CHAPTER 30

FARMING AND GARDENING

30. 1. TRADITIONAL FAMILY AGRICULTURAL FARMS

30. 1. 1. Introduction

According to Spanish records, at the time of western contact, our original Chamorro ancestors were "the most skilled fishermen ever to have been discovered". This tradition was sadly lost during the Spanish times as a direct result of the then Catholic mission's 'reduccion policy' (See Chapter 2).

The relatively few Chamorros who survived this tragic cultural devastation transformed into an agricultural people. Removed to Guam and forced to adopt the Spanish patrilineal, instead of their cultural matrilineal inheritance tradition, each surviving family farmed a plot of land. They learned to raise cattle, pigs, goats, and chickens and they grew their traditional *subsistence* crops. Corn became an important commercial crop (mostly for debt payments), as did other western-introduced (especially tobacco) and some more traditionally-grown crops.

Our original Carolinian ancestors likewise were primarily a fishing people and have, for the most part, culturally remained so. Traditional subsistence crops are likewise grown, these on matrilineally inherited family clan lands.

The soils of our Northern Mariana Islands are well suited for subsistence and some commercial crop production. The Germans instituted our first true export-oriented commercial farming early in the early 1900's. They oversaw the establishing of coconut plantations, and saw to the production of *copra* as an export.

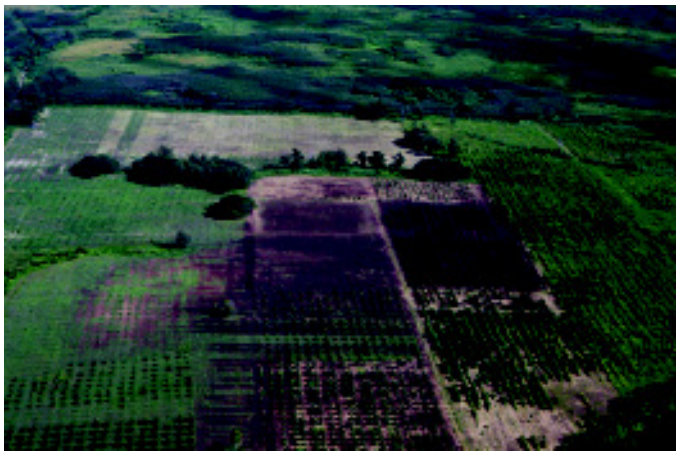
Later, the Japanese, Okinawans, and Koreans transformed Saipan, Tinian, Aguiguan, and Rota into vast *sugar plantations*. More than 12,000 hectares of land were in cane in 1938. They also grew rice on the wetland soils of the Susupe Lake marsh complex on Saipan. (Interestingly rice was also grown by the precontact Chamorros, the only Micronesians known to have done so.)

Today copra is no longer exported. Sugarcane is now grown only for specialty crop purposes and subsistence use. In truth — at the time of this book's writing — our past cultural traditions of fishing and farming are both rapidly disappearing. Modern fishing busi-

After the Spanish conquest, the Chamorros were transformed into an agricultural people. Here, workers use the fasiño to clear weeds.

nesses now depend greatly on foreign business capital and cheap labor to both exploit our fisheries and to remain competitive in our local profit-oriented markets. Many of our farms are likewise tended by people from other lands.

Yet, despite our changing markets and our changing cultural and societal ties, our lands remain here, relatively unchanged. Each of our acres on each of our islands is, for the most part, in exactly the same place it was centuries, in fact milleniums earlier. It was here before the Spanish, here before even our first Chamorro ancestors arrived.



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Each hectare of our islands is our inheritance, not from our forefathers, not from our matrilineal or patrilineal lineages, but from nature itself. The condition of these hectares, which we jointly inherit, is what we will leave to our children.

In our historic past these lands have shown themselves to be capable of being most productive if they are well cared for. Without care, their potential life-supporting soil washes away. What will we choose to do with this land of ours? What condition will our land tracts be in when we are no longer here?

This chapter explores the wonderful human experience of **agriculture** (sometimes called *'farming'*). It is also our invitation to you to experience growing your own food. Establish a school farm or a school garden and establish one at home as well. Involve your family and other students and other teachers. How, you might ask?

30. 1. 2. Establishing a New Farm

The old way of building a new farm or garden area started with clearing the land, usually dense undergrowth. Often it was done by the slow process of the *slash and burn technique*. Trees and shrubs were cut with a machete. Piles of debris were formed, and the dried material was later burned to rid the land of refuse and to fertilize the soil with ashes. Recall our chapter 26 reference to this as burning one's pen to roast one's pig.

The useful coconut tree is spared the machete's blade during slash-and-burn farming.

A preferred alternative to this slashing and burning is to compost the undergrowth. This takes more time, as all the cut vegetation must be collected into weekly cared-for compost piles. We will discuss these shortly.

30. 1. 3. Planting

If any wild trees of value are found on the property, these are spared the machete's blade. Such useful trees may be breadfruit, mangoes, coconut, lemon, and guava.

After the land is cleared, the farmer often plants banana shoots, taro shoots, tapioca, yam tubers and sweet potato leaf tips. Seeds of various vegetables and spices that grow in our *limestone or volcanic* are also planted. The most commonly grown plants are beans, watermelon, pumpkins, okra, bell pepper, and eggplant.

The seeds and shoots needed to start a ranch garden are often obtained from neighbors. A person wishing to start a garden might spend a day visiting the ranches of various friends and relatives. He or she collects desired plant specimens to plant in the garden.

After the garden is flourishing, the rancher can easily multiply plants by splitting tuberous roots and drying part of this yield for seed. Hybrid seeds from seed suppliers are also now readily purchased.

Most farms have a small sleeping hut and an outside cooking area. There is seldom electricity or water. Therefore, cooking takes place over open wood fires. Rainwater is collected in barrels. Water is plentiful during the rainy season.

The food produced on most farms is for family consumption. A growing market exists for locally grown products at the various hotels and restaurants.

30. 2. HECTARAGE IN CROPS

Tinian has the most extensive hectarage of commercial farms in the CNMI. More than 100 hectares are in small family farms, and about 60 hectares are in corporate farms. About 20 hectares are in subsistence farms.

About 80 hectares of land on Saipan are farmed commercially, and about 25 hectares are in subsistence farms.

On Rota there are about 40 hectares of commercial farms and 20 hectares in subsistence farms. So at the time of this book's writing the total amount of land in crop production on our three main islands is about 345 hectares.

30. 3. LOCAL ENVIRONMENTAL CONSTRAINTS ON FARMING

30. 3. 1. Crop Water Availability

The available water capacity of certain soils limits their use during the dry season. Thus, these soils require irrigation in the dry months.

For most vegetable crops **drip irrigation** is the most appropriate system to use. Even with our area's usual lower water pressures, drip irrigation allows for the light, frequent waterings necessary on drier soils and for younger crops.

Unlike sprinkler systems, drip irrigation is unaffected by the strong dry season trade winds and they will not damage crops by placing water on the leaves, flowers and fruit.

There are several common management problems with drip systems. Low quality water can clog emitters. During the dry season, rats often chew through the tubes in search of water. Therefore, rat control is necessary.

Do not overwater. For most plants, over-watering chokes plant root cells from their soil oxygen supply. Certain crops, however, have adapted to water saturation. Examples includes wetland taro and kangkun.

During the rainy season, vegetable production drops dramatically. For many crops, the frequent rains interfere with *fruit set* and increase susceptibility of the plants to disease.

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30. 3. 2. Hazards of Winds and Storms

Trade winds greatly increase the water demands of crops. Field windbreaks can reduce the amount of irrigation water needed for crops and reduce the physical damage to the plants.

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However, the hazard of tropical storm and typhoon damage is difficult, if not impossible to overcome. Windbreaks planted to control trade winds are not effective against our more powerful storms.

Farmers can protect themselves against complete loss, however, by growing typhoon-resistant crops such as taro and onion. Farmers should stagger the dates for planting, to produce continuously and consistently. A single typhoon event would then lower yearly income but not destroy it.

