

Animals are very important to the small farm. Their integration into farming activities provides uses for many byproducts of the farm. They provide high-quality food, income, fertilizer, status, companionship, transportation, labor, and much more for rural families. But seasonal feed shortage and parasite problems can frustrate people's efforts in animal husbandry. This chapter highlights information and resources on raising and caring for animals in the tropics.

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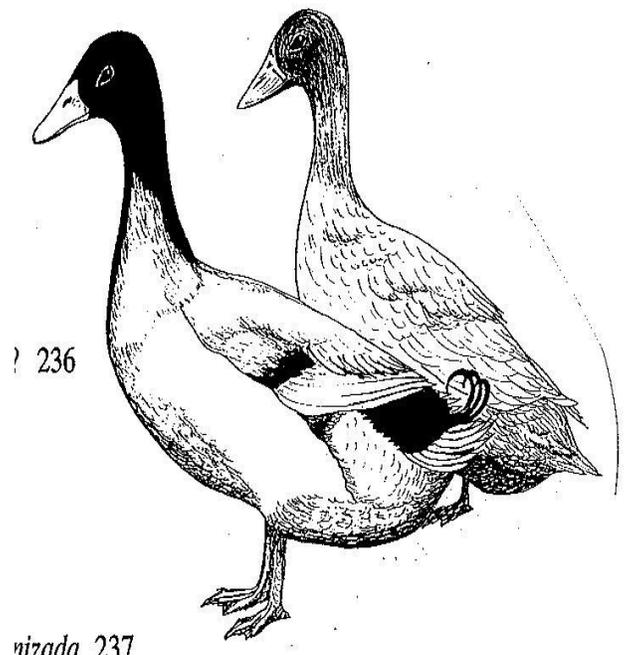
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WORKING WITH ANIMALS

NEWSLETTER ON ANIMAL HUSBANDRY IN THE THIRD WORLD. When people contact ECHO with questions on animals in development, we usually refer them to Heifer Project International (HPI), a group which specializes in that area (much like ECHO "specializes" in plants). If your outreach into the community includes working with animals, you will find the *Heifer Project Exchange* to be an excellent complement to *ECHO Development Notes*. The 4-page newsletter (now also with a 2-page insert called "Women in Livestock Development") is sent four times a year at no charge to development workers in the third world. They wrote that "we are happy to send it to those involved in livestock production projects upon receipt of their addresses and a description of their work." I am sure they would send it to others for a small donation to help cover expenses.

The *Exchange* shares with ECHO a determination to make available sufficient information so that you can act on what you read. I have not found tantalizing articles that leave me frustrated because the key practical information or address has been omitted. Articles are a mix of practical information and techniques with occasional comments providing perspective on a particular question. They also direct you to reprints, publications, and conferences on animal-related topics.

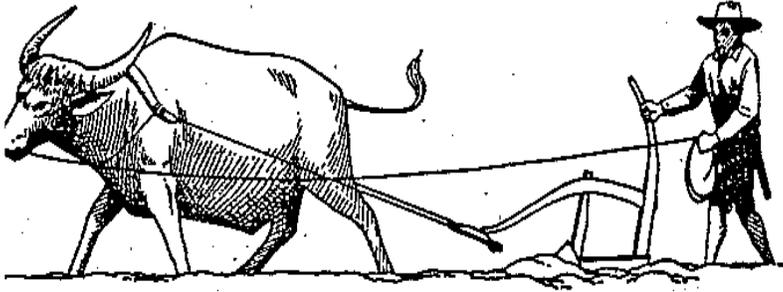
Let me pick some items from some past issues: "A goat medicine cabinet" suggesting medications that should be kept on hand by those working with goats; announcement of an upcoming seminar on beekeeping; a discussion of Caseous lymphadenitis in goats; plans for a manure-heated brooder; a method for pasteurizing milk on a small scale; midwifery for shepherds; lambing supplies check list; design for a Zimbabwe fly trap.

I especially appreciate the section called "Practical Materials which Readers May Find Useful." This is a very brief summary of articles that have come to their attention. In most cases they will send a free copy upon request from readers. If you would profit from the *Heifer Project Exchange* or want to receive Heifer's full publication list on development and livestock manuals, write to the editor Jerry Aaker, Heifer Project International, 1015 S. Louisiana, P.O. Box 808, Little Rock, AR 72203, USA; phone 501/376-6836; fax 501/376-8906.

LIVESTOCK FOR A SMALL EARTH: *The role of animals in a just and sustainable world.* Ed. by Jerry Aaker, 111 pages. The authors are all staff at Heifer Project, which provides technical training, livestock, and organizational assistance to rural community groups in developing areas. They present a theory and process of sustainable rural development which includes animals in the system because of their many benefits to the small farm family. Dotted with insights and case histories from HPI's fifty years of experience around the world, the text is a readable blend of facts and ideas. Emphasis is on the ecological and social facets of the work, although the book also provides practical suggestions for the beginner in village-level sustainable animal agriculture. It includes ideas developed by HPI such as "passing on the gift," in which recipients of female animals are required to give an offspring to another family in the community, and its implementation in several cultures.



There is an extensive bibliography on sustainable agriculture, rural development, and technical manuals on animal husbandry and related topics. This is an extremely useful book for a broad spectrum of people, from development workers to policy makers, who want to understand the key role of livestock in both the tangible and intangible sides of community development. Further information about HPI and copies of the book (send \$10; includes shipping) are available from Heifer Project International at the above address.



TRAINING IN ANIMAL TRACTION. Don Mansfield in Mali asked where he could get training in animal traction. We can recommend a good book, *Animal Traction* by the Peace Corps (245 pp., available for about US\$40 from ERIC Document Reproduction Service, EDR/CBIS Federal, 7420 Fullerton Rd., Suite 110, Springfield, VA 22153-2852, USA; phone 800/443-3742 or 703/440-1400). However, the subject is so complex that hands-on experience would be a great help.

Tillers International offers training in animal power, blacksmithing, woodworking, and international rural development. The goal of Tillers is to develop low-capital rural technology, including animal-powered agriculture, along with metal and woodworking support skills, so small farmers can achieve self-reliance. The program director, Richard Roosenberg, spent three years working with oxen as a Peace Corps volunteer in Benin. The program maintains a considerable interest in Third World applications. They have workshops, internships, and specialized training for North American and international students who want to receive hands-on instruction and opportunities for low-cost research in these fields. Tillers also studies and modifies designs and publishes a technical newsletter called *The Tillers Report*; subscriptions are \$25 for 2 years, and 15 backsets are available for \$25. Write for a current publications list, which includes full-scale yoke construction plans.

Workshops (1-5 days) and international development courses are given February through December on topics such as the following: ox driving and training, rope making, blacksmithing, woodwrighting, agricultural tool making, selection and care of oxen, draft horse use, animal-powered field work, sustainable pasture practices, building rural infrastructure, draft logging, road building, sweet sorghum molasses, timber framing and barn raising, etc. Tillers also has a highly competitive internship program which runs for 3-9 months from April through November. Interns are paid according to experience and skills. Write Tillers International, 5239 South 24th St., Kalamazoo, MI 49002, USA; phone 616/344-3233; fax 616/385-2329.

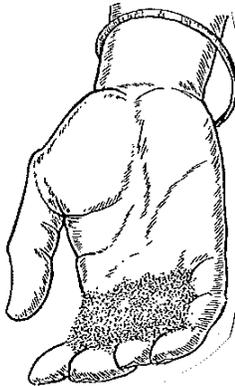
TECHNICAL NOTE ON OX YOKES. Tillers International also has a series of TechGuides. Titles include: Full-scale yoke plans; Hay baler construction plans; Training young steers (\$3); Selecting and pairing oxen (\$3); Advanced training of oxen (\$8); Slip-scraper construction and operation (\$4); Animal-driven shaft power (\$4); Measuring draft power (\$2.50); Bricks, brakes, head yokes for restraining loads behind oxen (\$1.50); Wood-framed harrow (\$2.50); Manual hay baler (\$3.50); Simple forecart design (\$1.50); and the MOP over-the-row weeder (\$3). Postage is \$2 per order. Order from Tillers at the above address.

One 10-page technical note is called *Tillers Tech Guide: Neck Yoke Design and Fit, ideas from dropped hitch point traditions* (\$3). ECHO claims no expertise in this area. But this appears to contain the kind of practical, applied, and well-illustrated information that might be helpful to you. I quote from the introduction.

"I was struck by the importance of yoke fit and design when training the first pair of oxen at Tillers. I had worked with a number of pairs in West Africa... I began training with a simple yoke like I had used in the African project. It had a pole for a beam, steel rods for bows, and a clevis extending behind the beam for hitching. After a few weeks the team pulled a stone boat willingly, but if I stepped onto it, they would stop.

"Then I placed an historic yoke on the team. They did not mind its extra weight and readily pulled the stone boat. I stepped on and they continued to pull without hesitation. A second person got on and the team still pulled. It took the weight of a third person to discourage them. I was amazed that changing the yoke permitted adding about 330 pounds (150 kg) to their load. I immediately started analyzing that old yoke and reading...about traditional yoke design and dynamics. Obviously these yokes were superior in some simple ways."





AN EXCELLENT RESOURCE FOR FORAGE SEED AND INFORMATION. I have found folks at ILCA (the International Livestock Research Centre for Africa--see note below) in Ethiopia to be unusually eager to help, including taking the initiative to get information to us at ECHO. I wrote to Dr. John R. Lazier, forage agronomist, asking if folks who read this newsletter would be able to request small quantities of seed. I realize that few of you are with research organizations or large programs of any kind. He replied, "ILCA does provide seed in small quantities to requestors, and your readers would be no exception." If you are doing a serious search for better forages for your region and cannot find seed for a particular forage plant, you might contact them for a small packet of that seed.

"ILCA is collecting germplasm of potential value to small farmers for cut-and-carry, grazing, browse and dual-purpose use (food and fodder)." They are especially interested in leguminous forages. They also publish a forage research newsletter (about 30 pages each), but this is quite technical and would only be of interest to the few of you who do a lot with forages.

Two International Agricultural Research Centers merge. The International Laboratory for Research on Animal Diseases (ILRAD) in Kenya and the International Livestock Centre for Africa (ILCA) merged in 1996. The new entity is the International Livestock Research Institute (ILRI) and will be located in both Kenya and Ethiopia. The addresses are P.O. Box 5689, Addis Ababa, ETHIOPIA and P.O. Box 30709, Nairobi, KENYA.

WINROCK INTERNATIONAL MAY BE ABLE TO ANSWER SPECIFIC QUESTIONS ABOUT LIVESTOCK. If something comes up in your work that you cannot answer, this free service by Winrock can be quite helpful. Some of the more frequently asked questions have led them to prepare Tech Notes on the topic. These 2-4 page notes are available in English or Spanish, at no cost to development specialists. Topics to date are: Protein sources for swine in the tropics; Alternative feeds for pigs in the tropics; Mammalian coccidiosis; Internal parasites in sheep and goats; Poultry and salmonella; Colostrum for the newborn; Vaccination and the Needle; Diarrhea in young livestock; Stocking rates in the tropics; Facilities for rearing young stock; Feeding the lactating female; Selection and management of replacements; Methods of animal identification; Establishing an artificial insemination service; and Techniques for feeding young ruminants. Their address is 38 Winrock Drive, Morrilton, AR 72110, USA.

WORKING WITH TRADITIONAL HERDERS. H.P. and Nancy Harmon work with people in the Transkei who are traditionally herders and whose first love is animals. Population pressures have forced the people to turn to cultivating the land, much of which is eroding badly.

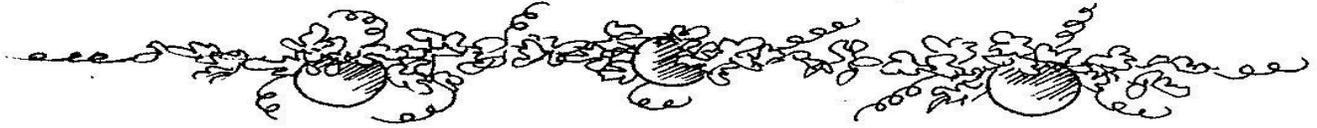
H. P. wrote that they start with the proposition that it is acceptable to raise livestock. Rather than entice people away from raising livestock, they first work with kinds of livestock that, with careful control, have little negative effect on the environment compared to herds of grazing animals: chickens, ducks, geese, pigs. "After people have these animals and are successful with them, then we are able to talk about the other animals (sheep, goats, cows, horses, donkeys), what is a sustainable stocking ratio, etc.



"We are able to increase farmers' interest in agriculture by having them plant some crops specifically to benefit their animals (e.g. comfrey, leucaena, winter oats). We are also able to talk about planting trees for soil stabilization and nitrogen fixation as side benefits from [their primary concern] for planting trees for forage.

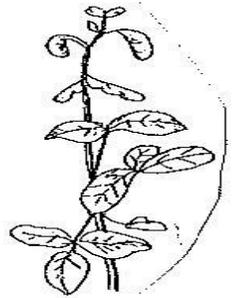
"This is slow work, but we seem to be successful where others have failed because we accept people's right to prefer

raising animals to cultivated agriculture. The ironic thing is that having accepted that fact, we now find that their interest in improving their agricultural methods is growing quite fast. I think this is because the benefits also extend to their animals and because they see that we are not trying to replace their animals with cultivated agriculture. ... the environment is slowly being brought back into balance as well. People are raising more small stock, which hardly ever overtax the land, and planting more trees so that the amount of fodder available is constantly increasing."



