

**INNOVATIVE METHODS OF TERRACING.** I made a special trip to Haiti about a year ago to meet Victor Wynne and to see his interesting small farm in the mountains. After walking through eroded hillsides and unimpressive "fields," we suddenly came to a beautiful productive area that seemed like the Garden of Eden by contrast. Victor has experimented with better methods of terracing for some time, combining his training as an engineer and his love of plants. He has at least three distinct systems. He has written a description of one to share with our network, which follows.

"There can be no viable long-term agricultural cropping from hillside or mountain slopes, unless these slopes are first protected from erosion of soil by heavy rainfalls. In general the same is true of reforestation. Protective measures to conserve soil must come first. The scheme which we have found to be entirely satisfactory consists not of terracing, but of digging trenches along level contours and using the material from the trenches to form elevated ridges for tree planting. The ridges are always made at right angles to the level contours. The work must always commence at a drainage divide and proceed downward. Otherwise runoff from above may destroy your work.

"The accompanying contour map of a section of hilly terrain illustrates the scheme. The level contours, shown by dashed lines, are laid out so that there is a 1.5 meter difference in elevation. This has been found to be a satisfactory spacing on most slopes for intercepting and temporarily holding runoff from heavy rains. In practice there is no need to make a map. A few level lines are staked out on the ground, starting just below the hill summit, at the stated 1.5 meter vertical elevation difference between them. A small inexpensive line-level hung onto a nylon string provides an easy way of laying out these level lines. With taller stakes readily visible, one chooses and marks the ridge lines roughly perpendicular to the direction of the trenches and spaced six or seven meters apart. This rather close spacing eliminates the necessity of any hauling of excavated ditch material, as all can be thrown by shovel from trenches to ridges. The ridges are represented on our contour map by the dotted lines. Trenches should be at least 30 cm in depth, and a minimum of 60 cm wide, with a level bottom. Of course, where the ridges are to be the trenches need not be dug out. Thus the trenches consist of short sections of ditch. Very careful leveling is less important than it would be for a long extended ditch.

"The hillside is now ready for agroforestry plantings. In general the ridges will be reserved for tree planting because of the greater soil depth. The rectangular plots between ridges and ditches can be used for annual cash or subsistence crops.

"Well, that is all there is to it. Simple isn't it, but fully effective. So let's save our mountain soils!"

For his complete description, plus my own description of two other distinctive methods he has been using, write for our Technical Note "Terracing on the Wynne Farm in Haiti."

**8-1. A PLANT RESOURCE CENTER IN ZAIRE.** Roy Danforth works with the Paul Carlson Medical Program in Zaire. He is planting as many kinds of fruit, nut and vegetable plants as he can get his hands on, and is eager to share. He wrote, "You may publicize my work to anyone, wherever. I would like to be sharing with others who are doing much the same work as I am." So far, he writes, he has planted 150 kinds of fruit and nut trees (that probably includes varieties of the same species?), 30 kinds of vegetables, 5 types of industrial crops, and several kinds of trees for reforestation. He is growing quite a number of plants from seed that ECHO has sent. If the current dry spell does not become more serious, he should within a year or two have a great deal of interest to show any of you who could visit him in Imeloko, Zaire. Pete Ekstrand who works not too far from there wrote that he recently visited Roy and

came away with a lot of good ideas. I think you would fly into Bangui, Central African Republic and proceed a few hours by land to visit him. You can write Roy at B. P. 1377 Bangui, Republique Centrafricaine.

**8-1. TRAIL BIKE RECOMMENDED FOR REMOTEST REGIONS.** Don Mansfield in Mali gave us an enthusiastic recommendation for the Super Bronc II by Carl Heald, Inc. You have perhaps seen the "all terrain vehicles" with three very, very wide wheels. The Super Bronc is a two wheeled bike that has the same large wheels. The trails are so narrow where Don works that the three wheeled bike would not work. He said that with the wide tires he can come to a complete stop and not fall over. Also the large knobs on the tires keep thorns from penetrating. They are terrific in mud. "With the Honda I had to make sure I got home before rain or I would not get home." He also liked the heavy shocks on the rear and heavy spring forks on the front. The only problem is the range, which he estimates at about 2 hours. He got an extra 5 gallon gas can so he can travel for a day.

