

Soil & Water Conservation for the CNMI



ADAP
PROJECT

Agricultural Development in the American Pacific
Pacific Land Grant Programs



Table of Content

Introduction	4
Contour Farming	6
Mulching	9
No-Till Farming	12
Micro Irrigation	14
Intercropping trees/shrubs	17

Ross. S Magnola; Dilip Nandwani, PhD; Lee Bowen; Claus Bier
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Introduction

Commercial farming has been established in the Commonwealth of the Northern Marianas (CNMI) for a long time. However, until today, the CNMI's farming community



has yet to adopt many of the farming methods that are in use throughout the contiguous United States. Many of the farming techniques presently applied by local farmers use heavy tilling, manual

weed pulling, and surface irrigation. These techniques are very labor intensive and put a heavy burden on our limited natural resources. Farming on bare soil promotes erosion and sediment runoff. The sediments will eventually end up in the lagoon disturbing the growth of corals, if not killing them, and so depriving our fish of food and hatching places. Thus, the islands might lose fishing grounds and income from the reef as tourist attractions.

With the ongoing economical development in our islands and rising costs, it is important for the local farming community to move to more efficient and resource caring production methods.

Northern Marianas College's Cooperative Research Extension & Education Services (NMC-CREES) as one of its agricultural development functions has been working with farmers on enhancing their agricultural profitability. This is done by considering the benefits of both traditional and modern agricultural techniques with emphasis on soil and water resources. With a growing population, land gets scarcer and water becomes a large concern, due to poor quality and availability throughout the islands.

NMC-CREES recently acquired two parcels of land with a total size of 62,929 square meters or approximately 6 hectare. The purpose of this acquisition was the development of an experiment station for agricultural research as well as a demonstration site for innovative farming techniques. It will give the islands' farmers first hand experience with modern trends in farming. Additionally, the demonstration farm will serve as a hub for agriculture producers and high school and college students who want to get involved in agriculture, as well as for the general public to view and mimic in their farming and gardening endeavors.

With the promotion of efficiency and profitability through scientific research in mind, NMC-CREES intends to reduce soil erosion and water overuse by performing the following practices on the experimental farm:

- Contour Farming
- Mulching
- No-Till Vegetable Production
- Micro Irrigation
- Intercropping Tree/Shrubs



The techniques described on the following pages can be used in subsistence backyard gardening, as well as in commercial farming operations. They are easy in the initial set up, save labor and natural resources and enhance efficiency and profitability for the farmer. Saving and enhancing the groundwater quality on the islands as well as the rational use of land is an advantage for the well-being of the whole community.

Contour Farming

Most of the arable land in the CNMI lies on sloping hills. Together with the conventional farming method of straight line tilling, this leads to heavy wind and especially water erosion and sedimentation run off during raining season. Instead of replenishing groundwater tables, the water runs off unused, washing valuable minerals and nutrients into the ocean. The washed out minerals and nutrients have to be replaced by fertilizers which drive up the cost of farming. At the same time, the sediment in the lagoon promotes algae growth which is detrimental to coral ecosystems.



To alleviate these problems, NMC-CREES has implemented the Contour Farming system on our experimental farm in As Perdido. Contour Farming describes a method which uses tilling parallel to the contour lines of a hill. This slows down erosion through slowing down water run off. Soil quality doesn't deteriorate as fast, and thus fertilizer usage can be minimized. Additionally, this method takes away strains on groundwater levels and adds to water quality in general due to less fertilizers leaching into the aquifers.

The use of hedge rows along the contour lines further improves the method of

Contour Farming. With hedge rows, erosion can be further reduced. Sediments that normally would be washed away is caught in the hedges. Nutrients and minerals stay in the field.

NMC-CREES chose to grow vetiver grass (*Vetiveria zizanoides*) as hedge rows along the contour lines. This fast growing grass has proven already to prevent erosion in several South East Asian countries. Vetiver grass is also known as couscous grass or wonder grass. Originally from India, it can grow nearly everywhere in tropical or subtropical climates. It can survive on soils with high salinity levels and is very easy to plant and maintain. All it needs to grow is direct sunlight.

Vetiver is a nitrogen fixing plant, thus adding nutrients to the soil. Its cuttings can be used as mulch, animal feed or for handicrafts. The species of vetiver promoted by NMC-CREES doesn't produce viable seeds, so it cannot become a pest. To plant vetiver, you just break away root pieces of an existing plant and set them into the soil.

