CHICKENS: IMPROVING SMALL-SCALE PRODUCTION

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INTRODUCTION

Domesticated food producing animals in the world outnumber the human population, two to one. There are thousands of animal species in the world, yet, only a few have been successfully domesticated on a permanent basis and none within the last 2000 years. In fact, five species (cattle, sheep, goats, chickens, and pigs) comprise over 95% of the world's farm animals and all five[1] are found in the humid lowland tropics. Of all traditional small-scale animals in the tropics, however, chickens are by far the most common --- as indeed they are worldwide[2].

The purpose of this paper is to help Third World families alleviate hunger and poverty by improving small-farm poultry production. Section I provides background information on small scale animal production and stresses the importance of poultry, while Section II focuses on the following three critical factors necessary for economically successful small farm poultry production:

1. Utilizing traditional small-scale production systems with low purchased inputs and low risk.
2. Availability of appropriate breeding stock that has the ability to hatch and raise replacement chicks by natural reproduction.
3. Application of fundamental disease control practices to prevent losses from common infections and parasites.

SECTION I: BACKGROUND ON THIRD WORLD POULTRY PRODUCTION

ROLE OF BACKYARD ANIMALS

Although many small farms in the humid tropics often lack an adequate land resource base for grazing ruminant livestock, almost all have some traditional small-scale animal production. In fact, the importance of backyard animals often increases as human population density increases. As human population density increases, small-scale limited resource farmers tend to place more effort on animal production in order to increase food supply and cash income from their farms.

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The major comparative role of grazing ruminant livestock is that of utilizing land resources of low agricultural potential, while the major comparative role of traditional small-scale animal production is that of utilizing available household labor and surplus on-farm resources. Utilization of these resources which commonly have very low or no opportunity costs is one of the major functions of traditional small-scale animal production.

Traditional small-scale animal production does not require heavy manual labor and is usually assigned to women and children, who normally have fewer off-farm employment opportunities. Surplus on-farm feed resources for backyard animals are of four types: 1) excess and/or unusable food crops, 2) crop residues, 3) household refuse, and 4) scavenger feed (e.g., weeds, seeds, insects, worms, etc.). The efficiency of traditional small-scale animal production lies in the fact that it utilizes excess family labor and surplus on-farm feed to produce important household income and high quality protein food.

Animals are valuable on the small farm because they 1) have high nutritional and financial value per unit of product marketed as well as high elasticities of demand; 2) often serve as living banks of stored capital, increasing in value through time similar to that of an interest-earning investment; 3) can provide important household income for children's medical and educational needs, a ready source of capital for financing on-farm agricultural investments, as well as financial and nutritional reserves during periods of adverse climatic fluctuations; 4) serve socio-cultural purposes (e.g., Bridal fees, religious feasts, etc.); 5) Can help control crop pests and provide high quality organic fertilizer for dooryard gardens. Thus traditional animal production fulfills multiple roles all of which help to enhance the household's survival potential and/or its quality of life.

IMPORTANCE OF THE TRADITIONAL SMALL-SCALE SYSTEM

Poultry production systems in the Third World can be divided into two distinct production systems: 1) traditional small-scale systems with low purchased-inputs and low risk, and 2) intensive large-scale systems with high purchased-inputs and high risk.

Large-scale intensive production systems, especially those producing broilers and eggs, are found throughout the tropics; but they represent only a small portion of the total animal industry in most areas. It must be emphasized that the large-scale intensive production system has not replaced traditional small-scale production in the myriad of villages and small farms throughout the Third World, and that countless millions of people still depend on traditional small-scale production for their supplies of meat and eggs.

The largest and most capital-intensive producers may have higher productivity levels but also require the most foreign-exchange for imported goods, have the highest feed costs per unit produced, and also displace the most labor. These specialized large-scale production systems are in fact "reverse protein factories." Intensive broiler and egg production systems, for example, utilizes from three to four grams of feed protein for every gram of food protein produced. The capital-intensive technologies (e.g. hatchery hybrids/breeds, artificial incubation, artificial brooding, artificial light, confinement buildings, balanced feeds, mechanized equipment, professional supervision, etc.) required for such specialized production are best suited (economically scale-biased) for large-scale production, and it is unwise to apply these on small farms.

"Transitional" production systems (i.e. the application of capital-intensive technologies to small farms) have been tried in the Third World since the 1950's. The results most often obtained with 200 to 300 birds per farm have been economic failures. Today one can find many buildings empty, chickens gone, money lost, and hopes dissipated.