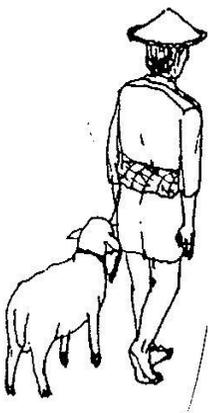
FEEDS AND ANIMAL NUTRITION

"FORAGES FOR THE SMALL FARM" TECHNICAL NOTE by Dr. Frank Martin addresses a topic about which we are occasionally asked and with which we have little first-hand experience. Though written with the needs of the small farmer in mind, this document probably best fits the needs of those with more than just a few animals to feed and who farm at least several hectares and perhaps even have some mechanized equipment. It addresses the following: the need for forages on the small farm; site selection; species selection; basic botany of grasses and legumes and the role both play in animal nutrition; the benefits and disadvantages of grazing versus "cut and carry" systems; general principles of forage management; and recommended forages for various sites and purposes. As ECHO carries relatively few forage species, an addenda has been prepared that lists sources for seed and further information. This document is larger than most of the ones we distribute so we ask that only those that really feel their work would benefit from such a document request free copies (\$3.50 to those not directly involved in development).



THE SMALL-SCALE MANUFACTURE OF COMPOUND ANIMAL FEED. Stephan von Malortie in Egypt asks: "...my main questions right now are in the field of feeding tables. I am trying to make guidelines for feedcrop use in different areas of the country."

I immediately thought of this book from the Natural Resources Institute. Chapters in this 87-page book include: Economic background to the industry, Nutrient requirements and feed formulation, Feed ingredients: characteristics and supplies, Outline of the feed manufacturing process, and Financial appraisal of small-scale production. These chapters are well-written, short, and to-the-point.



The 40 pages of appendices are especially useful. Appendix 1, Nutrient Specifications, includes detailed tables covering poultry, pig, ruminant, rabbit, and fish feeds. Appendix 2, Feed Formulations lists typical ingredients and proportions for small feed mills in Asia and Africa as well as normal maximum limits to ingredient inclusion. Appendix 3, Composition of raw materials, presents an exhaustive listing of the percentages of various nutrients in a wide variety of possible materials (from barley and buckwheat to spent brewer's yeast and feather meal). Another table lists the typical fatty acid composition of common fats and oils and a table of toxic or undesirable factors in feed ingredients (i.e. velvet bean contains trypsin inhibitors and needs to be heated to avoid problems, shea nut cake contains saponins and should make up no more than 2.5% of a feed). Appendix 4, Feed Processing, has diagrams of typical feed mills, tables comparing motor sizes and capital costs, a table of typical bulk densities of raw materials, etc. Appendix 5, Appraisal of Small-Scale Production Projects has a checklist of information to help decide project feasibility followed by detailed working tables for full financial analysis.

We have already found this publication a great aid in answering technical requests from our network. If your work includes the manufacture of your own animal feeds from locally available materials, this book may be a good addition to your library. Copies are available for £10.00 from: Publications Distribution Office, NRI, Central Ave., Chatham Maritime, Kent ME4 4TB, UK. No charge is made for single copies sent to government, educational, research, and non-profit organizations working in countries eligible for British Government Aid (most developing countries). Use official titles when ordering.

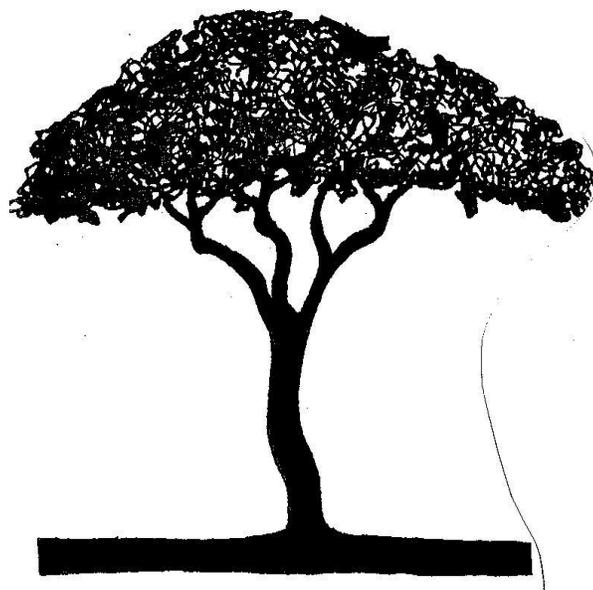
FEED ANALYSES. If you have been mixing your own animal feed rations, you might be interested in Ohio State University's feed analyses, although some knowledge of animal science would be necessary to interpret the results. Dairy feed standard analysis will measure dry matter, total crude protein, phosphorus, potassium, calcium, magnesium, sodium, manganese, iron, copper, zinc, neutral detergent fiber, estimated sulfur, and estimated energy for \$21.00. The beef feed analysis (\$20.00) is the same except it measures acid detergent fiber and does not estimate energy. Swine feed analysis includes dry matter, total crude protein, potassium, calcium, magnesium, zinc, manganese, copper and iron for \$23.00.

Write the Ohio State University; R.E.A.L.; Ohio Agricultural Research and Development Center; Wooster, OH 44691; USA; phone 216/263-3760. Prices quoted were in effect April 1995. Be sure to write them for current prices, detailed instructions on how to take samples, how much to send, etc. before submitting any samples.

USE OF TREES BY LIVESTOCK SERIES. Nick Davison, press officer for the Natural Resources Institute, sent us this new series. The attractive 18-30 page booklets deal with a particular genus of tree (*Gliricidia*, *Erythrina*, *Calliandra*, *Ficus*, *Cassia*, *Quercus*, *Acacia*, and *Prosopis* species). One booklet discusses anti-nutritive factors found in trees used as feed. The goal of the series is to bring together the information on selected genera which can increase the fodder supply for ruminants.

The series should be an especially helpful tool for agriculture teachers. There are 800-900 species of *Acacia* and 44 species of *Prosopis*. Looking at them one at a time would be out of the question in the classroom. Considering each as a group, how they differ and what they have in common in terms of livestock feed, is a handy approach.

A few items from the booklet on anti-nutritive factors follows. Hydrogen cyanide is potentially the most serious anti-nutritional factor in fodder trees. Symptoms of cyanide poisoning are labored breathing, intense red conjunctiva (whites of the eyes), frothing at the mouth, bloat, convulsions and a staggering gait. Post-mortem examination often reveals a characteristic smell of almonds from the stomach contents. A full stomach tends to buffer the absorption of cyanide in ruminants, possibly due to its reaction with sugars or sulphur compounds to form harmless compounds. Poisoning is more likely to occur during drought or feed scarcity, when hungry animals consume large amounts of a particular feed over a short period of time. Avoid feeding pods that are wet. Physically separate potentially dangerous feeds from water sources. Cold water appears to encourage the release of cyanide. Mix potentially toxic feeds with sulphur or molasses, or feed them in conjunction with licks that contain these substances.



Do not be too quick to decide that a tree species can or cannot be used for fodder based on a report you read or even your own quick test. "There are many contradictions in the literature regarding the acceptability of fodder from trees and shrubs." Some possible reasons follow. Acceptability can change during the year. For example, milk goats consume more *gliricidia* when foliage is older with mature leaves. As the growing season progresses, the proportion of mature leaves increases and leads to improved consumption by goats. In some cases it may take several days for animals to accept a new feed, but once accustomed they may consume it readily. Preference for one feed over another does not mean that they will not eat it when it is the only choice. Within a single species, differences can exist between varieties, individual trees and even between parts of the same tree. Acceptability can be influenced by climate and soil conditions. For example, acceptability of the same varieties of *Stylosanthes* spp. in Australia varies greatly between the sandy, infertile soils of one region and the fertile soils of another.

The booklets are £2 each. Groups working with community development in countries eligible for British aid can request single free copies by writing Publications Distribution Office, NRI, Central Avenue, Chatham Maritime, Kent ME4 4TB, UK.

FORAGES DIFFER GREATLY IN DIGESTIBILITY. As a general rule, tropical forages tend to have more lignin

than do temperate forages. The lignin is not only indigestible but also reduces the digestibility of some of the cellulose in the plant. This lower digestibility causes the material the ruminant eats to remain in the rumen for a longer time. The result is that the animal not only is getting less from what it eats but it cannot eat more until the rumen empties. A profitable area of research is developing varieties of forages or introducing new species which give greater yields and have a greater digestibility and a better balance of nutrients. The lushness of a field of tropical grass can be deceiving.

For information or seeds for tropical pastures I most often refer to *Better Pastures for the Tropics* updated in 1992 by Frank Sauer and Sons, P.O. Box 117, Rockhampton 4700, Queensland, AUSTRALIA. This 77-page, glossy,



magazine-size book with many color pictures and line drawings is both attractive and instructive. At A\$20 (about US\$15), it is still a considerable bargain. Chapters include improving tropical and subtropical pastures, establishing pastures, selecting species and mixes, seed quality, management of improved pastures, pasture grasses, and pasture legumes. They also have sowing guide tables that list rainfall range, seeds per kg, sowing rate, and tolerance to drought, water logging, frost and low fertility. When writing them be sure to ask for their seed price list. I know of no other source for many of these seeds.

A Guide to Better Pastures for the Tropics and Sub-Tropics was first published in 1980. (In May 1995, a new edition is under revision.) The foreword says it "is now well established as an elementary text" on the subject. The chapter titles are similar to the Sauers book, except for one on pasture species for irrigation or high altitude country. It has fewer pictures but appears to have more text and perhaps to cover more plants. For both books and many related, more specific publications, ask for the current booklist from the Tropical Grassland Society of Australia, Inc., c/o CSIRO, 306 Carmody Road, St. Lucia, Queensland 4067, AUSTRALIA. Credit card orders can be made by phone (07-3770209) or fax (07-3713946).

'ALFAGRAZE,' A FORAGE ALFALFA. Many of us know alfalfa as a nutritious, temperate, leguminous, hay crop. We usually do not think of it as a species to be grazed. After 12 years of testing and development, scientists at the University of Georgia have developed the high yielding, grazing tolerant variety called 'Alfagraz'. This cultivar is based on a broad genetic base of 22 cultivars and 1,100 introductions, but was developed for the dual purpose of grazing and hay production for farmers in the States. We do not know how it will do overseas. Dr. Clarence Bryner, a consultant in pasture projects, believes it merits trial and has purchased enough to enable our readers to give it a try. To stand any chance of success at all the pH of your soil must be over 6.5 and you must be able to protect the alfalfa from grazing animals until it reaches full maturity. (After establishment it can be kept grazed to 4 inches/10 cm.) If your work involves peasant farmers, you know the pH of your soil to be over 6.5 and you can protect a trial from grazing, we can send you a small amount of seed.

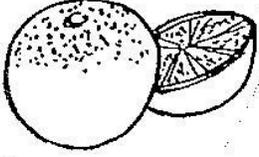
BUCKWHEAT IS A FAST CROP FOR COOL AREAS. One of the most important questions faced by our readers is how to feed animals when farmers cannot purchase commercial rations. Please write us about your personal experiences in this area so we can share your ideas with the rest of ECHO's network.

John Troesle says that he gets a crop of buckwheat (*Fagopyrum esculentum*) in about two months in Monte Verde, Costa Rica. They are near the "cloud forest" at something over 3,000 feet (1000 m). Potentially this could give several crops per year. It does best in cool, humid climates and is known for being disease-free. It is an excellent crop for beekeepers too. It is normally grown in northern temperate countries. In parts of Poland and Russia it is a basic item in human diets, but is used mostly for animal feed in the States. However, I had sourdough buckwheat pancakes nearly every morning during winters when I was growing up in Ohio and still love them (although those who did not grow up with them don't seem to like my pancakes as much as I do!).

I asked Dr. Hill at N. C. State University about its usefulness in animal feed. It is not as palatable as most cereals, so should not be used in more than 1/3 of the ration. It is best to grind it for all animals except for poultry, which apparently do well eating it whole. It is a substitute for grain in dairy rations. The nutritional value is about 10-15% less than oats. In the States yields range up to 40 bushels per acre. When used in too high a concentration in pig rations it makes soft pork. This means that fats are too unsaturated and tend to be runny. (Because unsaturated fats are said to be less likely to lead to high cholesterol levels I wonder if pork that is more unsaturated might not be a great

thing for human nutrition.) If you are in a region where it is cool and moist, but with no frost, for at least two months, this might be an interesting crop to try.

CAN CITRUS RESIDUE BE USED FOR ANIMAL FEED? Someone in our network asked us this question. The following is abstracted from a University of Florida bulletin "Citrus Feeds for Beef Cattle." Although the bulletin is directed toward cattle, similar results would probably be found with other ruminants. To the best of my knowledge the residues are not fed to monogastric animals such as pigs or chickens, because much of the material would be indigestible.



Dried citrus pulp is high in calcium and digestible energy, but low in digestible protein and phosphorus. (What is the difference between, for example, "digestible" energy and just plain energy? Just because something is present in a food does not mean an animal's digestive system can make use of it. Only the digestible protein is available to an animal; the rest is excreted in the manure.)

When good quality citrus pulp makes up no more than 40% of the ration, and is properly supplemented with protein and phosphorus, it has a feeding value 85-90% of shelled corn. It is highly palatable, i.e. is readily eaten. (We have purchased beef feed containing citrus residue. The smell was wonderful.)

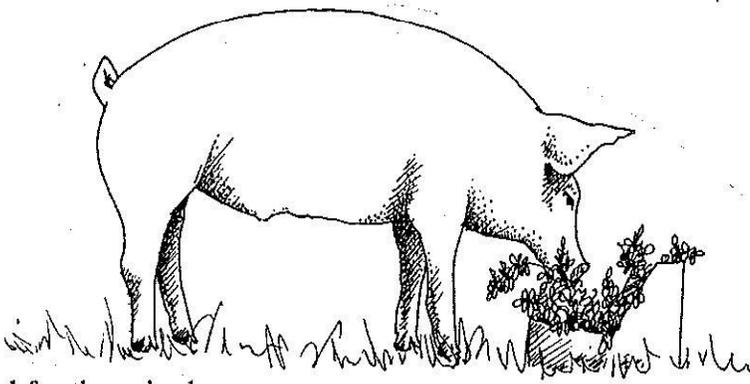
Citrus pulp is classified as a "bulky concentrate feed" because it is a bulky material that is also relatively high in digestible energy. Because it is relatively low in protein (approximately 6%) it is primarily an "energy feedstuff with roughage properties." The bulkiness of citrus residue limits how far it can be transported economically. The volume can be greatly reduced by pelletizing. Its density can be increased from 13 pounds per cubic foot to 42. The reduced volume not only makes transportation less expensive, but also cattle can hold more and might gain a bit faster.

