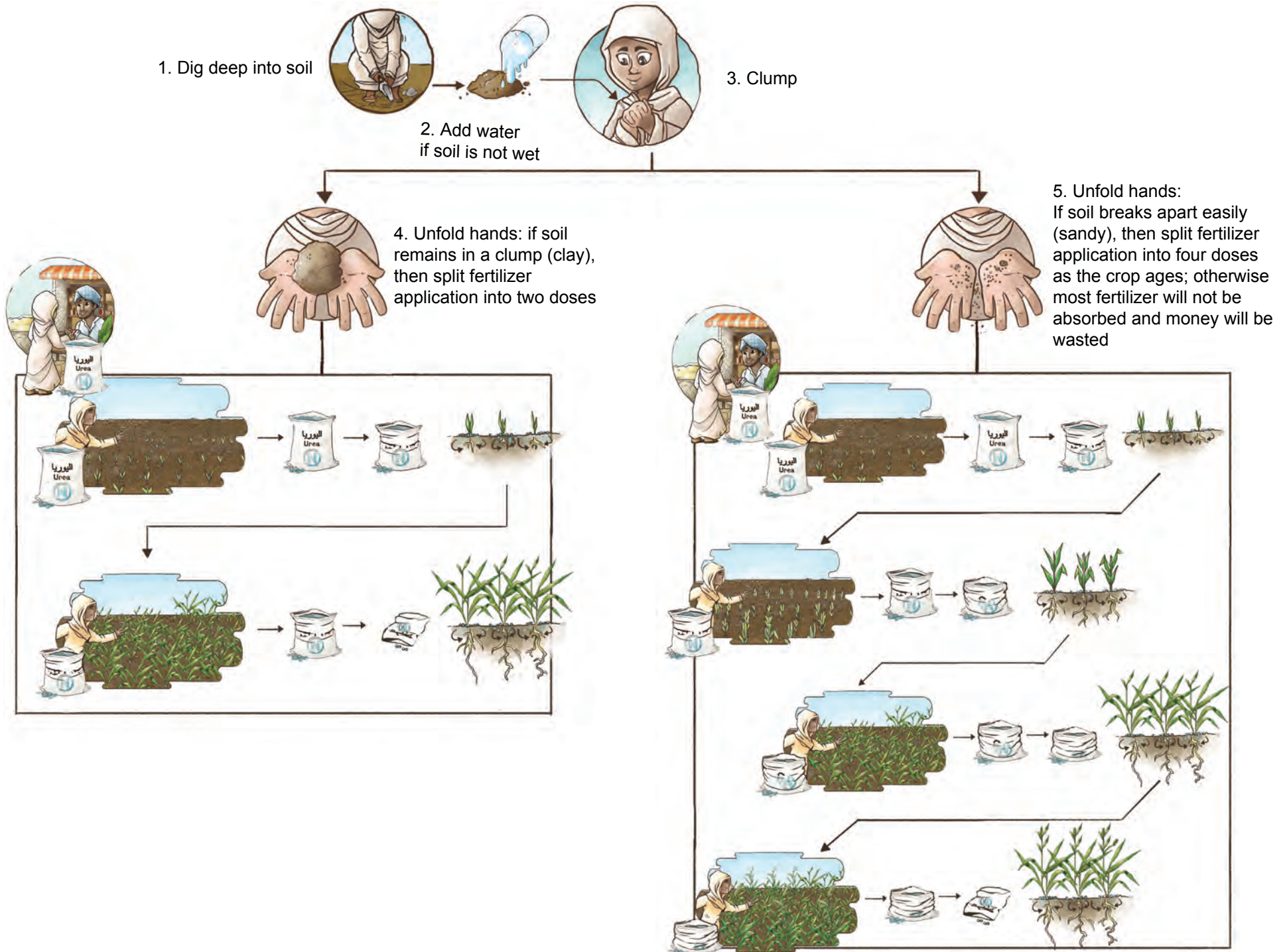
5. At a later stage, apply remaining fertilizer

7. High yields with less fertilizer and hence less money



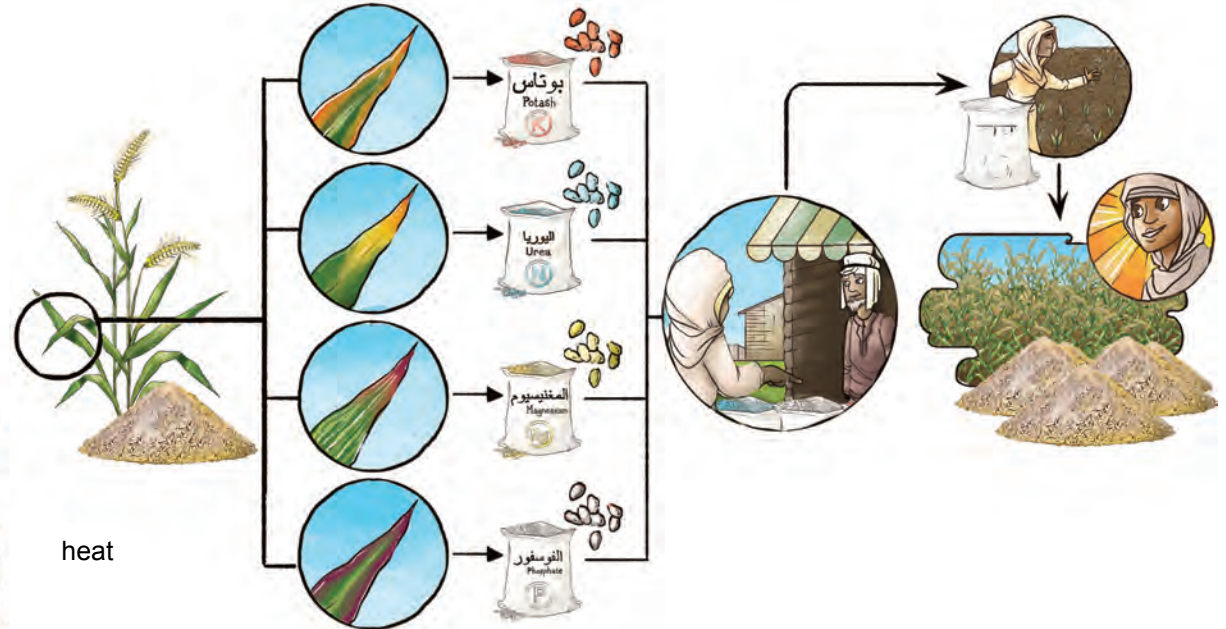
6. All fertilizer is absorbed

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

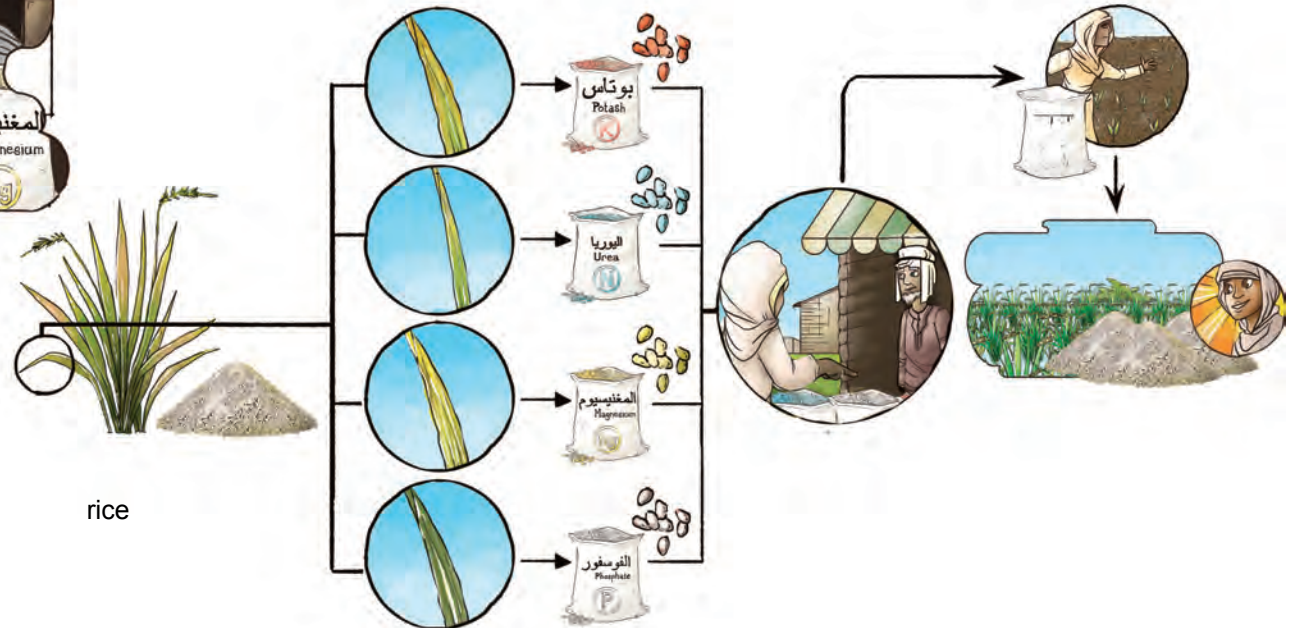


Lesson: A colour change in crop leaves can potentially indicate that one type of fertilizer is lacking

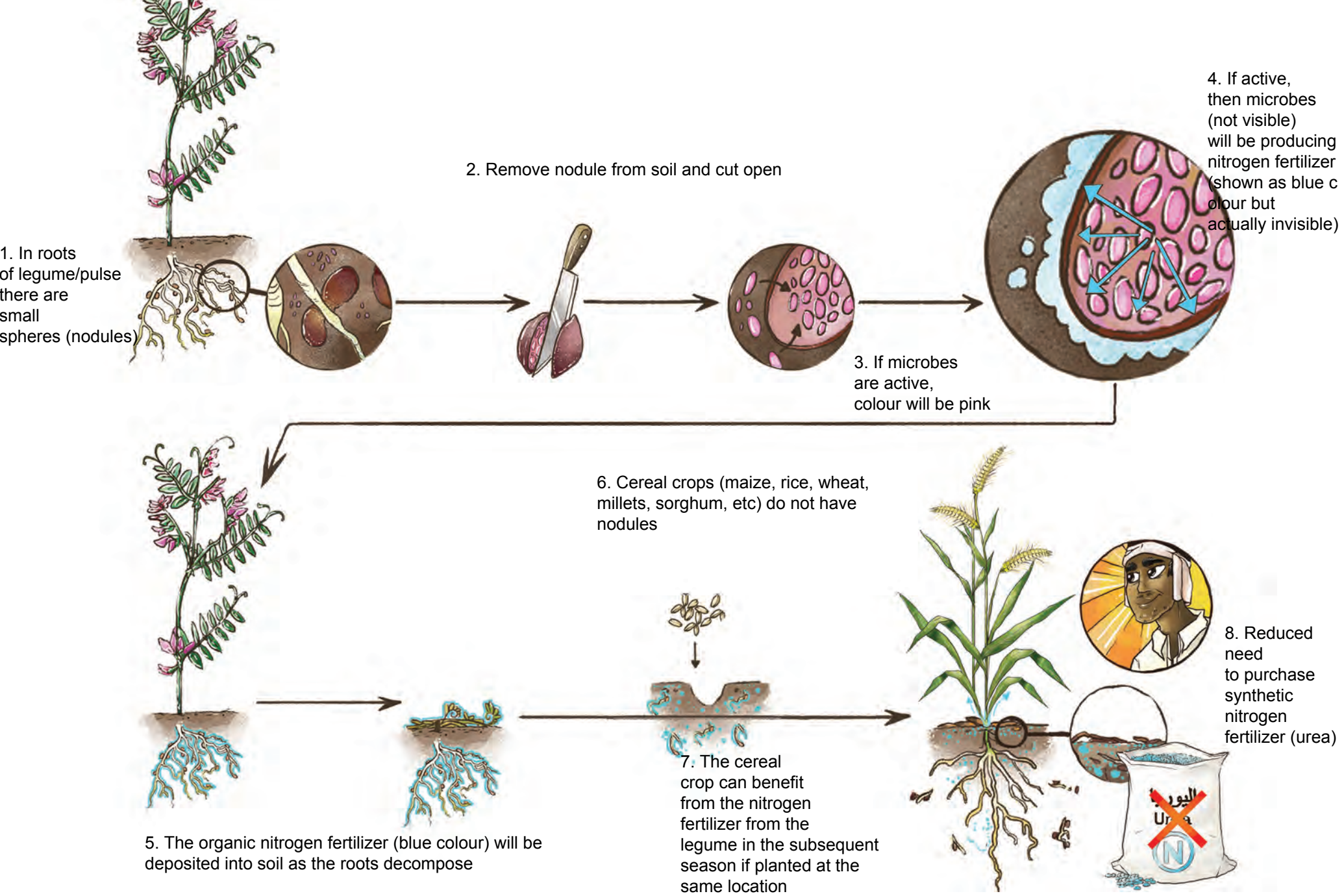
1. Traditional practice: crops are sick but the reason is unknown. To fix, a farmer purchases different fertilizers or pesticides but none may solve the problem.



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



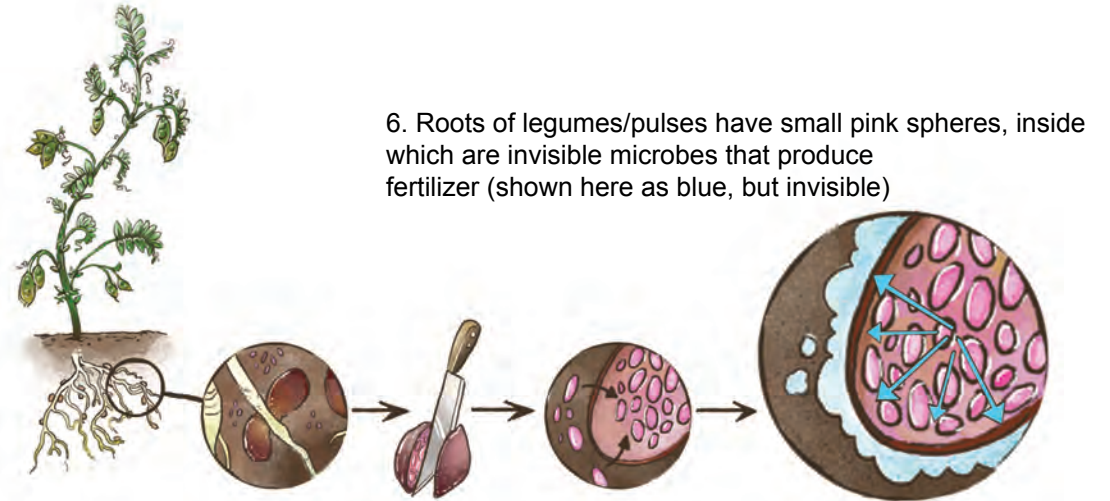
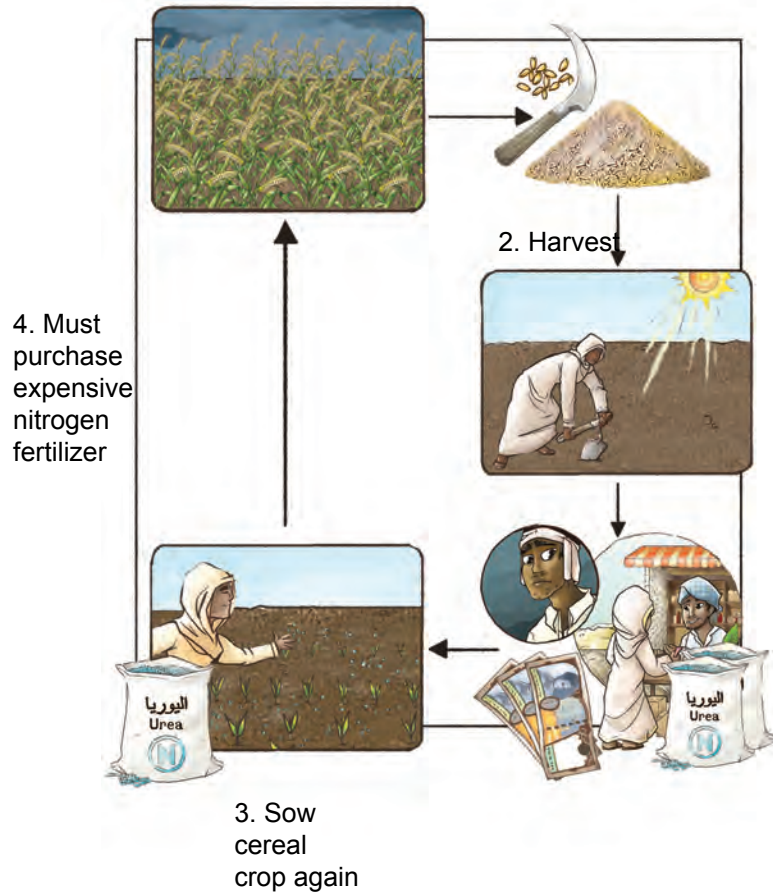
Background educational lesson: A legume (bean) or pulse can produce organic nitrogen fertilizer by associating with beneficial microbes (rhizobia) that inhabit spherical organs in the roots called nodules. If active the nodules are reddish in colour.



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.

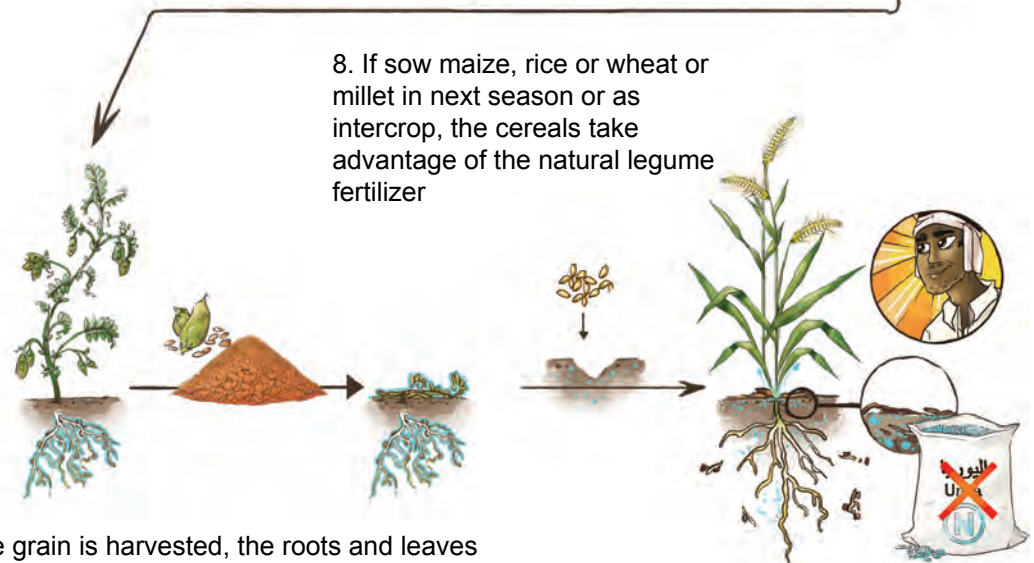
1. Bad practice: plant sole crop of maize wheat, rice, millet in all seasons (no legumes, no pulses)

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



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

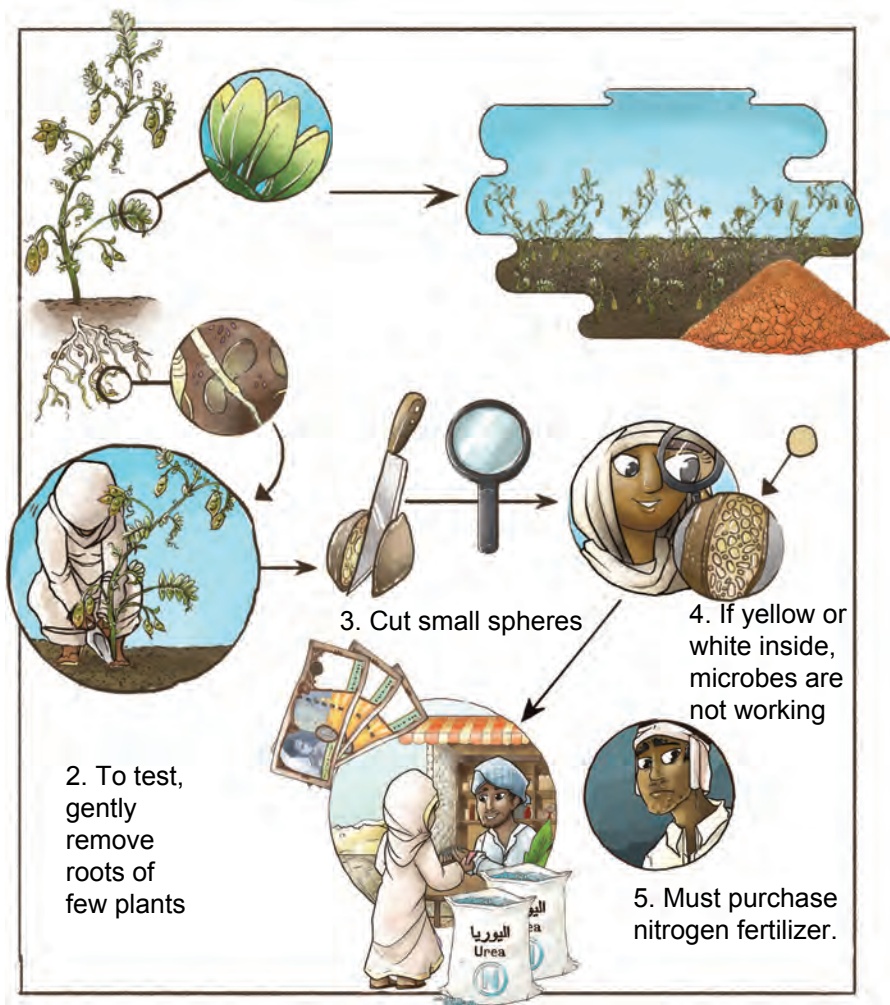


7. After legume grain is harvested, the roots and leaves remain rich in fertilizer (blue) which is deposited into the soil when they decompose

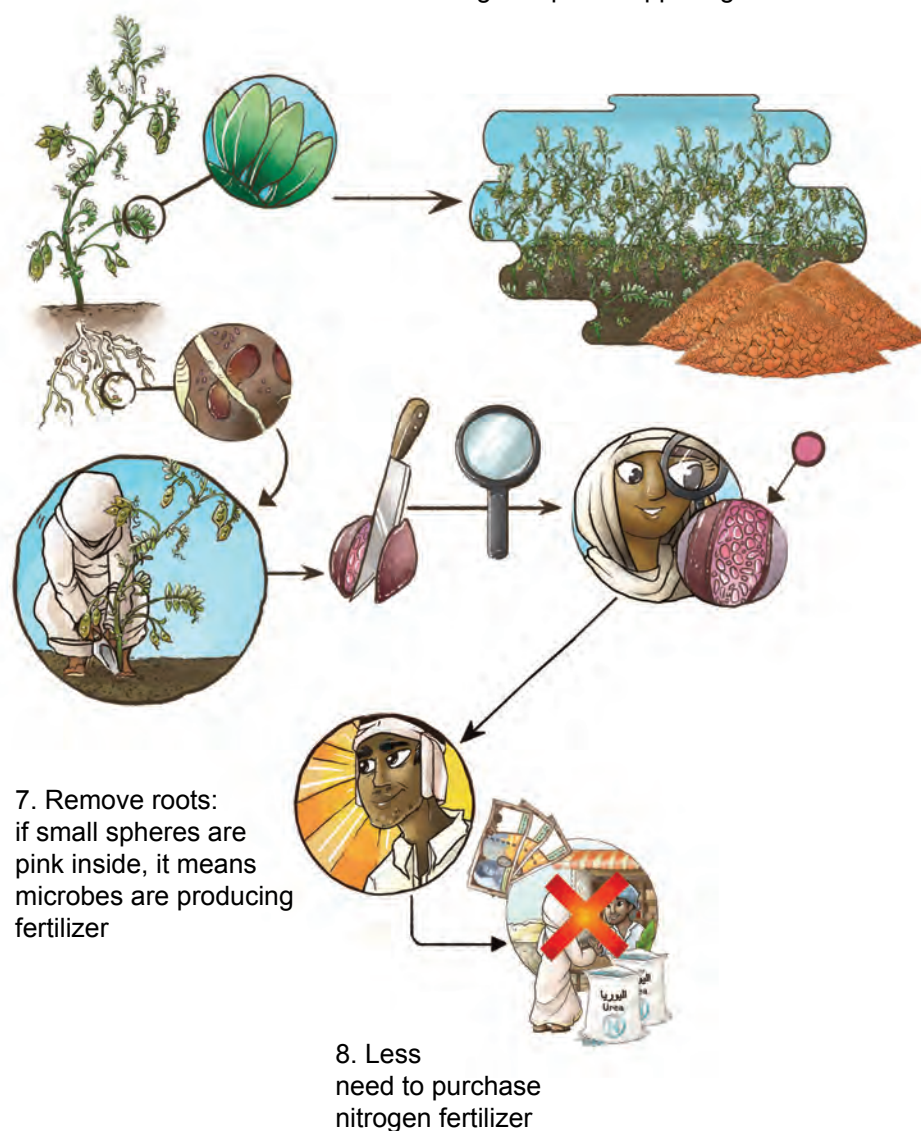
9. Less need to purchase nitrogen fertilizer

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

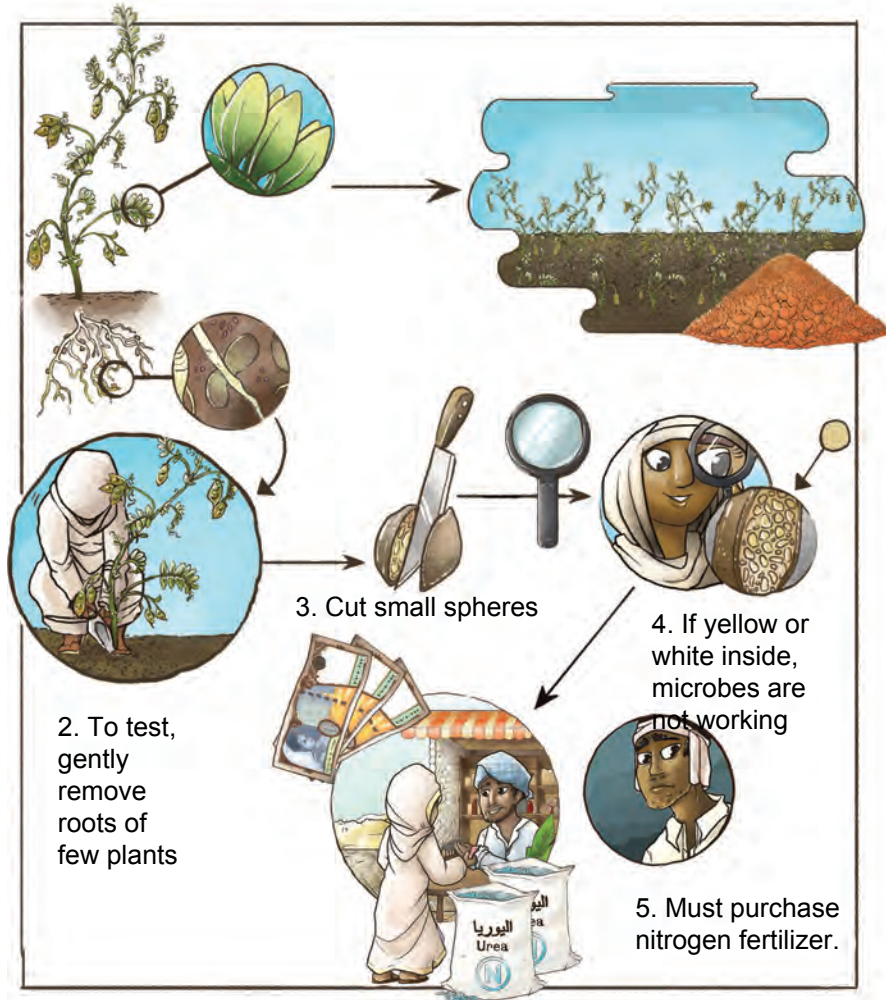


6. Good situation: legume plants appear green.



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.

1. Problem: legumes or pulses are yellow, growing slowly, with low yield



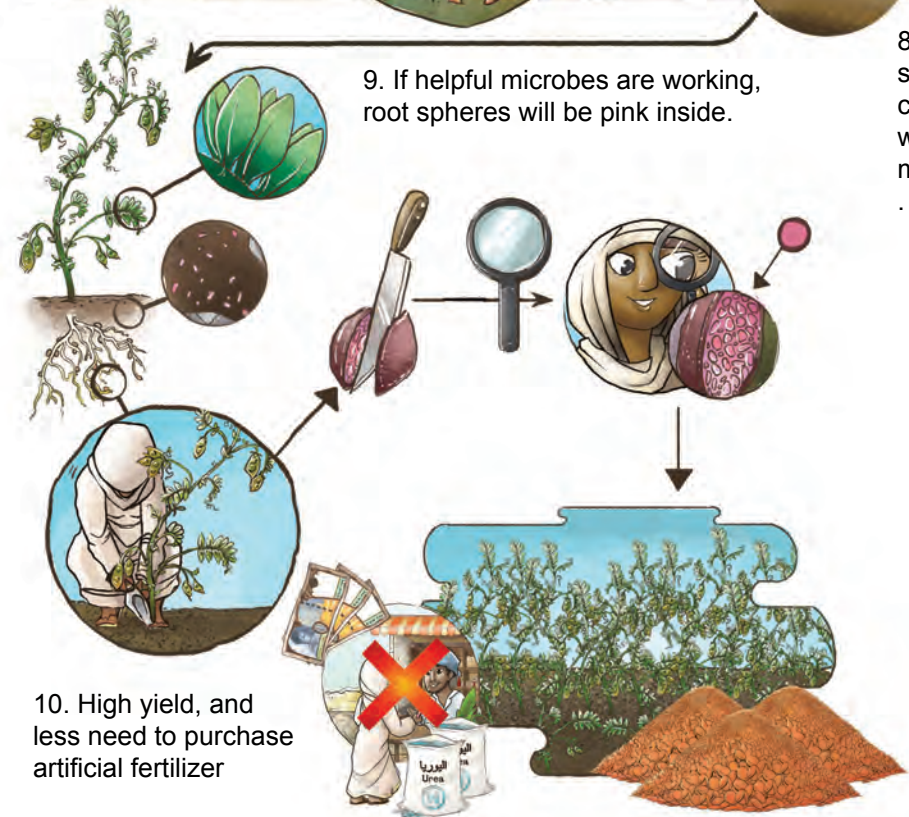
6. Solution: next time, purchase microbes in a bag (shown as pink inside green powder but invisible)

7. To attach microbes onto seeds, add sticky substance (white) to microbes (pink), plus seeds (brown), then shake



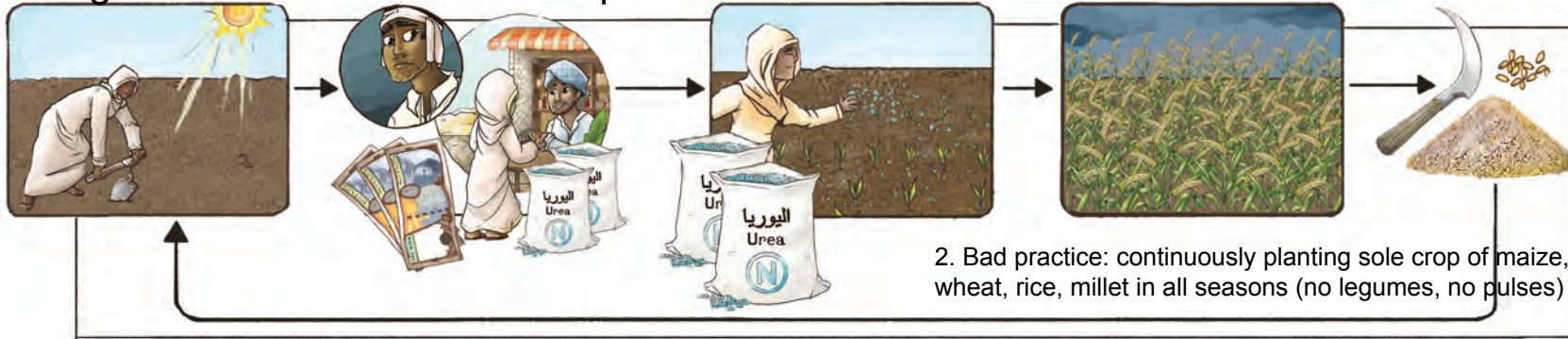
8. Sow seeds coated with microbes

9. If helpful microbes are working, root spheres will be pink inside.



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.