Traditional small-scale production is best suited (economically scale-biased) for home flocks up to 50 hens. The major comparative advantage of the system lies in its production efficiency -- as there are few if any purchased inputs, and the gross income received from sale of animals and eggs is virtually the net income. The increasing costs of energy and purchased feed supplies have slowed down the intensification of animal production in most

tropical countries, and the traditional small-scale production system continues to have economic and nutritional validity. This is particularly true when utilizing appropriate breeding stock and low-cost disease control practices.

ADVANTAGES OF TRADITIONAL SMALL-SCALE CHICKEN PRODUCTION

The importance of traditional small-farm poultry in the production of protein food and household income is frequently overlooked[3] by leaders and promoters of rural development. Chickens are a natural choice to fulfill the roles previously mentioned in Section I. Furthermore, the small-farm chicken population can be increased more rapidly and with less cost than that of other food animals. The egg is also one of the highest quality and least expensive forms of animal protein available at the market place.

Chickens are among the most adaptable domesticated animals, and there are few places on the globe where climatic conditions make the keeping of a chicken flock impossible. Probably more people are directly involved in chicken production throughout the world than in any other single agricultural enterprise. Chickens are especially adapted to the humid tropics as they were domesticated from wild Asian jungle fowl.

Furthermore, chickens and eggs come in small "packages" and can be "stored" in hot climates under local conditions more easily than most foods of animal origin. Eggs keep their quality at room temperature without spoilage, for at least ten days to two weeks. Refrigeration is also not required for preserving chicken meat, as individual chickens can be easily kept alive until slaughtered for consumption.

Backyard Chickens vs. Backyard Swine

Pigs are frequently found in small numbers as traditional small-scale animals in most[4] areas of the humid tropics. Traditional small-scale pig producers, however, usually have only enough pigs to fully utilize surplus on-farm feed resources and not many more.

The major disadvantage of backyard pigs compared to backyard chickens is that pigs are very destructive to the dooryard garden, whereas chickens are in fact beneficial (i.e., by consuming weeds, insects, worms, etc.). For this reason, (pigs most often are tethered or penned which greatly reduces the availability of protein-rich scavenger feed. Whereas backyard chickens can balance their energy-rich feed (excess and/or unusable food crops, crop residues, and household refuse) with protein-rich scavenger feeds (seeds, insects, and worms), the first limiting nutrient for pigs most often becomes protein due to a restriction of scavenger feed. This lack of protein can be supplied by feeding supplemental oilseed meal. However, this purchased input, when available, can be very expensive and small-scale producers do not traditionally purchase feed for their animals.

The first limiting nutrient for backyard chickens, however, is most often energy that can be easily and economically supplied by feeding small supplemental amounts of farm-produced cereal grain[5]. It is therefore much more feasible for small-scale producers to expand chicken numbers than to expand pig numbers.

Backyard Chickens vs. Stall-fed Ruminants

Small numbers of ruminant livestock (cattle, hair sheep, and goats[6]) are sometimes raised in confinement on farms with limited land resources in the humid tropics. Stall-fed ruminants can utilize farm-produced forage protein better than backyard pigs. The numbers of stall-fed ruminant livestock, however, is seriously limited because of heavy manual labor required to cut-and-carry large amounts of forage. For this reason, even on very small farms, ruminant livestock are most often grazed out during the day and then penned in the backyard area at night.

STRATEGIC IMPORTANCE OF EGG PROTEIN

The purpose of this section is to show the strategic importance of egg protein (especially methionine and cystine) in helping to solve the malnutrition problem common to small children in the humid tropics.

Protein Malnutrition

Small children between one and three years of age are the most vulnerable to protein malnutrition, defined as a low-protein diet causing irreversible physical and mental retardation. Furthermore, weakened by protein malnutrition, their bodies are highly susceptible to infectious disease.[7]

Malnourished children have up to 50% higher incidence of diarrheal disease and suffer more severe attacks than well-nourished children. Diarrheal diseases are especially critical in that they also inhibit the absorption of nutrients, and thereby boost nutritional requirements. Diarrheal disease has long been recognized as the major cause of ill health and of death among small children in less developed countries (LDCs).

In addition, infections further increase the protein requirement because of the need to repair tissue damage done by infections. Protein malnutrition and repeated infections when combined form the greatest hazard to the health of LDC children who live in poverty.