Farmers can sometime receive typhoon-related crop damage assistance from Federal Emergency Management Agency (FEMA), the USDA, and other agencies under certain circumstances. It is important to keep good farm records and comply with program requirements,,, just in case.

30. 3. 3. Soil Erosion and Fertility

Erosion can seriously reduce the productivity of soils. The potential for erosion relates to various factors, including the surface cover and the steepness of the land slope. One of the simplest and most effective erosion control practices is **cross-slope farming**. (See chapter 26.)

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The *native fertility* in the soils of our Northern Marianas is not adequate for sustained high yields of commercial or subsistence crops. Additional fertilizer is necessary.

Fertilizing is, however, usually not necessary for certain subsistence trees such as coconut and breadfruit. For most crop plants however, continuous harvest, without some form of fertilization, leads to declining crop yields.

A soil's organic matter content is an important source of nutrients, as well as providing a high nutrient-holding capacity. Good management practices replenish the soil's organic matter.

One method is to allow the field to lie **fallow**. Then it can grow back, with grasses and **forbs** (broad-leaved weeds). The farmer then disks these plants into the soil. A cover crop can be grown for the same purpose. One advantage of a cover crop over leaving a field untilled is that it produces no weed seeds. Another advantage, if a *legume* is the cover crop, is that it can add additional nitrogen to the soil.

Besides maintaining organic matter content, most commercial farming operations use commercial inorganic fertilizer. Generally, farmers use a balanced fertilizer with nitrogen, phosphorous, and potassium.

Nitrogen fertilizer quickly leaches out of the soil. Farmers must apply it several times during the growing period. Animal manure is a traditional fertilizer, and it can be effective if properly managed. Manure also adds organic matter to soils.

Subsistence farmers generally do not use commercial fertilizer, pesticides, or much machinery. Weeds, crop residue, slash from surrounding vegetation, and animal manure are mixed into *compost* and used as fertilizer.

Mulching is also important on a subsistence plot. Mulch conserves moisture, helps to control erosion in sloping areas, and prevents the soil from becoming exceedingly hot and dry. As the mulch decomposes, it adds nutrients to the soil. Slash from tangantangan is a good source of nitrogen if used in this manner. Tangantangan, however, inhibits seed germination. Thus, farmers should only use it around established plants.

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30. 3. 4. Some Advice for Getting Help

Assistance for both subsistence and commercial farmers is available from the local office of the USDA Natural Resource Conservation Service. This office can help with *farm planning, irrigation design*, *erosion control*, and other practices that help farmers make the best use of their land.

Assistance involving crop production practices is also available from the Natural Resource Conservation Service, and from Extension Services of the Division of Plant Industries (DLNR) and Northern Marianas College's Cooperative Research, Education and Extension Service (CREES). They can suggest what *varieties and amounts* of plants, *fertilizers*, and *pest and disease control techniques* to select.

30. 4. STARTING GARDENS: SEEDS AND SEEDBEDS

30. 4. 1. Introduction

With the use of *seed flats* and small plant containers, gardeners can provide themselves with many advantages. One of these is having a sure supply of plants when they need them. This is a cheaper way than buying seedlings and it helps to build an interest in one's garden and its preparation.

It is not necessary to start all plants in seed flats. Cucumbers, melons, pumpkins, squash, beans and similar fast-growing plants generally suffer a setback from transplanting.

However, with careful soil preparation, even seeds of these plants can be sown directly into individual small cans, which will confine the root system as it develops. When ready for the field, remove the containers carefully, so as not to break up the *soilroot unit*.

In this way the plants have the size and root system development needed to get them off to a good start in the ground.

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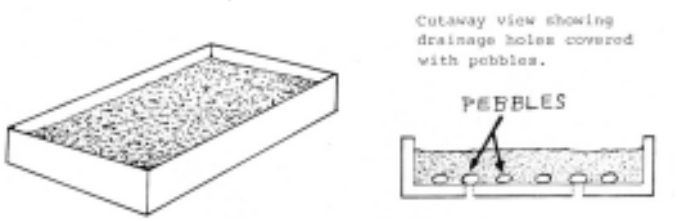
30. 4. 2. Getting Started

For the successful germination of any seed, farmers need to consider proper environmental factors, such as *temperature (1), moisture (2), carbon dioxide (3),* and *oxygen (4).*

Even though the temperature is ideal and moisture perfect, if the oxygen supply is too low or carbon dioxide is too great, poor germination will follow. For best results, these four factors must be at their best.

Desirable soil is one that will easily crumble when dry, and will not form a crust over the seeds. If a crust forms, the seedling may not be able to reach the surface.



Flats are shallow wooden boxes that are 5-10 centimeters deep, and of a size that is easy to handle, such as 45-60 centimeters. This size allows for easy movement into and out of the sunlight and for carrying into the field for planting.

Farmers must not overlook a fifth factor, *viability (5)*. This means the ability of a seed to live. Samples from most seed batches must be officially tested for viability before the seeds are marketed commercially. Check the dates and remember to only use "this year's" seeds. Soaking seeds in fresh water for two hours prior to planting helps germination and can also be used as a quick test for seed viability. Seeds that still float after two hours of soaking are most likely dead and should be discarded.

30. 4. 3. Soil Preparation

The best soil for seed-flat planting is one developed ahead of time from a *compost pile*. Compost material combined with sand makes an excellent soil.

If compost is not available, a good rich *loam soil* mixed with sand is an easily available soil mix. Consider the following points carefully, for best results.

- A desirable soil is one that will easily *crumble* when dry, and will not form a *crust* over the seeds.
- If a crust forms, the seedling may not be able to reach the surface.
- Soil must have enough well-decomposed *organic matter* so that it does not dry out too fast.
- The soil must be *fine* enough to make close contact with seeds and moisture, yet provide them with good aeration.

Never add plant food or fertilizers directly to the soil in these flats before sowing the seeds. A *too-fertile* soil may make the stem grow too fast for the roots.

30. 4. 4. Soil Disinfection

Do not plant clean, disease-free seed in soil that may contain disease organisms. The only sure way to have disease and insect free soil is to *disinfect* it.

There are many methods of disinfecting soil. Among them are steam, hot ovens (on a small scale), and electric soil heaters. Commercially prepared *fumigants* are also available. Information on these methods is obtainable through the CREES program, Northern Marianas College.

30. 4. 5. Seed Flats

Flats are shallow wooden boxes that are 5-10 centimeters deep, and of a size that is easy to handle, such as 45-60 centimeters. This size allows for easy movement into and out of the sunlight and for carrying into the field for planting.

We can avoid possible damage to young roots by reducing the time between removal from the flat and planting.

After washing the flats, it is always a good practice to disinfect them with *Clorox* bleach (1 part to 5 parts water) or boiling water before re-use.

30. 4. 6. Filling the Flats

Cover the bottom portion of the flat with *coarse materials* such as pebbles, to provide drainage. Place the soil mixture on top of this, to about 1 centimeter from the top. Press down the soil firmly with a small block of wood.

This slows the drying of the soil. This also provides good soil particle contact for easy upward movement of moisture. Then sift enough fine soil through 0.5 centimeters wire mesh screen to fill the flat. Level and re-firm the soil, and the flat is ready for sowing of seeds.

Sow the seeds thinly, as a heavy seeding will produce spindly, weak plants that are difficult to transplant.

30. 4. 7. Sowing the Seeds

After filling and firming the soil in the flats, mark out rows for seeds using a thin strip of board held edgewise. A ruler works well.

Sow the seeds *thinly*, as a heavy seeding will produce spindly, weak plants that are difficult to transplant. Mark all rows carefully and plant only varieties of seeds with similar germination times in the same flat. (These times appear on the packages.)

Plant small seeds about 0.5 centimeters deep. Plant larger seeds slightly deeper. Soil used to cover the seeds should be of the same material used for the top of the flat. Seeds sprout best in darkness, and newspaper placed over the flat will provide this. Remove this paper, however, when the seedlings break through the surface of the soil. Water the flats soon after seeding. (Be sure to remove the newspaper first and afterwards, replace it.) The most uniform way to water a flat is to place it in a container large enough to allow it to sit in 2-3 centimeters of water.

