

Indigenous Agriculture Manual:
The Milpa System in
Forest Gardens
First Edition



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Overseas Development Initiatives Foundation.

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1. Introduction

Agricultural land is becoming hotter and dryer and there are now more frequent floods and droughts. Food production is decreasing at the same time that the population is increasing. It is urgent to make food production resistant to extreme weather events.

The purpose of this manual is to provide agricultural producers, a handful of practices that were developed throughout the Americas and on other continents, by indigenous producers, long before the arrival of Europeans. This manual summarizes the results of more than 40 years of the author's experience, with the practices that allowed our ancestors to produce food, even during droughts and floods.



As a producer and as a researcher, Mel has worked in his own fields and in the fields of countless producers with whom he has shared the technologies that contained in this manual. With this manual he wants to inspire the descendants of indigenous people worldwide, to return to the original agriculture. If they put these technologies into practice, they will be reviving the systems that enabled our ancestors to produce abundant quantities of good quality, nutritious food in great diversity, even in difficult climatic conditions.

This first English edition of the Indigenous Agro-ecological System manual, produced by ZOECO Associates, has been sponsored by the Overseas Economic Development Initiative with help from Bob Mathews.

2. The Origin of Agriculture

Ten thousand years ago the people of southern Mexico transitioned from hunting and gathering to the production of agricultural crops by reproducing the natural environments where they found the plants they ate. These farmers developed foods like maize, pumpkin, beans, cocoa, tomatoes and chilies and cotton for the fibers. They grew fruit trees like avocado and mango, and cashew nuts; also plants for dyes, medicine and many others.

The knowledge and crops spread through the Americas through migration and trade. They named the system they had created, “milpa.” They called the area they cultivated, Forest Gardens: each one an agroforestry system that mimics the original productive ecosystem.

The Indigenous American farmers grew hundreds of varieties of crops in their fields using beneficial plant associations in raised beds that were continually covered with an organic matter mulch that kept the soil soft, cool and moist. The soil was not plowed and crop wastes and weeds were used as mulch; protecting from loss due to drought, excessive rain, insects and diseases. It did not harm the environment while it produced nutrient rich soils and plentiful harvests.



When the Spaniards came to America they found forest gardens established on millions of hectares over the entire continent. Although this greatly impressed them, they failed to understand how the people farmed the land. So, they imposed on the land and people the destructive system they used.



The agriculture that the Europeans practiced included burning weeds and crop wastes in preparation for planting; a harmful practice which eliminates soil organic matter. Trees were also cut to clear the land, and the soil was plowed to establish mono-cultures. Soils soon began to lose energy and nutrients, and over time they became impoverished. Since the soil was left uncovered, the rain removed the most fertile layer. These eroded, hot and dry soils lost their ability to produce good harvests. This brought poverty, hunger and malnutrition to farmland in the Americas.

However, the Europeans did recognize the value of the crops developed by Indigenous Americans which they carried with them over the rest of the world. That dissemination of foods started an agricultural revolution 500 years ago.

The rescue of indigenous agriculture could start another agricultural revolution now, to provide food sovereignty and security in the face of climate change.

A photograph of a terraced agricultural field. The field is divided into several rows of crops, with a large tree standing prominently in the middle ground. The background shows a hilly landscape with more vegetation under a cloudy sky. The text is overlaid on a semi-transparent white rectangular area in the center of the image.

Indigenous Agro-ecology:

How to use it
and teach it

3. Changes in the surface of the soil

The essential base for the establishment of the milpa system is to change the structure of the soil. For that purpose, indigenous Americans created the methods that are presented below.

Raised Beds

Raised beds are rectangular structures excavated in the soil that capture rain water and provide a planting surface higher than the surrounding soil. These are separated by channels in which the producer walks and works. The channels are interrupted by tied ridges, which keep all the rainwater where it falls. Immediately after construction, they are covered with mulch to provide a soil environment that is cool and moist for plant roots, earthworms and hundreds of other beneficial organisms. The decomposing organic mulch provides food for the micro-organisms and fertility for the soil. The beneficial organisms protect plants and provide them with nutrients.

The organic matter also provides the cool, moist environment needed by plant roots and prevents raindrops from splashing fungal spores up onto plant leaves, fruit and stems.

The first bed should be built in the highest part of the field. They increase soil humidity, organic matter, fertility and microorganism diversity. They reduce erosion, evaporation, and risk from droughts and floods.

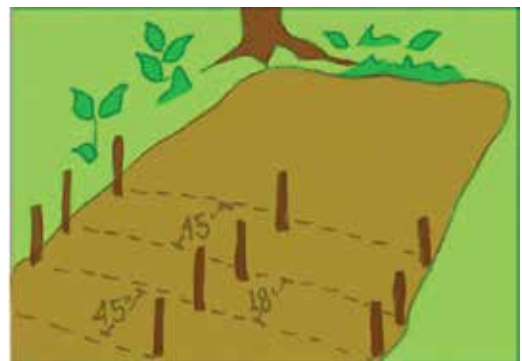




To construct the raised beds

Note: If the land is steep, dig the first bed at the highest point.

1. Use stakes to mark where to dig ditches and where to form beds.
2. Dig the ditch, 46cm wide (the width of two shovel blades) and 25 to 30cm deep. Put the soil where you will form the bed.
3. Dams (25 to 30cm) are left every 5 meters to capture rain water.
4. Form the bed between the ditches with a base of 115cm.
5. Level the top of the bed and cover it with organic matter for mulch.
6. This is repeated down the slope until all the beds are completed.



7. As soon as you finish a group of beds, immediately cover them with mulch.

- The beds are planted in sections of five meters long. • Each five meter section is planted with a different mix of crops to reduce pests and diseases.
- Fruit trees are planted at the ends of the beds in the direction of the wind. As they grow, they are shaped into fans and only allowed to cover a single five meter section of bed.