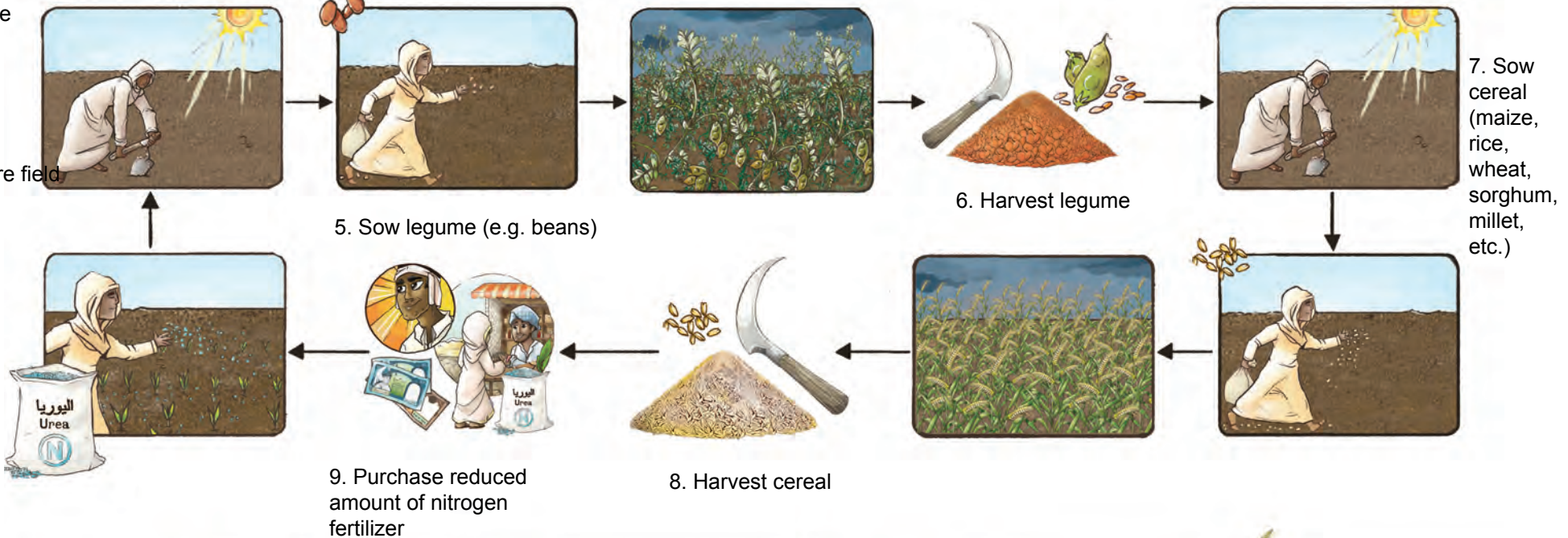
1. Prepare field and add lots of fertilizer



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

3. Improved practice

4. Prepare field

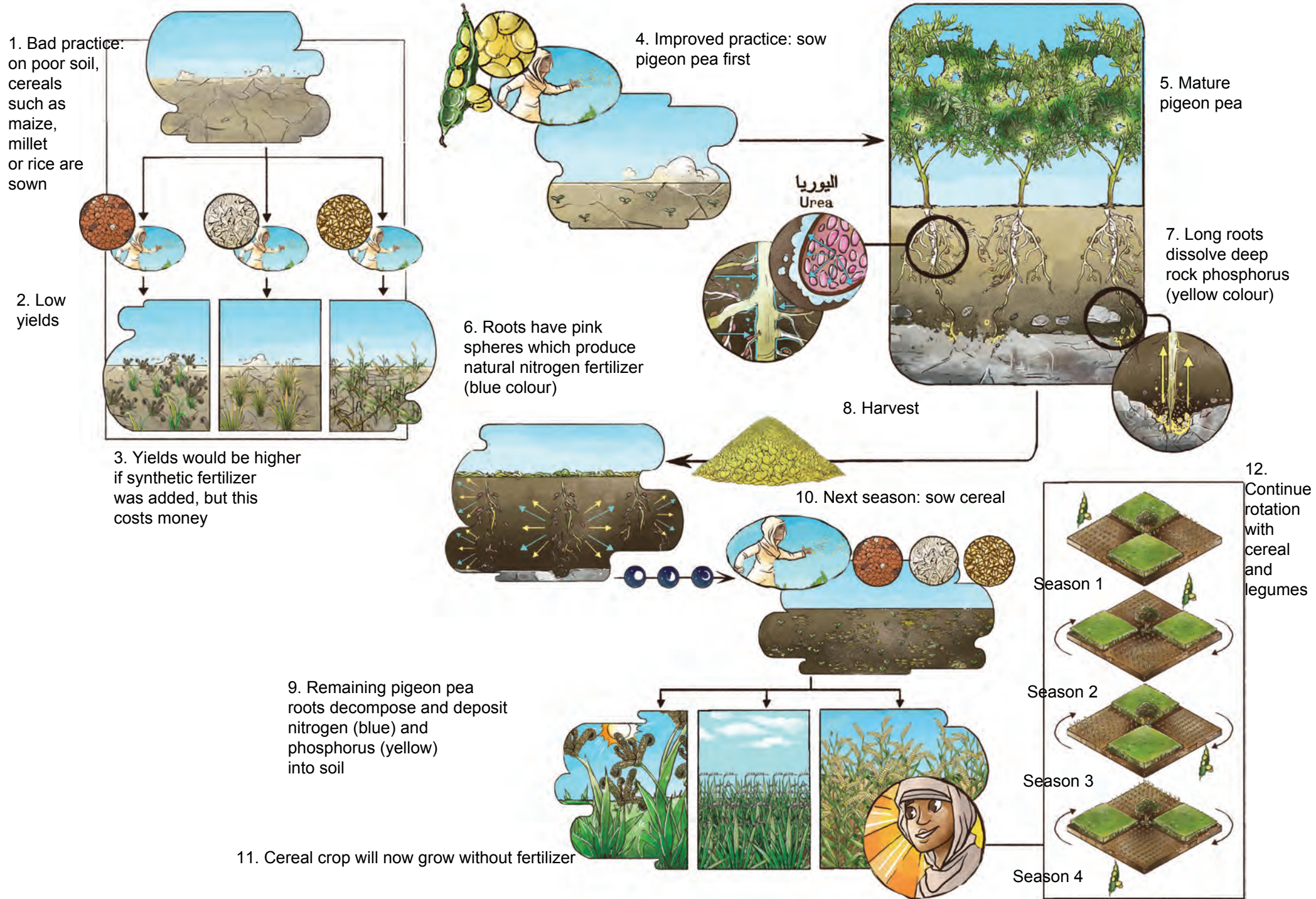


7. Sow cereal (maize, rice, sorghum, millet, etc.)

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

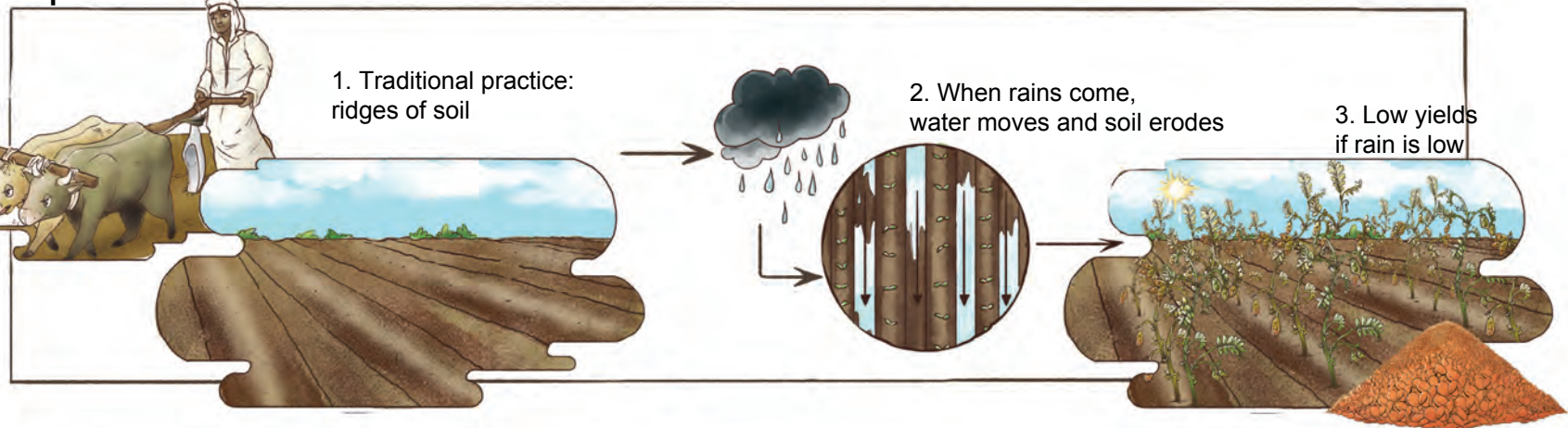


Lesson: When soil is poor, it is better to plant pigeon pea first instead of a cereal crop

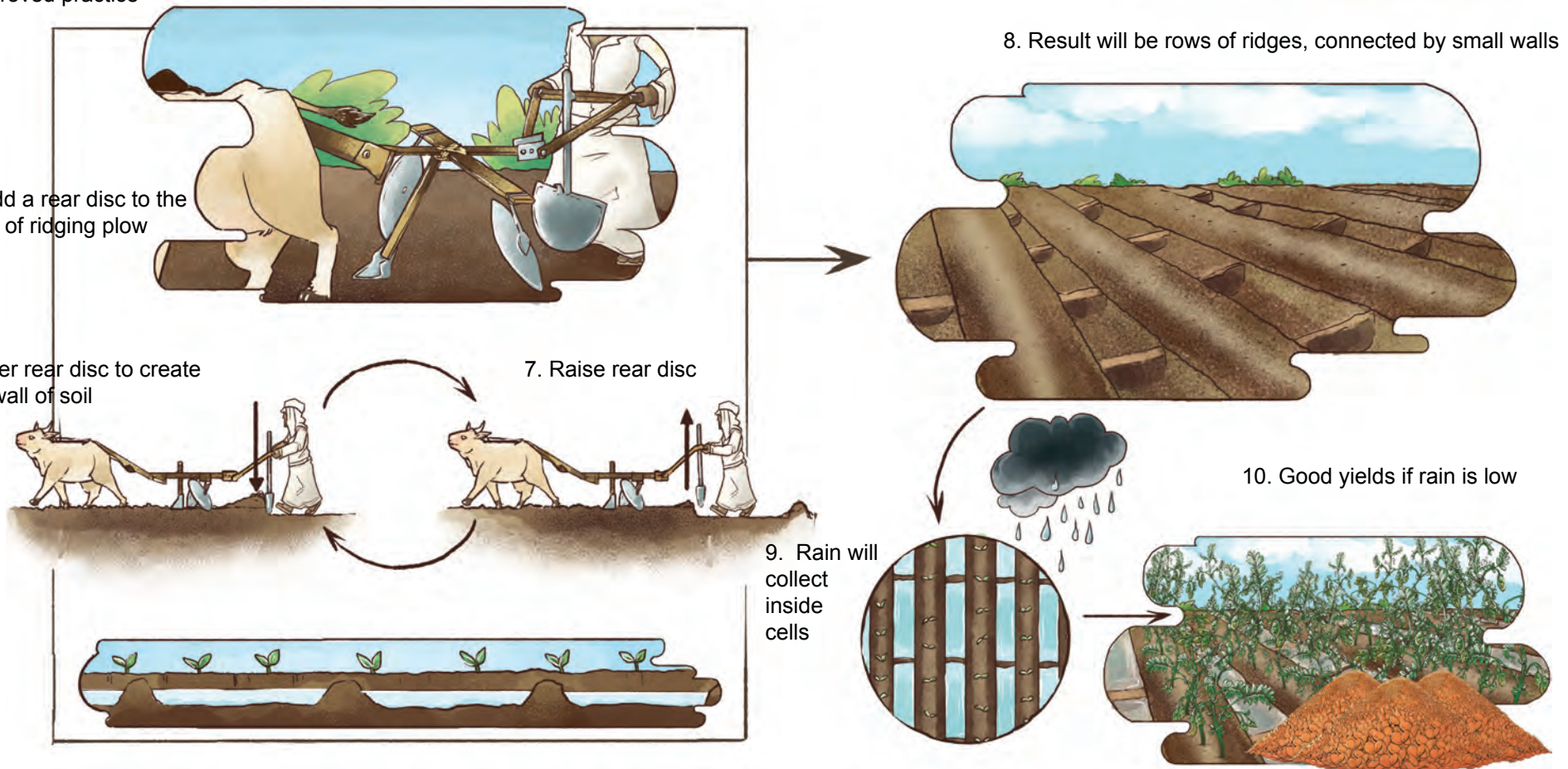


Chapter 5: Water

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

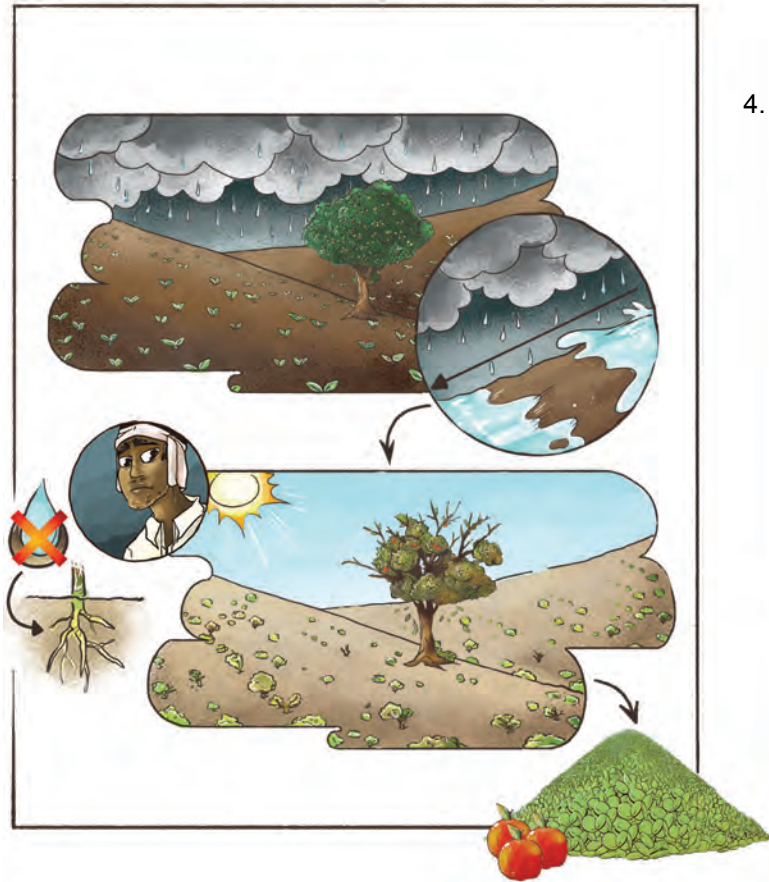


4. Improved practice



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

1. Traditional practice: water is lost

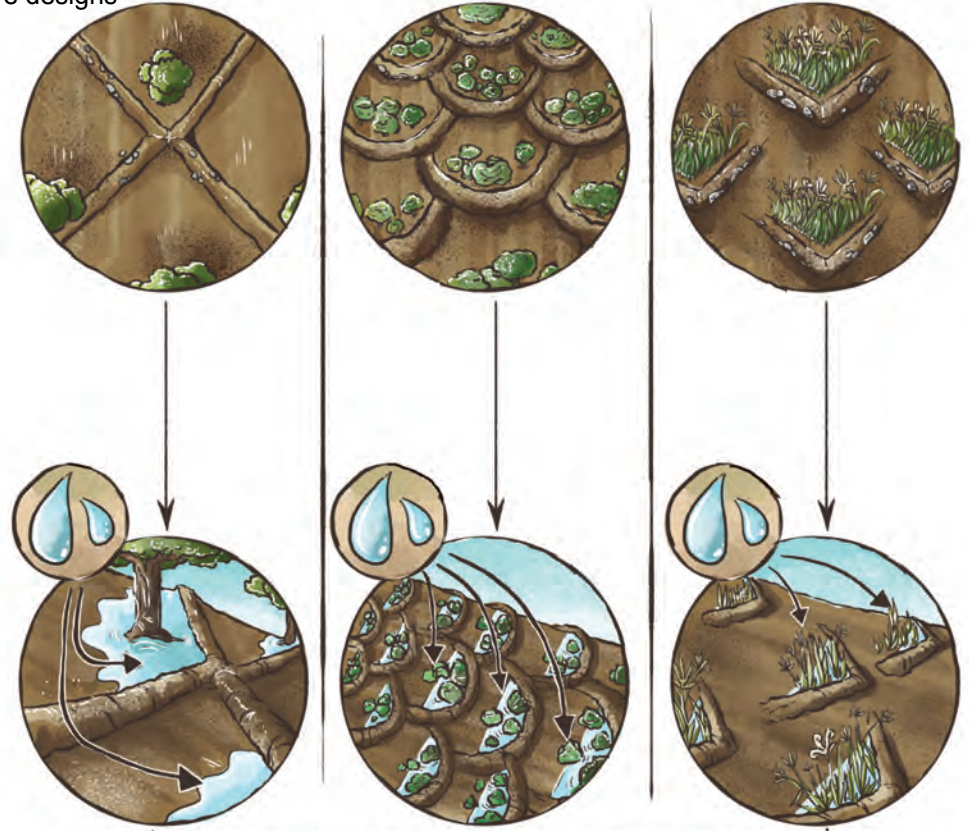


2. Low yields when rain is low (e.g. apple)

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



4. Alternative designs

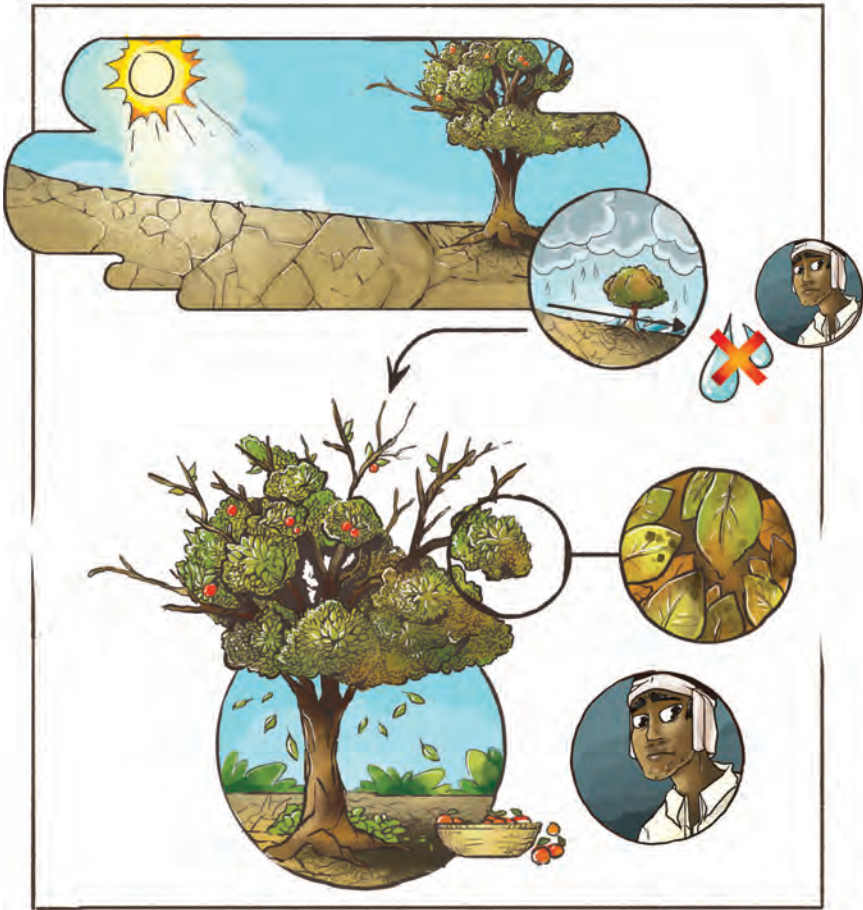


5. Improved yields



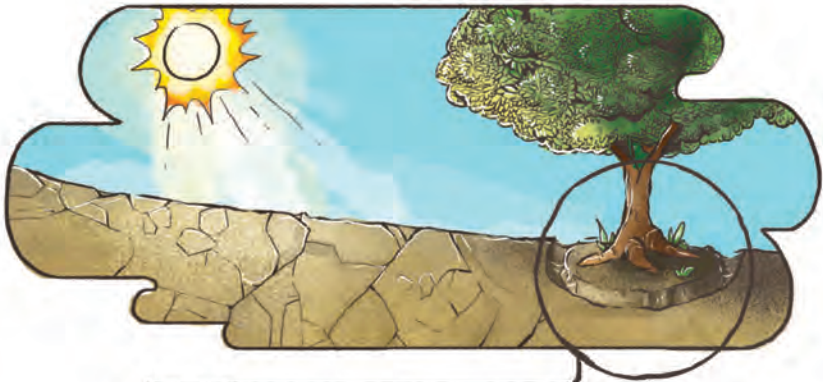
Lesson: Fruit trees can be grown in dry climates by harvesting rainwater around tree using a bund or pit

1. Traditional practice: no water collected



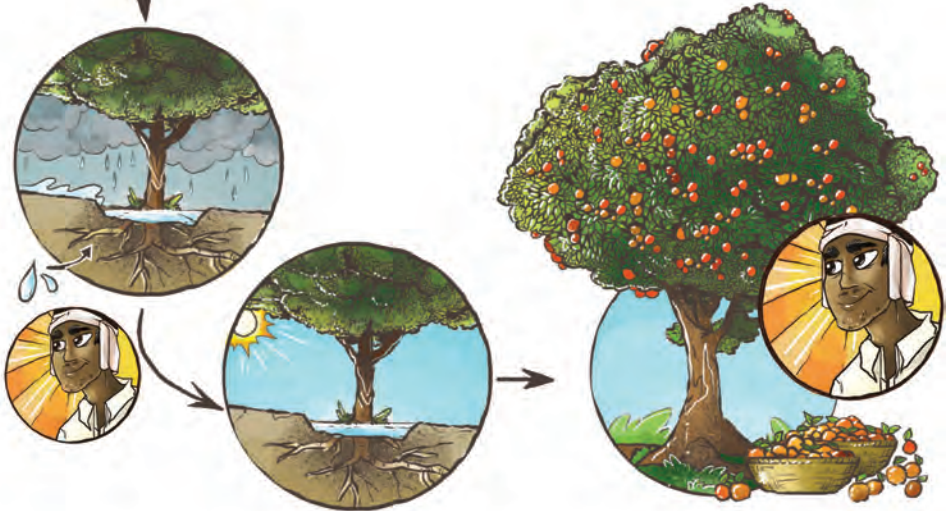
2. Low fruit yield (e.g. apple)

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

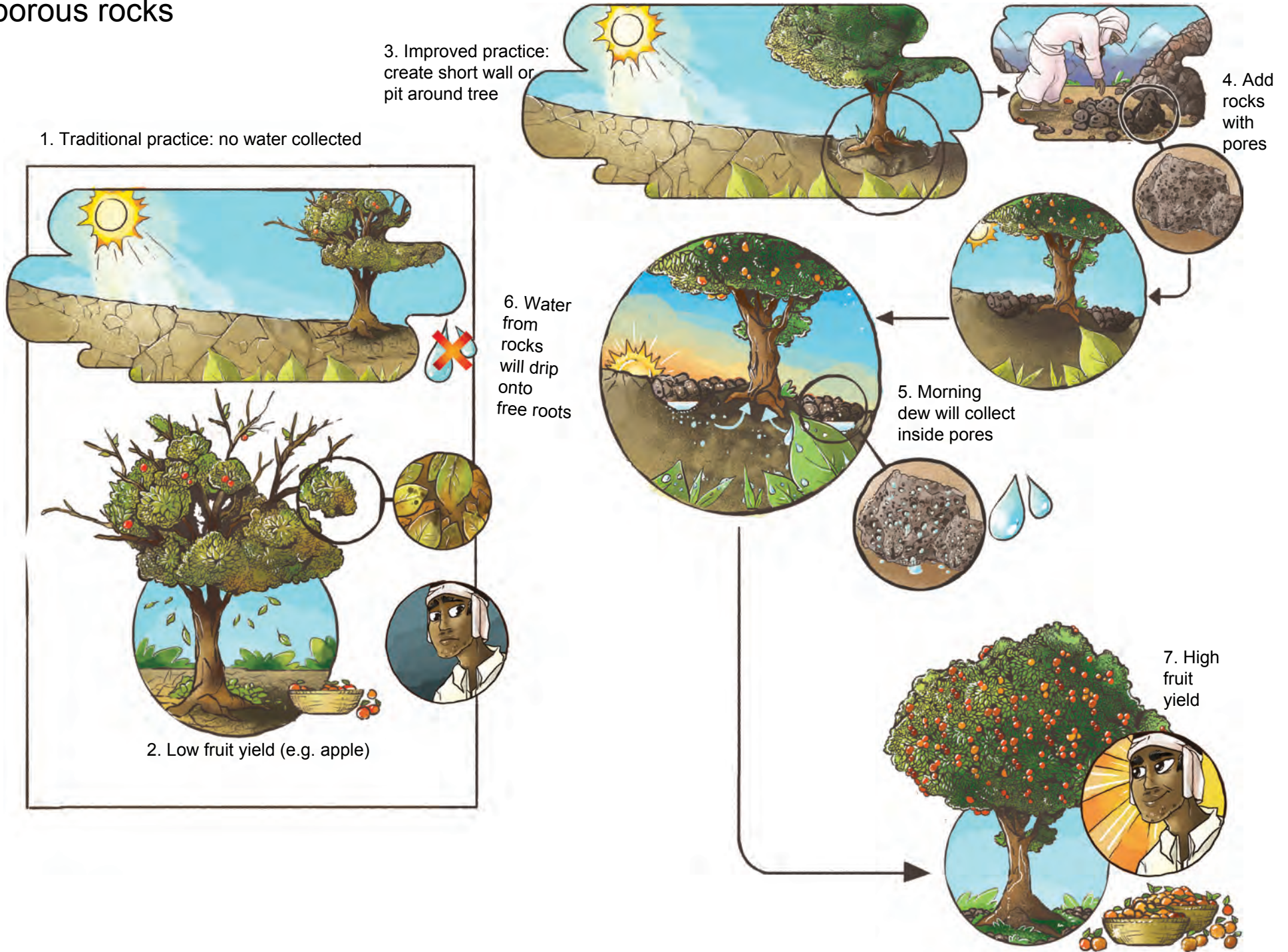


4. Rain collected

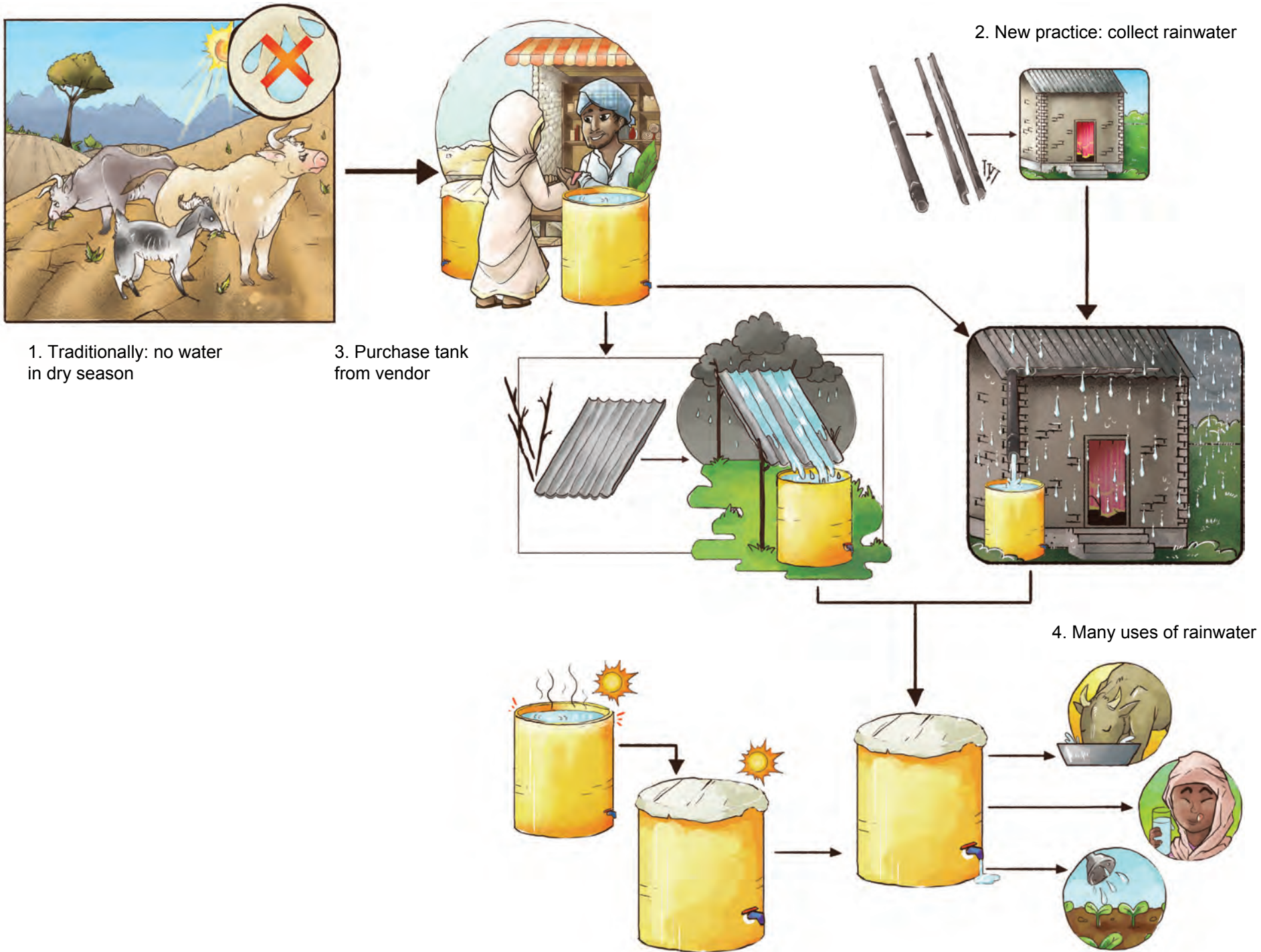
5. High fruit yield



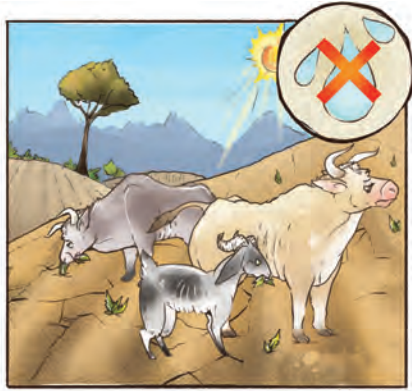
Lesson: Fruit trees can be grown in dry climates by harvesting rainwater around tree using porous rocks



Lesson: Rainwater can be collected



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

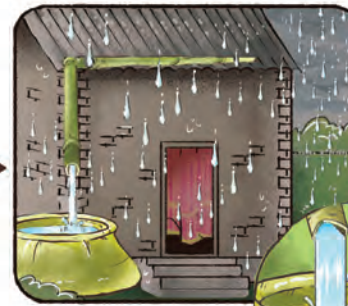


1. Traditional situation: rainfall is lost

2. In dry season, no water



3. New practice is to purchase folding plastic water tank



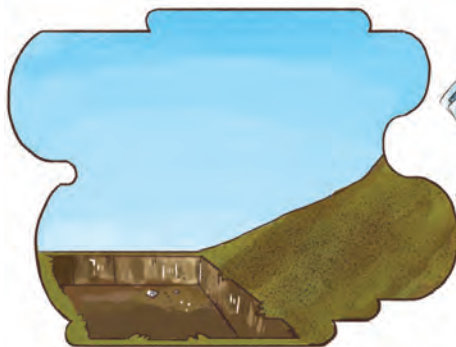
4. Collect rainwater



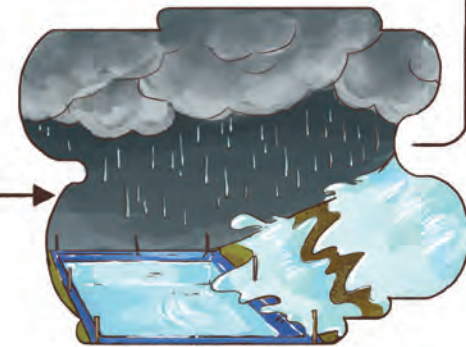
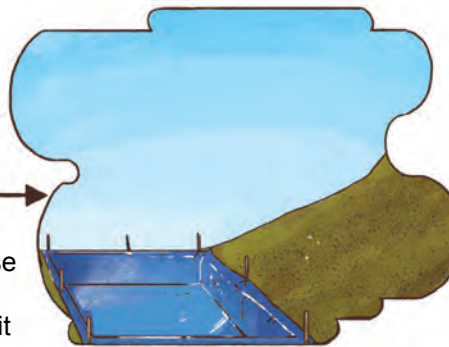
5. Many uses of rainwater



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

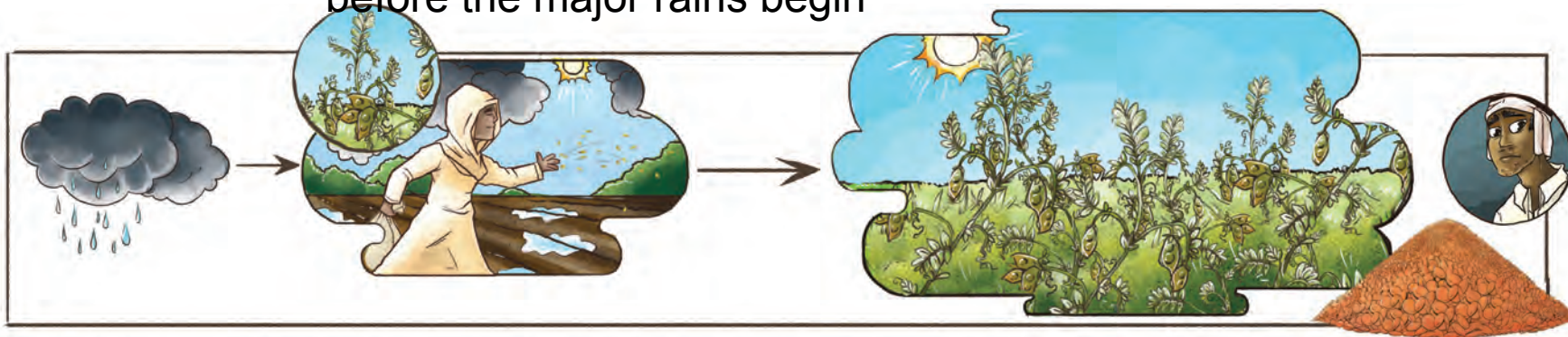


7. Purchase tarpaulin, then line pit



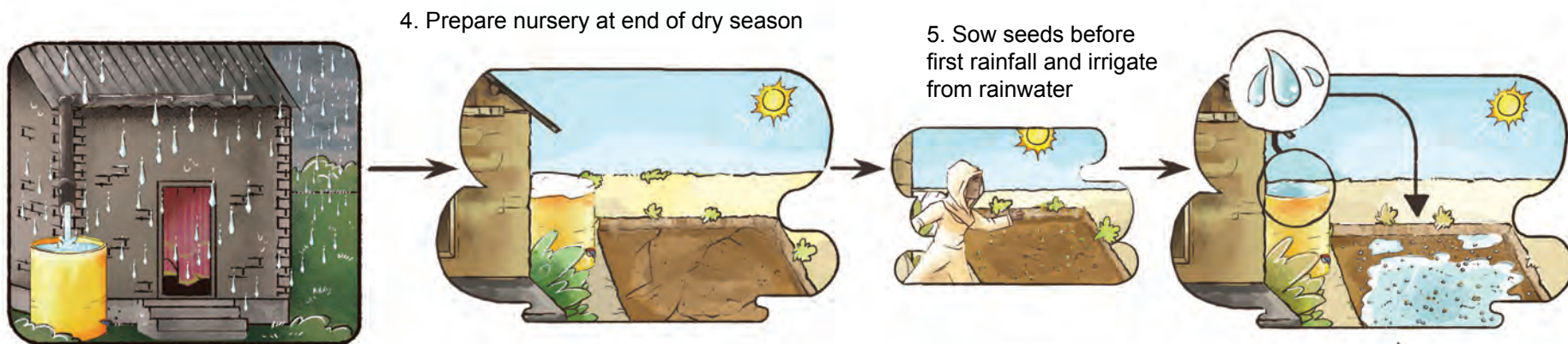
8. Collect rainwater in pit

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.