The moisture will move up by **capillary action** (creeping bit by bit through the soil) pretty quickly up to the surface and around the seeds. When this happens, take the flat out of the water and allow it to drain.

30. 4. 8. Transplanting

Plants started in seed flats are usually *transplanted* into pots at least one or more times. Such plants as tomatoes may be transplanted several times between the seed-flat stage and actual *field setting*.

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With practice, transplanting becomes quite simple and quick. Generally, set seedlings a little bit deeper than where they grew in the previous container. For tomatoes, eggplants, peppers and similar plants, small biodegradable (decomposable) containers such as paper cups and milk cartons, etc., can be used with one plant to each.

For best results, cut holes or completely remove the bottom of the container before placing it in the ground. The major advantage of such containers is that farmers can place them directly in the ground with the seedlings in them; thus the roots remain undisturbed.

Make the first transplanting when the first *true leaves* are fairly well-developed. Watering the plants after transplanting them helps to settle the soil around the roots. After transplanting small seed-

lings or tender plants, shade them for a few days. Do this by placing a framework of palm fronds over the plant during the hottest time of the day.

30. 4. 9. Hardening Plants

When plants reach the age and size for field transplanting, it is usually a good practice to **harden off** the plants to help them adjust to the heat, wind, and drying out field conditions. Generally, a well-hardened plant is darker green than a non-hardened one.

The easiest and most successful way to cause hardening is to *withhold water*. In other words, keep the plant drier than usual for several days before transplanting.

Hardened, well-watered plants will do better when set out in the field.

30. 4. 10. Field Planting

The plant flats should be well-watered before being taken out to set in the field or garden. Do this watering the day before setting, so that all excess water has had time to drain away. This allows reasonably firm but moist soil to remain around the roots.

To establish new transplants with a minimum of setback, practice the following steps:

- Dig a hole deep enough and wide enough so that the plant has plenty of room.
- Fill in with some of the topsoil around the roots and firm carefully and lightly to remove air pockets.
- Use a bit of water (a cup to several cups) after placing the plant, but before closing the hole. This is to puddle the soil about the roots for better soil-root contact and to remove any air pockets. Sometimes commercial starting solutions are used instead of plain water.
- Close the hole completely, again using some of the better topsoil. Except for woody plants, do not prune plant parts when transplanting. Pruning the leaves will remove the plant parts used to manufacture carbohydrates necessary for growth. Root pruning is even less desirable because transplanting generally causes some root damage, even under the most careful conditions.

Transplanting helps ensure a strong stem and root for successful crop production.

30. 4. 11. Transplanting Advantages

Successful crop production requires carefully grown, healthy plants. A young plant should have a strong stem and root and be free of disease.

The use of seed flats and transplant containers such as cartons, cans, and cups gives a grower the following advantages:

- More time in which to prepare the soil for field planting.
- Protection against snails and insect diseases while plants are in the seedling stage.
- Easier weed control.

•The chance to grow other crops while future transplants are growing in the flats.

•A saving on costly seed, because the excess or thinned plants can be saved and become healthy transplants.

•Provides the grower with plants of the variety he wishes and at the time he wants them.

•Easy removal of weak or sickly plants without loss of field space.

•Easier and cheaper watering.

•Easier protection from bad weather.

•Plants can be started well before the field soil is ready. In this way the grower gets a running start on the early, usually high-priced market.

•The expense of insect and disease protection is less than in the field. The dust and sprays are concentrated directly on the plants themselves so there is very little waste.

30. 5. ON COMPOSTING

30. 5. 1. Compost for Gardens

Compost refers to a decomposed mixture of plant materials with animal manure or commercial fertilizers and moisture. This mixture is usable as plant food to improve rooting, and generally to increase the growth of plants.

Any combination of vegetation such as grass, wood, small branches, leaves, paper, or straw is recommended. Animal or poultry manure, or commercial fertilizers may be added to this. Properly handled, even the family vegetable scraps are usable in a compost pile.

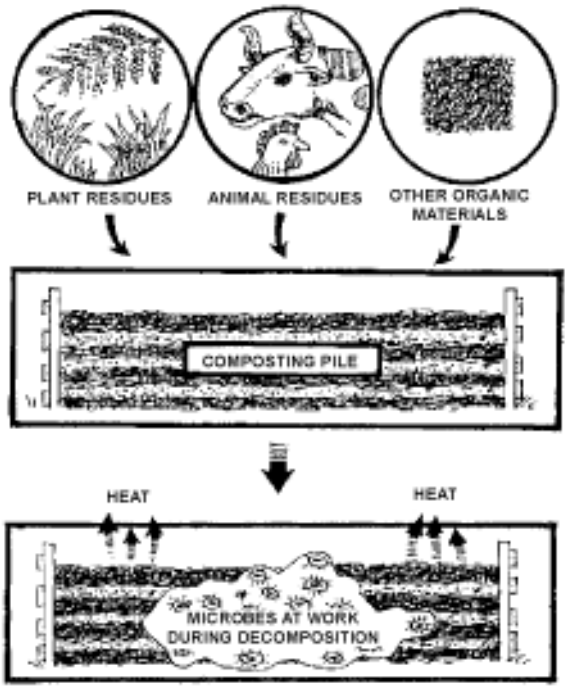
Compost made from plant and animal waste material also contains the minor elements used by plants. Decomposed plant materials contain at least a small amount of each element necessary for plant growth. Further additions of complete fertilizers will help in the production of better plants than is possible without them.

Many people try to judge the richness of soil by its color. This is not a good method because of the many variables involved. Rich soil should be loose, high in organic matter, and easy to cultivate.

It should also have good depth and contain the necessary nutrients for maximum plant growth. Compost that's properly made can do much to make a poor or ordinary soil into a good fertile soil. Soil is generally dead without *humus*, which is exactly what makes up a compost pile.

30. 5. 2. How to Make a Compost Pile

There is no exact way to make a good compost pile. Much depends upon the materials used, their quantities, and their processing: One method is described below.



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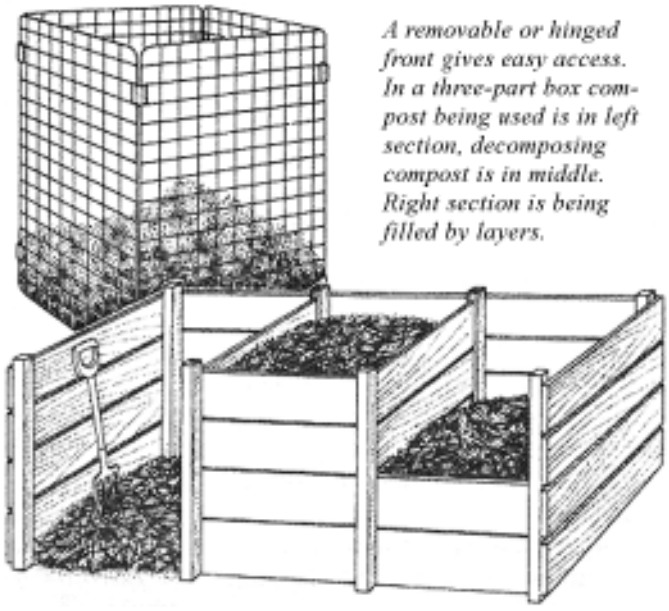
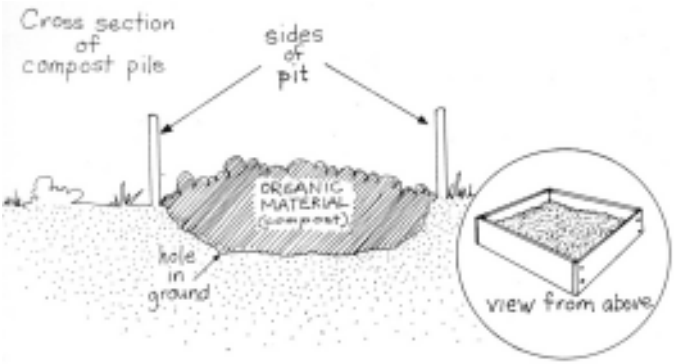


A removable or hinged front gives easy access. In a three-part box compost being used is in left section, decomposing compost is in middle. Right section is being filled by layers.