Dried citrus meal (the material that passes through sieves while dried citrus pulp is being made) can be used as a substitute for cottonseed or soybean meal.

The more relevant question for most of our readers, who will not have the facilities to process citrus waste, is the feeding value of fresh wet pulp. It is not widely used today in the States because of the expense of transporting and handling a material containing 70-85% water. Fresh grapefruit was fed routinely by Florida farmers before the dried product became available. Fresh grapefruit is more palatable than orange pulp.

The greater the water content of the pulp the lower the nutritional value. It is basically a carbohydrate (energy) feed, so supplements are necessary. If fed in a feedlot, supplements must include protein, a dry carbohydrate material, a source of roughage, vitamin A and minerals. If fed as a supplement to pasture, it is important to also feed protein and minerals. During the 1940s, several experiments were done on making silage from citrus waste. Including some hay or sugarcane improved the quality and palatability.

IS THERE A BENEFIT TO HAYMAKING? When compared to making hay, much less work is involved if livestock are simply allowed to graze on dead grasses during the dry season. "A major benefit of haymaking is that the nutritional value of green grass hay is substantially better than standing brown grass. Nitrogen content was on the average more than 50% higher in hay, and *in vitro* dry matter digestibility of hay [Ed: a laboratory test to estimate how much of the material a ruminant animal can digest] was 60% greater in a study conducted by the International Livestock Center for Africa." (Taken from the *International Ag-Sieve* #6, 1992.)



RAISING PIGS ON MORINGA LEAVES is a system developed by missionary Paul Ronk in Jeremie, Haiti. Some people object to raising pigs because "pigs eat people food" and compete with humans. Paul tested and introduced a new feeding system based on moringa and leucaena leaves.

Every pig in Haiti was killed in 1981 because of the threat of an outbreak of the highly contagious

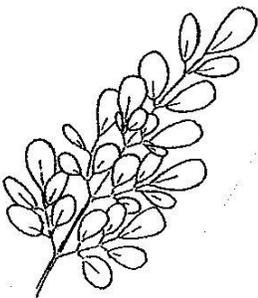
African swine fever. Paul Ronk first went to Haiti to assist the U.S.-supported repopulation efforts which began in 1985. He found that the intensive production systems promoted along with the new pigs taken to Haiti were unsuitable for most Haitian farmers. Farmers were taught to use commercial hog feeds which were not too expensive initially but soon were priced far beyond the reach of small farmers. Paul witnessed many failures in the reintroduction projects due to the lack of adequate feed for the animals.

In 1991, the Ronk family moved to Jeremie in southwest Haiti. There were no pigs in the area when Paul arrived, so he decided to design and test a pig production system appropriate for the Haitian farmers. Before going to Haiti in 1987, he had spent several days at ECHO, and what he learned about trees with nutritious leaves led him to design a leaf-based feeding system which did not compete with humans for food. Four years later, the program has distributed 418 pigs. He estimates that now there are 5000 pigs in an 80-mile radius of Jeremie. Paul says that he must now address transport and marketing.

Regular food supply is critical to the health and successful raising of pigs. Farmers who wish to receive a pig are required to attend two weeks of training in which they learn the leaf-based feeding system, management of the trees, and basic veterinary care for their animal. They take home seeds of moringa (*M. oleifera*) and leucaena (*L. leucocephala*) for planting, and in six months an extensionist makes a field check on their farms to make sure the trees have become established. Paul reports that farmers have little trouble maintaining these species in his area. Farmers must have 100 trees each of both species before they receive their pig.

Farmers have a brief refresher course on veterinary care, then return home with a 12-week-old gilt (female pig) which weighs 30-40 pounds (13.6-18 kg). Monthly extension visits are made to each farm. Gilts reach 200 pounds (90.7 kg) in 12-14 months, at which time they are bred to selected boars. Piglets are born in 150 days; these pigs average 7 to a litter, while the world average is 8 and traditional Haitian pigs (before 1981) averaged only 3. The female pick of the litter is taken back to the mission at 8 weeks (about 20 lbs/9 kg), where it is nourished on commercial feeds for 3-4 weeks, until it is given to another farmer and the cycle begins again. Paul mentioned that the few weeks of commercial feed is not necessary, but is just a nutritional boost for the pig.

Moringa has many advantages in this system. Not only is it extremely nutritious and common in the area, it also withstands frequent severe prunings and can be cut short yet out of the reach of goats. Approximately 30 moringa trees, 10 leucaena trees, and a small quantity of other leaves such as banana and yam are needed to support each pig. The optimum diet in this system is about 70% moringa, 10% leucaena, and 20% other leaves. It is possible to feed pigs 100% moringa, but it is important that the diet not contain more than 30% leucaena, as the toxins have negative effects from infertility to death when given in high quantities. (Pigs with leucaena toxicity are identified by hair loss, a malnourished look, and inability to breed. If this happens, feed no more leucaena for 3 months and give high-protein feeds.)



Paul reports that the meat from these pigs is lean and tastes the same as pigs raised on other feeds. He describes the meat of sugarcane-fed hogs as fatty-watery. If sugarcane must be fed to the animals, it needs to be finely chopped--otherwise they expend more energy in chewing than they gain from calories. Dried leaves may make better feed, but Paul has found the drying process too laborious to justify the benefit in his situation. If you have questions for Paul Ronk, write him at Lynx Air International, P.O. Box 407139, Ft. Lauderdale, FL 33340, USA. ECHO will be EXTREMELY interested to learn of your results and/or innovations if you try this system.

NEEM SEED AS A FEED INGREDIENT. As more and more neem trees, *Azadirachta indica*, are planted in reforestation projects around the world, large quantities of neem seed are becoming available. We have written before of the usefulness of neem oil in making a home-grown spray for insects. Now four Nigerian scientists have shown that the ground seeds can replace up to 28% of the corn and cotton seed meal in a rabbit ration. (*The Journal of Applied Rabbit Research*, vol. 13, pp 125-126, 1990. We can send a copy of the article upon request.)

Fresh neem fruits were soaked for one day, after which the pulp was removed manually and discarded. The seeds were washed, dried several days, then ground. Four diets were prepared, each calculated to contain 18% protein. Each diet was fed to a set of nine rabbits and statistical studies were made of the results.

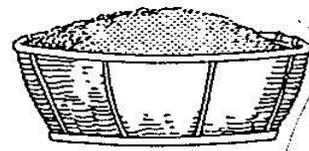
Feed Ingredient Diet Composition (%)

Neem Seed Meal	0	10	20	30
Corn	54	45	36	27
Cotton Seed Meal	18	17	16	15
Fish Meal	2	2	2	2
Blood Meal	2	2	2	2
Rice Hulls	20	20	20	20
Bone Meal	1	1	1	1
Limestone	1	1	1	1
Salt	0.5	0.5	0.5	0.5
<u>Vitamin/mineral mx</u>	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>
<u>Total</u>	<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>
Number of Rabbits	9	9	9	9
Avg. Daily gain(g)	12.1	14.5	11.1	2.14
Avg. Daily Feed Consumption (g)	69	74	74	49
Deaths	0	0	0	3

The statistical analysis showed that the greater daily gain with 10% neem seed meal is statistically significant. The authors speculate that the foul-smelling odor of neem seed meal and bitter taste account for the lesser amount of feed eaten with the highest level of neem.

Note that in these experiments the entire seed was ground. Many farmers might prefer to extract the oil first. This would presumably remove some of the bitter tasting substances. The extracted meal would contain a higher percent of protein, but less energy. Without the oil, the extracted neem seed would presumably more closely resemble the cotton seed meal (meals have had the oil removed) than corn. I would speculate that it could replace cotton seed meal or even soybean meal.

HOW SHOULD I TREAT SOYBEANS SO THEY CAN BE FED TO ANIMALS? Dick Both in Haiti asked us this question. Like many of you, he has found varieties of soybeans that do quite well. They are one of the best sources of protein supplement for animals, a difficult problem on the remote, small farm. Chickens and pigs, for example, are supposed to be fed over 15% protein, yet even a pure corn diet would not go over 10%. Raw soybeans, however, contain a substance called a trypsin inhibitor. It renders the enzyme trypsin incapable of digesting food. This helps protect soybeans from pests, but is a serious nutritional problem.

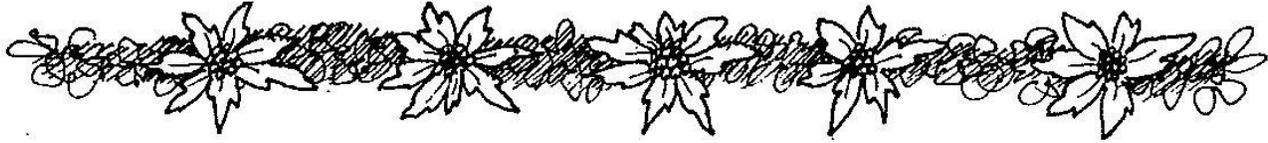


Commercially, the oil is expelled from soybeans and the meal is heated. The heat destroys the inhibitor. Not many of you will have the equipment to expel oil. I asked Dr. Charles Hill in the Poultry Science Dept. at North Carolina State University for advice. He said that they use an autoclave, heating ground soybeans in about a 1 inch layer for 15 to 20 minutes at 15 psi. He thought that if you could rig up a device to provide steam heat at atmospheric pressure, 30 to 60 minutes would be adequate. It is best to grind the beans first. Dr. Garren at Western Carolina University said he has found that 10% raw soybeans was acceptable in rations for laying hens.

Several of you have asked for a commercial appropriate technology oil expeller. You might want to write to S. P. Engineering Corp., P. O. Box 218, 79/7, Latouche Road, Kanpur, INDIA. (They have several models of "table" oil expellers which were designed for cottage industries. Models require either a 3 or 5 horse power motor.) A source of information about the Sundhara village oil expeller and other designs is FAKT, c/o M. Dietz, R. Metzler, or C. Zarate, Buro Furtwangen, Stephan Blattmann Str. 11, 78120 Furtwangen, GERMANY; fax 49 772 35373.

SUGAR CAN BE USED IN PIG DIETS. I do not know how cost effective this would be, but with the depressed prices of sugar it might be of interest to you. The April 1986 issue of *Agricultural Science Digest* summarized a report in *Australian Agriculture* that pigs will grow faster and produce a better quality carcass if they eat plenty of sugar. Sugar was used to replace the cereal content of a normal ration. Pigs were switched to a 75% sugar and 25% soybean, meat and blood meal plus trace elements diet when they weighed 25 kg. Pigs on the sugar diet reached their 80 kg slaughter weight 10 days earlier than those fed conventional rations (710 g weight gain per day compared to 612 g).

The carcasses of the sugar-fed pigs was 80% edible compared to a more normal 75% for pigs fed the control diet. The authors point out that because sugar has no fiber content, protein sources that are too high in fiber to be used normally in pig rations can now be used. (The only problem with the low-fiber diet was some diarrhea the first day.)

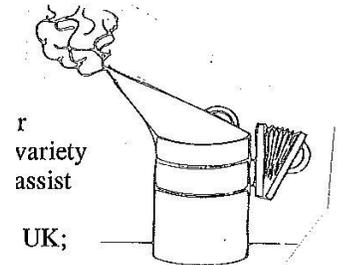


BEES

BEEKEEPING & DEVELOPMENT, AN "EDN" FOR BEEKEEPERS. This quarterly networking newsletter specializes in information related to all aspects of beekeeping in the tropics and subtropics. A typical issue contains: news briefs related to past, present, and future happenings around the world; practical beekeeping tips, like how to make your own smoker, how to build a hive out of mud bricks and concrete, and queen rearing with African bees. Feature articles deal with case studies and special issues (e.g. tropical trees for beekeepers). Useful bits of information related to job openings, books, meetings and resources of interest to beekeepers in the tropics round out each issue.

One tidbit we recently picked up is how to use a paper clip (with 4 mm inner measurement) as a queen excluder. Newsletter subscriptions (4/year) are £16.00 (US\$35).

Folks living in developing countries may also pay by beeswax barter or request a sponsored subscription. In addition to the newsletter, they distribute a variety of educational materials, provide free expert advice to those on the field and can assist in project planning and implementation, teaching, organizing seminars, preparing documentation, etc. Write Bees For Development, Troy, Monmouth, NP5 4AB, UK; phone: 44(0) 16007 13648; fax: 44(0) 16007 16167; e-mail 100410.2631@CompuServe.COM.



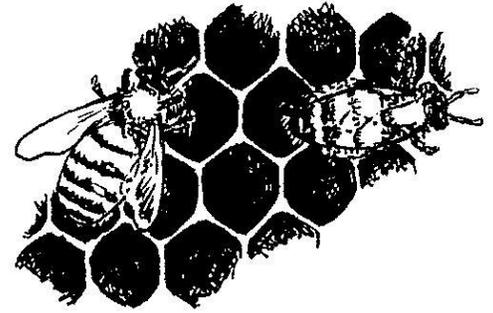
INDEPENDENT STUDY COURSE ON TROPICAL BEEKEEPING. The University of Guelph publishes many independent study courses on topics in agriculture. The course "Tropical Beekeeping" was written by Dr. Townsend who wrote the article on trees for beekeepers in EDN. It is based on his experiences in directing apiculture programs in Kenya and Sri Lanka and consulting in South and Central America and elsewhere. It details the behavior, management and pests of the African, Asian and Africanized bees, and examines beekeeping in the South Pacific and Caribbean. Processing, marketing, hive designs and protective equipment are also covered. There are 120 color slides on microfiche, a text, a cassette tape and a fiche viewer. The cost is C\$70, (about US\$50) including surface postage. Write to Independent Study, OAC ACCESS, Univ. of Guelph, Guelph, Ontario N1G 2W1, CANADA; e-mail to request a catalog is handbook@access.uoguelph.ca. They also have an advanced apiculture course for C\$225 (Tropical Beekeeping is the last part of the latter).