Another advantage of this grass is that it attracts insects to lay eggs. These eggs, however, won't survive on the vetiver leaves.



The main attraction of this “Wonder Grass”, however, is its root system. The dense, up to 5 feet wide roots of vetiver can reach to a depth of 10 feet, so it doesn’t compete for water with other plants – on the contrary, it helps to “pump up” water and nutrients from lower soil levels, and so improving soil moisture and health to the advantage of the field crops. Planted densely together along contour lines, vetiver can reduce erosion by 50%. Vetivers main strength is its capability to hold soil together, thus strengthening sloped areas. Over time, natural terraces will develop behind the Vetiver.



When planting Vetiver Grass along the contour lines, there should be staggered gaps in the lines to give the possibility for excessive water to run off during raining season. Having water puddles behind the Vetiver would defeat its purpose. The water should be given the chance to run off on grassy waterways. The grassy waterways slow down the run of the water, so sediment is not carried away. Additionally, the slow moving water will have a better chance to leach into the ground and replenish our aquifers, instead of flowing into the lagoon unused.

The advantages of Contour Farming with vetiver hedge rows are higher quality groundwater, minimized erosion and nutrient run off, as well as reduced need for fertilizers, thus an advantage for the whole community.

Mulching

The traditional farming methods leave much of the soil uncovered. This has several disadvantages: Weeds can grow unabated which leads to heavy use of herbicides and/or manual weed pulling, resulting in higher production costs and additional labor. Water evaporates faster from bare soil. The evaporation not only results in the need for more irrigation, but also in compacting of the soil. The first brings high cost and a huge burden on the already strained water supply in the CNMI. The latter hampers the soil's productivity. Crops have difficulties to grow in hard, compact soil.

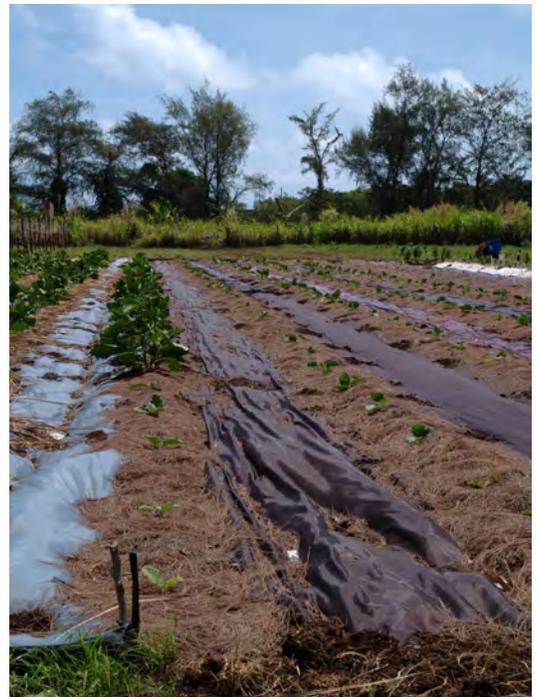


These problems can be averted by mulching. Mulching means that the soil around the crops are covered. The covering can be done by plastic mulching foil, paper shreds or

cuttings from vetiver grass. It doesn't matter much which material you use for mulching. Important is that it reflects sunlight, water can permeate through it and that the material is slowly decomposing, so you can simply till it into the soil after harvest.

The idea of mulching is to keep the soil around your crops covered. This has the advantage that weeds don't get enough sunlight to develop, saving the farmer the cost and labor of weeding. Additionally, the farm crops don't have to compete for nutrients with weeds. More nutrients for the crops means higher yields and profits for the farmer.

Mulching keeps the soil moist and regulates soil temperature. Less nutrients will evaporate. Moist soil doesn't get compacted. The roots of the crops have it easier to dig through the ground and grow faster, enabling the plants to take up more nutrients. Furthermore, the force of falling raindrops will be reduced. Less soil is sprayed around from falling water. The fruits stay cleaner, but, most important, less nutrients are lost.



The ideal plastic mulch for the CNMI has a white, reflective surface. This doesn't heat up the the soil too much. The best plastic mulch is not too UV resistant, so it decomposes faster. It should not hold longer than one seeding-harvesting cycle. There is foil on the market that can be re-used. However, this adds further labor to the process. Just tilling the foil into the ground and let it decompose, is much more convenient.