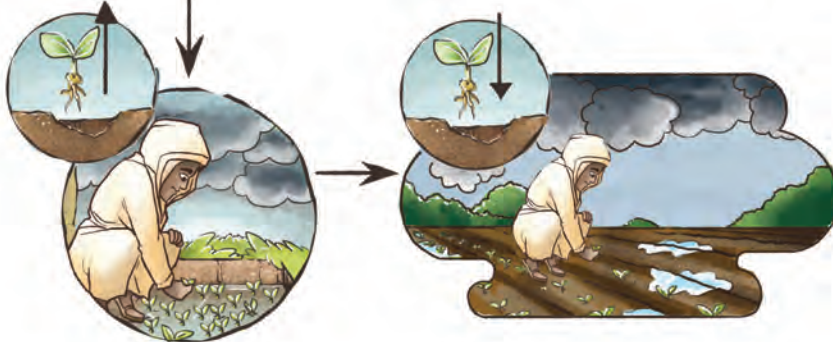


4. Prepare nursery at end of dry season

5. Sow seeds before first rainfall and irrigate from rainwater

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

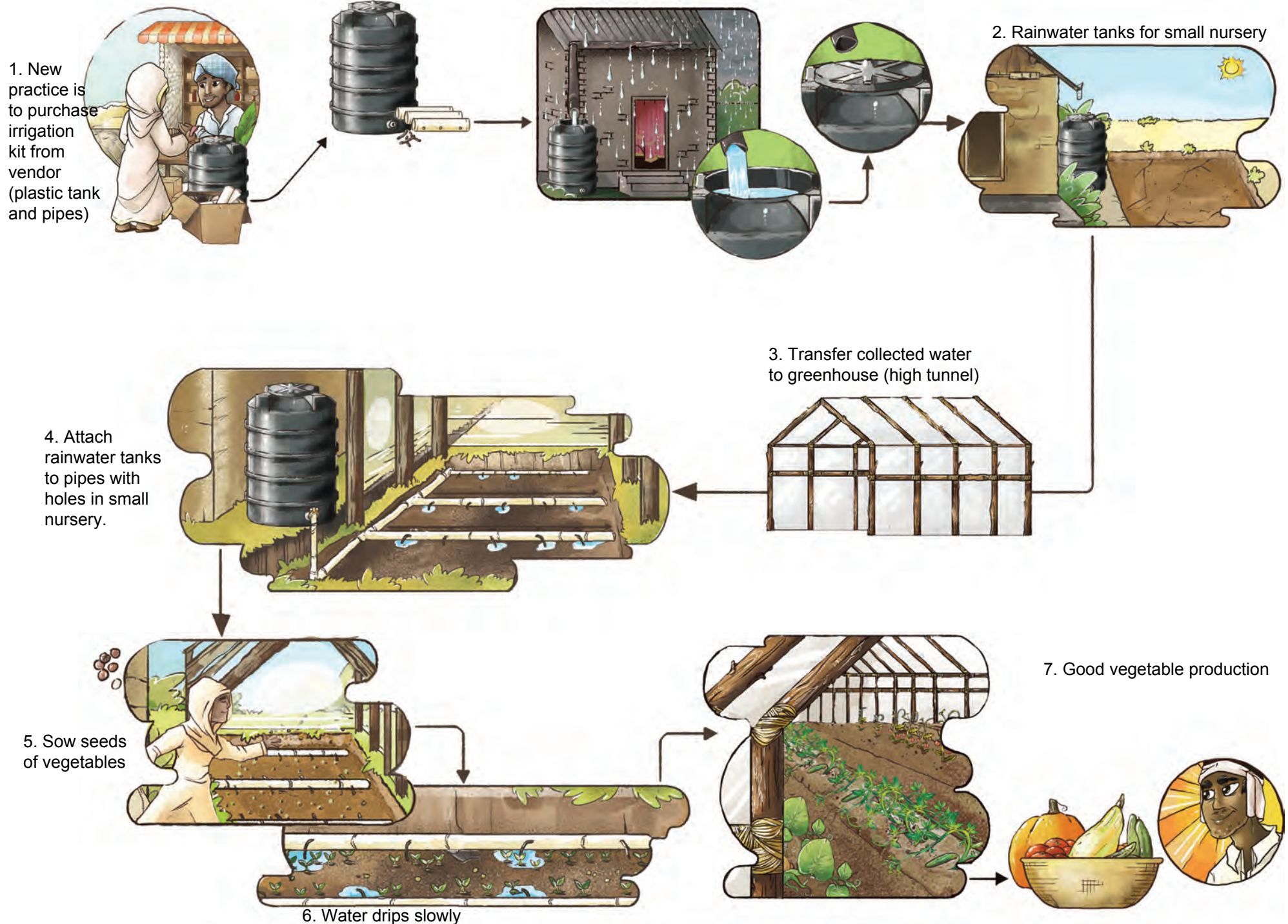
6. When rains arrive, transplant seedlings to the field



7. Yield is higher because the crop duration was increased

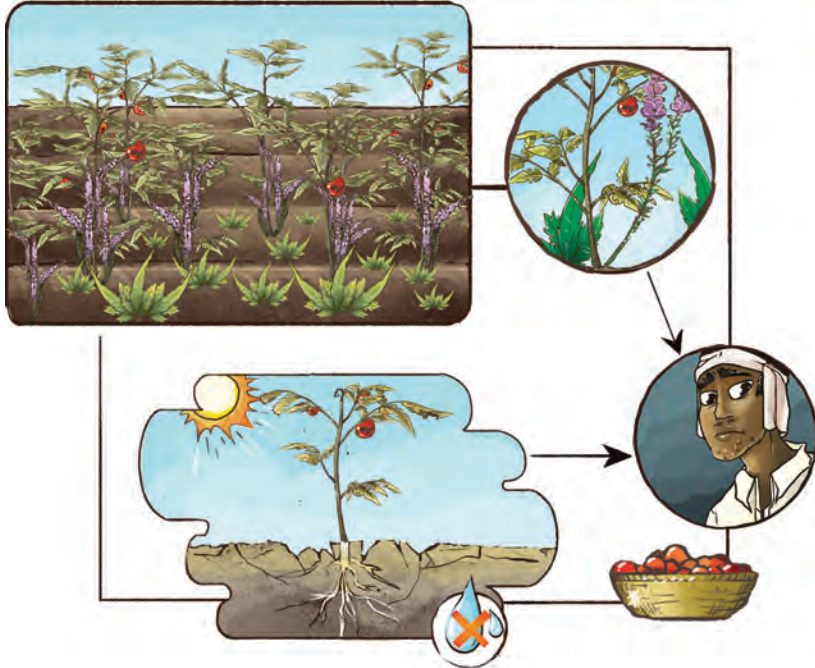


Lesson: Collected rainwater can be connected to pipes with holes to feed water directly to roots



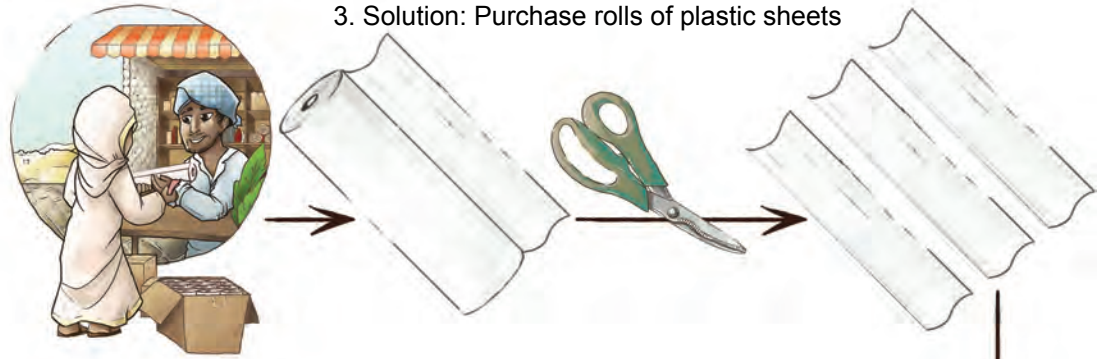
Lesson: Use plastic mulch to suppress weeds in the garden, prevent water loss and keep soil warm.

1. Problem: in garden weeds can grow



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

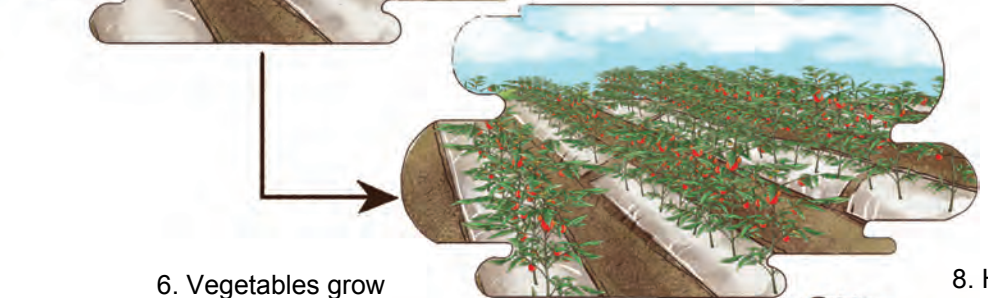
3. Solution: Purchase rolls of plastic sheets



4. Place on ground, create holes.



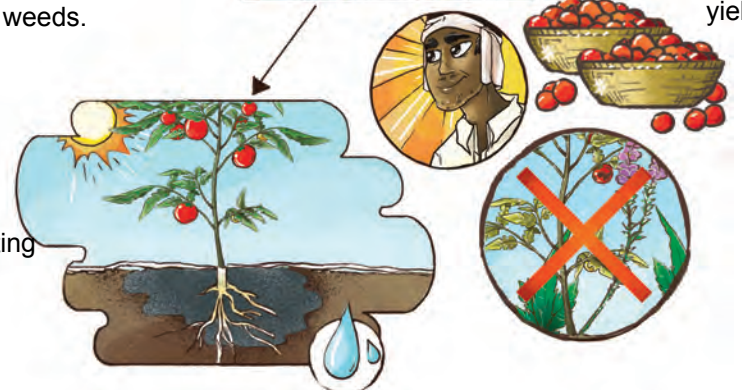
5. Sow seeds in holes

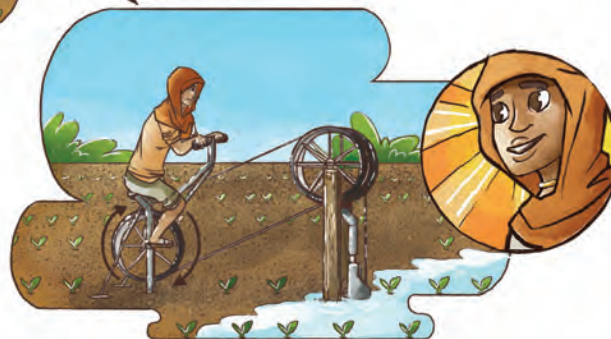
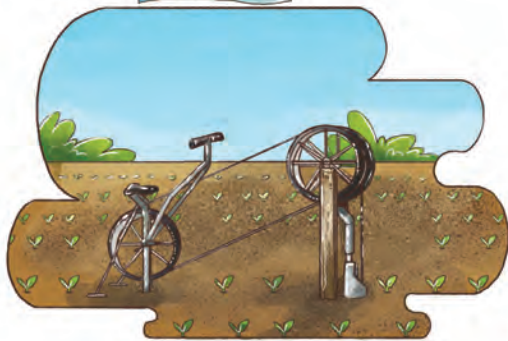
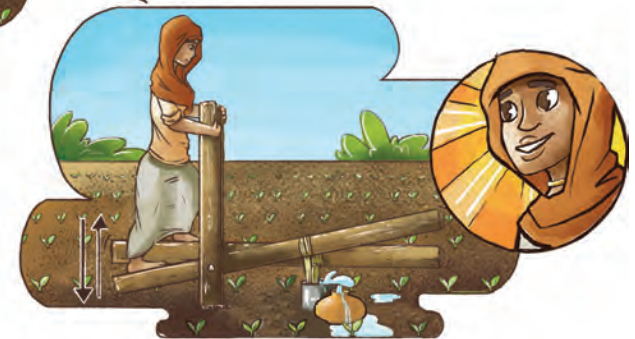
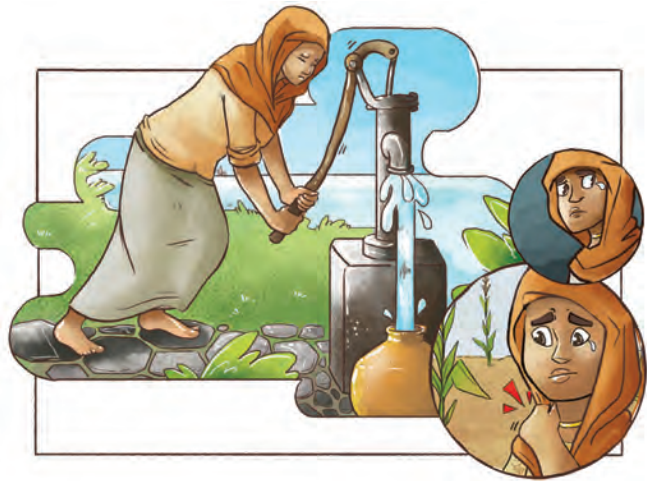


6. Vegetables grow without weeds.

8. High yield

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

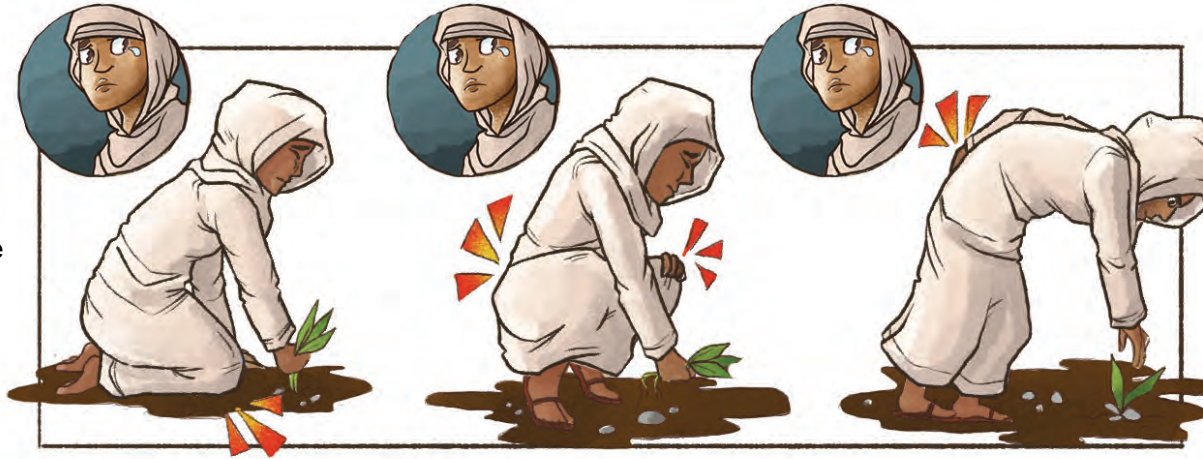




Chapter 6: Weeds

Lesson: 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



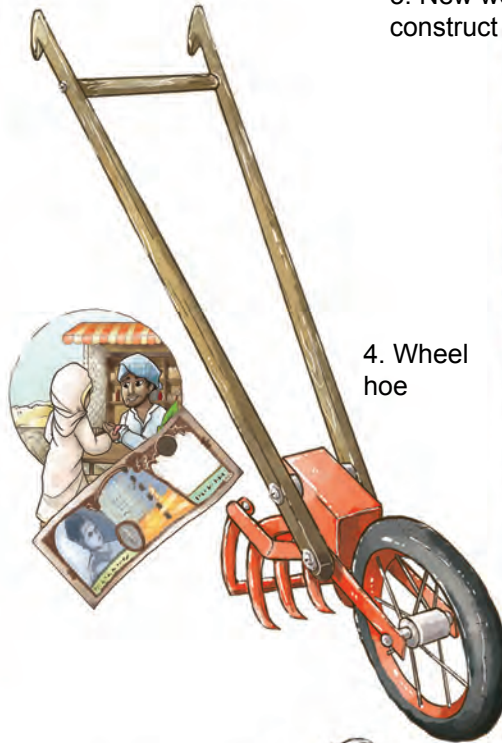
Lesson: New tools to reduce drudgery of hand removal of weeds

1. Traditional practice



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

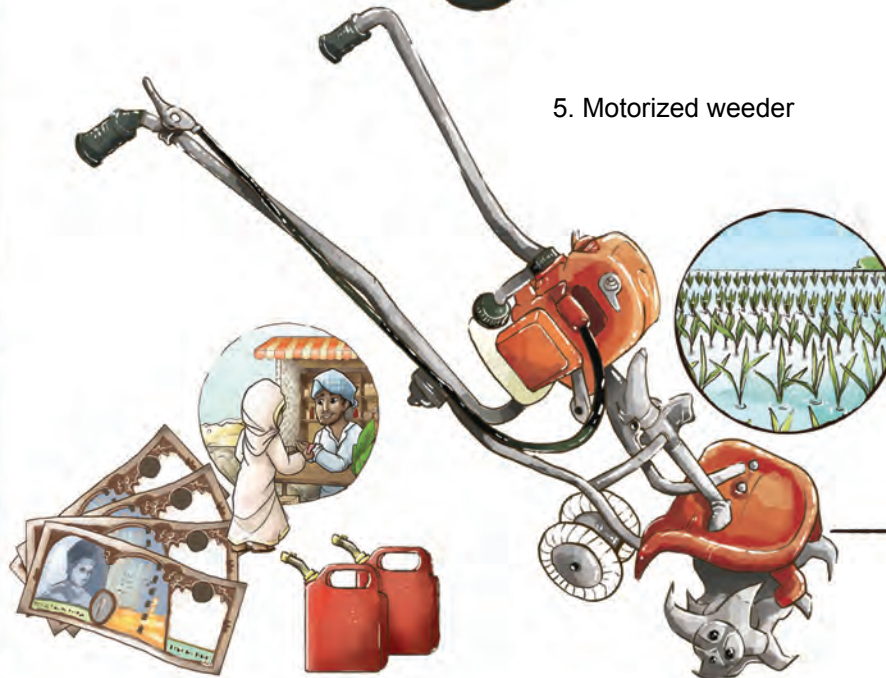
3. New weeding tools: ask nearby vendor to supply or ask local blacksmith to construct



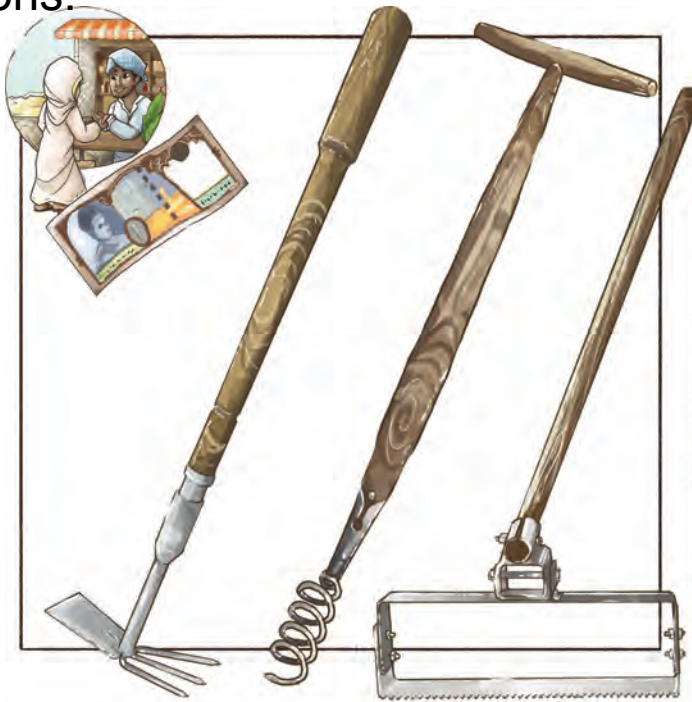
4. Wheel hoe



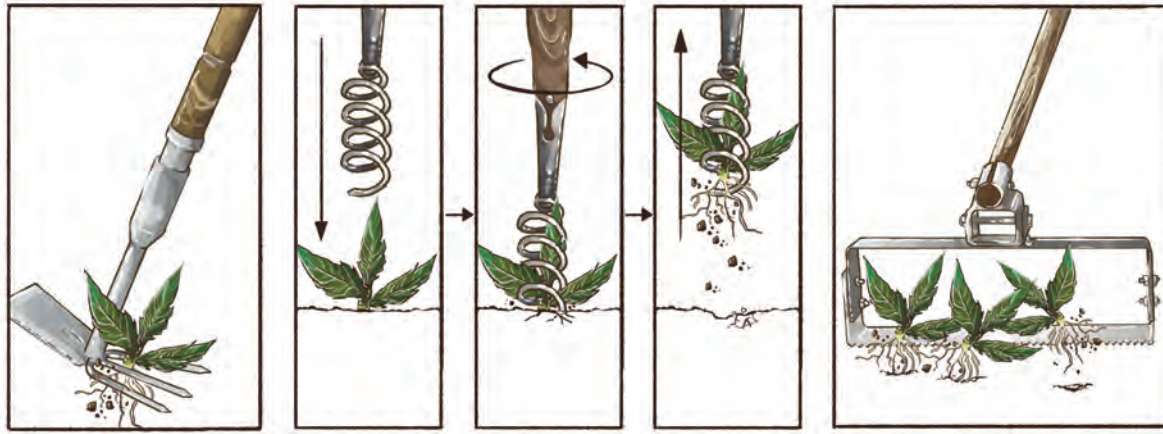
5. Motorized weeder



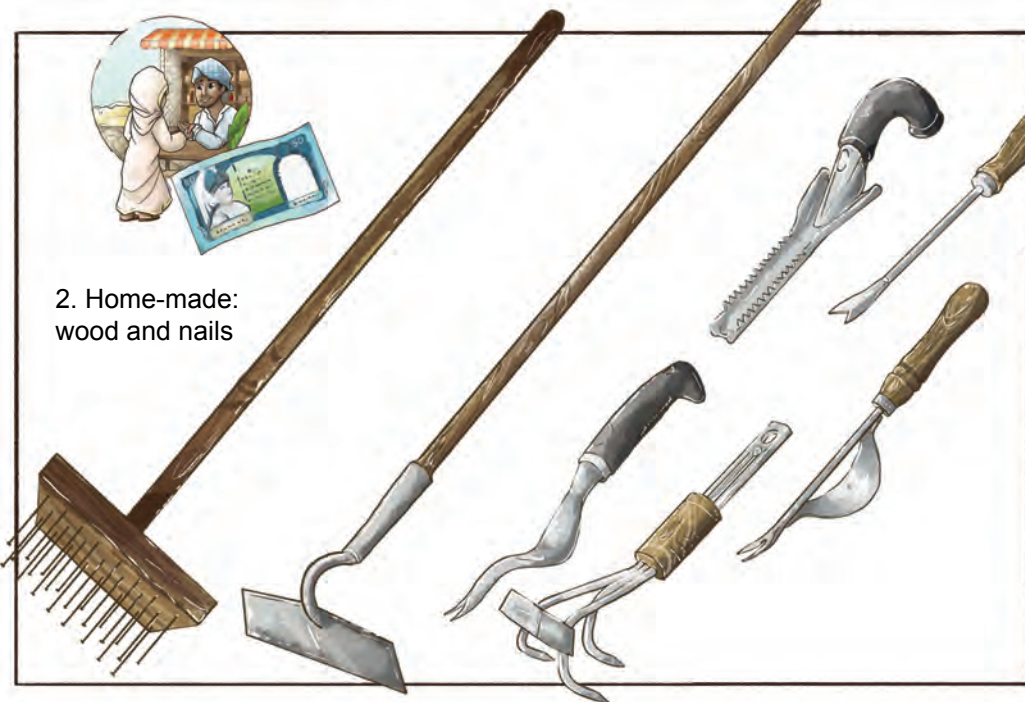
Lesson: New tools to reduce drudgery of hand removal of weeds: Long-handled, medium cost options.



1. Long handled weeders



3. Short handled weeders



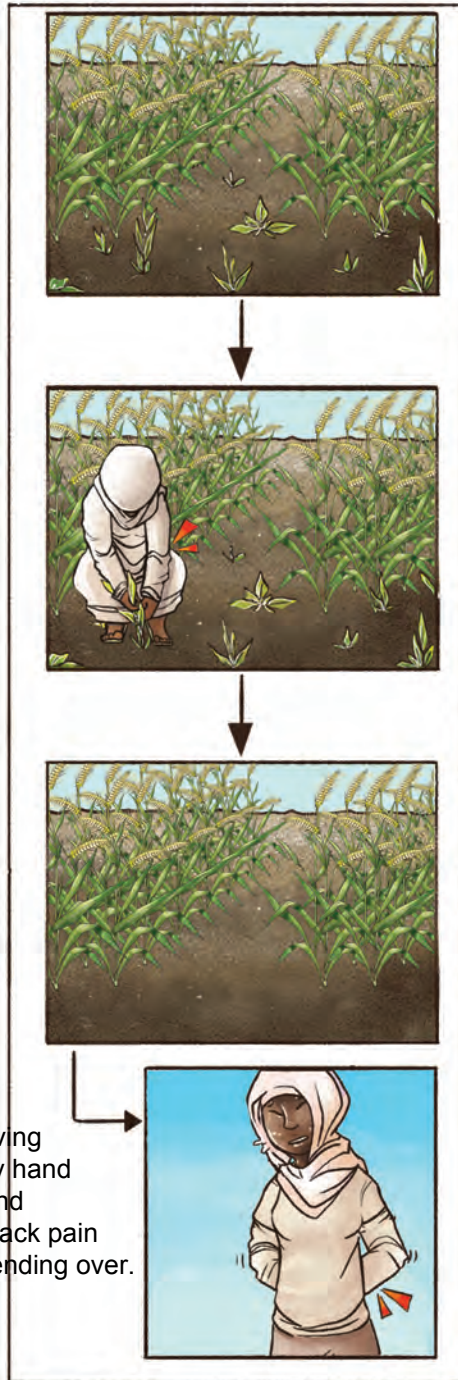
2. Home-made: wood and nails

4. How to use



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

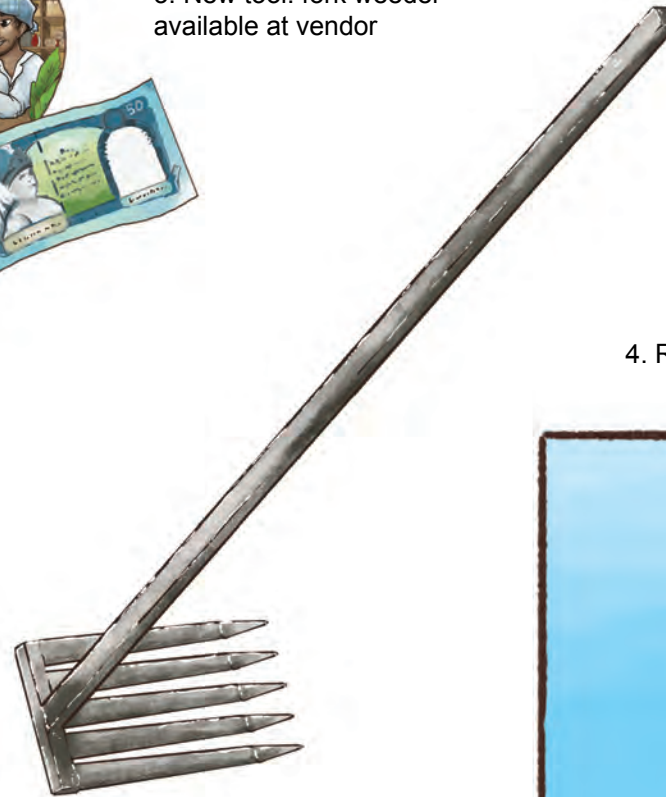
1. Traditional practice



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



3. New tool: fork weeder available at vendor

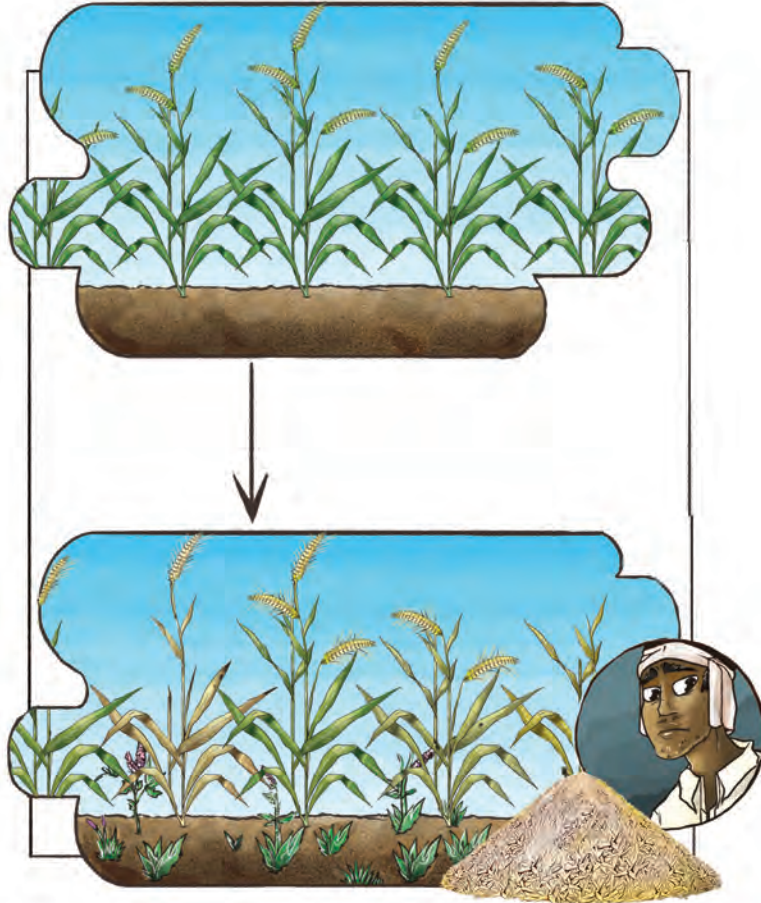


4. Remove weeds easily



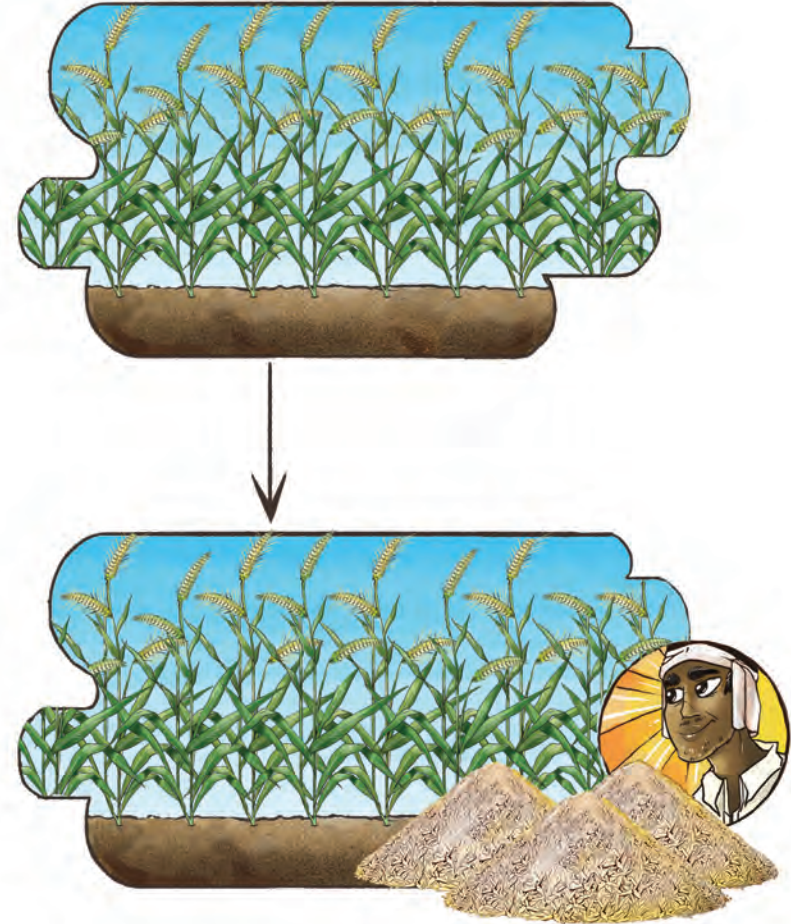
Lesson: Sowing crops at a high density can suppress weeds

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



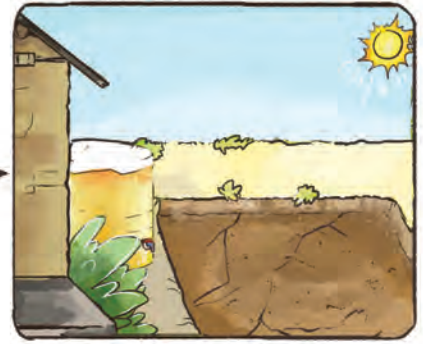
4. Fewer weeds, higher yields

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

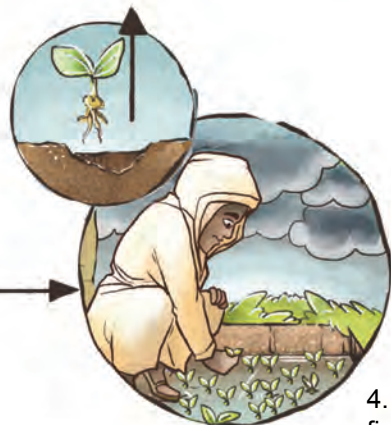
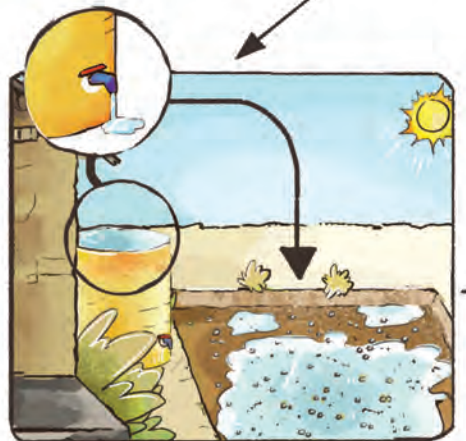


1. Problem: weeds (red flower) reduce yield of millet

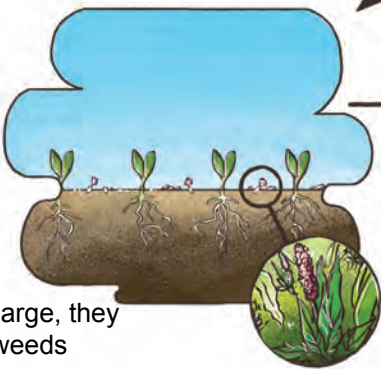
2. Improved practice



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

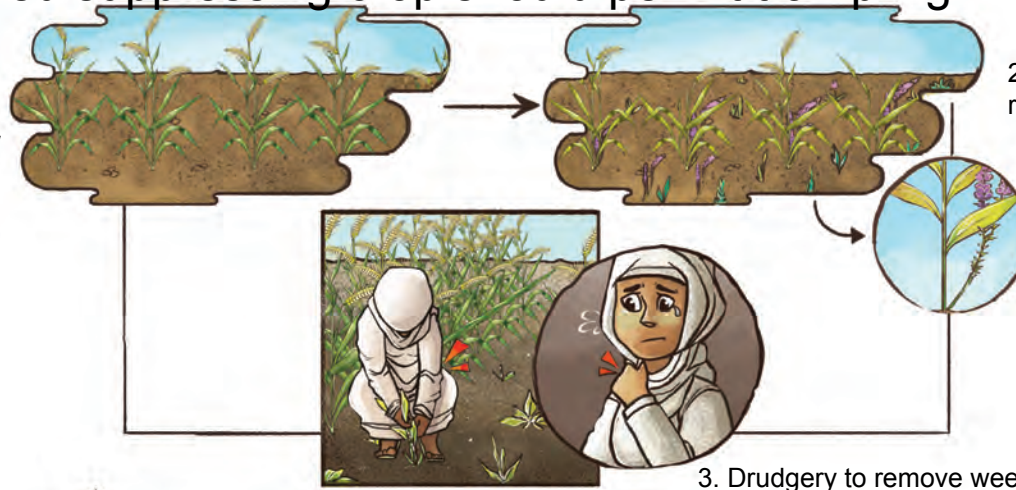


6. High grain yields



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.