BEEKEEPING OF THE ASSASSIN BEES/LA ABEJA AFRICANIZADA. (Review by Dr. David Unander.) Since being introduced into Brazil in 1957, African honeybees have been spreading through the tropical and subtropical parts of the Americas. They readily interbreed with the honeybees of European ancestry, so that today it is correct to speak of the honeybees through much of Latin America as being Africanized; that is, most of the wild bees and many of the bees in hives now have at least some African ancestry and behavior traits.

Can Africanized bees be successfully kept, or are they too dangerous? The newspaper where I live, normally not overly hysterical, once devoted the cover story of its Sunday magazine to predictions of great personal danger to citizens and grave economic loss to farmers as the "killer bees" begin to arrive in California. Dr. Dario Espina-Perez, a Latin American entomologist and beekeeper, disagrees strongly with this B-movie scenario in his excellent book.

He begins with a very interesting chapter on tropical apiculture (beekeeping) per se. He discusses, for example, problems with heat, humidity, termites and dry seasons; various options for hive construction; how to move established wild colonies from undesired places, such as the eave of a house, to a hive; evaluating the apiculture potential of a region; and problems from agricultural insecticides. A chapter on African honeybees describes in what ways they differ from their European cousins. In particular, they are smaller, tend to swarm more often, are more aggressive and seem to produce 50-100% more honey.

He carefully makes the point that all bees are aggressive some of the time. The aggression of Africanized bees has been found to vary with region and altitude. The higher the altitude, for example, the more pacific their behavior becomes. (I hope this is good news for some of you living in mountainous areas). Like all honeybees, they are most aggressive when they perceive their hive as being threatened, and least aggressive when collecting pollen (unless directly stepped on). There is a chapter on bee aggression; how it is regulated in the hive, how a stinger works, different human reactions to the venom, including allergic reactions and, of great value, a list of medications to have on hand for various numbers of stings and reactions to them.



After this foundation, there are four chapters with recommended management techniques for Africanized bees organized under: (a) controlling aggression, (b) controlling swarming, (c) controlling migration, and (d) miscellaneous tips. He has a well-developed plan for maintaining breeding colonies of both European-ancestry and local Africanized bees, with hives for honey production using hybrid bees. There is a good discussion of where to place--and where not to place--Africanized hives. For example, Africanized bees do not like vibrations from highways nor strong smells of any origin near the hive. Also there is a review of necessary bee-keeping equipment. I learned that Africanized bees react most negatively to dark colors, better to white, and best of all to orange. There are various recommendations for hive dimensions and openings, honey harvesting schedules, keeping track of new queens, and other management techniques, in order to control the swarming and migratory tendencies of these bees.

Additional ideas are contained in five appendices. There are also some pages of references. One appendix contains the minutes from a question and answer session between Honduran beekeepers and a round table of entomologists and beekeepers experienced with Africanized bees, followed by detailed recommendations for Honduras beekeepers which were worked out at that meeting.

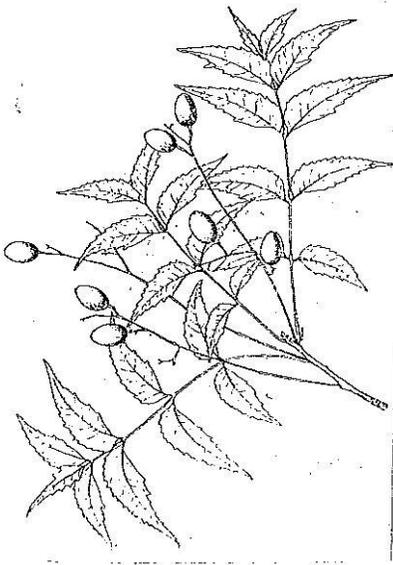
Excellent diagrams and photos illustrate successful apiculture operations with Africanized bees by various Latin American beekeepers. There are also photos of hive structures he advises against. Although the Africanized bees are not the "killer bees" of Hollywood, it seems clear that their aggression merits enough respect that some low-cost apiculture techniques which were previously acceptable in the Americas are no longer safe; beekeeping will now need greater forethought and some additional equipment.

La Abeja Africanizada by Darío Espina P., 158 pp., US\$4; or *Beekeeping of the Assassin Bees*, 170 pp., US\$6 are published by Instituto Tecnológico de Costa Rica, Editorial Tecnológica de Costa Rica, Apartado 159-7050, Cartago, COSTA RICA. If you are a beekeeper in the Americas, it would be a good investment.

Dr. Hal Reed, an entomologist at Oral Roberts University, wrote, "The review states that the Africanized bees readily interbreed with honey bees of European ancestry. This is not entirely correct. Recent evidence published in *Nature* and discussed at the recent National Entomology meeting indicate that very little interbreeding is taking place between the European and African strains. Indeed, researchers feel that the leading edge of the invasive population in Mexico is almost purely African, like the original bees introduced in Brazil. There is disagreement about the degree, if any, of interbreeding."

Dave Unander wrote, "Debate continues among scientists regarding the extent to which the African bees are hybridizing with European bees as they migrate northward. (All honeybees in the Americas are believed to have been introductions since Columbus.) If there is substantial mixing of the populations, it is hoped that the undesired behavioral traits of the African bees, such as aggressiveness, might be modified. At this time evidence seems to suggest that bees of purely African ancestry out-compete the hybrid African-European bees. Several prominent bee scientists believe they have data, however, suggesting that the advancing bees are hybrids. Whether they are or not, they so far do not seem to be changing their behavior. So all of the changes in beekeeping methods recommended by Dr. Espina continue to be relevant. As of the summer of 1991, African bees have entered the United States and are expected to ultimately establish themselves from throughout the southern USA to the temperate region of Argentina."

IS THE NEEM TREE HARMFUL TO HONEYBEES? Dave Morneau in the Central Plateau of Haiti asked us about the Haitian beekeepers' belief that neem (*Azadirachta indica*) or chinaberry (*Melia azedarach*) blossom nectar is harmful to honeybees, since leaves and seeds are widely used to control insects. We checked ECHO's library and found no written evidence to support this concern.



Neem: A Tree for Solving Global Problems reports that neem is benign to most beneficial insects, and "[insects] that feed on nectar or other insects rarely contact significant concentrations of neem products." The authors cite a study which found that "only after repeated spraying of highly concentrated neem products onto plants in flower were worker bees at all affected. Under these extreme conditions, the workers carried contaminated pollen or nectar to the hives and fed it to the brood. Small hives then showed insect-growth-regulating effects; however, medium-sized and large bee populations were unaffected."

Beekeeping in India mentions that neem is an erratic producer of nectar, but that the chinaberry does not seem to be visited by bees. Another source lists neem in its list of common nectar sources for Sri Lanka, flowering in May and June. A table in *Agroforestry in Dryland Africa* shows that providing fodder for bees is a major use of neem and a secondary use of chinaberry. Finally, the thorough *Handbook of Plants with Pest-Control Properties* does not include either neem or

chinaberry in its group of plants which are toxic to honeybees. A visitor from India told us that bees are used to pollinate the extensive neem orchards in his area. Based on our research, we cannot confirm the Haitian farmers' concern that neem could harm their beehives.

Dr. Nicola Bradbear with Bees for Development responded to this article. "Here at Bees for Development we have never received information that either [neem or chinaberry] is harmful to bees. On the contrary, both are frequently cited as excellent sources of pollen and nectar for honeybees (see for example *Honeybee Flora of Ethiopia* pp. 340-345). It would not be in the interest of flowering plants to produce pollen and nectar that are toxic to possible pollinating insects. ...In *Beekeeping and Development* 27 we carried news of research in India which indicated that [spraying with] neem derivatives did not deter three bee species from visiting coconut spathes having receptive female flowers with nectar. However the research did not indicate whether the derivatives were toxic to the bees."

WHEN HONEYBEES BECOME DRUNK. According to the October 1992 issue of *Apis*, drunk bees can be a problem. An Australian scientist studying beekeeping practices in Kenya observed strange behavior. Drunk bees had difficulty coordinating their actions. They may die or be unable to return to their hive. When they do make it to the entrance, strange acting drunk bees are rejected by the guard bees. Finally, drunk bees are more vulnerable to predators.

Apparently local beekeepers were feeding hives weak sugar solutions, which often fermented. Fermentation of weak sugar syrup can be avoided by feeding bees stronger solutions and/or ensuring that the sugar water is consumed quickly. "Because many beekeepers do feed sugar syrup during marginal times, this brings into focus another possible reason colonies might suffer either autumn collapse or spring decline in population."

HOW DO THE AFRICANS HANDLE AFRICAN BEES? I know of folks in the Americas who are giving up beekeeping because of problems that arose when the African bees migrated into their areas. On the other hand, a beekeeper told me of a government project that was proposed to some farmers in Argentina some time ago to supposedly get rid of the African bees there. The beekeepers were not interested because of the higher yields of honey with the African bees. Our readers in Africa work with these bees all the time, so I wrote to Neal Eash in Botswana and asked if he could recommend a practical beekeeping guide for handling African bees. He sent us an excellent book called the "Beekeeping Handbook." You can order it from the Beekeeping Officer, Dept. of Field Services, Ministry of Agriculture, Private Bag 003, Gaborone, BOTSWANA, Southern Africa. You can order them for \$2 each, postage paid by surface mail. There is a discount price of \$1.50 for 10 or more books.

I think you will find this basic 76-page book to be an excellent and practical guide. It is especially surprising to see

pictures of men and boys wearing short-sleeved shirts and shorts handling the African bees. Neal wrote, "My father kept bees. I remember putting on coveralls and heavy gloves, tying pant legs and shirt sleeves and we still got stung. It took a little courage here the first time I worked with bees in a pair of shorts, a T-shirt and straw hat, but I rarely get stung by this so-called 'vicious' bee anymore." He did mention that he recently was stung 7 times when a frame broke just as he ran out of smoke. The *Heifer Project Exchange* says the book can also be ordered from International Bee Research Assoc., Hill House, Gerrards Cross, Bucks SL9 0NR, ENGLAND.

ONE EXPERIENCE WITH BEES IN AFRICA. Herb Perry gave us this report of an experience with bees while at the Mt. Silinda Mission in southeastern Zimbabwe, located in a subtropical rain forest at 1500m elevation. "One day on returning to my home in a car, I found a large group of African children along with my own children inside the house where my wife was busy extracting bees from the children's hair. It seems they were all playing outside when suddenly the bees attacked and the children all ran screaming into the house. Once inside my wife took to dunking the children's heads in basins of water in an effort to remove the bees from the hair in which they were lodged. This seemed to work, but of course the bees' stingers remained in the scalp and the bees soon died. For about half an hour in the vicinity of our home, nothing moved without being attacked by an angry horde. After things had quieted down somewhat I ventured outside to survey the area. We had a flock of chickens, and they were all dead. We also had a cat which had recently produced a litter of kittens. The mother cat had disappeared into the forest, but the kittens were all dead. The mother returned eventually, but had been stung repeatedly all over her head. Our dog suffered the same fate. He also sought refuge in the forest, and also returned with many stings on his face. Laundry that had been hung on a line to dry, and which had blown in the breeze, had also been stung. The bees appeared to attack anything that moved. We can only guess at what made them become so ferociously hostile, but it has been suggested that perhaps a chicken had eaten one, or someone had carelessly swatted one. At any rate it was a terrifying experience for everyone, especially the children and the animals.

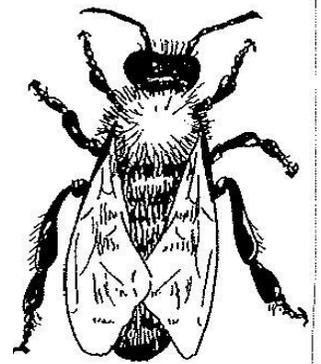
"In spite of the perils involved, many African families would harvest the honey from these wild bees whose hives were generally to be found in hollow trees in the forest. The honey was always very dark, very much like molasses in appearance. Generally speaking the honey would be gathered during the early morning or late afternoon, suggesting perhaps that the bees are inclined to be more docile during these periods."

STOPPING BEES. Suppose a situation arises where you must quickly eliminate an exposed group of bees. For example, a swarm is hanging in a school yard or a truck carrying hives has upset. How can you kill or immobilize the bees?

Dr. Eric Mussen, a California extension bee keeper, writes in his newsletter *From the U.C. Apiaries*, "The answer in many cases, especially in areas of Africanized bees, is 'soap water.' Mix one cup of dish washing detergent in a gallon of water and apply to the swarm using any sprayer. He says it is just as effective as using a flame thrower.

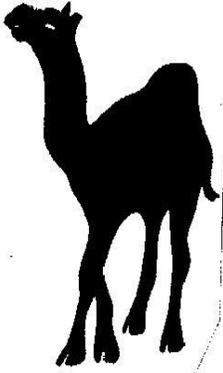
Dr. Mussen believes this works because detergents are "wetting agents." This means that water sticks to every surface of the bee instead of running off. The bees are unable to fly with wet wings [and perhaps heavier body weight when wet?]. The spiracles, or breathing holes, which normally are able to repel water, are entered by the "wetter" water, suffocating the bee.

Do not use it near a hive where it might get on the comb, if you want the hive to return to normal activity. [The above is based on an article in *Apis*, the state of Florida beekeepers' newsletter.]



CAMELS

INTRODUCING THE CAMEL, by Peter Grill. Lamar Witmer in Kenya sent us a copy of this unique book. He wrote, "I've read a number of books about camels. The one I am sending you is the one I believe to be the most useful as a single guide for development workers among pastoralists who herd camels. It emphasizes practical concerns rather than purely scientific ones. It was written from the perspective of eastern Africa, which may limit its usefulness in other regions.



"One of the problems is that it was printed by special project money in 1987 and only a limited supply remains." Well, we agreed that it was a practical and unique book that should be easily available. So it was reprinted by the Mennonite Central Committee Office in the USA for distribution by ECHO.