Terraces

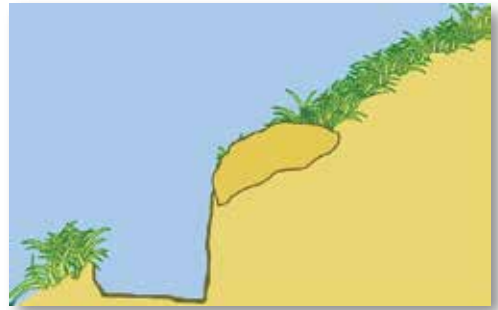
Terraces provide level soil for cultivation on sloping land. On gentle slopes you can use vetiver grass to retain a soil wall. But, steep slopes require rock walls to remain stable.

Terraces also make work easier and prevent erosion and landslides. They increase available land for cultivation and increase agricultural productivity. Raised beds can either run perpendicular to the wall or parallel to it.



To Construct Terraces

1. Construct the first terrace in the lowest part of the field with the next one just above it; opposite what you do with raised beds.
2. Dig a channel 20 to 25cm deep sloped into the hill by about 8cm so that the wall leans into the slope for stability.
3. The width of the terrace is dependent on the height of the wall. It should not be more than four times the height.
4. The soil from the trench is thrown onto the slope above to fill in behind the new wall.
5. The wall is built in the trench with the width of the base a quarter the height of the wall.
6. Fill in behind and compact the soil after each layer is completed.
7. Use the largest rocks for the base, small ones in the middle and longer ones in the last layer to hold everything together.



Vetiver Terraces

Vetiver terraces are built on moderate slopes where there are no stones available.

The roots of the vetiver penetrate deep, mooring and retaining the terrace wall. Once the plants are established, water can flow through them, but soil cannot pass.

Pieces of Vetiver can be planted directly into moist soil, but, if the climate is dry, it should be started in paper pots to develop roots before transplanting.

To construct Vetiver Terraces:

1. Dig soil from what will be the back of the terrace and pile it to the front and compact that which will be the front wall.
2. Plant the vetiver across the front wall of the terrace, leaving a distance of 10 cm between plants. The spaces between plants will close as the plants grow.



Platforms

Platforms are constructed to prevent the loss of crops in those areas that are frequently flooded.

The walls of the platform are formed with compacted soil, while loose soil fills the interior of the platform.

Then raised beds are built on top of the platforms.

The platforms are strong structures that provide soil above the water level for crops.

The water between the platforms is used for irrigation in dry periods.

In addition to increasing the productivity, the use of platforms helps to reduce erosion and risks by floods or droughts.





To Construct Platforms

1. The surface layer of the soil is removed by cutting it into blocks of the same size and shape as the adobe bricks that are used in construction. These should be stacked on one side of the field.
2. The area where the platforms are to be built are marked with stakes, Each platform should have a width of 6.25 meters.
3. Also mark the distance between platforms, which is 2.75 meters. This area will be excavated to form canals and to provide soil for the platforms. This soil is put into the center of the area where the platforms to be built.
4. The platform walls are built using the soil blocks by stacking them against the sides of the canals (against the platforms).
5. Once platforms are complete, five meter raised beds are built on top of the platform from one side to the other.
6. Leave a 75 cm walkway on each side of the platform for access.



Improved Soils

In improved soils, plant roots have a better environment to develop because they have enough nutrients, they are cool, moist, well drained and they have more oxygen available.

These soils allow the growth of organisms that help plants to produce more food as long as chemicals are not used and the soil is not compacted.

This is the type of soil that develops in the raised beds; a moist soil with lots of organic matter, abundant and diverse beneficial organisms that help plants take nutrients and produce more food.

To produce this soil it is necessary to use all the available Organics matter as mulch (including crop waste and weeds).

If there is not sufficient organic matter, it is necessary to grow more with legumes such as velvet bean and sward bean and with kale or collards during the dry season with residual soil moisture. If that isn't enough, some beds can be devoted to the production of organic matter.

Under the mulch the soil becomes rich and soft.

Soil improvement reduces erosion and risks from droughts or floods. It also manages to overcome dependence on chemical inputs while increasing production and lowering production costs. Mulch will improve almost any soil within 6 months to 12 months.



Sward bean



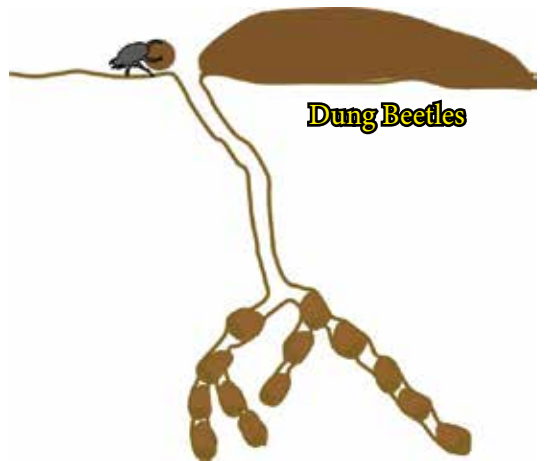
Velvet Bean

Black Earth Soils

The richest soils in the world are from the tribes that made the black earth soils. The mulch is just one of the requirements for producing these soils. They also require charcoal and humus.

The charcoal is produced using hard crop wastes such as grain husks, fruit seeds and maize stalks that are burned without enough Oxygen to consume all the material.