The application of mulch is as simple as can be: Paper shreds or plant cuttings are simply spread around the crops. Plastic mulch can be applied with the help of a ridger – this machine can be borrowed from NMC-CREES. The first step is to ridge your bed. Then you apply the mulch foil. A second run with the ridger, set to a larger working width, fixes the



mulch on the ground. The last step is to sow your seeds or set your seedlings through precut holes.

Different crops need different ways of mulching. Organic mulching with paper shreds or plant cuttings are best for corn or string beans. Plastic mulch has the most advantages for tomatoes, okra, eggplant, peppers or melons.

The ideal way of using mulch is in combination with a micro irrigation system described in a later section of this booklet.

Mulching seems to be labor intensive on the first look, but actually the savings in cost for manual weed pulling, herbicides and watering in combination with higher yield of crops brings mulching in a very favorable light.



No-Till Farming

Tilling is used to fluff up soil and to add organic matter to it by tilling weeds into the soil. Additionally, it helps to manage the weeds. However, relying on heavily tilled soil speeds up evaporation and water run off. This results in reduced replenishment of our already strained water wells, as well as loss of nutrients in the soil. The soil compacts and gets harder. Crop roots can't develop as well in a dry, compacted soil as they could in soft, moist soil. To counteract the evaporation, farmers have to use even more water to and use more fertilizer to feed the crops. Additionally, tilling of fields is time consuming and needs expensive specialized machines. Tilling disturbs the soil. Any soil disturbance leads to a loss in soil fertility.

One solution for these problems is the use of a technique called no-till farming. It is a very simple method. To establish a field, the land is simply cleared. No tilling takes place at all. Crops are planted by digging a small hole in the ground, sow the seeds or set the seedlings and just cover them with the dug out soil.

It might be necessary to use herbicides. When these herbicides are dosed correctly and brought out with the needed care, there won't be any harm for the environment. Vetiver grass will be able to filter out the herbicides, so there won't be any danger to the groundwater.



To make maintenance of the field easy, just keep the crop rows about a lawn mower width apart, so you can control weed by just mowing them. Leaving the clippings behind adds organic matters to the soil, thus promotes soil fertility even more. Additionally, the clippings function as mulch, as described before. It is a further way to control weeds, as the mulch prevents weeds from growing.

The main advantages of the No-Till method are reduction of erosion from water and wind, less sedimentation, maintained or even increased levels of organic matter in the soil – and therefore minimized need for fertilizers, provision of habitats for useful insects, and, most important, improved quality of groundwater and air on-site and off-site.

No-till farming actually is nothing other than the way of farming, traditionally done by ancient Chamorro.

The no-till farming technique works with several root crops, tapioca, tomato, melons, bananas, fruit trees, pineapple, long beans, and many others. Basically any crop that can be transplanted is usable for no-till farming.



Micro Irrigation

Considering the long drought season in the CNMI, the use of water has to be managed wisely. Water resources are scarce and groundwater levels are depleting. Many parts of Saipan are on a water scheduling system. Some wells around the island have been measured with a salt content of 1 ppt which adds to the water supply problem. Farmers and the non-farming community compete for water.