The vicious cycle of protein malnutrition and repeated infection ends in fatal infection[8] in an estimated 30% of LDC children under the age or three. In addition, many children that "survive" this vicious cycle still face permanent physical and mental retardation. This vicious cycle can be broken only by provision of a diet adequate in protein.

Egg Methionine and Cystine Levels

In the past, protein allowances have been expressed in terms of total grams of protein needed. However, as knowledge of protein metabolism increases, the trend is now to recommend allowances for each essential amino acid rather than total protein. This approach is logical as dietary proteins are broken down to their component amino acids in the gastro-intestinal tract before absorption in to the bloodstream.

The essential amino acid in shortest supply determines the nutritive value of a dietary protein since all amino acids must be present at the site of protein synthesis in sufficient quantities for synthesis to occur. An equal percentage deficit of an essential amino acid limits protein synthesis to a comparable degree. The required pattern for the eight essential amino acids is shown in Table 1.

Lysine and the sulfur-containing amino acids (methionine and cystine) are the essential amino acids found to be first limiting in most LDC foods and diets (FAO/WHO, 1973). Table 2 gives the percent above or below the required level for these amino acids in selected energy-rich and protein-rich foods produced in the humid tropics. From Table 2, one can detect that methionine and cystine deficiencies are extremely critical[9] in the humid tropics where root crops and grain legumes are the major staple foods, and that eggs are especially rich in methionine and cystine.[10] In fact, one egg can supply over one-third the total protein and over one-half the methionine/cystine required daily by a child[11] between one and three years of age!

Eggs are also an easily prepared and highly digestible protein-rich food for small children from the age of six months onward. As a first priority, eggs should be fed to children in the household that are under three years of age. Chicken meat is relished, too, as it is a tasty and highly digestible food which is acceptable to most people.

Table 1. **REQUIRED AMINO ACID PATTERN FOR HUMANS.**

Amino Acid	Required Level (mg/g protein)
Isoleucine	40
Leucine	70
Lysine	55
Methionine + cystine	35
Phenylalanine + tyrosine	60
Threonine	40
Tryptophan	10
Valine	50

Source: FAO/WHO. Energy and Protein Requirements. FAO Food and Nutrition Series No. 7. Rome, 1973

Table 2. **RELATIVE AMOUNTS OF LYSINE, METHIONINE AND CYSTINE IN SELECTED FOODS PRODUCED IN THE HUMID TROPICS.**

Food	Lysine	Mehionine + Cystine
	-------(% of required level)-------	
Cassava	-24	-22
Yams	-25	-22
Sweet Potatoes	-37	-21
Cowpeas	+26	-36
Dry Beans	+33	-46
Pigeon Peas	+42	-56
Meat	+63	+14
Eggs	+28	+65

Source: Adapted from FAO. Amino Acid Content of Foods and Biological Data on Proteins. Nutritional Studies No. 24. Rome, 1970

Nutrition plus Income

Traditional small-scale chicken production is thus extremely important in helping interrupt the vicious cycle of poverty, malnutrition, disease, physical/mental retardation, and continued poverty commonly found in low-income LDC households. Not only do eggs provide vital amino acids for the health and development of small children, but the sale of cull hens and excess roosters provides critical household income often used by the mother to cover children's medical and educational needs. Therefore, with traditional small-farm chicken production, the household's nutritional objectives can also be compatible with its economic objectives.

Traditional small-farm chicken production should, therefore, be encouraged whenever possible, even in the small backyard of urban dwellings. The cow is often said to be the "mother" of civilization. For the third world poor, however, the backyard chicken must be a close relative!

SECTION II: IMPROVED TRADITIONAL SMALL-FARM CHICKEN PRODUCTION

USE THE TRADITIONAL SMALL-SCALE PRODUCTION SYSTEM

Small-scale chicken production has all the traits listed in Section I for other small-scale animal production enterprises. Its efficiency lies in the fact that it utilizes excess family labor and farm surplus to produce income and high quality food.

Chicks in traditional small-scale systems in the Third World are most economically produced by natural incubation with a broody hen setting on a clutch of eggs. Under small-farm conditions the hatched chicks are also fed, protected, and raised by broody hens of traditional local breeds.