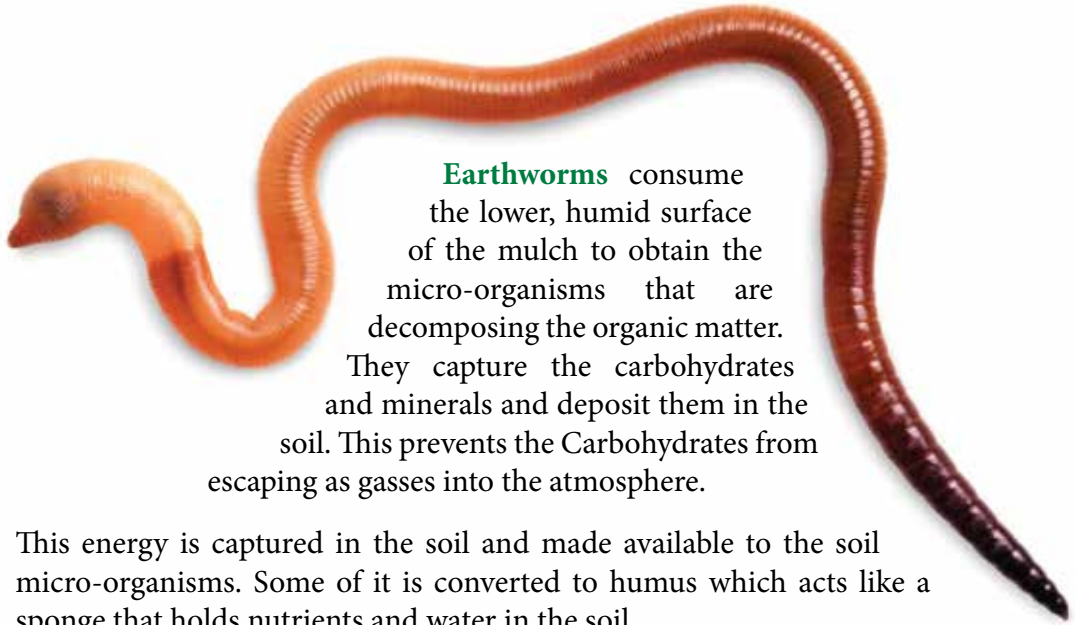
The humus is produced from feces and manure that is buried by dung beetles or worms deep in the soil, where anaerobic bacteria consume it.



This humus can be produced in an area set aside for the purpose, where dung beetles can be introduced and fed; with the soil being harvested at a later date.

Later this high humus soil and the powdered charcoal can be applied to the top of the beds under the mulch. Earthworms will mix it into the beds.

Or, you can set aside a group of beds that you want to improve and introduce the dung beetles and manure there for three to for five years.



Earthworms consume the lower, humid surface of the mulch to obtain the micro-organisms that are decomposing the organic matter. They capture the carbohydrates and minerals and deposit them in the soil. This prevents the Carbohydrates from escaping as gasses into the atmosphere.

This energy is captured in the soil and made available to the soil micro-organisms. Some of it is converted to humus which acts like a sponge that holds nutrients and water in the soil.

Earthworms turn the soil twice a year, aerate it with their tunnels and enrich it with their feces. Earthworms can be introduced by placing them on the surface of the beds under the mulch.

Micro-organisms. There are thousands of different organisms that live in nutrient rich, cool, moist soil. Many of these are beneficial to plants because they release minerals from soil particles, kill pests and disease organisms, or directly provide nutrients and water to plants.



Mycorrhizal fungi collect nutrients and water from throughout the soil and deposit it inside the roots (in the photo to the right).

Nitrogen fixing bacteria convert atmospheric Nitrogen to a form that plants can use (in the photo below).



There are many more examples of beneficial organisms that provide health, safety and development to our plants. These organisms can be introduced to lifeless soil by applying a small amount of decomposing leaves and soil from areas that have not been plowed and have not received applications of chemicals.



4. Indigenous Practices

La Milpa

The milpa is the system of raised beds, mulch and diversified crops that was used to provide everything needed by Indigenous American families in what they called, “forest Gardens.” This natural environment allows production with only the resources that are available in the field; producing more food without harming the environment.






This system increases the diversity of beneficial microorganisms in the soil and also diversifies the crops grown in that soil. The diversity of crops reduces pests and diseases and escalates productivity leading to increased food security and financial security.



Companion planting

When grown close together plants of different species are benefited because the odor of some plants confuses or repels insect pests. Some plants give shade or support and they utilize different nutrients at different levels of the soil. These are called companion plants.

Some examples of companion plants include:

-  Plant marigold on both sides of the beds to kill root knot nematodes and to repel various pests.
-  Plant cabbage with carrots to repel cabbage moth and carrot root fly.
-  Plant basil with tomatoes and peppers to repel their pests.
-  Plant nasturtium or rosemary with beans to repel bean beetles.
-  Plant oregano, dill and other herbs to deter many types of beetles.

The Three Sisters

The Three Sisters method is a type of companion planting that consist in the planting of maize, beans and squash (or melons) in the same area.

To plant the three sisters:

The three sisters method includes Maize, beans and squash grown together in the same space.

- 🍊 Plant the maize in two rows on each side of the bed, with two seeds spaced 50cm apart.
- 🍊 When the maize is 30cm high, plant three bean seeds around the base of the plants.
- 🍊 When the maize is 60cm high, plant a squash plat at each end of the 5 meter section and train them to grow in the 5 meter section and in the channels on each side.
- 🍊 The maize supports the beans, the beans provide Nitrogen and the squash shades to the soil.





5. Growing on raised beds

- 🍎 Marigold is planted a meter apart on the side walls of both sides of the beds to control the nematodes that cause damage to the roots.
- 🍎 To repel a variety of insect pests, plant herbs such as basil, oregano and dill between crops and the center of the beds.
- 🍎 After harvesting a section of bed, immediately plant another group of crops. Thus, the beds are kept producing all the time.
- 🍎 If possible have the next crops growing in the nursery, in order to have them ready to be transplanted when harvesting the previous group.
- 🍎 You should always rotate the beds. That is, when harvesting a group of plants of one type (such as cabbage, broccoli and radish), the next group should be of another type (such as tomato, chiltoma and chile).

Trees in the Beds



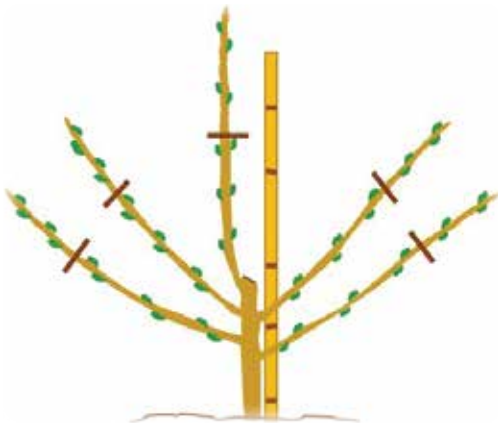
Each tree needs only one section of bed. Its contribution to the system is important. Trees protect crops by reducing wind force. Their flowers attract pollinators and their odor helps prevent insect pests from finding the plants they prefer.

Each tree is trained in the shape of a fan. The main branches extend along the bed, but, side branches are cut short so that they do not hamper walking and working in the channels.