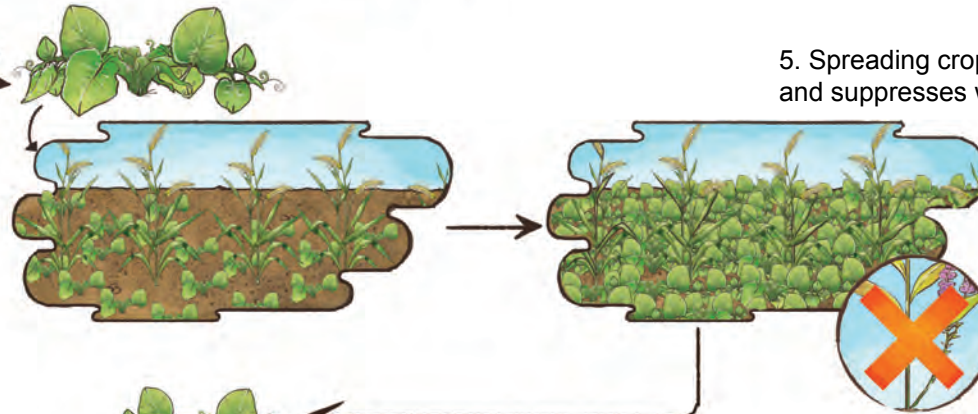


2. Problem: weeds grow in between rows.

3. Drudgery to remove weeds

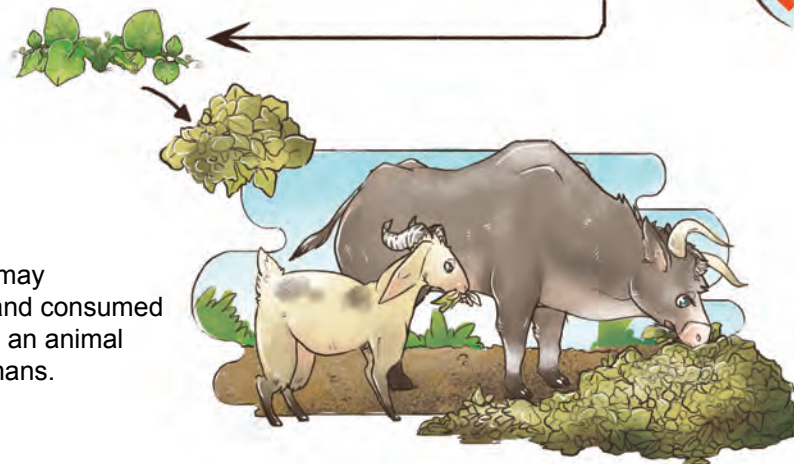


4. Improved practice: in between rows, sow seeds of a spreading type (e.g. cucurbits)



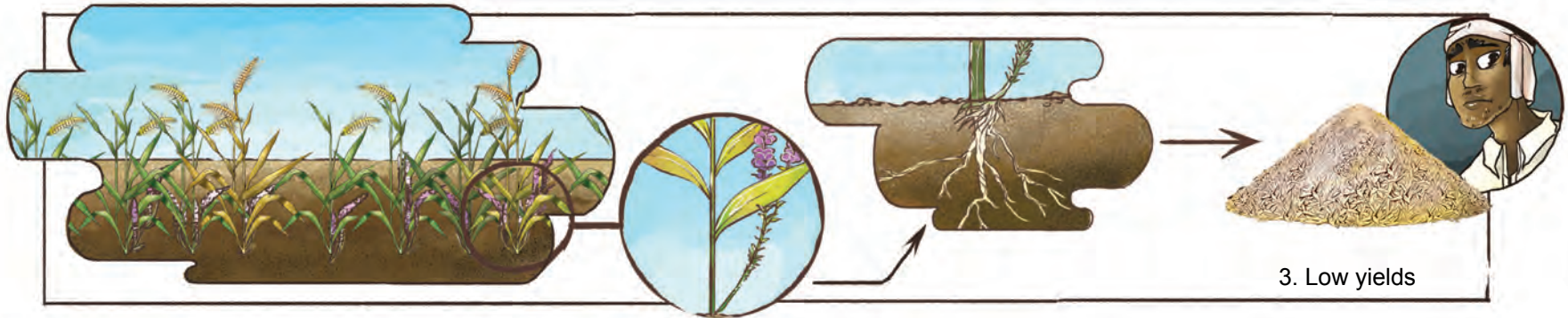
5. Spreading crop covers the ground and suppresses weeds.

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

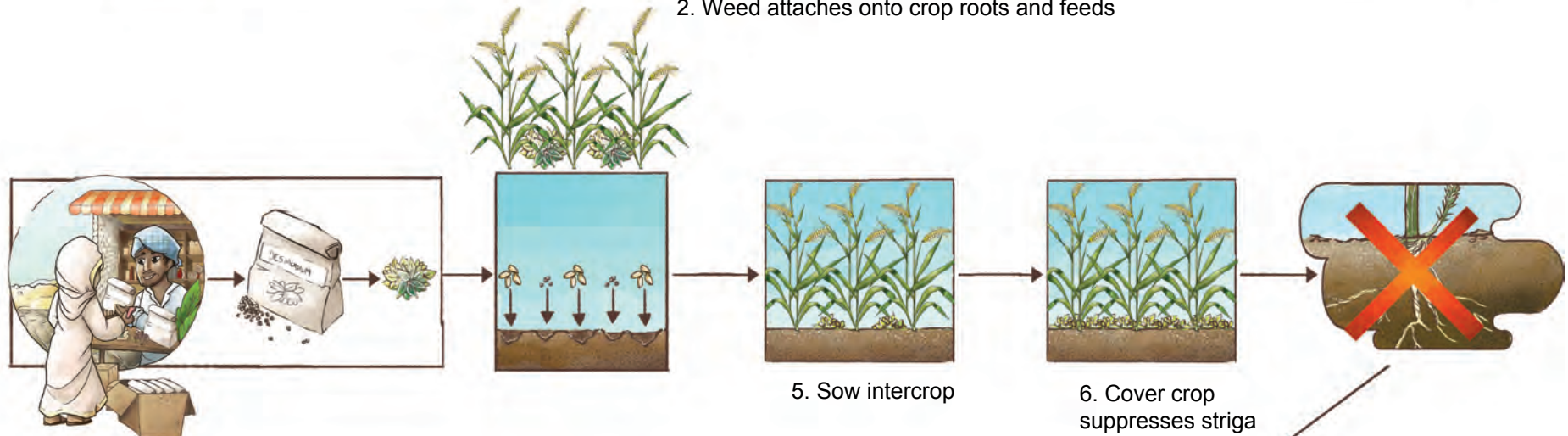


Lesson: Parasitic striga weed can be suppressed by intercropping with Desmodium or other spreading-type crops

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

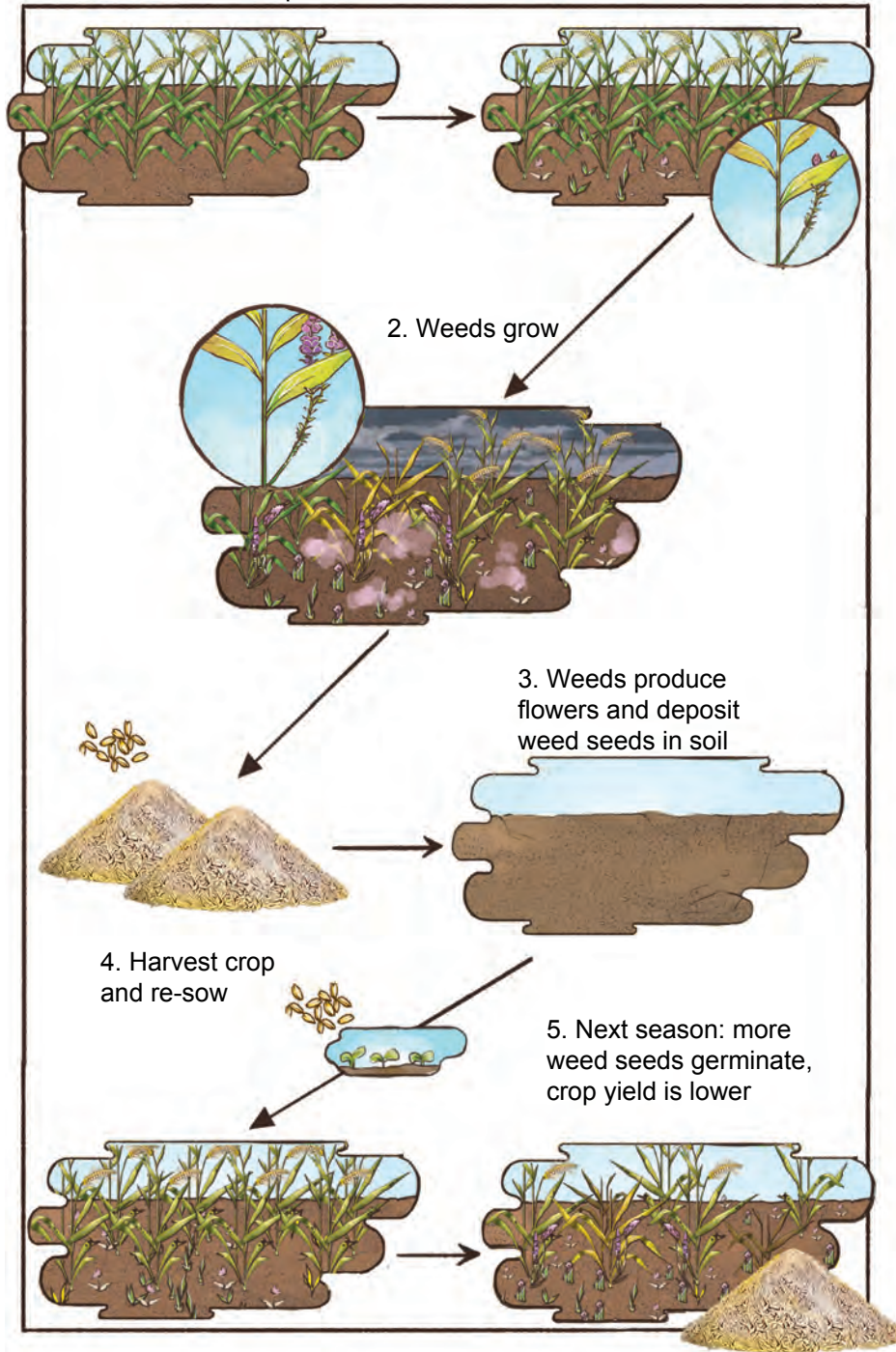
6. Cover crop suppresses striga weed

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

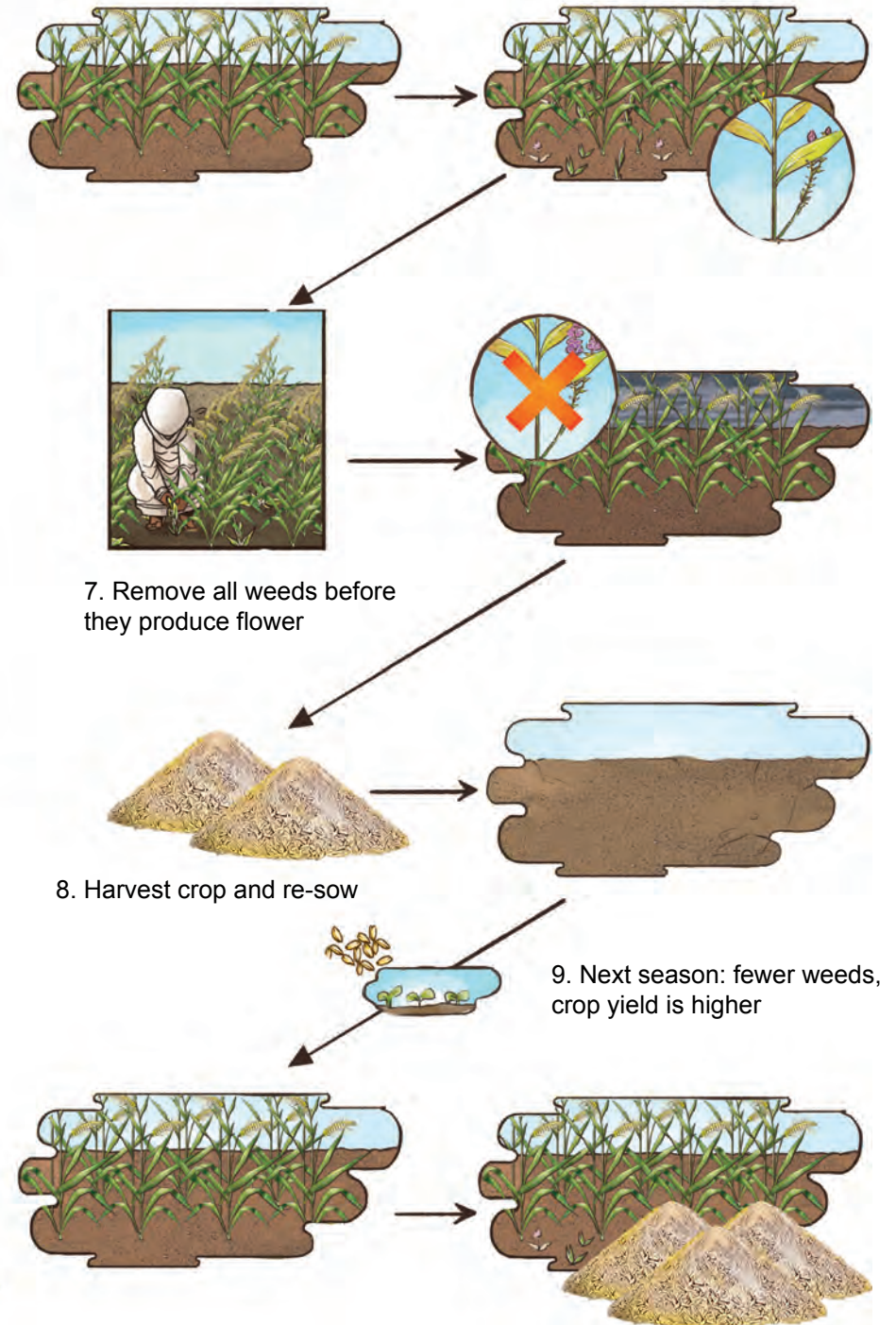


Lesson: Removing weeds before they produce flowers will reduce weeds in future years

1. Traditional practice

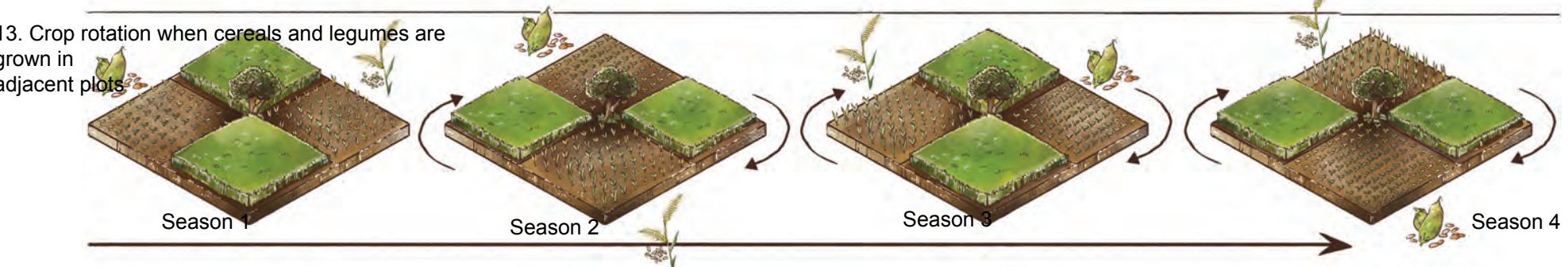
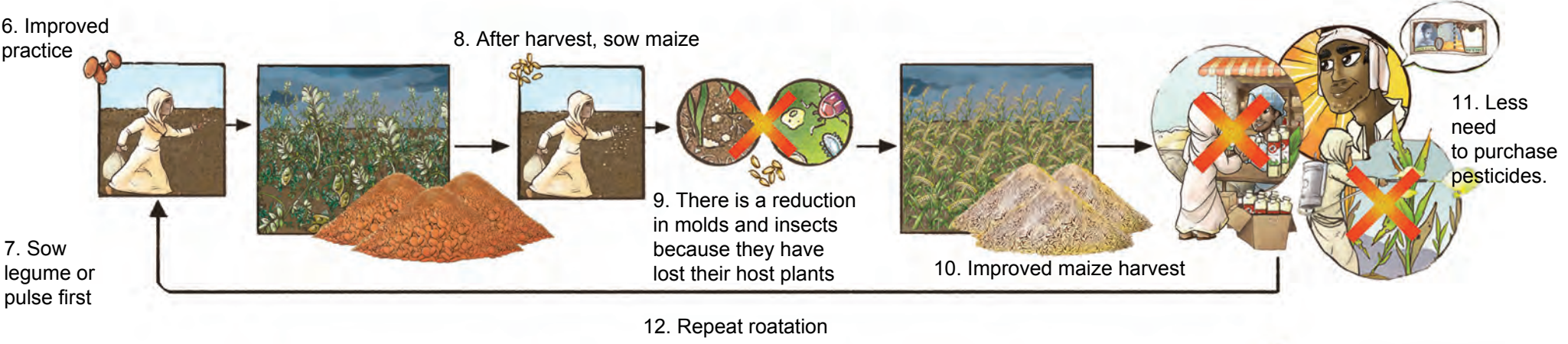
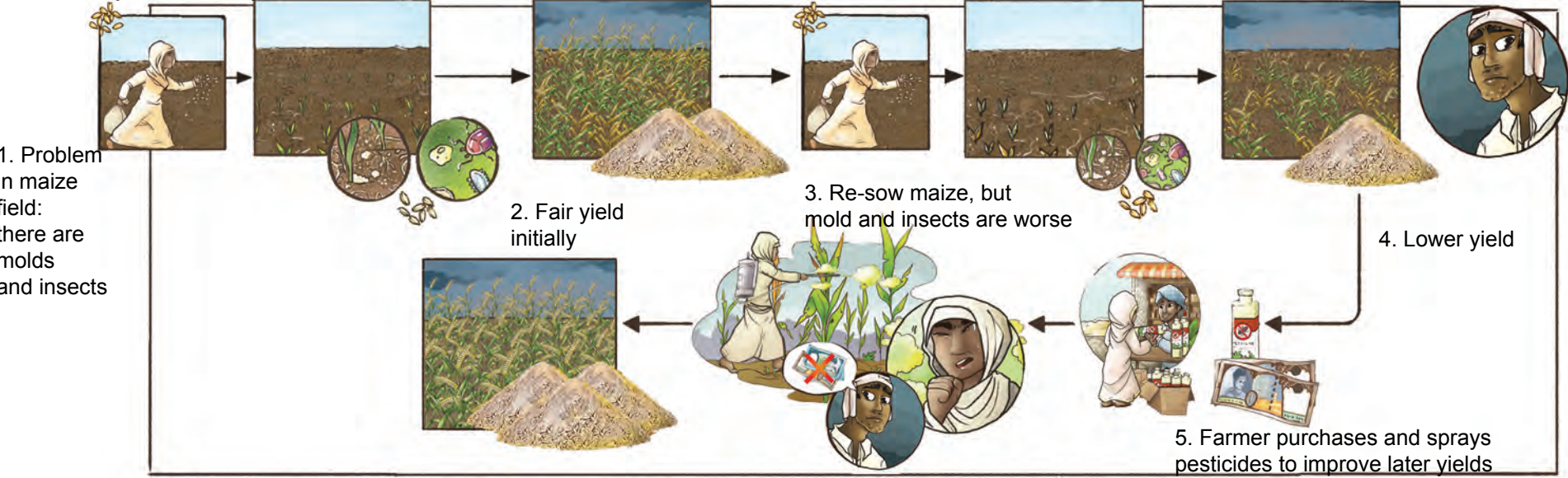


6. Improved practice

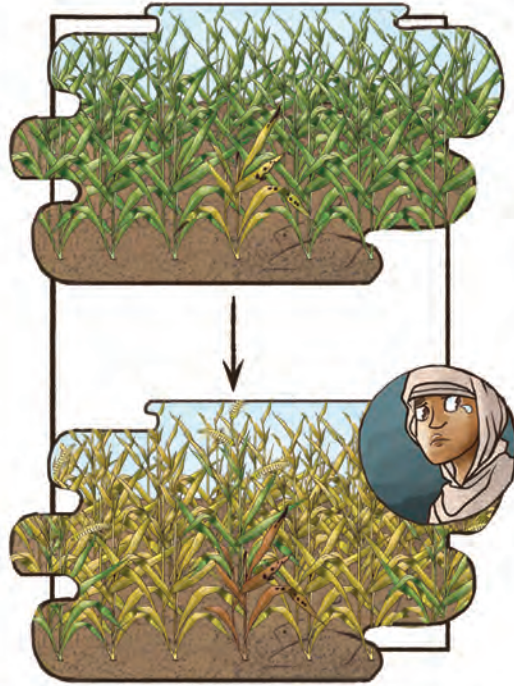


Chapter 7: Pests & Disease

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.



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



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

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

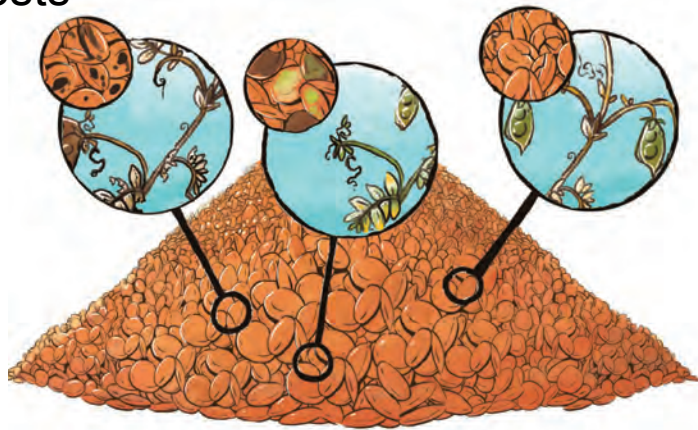


3. Wash the cutting knife as it may be contaminated with disease or pest



4. Field is healthy, high yields

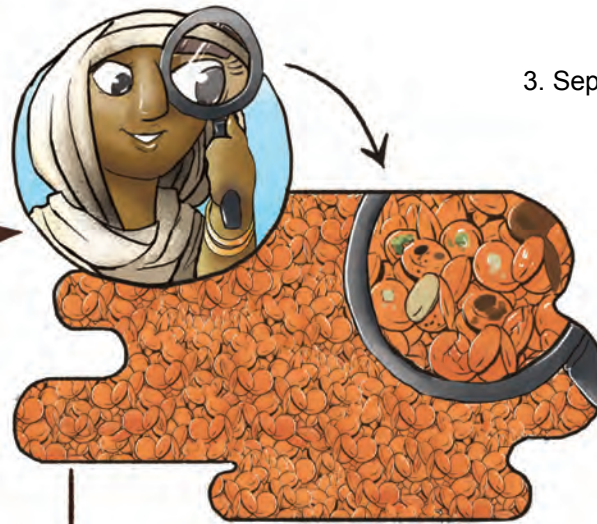
Lesson: Before sowing seeds, use a magnifying glass/sheet to help remove seeds with disease or pests



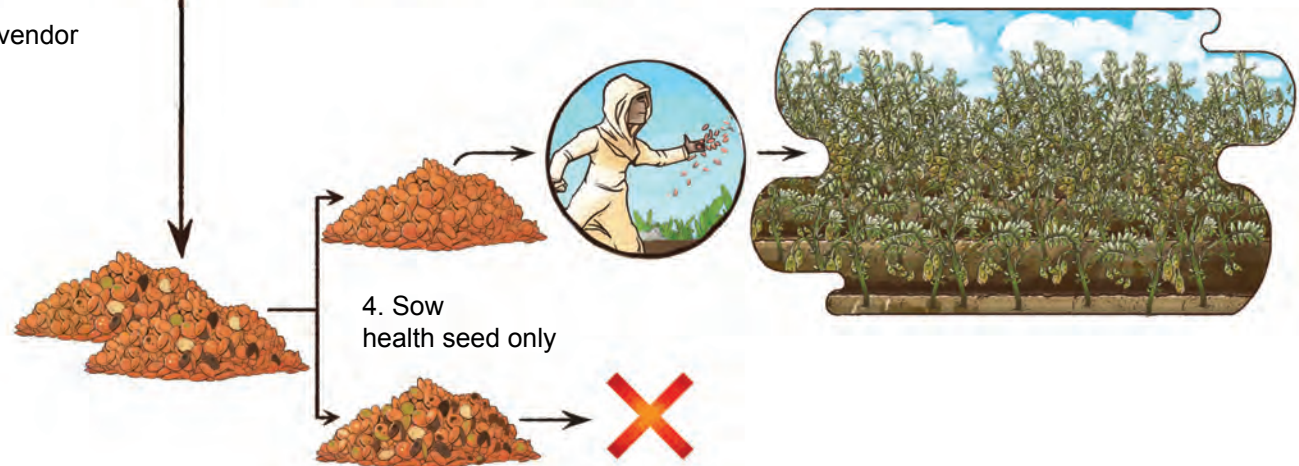
1. Seeds for sowing may have small spots or damage due to insects or mold



2. Purchase magnifying glass/sheet from vendor



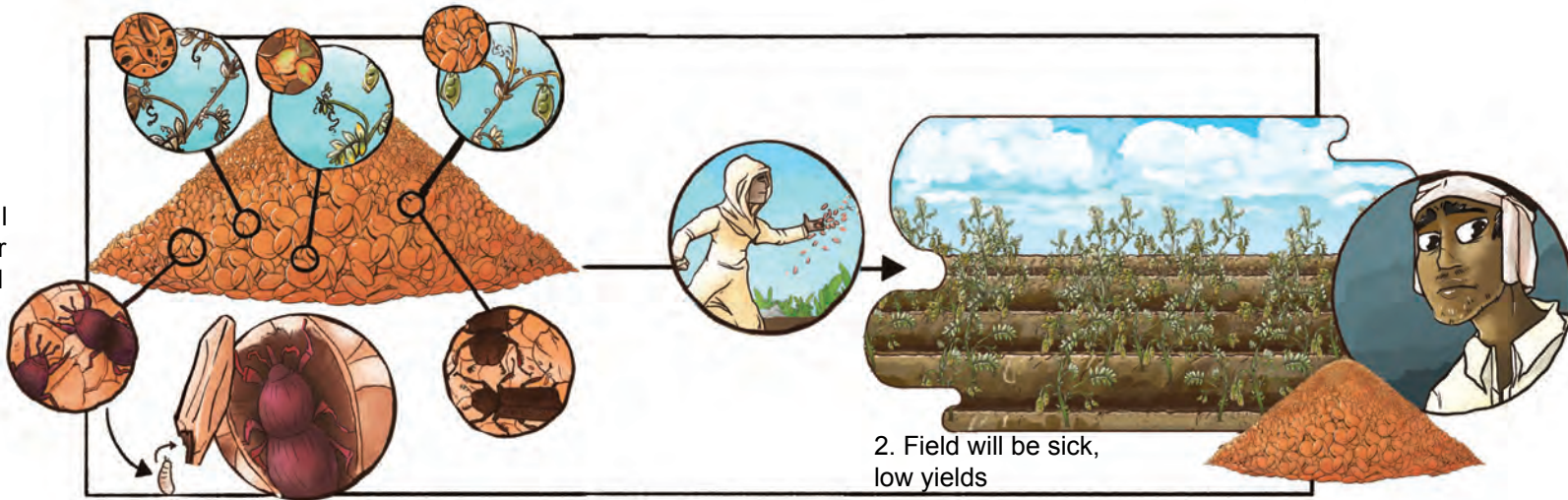
3. Separate unspotted, undamaged seed



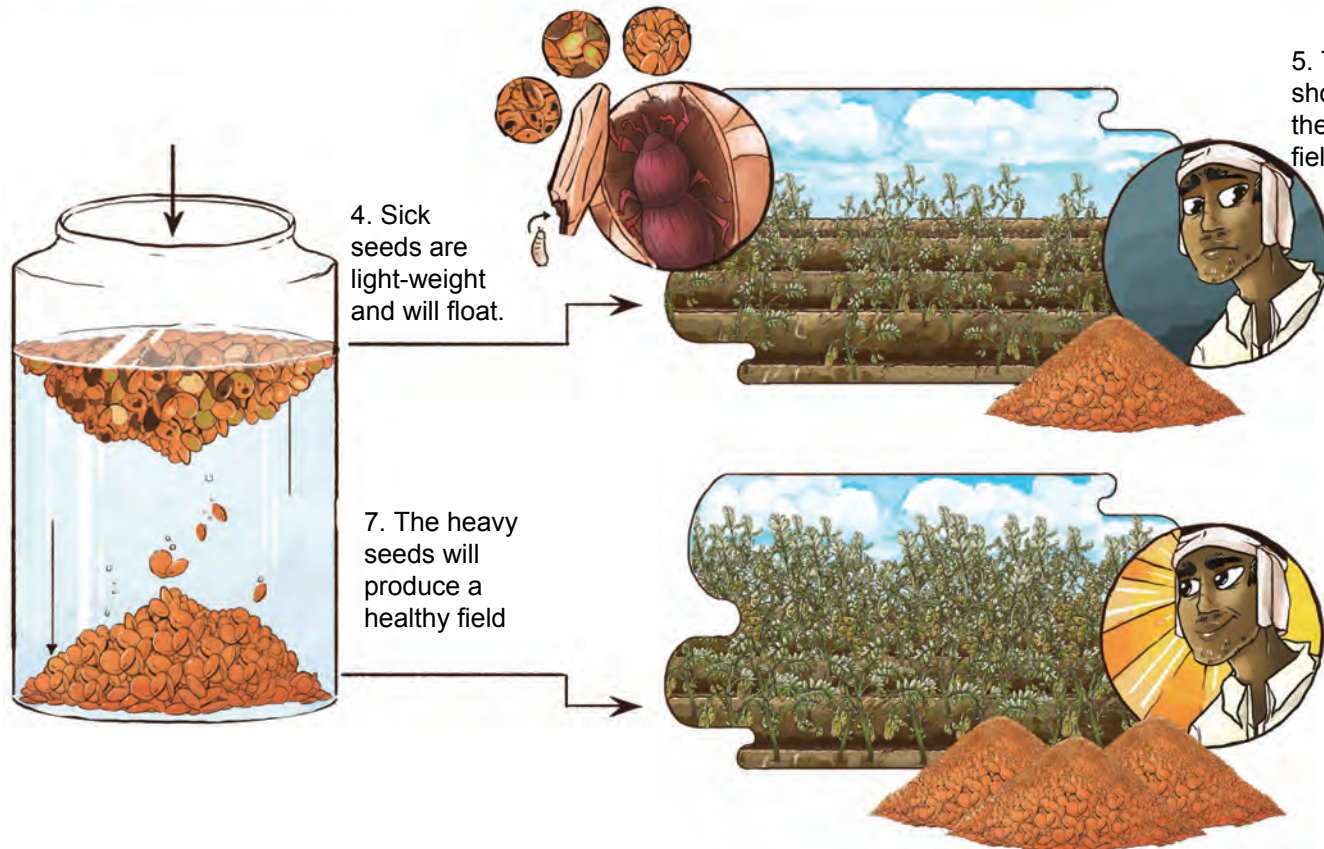
4. Sow health seed only

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



3. Improved practice: Add seeds to water.



6. Healthy seeds are heavy and will sink

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

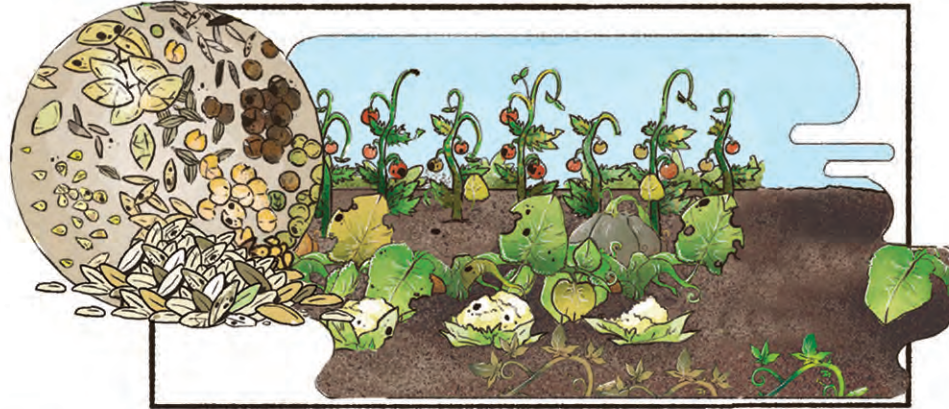
7. The heavy seeds will produce a healthy field

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



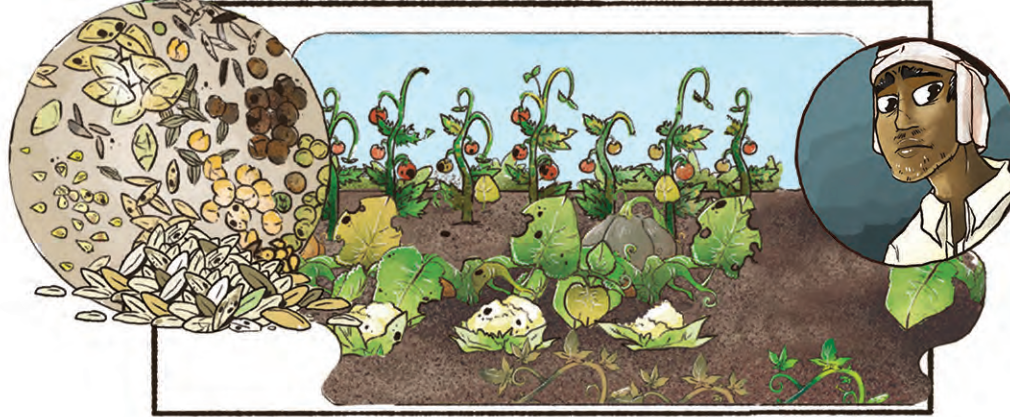
5. Be careful: excess temperature or time will kill seeds.



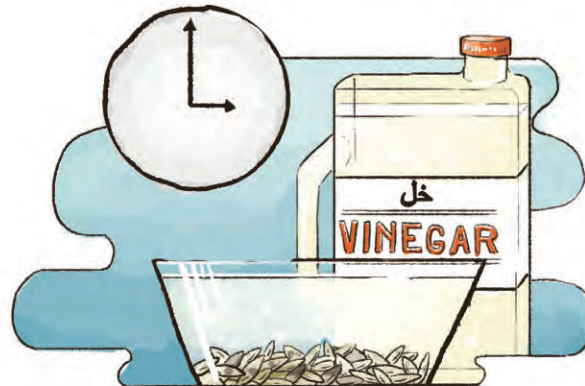
4. Vegetable garden may be healthier but if the water temperature is too high, then seeds will be damaged

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.