The traditional chicken breeds found throughout the tropics are, in fact, triple-purpose breeds which: 1) hatch and raise chicks, 2) produce meat, and 3) lay eggs. For most traditional small-scale producers, the first two are more important as the sale of live chickens (for meat) is often a primary source of household income. As an important but secondary product, the farm family can be assured of eggs for better nutrition.

All too often, the drastic introduction of modern "egg-laying" hatchery hybrids/breeds has proved inappropriate in small-farm situations. The modern hatchery hybrids/breeds are inferior to the hardy and well-adapted local breeds on small farms where a less intensive level of feeding and management will remain the only economically feasible one for many years to come. The greatest danger from the introduction of modern hatchery hybrids/breeds, however, is that modern roosters cross indiscriminately with local hens and resultant crosses all too often lack the ability to hatch and raise more chicks which is so important for efficient traditional small-scale production.

The disadvantages of hatchery hybrids/breeds for traditional small-scale chicken production can be summarized as follows:

- Modern hatchery hybrids/breeds do not hatch and raise their own chicks and thus require the purchase of all replacement chicks from hatcheries (expensive);
- Hatchery chicks requires artificial brooding and special starter feed (expensive);
- Hatchery hybrids/breeds require higher quality feeds for optimum meat and egg production (expensive);
- Modern hatchery hybrids/breeds require more disease control (expensive)
- Modern egg-laying hybrids/breeds also require artificial light (14 hours light/day) for optimum egg production (expensive).

In addition, the flavor and color of traditional small-scale chickens and eggs are preferred over "factory" birds and eggs by buyers in many local markets. Traditional breeds, therefore, are very appropriate for small-scale production systems and should be maintained and improved wherever possible.

USE APPROPRIATE BREEDING STOCK

Importance of Natural Reproduction

The single biggest problem that Third World families face with poultry production is how to maintain flock numbers. Third World families continually need replacement birds to compensate for: (1) birds sold to pay routine and emergency household expenses, (2) birds eaten in family meals and social activities, and (3) birds lost from diseases, predators, thieves, and other calamities.

In many areas of the Third World today, traditional flocks are on the decline because families cannot afford to buy and raise costly replacement hatchery chicks, and remaining hens often lack the ability to naturally incubate and brood replacement chicks due to cross-breeding with hatchery birds. Where this has occurred, large-sized self-reliant breeding stock that are good foragers and that have the ability to hatch and raise replacement chicks by natural reproduction[12] should be reintroduced.

Triple Production Reds are a composite[13] strain of select traditional single-combed red chickens which the author has been developing since 1984 to improve the triple production of chicks (by natural reproduction), neat (large-sized), and eggs (large brown). Triple Production Reds are also good foragers and well-suited for low-input Third World family flocks. Triple Production Reds have above average egg and meat production compared with other

traditional chickens in low-input small-scale free-range systems. Triple Production Reds have been tested in several Third World countries and multiplier flocks are now available.

Productivity with Appropriate Breeds and Feeds

The efficiency of traditional Third World family flocks lies in the fact that they utilize surplus on-farm feed and available family labor to produce important household income and high-quality protein food. Utilization of these resources which commonly have very low or no opportunity, cost is one of the major functions of Third World family flocks.

With a home flock stabilized at twelve adult hens and one rooster, a family can easily set one broody hen with a clutch of 10-12 eggs per month and thus produce (after losses during incubation and brooding) at least four replacement chicks each month. A mother hen takes approximately four months to incubate and brood her batch of chicks.[14] Therefore, out of a permanent flock of twelve hens, there will be approximately four hens incubating and brooding chicks at any one time, leaving the remaining eight hens for egg laying.

Chickens raised in traditional semi-confinement production systems are usually able to meet their protein, vitamin, and mineral requirements by scavenging for seeds, insects, worms, etc.; but they are not normally able to obtain sufficient digestible energy from the excess or unusable food crops, crop residues, and household refuse that they are typically fed, for adequate egg production. Thus, the first limiting nutrient is most often energy.

Supplemental energy can be economically supplied by feeding small amounts of farm-produced cereal grain (e.g., one pound of shelled corn/10 hens/day), which is high in digestible energy and low in bulk and moisture. Newly hatched chicks should be offered small amounts of cracked corn or cooked rice for the first few weeks. A family flock given one pound of shelled corn/10 hens/day will about double traditional egg production (from about 20-25% to 40-50%). It is, therefore, usually more profitable for the family to convert surplus grain into eggs than to sell it directly. Also, with lower growth rates and egg production, traditional free-range flocks have a lower protein requirement which further helps eliminate the need for costly supplemental protein.