It is a 149-page, spiral bound book. Chapter titles include: habitat of camels; camel adaptations to heat stress; reproduction (reproductive habits, rutting behavior, signs of oestrus, oestrus cycle, coitus, pregnancy testing, parturition); raising camel calves; establishing a camel breeding herd; products from the camel (milk production, composition and products, meat, blood, hides and wool, misc.); the riding camel (uses, selecting, pace, selecting by age, training, handling, weight bearing, breaking the lead, riding saddle), camels as beasts of burden (potential uses, capacity, age for training, moving a camel train, loading a camel, types of baggage saddles, making a baggage saddle, draft camels, plowing with the camel, other uses as a power source); buying camels (marketing system, difficulties, selecting, determining the age); feeding and watering camels (eating habits, feeding management, watering, drinking rate); common camel health problems in Kenya (general health, signs of a sick camel, examining the camel, common health problems, diseases [protozoal, bacterial, viral, internal parasites, external parasites, other problems]); developing a record system.

An excerpt from the feeding chapter follows. "Camels are primarily browsers. This gives them an advantage over cattle because they will eat leaves from trees in addition to grass much more readily than cattle will. ... [This] makes them ideal animals to add to the livestock mix of commercial ranches. Some ranchers in Kenya have added camels to their cattle and small stock ranching system so that they can use the camels to open up new pasture areas for the small stock. In dense brush the camels are brought in to browse the bushes. This breaks up some of the dense brush so that the goats can come in and browse the lower branches. The goats thin out the foliage so that the sun can reach the grasses. The additional sunlight increases the growth of the grass so that the cattle and sheep have more to eat. ... they increase the carrying capacity of the land for cattle and sheep in addition to the meat and milk from camels who are eating what would normally be unused by the other stock." Available from ECHO for \$5 plus postage.

CAVIES



TECHNICAL NOTE "MEAT PRODUCTION ON THE SMALL FARM WITH CAVY (GUINEA PIG)" by Dr. Frank Martin, 6 pages. The cavy is a rodent that was domesticated in the Andes as a source of meat. Because it is small, it can be eaten by a small family in one meal and does not require refrigeration. The meat is much like that of a rabbit, with low fat content. The cavy multiplies rapidly, though not at the rate that folk literature would suggest. With breeding as recommended in the technical note, one pair might produce 260 new pairs in 2 years. The wide variety of foods that the cavy will eat is a benefit. In parts of Latin America, cavy breeds much larger than those common in the United States are used. Request the note from ECHO.

CHICKENS

IMPROVING BACKYARD CHICKEN PRODUCTION. "Probably more people are directly involved in chicken production throughout the world than in any other single agricultural enterprise," according to Dr. John Bishop, a poultry specialist who has worked extensively in Latin America and Africa to improve the production of traditional small-farm poultry. Maintaining and improving the productivity of backyard chicken flocks is important for the well-being of rural families.

Backyard producers value chickens for their adaptability, contributions to the family's income and nutrition, and for insect control and fertilizers in the garden. In most family flocks, chickens scavenge plant or food residues and insects around the home. With minimal care, they can hatch and raise chicks, produce high-value meat, and give eggs which meet a strategic nutritional need of children. Live chickens sold for meat bring a good price and are a primary source of household income. (This is why "new" fowl are not always quick to catch on in village settings: farmers raise chickens because they sell easily in markets--not primarily for home use or egg production--and it would be harder to sell more unusual birds.)



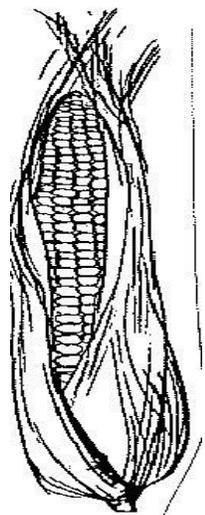
"The efficiency of backyard animal production lies in the fact that it utilizes excess family labor and surplus on-farm feed" with few purchased inputs, so income from sale of the chickens is virtually all profit. High-input, large-scale poultry systems are obviously not suitable for family flocks, and even "transitional" systems of 200-300 birds which apply large-scale technologies (such as hatchery breeds, balanced feeds, and artificial lighting and brooding) to small farms are rarely successful.

It is extremely difficult for families to maintain flock numbers and replace birds which are lost or sold if they cannot produce chicks on their farm. Buying replacement chicks from a hatchery is expensive and can be disastrous for household chicken production. Hatchery birds may require artificial incubation, disease control measures, or special feeds not available on the small farm. All these effects are serious for the farm family, but the loss of hens' broodiness (readiness to set on eggs for hatching) is particularly serious.

When hatchery roosters cross with traditional hens, flocks can lose their ability to hatch and raise chicks in just one generation. In Ecuador, for example, the commercial hatcheries surrounding the cities may "dump" their extra birds (mostly roosters) in rural areas at low prices. While traditional ('criollo') hens are selected for broodiness, superior egg-laying hatchery varieties are not broody or show only incomplete broodiness, such as laying eggs but not setting consistently. This can quickly make the farmer dependent on buying incubated hatchery stock, which may not perform well in backyard conditions. People who substitute them for criollo birds may have little success with incubator hatching methods in areas of erratic electricity.

Farmers who have encountered this problem learn quickly. Dr. Bishop told of a worker in the Amazonian region of Ecuador who was improving a flock to share with local indigenous farmers. When the farmers saw one white bird they said, "We don't want to contaminate our flocks." They then told how a specialist gave them "superior" white roosters, and they had to get rid of their flocks and start over with chickens from tribes that had not participated. Broodiness is a key link in the small-scale poultry production system, since the producer sells hens, not eggs. Of criollo birds in a backyard management situation, only one third of a flock usually lay each day; one third laid the day before, and the other third are setting or caring for chicks.

Dr. Bishop suggested that development projects make it their policy to avoid dealing in hatchery birds (even traditional breeds like Rhode Island Reds have lost most of their ability to successfully hatch eggs) and purchased feeds. He named the following key elements for economically viable family poultry production. (1) Use small-scale production systems with low purchased inputs and minimized risk. (2) Choose appropriate breeding stock which can incubate and brood replacement chicks by natural reproduction. (3) Apply the fundamental pest and disease control practices outlined below.

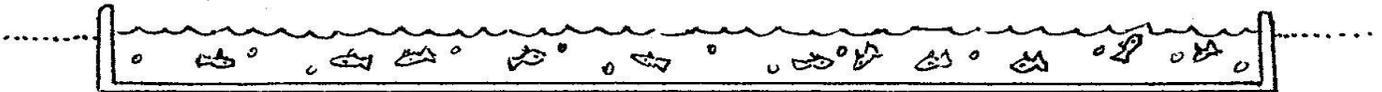


Basic, inexpensive disease control markedly increases the survival and productivity of a family flock. Traditional chickens that are vaccinated and treated for common infections and parasites are usually hardy enough to thrive in backyard conditions. The following four preventive practices, given every three months, will eliminate most health problems in poultry flocks: vaccination in the eye for the Newcastle disease virus (which is highly infectious and can kill the whole flock), deworming for roundworms and tapeworms, dusting under wings for irritating external parasites such as lice, and treatment for chronic respiratory disease which lowers production.

As for nutrition, the main limiting factor in traditional production is inadequate energy in the feed available to backyard birds. Scavenging chickens can usually fulfill their protein, vitamin, and mineral requirements, but are unable to obtain sufficient energy for adequate growth and egg production. Small amounts of supplemental grains such as corn can yield impressive results in weight gain and egg production. It is often more profitable to convert surplus grain into eggs and birds for sale than to sell the grain directly, since in many areas a chicken sells for more than a whole sack of corn.

Consider a permanent flock stabilized at 12 adult hens and one rooster. The farmer could let one broody hen set per month with 10-12 eggs and thus produce at least 4 replacement chicks per month, after losses in incubation and brooding. A hen takes about 4 months to raise her chicks, so at any given time about 4 of the 12 permanent hens would be caring for chicks, leaving the other 8 hens for egg laying. Without supplemental energy feed, the farmer would probably only get 2 eggs per day. By feeding the twelve hens one pound of corn per day, the 8 laying hens will give an average of 4 eggs per day. This system would produce 4 replacement chicks and about 10 dozen eggs per month. For the farmer, the broody hens likely earn more by raising 4 chickens for sale than the value of 4 months of eggs.

Dr. Bishop says that where the traditional flocks have disappeared or are being eroded, it is necessary to establish **multiplier flocks** of appropriate breeding stock which can naturally incubate and brood replacement chicks. He has a foundation breeder flock in Ohio of "Triple Production Reds" (meat, eggs, and chicks), and can provide a limited supply of hatching eggs for a starter multiplier flock. He is the founding director of the nonprofit ministry Poultry Development Service, 11806 SR 347, Marysville, OH 43040; tel: 513/348-2344. For more information on this subject and details on the disease control measures, write to ECHO for Dr. Bishop's Technical Note "Chickens: Backyard Production in the Humid Tropics." To inquire about receiving hatching eggs, contact Dr. Bishop directly.

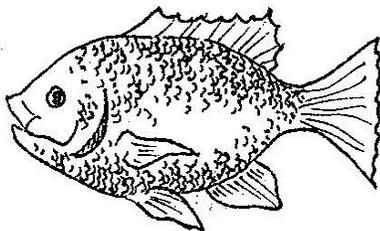


FISH

DRY FISHPONDS BECOME OASES OF PRODUCTIVITY. (Excerpted from *Spore* August 1994, p. 12.)

"Fishponds are a relatively new innovation for farmers in Malawi. ... [During the 1992 drought] farmers with fishponds were able to harvest the fish before the ponds dried out. ... the farmers were then able to plant vegetables in the pond. This gave them an extra crop when other farmers were unable to grow anything."

AUBURN UNIVERSITY IS EXCEPTIONALLY SUPPORTIVE OF PVO WORK IN AQUACULTURE. I



spent a stimulating week at Auburn University's International Aquaculture Program. I have never seen such a concentration of both faculty and graduate students who were eager for opportunities to help private voluntary organizations (PVO's) with aquaculture problems and opportunities! Auburn will assist you with technical information, ideas from their development experiences, and even "tailoring" training for visitors or requesters.

They offer an annual eight-week aquaculture training program (in 1995 it was July-September). The comprehensive course is designed for fisheries technicians and administrators, as well as for those who practice aquaculture with PVOs. The emphasis is on practical experience and techniques appropriate for developing countries. Cost in 1995 was \$4000 plus living expenses. Write to ATP Coordinator, Department of Fisheries and Allied Aquacultures, Auburn University, AL 36849-5419 USA; phone 205/844-4786; fax 205/844-9208. If you are looking for staff with expertise in this area, you may also want to

mention your need to Dr. Bryan Duncan of the International Center for Aquaculture at Auburn University; he may be able to refer some graduate students to assist you in your project.

CONSULTING HELP IN WATER RESOURCE MANAGEMENT, FISHERIES AND AQUACULTURE. The Auburn University staff are exceptionally knowledgeable about third world applications in these areas and have been ready to help with technical information.

Living Water International (LWI) started with Auburn scientists. Dr. Bryan Duncan writes that LWI "is an association of specialists in water resource management, fisheries and aquaculture. LWI was founded to provide information and technical assistance to Christian missions, and similar humanitarian organizations with limited resources working in developing countries. LWI associates hold graduate degrees in their specialties, and are experienced in working and living internationally.

"Specialists are qualified in the following: aquacultural production; freshwater capture fisheries; aquatic ecology and environmental assessment; site assessment and design of aquacultural facilities; harvesting and storage of surface water for multiple use; water quality; integration of agriculture and aquaculture; project feasibility, design, implementation and evaluation; education and training.

"LWI provides services, rather than funding, to other organizations. LWI may be approached directly by organizations desiring assistance, and a response will be tailored where possible to meet the needs and resources of the requesting organization. Write Living Water International, 805 Cary Drive, Auburn, AL 36830, USA."

NEW BULLETIN SERIES: WATER HARVESTING AND AQUACULTURE FOR RURAL DEVELOPMENT.

The Water Harvesting/Aquaculture Project (WH/AP) at Auburn University has designed this new series primarily for development workers and extensionists with little or no prior experience in the area. The booklets are very practical with a writing style that is easy to read and not overly technical (about half the information is presented in diagrams and illustrations). All are available in English, French, and Spanish.

The series contains 20 booklets so far. General manuals include: Transporting fish, Feeding your fish, Intro. to water harvesting, Eliminating unwanted fish and harmful insects from fish ponds, Intro. to polyculture of fish, Intro. to fish culture in ponds, Intro. to aquaculture, Fish culture in rice paddies, and Intro. to intensive cage culture of warmwater fish. Fertilization manuals are: Intro. to fish pond fertilization and Chemical/Organic fertilizers for fish ponds. Tilapia manuals include: Intro. to Tilapia, Reproductive biology of *Oreochromis niloticus*, Intro. to *Oreochromis niloticus* fry and fingerling production systems, Net enclosure system for *Oreochromis niloticus* fry and fingerling production, Production of mixed-sex *Oreochromis niloticus* fingerlings in earthen ponds, Culture of hand-sexed male tilapia, Single pond system for sustainable production of *Oreochromis niloticus*, and *Oreochromis niloticus* production in tanks.



We will share one helpful hint mentioned in the manual "Transporting fish." A key to success is, of course, to have plenty of oxygen in the container. If it is necessary to have very many fish in the transporting container, or if the trip is unusually long, the oxygen added at the pickup point (if any) may become exhausted. But if you can purchase hydrogen peroxide, which is widely available around the world in pharmacies, you can actually generate oxygen.

Dip a 2 liter plastic bag (26 x 26 cm) in clean water several times to get it wet, then shake to remove excess water. Place 1 gram of fish liver in the bag then crush it by hand. Add 40 ml of 6% by weight hydrogen peroxide, then quickly expel all the air and seal the bag with an elastic band and shake it. Within 5 minutes the bag will be filled with oxygen. Use a tube to connect the oxygen bag with the transport bag and squeeze to transfer the oxygen. Do not squeeze liquid from the oxygen bag as it may kill fish. If the transport bag is not completely filled, use a tire pump to finish filling it.

If none of this is possible, you should at least periodically bubble air through the container using a tire pump.