Training as a fan

To begin training, bury a stake beside the tree when it is one year of age; tying it to the stake with heavy string, but do not tighten it. That stake will serve as support to the main stem. Cut the stem diagonally at about 45 to 60 cm above the ground, just above two buds that point toward the ends of the bed.

Allow all branches to grow for 6 months, before choosing the branches to be retained. The upper most branch will be the central branch and four other branches will be left



to provide the rest of the structure. All others are eliminated.

In the second year each branch is cut to 60cm, just beyond a pair of buds. Keep two new branches from each of the original five in order to form the fan shape.

The ends of these secondary branches are cut when they have grown from 60 to 90cm long.



Allow branches to form off of the primary and secondary branches and cut them when they have grown out to the edge of the bed.

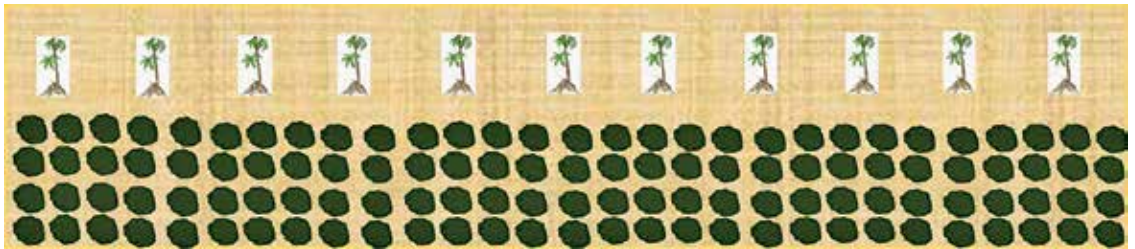


6. Recommended mixtures of crops in beds

Cassava and peanuts

Cassava cuttings of 5 to 6 nodules (25 to 30cm) are planted 25 to 30cm apart, through the mulch.

Plant 2 peanut seeds 30cm apart, 3cm deep in holes in the mulch. Leave only the best plant to develop at each point. Peanuts are harvested when the plants begin to turn brown.



Okra, basil, dill and Oregano

Make a small cut in each okra seed and let it soak overnight in water. Sow two seeds in each paper pot, 1cm deep. Keep one plant per pot.

Transplant 60cm apart on the row. Plant a row of okra on each side of the bed and harvest the pods when they are 8 to 10cm long.

Plant herbs in paper pots (2 seeds in each). When they are ready, transplant them in the center of each four okra plants (as in the drawing below). Plant Basil seeds at the surface and the others a little deeper.



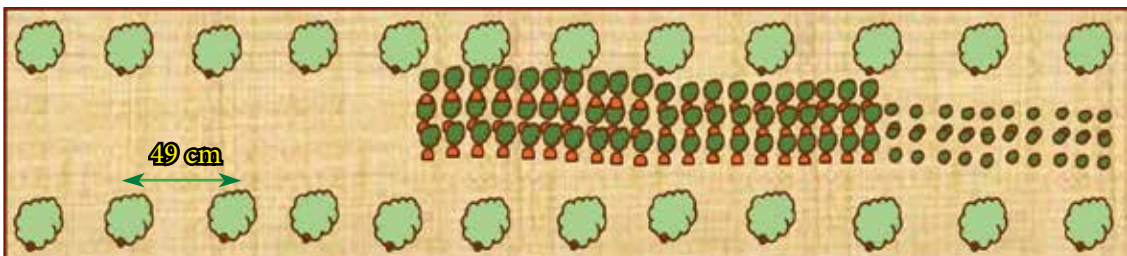
Cabbage and Carrot

Sow two seeds of cabbage in paper pots, 0.5cm deep. Transplant 25cm apart.

Plant carrot seeds in small grooves after opening a channel in the mulch. Cover them with a little soil. When the leaves are about 10cm in height remove extras to leave only the best plant every 8cm. Plant a quarter of carrots every two weeks.

The smell of cabbage repels the fly that damages carrot roots.

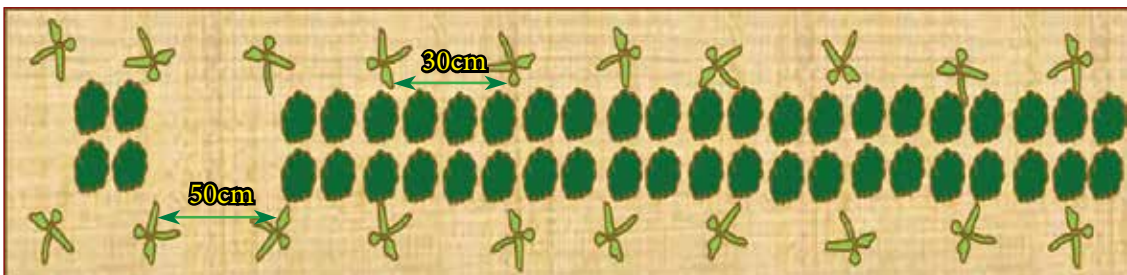
The smell of carrot repels the white moth that affects cabbage.



Maize and Bush Beans

Plant 2 seeds of maize 2cm deep every 50cm in 2 rows, one on each side of the bed. Harvest when the ears are dry.

Sow 2 bean seeds 0.5cm deep every 30cm in 2 rows in the center of the bed. When you harvest the beans leave the bean roots in the soil to provide Nitrogen to the next crop.



Tomato, Peppers, Chili and Basil

Grow them where they can receive light shade for best production.

Plant 2 seeds of tomato, chilies or peppers 0.5cm deep in paper pots.

To plant Basil just mix with the surface soil.

Transplant peppers before they have 8 true leaves.

Transplant these in groups of four, with 50cm between plants.

Put Basil in the center of each group of peppers, chilies or tomatoes.