When even small amounts of on-farm cereal grain are not available, then a variety of chopped fresh root crops and/or bananas should be given. Weight gains and egg production will not be as high because of lower digestible energy levels and higher amounts of bulky non-digestible fiber, but it is a good economical trade-off.

With about one pound of corn per day for a flock of twelve hens, the eight hens which are in their laying period can be expected to produce an average of about four eggs per day. Without any supplemental cereal grain, the eight egg-laying hens can be expected to lay an average of only about two eggs per day. It is therefore, most often more profitable for the farmer to convert his surplus grain into eggs than to sell[15] it directly.

The expected productivity of a home flock stabilized at just twelve hens and one rooster receiving one pound of supplemental grain per day can be summarized as follows:

- two cull hens and two surplus roosters per month (four replacement chicks produced each month); and
- ten dozen eggs per month[16] (four eggs per day).

This production on a yearly basis can be a substantial supplement to the diet and income of Third World households. Most families, however, cannot reach these production levels without the vital disease control practices which follow.

PRACTICE AN IMPROVED DISEASE CONTROL PROGRAM

Disease outbreaks are the greatest single cause for loss in traditional small-farm chicken production. Chickens that have been vaccinated and treated against common infections and parasites usually remain healthy. The greatest

emphasis should be on disease prevention, as it seldom pays to cure sick birds. Prevention practices should be routinely given (every three months) against the following common diseases:

Newcastle Disease

Newcastle disease is highly infectious and probably causes more losses than any other poultry disease in the tropics. When the Newcastle virus strikes, it spreads rapidly through the flock and mortality can reach 100%. First signs are usually respiratory problems such as gasping, coughing, sneezing, and hoarse chirping. A greenish diarrhea may also be present. No treatment is known.

The disease can be prevented only by vaccination. The new freeze dried vaccines are very stable, inexpensive, and commonly available throughout the tropics in one-hundred dose vials. Once purchased, the freeze dried vaccine can remain effective without refrigeration[17] for one week if kept away from sunlight (this is an extraordinarily stable vaccine - as most other vaccines known require continuous refrigeration). The vaccine can be easily administered via the ocular route using an eye dropper. All birds (large and small) in a flock should be vaccinated at three month intervals.

Internal Parasites

Internal parasites, especially roundworms and tapeworms, are very common in traditional small-scale production systems. Internal parasites cause reduced growth, lower egg production,and increased susceptibility to other diseases. Backyard flocks with heavy parasite infestations have more disease outbreaks and suffer more severe attacks than dewormed flocks.

The most widely used product for treatment of both roundworms and tapeworms is a three-way combination of piperazine, phenothiazine, and butynorate which is commonly available in tablet form for individual oral administration (1 tablet for adult birds; 1/2 tablet for chicks). If this is not available, the second wormer of choice is Panacur, and other wormers will also work. The entire flock should be dewormed every three months and this can easily be done at the same time as the vaccination against Newcastle disease.

External Parasites

External parasites, especially lice, are also very common in traditional small-farm flocks. Because lice causes constant and severe irritation of the skin, heavily infested chickens are extremely restless and do not eat or sleep normally. This causes poor weight gains and lowered egg production.

A 5% malathion dust applied by means of a shaker (jar with perforated top) directly to each bird is the most cost-effective way to control lice in small flocks (one pound treats approximately 150 chickens). The treatment should be repeated at three month intervals and this can easily be done at the same time as vaccination and deworming. Broody Hens and their nests should also be dusted at the beginning of the incubation period. The 5% malathion dust can be easily prepared by mixing one-part 25% malathion powder (agricultural grade) with four-parts ashes from the cookstove.

Chronic Respiratory Diseases

Chronic respiratory disease is a common infection of the upper and lower respiratory tract and is characterized by tracheal rales,[18] coughing and nasal discharge. The clinical manifestations are usually slow to develop and the disease has a long course. Spread is also slow within the flock and mortality is significant only if there are complicating infections. Weight gain and egg laying, however, are adversely affected. The mycoplasma organisms which causes this disease is often spread to remote rural areas through chicks from infected hatcheries.