WH/AP intends to continue the series with new booklets being published and old ones updated as long as funding allows. Brochures are free of charge, although you may be charged for postage. (Specify language preference.) The

brochures are also available on floppy disk in MacIntosh format. They ask that development workers interested in obtaining copies have their field office write, listing the particular titles wanted, to Dr. Bryan Duncan, International Center for Aquaculture, Auburn University, AL 36849-5419, USA.

HOW TO GROW FISH IN THE MOUNTAINS is by Joe Richter, a missionary-biologist with FARMS in the Philippines. He wrote this book for the farmer and has done a good job of keeping it simple yet covering a great deal of practical information. Every one of its 37 pages is illustrated with one or more drawings. Topics covered are: why grow fish; common cultured fish; pond construction; fingerlings and their production; sexing brood fish; predators; fertilizing and feeding; integrated fish farming; harvesting; and common mistakes in growing fish. You may order the book from ECHO (\$5 including postage). Here are some excerpts.

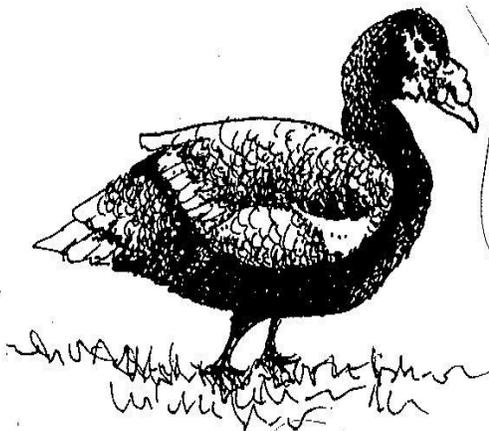
A simple test will determine if your pond site will hold water. "Dig several holes, a bit deeper than your intended pond bottom. Fill with water and observe. If the water still disappears after several fillings, the site may not be suitable for a pond. But if the water remains in the holes the soil is suitable for a pond." Because of the danger of theft, "submerged wire firmly staked into the pond bottom will hinder fishing and netting. Barbed wire may be necessary." Are all fingerlings of good quality? "No! ...inbreeding (breeding between relatives) will produce poor quality fingerlings. In-breeding is a problem in using fingerlings from your own pond, because some of your original stock will be related to each other. [Avoid] stunted fingerlings, fish that may be several months old but still are very small due to lack of food in the pond they came from. They may be already sexually mature and will quickly reproduce and fill your pond with unwanted fingerlings. These stunted fish will grow very slowly." Farmers in the mountains should produce their own fingerlings. "You will need a 1/2 meter deep brood pond that is easy to net and to drain. Initial brood fish need to come from a reliable hatchery. Stock one male for every three females. Stock at a rate of 200 kilograms of brood fish per hectare (e.g. 40 fish weighing 50 grams in 100 square meters)."

"For every kilogram of fish in your pond you can add 80-160 grams of wet manure daily. If your manure is dry, add only 20-40 grams." "Sunny days are best for manure application. The morning is the best time to manure, so the nutrients can be used during the sunny part of the day. Afternoon application can cause a loss of oxygen during the night which can kill the fish." "How do I know when I am fertilizing enough? An easy test is to bend over and place your hand under the water. If your hand disappears before your elbow reaches the water, the pond has enough fertilizer. You should never be able to see the pond bottom." "Carp will eat some of your fingerlings and may allow your tilapia to grow to a larger size."

THE INSTITUTE OF AQUACULTURE at the University of Stirling, Scotland, is a resource center which concentrates on nutrition, reproduction and genetics, disease, and environmental studies in aquaculture. They offer many (commercial) consultancy services. The Institute offers studies through the doctoral level, as well as several short courses. You may inquire about their publications and services at: Institute of Aquaculture, University of Stirling, Stirling FK9 4LA, Scotland, UK.

MUSCOVIES

MUSCOVY DUCKS FOR DEVELOPMENT PROJECTS IN THE TROPICS. We mentioned that both Frank Martin with the USDA and Fred Harder with the Heifer Project had told us that for really efficient meat production in the tropics we should be looking at Muscovy ducks. I asked if any of our readers could help us out from their own experience. We received some interesting replies.



Fremont Reiger in Botswana wrote, "Along with our rabbits and a few laying hens, we kept quite a few Muscovy ducks in Zaire. We had duck as our favorite Sunday dinner. We found them much more hardy than chickens--once you got them past the early few days. As hatchlings they were very susceptible to drowning in water, rain, getting killed by predators, etc. But once they were a week or two old, they were almost disease free, and grew very rapidly. We fed them chicken mash and often had a hen and her new brood on grass in a false bottom pen/house

combination that we moved each day over new grazing grass. I have seen Muscovy ducks in many countries under varied conditions. They seem to thrive everywhere. Taboos against duck meat were a problem in Zaire with some groups. Fencing is easy because ducks normally require a quite low fence. An occasional one may take off and end up outside the pen. We had to build some small pens to keep drakes away from new ducklings, for they would kill them. They do not need water to swim in, but need lots of water to drink, which they dirty quickly by mixing feed in their water. Setting hens also need water to wet their feathers to maintain incubation humidity conditions."

Cheryl Campbell wrote from Zaire. "I have had good success with Muscovies. Unlike rabbits, cattle, goats and local chickens, the ducks need no veterinary products or special feed requirements. Where we work we can never count on medicines or feed supplements. Muscovies like water but survive well on only a dish pan full. They breed readily on land and are not as well equipped for swimming as are other ducks. There is no need to make a pond for them. They are better foragers than most ducks. Here in the village they survive quite well on foraging only. They take much less care than rabbits.

"They come in various colors. Ours are black and white. The Africans think the black ones are less susceptible to hawks. We started with one male and two female adults. After 8 months we have had about 25 eggs to eat and 45 ducks of various sizes to eat. We had losses from drakes killing ducklings until we separated them. You must keep the ducklings out of the rain and tall wet grass. I keep them penned up in the rabbit house at night. In fact, I raise the ducks with rabbits because they clean up all the feed that the rabbits spill. Make sure that the feeder and waterer are close together and that the waterer is shallow enough that they cannot get trapped in it and drown. I use a basin with a small log in it so they can get out. They need to have enough water to keep their noses clean. Feeding can be just a nice lawn if you don't mind them wandering. They usually will return to their pen before dark. They eat insects and grass enough to keep them healthy. I supplement my older ducks with manioc flour mixed with very little millet and corn. Or I feed millet if I have a lot. They can survive from scavenging around the yard, but grow very slowly. When I can feed them a high protein ration with soybean flour or dried fish in a millet base during the first 2-3 weeks, they grow much faster.

"Nesting boxes need not be fancy, just a corner in a dry place. No floor or ceiling is needed: let them nest on the ground--fowl eggs often need the extra moisture. Provide some dry grass or straw for nesting material, then partition them from any disturbances in a 3-sided box. They lay about 9-16 eggs, then set for 33-35 days.

"Spacing in the pens is important because too many ducks can result in cannibalism. You will know when there are too many because there is a definite pecking order, with the youngest the most affected. After 3 age groups were put together we noticed the fourth group was not well accepted. So we put all the older ducks in a new pen and start to fill the old one again. Once they are old enough to defend themselves we can add them to the older ducks. Drakes especially tend to fight more if they are crowded. In other words, it is nice to have an extra pen."

Geoff Clerke in Papua New Guinea sent us a good 8-page mimeographed article called "Muscovy Ducks for PNG Villages." (We can send you a copy of this upon request.) Here are a few highlights. The Muscovy is ideally suited for PNG village conditions where farmers rely on natural incubation and foraging. You need good shade, because the ducks may get sick if they stay in the sun for long. Do not put them near a pig fence because hogs kill and eat ducks. If possible, feed commercial feed for 6 weeks. A duckling will eat about 3 kg. In the highlands you might need a brooder for extra heat for the first two weeks. To do this, make a small round enclosure about 1 m in diameter with flat iron, woven bamboo, cardboard, etc. and cover it with old bags, leaving an uncovered strip about 30 cm wide in the middle. Put a kerosene lamp inside the strip not covered by the bags.

After 6 weeks, ducks can be fed entirely on locally produced food: sweet potatoes, taro, banana, pumpkin, choko, etc. Ducks will eat anything that humans eat, but their food must be cooked. Follow this rule to know how much feed to give them: If they eat everything within half an hour they are still hungry; cook more the next time. If they start to wander away from the feed after half an hour and some is left, they have had enough. Feeding locally-produced feed is not enough. They must be able to graze/forage daily in order to get enough protein, mainly from insects and grass seeds which are not found on bare ground or in short grass. Even a very big fence is not enough because as soon as all the grass is finished it will become bare and hard from grazing and trampling. There must be no fence around a duck house: a fenced-in project is a project that will fail. It is better to have a few ducks lost to dogs or other predators than

to have the whole flock dying due to protein deficiency. Lack of protein will result in poor growth, never getting heavy enough to eat. Also, lack of feathers will let them get cold and die. Finally, they will never lay eggs.

In selecting breeding stock, choose the heaviest drake with a belly parallel to the ground. Do not keep any drake which looks like it is standing with the breast much higher than the belly. Do not keep more than 10 ducks for breeding; otherwise, it is probable that the garden produce will be in short supply to feed the flock and all the birds will do poorly. Hens can be kept for 3 years and drakes 2. Ducks start to lay at 8 and 1/2 to 9 months. The first eggs are small and should not be used for hatching, as they are likely to be either sterile or to give small and weak birds. If a duck does not lay eggs, it should be eaten or sold. It can be recognized because (1) it is heavier than the other birds, (2) the flesh around the eyes is red, like a drake, instead of being pink or orange, (3) the space between the two pelvic bones is about 1 finger wide instead of 2 or 3. Eat or sell ducks at 4 months unless they are to become breeding stock. [There is much more practical information like this in the PNG write-up.]

ECHO no longer has Muscovies. We found that muscovies would periodically swing through planting areas eating young vegetables. We fenced in the pond and clipped their wings to keep them in, but then predators killed most of them. When our local bobcat problem is not too serious, we maintain a flock of Khaki Campbell ducks, known for their egg-laying. Ducks are hardy, low-maintenance animals, suited for flooded areas in the tropics where chickens or other animals may not thrive.

Where can you obtain muscovy ducks? Try to obtain ducks in your own country. If this is difficult, you might ask Heifer Project (see above) for help in locating a source; they may know of one near you. Dr. Jim DeVries at Heifer Project said that Muscovy ducklings are especially difficult to ship, even in the States. If they do not receive special care within 48 hours, the losses will be high. It would probably be best to ship eggs, but they are very difficult to hatch in an incubator. He recommended that you hatch them under a chicken or duck.



RABBITS

INSIGHTS ON RAISING RABBITS IN THE TROPICS. I have talked with some development workers who have been very positive about the role of rabbits in their work. Others have been equally negative. Fremont Regier has worked for some time in Zaire and now in Botswana. He was recommended to me as one who is both successful and enthusiastic about rabbits. So I wrote and asked him why rabbits catch on with one person/place and fail with another. He not only sent a thoughtful reply to this question but included a write-up for volunteers called "Some planning ideas to remember when considering rabbit production as a church project." We will be happy to send you a copy of all of this upon request. Here are some highlights summarized for you.

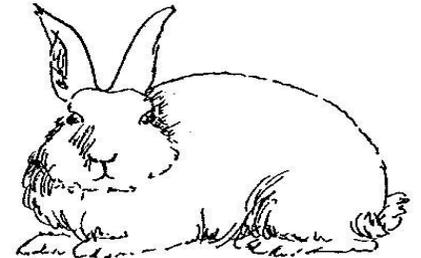
"In questioning many one-time rabbit raisers who later abandoned the work, I got many reasons why they stopped. Some said their rabbits died, others that they couldn't sell them, or that they had no food. In questioning other raisers who had continued to raise rabbits, I was told that rabbits do not die for no reason (hunger or ill care of dirty cages cause it), that these people had no trouble selling any rabbits they had and that feed was available. I surmised that in many cases it boils down to the fact that it just takes too much time and work for some people. Not that this is necessarily bad. But you can't raise rabbits with no work or with as little work as an equal number of chickens would take."

Another problem is the greater need for management. "A person can have a flock of chickens, throw them a bit of grain occasionally, shut them up in his kitchen at night and get away with it. Much more is required of the rabbit raiser. We found that it is best to start with a farmer who has had no experience with rabbits than with one who has

'raised' rabbits before under improper methods such as letting them run around the house. Also, farmers need regular visits to train, give new ideas, support, trouble-shoot etc. ...In areas where the traditional scavenger method of animal husbandry has been practiced, where animals are largely left to find their own livelihood, a fundamental change in attitude must take place for rabbits to be successful. To cage and regularly feed the animal is quite foreign, especially when the farmer and his family may be hungry. We must not underestimate this educational process."

To be economically feasible, the rabbit project must be based primarily on large amounts of green roughage. Though weight gain will not be as rapid, the gains will be inexpensive. The beauty of the rabbit in this situation is that it converts cheap roughage unfit for human consumption into meat of very high quality.

We then received an unexpected letter on the same subject from Gary Shepard in Nepal. "About 8 years ago I tried raising rabbits in the village, but nearly all the 80 young died and I gave up. Last fall I got a few tips and raising rabbits has caught on like wildfire now. The important points were: (1) Clean the pen daily, i.e., throw out all old grass, etc. (2) keep feed off the bottom of the pen by either building a feed rack or tying it up. (3) Make sure villagers build pens with bottom slats of bamboo or wooden rods so that it is as self cleaning as possible. (4) Avoid giving grass that is wet during the hot season. Though you might get away with it for a month or more, one day you will find that a bunch have died overnight. Cut grass in the morning and spread it out to dry excess moisture in a sheltered place (on top of the pen) and feed it in the evening. In the evening you can cut grass and dry it overnight. Rabbits do OK on a 90% banana leaf diet, but prefer a mix of foliage, weeds, etc. (5) Some books say not to give salt. This may be OK for cold climates, but if you don't, you risk the mother killing and eating her young, as is common here in the monsoon season. (I have never known it to happen to those who feed a little salt.) I put it in with a little ground grain made damp with water. Our villagers feed their rabbits a lot of mustard cake. They are far more profitable than chickens and require comparatively little grain."