The bike comes as a kit. The company claims that with common wrenches, screwdrivers a drill and pliers you can have it together in as little as 6-8 hours. Having put it together yourself could be an advantage for those of you who will have to do all repair yourself. Don said the price is far less than others he priced. The basic bike with an 8 horsepower engine is \$900. Many things are options that are purchased separately if you want them, such as windshield (\$33), speedometer (\$20), knob tires (\$18), auxiliary gas tank (\$28) etc.

I asked the company's vice president, Ron Kimball, whether they would ship overseas. He said they do so frequently and have sold a number to missionaries. If you prefer to pick it up when you are in the States, they ship 2 days after receipt of order. To get a rough feel for shipping costs, I asked what it might cost if they shipped one to Africa. He said roughly \$500-700. If you wish more details, write to Ron Kimball, Carl Heald Inc., Dept. M, P. O. Box 1148, Benton Harbor, MI 49022

**8-2. QUAIL GRASS (CELOSIA ARGENTEA) IS AN EXCELLENT SPINACH SUBSTITUTE FOR HOT WEATHER.** Often folks from the States form the opinion that vegetables will not grow under the difficult conditions where they work. It would be more accurate to say that vegetables which they knew in the temperate zone may not thrive there. You will find gardening to be much easier if you grow food plants that God made for climates like yours. Quail grass is a good example. Even in temperate regions spinach only does well in the cooler part of the season and certainly will not grow in the hot tropics. Quail grass, on the other hand, will grow to about 8 feet when spaced about a foot apart and has leaves which taste very much like spinach. (It might be more productive to plant much more closely than that, however). Roy Danforth tried it in Zaire. He wrote that he was very pleased that it tasted so much like spinach. More important, the local folks are quite interested in it also.

I understand that it is already an important vegetable in parts of Africa and elsewhere. It is not a grass at all, but is in the same genus as the ornamental celosia and cocks comb. Young growing tips or older leaves are cooked for only a few minutes to soften. The water becomes an unappetizing black, but the leaves are an attractive green. The taste is spinach-like with no trace of bitterness. The cooking water should be discarded because it contains oxalic acid.

We sometimes like to cook greens in a steamer. The night we cooked quail grass that way the leaves were black and had an unpleasant taste that we had not noticed before. Apparently the black pigment and the oxalic acid that are normally removed in the cooking water were all left in the steamed leaves.

I have found no specific nutritional information, but it is in the same family as amaranth and is claimed to be similar except lower in protein. The leaves should be high in vitamins A and C, iron and calcium. The calcium would not be available because it is tied up by oxalic acid. The oxalic acid should pose no danger unless leaves were eaten in unusually large quantities.

Like its ornamental relatives, quail grass is attractive in its own right. When the days become shorter in late August it is covered with purple blooms. The inflorescence becomes longer and longer, remaining purple at the tip. The basal end turns brown and contains ripe seeds while the tip continues to bloom (and attract bees and other insects). A row in the garden is attractive with or without blossoms.

I have often wished for a vegetable that grew like a weed without all the tender loving care that is so often needed. Quail grass is such a vegetable. Every place I have grown it, it reseeds itself abundantly. We need do no work to grow it. It definitely could become a weed problem (although an edible problem). We have had no disease problems and very little insect damage. It is susceptible to nematodes, so a mulch is helpful. It is killed by standing water or freezing temperatures, but does quite well in our cool winter as well as the hot summer.

We have plenty of seed. We will be happy to send you a small packet upon request. There is no charge for folks working with Third World farmers. We only ask that you share your results with us.