Tylosin[19] is the most effective antibiotic for the control of chronic respiratory disease. A single oral dose of 35 mg of tylosin per bird (same dose regardless of size) eliminates most signs and production loss from the disease. The entire flock should be treated every three months and this can be easily done at the same time as vaccination and deworming. Tylosin powder can be purchased in four gram envelopes and can be easily administered using a water solution that has a concentration of 35 mg tylosin per medicine dropper (roughly four grams in two cups of water), so that one medicine dropper full is the dose given to each bird.

Summary of Disease Control Program

The above disease control program reduces the risk of death loss. Furthermore, the increases in weight gain and egg production more than pay for the small cost of the control program.

No disease control program can prevent all diseases. The strategy of the above program is to use widely available, cost-effective control measures to prevent losses from four common diseases. With such a disease control program, the traditional small-scale flock will then be in general improved health and better able to withstand most other diseases problems without major losses.[20]

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Two groups that specialize in raising livestock in developing countries: The Christian Veterinary Mission (19363 Fremont Ave. North, Seattle, WA 98133, phone 206/546-7201). They publish a series of booklets on raising healthy: fish, pigs, rabbits, goats, poultry, etc., under primitive conditions. The Heifer Project International (P.O. Box 808, Little Rock, AR 72203, phone: 501/889-5124) is another great resource. In addition to other programs, they publish *The Heifer Project Exchange*, a newsletter similar to *ECHO Development Notes*, but focusing on livestock.

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1 Water buffaloes and ducks are also in the humid lowland tropics. These animal species comprise less than 3% of all farm animals worldwide and are located largely in the Asian wetlands under specialized production systems. Other minor species (turkeys, geese, rabbits, etc.) comprise less than 2% of all farm animals worldwide and are either not well adapted to the humid lowland tropics or have low market demand.

2 The world's inventory includes 6.5 billion chickens, 1.2 billion cattle, 1.1 billion sheep, 0.8 billion pigs, and 0.5 billion goats.

3 In fact, Asian-style aquaculture is often promoted. However, even in Asia, poultry production is over 4 times that of inland fish production. This is due largely to the high market demand for poultry products.

4 Except for areas with large Islamic populations and where African Swine Fever is enzootic.

[5] In fact, grain is generally only fed to chickens on small farms. It is almost always more profitable for the farmer to convert his grain into eggs than to sell it directly.

[6] The milk goat is often suggested as the "ideal" stall-fed ruminant for small-scale limited resource farmers. Existing milk goat breeds are not, however, well adapted to the humid tropics. In fact the goats found in the humid tropics are meat goats, whereas milk goats are most often found in drier and/or mountainous regions of the world where they are better adapted than milk cows.

[7] Small children between 1 and 3 years of age are most vulnerable to protein malnutrition and repeated infections as they: 1) have very high protein requirements (1.19g protein per kg body wt per day), 2) no longer receive sufficient quantities of breast milk, 3) become fully susceptible to childhood diseases from which they were partially immune during early life, and 4) become more active and during this age most often receive their initial exposure to childhood diseases.

[8] Especially from common gastro-intestinal and respiratory disease, which in properly nourished children would not be particularly serious.

[9] In fact, kwashiorkor due to protein deficiency is most common where young children are weaned onto cassava. Even though cassava has lower quantity and quality protein than most food crops, it is important to note that its popularity as a staple food is increasing rapidly in many LDCs as it grows better and outproduces other food crops on less fertile soils.

[10] One should also be aware that cow's milk has a 5% deficiency in methionine and cystine.

[11] With an average body weight of 12 kg.

[12] For more information on natural reproduction, see PDS Booklet: *Protected Free-Range: Movable Brooderhouse with Free-Access Range Run for Natural Reproduction of 25 Chicks.*

[13] 1/4 Single Comb Rhode Island Red (US), 1/4 Single Comb Rhode Island Red (UK), 1/4 Rose Comb Rhode Island Red (US), and 1/4 New Hampshire (US).

[14] One mother hen can produce at least four replacement chicks in four months which most often equals or exceeds the value or four months of egg-laying. The moral of the story is that "broody" hens are not lazy hens!

[15] Corn that is marketed is often utilized as an energy feed component in large scale intensive poultry production systems described earlier.

[16] This number includes the clutch of eggs needed each month for hatching out replacement chicks.

[17] Once mixed with liquid, however, the vaccine should be used the same day.

[18] An abnormal or bubbling sound accompanying breathing.

[19] Second choice is Baytril (other antibiotics will also work).

[20] Poultry Devlopment Service, 11806 SR 347, Marysville, OH 43040.