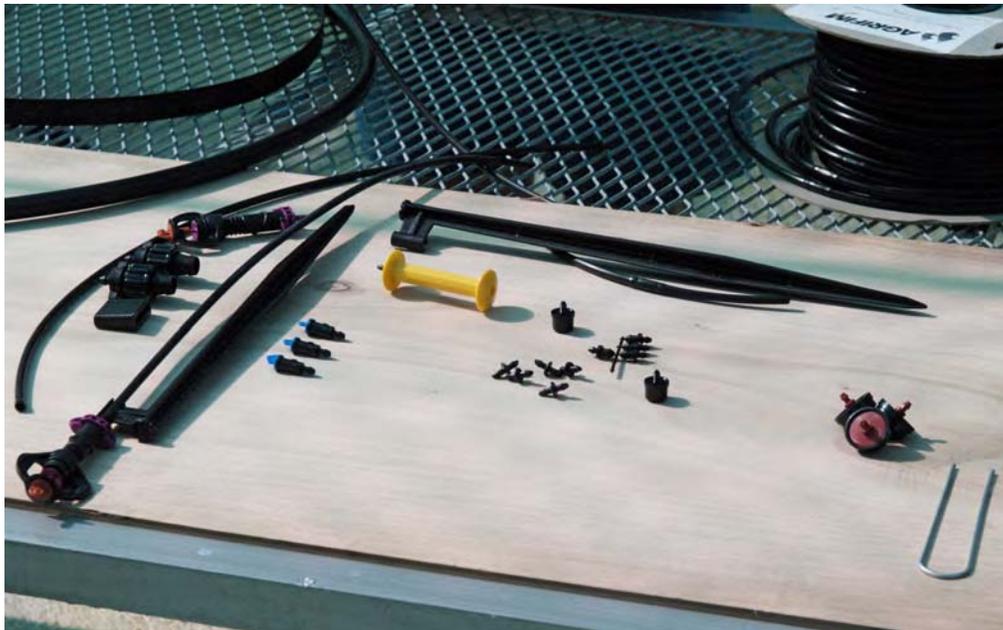
To ease these water supply problems, NMC-CREES propagates Micro Irrigation systems. These systems are in use in the US-mainland already for years. Set up and maintained correctly, they can save up to 50% on water for a farm. Additionally, the use of fertilizers is reduced, thus Micro Irrigation saves the farmer a good amount of money, and the community gains a better quality and availability of water.

Micro Irrigation systems are defined as irrigation systems for frequent application of small quantities of water on or below the soil surface: as drops, tiny streams or miniature spray through emitters or applicators placed along a water delivery line. In plain English, it simply means that Micro Irrigation uses mini sprinklers, seeping hoses or bubblers to release small, exactly dosed amounts of water directly to where the crops need it: At the roots.



The advantages of Micro Irrigation systems above saving water and fertilizer are manifold: As the amount water is exactly measured, the soil has the exact moisture that is needed to give crops the perfect growth environment. Only crops are watered and fertilized, not the weeds around them. Leaves and fruits are less likely to have spots from water burn – the farmer will harvest better looking produce.

The set up of a Micro Irrigation System might look intimidating at first, but is very simple and not expensive. All that is needed is pipe for the mainlines and laterals, a pump, filters, a flow meter, some valves, and of course the sprinklers or seeping hose. If you want, you can even build a fully automated system by adding a timer and solenoids.



Micro Irrigation Systems allow for injecting fertilizers and pesticides directly into the pipe system instead of into the soil. As less chemicals are needed, the cost reduction for the farmer can be tremendous. Furthermore, there is less labor needed, as the injection

can be automatized.

Micro Irrigation systems have the advantage for the community that there is less strain on the groundwater. The reduced use of chemicals protects the water quality. The higher yield of crops helps to nourish the island with less reliance on expensive imports.

Micro Irrigation can be used for nearly every crop that is produced in the CNMI.



Intercropping trees/shrubs

With the ongoing need for economical development, land has become a scarce commodity in the CNMI. Arable land has been lost to the establishment of hotels, businesses and homesteads. Therefore, it is important to wisely use and manage whatever arable land that is left over.

A suitable method to produce fruits and vegetables on an ever decreasing area is a technique called Alley Cropping or Intercropping. Alley Cropping can be compared to the building of sky scrapers on the small, valuable space of inner cities. It adds the third dimension to farming. The idea behind Intercropping is to plant trees or shrubs in two or more sets of single or multiple rows at wide spacings. Between these spacings alleyways are created within which agricultural, horticultural, or forage crops are cultivated.

Besides the space saving aspect, Intercropping has many more advantages. It will help to diversify farm profits by providing short-term cash flow from annual crops while also providing medium to long-term products from the



trees. On sloping land, water erosion is reduced through the interception of rainfall by the tree canopy and increased infiltration as a result of tree and herbaceous roots.