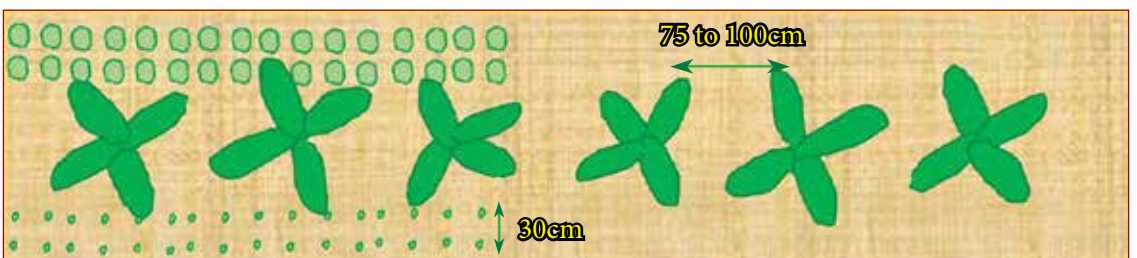


Banana or Plantain and Spinach

Plant banana suckers in the center of the bed about 80 to 90cm apart.

Start spinach in paper pots sowing 2 seeds 0.5 cm deep, three weeks before transplanting. Transplant 30cm apart in two rows 30cm apart.

For home use, harvest large leaves first and let small leaves grow. For the market, cut the stem to 7.5cm above the ground and let it grow back for a second harvest. Plant more spinach every 3 or 4 weeks for a continuous of leaf harvest.



Moringa

Plant two seeds in each hole in four rows spaced 20cm between rows and between plants. Reduce to only one plant per hole.

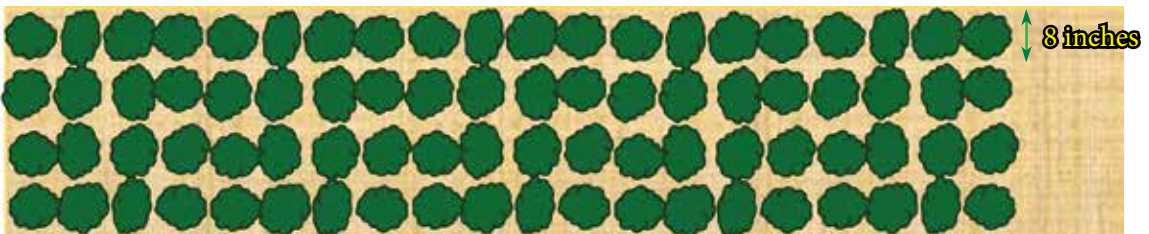
Another option is to plant woody cuttings: they set roots well and develop fast.

To have a continuous harvest is recommended planting a line of 4 plants every 2 days.

When the tree reaches two meters it is cut off to 20cm.

They regrow and each group is harvested every 45 days.

Use the fresh leaves in soups, eggs or salads. Or, left to dry, they are crushed (or ground) to a powder and stored for eating little by little.

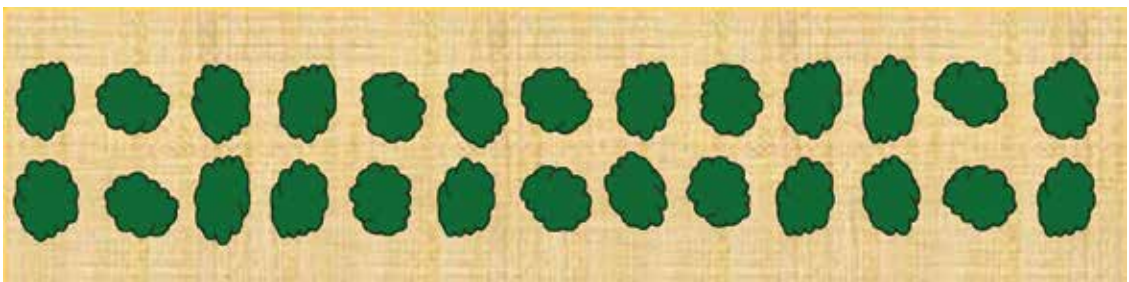


Potatoes

Plant whole potatoes the size of large chicken eggs. They are spaced 40cm between them in two rows spaced 50 cm apart.

The beds are covered with a thick layer of mulch (40cm) before planting. Place the potatoes on the mulch and then cover with another 40cm of mulch.

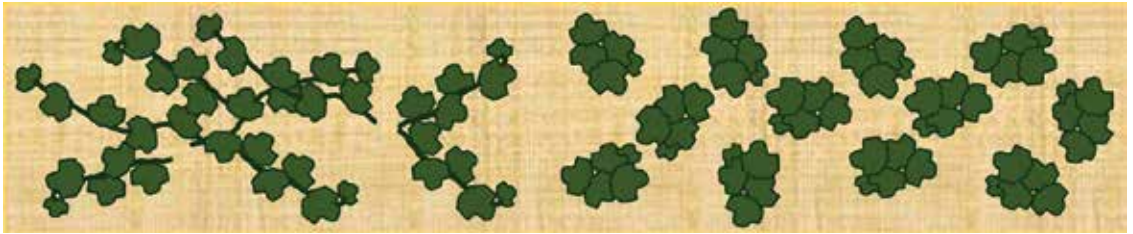
After 3 or 4 months check in the mulch for large potatoes, but, leave the others until the plants begin to die.



Squash and Pumpkin

Plant Zucchini in groups of 4, 75cm apart in 2 rows. Plant herbs in the center of each 4 Zucchini plants.

Plant winter squash or pumpkin every meter in the center of the era. These plants can grow over the beds and in all channels.



Sweet Potato

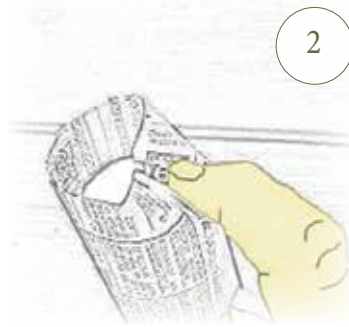
Plant 6 cuttings, (15cm long) directly into the center of the bed or in paper pots to root them before planting. Lift the vines weekly to prevent them from forming small roots, which would rob nutrients from the harvestable roots.



Watermelon

Plant 2 seeds in each paper pot and leave only one. Transplant to the center of the raised beds. Space watermelons 40cm apart. Space other melons a meter apart. Watermelons are ready to harvest when the tendrils on each side of the stem turn brown. Other melons should separate from the stem when lifted, when mature.