Two types of composting systems, box...



...and pit type.

Dig a shallow hole 25 - 35 centimeters deep and about 2 meters square. For the sides, construct a small pen or framework. Used corrugated metal roofing, wood planks, boards, or even soil will do.

Throw into this area all types of vegetation and animal wastes.

Add the materials in layers, spread evenly about 20 centimeters deep. The center of the pile should be low, to catch and hold all available moisture. This moisture is very necessary.

Turn the pile weekly, adding fresh materials.

Water the compost pile as often as you water the garden.

30. 5. 3. A Scientific Method Example used by George Washington

In George Washington's time, garbage was not the problem it is today. There were fewer people. People did not use paper as widely as we do today. Food did not come in cans.

People reused cans and bottles, instead of throwing them into the trash. Plastic did not exist. Much more space was available where things could be thrown away and left to rot. But, more than that, people lived differently then. Their way of life is described by this New England adage:

"Eat it up. Wear it out. Make it do or do without."

And so, those early Americans made compost, usually with animal manure and some other kinds of organic matter, mostly for agricultural use. The end product was applied to the soil in an effort to increase crop yields.

Before becoming a general, and later the first president of the United States, George Washington was a farmer. He experimented with composting. If he were alive today, he would be an **organic farmer**, and a staunch advocate of composting! Washington returned to farming after his public service days, much to his lowered stress level satisfaction.

One thing that interested him was how to build up and conserve the fertility of the soil. This is clearly revealed in the book, *George Washington, Farmer*, written by Paul L. Haworth in 1915.

After the Revolutionary War ended, one of Washington's main concerns was the restoration of the land on his plantation. For this purpose, he wanted to hire a farm manager, but one with very special qualifications. Washington wrote that the kind of man he was looking for had to be:

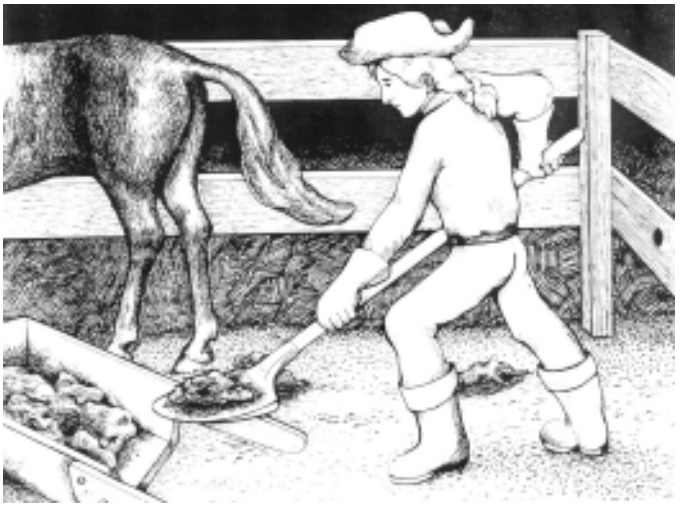
> "...above all, like Midas, one who can convert everything he touches into manure, as the first transmutation toward gold; in a word, one who can bring worn-out and gullied lands into good tilth in the shortest time."

According to Haworth, Washington "saved manure as if it were already so much gold, and hoped with its use and with judicious rotation of crops to accomplish" exactly this.

In 1794, Washington himself wrote that, "Unless some such practice as this prevails, my fields will be growing worse and worse every year, until the crops will not defray the expense of the culture of them."

Thirty-four years earlier, Washington documented his concern with composting in a diary entry for April 14, 1760. This entry reveals an experiment that he conducted. Here is his report:

> Mixed my compost in a box with the apartments in the following manner, viz.
> No. 1 is three pecks of earth brought from below the hill out of the 45-acre field without any mixture.
> No. 2 is two pecks of sand earth and one of river sand.
> 3 has two pecks of sand earth and one of river sand.
> 4 has a peck of horse dung.
> 5 has mud taken out of the creek.
> 6 has cow dung.
> 7 has marle from the gulleys on the hillside, which seemed to be purer than the other.
> 8 sheep dung.
> 9 black mould from the gulleys on the hillside, which seemed to be purer than the other.
> 10 clay got just below the garden.
> All mixed with the same quantity and sort of earth in the most effective manner by reducing the whole to a tolerable degree of fineness and rubbing them well together on a cloth. In each of these divisions were planted three grains of wheat, 3 of oats, and as many of barley, all of equal distances in rows and of equal depth done by a machine made for the purpose. The wheat rows are next the numbered side, the oats in the middle, and the barley on the side next the upper part of the garden. Two or three hours after sowing in this manner, and about an hour before sunset I watered them all equally alike with water that had been standing in a tub about two hours exposed to the sun.



George Washington got his start as a farmer and was a staunch advocate of composting.

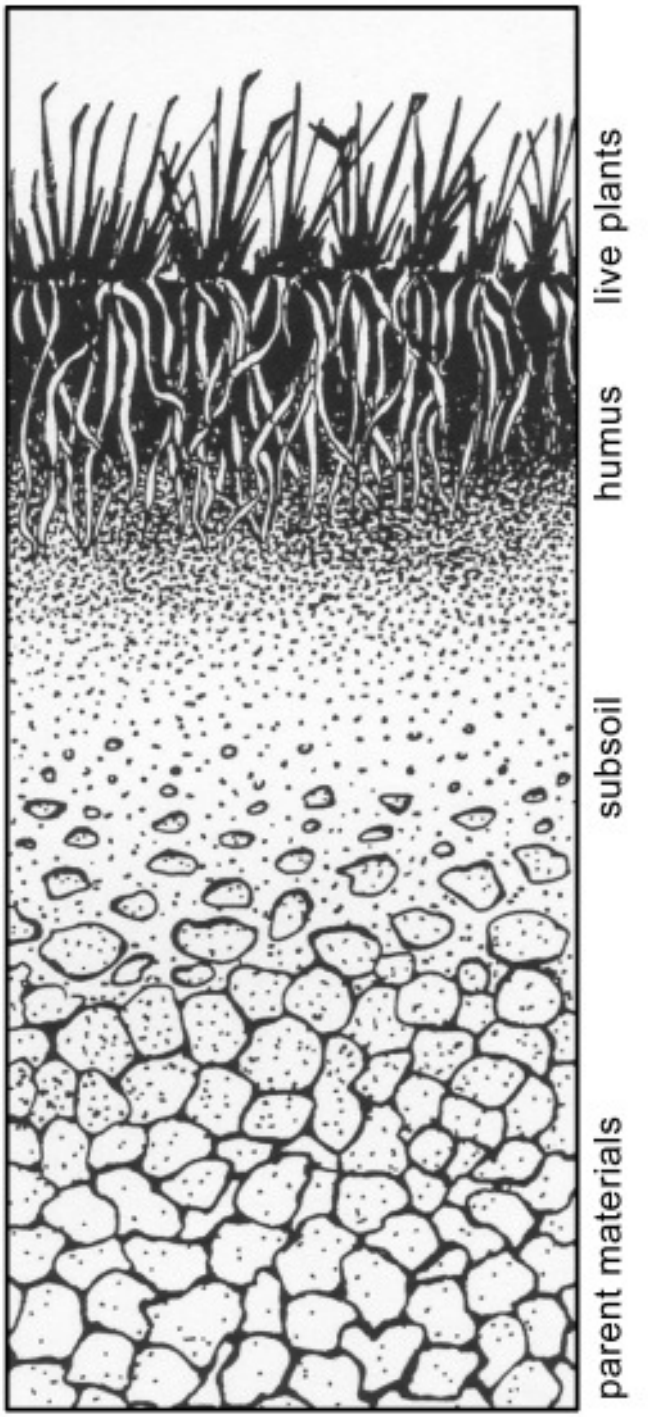
Washington kept this experiment going for three weeks. He then concluded that Nos. 8 and 9 gave the best results.