**8-3. INFORMATION AND ADVICE AVAILABLE ON BUILDING IN THE TROPICS.** When Dr. Reuben Sperling visited with us to discuss structural aspects of roof top gardens, he mentioned that he used to work with the overseas division of the Building Research Establishment in England. After seeing some of the practical literature they have published I am convinced that many of our readers should know about this group. I quote from their literature:

"One of the Division's most important publications is the series of **Overseas Building Notes**, which is distributed to readers in over 80 countries. The Notes are published approximately six times a year and recent titles have included 'Preservation of timber for tropical buildings', 'Stabilized soil blocks for building', 'Roofs in hot dry climates' and 'The management of resources on construction sites.'" Many papers are written by experts from Third World institutions. "Several hundred inquiries are answered each year. Similarly many research workers, builders, architects, housing managers and students from all over the world visit the Division each year ... [to discuss] building research or building techniques in use elsewhere."

I have copies of some of their publications. Although this is far removed from my expertise, they seem to be very practical and understandable. You can obtain copies for a small charge (or perhaps free if you explain what you are doing). Here are some selected titles: Roofs for warm climates; Small buildings in earthquake areas; Accommodation standards for medical buildings (vol 1, dispensaries etc., vol 2, hospitals); Limiting the temperature in naturally ventilated buildings in warm climates; Brickmaking in developing countries; Problems of concrete production in arid climates; Durability of materials for tropical building; Timber in tropical building; Bitumen coverings for flat roofs; Low cost housing in urban and peri-urban areas; Simple classrooms for Pacific islands. Address your requests to : Overseas Division, Building Research Establishment, Garston, Watford, WD2 7JR, England.

**CUCURBIT SEEDS AS POSSIBLE OIL AND PROTEIN SOURCES FOR SMALL SCALE HOUSEHOLD USE IN THE HOT HUMID TROPICS.** Dr. Frank Martin at the USDA's Tropical Agriculture Research Station in Puerto Rico wrote an 11 page article on this topic for us. You may have a copy upon request. I summarize the highlights here.

Oils are necessary in the diet as a source of non-saturated fatty acids. They also are a concentrated source of energy, give flavor to foods and are used as a cooking medium in the kitchen. How can oils be produced at the level of the individual household in the tropics?

On a small scale, animal fats are more easily obtained from small animals than plant fats can be obtained from plants. Animals fats can be stored 1-2 weeks or more without refrigeration, but plant fats are less stable and more readily turn rancid. Most plant fats contain a good proportion of non-saturated fatty acids (palm oils are an exception) and are therefore more useful nutritionally.

Most plant oils are stored in the seeds. It is not necessary to extract the oil to obtain its nutritional value, but this is often desirable for other reasons. It is also often desirable to remove the hulls. A convenient way to use the fats without first extracting them is to prepare a vegetable curd. This is done by grinding the seeds in water, filtering, and precipitating the protein with an appropriate agent, such as lime juice, vinegar or epsom salts. Most of the oil comes out with the protein.

In the tropics there is often a shortage of oil in the diet and/or cooking oil for the kitchen. It is difficult to mature many of the most typical oil crops during the rainy season. A suitable crop for small scale oil production in the tropics should be an annual, or a perennial that produces during the first or second year. The oil producing fruit or seed should be available year round or the seed should be storable for oil production year round. It is also useful if the seeds are also good sources of protein.

The oil palm out-produces all other species. Its oil is principally saturated. The coconut palm is also excellent. The oil can be extracted at the household level. Because of the space and time required, however, they may not be convenient crops for the small household. The soybean, peanut and possibly winged bean are suitable for high quality cooking oil, but are very difficult to extract on a small scale. They are excellent sources of non-saturated fatty acids. Okra seed is another possibility.

Cucurbit seeds as oil sources. Cucurbit seeds [e. g. melons, squashes, pumpkins] contain about 50% oil and up to 35% protein after the hull has been removed. Most of their oil is non-saturated fatty acids, thus of high nutritional value. Conjugated fatty acids of some cucurbit oils make them quite useful as drying oils. The proteins are typically deficient in lysine and sulfur amino acids.

There are many precedents for using cucurbit seeds for oil in the tropics. Two species of Telfaria (oyster nut) are used for their large oily seeds in Africa. Hodgsonia (lard fruit) is a perennial vine with large, fatty seeds that has been domesticated as an oil source in China. In West Africa, seeds of watermelon are used as commercial sources of oil. These and seeds of egusi and bottle gourd are used in melon soups for their oil and protein content. (Seeds of Luffa acutangula and L. cylindrica, the angled and sponge luffa gourds, are bitter and may be poisonous).