3



4



5



6



7



8



Planting in Paper pots

1. Cut newspaper into 7.5 by 27 - 28cm strips. Roll the strip onto a tube, dowel or jar that is about 4cm in diameter; Leaving 2.5cm of paper protruding beyond the edge.
2. Fold the protruding paper to make the bottom of the pot.
3. Press the bottom so that it maintains its shape and slide it off.
4. Fill the pot with soil.
5. Drip water from a bottle to wet the soil.
6. Make a hole in the center to the correct depth.
7. Plant the seeds and cover them with the correct amount of soil.
8. Place pots in the nursery and keep them moist until the plants are ready to be transplanted.



7. Maintaining the Indigenous System

Whether the soil is sandy or clay, once the worms and micro-organisms incorporate organic matter, it will become soft, loose and fertile.

Organic matter in decomposition offers many of the nutrients needed by the ground, and the acids produced by the decomposition will facilitate a greater release of nutrients from stones in the soil.

Therefore, it is important to maintain a healthy environment for the beneficial organisms that do this work.

Conventional agriculture with agrochemicals, destroys the organisms that help plants to grow.



The things you must do

- ✓ Keep the beds covered with mulch at all times to protect the soil, organisms and roots, prevent erosion and to feed the soil microbes and the crops.
- ✓ Cut back tree branches when they produce too much shade.
- ✓ Allow the diversity of plant odors to repel pests. Use natural infusions that repel or kill insect pests when needed. NEVER USE CHEMICALS.
- ✓ Plant cover (especially legume) crops in the dry season to produce more mulch materials.

The things you must not do

- ✗ Do not burn organic matter. It is the wealth of the land.
- ✗ Do not use chemicals, because they kill the organisms in the soil
- ✗ Do not plow the land. It destroys organic matter worms and beneficial micro-organisms.
- ✗ Do not open the soil of the beds except to harvest cassava, potato, sweet potato, etc.
- ✗ DO NOT WALK ON THE BEDS. Walking on the surface of the beds compacts the soil and kills Mycorrhizal fungi, which are vitally important.



8. Seeds: Our Livelihood

Living seeds contain the embryo of a new plant and the nutrients it needs to thrive in moist soil. If you purchase imported seeds, you are planting varieties that are designed to produce in a variety of conditions. But, they are not designed to produce abundant crops in the conditions that you encounter in your community and on your farm.

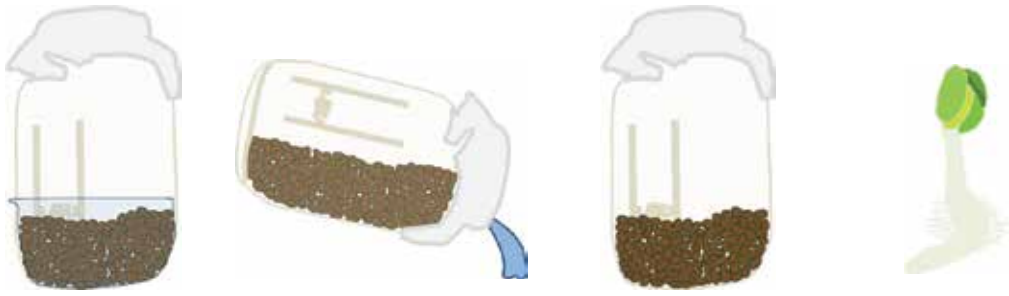
Seeds you save are better than those you buy. They also have no cost. And, they help provide you with food sovereignty. You have ownership of these varieties. This is important, because without food sovereignty, there is no food security.

Native seeds are the legacy left to us by our ancestors. Indigenous producers and farmers have improved our seeds from generation to generation for thousands of years, at the family level and at the community level, adapting them to the areas where they live. The use of these seeds helps guarantee a harvest because they are adapted to local conditions. The seeds you harvest are adapted to the unique environment of your farm.

To obtain good seed, first select the best plants: the strongest, most pest and diseases resistant, drought and flood resistant, the most productive, with the best flavor, color and size. Select for whatever traits are the most important to you.

Dry seeds like maize, beans and peppers are the easiest to process: just dry them completely in the shade and store in plastic bottles.

Wet seeds like the tomato and the cucumber need to ferment: they are left with pulp in a bowl with water for 3 to 5 days in a warm shaded place and stirred each day. When white mold forms on the surface and the pulp is dissolved they are rinsed until clean. They are then left to dry in the shade and then stored in plastic bottles.



Pre-germination of Seeds

Pre-germination of seeds insures the vitality of every seed that is planted. To pre-germinate, the seeds are put in a jar of water for 8 to 12 hours. Remove the water and leave the jar covered with a cloth. The seed is rinsed 3 or 4 times a day, until they germinate.

The germinated seed can be transplanted directly in the field just as you would plant the dry seed, only taking care not to damage the roots. Or, plant them in paper pots for later transplanting. Be sure to protect the pots from rain.



Visual Selection

To select the best plants and thus achieve the best maize seed for the next cycle, the first thing you have to do is decide the criteria for choosing plants.

It is best to select seeds from plants that:

- 🌽 Grow and develop quickly
- 🌽 Have strong stems
- 🌽 Are resistant to the insect pests
- 🌽 Are resistant to major diseases
- 🌽 Are resistant to drought
- 🌽 Have no less than two ears;
- 🌽 Have large ears;
- 🌽 Bloom at the same time;
- 🌽 Mature early and all at the same time;
- 🌽 Any other feature that interests the producer.

The process is begun by putting stakes next to all the plants which germinated rapidly. (As in the photo below, but not in a mono-culture). Thereafter, daily walks through the plot are made to observe the development of the plants; removing stakes of each plant that does not comply with the Criteria: those that have weak stems; the most affected by insects and diseases, drought or floods; having only one ear, or that have small ears, etc.

The only plants from which you will harvest seed will be those that still have stakes at the time of harvest. These should be the first harvested (for maize it is preferable to harvest cobs of not less than 200 plants). The rest of the harvest will be for family consumption and for the market.

The visual selection is a good strategy for saving seed to ensure productivity and adaptation to local conditions. The family will own their own varieties, thus ensuring food sovereignty and security.