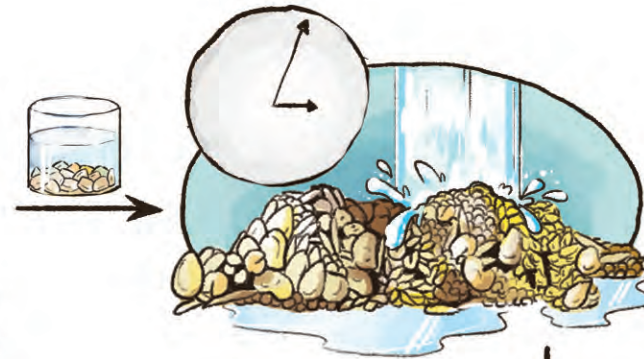
1. Problem: vegetables damaged by pests and disease



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

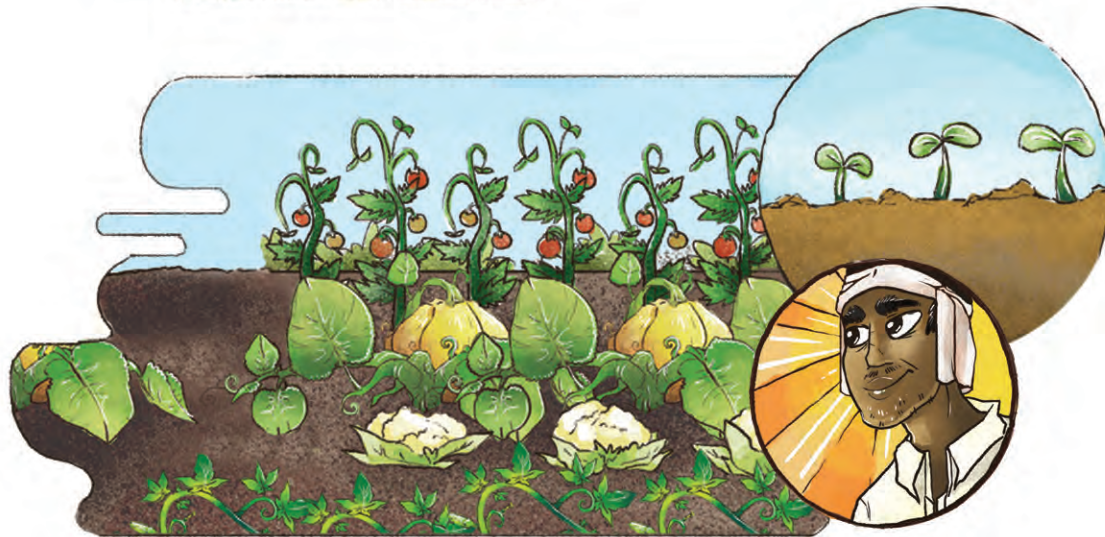


3. Rinse with water



4. Sow seeds

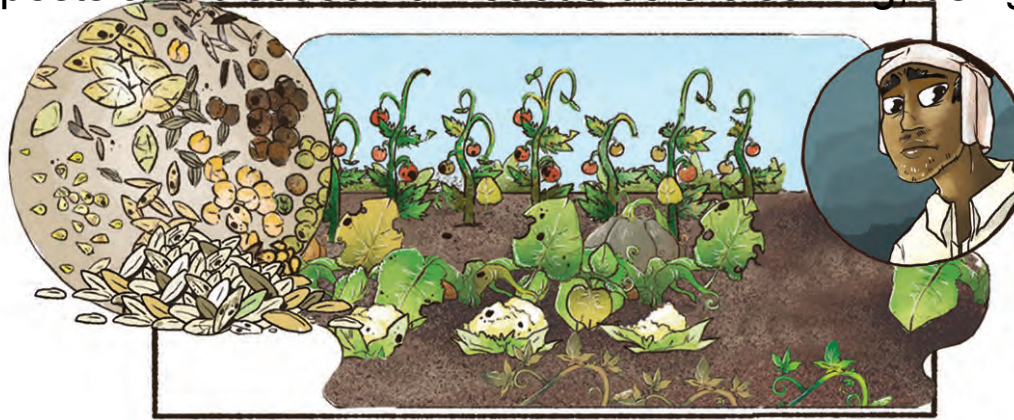
5. Healthier plants



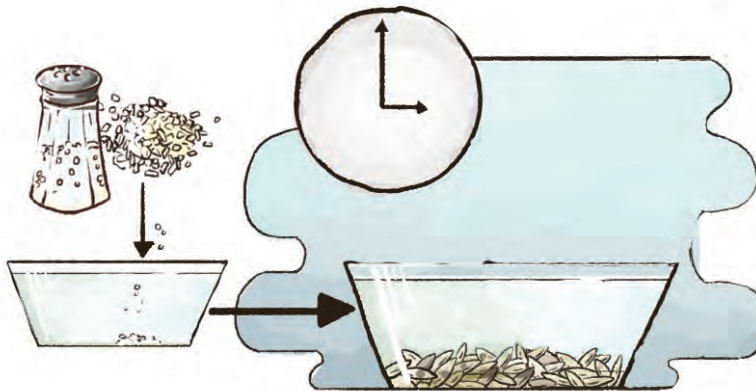
6. Be careful, excess concentration or time of vinegar will kill seeds. It is recommended to try different dilutions and durations of the treatment, and then sow the seeds to ensure germination is not reduced.

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 salty water.

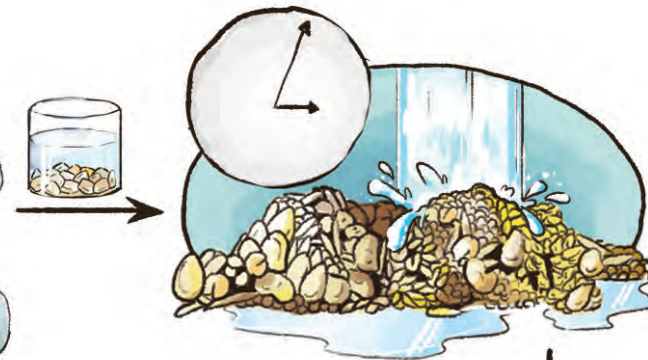
1. Problem: vegetables damaged by pests and disease



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

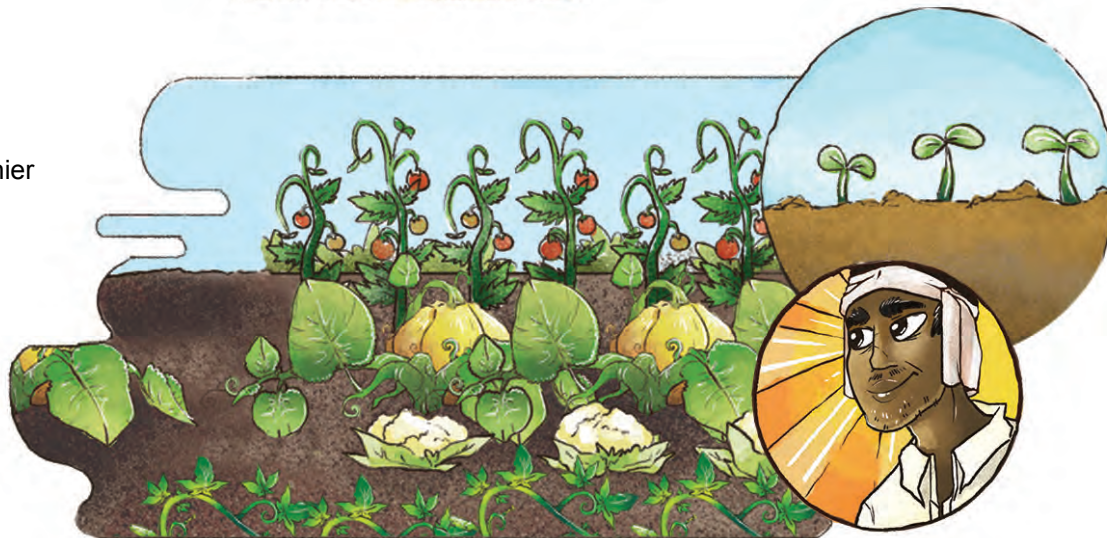


3. Rinse with non-salty water



4. Sow seeds

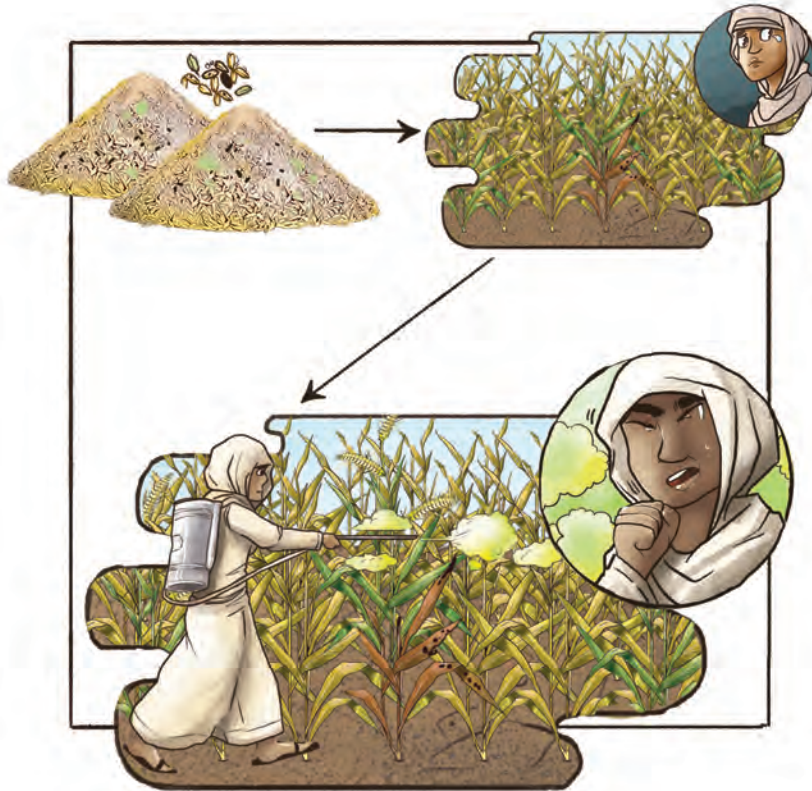
5. Healthier plants



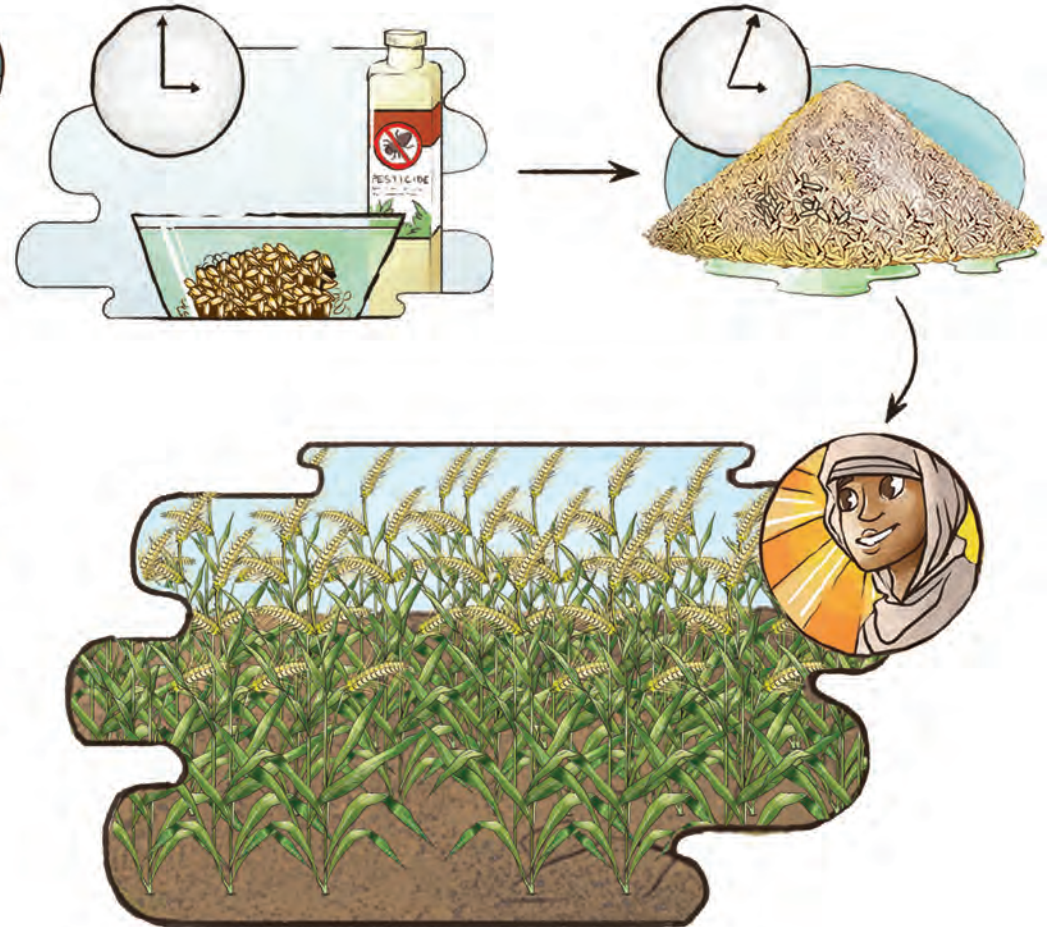
6. Be careful, excess concentration or time of vinegar will kill seeds. It is recommended to try different dilutions and durations of the treatment, and then sow the seeds to ensure germination is not reduced.

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



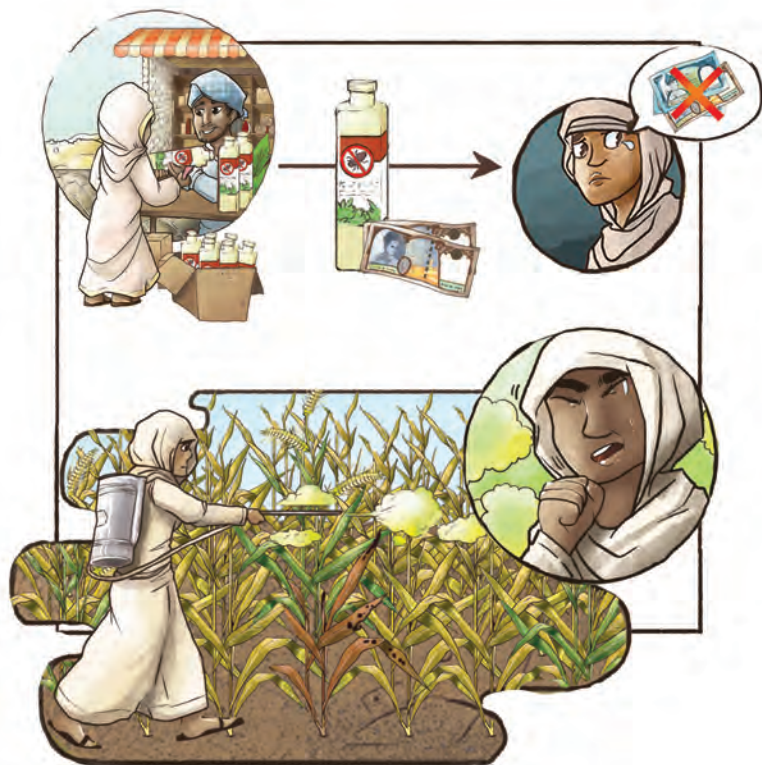
2. Improved practice: soak seeds in pesticide prior to sowing



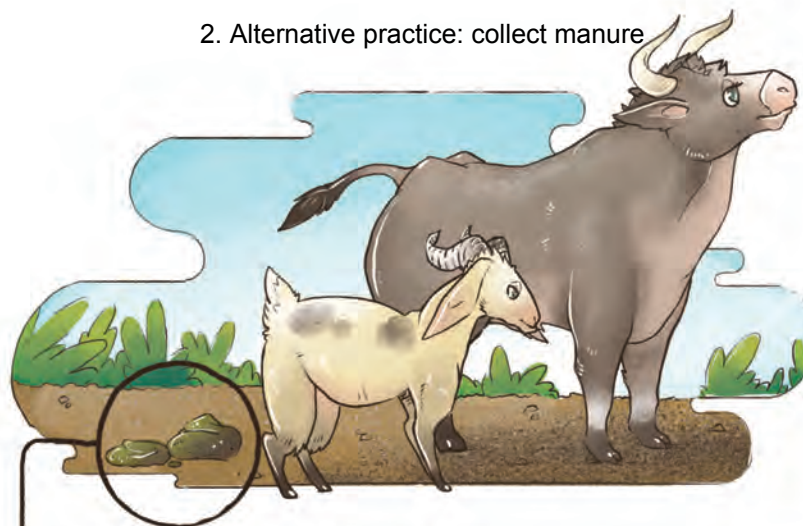
3. Less spraying in the field

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



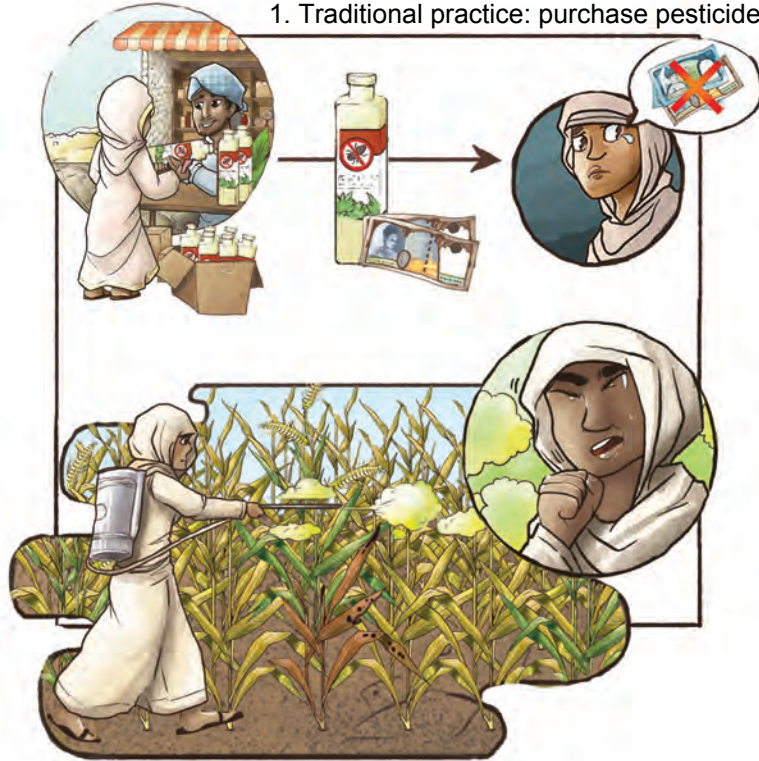
5. Spray manure liquid onto field. Healthy microbes in manure will fight microbes that damage crops.



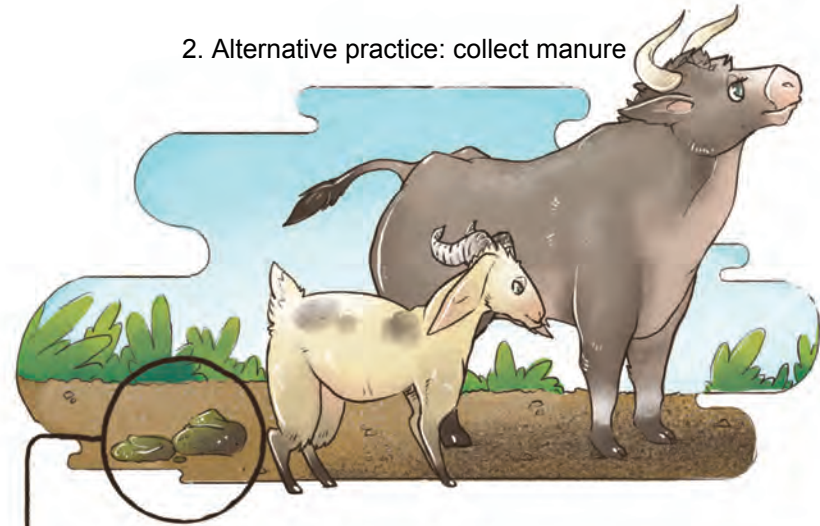
6. Less need to purchase pesticides.

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

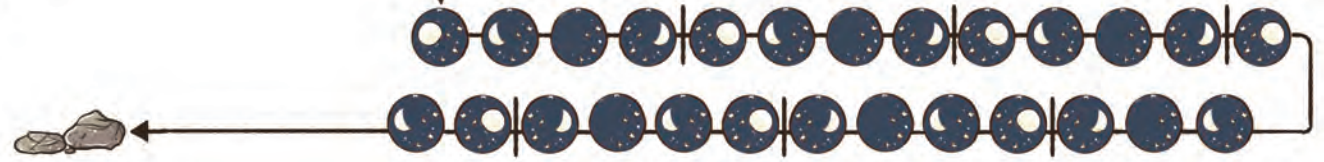
1. Traditional practice: purchase pesticides and spray onto field



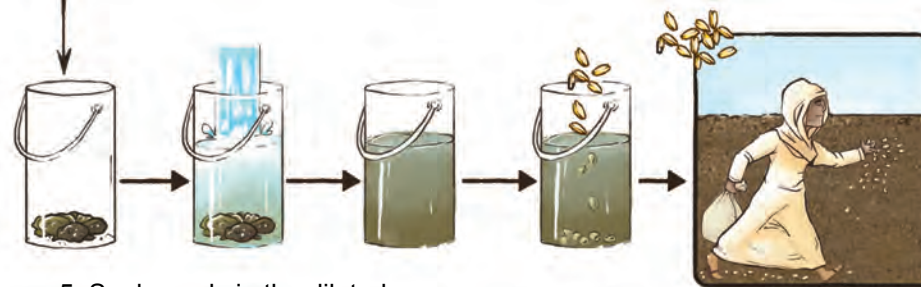
2. Alternative practice: collect manure



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.

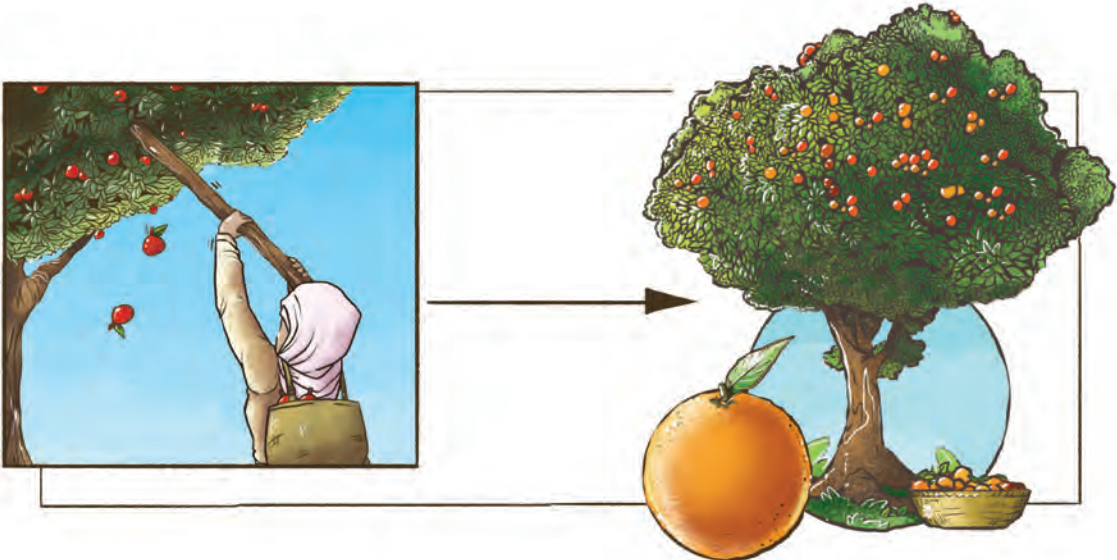


6. Less need to purchase pesticides.

Chapter 8: Post-Harvest

Lesson: New tool to harvest tree fruits without climbing trees

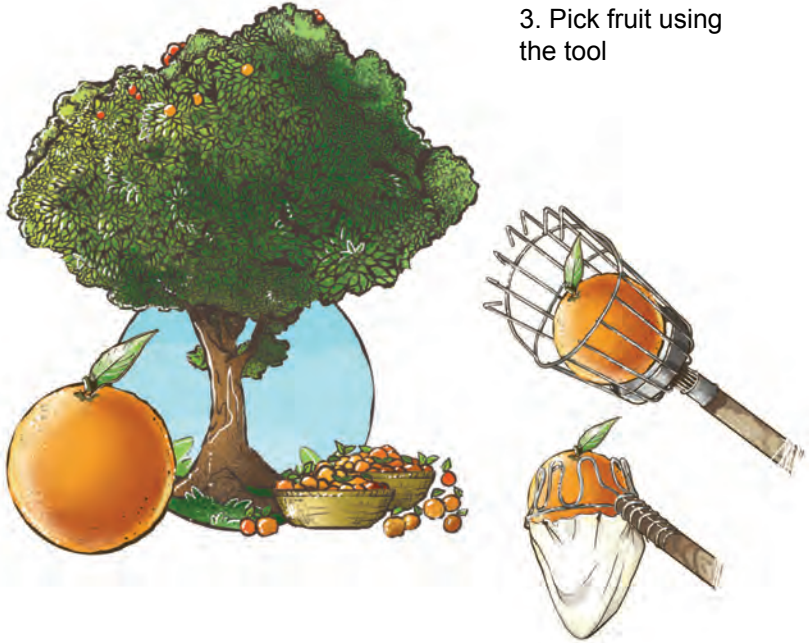
1. Traditional practice



2. New practice: purchase tool from vendor



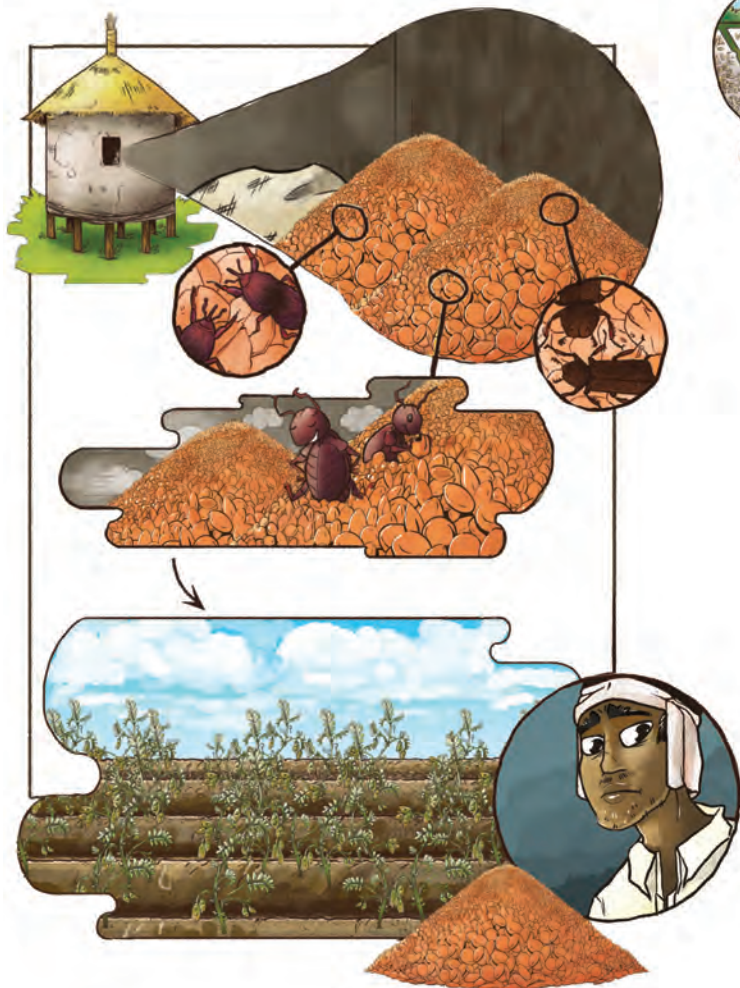
3. Pick fruit using the tool



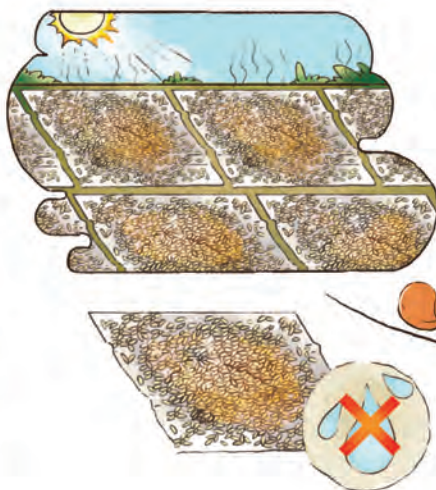
Lesson: Special bags can be used to store grain which reduce oxygen inside bag which prevents insects and fungal molds from surviving, which also reduces toxins.

2. New practice

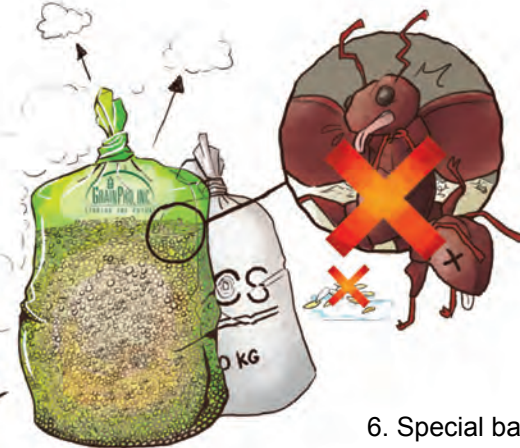
1. Traditional practice: stored grain is damaged by insects and mold. The mold can produce toxins in the grain.



3. Dry grain completely

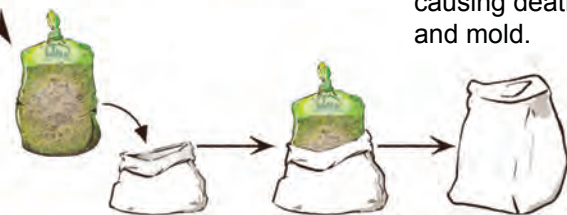


4. Purchase bag from vendor. Put grain in bag, remove air and tie.

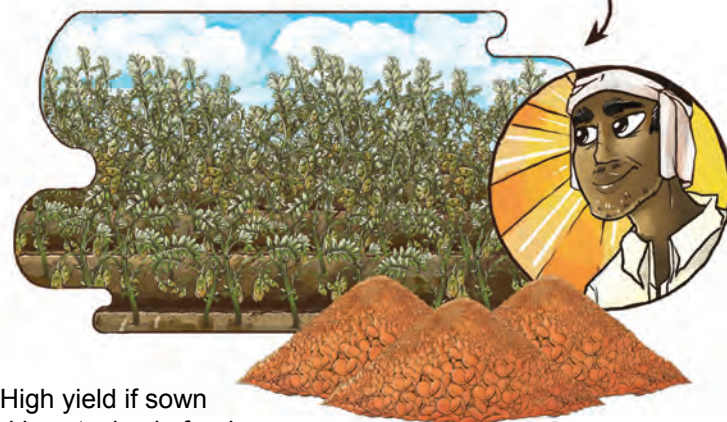


6. Special bag causes air to flow outside, causing death to insects and mold.

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



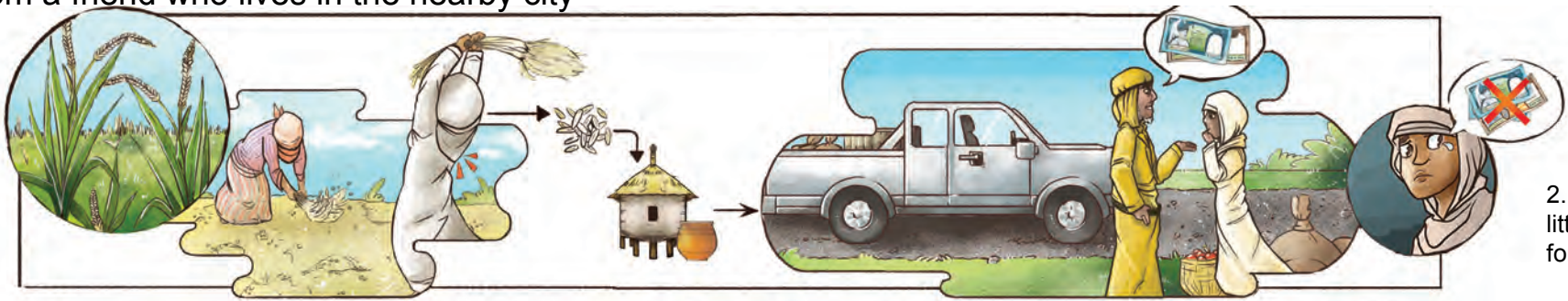
7. High yield if sown and less toxins in food.