30. 6. GIVING IT A TRY AT SCHOOL OR HOME

30. 6. 1. Selecting a Good Garden Location

If your house owner or school principal chooses a site for a garden, the following criteria are recommended for selection:

> Near the house or school for easy access and protection.
> Close to a source of water.



Soils are composed of several layers, each of which has a specific role in plant productivity.

Away from large trees, shrubs, and hedges. The roots of these plants would deprive your garden plants of water and nutrients.
Well-protected from strong winds.
Has a good amount of soil that is high in organic matter and plant food necessary for growth.

30. 6. 2. Some Aspects of Our Soils

Our Commonwealth's soils have the same basic elements contained in soil elsewhere. However, the proportions of **nitrogen** (**N**), **phosphorus** (**P**), and **potassium** (**K**), vary from place to place. By experimentation and chemical analysis of soils, we can note the differences.

Small particles of rock or mineral matter — called sand, silt, and clay, according to size— make up the physical part of soil. Through *decomposition*, roots, leaves, and stems add to the decomposed organic part of the soil. Animals such as insects, birds, and countless others die within the soil or on its surface. The total of these decaying remains is part of the soil and is called **humus**.

Soil formation continues as rocks break down via weathering. Larger rocks break down to pebbles; pebbles to gravel; gravel to soil forming sand, silt, and clay. Such agents as wind, water, heating and cooling, chemical action and the action of animals and plants are responsible for this breakdown. Finally soils are rich with a living organic element of soil organisms.

30. 6. 3. Soil Types

There are three main types of soil that vary in composition and texture depending upon the size of the rock particles:

Soils containing hard, coarse particles are called **sandy soils**.
Soils composed of much finer particles are **clay soils**.
Soils having a mixture of sand and clay are **loam soils**.

If the soil mixture is mostly clay, it is said to be **clayey loam**. If the mixture is mostly fine sand, it is **sandy loam**.

Large amounts of humus in loamy soils enable plants to obtain minerals. Humus is present in the top layer of the soil, and is usually dark-colored. Below the topsoil is the *subsoil*. It is lighter-colored because it has been undisturbed by cultivation.

Beneath the subsoil are the *parent materials*, which break up into smaller and smaller pieces and eventually become soil. When preparing soil for planting, take care not to mix the subsoil with the topsoil. To avoid this, cultivation should reach only to the depth of the topsoil. Do not mix subsoil with topsoil!

30. 6. 4. Preparing the Soil for Planting

It is very important to *loosen* the soil well, so that when seeds are planted, they have all the necessary things for germination, such as warmth, air, and moisture. A well-loosened seedbed has the following advantages:

Plant roots, in search for minerals, can push through the soil easily.
Plants readily take up water.
Air circulation is good.

30. 7. OUR LOCALLY GROWN VEGETABLES AND FRUITS

30. 7. 1. An Introduction to the Types of Crops Grown in the CNMI

The types of commercial crops commonly being grown differ somewhat between our islands. A wide variety of crops are grown on Saipan. The main ones are cucumbers; melons, such as watermelon, cantaloupe, and honey dew; varieties of green beans; tomatoes; bell peppers; taro; and onions.

Other important vegetable crops include varieties of squash, eggplant, cabbage, radishes, and sweet potatoes. Fruit crops include bananas, papayas, avocados, citrus fruits, sweetsop, and soursop.

On Tinian, members of the **cucurbit family** (melons and squash) are the main crops grown commercially. Other field crops have been grown in the past for livestock feed. Farmers also grow tomatoes, bell peppers, hot peppers, taro, and onions.

Commercial crops on Rota are primarily taro, sweet potatoes, hot peppers, yams, and bananas.

Subsistence farming is similar throughout the Northern Marianas. Taro, sweet potatoes, yams, cassava (tapioca), peppers, bittermelons, bananas, coconuts, mangoes, citrus fruits, and breadfruit are the main subsistence crops.

Watermelon is a member of the cucurbit family, widely grown in the CNMI.

30. 7. 2. Tomatoes, Peppers, and Eggplant

Start these plants in flats with seeds planted 2-3 centimeters apart, and with about 5 centimeters between rows. Transplant them to the field when they develop the second set of leaves, and reach a height of 10-12 centimeters

All of these plants do best in good fertile soil. Adding humus will help to hold moisture and the minerals added to the soil as commercial fertilizers. Peat moss, leaf mold, coconut fibers, grass cuttings, and straw are a few examples of materials that make good humus. For best results, *stake* (tie up) tomatoes, peppers and eggplants. Do this to prevent the *fruit* (edible part) from contacting the soil.

Several varieties of tomatoes are now available in the CNMI.

Several varieties of each of these plants are available here in our islands. Up-to-date information about their culture is available from the DLNR Division of Agriculture and from the Northern Marianas College CREES Program.

30. 7. 3. Corn

Plant corn on the best-drained and most fertile soil on the farm or school garden. Plant the seed in rows or in hills (mounds), with 3 - 5 seeds to a hill. The hills should be a meter apart in the rows. This can vary, depending on the method of cultivation used.

Corn grows well in well drained, fertile soil.

Green, leafy crops grow quickly and respond well to extra nitrogen.

Cucumbers grow well both in fields and as a potted plant.

Pumpkin squash is native to the tropics, thus does very well in the Marianas.

The *germination time* is less if the seed is soaked in water for about two hours. Weed control is important until the corn plants are well-established. Block-planting helps to ensure pollination.

30. 7. 4. Salad or Leafy Crops

Many leafy crops grow easily in backyard gardens. Chinese cabbage, Swiss chard, bok choi (nappa/pechay), endive, kale, leaf lettuce and mustard greens are just a few of these.

Start these plants in flats or directly in the field. If planted in the field, a good supply of tender salad material can be ready in a short time, as the plants are *thinned* to proper spacing. Allow about 15-25 centimeters between plants, and 45-50 centimeters between rows.

Fast-growing crops like these respond well to additional nitrogen. Give this to plants as commercial fertilizers or well-rotted barnyard manure. Place this 10-12 centimeters from the plant, as a **side dressing.**

Head lettuce is not well-suited here to open field farming during much of the year. It may be grown during the dry season, however, if kept in germinating flats for about 4 weeks before planting in the field. Too much rain will rot the head before maturity. Leaf lettuce does not form a head. It is more successful and may be grown anytime of year. Sow it directly in the field and later thin it to 10 centimeters apart. The thinned plants can be used in salads, so no seed is really wasted.

Mustard greens can provide plenty of leaves for cooking. Grow them only in the dry season. They grow best in rich moist soil and can be treated in the same way as lettuce.

30. 7. 5. Cucumbers, Melons and Other Vine Crops

It is best to plant these in 1/2 foot high, 1 foot diameter hills, with 3-5 seeds per hill. Vine crops need plenty of space — at least 1.3 meters between hills and about 1.5 meters between rows.

The addition of *well-rotted barnyard manure* under each hill is a good practice. Place the manure 10-15 centimeters below the surface of the ground, and cover it with 15-20 centimeters of soil.

The seeds can then be planted with no danger of burning the roots when they start growing. **Clean cultivation** is best. At least weekly *hoeing* to clear away weeds is necessary until the plants are well underway.

Pumpkin Squash

Cucurbita moschata is in the *Family Cucurbitaceae*. Its common names include Pumpkin Squash and KALAMAS (CHAMORRO) and GHALAMAASA (CAROLINIAN). This is a creeping herb with large leaves and branching tendrils. Male and female flowers are separate and are both yellow.

The fruit is large and wider than it is long. Pumpkin Squash is native to tropical America. The young, green fruit is peeled, sliced and fried as a vegetable.

The large, mature, yellow fruit is grated and cooked with sugar, as a preserve or pastry filling. The leaf tips of the vine are also used as a cooked vegetable.

30. 7. 6. Beans

Beans can be grown anytime of year, on almost any soil, as long as it is well-drained.