Seed Storage

It is important to manage and conserve seeds produced on the farm to keep them in good condition for the next harvest.

The most practical and effective way to store seeds is in tightly closed plastic bottles; to protect them from air, moisture and insects. For the best insect protection, put neem leaves in the bottles before closing them, and then place them in a cool shaded location.













9. Control of Pests and Diseases

The first priority for the control of diseases and pests, is to grow healthy plants with healthy immune systems. Insuring adequate soil moisture, providing a cool moist root zone and maintaining diversity are all important to a healthy immune system. The control of pests also helps to control diseases. Most diseases are transmitted by insects when they feed.

For that reason, it is advisable to:

-  Improve the soil, capture all of the rain and provide nutrients for microorganisms through the application of mulch.
-  Keep the ground covered with mulch to avoid rain from splashing fungal spores from the soil onto the plants.
-  Diversify crops to confuse and repel insect pests.
-  Do not work with plants when they are wet to prevent the transmission of diseases from one plant to another.
-  Do not let smokers into the field. They are contaminated with a virus that kills tomatoes, peppers and chilies.
-  Allow chickens and ducks to eat insects in the field.
-  Build small wooden or cardboard boxes covered with plastic and hang them in trees so that wasps build their nests in them. The wasps lay their eggs in the larvae of insect pests.
-  It is important to keep field tools clean to prevent the transmission of diseases from one plant to another; especially if those tools have been used on infected plants.

Control of some Principal Pests

Aphids

Garlic and onions repel aphids. Zinia flowers attract hummingbirds, which feed on aphids and other soft-bodied insects.



Armyworm

Armyworm can be controlled by wasp larvae, ducks and by manual harvesting.



Asparagus Beetle

Chickens and ducks eat these beetles; They can also be controlled using neem and by hand picking.



Cabbage Root Worm

They live in the soil, so, they are controlled by rotating crops so that there are no plants of the cabbage family growing in the same section for three years.



Inch Worm

Inch worms can be controlled by wasp larvae. They are repelled by dill, carrot and Mint that are inter-planted with cabbage, mustard, collard, broccoli and cauliflower.



Carrot Root Fly

Carrot root fly is repelled by plants of the cabbage family and by onions.



Potato Beetle

Chickens and ducks eat them. They can be controlled with neem or by manual harvesting.



Maize Earworm

They are controlled by applying mineral oil to the silks when they form.



Cucumber Beetle

Repel them with onion and neem. Control with sticky yellow traps, ducks or by manual harvesting.



Cutworm

Set out well established plants and, place a ring of plastic or thick paper around the stem.



Flea Beetle

They can be controlled by spraying water with liquid soap or neem spray.



Grasshopper

Grasshoppers are easily controlled by the chickens and ducks.



Red Spider Mite

Control them by spraying an infusion of neem leaves.



Japanese Beetle

Ducks and chickens eat the beetles and the larvae.



Bean Beetles

Control them with chickens or ducks, with an infusion of neem or by hand picking.



Nematodes

They are controlled by planting marigold every meter on both sides of the beds.



Onion Fly

Onion fly larvae are controlled by crop rotation because they go into the soil to pupate.



Snails and slugs

They are controlled with beer left in bottle tops on the ground. They enter and drown. Or let them accumulate under banana stem sections and sprinkle with salt.



Vine borers

Locate the bug and remove it by cutting open the stem. Then, cover the stem with soil.



Stink Bugs

Hand pick adult beetles, destroy their green eggs on the underside of leaves and plant marigold and sun flower to attract the predators that eat them.





Tomato Horned Worm

The tomato horned worm is controlled by manual collection.



White Fly

White fly is repelled by Basil. Control it by spraying an infusion of neem seed oil or neem leaves.



Control of some Major Diseases



Anthracnose

To control anthracnose, rotate crops and remove infected plants. Do not touch healthy plants with infected hands, tools or clothing.



Blight

Mulch and crop rotation help control blight. Spray plants with a gallon of water with 2 Tablespoons of baking soda and neem. Do not touch healthy plants with infected hands, tools or clothing.



Rust

Mulch and crop rotation help control blight. Spray plants with a gallon of water with 2 Tablespoons of baking soda and neem. Do not touch healthy plants with infected hands, tools or clothing.



Damping Off

This disease can be controlled in the nursery by using high organic matter soil from the beds to start the plants, by controlling humidity and by ensuring a good flow of air.



Smut

Smut disease is controlled by burning infected ears before they open.



Mold

Mulch and crop rotation help control blight. Spray plants with a gallon of water with 2 Tablespoons of baking soda and neem.



Viruses

Viruses are controlled by controlling sucking insects and by burning infected plant material.



Citrus Greening

It is necessary to control sucking beetles and to burn infected plant material. The application of a gallon of water with 2 Tablespoons of baking soda to plants may prevent its spread.





How to Make a Good Spray to use against Pests

To make a good infusion against pests the ideal is to use a mixture of chili, nim, garlic, marigold, castor bean, tobacco and lemongrass.










If some of the ingredients are not available, a part of them can be used. The infusion is prepared by boiling the ingredients in water. Mix one part of the infusion with two parts water and spray all surfaces; both over and under leaves.

This is done late in the afternoon or in the evening so that you do not harm bees. Prevent the infusion from penetrating the mulch, since it could harm beneficial organisms.
















10. Establishing the System

-  Determine what foods the family wants to eat and design the five meter sections to fit them in to the beds. Make changes on the ground during the dry season so that is ready when the rains start.
-  Think about what medicinal plants, fiber plants, bamboo, etc. Should be included in the system.
-  Decide what fruit trees will be planted in the beds as windbreaks.
-  It is easier to do the work when done as a group. Five families can work one day on each families land during five days.
-  Save all organic matter that is cut from any area to use as mulch.
-  After the bed is built infect it with organisms with a bit of soil which is from where organic matter is decomposing. With a few handfuls of that material beneficial microorganisms will begin growing in the soil. They will help prevent diseases and pests in the soil.
-  If there are no earthworms, they can be introduced under the mulch. Earthworms will loosen the soil. Their tunnels facilitate the movement of air and water. They also transform organic matter into fertilizer.
-  Cover the bed immediately after building it with organic matter to protect it from rain, wind and Sun. This mulch provides the energy and nutrients to plants and soil microorganisms.
-  Pre-Germinate seeds and plant in paper pots or directly in the ground according to the type of seed. Sow the raised beds with a diverse mixture of crops.