Most cucurbits cannot be grown except when there is a pronounced dry season because of disease problems. The most successful species for the humid tropics, from our experience in Puerto Rico, are Benincasa hispida, the wax gourd, and Cucurbita moschata, the tropical pumpkin. If fruits are carefully protected from excess moisture, Lagenaria siceraria, the bottle gourd, can also be grown.

The wax gourd is perhaps the best of the cucurbits as a source of seed oil for the hot, humid tropics. It can be produced any season of the year. Though the fruits may rot during the rainy season, they can be protected by growing the vines on trellises or by placing thick but porous supports between the fruit and the wet ground. The fruits are very large and very seedy. If the fruits are sound, they can be stored for many months, even a full year, until used. Or, the seeds can be removed and dried. Per hectare yields of seeds have been estimated in our fields as 500 Kg/ha. [The fruits of some varieties are covered with a white wax that keeps microorganisms from attacking. The white flesh is eaten much as a summer squash, though is somewhat more firm. Ed.]

Seeds of cucurbits can usually be readily separated from the pulp. Sometimes a light fermentation of the wet seeds for 1-3 days is useful to clean the pulp from the seeds. Fresh, wet seeds can be chewed without further processing or are toasted. They can be used in soups with or without removing hulls. The naked seeds of the hull-less pumpkin, *Cucurbita pepo*, are especially desirable because they lack a seed coat. Stored seeds contain most of their nutrient content for years and are convenient for rapid use later. Dried seeds can be ground into a nutritious oily meal.

In our own laboratories we have emphasized the preparation of vegetable curds. All of the cucurbits with the exception of the Luffa species produced a very satisfactory vegetable curd, as good as tofu from soybeans. They were rich in protein and oil and contained only insignificant traces of the seed coat. However, the curds are usually very fine and difficult to separate from the whey by filtration. In the case of wax gourd, vinegar or lime juice gave a more manageable curd. We consider these results preliminary, but very promising.

Hand presses and solvent based methods of oil extraction may be used. We consider these too advanced for the smallest households, but have not yet found a satisfactory alternative.

ECHO can provide seed for luffa, wax gourd, tropical pumpkin and bottle gourd. We have not yet found lard fruit. [UPDATE: We finally found oyster nut. One vine TOTALLY covered a tall pine tree from top to the ground. Until we learn more about its weed potential ECHO does not feel free to distribute seed.]

**8-4. HOW CAN I GARDEN IN THE HOT HUMID TROPICS?** Letters from our readers often contain questions similar to this. Even an experienced gardener can get discouraged when he moves to the humid tropics from a temperate country and plants the vegetables he is familiar with. Others of you have not had gardening experience in any climate, but now face the need to learn fast. The approach of the two books is so different that they make an excellent complement to each other.

The best way to begin gardening in hot humid regions is to try those plants that God has clearly made for such climates. However, temperate crops are often in demand because of the increased variety that they add to the diet and their value as a cash crop to replace imported vegetables. **Techniques and Plants for the Tropical Subsistence Farm** is oriented toward plants that are adapted to the tropics. **Growing Vegetables in Fiji** is more oriented toward growing temperate vegetables, with some discussion of other vegetables.

Dr. Frank Martin and Ruth Ruberte with the USDA's Tropical Agriculture Research Station in Puerto Rico wrote a 56 page book called **Techniques and Plants for the Tropical Subsistence Farm**. It is now out of print, but ECHO will sell a photocopied version in a binder for \$8 (plus postage of \$1 US, \$5 overseas airmail). It is an excellent introduction to a wide variety of foods that are adapted to hot, humid regions. Its scope is a bit broader than only gardening, as the title implies. The Table of Contents lists: Overall planning; vegetables and cereals (leaves, legumes, roots and tubers, fruit vegetables, cereals); trees (fruit trees, vegetable trees, leguminous trees, trees for wood); forage crops (site

selection & preparation, planting, management, grazing, storage, selecting forages, grasses, legumes, misc. forages). Their approach to insect control is less specific with an emphasis on organic methods. (It is quite likely that insect control is less of a problem with the native tropical plants). Let me present a couple excerpts.