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

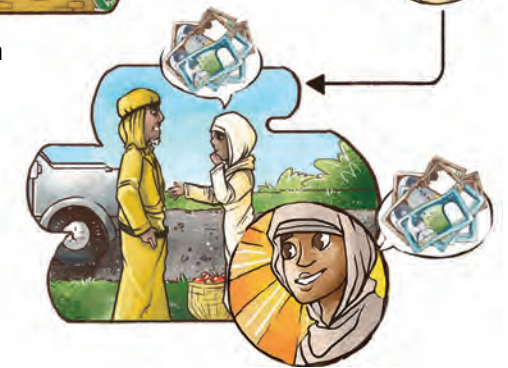
8. Time passes



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

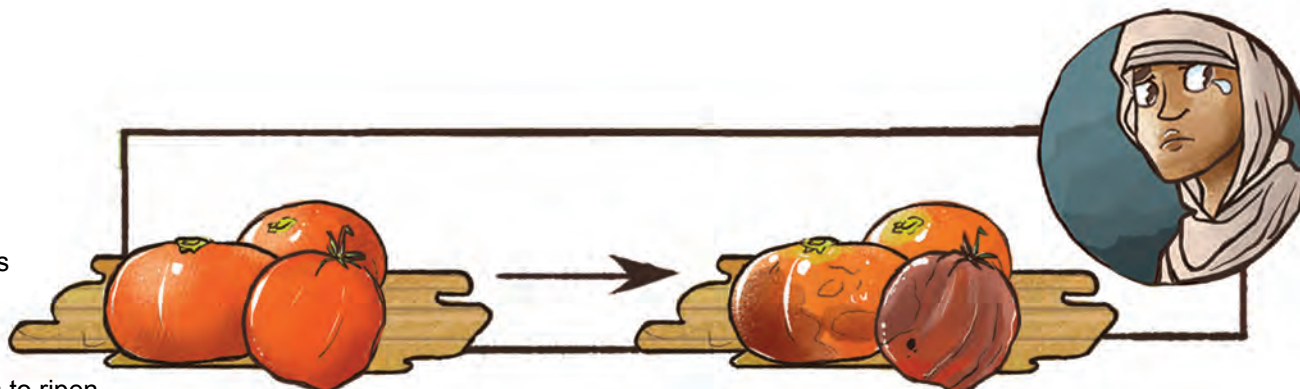
10. If price is low, farmer should not sell

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

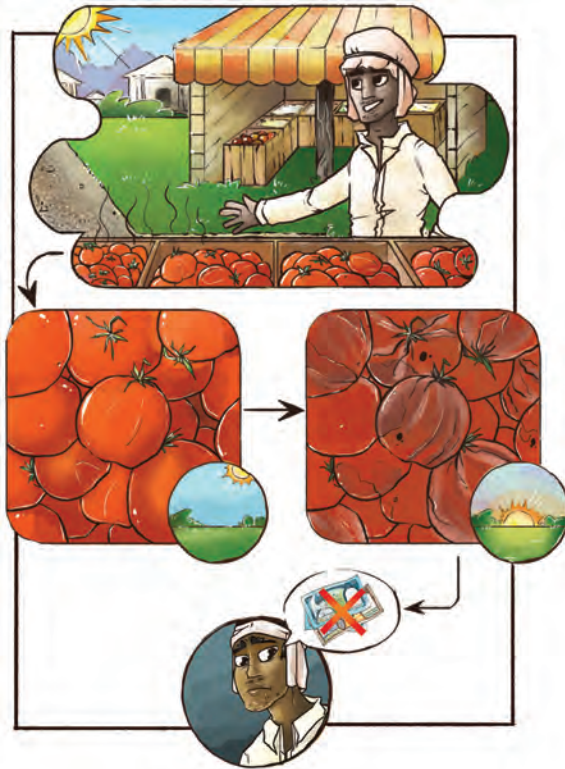


4. Wash in water



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



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



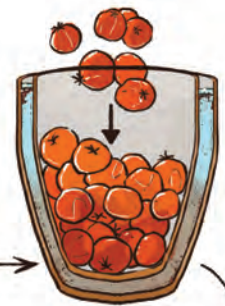
5. Insert small pot
in large pot and add
sand to outside of
small pot



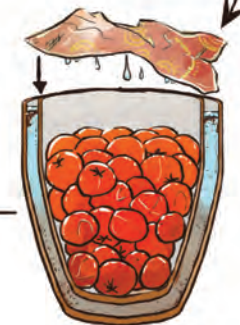
6. Add water
to sand



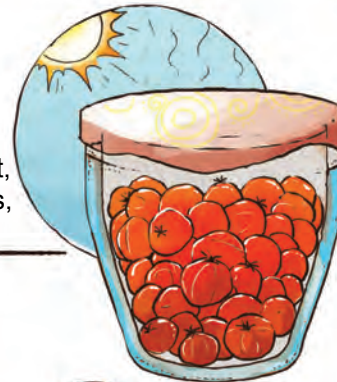
7. Add fruits/vegetables
into small pot



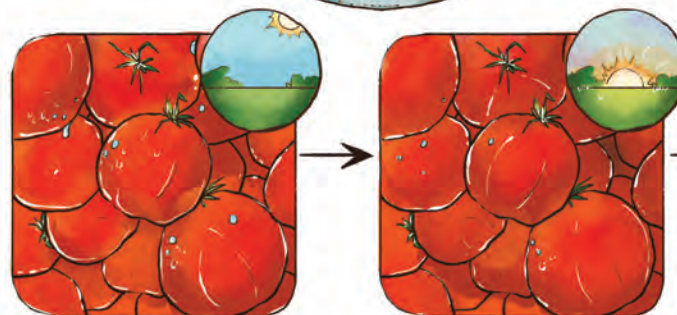
8. Cover
with wet
cloth



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



11. Higher income

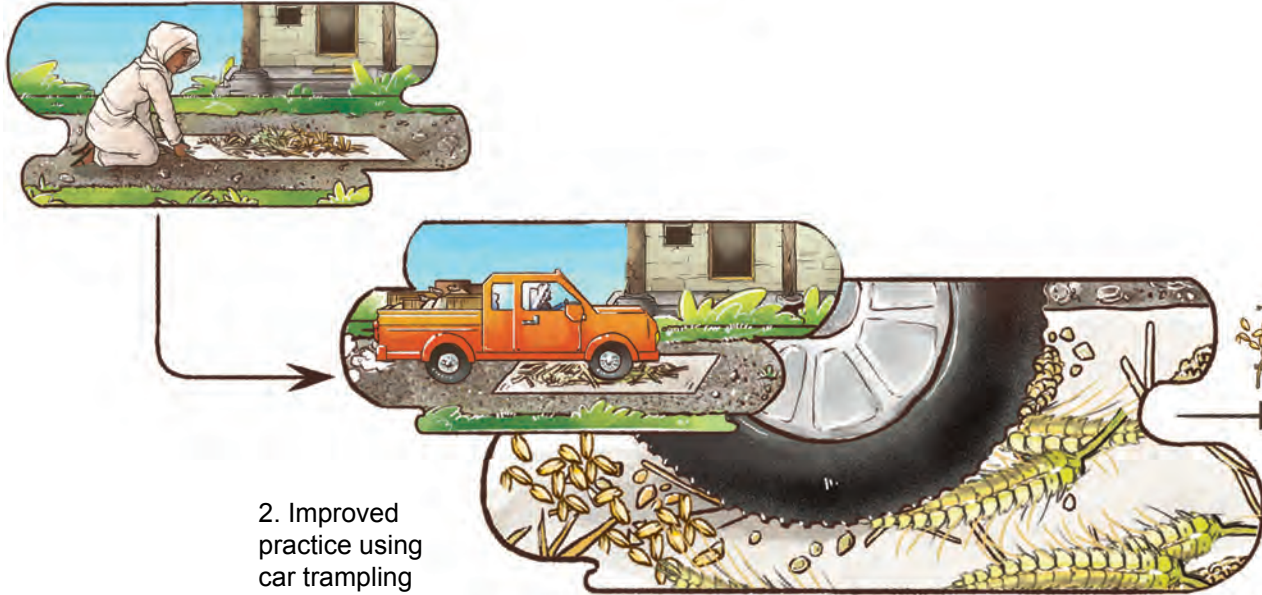


Lesson: Instead of manual threshing of grain, grain may be placed on a road to reduce labour

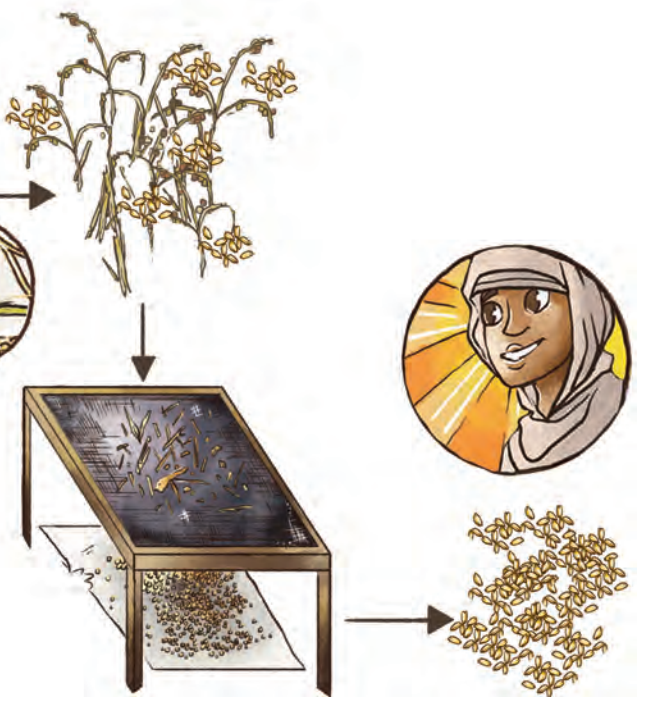
1. Traditional practice



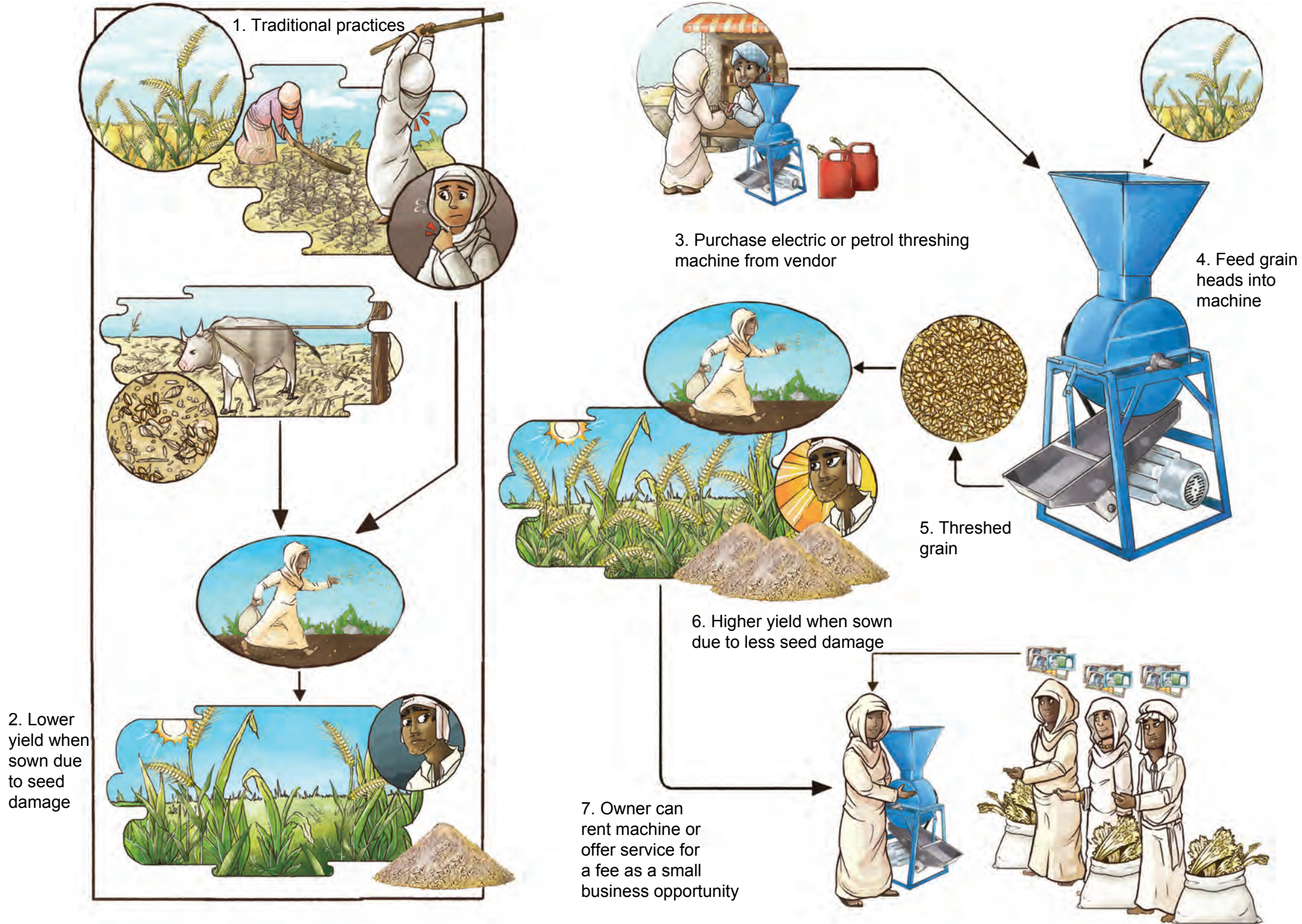
2. Improved practice using car trampling



3. Also use sieve



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



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

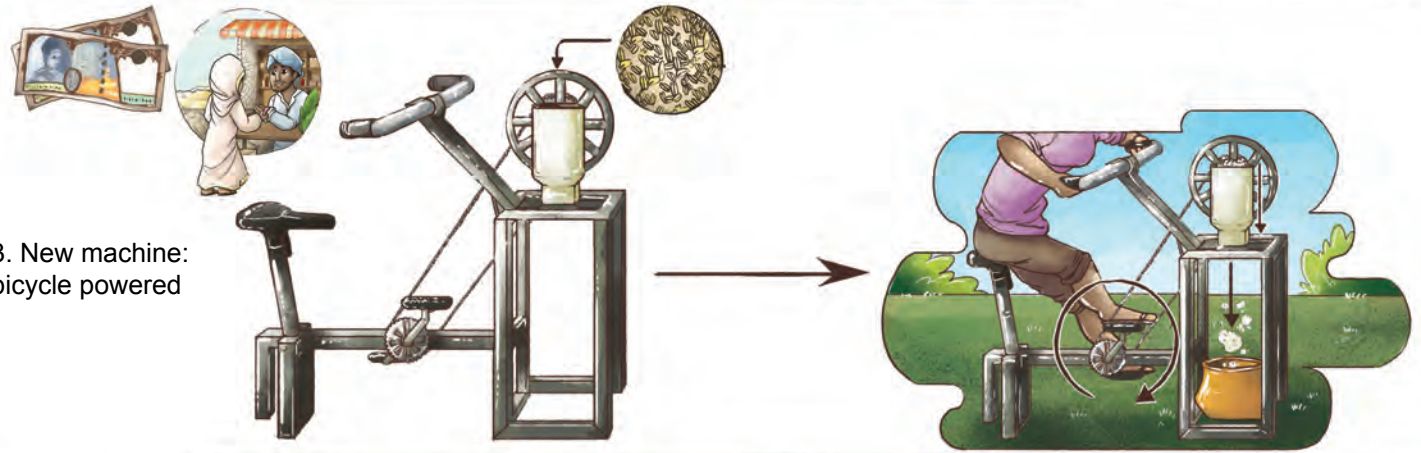
1. Traditional practice



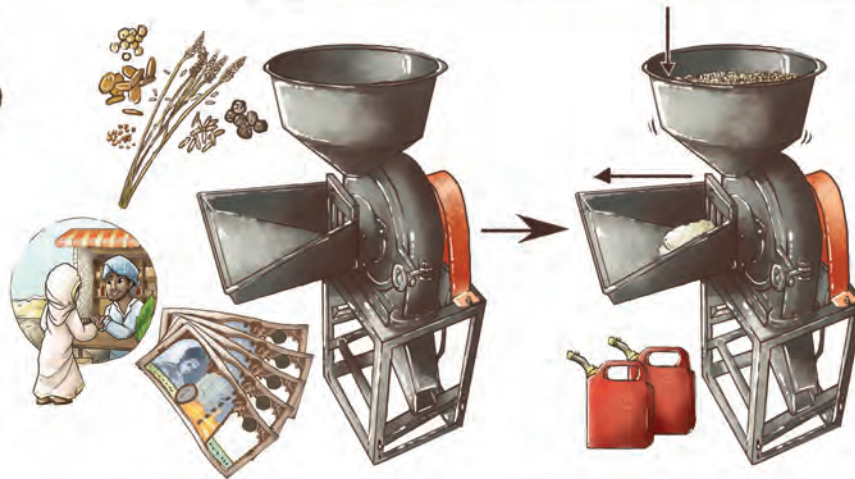
2. New tool: hand crank



3. New machine: bicycle powered



4. New machine: electric/gas

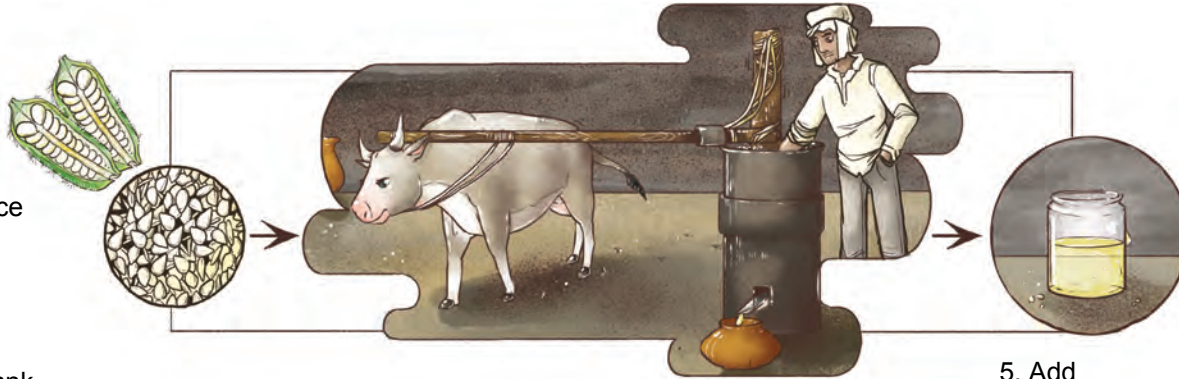


5. Owner can rent machine or service for money

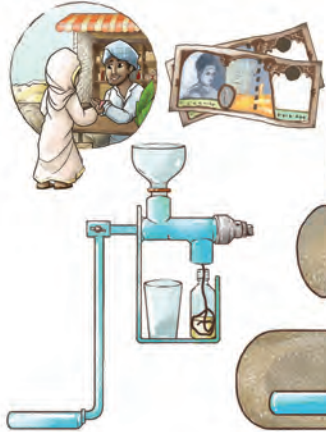


Lesson: New machines may be used to extract cooking oil from seeds

1. Traditional practice



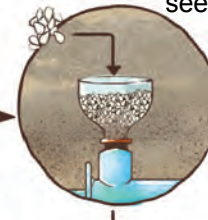
2. New machine: hand crank
Purchase from vendor



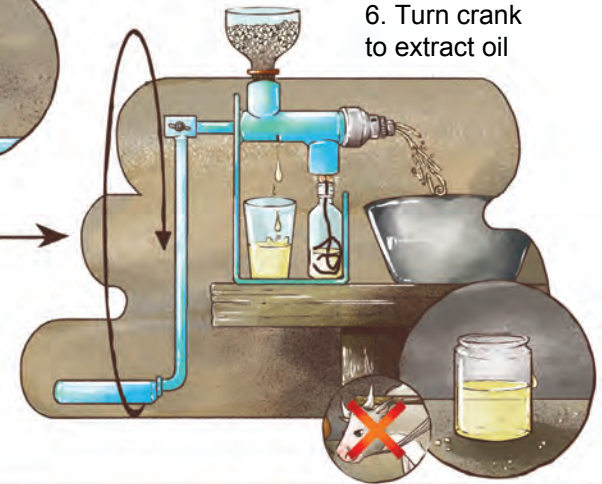
3. Light flame in kerosene



5. Add seed

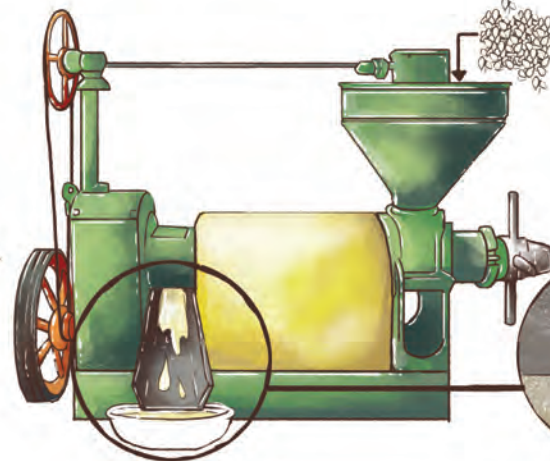
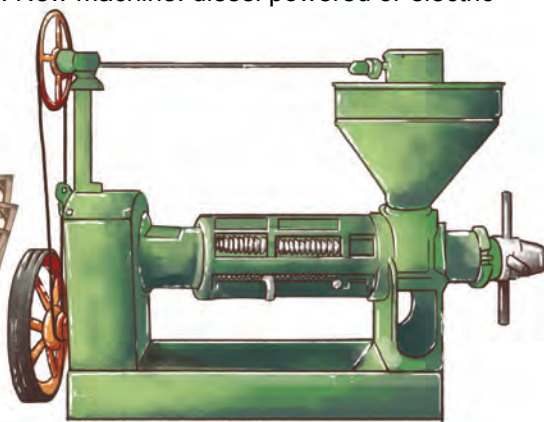


6. Turn crank to extract oil



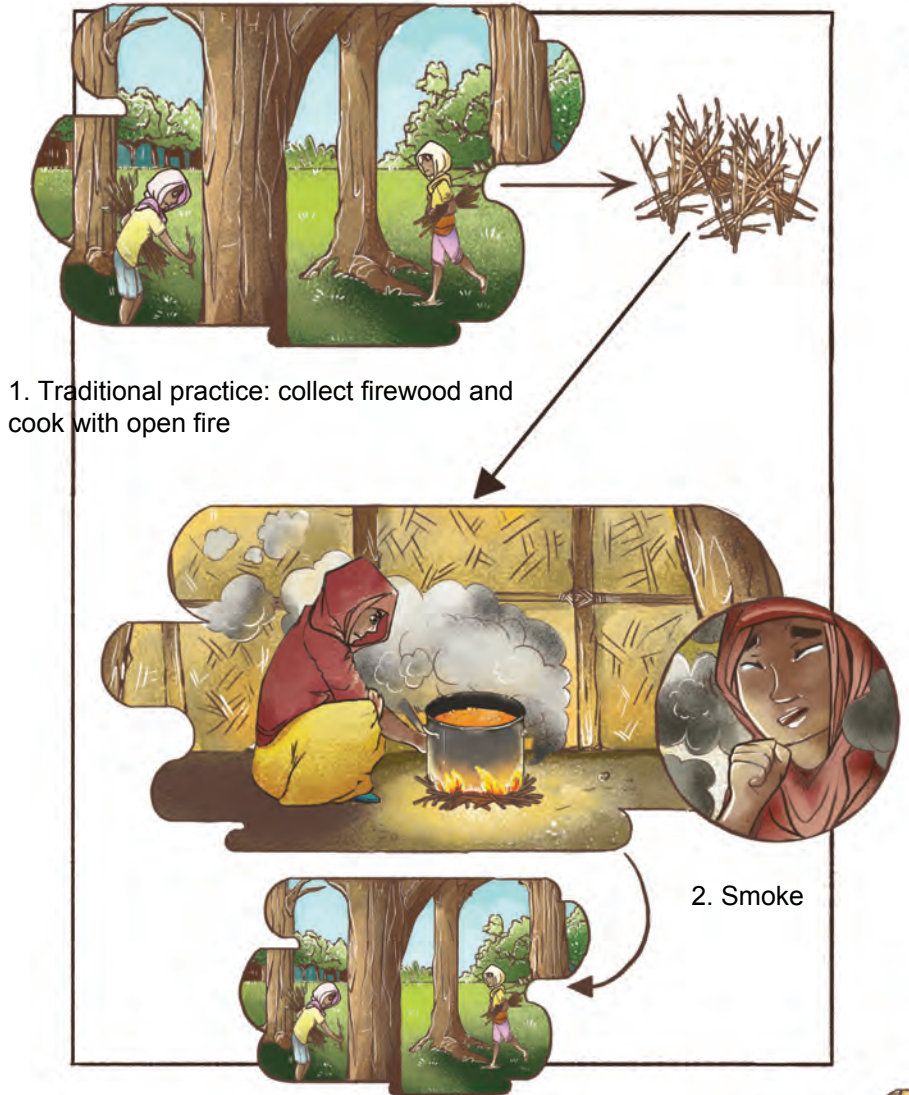
7. Final oil

8. New machine: diesel powered or electric



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

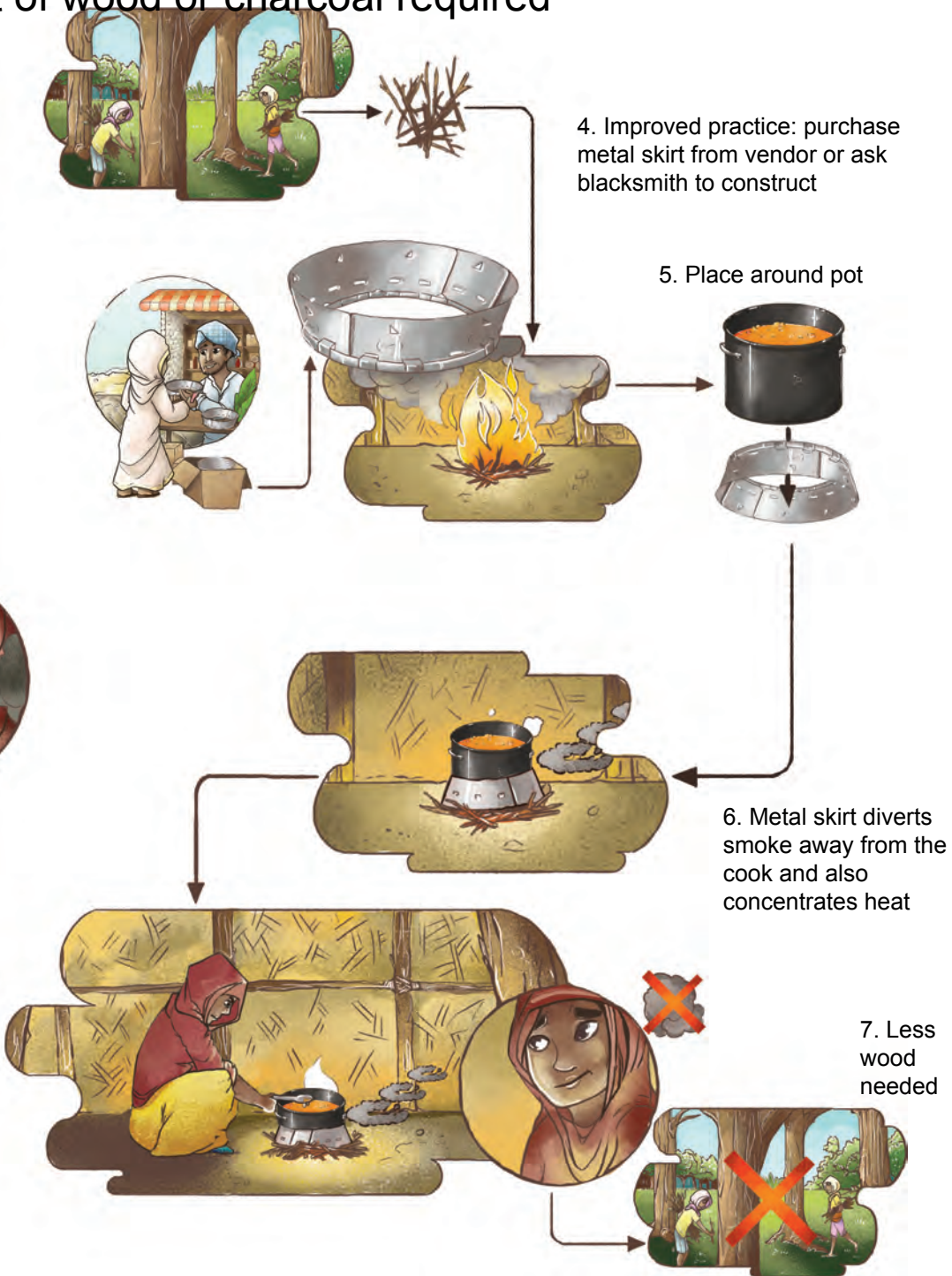
Lesson: Use of a metal skirt around the cooking fire can reduce smoke and raise the heat, which reduces the cooking time and amount of wood or charcoal required



1. Traditional practice: collect firewood and cook with open fire

2. Smoke

3. Since much heat is wasted, but collect more wood



4. Improved practice: purchase metal skirt from vendor or ask blacksmith to construct

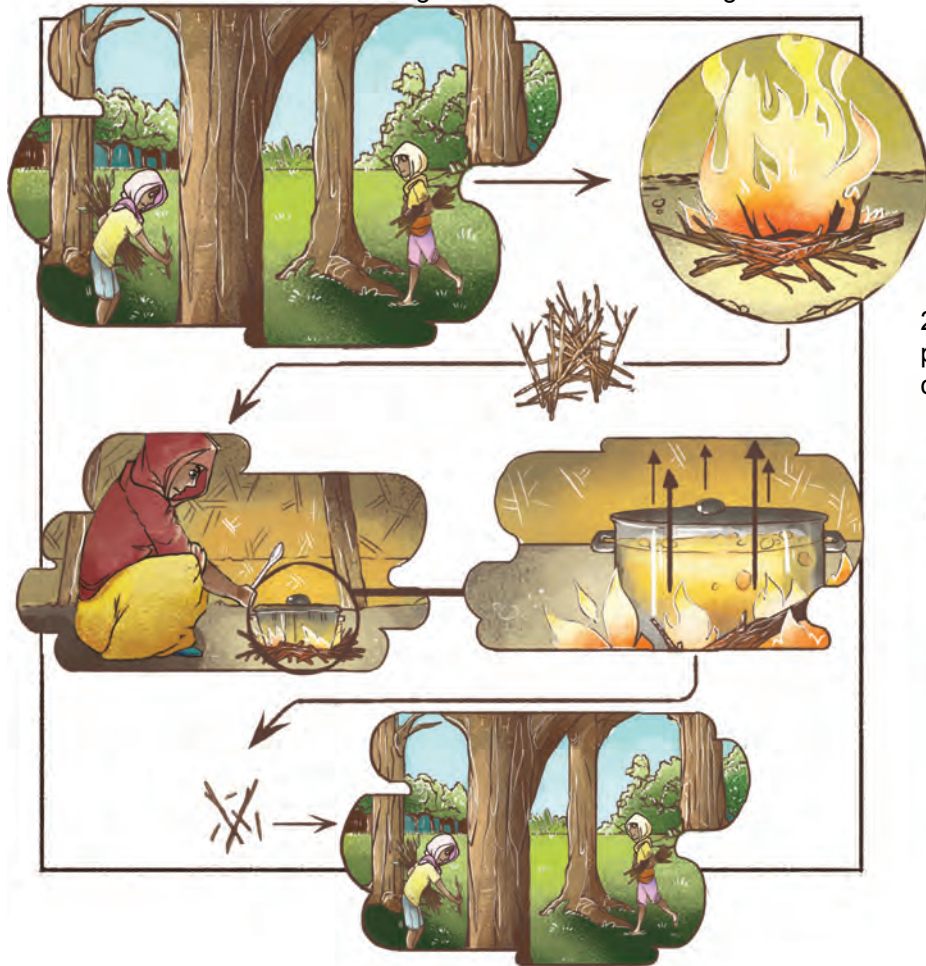
5. Place around pot

6. Metal skirt diverts smoke away from the cook and also concentrates heat

7. Less wood needed

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

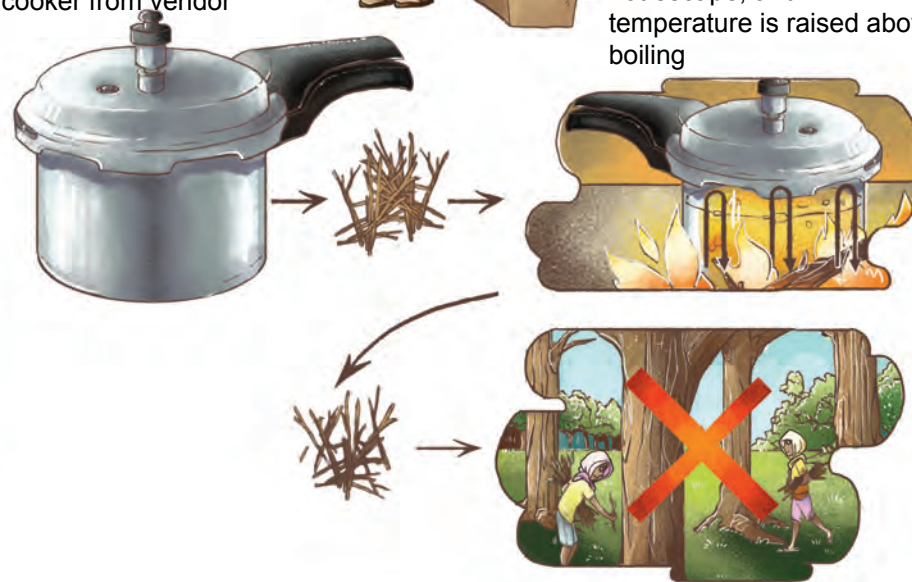
1. Traditional practice: collect firewood and cook using a regular pot which cooks at a low temperature and loses heat. Cooking time is slow and consumes firewood so more must be collected. Cooking time is even slower at high altitudes.