Plant pole beans (climbers) in hills 45-60 centimeters apart, with 1.2 meters between rows. Plant 5 - 7 seeds to a hill at a depth of 5 centimeters. When seedlings emerge, thin them to the strongest three. It is advisable to stake pole beans.

Sow bush beans in rows with seeds 8 centimeters apart. Later thin them to 15 centimeters apart. Distance between rows should be about 1.5 meters.

A handful of complete fertilizer under each hill, or sprinkled lightly in rows, gives the plants a good start. Side dressings, after about the first month and after the first picking, help extend production of beans.

Beans can be grown anytime of year, on almost any soil, as long as it is well-drained.

30. 7. 7. Cassava

Manihot esculenta is in the ***Family Euphorbiaceae***. Its common names include Tapioca, Cassava, and MENDIOKA. This is a bushy herb. Multiple, elongated *tubers* compose the root system.

Tapioca is native to Brazil and is pantropical in cultivation. There are two variations of tapioca cultivated in the CNMI:

> The first variety is short, fast growing, green-stemmed and has dull-leaves. This type produces multiple tubers that are small, but do not need soaking to remove a toxic substance.
>
> The second variety must be soaked, takes longer to mature, grows taller and has red stems with glossier leaves. This variety is toxic unless first soaked.

The tubers from both varieties are peeled before cooking with coconut milk. The result is a starchy, potato-like vegetable with a slight acid taste.

Tapioca (Cassava) is native to Brazil and is pantropical in cultivation.

30. 7. 8. Red Yams

Dioscorea alata is in the ***Family Dioscoreaceae***. Its common names include Red Yam and DAGU. This is a high-climbing vine with heart-shaped leaves and a thick, edible underground tuber.

The stems are square and winged. DAGU is native to Southeast Asia and is widely cultivated in the tropics. DAGU is a popular food item, particularly at holiday time. It is usually boiled and then peeled.

The taste is sweet and starchy. Plant it at the base of a tree, or amidst a network of poles. This is so that it can climb when growing.

Dagu, native to Southeast Asia, is widely cultivated in the tropics and is a popular food item, particularly at holiday time.

Taro is native to tropical Asia and the Pacific. The mature fruit is boiled as a starchy vegetable.

Sugarcane is a tall perennial grass with thick stems and long, broad leaves.

A native of tropical America, avocados are widely cultivated in the tropics.

30. 7. 9. Taro

Colocasia esculenta is in the ***Family Araceae***. Its common names include taro and SUNIN AGAGA'. This is a large *perennial herb*.

It has heart-shaped leaves arising from an underground tuber. The leaves are green or purplish with a down-pointing tip. The flower spike is in a yellow sheath.

Taro is native to tropical Asia and the Pacific. The mature tuber is boiled as a starchy vegetable. The young leaf and stem can also be eaten. They are usually diced and boiled with coconut milk.

This species of taro grows best in moist soil. It is usually planted in a water drainage area, such as near an outdoor sink or pig sty.

30. 7. 10. Sugar Cane

Saccaharum officinarum is in the ***Family Graminae***. Its common names include Sugarcane and TUPO. Sugarcane is a tall perennial grass with thick stems and long, broad leaves.

The flower panicles are silvery and up to 50 centimeters long. Agronomists believe it to have originated in India. Farmers in most tropical countries cultivate it. The pre-contact Chamorro probably brought sugarcane to the Marianas. It is chewed for its sweet taste. It also can be pressed, to render a syrup used to make sugar.

Recall our second chapter, on our islands' cultural history. Remember how extensive the sugar cane fields were in the Japanese period?

30. 7. 11. Avocado Trees

Persea americana is in the ***Family Lauraceae***. Its common names include avocado, alligator pear, and ALAGETA. This is a small to medium-sized tree, usually richly branched with large, dark green leaves.

The flowers are yellowish and occur near the ends of the branches. The fruit is green or purple, with a single large, brown-skinned seed. A native of tropical America, it is widely cultivated in tropical areas of the world.

The mature fruit may be either green or purple and is soft when ripe. Once peeled, we can view a rich yellow-green pulp. It is most commonly eaten with salads, but can also be baked. **Guacamole dip** is made largely by mixing mashed avocados and salsa.

30. 7. 12. Guava Trees

Psidium guajava is in the ***Family Myrtaceae***. Its common names include Guava and ABAS (CHAMORRO) and AABWAS (CAROLINIAN). Guava is a shrub or small tree with smooth, reddish-brown bark.

The flowers are showy with white petals, fragrant and about 3 centimeters in diameter. The fruit is about the size of a lemon, yellow when ripe. Guavas are native to tropical America and are widespread in cultivation in tropical countries. It has naturalized here in the CNMI.

The green or mature yellow fruit is eaten raw. It can also be used to make preserves and wine. Recently, hybrids have been introduce from Hawaii. One example is the pineapple guava. This is larger than the common, naturalized variety and has bright pink, very sweet pulp. The leaves of this tree are often added to local medicinal combinations.

Guavas are native to tropical America and are widespread in cultivation in tropical countries. It has naturalized here in the CNMI.

30. 7. 13. Mango Trees

Mangifera indica is in the ***Family Anacaridaceae***. Its common names include Mango and MANGGA. This is a medium to large tree with a dense crown.

The leaves are long and narrow. The flowers are yellowish. The fruit is flattish from side to side, and is pointed at one end. Mango fruits hang straight down on a long stem.

Mangos are native to India. They have been introduced to most warm countries throughout the world. This is the best known of all the tropical fruits. Many island residents — especially children — eat the immature green fruit pickled, or raw with salt and hot pepper.

The mature fruit is still green on the outside when ripe, but is soft and yellow on the inside. Its delicious flavor is very popular. Recently, hybrid varieties have been introduced to our islands. These are larger, smoother in consistency, and brilliantly colored with red and yellow skins.

Our varieties of mangoes are MANGGAN SAIPAN, MANGGAN KARABAO, and MANGGAN PIKOSE. Those sold in supermarkets are usually Haden mangos. A few of these are now being grown here.

MANGGAN SAIPAN is the variety that children often eat with salt and pepper. When freshly picked, the fruit stem oozes a milky sap. Wash this sap off thoroughly before eating, to avoid an allergic rash reaction around the mouth. The young leaves are purplish. These can be collected and pickled in fina'denne'.

Mangos are native to India, but have been introduced to most warm countries throughout the world. Mangos are the best known of all the tropical fruits.

30. 7. 14. Soursop and Sweetsop Trees

Annona muricata is in the ***Family Annonaceae***. Its common names include Soursop and LAGUANAHA (CHAMORRO) and LAGUANAA (CAROLINIAN). This is a small tree with light green foliage.

The flowers are small and yellowish. The fruit is heart-shaped, curved slightly at the base and covered with fleshy or soft spines. Soursop is native to tropical America. The soft green mature fruit is edible when ripe, with a sweet tropical flavor.

The soft green mature fruit of the Soursop tree is edible when ripe, with a sweet tropical flavor.

Annona squamosa is also in the ***Family Annonaceae***. Its common names include Sweetsop, Sugar Apple, Bullock's Heart and ATIS (CHAMORRO) and AATIS (CAROLINIAN). This is a small tree with narrow leaves and greenish flowers.

The fruit is heart-shaped, about 10 centimeters wide, and has the form of an artichoke. Atis is native to Tropical America. When the

green segments of the fruits split and show a pinkish tinge, the fruit is ripe and edible.

The fruit contains many black seeds. The fleshy pulp is slightly sweet with a custard-like consistency. It is a favorite of children and of the CNMI's first resident mammal, the fruit bat.

Tangerines originated in Asia, and are widely cultivated in most tropical countries. This is a common tree found on ranches and around homesites and is highly valued for its edible fruit.

30. 7. 15. Citrus Trees

Citrus aurantium is in the ***Family Rutaceae***. Its common names include Sour Orange, Seville Orange, KAHET (CHAMORRO) and LOOMWUL (CAROLINIAN), and Lemon. This is a small, spiny tree with dark green leaves.