We really appreciate receiving such letters. Let us hear from you about things experience has taught you.

KINNEY MITCHELL REPORTS ON HIS EXPERIENCE WITH RABBITS IN ST. KITTS. For some years we have followed Kinney's work with rabbits, which turned out to be quite a successful project. He kindly wrote up some highlights from his experience.

"We tried three basic diets. Rabbits that were fed 50% pellets and 50% green matter did best. Those fed only locally produced commercial pellets did second best. Those fed only greens suffered some losses due to feeding improper materials, but as a whole survived and grew, but not as fast.

"Many locally grown things that are considered rabbit feed turn out to be very harmful to rabbits. A healthy adult rabbit begins to suffer when these traditional bushes are introduced.

"We fed velvet bean, leucaena and banana leaves. Others added sugar cane tops, grasses and sweet potato and black-eyed pea (cowpea) vines. Most of our rabbits preferred velvet beans over other leaves (sweet potato, black eye pea, or green bean vines) or pellets, though a few preferred banana leaves. Bunnies began to eat the velvet bean leaves as soon as they could hop out of the nest box. We never had trouble from rabbits eating velvet bean leaves. They also ate the vine part. By the way, when cutting the velvet beans a brown stain got on my hands and clothes. This usually washed right off. [MLP: I stained my shirt with velvet bean vine and did not wash it off immediately. My wife, who excels in removing stains, could not save the shirt. Sweet potato vines will do the same thing.]

"We planted the velvet beans around the outside of the rabbit barn. They grew up the sides and actually covered the top of the barn. The shade helped keep the rabbits cool. The vines lived 3 years and grew vigorously, in both the hot and dry season. While we were heavily harvesting the leaves they would not make beans, but made tons of leaves. [Ed: Supposedly velvet bean vines die after the seeds mature. The lack of seed production is probably why these lived so long]. I guess the manure from the rabbits made them grow so well. Mice began to live in the leaves, but our cat kept them under control. We harvested the vines that hung over the front of the barn, and from the back and sides as they became too thick.

"Our barn is made from split bamboo for a roof. Once the velvet beans covered the roof, it was quite water tight and cool. We placed bamboo around the bottom to a height of 2.5-3 feet to keep out dogs and wire fencing on up to the top to keep out other things. The bamboo lasted 3 years.

"Our rabbits really liked the leucaena. They would eat the leaves and tender green stems and would also chew on the wooden stems. They seemed to enjoy pulling the soft bark off to eat and then chew on the wooden parts. We fed a lot of leucaena and never saw any problems, such as hair loss which is a reported problem with non-ruminants. Our leucaena are all improved types. Rabbits would also eat the dwarf wild leucaena that grows here if they were hungry, but it seems bitter and they did not like it very much. The improved leucaenas were preferred over pellets. Bunnies would also eat it as soon as they left the nest.

"Rabbits also liked banana leaves, which my tropical agriculture book says are very nutritious. The mature rabbits also liked the center part of the leaf, which has a celery-like texture. I cut the leaf away from the center part, then split the center 3/4 of its length. I could then hang these from the top of the cage so I did not need to worry about them getting soiled. Rabbits had to be very full not to eat all of them quickly.

"Rabbits also like the moringa and winged bean leaves, though we did not have enough of either to be very important.

"SOME PROBLEMS WE ENCOUNTERED [AND HOW WE ADDRESSED THEM]. 'I don't want to eat rabbit.' We invited 40 young adults from our Sunday school class for a party at our house and served rabbit--fried, baked, BBQed, stewed with tomato and rice, rabbit with rice, and rabbit salad. Everyone ate heartily--over 30 rabbits. After that we never had to worry about people being willing to eat rabbit. It is now a special meat for holidays and special occasions. I recently had to make 40 pounds of rabbit salad for a wedding reception.

" 'Rabbits do not need water.' The common belief here is that animals (cows, sheep, goats, rabbits) get all the water they need from the grass and leaves that they eat. Some time after the class for new rabbit raisers, one said to me, 'Brother Kinney, you cannot believe how much better my rabbits do when I give them water.' I told him his milk cow would give more milk too if he watered it--and sure enough it did.

" 'Rabbits can survive on local brush.' As mentioned earlier, those that ate a lot of local bushes soon got sick and died.

Rabbits that did not soon prospered and got fat. The smart raisers noticed the difference and changed their ways. The others would not listen to advice and soon had no rabbits.



" 'Rabbits will not grow in St. Kitts. They get diarrhea and die.' This belief has come about because of poor diet and a poor local strain of rabbit. The main rabbit raiser had a sickly, inbred strain. After he replaced his herd with our rabbits and changed his feeding, the diseases went away. We have a rule that if a rabbit gets sick, kill it. We do not try to doctor them. We do not want to keep sick rabbits around nor pass on any genetic susceptibility to disease. We have raised over 500 rabbits and butchered 300-

400 more. During this time we lost 1 to mastitis (infected mammary gland), 1 to an unknown disease, 1 broke its neck during a thunder storm (and several mysteriously opened their cage door, jumped out and re-latched the door). We started with 6 unrelated females and 2 unrelated males. The next year we added the same number of unrelated rabbits. We tattooed all the breeding animals and kept careful records so as not to interbreed."

RAISING RABBITS IN PITS. Jeanette Swackhammer in Cameroon writes that she has "heard of a method of raising rabbits in the Sahel where rabbits were kept in pits. The rabbits would then dig their own burrows in the sides of the pits and would come out into the middle to feed. Some sort of enclosure was made to cover the entrance to their dens in order that they could be caught." This keeps them much cooler. It obviously would not work in sandy soil, nor during a rainy season unless drainage could be provided. I would expect rabbits to select a site in the open pit where manure would be concentrated, in which case it could be removed. However, disease could spread rapidly if it entered the flock. If you have had experience with this, let us know.

NEST BOX BEHAVIOR OF RABBITS. At ECHO's weekly seminar our interns share highlights of what they have studied during the week. I found the article that J. R. Crouse summarized on nest box behavior of rabbits so interesting that I asked him to write it up for you. Some of the things we worried about when we got our first rabbits, I now know, were normal rabbit behavior. He based the following on an article by Dr. James I. McNitt and George L. Moody, Jr. in the *Journal of Applied Rabbit Research* (Vol. 10, no. 4, 01987; publication discontinued in 1992).

It may well seem that a doe does not take much interest in her offspring. Closer examination, however, reveals that the reproductive behavior of the domestic rabbit is apparently based upon that of its relative, the wild rabbit. "Non-interest" behavior towards kits may actually enhance their chances of survival in the wild. Unlike many other domestic animals, does only nurse their young once per day, and for only a short period. In the wild this behavior has survival value because the infrequent, brief visits to the nest area by the doe decrease the chance of detection by predators. Domestic does also will not retrieve their young if they climb out of the nest box. Wild rabbit nests are built at the lower end of the burrow, causing all strays to be returned to the nest by gravity. Thus, the wild doe has had no selected behavior for kit retrieval.

As mentioned above, the doe is in the nest box for nursing for only a short time. The blind kits benefit if they are ready to receive the mother for suckling. Observation by Dr. McNitt showed that at about 22 hours since the previous nursing, the kits actively gathered in a group on top of the nesting material. It is critical that each kit nurse, as a missed suckling period decreases its chance of survival. Rabbit raisers who cover up the young when exposed may be interfering with their preparation for nursing. A few seconds after the doe has entered the nest box, the young contact the nipple. This quick detection is facilitated by pheromones (chemicals the mother secretes which are detected by smell).

Does were further observed depositing a few fecal pellets in the nest box at each nursing. Kits showed excitement over this event and nibbled on the pellets. Dr. McNitt feels this normal behavior (different from definite nest fouling) may be a means of inoculating the kits with intestinal microorganisms.

Another interesting observation was urination by the kits during nursing. After nursing, the kits vigorously dug into, and fluffed up, the nesting material. These may be adapted behaviors to promote drying of the nest in order to maintain nest health. The nest is only wetted (and immediately dried) once per day, instead of continually being soiled.

When kits open their eyes at about 10 days, they are approximately three times as large as at birth and have greatly improved motor coordination. Because larger kits will displace smaller kits in the struggle for space in the nest box, the boxes should be removed as early as possible. This will allow ample nursing space and opportunity. Two weeks is the maximum time to keep young in a nest box.

MANUAL ON RAISING RABBITS FROM HEIFER PROJECT. Dr. Steven Lukefahr sent us a copy of his new book, *The Rabbit Project Manual: A Trainer's Manual for Meat Rabbit Project Development*. In addition to coordinating the International Small Livestock Research Center at Alabama A&M University, Dr. Lukefahr works closely with Heifer Project International assisting rabbit projects around the world.



Two things make this book different from most rabbit books in our reference library. First, it is written with Third World applications in mind. Second, it is a "trainer's manual," presented in the form of "Instructional Modules." Each module is designed to complement a development worker's own personal experience raising rabbits as he prepares lessons to share with others.

The book is divided into two sections: Instructional Modules and Stages of Rabbit Project Development. The 11 modules cover all the bases (breeds and selection, housing, feeds and feeding, reproduction, disease control, marketing etc.). Modules are well illustrated by diagrams, charts, and photographs and each one is followed by suggested lesson plans, training activities and helpful references. The second section, Stages of Rabbit Project Development, deals with the logistics of rabbit project development, covering: project feasibility, project design, project monitoring and project evaluation.

Copies of this spiral bound, 8 1/5" x 11", 103 page book are available by writing the publisher: Heifer Project International, P.O. Box 808, Little Rock, AR 72203, USA. A donation of US\$10 is suggested.

HOW GREAT IS THE DANGER THAT RABBITS MIGHT ESCAPE FROM YOUR PROJECT AND "CREATE ANOTHER AUSTRALIA"?

I asked this question of Fremont Regier in Botswana after he had been so kind in answering other questions. His reply follows: "I've heard this argument before but I believe it is a rather ridiculous one. The problem in Australia was caused by the introduction of wild rabbits, not of domestic rabbits. J. E. Owen in "Rabbit Production in Tropical Developing Countries: A Review," *Tropical Science*, 1976, 18 (4) pages 203-210 says, 'One aspect of rabbit keeping which causes concern to many developing countries is the potential threat of escaped domestic stock and their effects upon other agricultural enterprises. The unfortunate experience in Australia is probably responsible for this. It should be pointed out, however, that in Australia in the mid-19th century domestic rabbits were kept in almost every town and city. Those which were liberated or known to have escaped gave little or no trouble, except around Sydney where they became established and merely constituted a local nuisance. However, this problem paled into insignificance compared with the damage caused by wild rabbits which were introduced later on. All successful mainland invasions (of England, Australia, New Zealand and South America) have developed from the introduction of wild stock. But even in Australia wild rabbits have not spread into the tropical parts of the country.

"There are many instances of escaped domestic rabbits multiplying on small islands, to the detriment of the vegetation in both tropical and non-tropical climates. The burrowing habit has undoubtedly helped them to withstand periods of very high temperature and water shortage in warm countries. On large land masses such as Africa, escaped domestic stock are extremely unlikely to cause serious problems. On small islands with no natural predators, however, the situation may be very different, although the island of Malta has both wild and domestic rabbit populations and has suffered no such problems. In these situations expert advice from ecologists who are familiar with local circumstances should be sought."

The cited article by Owen is included in ECHO's Technical Note "Observations on Raising Rabbits in the Tropics." Also included is a review of some of the literature available from World Neighbors. The most unusual is a manuscript called "Commercial Rabbitry Handbook." This is written by two Ghanaians who have an interesting method of reducing labor and number of cages by housing rabbits in large groups which they call intensive gangs. Even does about ready to kindle are caged in pairs. Also interesting is a method called "rotary crossing" that they use to ensure that a uniform number of bunnies are produced each week even in a large rabbitry. Request this Note from ECHO if you are interested.



HEALTH AND PARASITES

TWO SERIES ON VETERINARY CARE. *Raising Healthy [Animals] Under Primitive Conditions.* These booklets provide a lot of information! Each booklet (80-180 pages) summarizes basic care of an animal, with housing and equipment, flock/herd management and nutrition, and disease and parasite prevention and control. The books are like summaries of a textbook on each animal. Nutrient components of various tropical feeds is particularly interesting. Medicines and dosages for common illnesses are also listed, for those with access to commercial treatments.

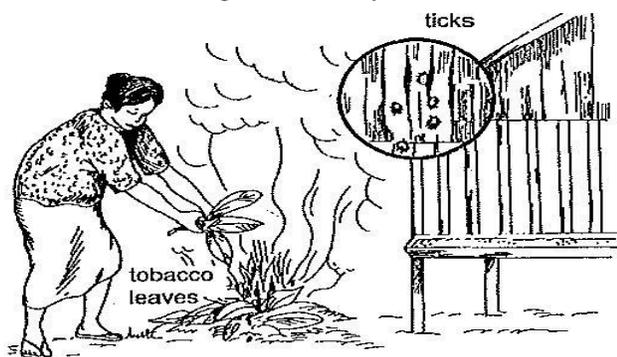
The booklets are written by veterinarians with Christian Veterinary Mission. Titles in the series include Pigs, Rabbits, Fish, Goats, Beef Cattle, Poultry (also in Spanish: Aves de Corral), and Dairy Cattle. Booklets are US\$5 each in developing countries, \$7.50 elsewhere. Books on Horses, Sheep, and Drugs and Their Usage are expected in 1996.

Look for: Slaughter and Preservation of Meat, Where There Is No Vet (in the style of WTINDoctor), and some translations of these books into Spanish and French in 1997. Write Dr. Leroy Dorminy, the founder of Christian Veterinary Mission, 19303 Fremont Ave N, Seattle, WA 98133, USA; phone 206/546-7343; e-mail ald@CRISTA.wa.com.

Ethnoveterinary Medicine in Asia: an information kit on traditional health care practices is another excellent publication by IIRR. This 4-part kit (400 pp.) outlines remedies using locally available plants and simple techniques. Traditional practices throughout Asia were collected and discussed among workshop delegates from seven Asian countries.