2. Improved practice: purchase pressure cooker from vendor

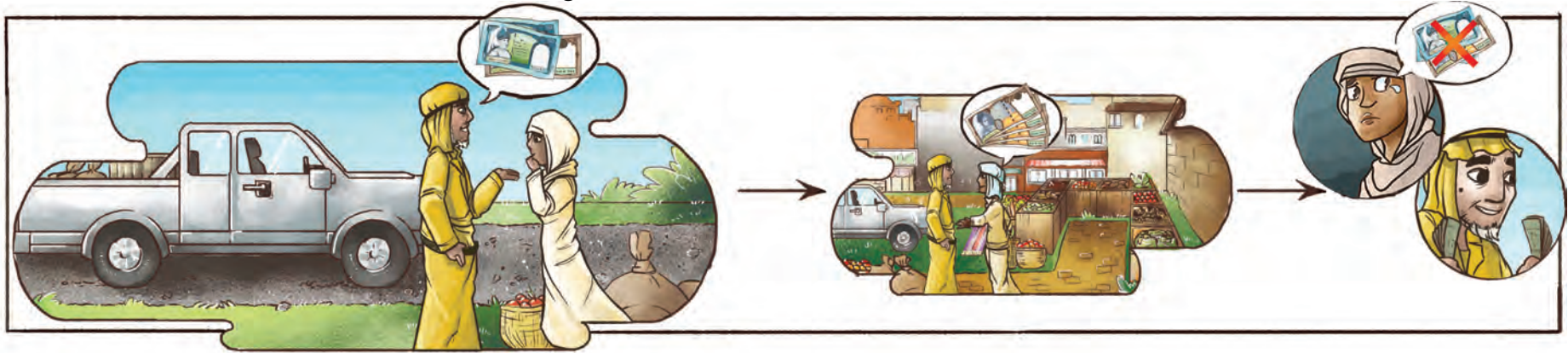


3. Pot is sealed, so pressure builds, heat does not escape, and temperature is raised above boiling



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

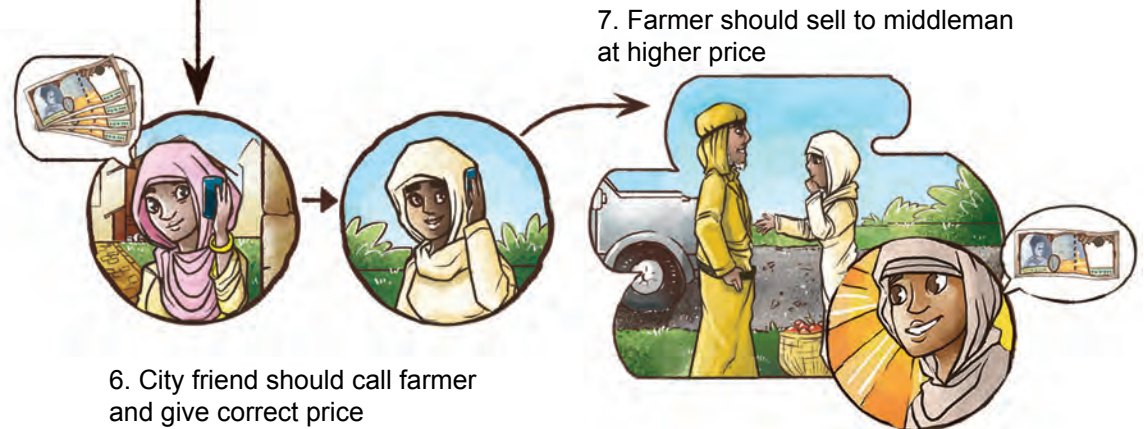
2. Middleman goes to city merchant and sells for a higher price

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



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

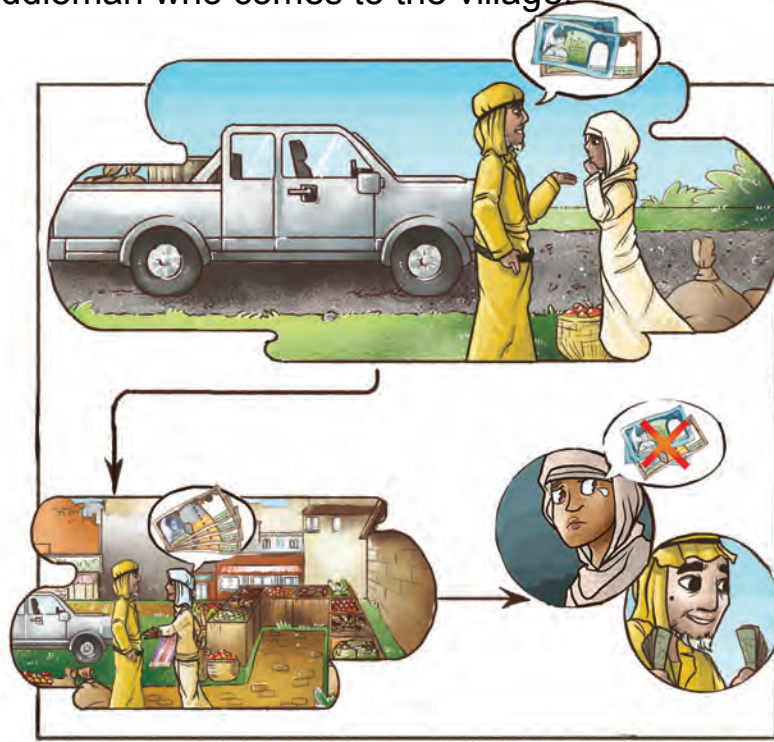
5. Friend should speak to merchant in city to inquire about grain price



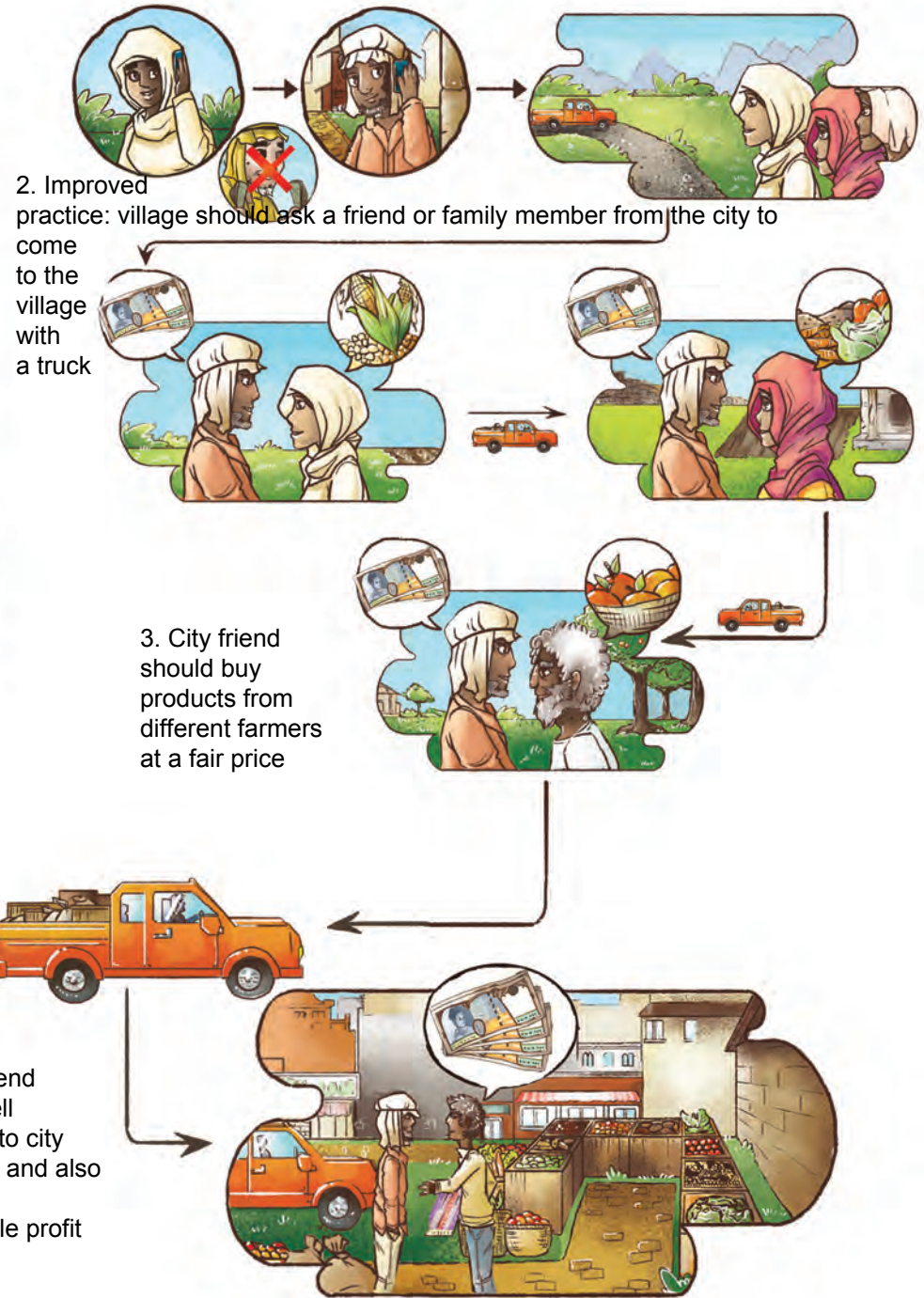
6. City friend should call farmer and give correct price

7. Farmer should sell to middleman at higher price

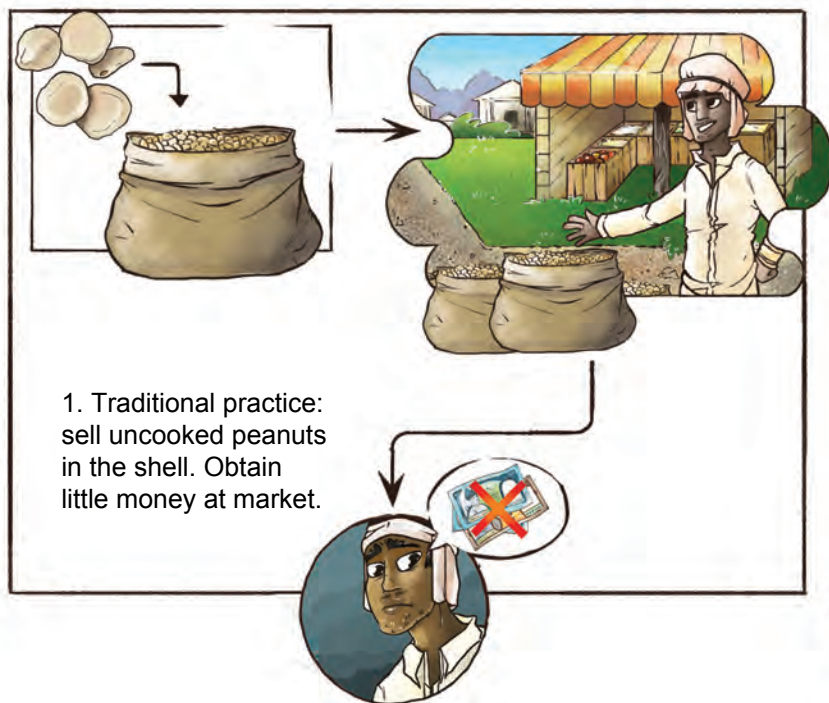
Lesson: It is better to sell farm harvest products directly to a friend or family member who lives in the city rather than to a middleman who comes to the village



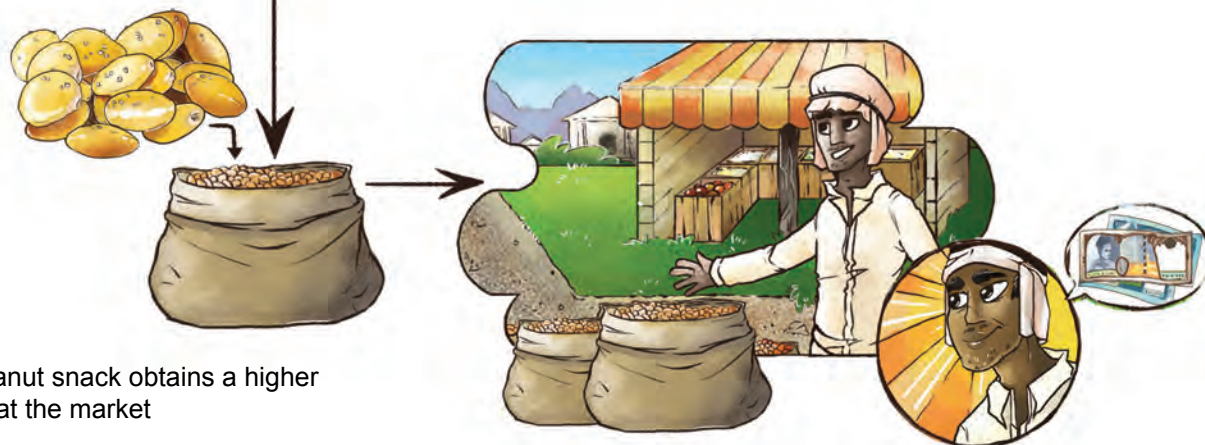
1. Traditional practice: middleman comes to the village and offers a low price for the farm harvest, then middleman goes to city merchant and sells for a higher price.



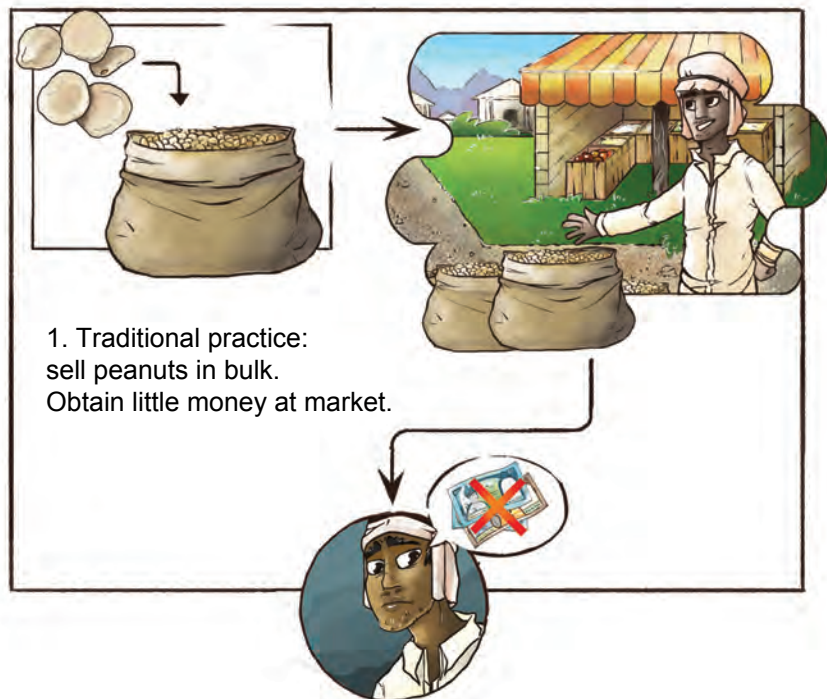
Lesson: Rather than selling raw harvested products, it is more profitable to sell cooked and tasty snacks



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



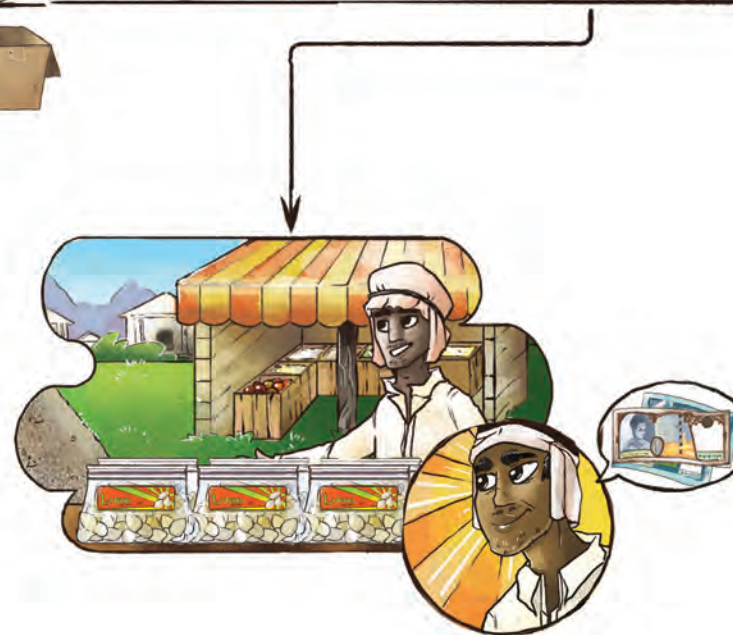
Lesson: Rather than selling harvested products in bulk, it is more profitable to package them beautifully



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



3. Packaged peanuts obtain a higher price at the market

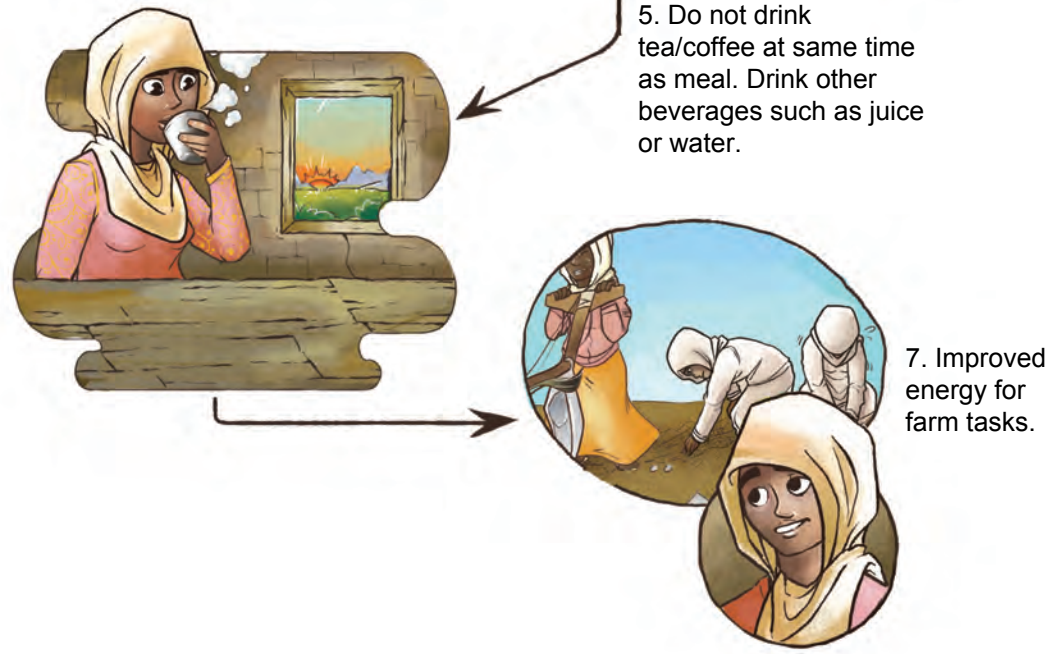
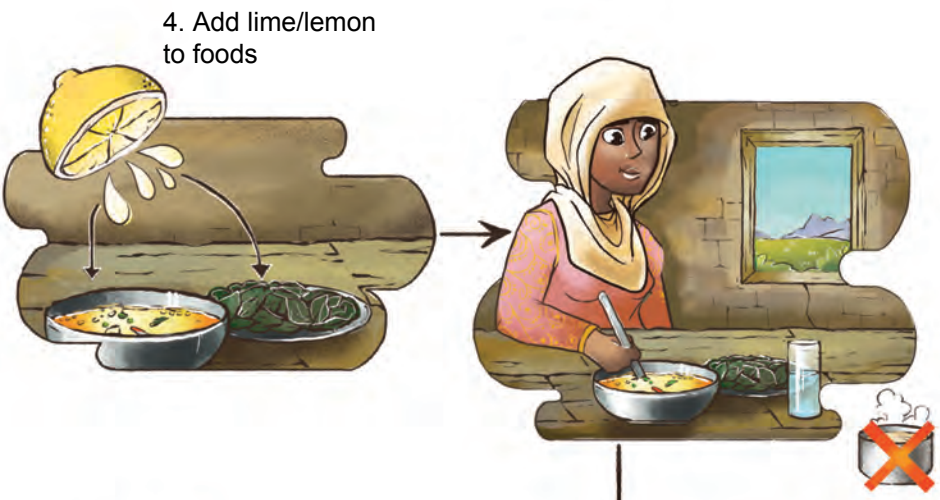


Chapter 9: Human Nutrition

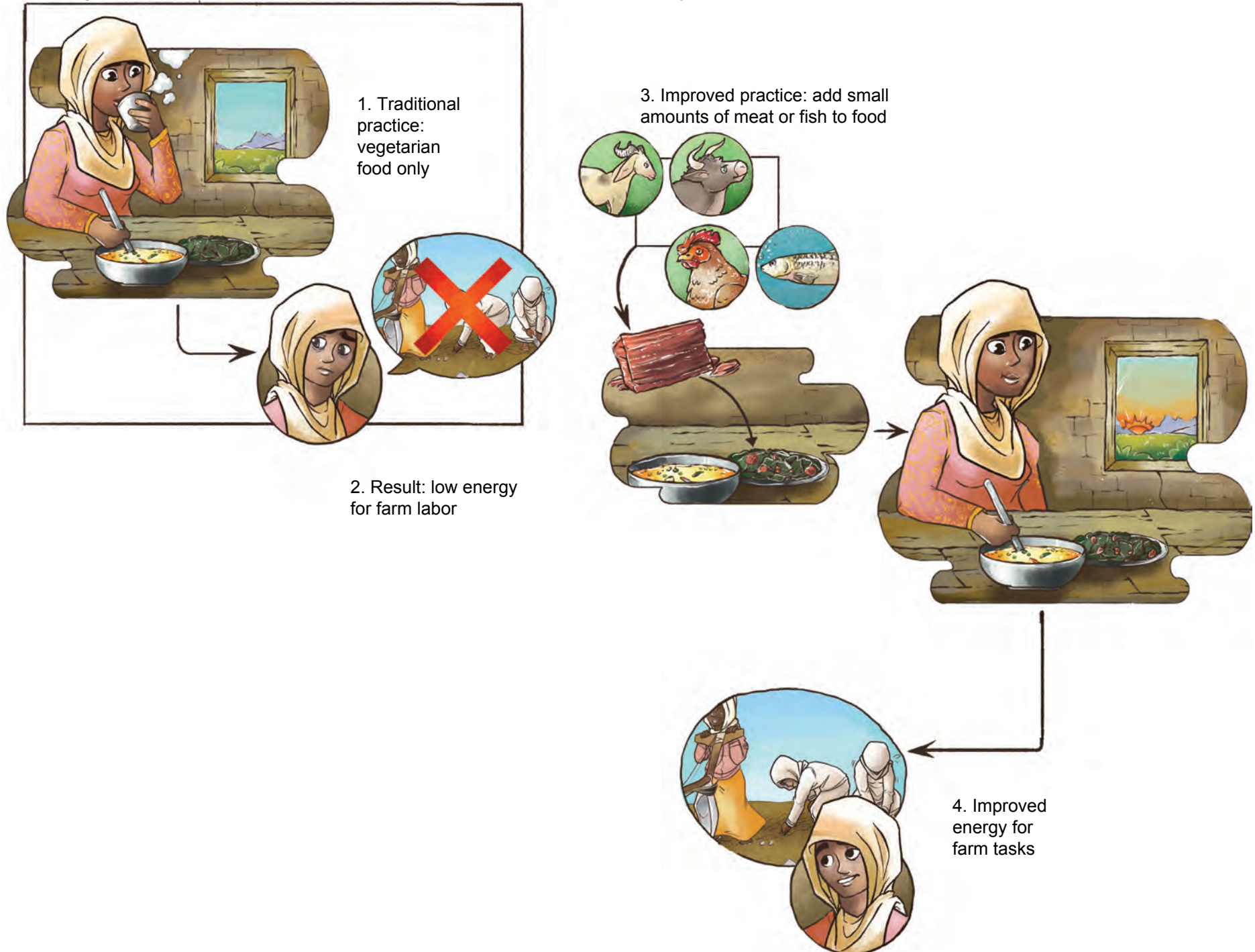
Lesson: Not drinking coffee/tea at the same time as meals, and adding lemon/lime to food, will make people feel more energetic due to improved iron absorption, especially women.



3. Improved practices



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

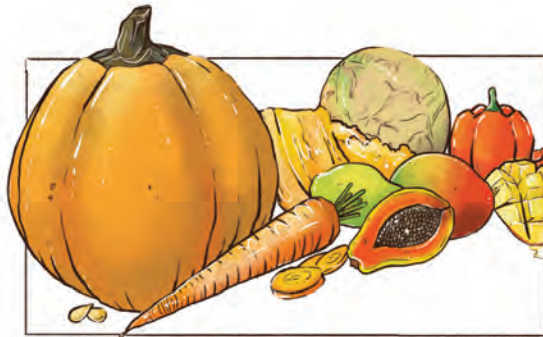
1. Less recommended: Blue-shirt child eats maize, rice, or tubers only



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

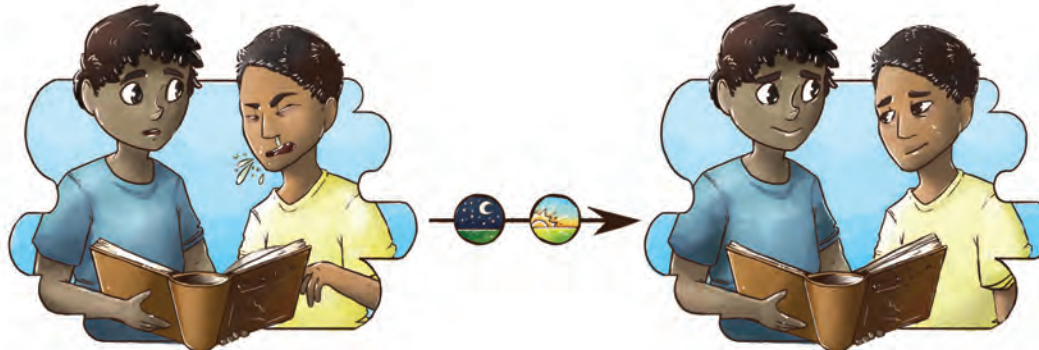


4. Solution: eat a diversity of colourful foods which help to fight diseases.



5. Blue shirt child eats colourful foods

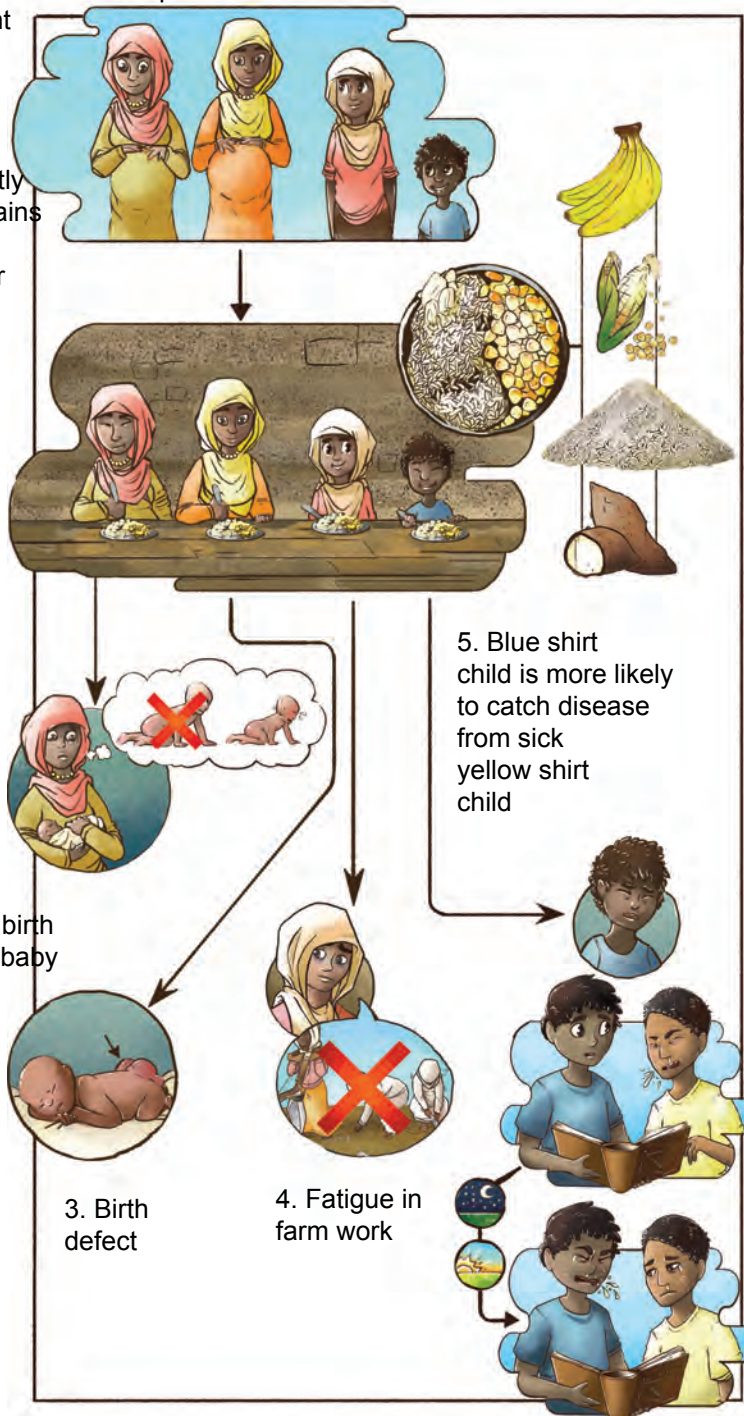
6. Blue shirt child less likely to become sick after contact with sick yellow shirt child



Lesson: Pregnant women and children should eat leafy green vegetables

1. Not recommended practice:

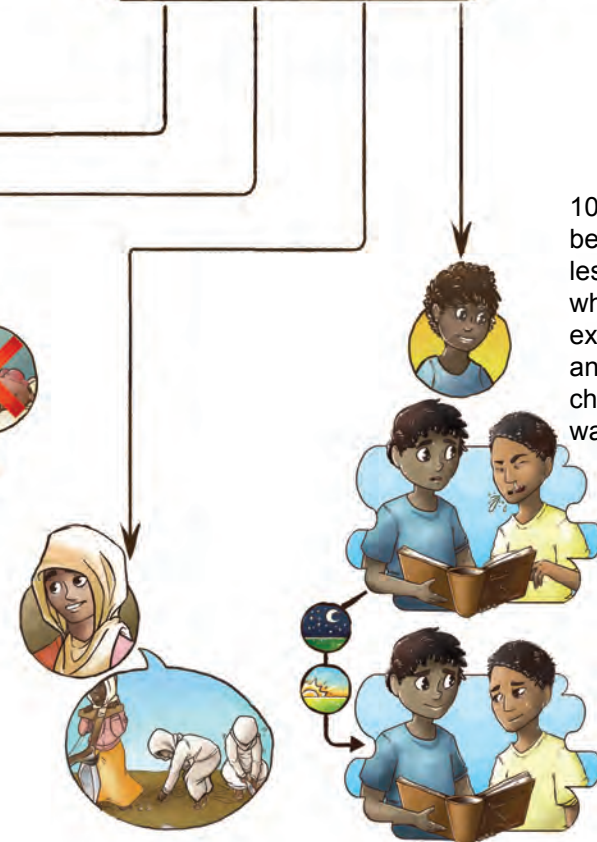
Pregnant women, teenage girls or children eat mostly large grains such as maize or rice or tubers such as cassava



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

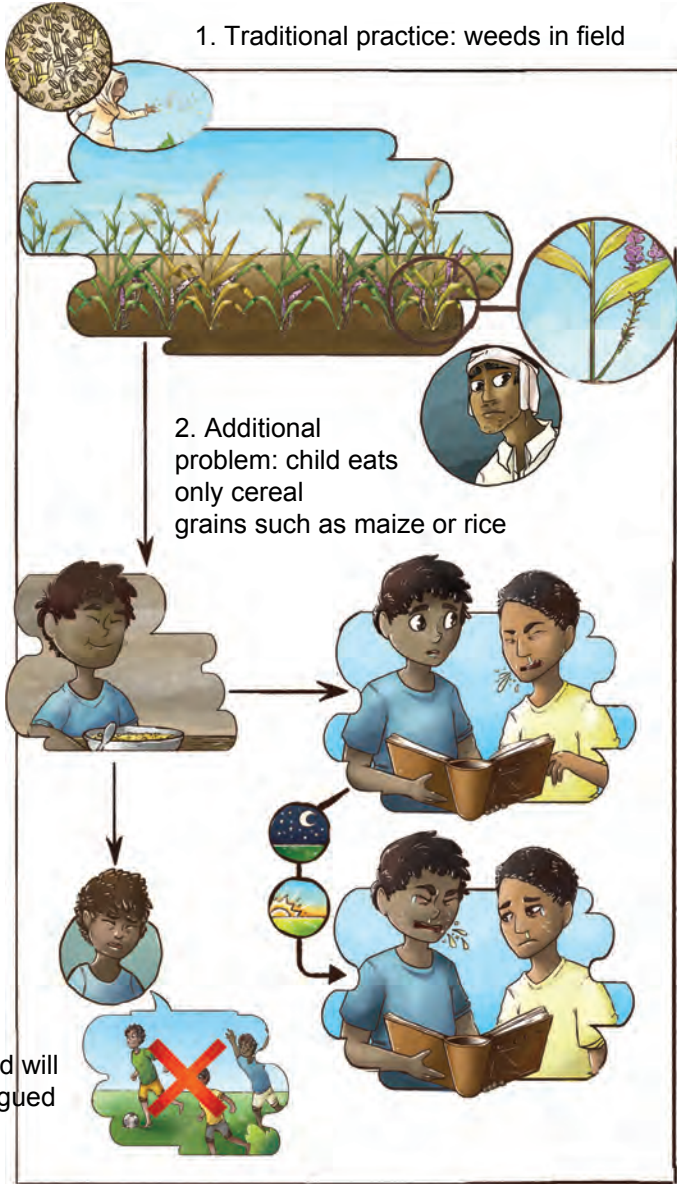


10. Child becomes less sick when exposed to another child who was sick

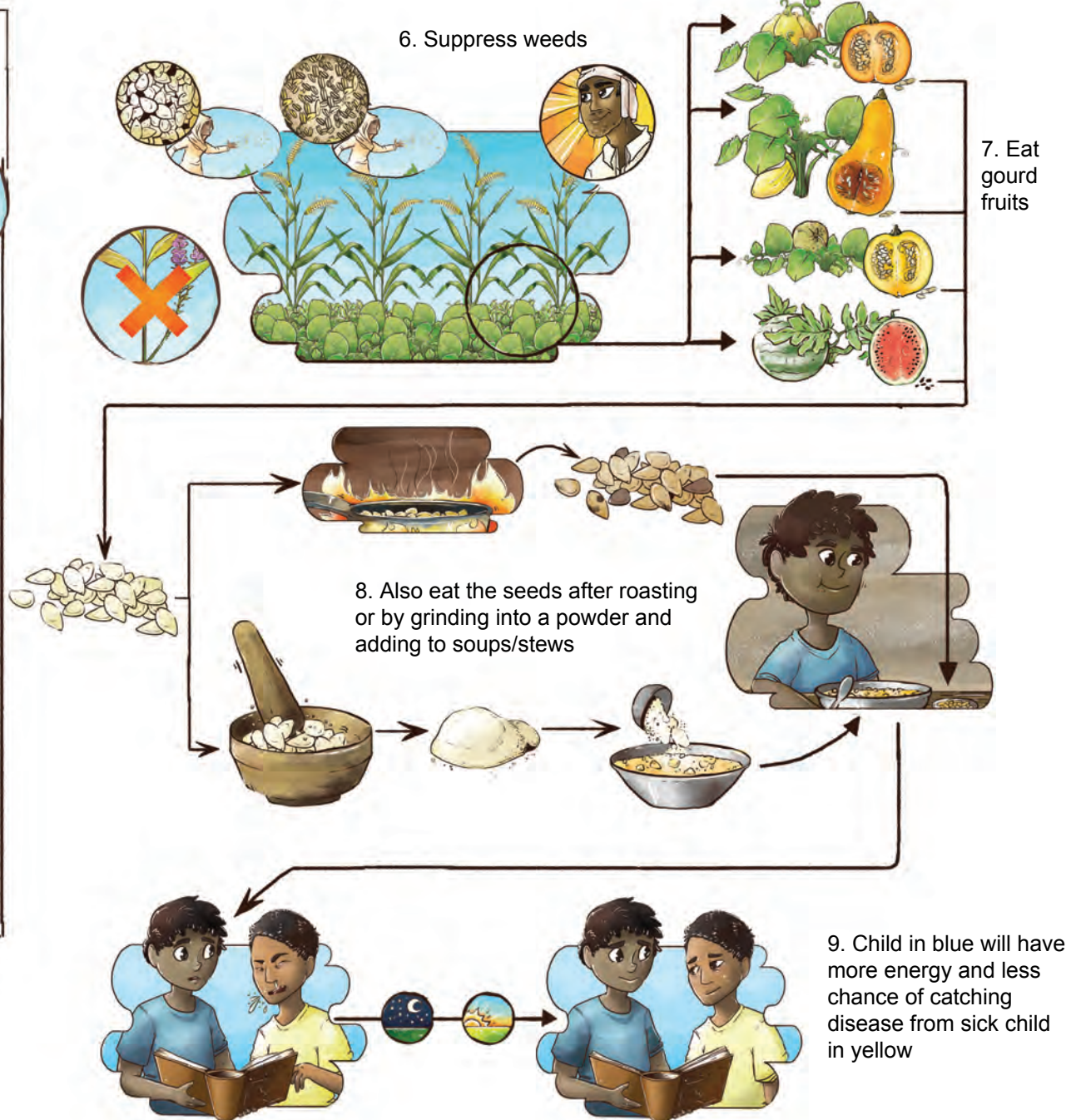


Lesson: Cucurbit intercrops suppress weeds and provide nutrients to reduce disease in people