The fruit is slightly flattish, rough-skinned and orange when ripe. The pulp is very sour with many seeds. The flowers are white. Sour Orange is native to southeast Asia, and is cultivated throughout the tropics. The fruit is very sour and used for cooking, making sauces and for orangeade.

Citrus reticulata is in the ***Family Rutaceae***. Its common names include Tangerine and LALANGITA. This is a small, spiny tree with dark leaves. The fruits are orange-colored when ripe, rounded and slightly depressed with an easily removed skin. As in the case of citrus orange however, often our ripened form of tangerine is still green due to our lack of cold weather.

Tangerines originated in Asia, and are widely cultivated in most tropical countries. This is a common tree found on ranches and around homesites and is highly valued for its edible fruit.

30. 8. HYDROPONICS

30. 8. 1. Introduction

Hydroponics is the culture of plants in water. Chemicals, added to the water, supply all the nutrients necessary for growth. The plant roots are held in a growing medium (sand, peat, gravel, etc.), through which the water flows.

Hydroponics is the culture of plants in water. Chemicals, added to the water, supply all the nutrients necessary for growth. The plant roots are held in a growing medium (sand, peat, gravel, etc.), through which the water flows.

Plants such as tomatoes, or any of the vine crops should be tied up with string from a framework above. This confines each plant to a relatively small space and takes advantage of the air space above each plant.

For moisture, water is either flushed to the surface from below or sprinkled on from above. Water does not stand (stay) in the growing medium. The medium is kept wet, however, so that the roots can readily take up mineral salts.

Ready-mixed nutrient ("Hyponex" is one kind) is available on our islands at home/garden stores. Complete instructions for use are printed on the container. Follow them carefully.

Most garden plants can be grown in a very small space to support the needs of a family. The growing room for garden plants can be cut in half. In other words, twice as much can be grown in a small space as could be sown in soil.

People have sometimes said that hydroponics will someday feed the world. This statement may very well come true. Think about the rate at which farmland is being used to build our houses, highways, and factories. Today, in many places, cattle feeds such as hay, alfalfa, oats and barley are grown hydroponically. Colleges and universities are offering courses in hydroponics. They are training people to provide agricultural help for areas across the United States and in other countries.

30. 8. 2. Growing Mediums

The growing medium can be anything from crushed rock to styrofoam. In the CNMI, however, the "easiest to get" materials—beach sand and crushed coral—have not proven satisfactory. The limestone breaks down and this causes an alkaline condition that is hard to adjust. If limestone is used, change it after each crop. Also, add acid to it, to correct the pH, or alkaline-acid balance.

The best medium is any non-active material that is easy to find. Well-rotted coconut husks that break or crumble into small chunks could be used successfully. Styrofoam packing or the cork sheets from old refrigerator trucks make an excellent growing medium when broken into small pieces. Vermiculite and peat moss have been used also, and have proven to be very successful.

In the CNMI, the "easiest to get" hydroponics mediums - beach sand and crushed coral—have not proven satisfactory.

30. 8. 3. Containers and Nutrient Flow

Any container can be used for hydroponics, as long as it will drain fast. Beds can be constructed of wood or cement. Good containers can be made from 55-gallon drums. Cut these in half lengthwise and weld them end-to-end, to make a convenient length. The beds should be raised and slightly sloping. This is so the nutrients can drain out and be returned to a storage tank after each wetting.

A family-sized hydroponics plant can be as elaborate or simple as the grower wants. An automatic sprinkler system with storage tanks and electric pumps can be used.

If a simpler system is desirable, pour the nutrient over the medium with a sprinkling can. Then catch it in a pail, as it drains out. A good, but simple, way would be to use a raised tank. Then, the nutrient will drain out through a hose by gravity flow. The water can be collected again and returned to the tank.

30. 8. 4. Transplants

Germinate seeds right in the hydroponics tank. Or, start them in flats and later transplant them into the tank. The easiest way is to sow the seeds in 5 centimeter peat fiber pots. These pots are available in any garden supply store.

When the seedlings are ready to transplant, place the pots with the started plants into the growing medium. With this method, the shock of regular transplanting is much less. Sow two or three seeds in each pot to make sure at least one germinates. Later, thin them to the strongest seedling.

Tall plants, such as tomatoes, may require staking.

30. 8. 5. Staking Methods

Most garden plants adapt well to this type of culture. Some tall plants need support by staking or tying, while others do not. Careful planning then becomes important to avoid crowding, or one plant being shaded by another.

Tomato plants, for example, need at least a square foot of surface space each. These grow quite tall. Lettuce, on the other hand, takes only half as much space and is a low-growing plant.

Vine crops such as cucumbers, squash, and melons also need support. Support them by running a string from the base of the plant up to a framework built above it.

30. 8. 6. Nutrient Quantities

The growing medium should always be moist with the liquid nutrient. Too much nutrient will cause *rank growth* (much stem and leaf growth), and fruit production will be less. The best method is to follow directions (for the most part) and watch the plants carefully for normal growth, adjusting amounts as necessary.

Pruning (reducing the size) or suckering (removing excess branches) plants is important in hydroponics culture.

30. 8. 7. Controlling Plant Size and Growth Patterns

Pruning (reducing the size) or **suckering** (removing excess branches) plants is important in hydroponics culture. The number and quality of fruits can be improved by carefully controlling the number and position of new fruit-bearing branches. Some growers suggest removal of the first flowers to appear. The idea is to sacrifice the first fruits for a stronger plant.

30. 8. 8. Some Suggestions on Getting Started with Hydroponic Gardening

To begin using hydroponics, the following activities are recommended:

1. Find out where the commercial growers are located on your island and observe them carefully to see “how it’s done”. Then adapt their basic plan to your own use.

2. Talk to the people at the DLNR Division of Agriculture or the Northern Marianas College Cooperative Research, Education and Extension Service (CREES) for suggestions on plant varieties and insect control.

3. Keep careful records. Write the answers to the following questions:
    a. How long do the seeds take to germinate?
    b. How long does it take the plant to start producing?
    c. What is the yield per plant? (Find out what to expect and try to improve the yield by varying the feeding.)
    d. What happens when different factors are changed? For example, what happens when different varieties are used? What occurs when spacing,

the amount of light, and nutrient control are varied? This is a matter of comparing one bed with another and keeping carefully written records.

30. 9. VEGETATIVE PLANT REPRODUCTION

30. 9. 1. Cuttings and Layering

In **vegetative reproduction,** new plants are produced from the stems, roots, or leaves of parent plants. The main advantage is the time saved in growing new plants. Starting plants, particularly fruit trees, from seed is a longer process.

A seed is the result of sexual reproduction. Because of this the **progeny** (off-spring) may be very different from the parents. Most **herbaceous** (soft-stemmed) plants such as tomatoes, eggplants, and cucumbers are usually grown from seeds.

They grow quickly and can produce fruit in a few months. Some herbaceous plants like bananas, taro and yams are usually grown *vegetatively* from cuttings of plant parts. Most woody plants are also grown this way.

Cuttings or **scions** are parts taken from the stem or branch. These should be from young wood near the ends of branches or the tip of the stem. Root cuttings are taken from a section of the root. In the case of yams, however, they are from a section of the tuber, containing a bud.

Root cuttings into sand and then transplant them into soil when the roots develop. Water the plants heavily every day. For best results, use commercial **rooting hormones**.

Another method for starting new plants is to cover a section of stem with soil. This is so that roots will form at the **nodes** (joints). Plants with trailing stems or any of the **succulent plants** respond nicely to this method. This method is called **layering**.