The booklets are in IIRR's very hands-on, well-illustrated style. The first book includes the preparation of medicinal plants, simple surgeries, and a list of all the ethnoveterinary plants (about 250) listed in the series. Many of the plants are weeds or food plants common in the tropics; some are specific to Asia. The other three books are on ruminants, swine, and poultry. Diseases are discussed according to symptoms, causes, prevention, and treatment. Practical dosages and complete instructions for preparing and administering the herbal medicines are given in every case.

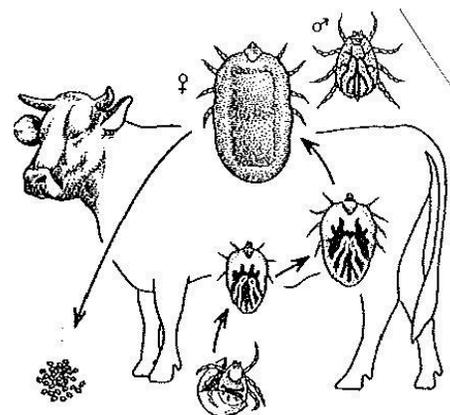
A few examples from each book should give you an idea of the material. For ruminants: treat constipation with a salted banana blossom; 10 plants used for internal parasites; safe management of infectious diseases; and simple housing models. For swine: treat piglet anemia with *Moringa* leaf extract; use *Leucaena* seeds to treat for roundworm; and various rinses for eye infections. For poultry: smoking bird houses for ticks, lice, and mites (see picture from the book); and how to care for infected wounds using oil and ash. To order: in the US, send a check for US\$17.25 payable to IIRR; overseas, pay only by int'l money order, US\$18 for overseas surface mail at IIRR, 475 Riverside Dr., Room 1035, New York, NY 10115, USA; phone 212/870-2992/fax -2981; e-mail iirr@cce.cornell.edu. In Asia, contact IIRR Bookstore, Silang, Cavite 4118, PHILIPPINES; phone (63-9-69)-9451/fax -9937; e-mail iirr@phil.gn.apc.org. Pay US\$11.40 in the Philippines, \$18 airmail within Asia.



NATURAL VETERINARY MEDICINE by Uly Matzigkeit. The Swiss agricultural information network, AGRECOL, has published a 183-page book on ectoparasites of animals in the tropics (i.e. in contrast to internal parasites). They see this as a sequel to their exceptionally useful book *Natural Crop Protection in the Tropics* by Gaby Stoll. Consequently, 80 pages are devoted to "Insecticidal, repellent and wound healing plants." The botany and propagation of the plant is summarized (often a botanical drawing is pictured to help in identification), then uses are briefly discussed and references listed. Sometimes I find this crucial how-to section frustratingly brief with many unanswered questions, but this is probably due to the inadequacies in the literature upon which they had to rely. A research scientist could find a wealth of research ideas by looking for these gaps.

The first 86 pages discuss the ectoparasites of primary importance. Each section includes a picture of the parasite (see picture from the book), a discussion of its life cycle, hosts, symptoms/damage and control measures. Some "gems" from the general discussion follow.

"Plant preparations applied for ticks should be applied especially when resistance to ticks is low. Some factors having influence on tick resistance are: (1) Livestock shows its lowest resistance in tropical autumn. (2) Female calves are more resistant to ticks than males. (3) Young cows are more resistant than old ones and sucking calves more than their mothers. (4) Pregnancy might lower resistance, especially in the last stage. (5) Lactation also lowers resistance, especially at the end of lactation.



"It is of great importance to assure a confrontation of cattle with ticks and tick vector diseases in areas where anaplasmosis and babesiosis is prevalent (not more than 10 engorged female ticks/animal!). Animals kept tick-free for

long periods will lose their immunity to these diseases and a heavy reinfection might be fatal. Newborn animals should not be kept tick free for the first half year, when they can gain a natural immunity."

The book can be ordered in English or French for about US\$25 plus postage from Margraf Verlag, P.O. Box 105, 97985 Weikersheim, GERMANY; fax 49-(0)7934-8156. The book is also available for 28.50 SFr (about US\$23) plus postage from AGRECOL, c/o Oekozentrum, CH-4438, Langenbruck, SWITZERLAND. By the way, we asked if an endoparasite book is planned, but it is not.

POULTRY IN TICK CONTROL ON CATTLE. Nicola Mears wrote, "Here in coastal Ecuador the area has been transformed in the last 20 years from tropical forest to cattle farms, so the ecology has changed dramatically. Perhaps this is why we have a population of ticks that is absolutely out of proportion. Controlling them has become worse over the past 5 years. All animals must be sprayed with insecticide at least weekly. Until a correct dose was established many cattle and horses were lost (and who knows how many children were affected). I am continually asked if there is a biological control for ticks."

The International Centre of Insect Physiology and Ecology in Nairobi says that poultry might be able to play an important role in reducing tick populations. A brief excerpt from *Spore* magazine quotes their studies as showing that engorged ticks generally drop from their hosts either late in the evening or early in the morning. This leads them to suggest that, if cattle are kept in their kraals [enclosures] at those times, and chickens are allowed access to the kraals, the chickens would pick up the engorged ticks.

Marsha Hanzi with the Instituto de Permacultura da Bahia in Brazil wrote, "Regarding ticks on cattle, this is also a serious problem in the Brazilian altiplano, where it has been successfully kept within limits with the guinea fowl. They have the advantage over the chicken of liking the hot climate and of adapting to the wild. They virtually become wildlife, living and reproducing without human aid.

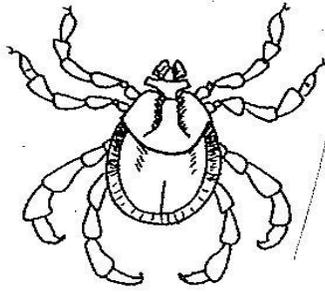
"Proliferation of ticks is a sign of soil degradation, at least here in Brazil. On our farm we had an outbreak only when the pasture became old, even though the neighbors farms were always infested. Healthy animals on healthy soil have relatively few ticks. I personally suspect it has to do with microelements which are often deficient in tropical soils. One homeopathic doctor suggested that adding a little sulfur to the cattle's drinking water helps increase resistance. It seemed to work in our case."

These comments were from L. E. Andrews in Houston, Texas: "I think the solution is with guinea fowl rather than chickens. They love to eat ticks, as well as beetles, spiders, flies, etc. A big plus is that they eat snakes. We have a lot of copperheads in this area. A friend bought some land that was infested with copperheads and some rattlesnakes. In 3-4 years after bringing in some guinea fowl you could not find a snake on the property. They eat the small snakes and gang up on larger ones, pecking them to death. They also eat young mice. They are the best watch dog you can have to alert you of any activity at night.

"I'd recommend raising the young (called keets) in a pen near the feed lot to help them bond to the cattle. Feed them just a little grain and a lot of ticks (you could hire kids to collect the ticks). When they are mature, they will form teams moving through the fields and feed lot. Feed them only a little bit, at night, in the feedlot with the cattle to encourage them to center around that area."

[Ed.: Thanks for the good suggestions. Beware, though, if you have a lot of mulched gardens. Several years ago ECHO obtained 12 guinea fowl because I read that they would go through gardens eating only insects and leaving plants alone. A week after we turned them loose on the farm we butchered them all. They did not eat the plants, but they were a disaster in our heavily mulched gardens. Their constant scratching quickly dug out some plants and buried others. If we did not use so much mulch they would have become a permanent fixture here.]

David Showalter in Paraguay said, "Concerning ticks, one farmer keeps chickens in a grove of trees, where they run loose. When the cattle come into the woods in the heat of the day, the chickens eat the ticks right off of the cattle. The cattle get used to this and do not seem to mind."



From Daniel Priest in Bolivia: "I just received the latest EDN and noticed that people continue mentioning chickens for tick control in cattle. Since I have had a little experience with this, I thought I would write.

"First, good 'indicus' (hump on the back) cattle are naturally very resistant. Crossing with European breeds usually gives potential for higher production, but also greatly increases the tick problem. There is a wide variation in degree of tick resistance in those cross-bred cattle, so selection can be very effective.

"Several years ago I bought Brown Swiss bulls to cross with Nelore. The bulls, and their progeny, had a very high capacity for picking up ticks. The cattle would come to loaf in the yard where we also raised chickens. The chickens would pick the cattle clean, even jumping a couple of feet in the air to grab a juicer, and the cattle seemed to enjoy it. A side advantage was the nutrition of the chickens.

"After about three years I started to notice indications of a significant transfer of fertility from the pasture to the loafing area. Because of this I stopped letting the cattle spend much time in the same area. Now, although the cattle do spend a little time near the chickens, both cattle and chickens seem to have lost the custom. Apparently the two must spend a good bit of time together to get acquainted and start to help each other out.

"A practice that is becoming more widely used in Brazil is the feeding of the aerial part of the cassava plant to cattle. It must be chopped and left for a day before feeding to lower the toxicity. Not only does it contain around 12% crude protein, but it controls ticks, probably due to the small amount of prussic acid remaining even after drying for a day. Although this practice is encouraged by Brazilian researchers, I still wonder if it might not adversely affect the beneficial micro-organisms in the rumen as well as the ticks." [Does anyone have more information concerning this? Perhaps an extension bulletin from Brazil?]

TICK CONTROL POTENTIAL. According to a USDA press release, young ticks died and adult ticks shied away when they touched extracts from an African plant, *Commiphora erythraea* (Haddi tree). A syrupy oil bearing the chemicals was made from the thick gum of the plant. "In Africa, the oil is rubbed on cattle to repel ticks and insects and soothe cuts, bruises and scabies. It is also used as a perfume because of its pleasant odor. The plant is closely related to myrrh, known for its Biblical reference as a gift of one of the wise men." We have been unsuccessful in obtaining seed for this plant, or even to learn any of its common names. Can anyone in Africa help with information or seeds?

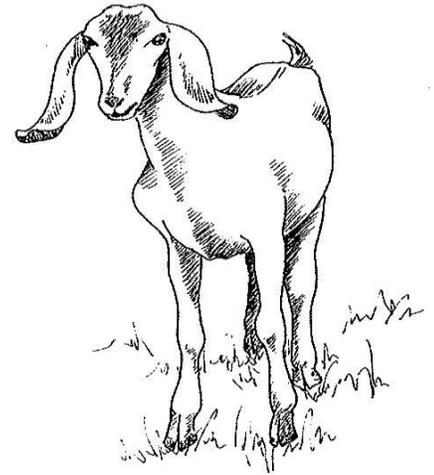
HOMEMADE DEWORMER FOR GOATS. According to the September 1991 *Sustainable Agriculture Newsletter*, some small farmers in the Philippines are using ipil ipil (*Leucaena leucocephala*) seeds to deworm young goats. About 50-100 young seeds are removed from the pods and are pounded to form a paste. This is mixed with 5-8 ounces of water and given to the goats as an oral drench. The laxative effect kills or expels the ascaris (*Ascaris lumbricoides*?) and other stomach worms.

VETERINARY STUDENTS AT MICHIGAN STATE UNIVERSITY ARE AVAILABLE TO ANSWER QUESTIONS. Since 1986, students in the veterinary department at MSU who have an interest in Third World development have been organized to help missionaries and others doing similar work when animal health problems perplex them. They get an average of 10-20 requests per year. There are two main ways in which they have helped people to date. (1) People have written with disease symptoms and they have tried to diagnose the likely problem. A few times someone from MSU or known to them has been traveling in the area and was able to actually visit to assist with especially difficult problems. (2) They have sent literature that they believe will answer a problem, or particular articles that someone has requested.

Contact the faculty director Dr. Edward C. Mather, Coordinator of International Programs, G-100 Veterinary Medical

Center, College of Veterinary Medicine, Michigan State University, East Lansing, MI 48824-1314, USA; phone 517/432-2388; fax 517/432-1037.

COURSE IN TROPICAL ANIMAL HEALTH AND PRODUCTION (IN FRENCH). After receiving his masters in horticulture from Florida, Pete Ekstrand went to the Prince Leopold Institute of Tropical Medicine in Antwerp, Belgium for a year of study before beginning work in Zaire. I could tell from his exciting letters that he was gaining much from the studies, so I asked him to write a bit about the school. "The course lasts for ten months (early October through June). It consists of two programs, one in animal health and hygiene and the other in animal production. In the first program we studied tick-borne diseases, trypanosomiasis, other protozoan diseases, insect control, infectious disease and the role of veterinarians in prophylactic campaigns. In the second we studied agronomy, fodder crops and natural pastures, animal husbandry, management of farms and stations, construction, molasses and non-protein nitrogen, agricultural by-products, trade policies, wildlife use, hydrobiology, fish farming, handling of hides and skins, biometry and statistics.



"So what do I think of it? I have thoroughly enjoyed the course! Although French is a second language and I was able to study it only four months, I have had no problem following and understanding the material, except for the expected new vocabulary. In fact, they greatly helped my French. The students this year are from Bolivia, Spain, Zaire, Benin, Ghana, Cameroon, Ivory Coast, Togo, Belgium and the USA (myself). It has been enjoyable and enlightening to talk with them about situations and potentials in their countries. The professors have had experience in developing countries and are current in what they teach. I have been impressed with their knowledge and understanding of all the parameters involved in development. I am sure the year will greatly benefit my future work in Zaire."

The only fee mentioned in the catalog is 42,000 BF registration, about US\$1400. For more information, write to Institut de Médecine Tropicale Prince Léopold; Département de Production et Santé Animales Tropicales; Nationalestraat 155, B-2000 Antwerpen, BELGIQUE; phone 32/3/2476666; fax 32/3/2161431.



BASIC SEED HARVEST GUIDELINES FROM ECHO'S SEEDBANK. VOLUNTEERS IN COOPERATIVE ASSISTANCE (VOCA) is a nonprofit organization which recruits volunteer consultants (farmers, executives, and specialists who are US citizens with at least 10 years' field experience) for short-term assignments in developing countries and emerging democracies.