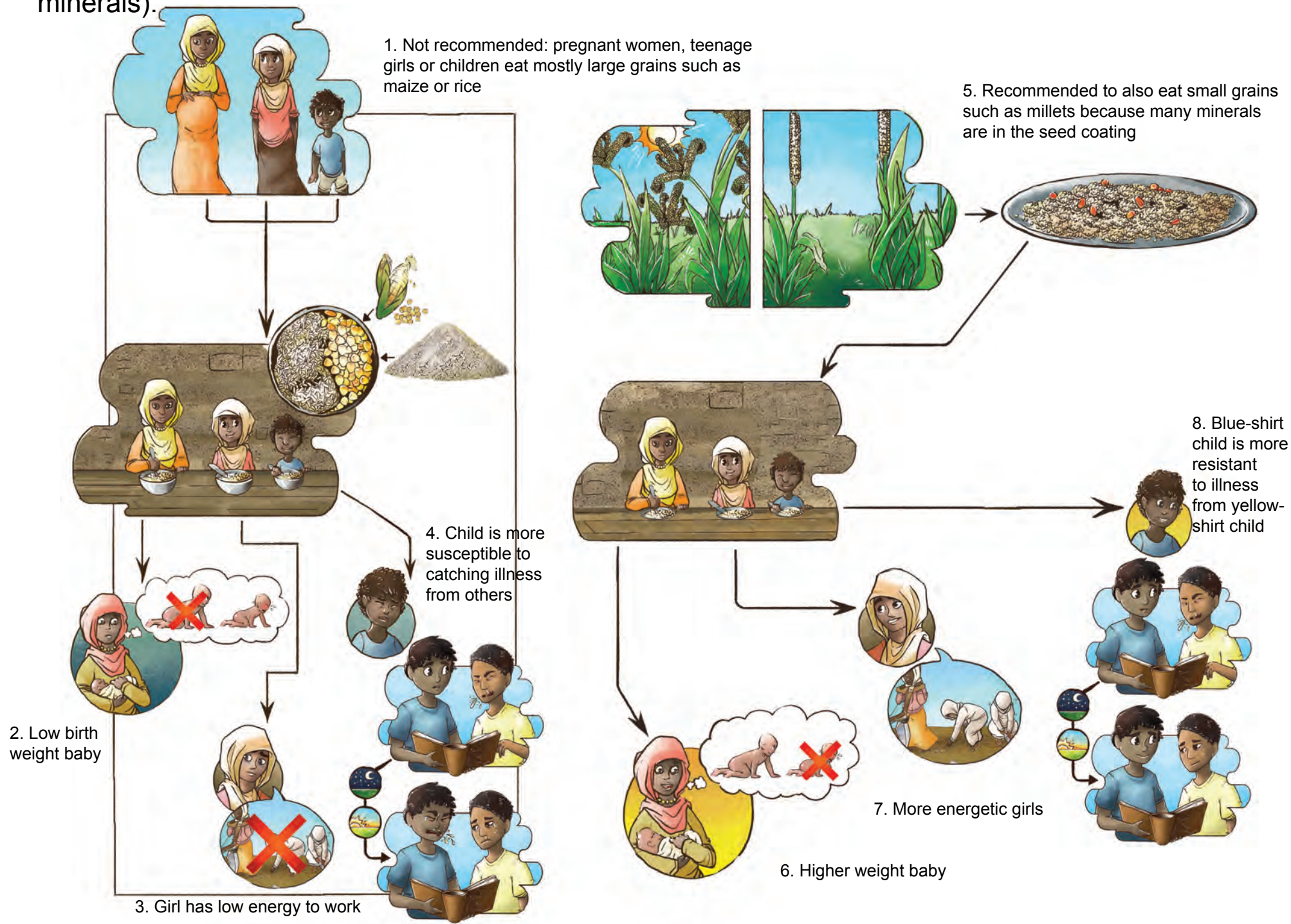
1. Traditional practice: weeds in field



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



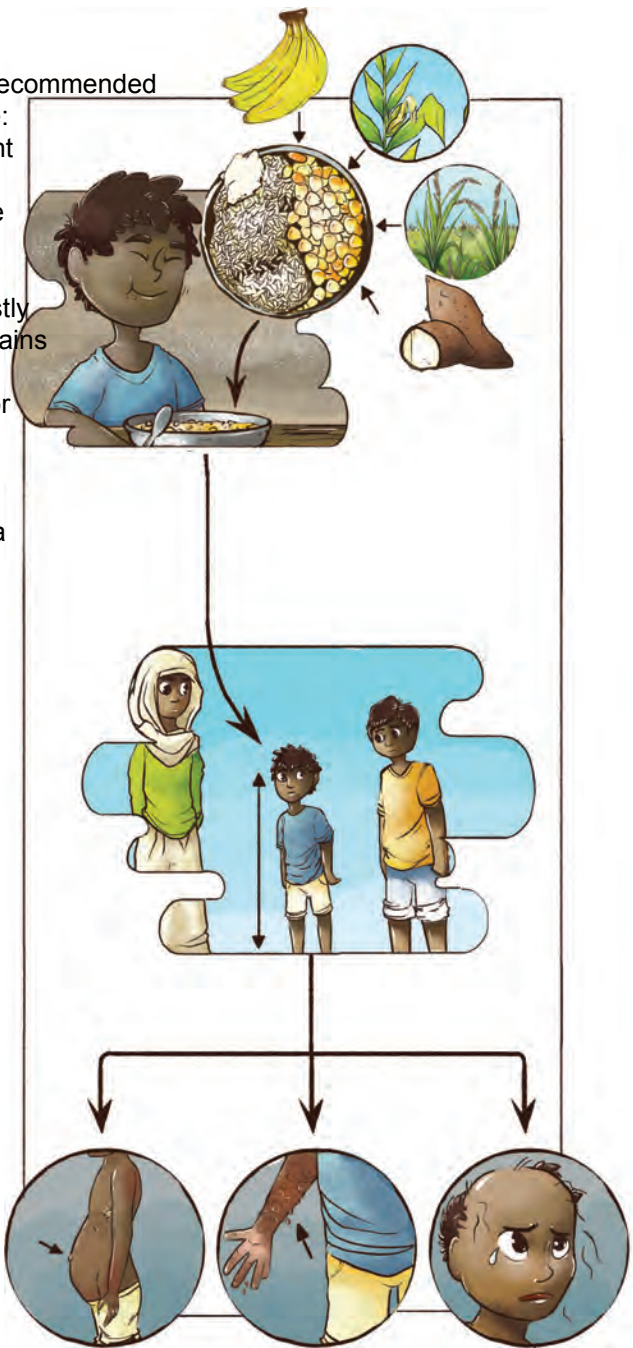
Lesson: Pregnant women and children should eat whole small grains to be healthier (folate and minerals).



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

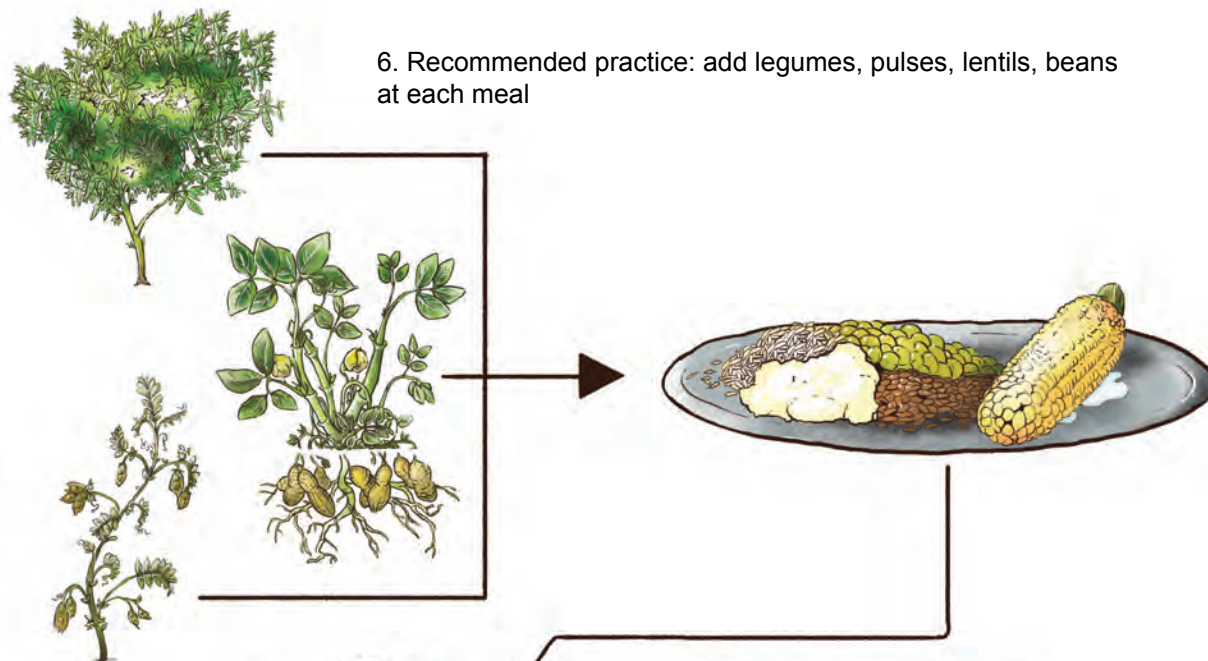


3. Extended belly

4. Skin cracking

5. Hair discoloured or falling out

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



7. Normal child growth

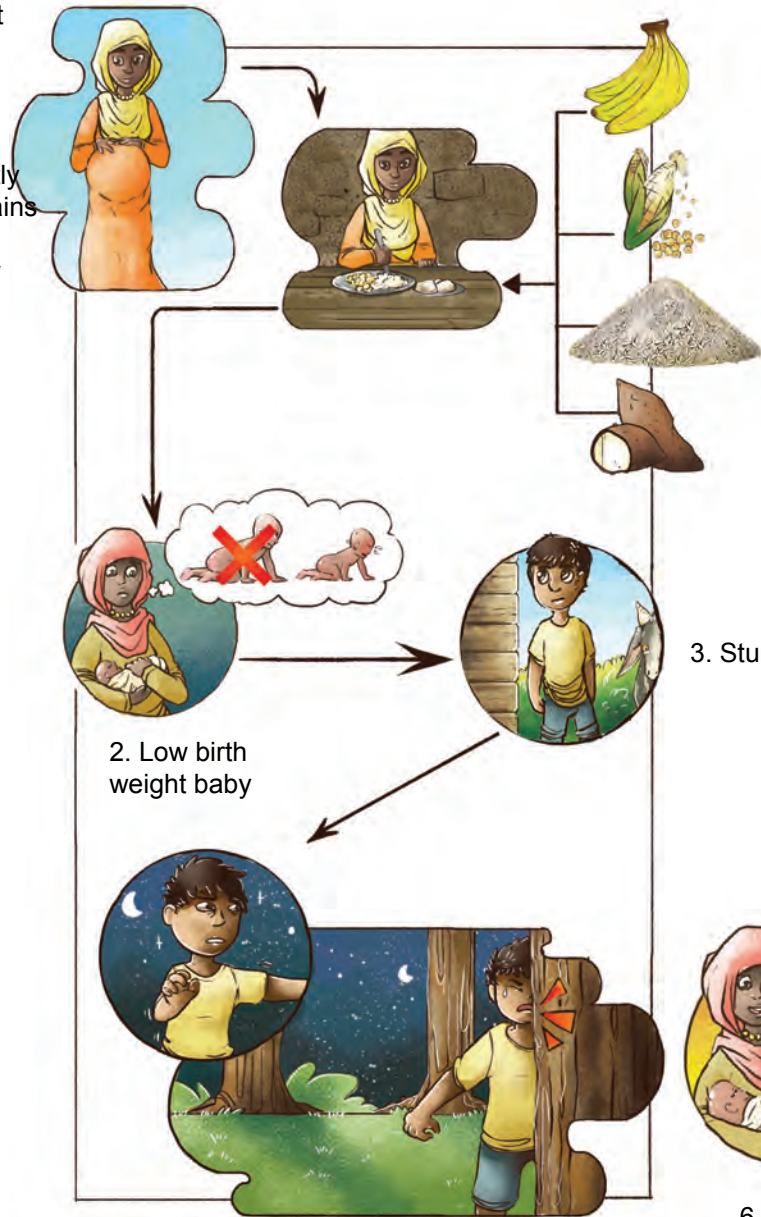
8. Normal belly

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

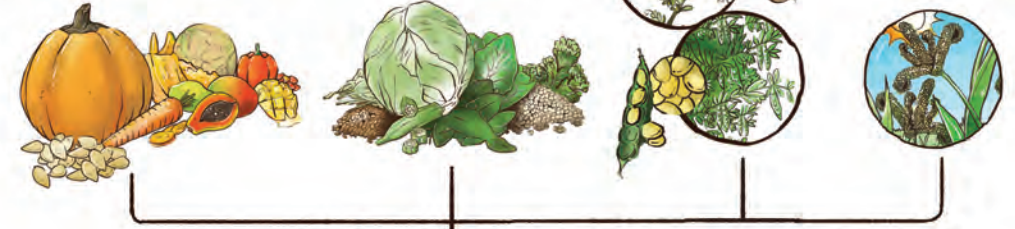


colourful fruits and vegetables and cooked cucurbit seeds

5. Recommended foods to eat

small grain legumes/pulses

small grain cereals (e.g. millet)



3. Stunted child



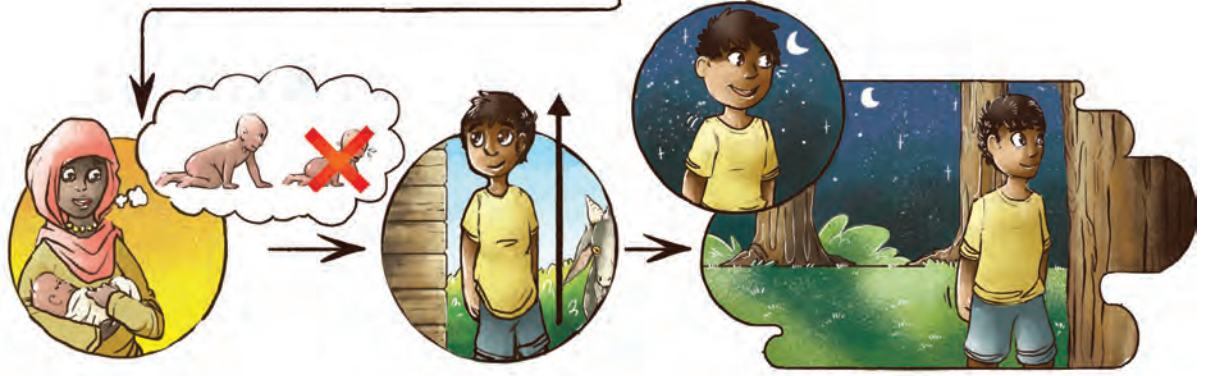
2. Low birth weight baby

6. High birth weight baby

7. Normal growth

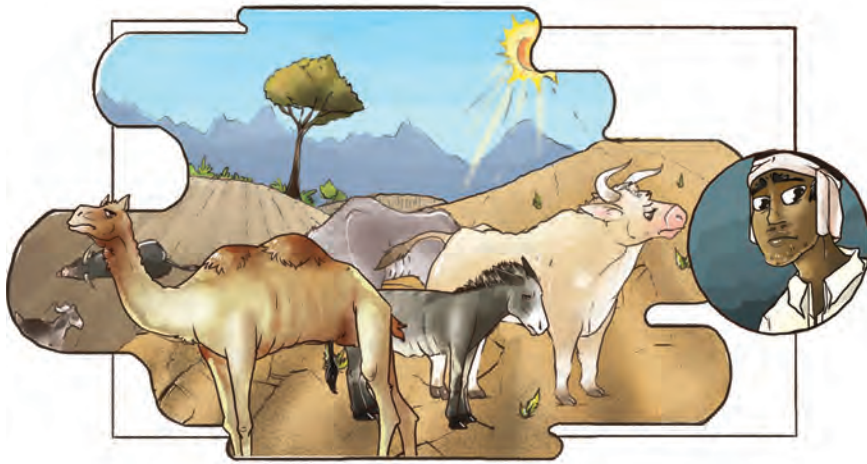
8. Proper eyesight at night

4. Night blindness



Chapter 10: Animals

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

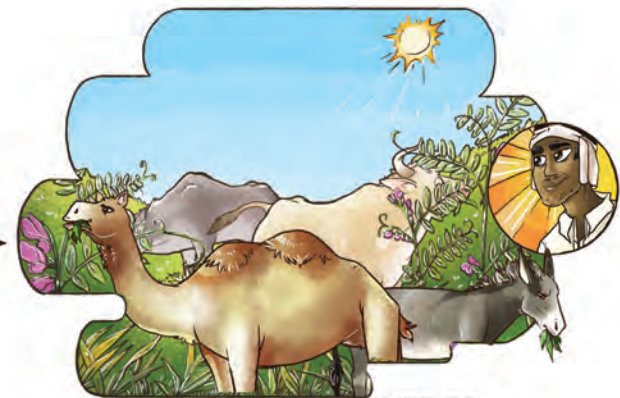


1. Traditional problem is lack of feed for animals in dry season

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



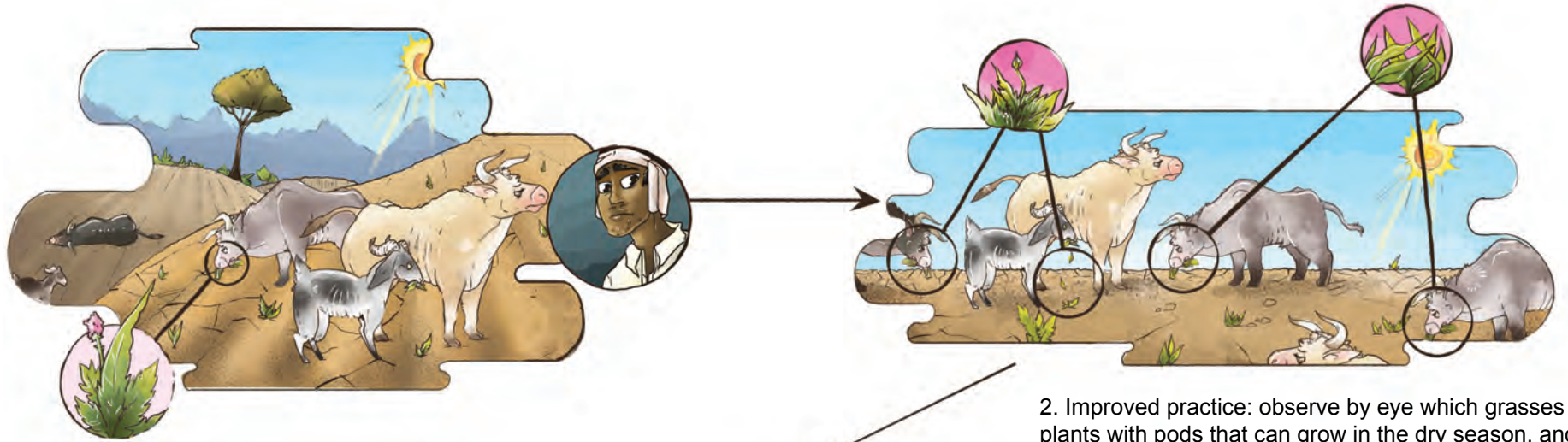
3. Animals have feed in dry season



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

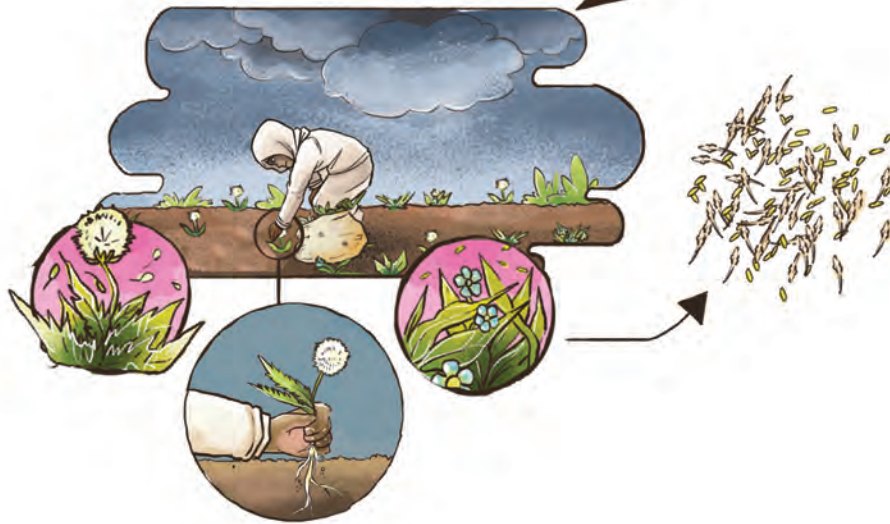


Lesson: Observe which plants grow in the dry season, then deliberately grow them, to provide livestock fodder

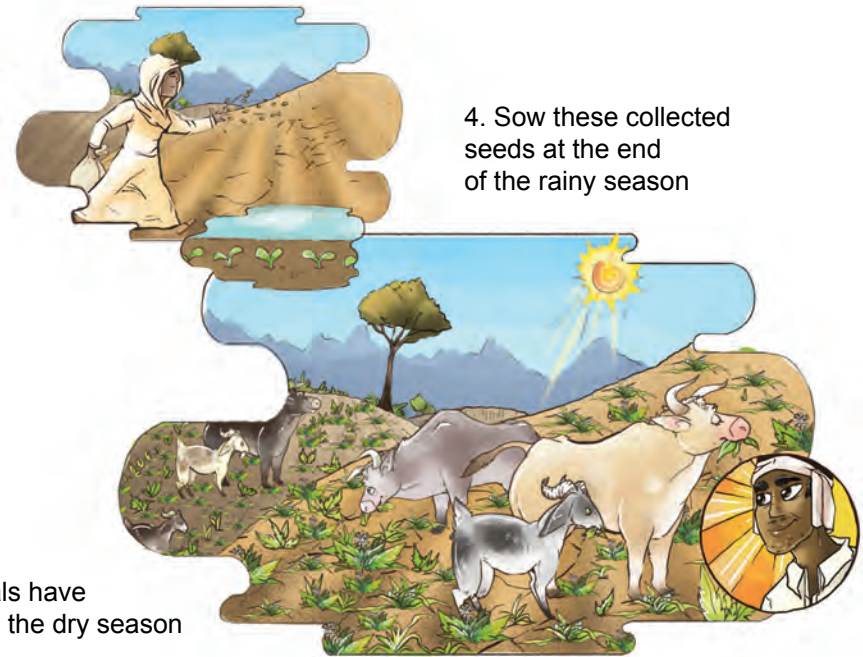


1. Traditional problem is lack of fodder for animals in the dry season

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



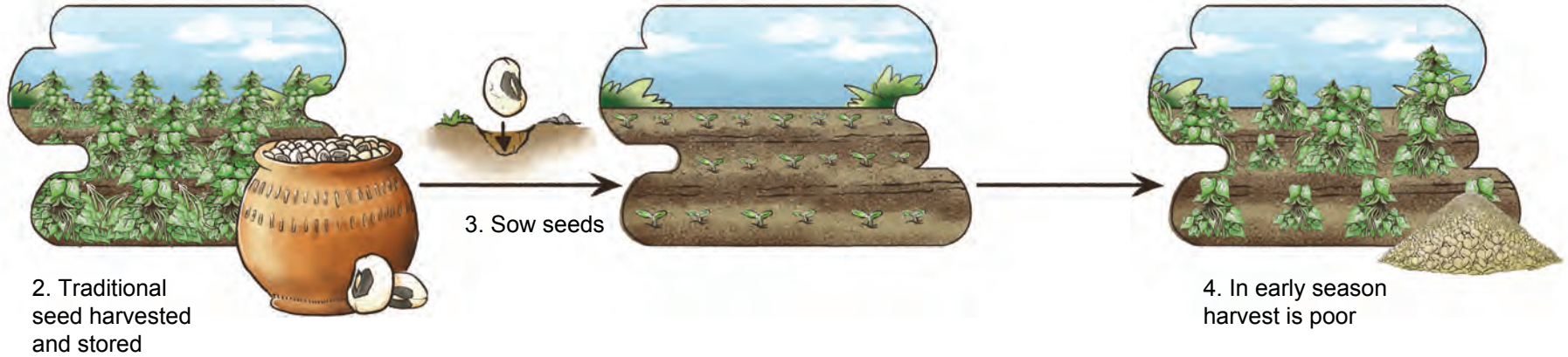
4. Sow these collected seeds at the end of the rainy season

5. Animals have fodder in the dry season

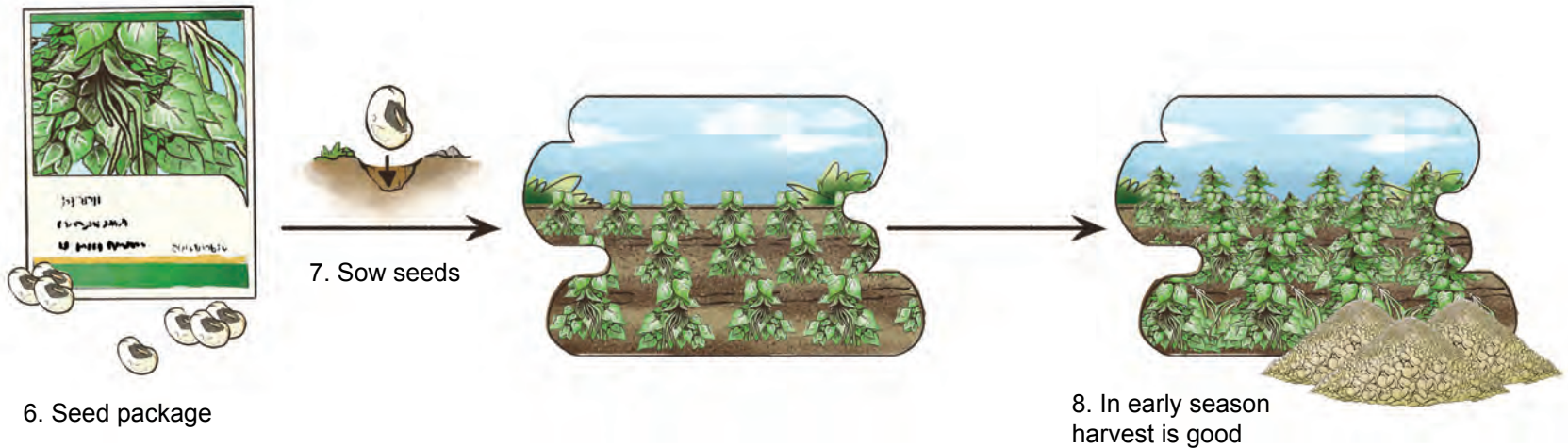
Chapter 11: Disaster Relief

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

1. Traditional seed variety



5. Early maturing seed variety

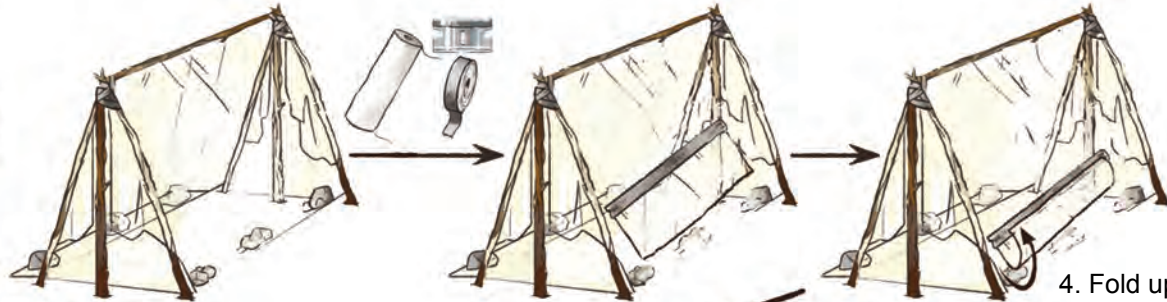


Lesson: A roll of plastic or tarpaulin may be used to collect clean drinking water from rainfall (water harvesting)



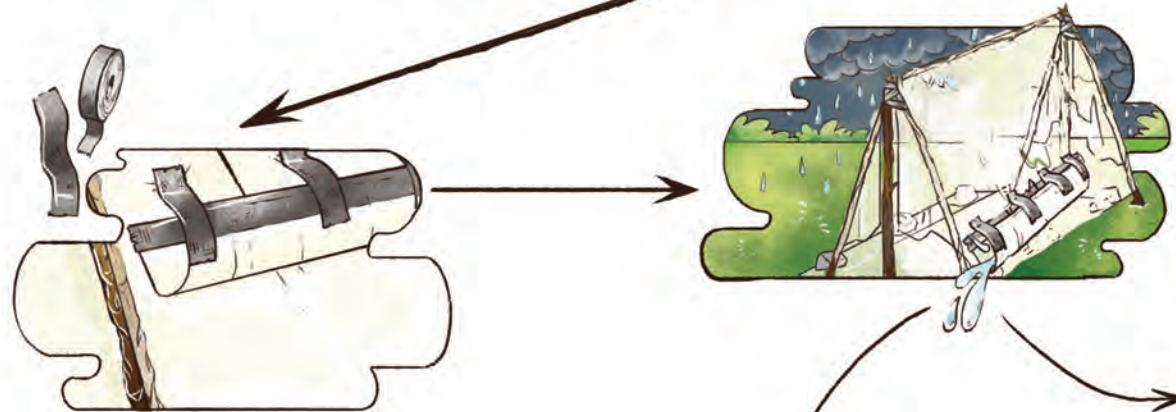
1. Thirsty

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



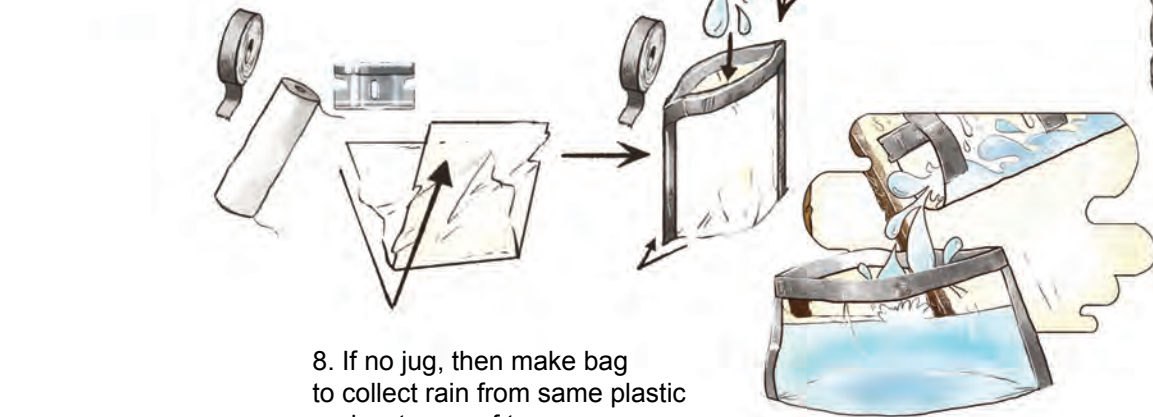
3. Tape plastic at a sloping angle

4. Fold up

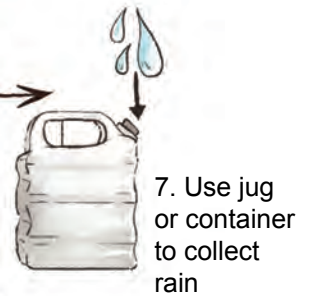


6. Collect rain

5. Add tape



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



7. Use jug or container to collect rain

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

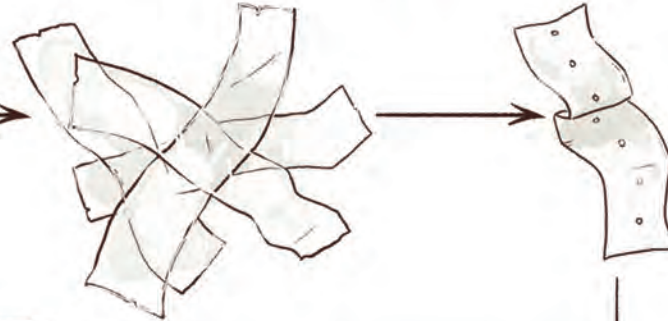
1. Vegetable garden with weeds



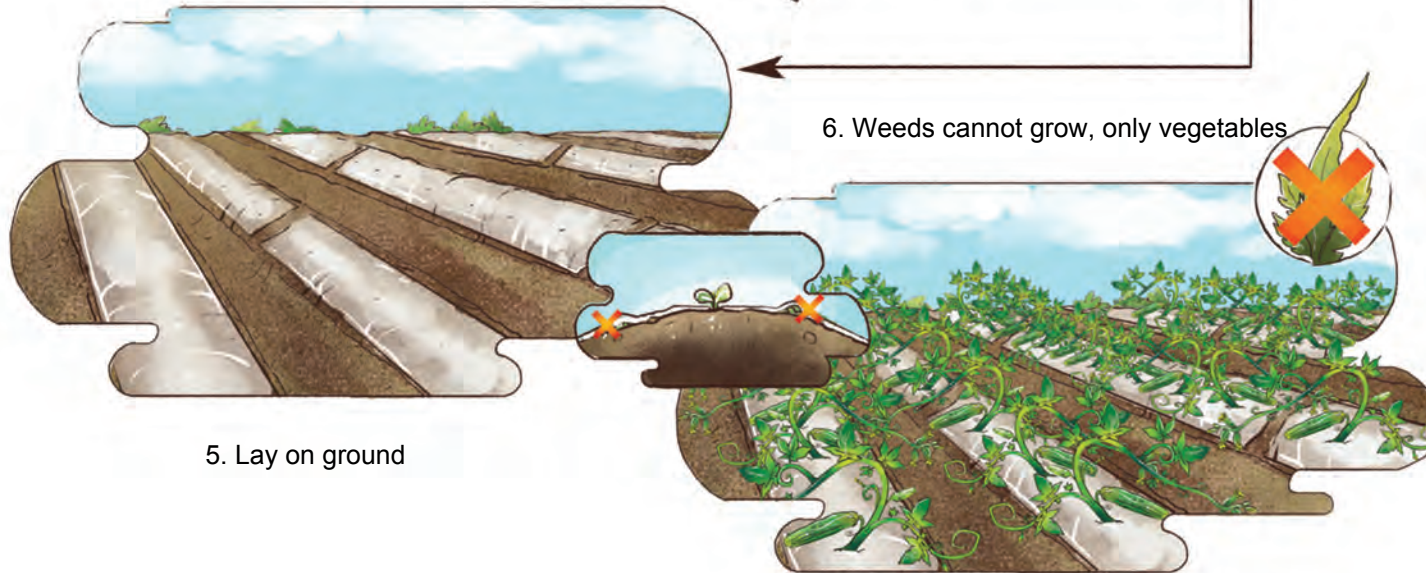
2. Tent



3. Cut



4. Create holes to insert vegetable seeds



5. Lay on ground

6. Weeds cannot grow, only vegetables