"Phosphorous is an essential, limiting element in tropical soils as often as nitrogen. It is important in stimulating root development and is necessary for fruit and seed development. Although it is common enough in the soil, most of it is insoluble, unavailable for plant use. Manure, compost and cover crops do not add enough phosphorous to the soil" and tend to become insoluble when they are added. He then discusses deficiency symptoms. Commercial fertilizers are one source. "Bonemeal is a useful additive though much of its phosphorous is insoluble. Marine organic materials (seaweeds, fish) are other good sources. There does not seem to be an easy solution to the problem, but a soil with adequate humus and good aeration slowly releases soluble phosphates from the insoluble forms."

"Indian lettuce from Southeast Asia is considered by some to be the best lettuce for the hot humid tropics. Like all lettuces, it requires a fertile soil. Seeds are small and seedlings require careful attention [So many plants come up wild we no longer need to replant, however -- Ed]. The plants grow rapidly and produce large succulent leaves. These may be harvested individually, or the tops may be snapped off... [to be] replaced rapidly by new growth. Once flowering begins, it cannot be suppressed, but leaves may be harvested until exhausted. Year-round production is easily achieved by planting every 3-4 months. Yields are excellent and the plants can be grown in pots. The lettuce is somewhat bitter in taste, but its flavor and texture are perfect for mixed salads. [It is also excellent as a cooked green. We will send seed to those requesting it -- Ed.].

Kirk Dahlgren is the Rural Development Director for the Peace Corps in Fiji. He wrote a 123 page book for the Peace Corps called **Growing Vegetables in Fiji**. This book is an excellent general introduction to gardening in the tropics (or elsewhere for that matter). As mentioned earlier, a special emphasis is placed on growing temperate vegetables. The climate is hot and humid in much of the country, similar to conditions faced by many of you. His writing is clear and choice of subjects excellent. He has an unusual ability to get right to the most important points and to explain them clearly in as few words as possible. The Table of Contents lists: The Fiji vegetable crop environment; building and maintaining soils; cultural methods of vegetables; the garden crops of Fiji; growing vegetables under plastic; composting and mulching. Let me share a couple examples.

"The culture of many of these new crops required the learning of a totally foreign propagation method -- the use of seeds." Traditional Fijian crops are propagated vegetatively, i. e. a piece of the plant other than a seed is used to produce new plants. "The vegetable crops the missionaries brought evolved in temperate zones where plants needed to produce resistant bodies, i. e. seeds, to survive the harsh winters." Crops the Indians brought had a similar need to survive dry months. Because in Fiji the weather is always just right, it is often advantageous for plants to reproduce through means other than seeds.

Here is an excerpt from the discussion of carrots. "Fiji relies largely on carrot imports to satisfy local demand. Carrots do well in Fiji, however. ...Carrots are small-seeded, slow-germinating, and slow to establish so require a steady supply of moisture and a high measure of weed control. Quick growth produces better carrots. Carrots are high in vitamin A and have good keeping qualities." He then gives recommended varieties and detailed cultural procedures. "Show extra attention to weed control. Weeds in carrots can be controlled by spraying with kerosene at the three-true-leaf stage. The rate is 450 litres/ha (45 ml/square meter). Spray on a sunny day for best control." Diseases, pests and their control [usually chemical rather than organic] are discussed for each vegetable. He lists three

common problems: cavities caused by calcium deficiency, galls caused by nematodes and split root tips caused by excess soil nitrogen.

We think so much of the book that we have reprinted it. The price is \$5.00. (Plus postage of \$1 US, \$5 overseas airmail).

**8-6CAN YOU HELP US?** [UPDATE: We are still looking for seed of the lard fruit mentioned in Dr. Martin's article. If you can help, drop us a note and we will send a plant import permit. We also asked in issue # 8 for help with methods to keep monkeys out of crops. Some answers were printed in EDN 9-5 and 11-6. I want to keep this as an open question.]