11. Final recommendations

-  Always plant on raised beds.
-  Leave small dams or dikes in the channels between beds to prevent erosion and to catch all the rainwater that falls.
-  Never walk on the raised beds.
-  If you want to have production in the dry season, water the beds at least once a week to keep them moist.
-  Except for harvesting, never open the ground after building beds, tillage kills organisms that contribute to the plants.
-  Beds should never have empty areas, even in the dry season.
-  Do not use all the seeds: always save enough seed for replanting if losses occur in the first plants. The extras are a guarantee of food security.
-  Pre-germinate seeds. This reduces the risk of lost production and uses less seed.
-  Diversify the plot as much as possible, with fruit trees, medicinal plants, herbs, shrubs, vegetables, roots, tubers and any plant you need or want.
-  Do not burn organic matter or make compost: Weeds and crop residues are the real wealth of the farm.
-  This system will produce good harvests in both wet and dry years. But, if it is not applied in an integral manner, it will not be sustainable. It is vitally important that you not try to mix this system with other agricultural methods.

12. Final Comments



Most food is produced by small farmers: they are the ones who are feeding a growing population.

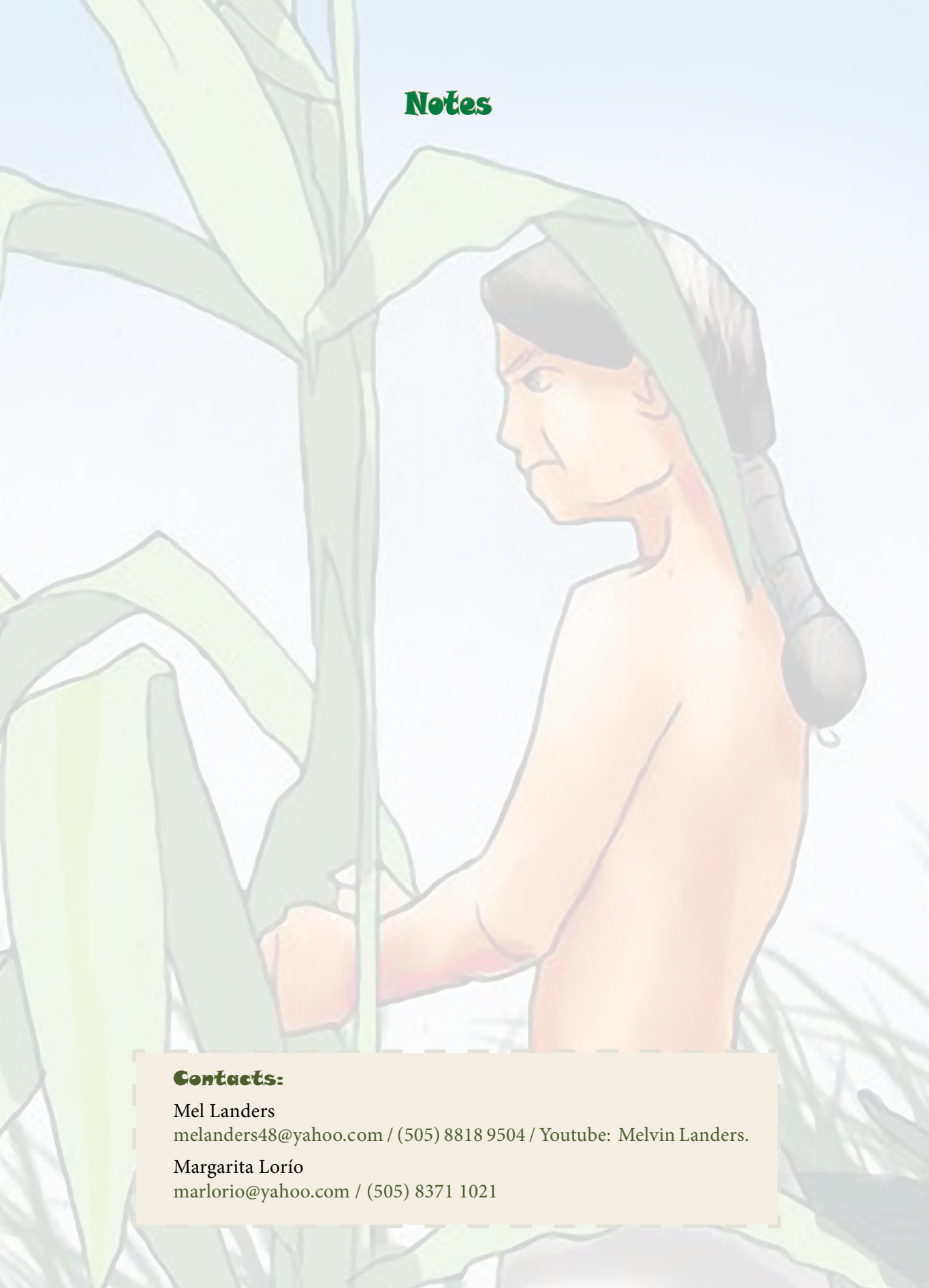
The main challenges facing food production today are extreme weather events: drought and floods. Indigenous systems were developed and used over thousands of years of evolving climatic conditions. It was continually adapted to produce food during extreme conditions.

This form of Agriculture makes food production resistant to climate extremes, increases productivity, produces healthy food and accomplishes this in a sustainable, and environmentally friendly manner.

In the event of flooding, the beds hold roots up in well oxygenated soil. During droughts, the beds retain moisture, which allows the plants and trees to absorb the little water that falls as rain. This also contributes to the continual recharge of waterways.

Finally, we want to say that it is our desire that the information shared in this manual is useful for the production of abundant food in all weather conditions by the people who are affected the most by the erratic weather that has been caused by the quickly deteriorating climate system on the earth. We have hope that this information will enable them to survive and thrive in these difficult times.

Notes



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