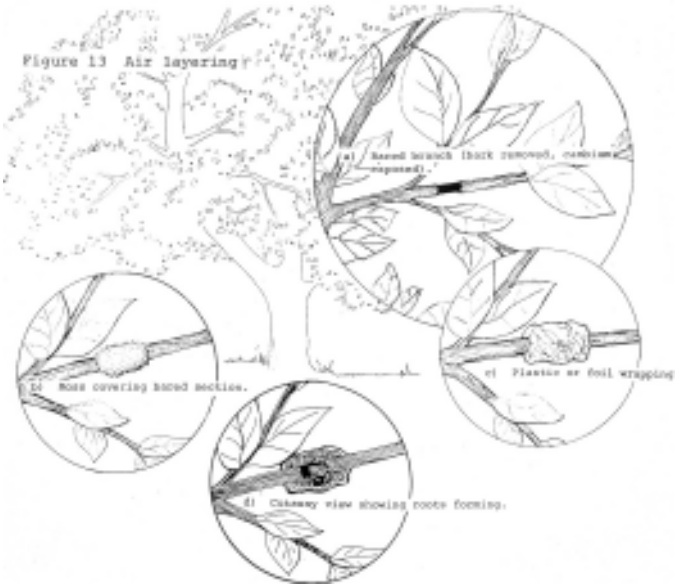
30. 9. 2. Air Layering

Use this method for starting new breadfruit, citrus, and many other local trees and shrubs. Instead of bending a branch down to cover it with soil, take off a short length of bark from a small branch. Then wrap the exposed wood tightly with moss and surround with plastic.

Best results come from a young branch of about 2 - 3 centimeters in diameter. Make two cuts 7-8 centimeters apart. Peel the bark off and wrap the bare wood tightly with wet moss. Then cover the moss with aluminum foil or plastic, to hold in moisture.

Some growers leave a small strip of bark for food supply to the developing roots. This is not necessary, but may be a good practice.

Taking off the bark does not damage the water-carrying cells. Therefore the leaves at the end of the branch can continue the food-making process. The food made in the leaves will help roots to form under the moss.



Air layering is a good method for starting new breadfruit, citrus, and many other local trees and shrubs.

Roots will form in about three weeks and the branch can then be cut off and planted in soil. (Caution: To prevent roots from drying out, remove the plastic "only just before" planting in soil.)

30. 9. 3. Grafting and Budding

Any one of several methods can be used successfully in **grafting.** The important thing to remember is that the **conducting tissues** (water-and-food-carrying tissues) must match. This is so that the flow of water and food passes through the graft.

The advantage of this type of vegetative reproduction is that buds or cuttings from a plant can be grafted onto an already healthy root stock. Most woody plants can be grafted with success.

As an example, *Bougainvillea* and *Hibiscus* can be grafted with a variety of flower colors. Fruit trees (within the same family) can be grown with several different varieties of fruit on the same tree.

Plants that are native to a certain part of the world make the best rootstocks for that area. This is because they are best adapted to local conditions. Cultivated roses and many kinds of fruit are grown successfully by grafting.

Most grafted non-native plants do better than they would if they were growing on their own rootstocks. The idea is that the stock is already adapted to local conditions and can readily support a *scion.*

Through grafting, a variety of hibiscus flower colors can be achieved on a single plant.

30. 10. SEXUAL REPRODUCTION IN PLANTS

30. 10. 1. Seeds and Pollination

As mentioned earlier, a seed is the result of **sexual reproduction**. The plant that grows from that seed may be quite different from the parent plant.

The **pollen grain** contains the male sex cell. It is carried by the wind, or on the bodies of bees, to the female part of the same flower. Alternatively, it may be carried to the female part on the flower of another plant of the same species.

In some cases, as with corn or coconut, male flowers and female flowers are on the same plant. In others such as Fadang, and Papaya (usually), male flowers grow only on male plants, and female flowers only on female plants.

Papaya male flowers grow on a stalk in a cluster, while female flowers grow in a single, axial pattern.

30. 10. 2. Flowers and Fertilization

Whatever the arrangement of flowering parts, the same basic process occurs. The pollen from the **stamen** (male organ) lands on the **stigma** (sticky surface) of the **pistil** (female organ).

The pollen then *germinates and grows* down the **style** (long neck) of the pistil, delivering the male's sex cells (sperm) to the female's sex cells (eggs) waiting within the **ovary**. This is where fertilization of the eggs occur. Following this, the walls of the ovary swell forming the **fruits**.

This union of sex cells produces a *new combination of genes*. This combination results in an individual that is different from either parent. In this sense, sexual reproduction in plants is exactly the same as it is in animals.

30. 10. 3. Pollination Methods

Self-pollination is the transfer of pollen from the male organ to the female organ of the same plant. **Cross-pollination** is the transfer of pollen from the male organ on one plant to the female organ on another plant of the same species.

Controlled pollination can be done by making this transfer by hand, so that parentage is known. This method is used in the production of **hybrid plants**. It involves covering female flowers with a sack.

This ensures that pollen from another plant does not fall on the pistil. When the pollen is ready for transfer, the sack is removed long enough to make the transfer. Then, it is replaced over female flowers.

30. 11. AGROFORESTS

Agroforests are areas where people have managed an area intensively to produce desired tree species.

30. 11. 1. Coconut Plantations

At various areas throughout the islands, including some in our northernmost islands, there are more or less pure stands of coconut palm trees. These had been planted to provide food for island inhabitants and their animals and to produce copra for export.

Large planted coconut groves occur where there are sand flats behind beaches and in some upland places, such as just northeast of Achugao Peak on Saipan.

These plantations are mostly mature and consist of trees 15 to 25 meters in height, either in regular rows or spaced irregularly 5 meters or more apart. The trunks are slender and there is generally a more or less complete canopy of leaves overhead.

In most groves and plantations there is a thick undergrowth, often 2 or more meters in height, composed of various shrubs and young trees as well as an abundance of self-sown coconuts.

Copra is no longer produced at these plantations. Labor costs are so high that the copra does not pay the cost of production and shipping. Today the nuts are used as feed for pigs, chickens and other livestock, plus a proportionately minor use for human food. Many of our coconut plants are currently subject to defoliating diseases and insect infestations.

30. 11. 2. Betel nut Plantations

Today the betel nut palm *Areca catechu*, PUGUA (Chamorro) and PPWU (Carolinian), is being grown on many agroforest tracts. Growing to about 10 meters tall, its trunks are pale gray, slender and straight. It can be distinguished from the ornamental 'Chinese betel nut' tree by its wider growth rings along the trunks.

The trees are planted close together (reportedly oft times too close) and are harvested for their cash crop, betel nut. This nut, actually a fruit, - fresh or dried - is chewed as an *astringent* and *stimulant*

Large planted coconut groves occur where there are sand flats behind beaches and in some upland places such as just northeast of Achugao Peak on Saipan.

Today the betel nut palm, Areca catechu, pugua (Chamorro) and ppwu (Carolinian) is being grown on many agroforest tracts.

drug. This is most often done together with a leaf of the betel-pepper, *Piper betel* (PUPULU) and a pinch of lime. This drug combination causes one's saliva to turn red. Archeological excavations in the CNMI found that the ancient Chamorro ancestors of our islands regularly chewed this fruit.

Chewers, sadly including children, often drop (or never gain) the habit of properly brushing and flossing their teeth. Even more unfortunately — many people combine tobacco into their mixture, this even at young ages. The *lime* in the regular betel nut mixture is a known **carcinogen**. The adding of tobacco compounds one's cancer health risk many times again. Tobacco's *nicotine* greatly adds to the betel nut mixture's *addictive* nature.

Betel nut fruit, - fresh or dried - is chewed as an astringent and stimulant drug.

At the time of this book's writing a local dental hygienist stated that the youngest child whom she discovered having oral mouth, gum, and skull cancer was ten years old. She laments that many, many more cases go undiscovered — with their likely resultant early tooth loss and their early, though preventable death from cancer.

Non-chewers frequently complain of the unsanitary and stain-causing aspects of those insensitive chewers who spit their red-stained saliva here, there, and everywhere. More sensitive chewers carry their own betel spit cans and do not 'mark' their surroundings.

At the time of this book's writing, the US federal government bans any importation of *Areca catechu* into the United States and its sale. This regulation presently applies to Guam but, again at the time of this book's writing, not here in the CNMI.

30. 11. 3. Agroforestry on Other Micronesian Islands

It is interesting to note that on many of the Caroline Islands, people have developed the practice of agroforestry — growing food, medicine, and other useful trees and plants in combination — to a high degree of sophistication. Many of our residents in the CNMI are from, or have close family ties to these islands.