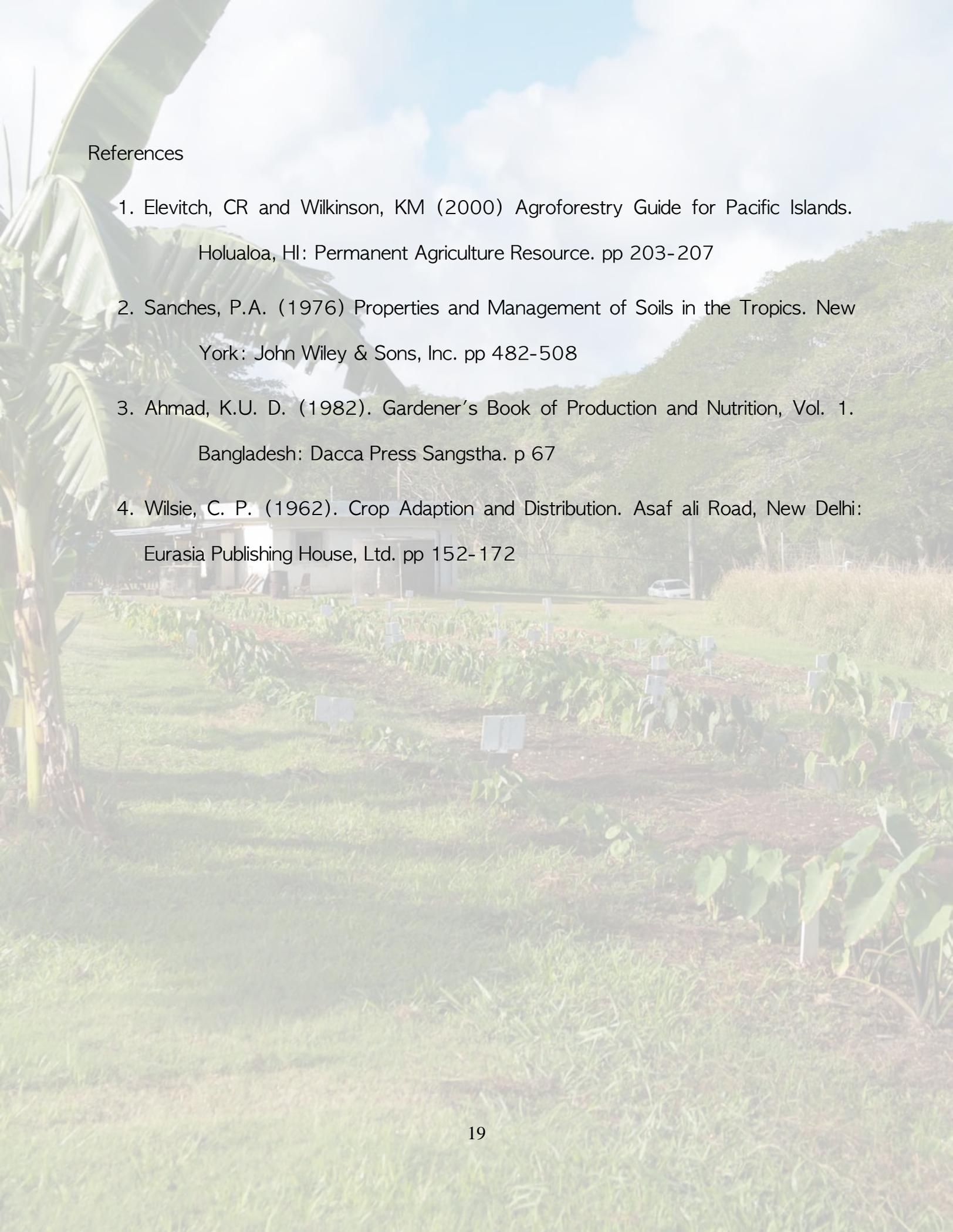
Intercropping provides a very good protection from pests because of plant diversity and distribution. At the same time, Intercropping interferes with pest movement. As there is less bare soil, wind erosion is reduced. Less stress from wind also means a better growth environment for farm crops. Trees also provide shade to lower growing plants if needed, thus enabling the production of crops sensitive to direct sunlight, and so diversifying farming even further.

Advantages for the community are the increased quality of our groundwater, as well as higher availability and diversity of fruits and vegetables. Furthermore, Intercropping adds to the beauty of our islands' landscapes.

The set up of an inter-cropped field is very simple: Choose plants that would compliment each other in their characteristics. To improve soil quality, you might want to choose one of your plants from the legume family. Not clearing too much of the jungle surrounding the orchard, adds to the advantages of Intercropping.



Intercropping of trees and shrubs enable a farmer to produce income from land that might not be suitable for farming. On our experimental farm, NMC-CREES is intercropping da'ok and noni with lowland coffee and cacao. The products of these plants are highly priced in the world market, so they might promise good profits to a farmer. Da'ok and noni are seen for profit production over a long term, as they will take some years to produce fruits, while the coffee and cacao are for a return of profit in a shorter term.



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