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Pastured Poultry Production

An Evaluation of Its Sustainability in Hawaii

Poultry broiler production in Hawaii declined 30 percent in the past 10 years, a reduction and trend largely due to high production costs associated with land, housing, and imported feeds. In addition to high production costs, many former poultry farmers have retired, and new farmers are not taking their place.

This publication describes a new and innovative method of raising poultry that capitalizes on Hawaii's productive pastures. Two experiments were conducted to test the method by raising broilers on pasture, slaughtering the birds to evaluate carcass weights and feed conversion, and marketing the product. The results suggest that the pastured poultry production system offers potential economic opportunities for agricultural entrepreneurs. However, careful management and proper environmental conditions are vital to the profitability of the system.

Demand for poultry broiler products is increasing, due in part to marketing efforts by the national poultry industry. To meet the market demand, inshipments of broilers to Hawaii increased 27 percent between 1987 and 1991 and an average of 3.5 percent in each of the past ten years. The supply of locally grown fresh poultry in the market is limited, although there are established niche markets, for example in local grocery supermarkets where imported range-raised chickens are sold for approximately $8.00 for a 4-pound bird, and in "ethnic" markets where locally produced processed or live birds are sold. Considering the strength of current consumer demands for "Island Fresh" food quality and freshness, the potential market in Hawaii for range-raised poultry is large.

Also, with the decline of plantation industries (sugarcane and pineapple) in Hawaii, more land is becoming available for other agricultural uses. If land leases for former plantation lands are reasonable, young entrepreneurs with limited financial resources and credit can enter the farming business.

The pastured poultry production system does not require costly equipment or structures. It offers the flexibility of seasonal production during peak seasons of product demand. It represents a low-input, sustainable alternative for new farmers and a potential diversification of on-farm enterprise for established farmers.

The method we tested is adapted from a system developed and popularized by Joel F. Salatin of Swoope, Virginia. In this system, up to 30 percent of the broiler diet is provided by pasture grazing, significantly lowering costs for feed (in our case, imported grain) and thus making broiler production more sustainable. Because the manure is recycled directly to the pasture in small amounts, problems often associated with livestock manure management are limited. There is no build-up of manure or need for manure storage or processing; nuisance pest establishment and odor management problems are reduced; and nonpoint-source pollution concerns are minimized. Effects on the environment are generally positive. This whole-system approach enhances the ecosystem of the farm and maximizes land use, improving soil fertility and consequently plant growth and quality. Nutrients are also recycled through the poultry and other animals that graze the pasture after the poultry rotation.

This system also offers the perception that the birds are raised in a clean and healthy environment and are supplied with a more optimum, natural dietary balance of forage, grain, and other feed sources such as insects and worms. Moving the pens daily to fresh pasture is believed to result in better and more wholesome birds compared to those reared with the conventional production methods of the broiler industry.

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The system advances the concept of "low-input, sustainable agriculture." No machinery is required for manure handling. The structures are relatively low-cost and portable. Poultry manure improves the pasture nutrient value for other classes of livestock with limited negative environmental impact (odor, vector buildup).

Our studies raised four batches of birds to investigate the feasibility and economics of producing a poultry on pastures in Hawaii and, to a limited extent on the island of Hawaii, explore the market for fresh, locally grown, pasture-produced poultry. We also investigated the impact of the system's mineral cycling on forage quality changes and considered the potential soil fertility improvements.

Poultry production experiments

Growth experiment 1

We grew three groups of birds, each for 8 weeks. The intention was for each group to have 100 Jumbo Cornish-Rock cross birds, but the third group had only 73. The chicks ordered were "straight-run" (non-sexed males and females) vaccinated for Marek's disease at the hatchery. They were delivered by mail, arrived about 3 days old, were raised in a brooder for about 4 weeks, and then were placed in a portable pasture unit until processed at 8 weeks of age. The pen was 12 x 10 ft in area and 2 ft high, providing 1.2 ft^2 per bird at 100 birds per pen. Half of the unit is enclosed for rain protection and shade (Figure 1). The experiment was done in a mesic grassland environment at 2800 ft elevation.

The pasture unit was moved daily, exposing the birds to fresh forage. During the last week, the pasture unit was moved twice daily. Figure 2 diagrams the 28-day rotational grazing pattern used. Water and supplemental grain were available *ad libitum* throughout the period. A commercial poultry finisher ration (21% crude protein) was fed, although for one group a lower-protein formulation had to be used due to supply failure. Records were taken on mortality, quantity of feed consumed, feed cost, housing cost, and broiler production. The three groups were grown in a 4-week sequence. At 8 weeks of age, the first batch was processed, the second batch was moved from the brooder to the pasture unit, and the third batch arrived and was placed in the brooder.

Figure 1. Pasture poultry pens.
Above, the original design by Joel Salatin; below, a slightly larger pen made of PVC pipe.

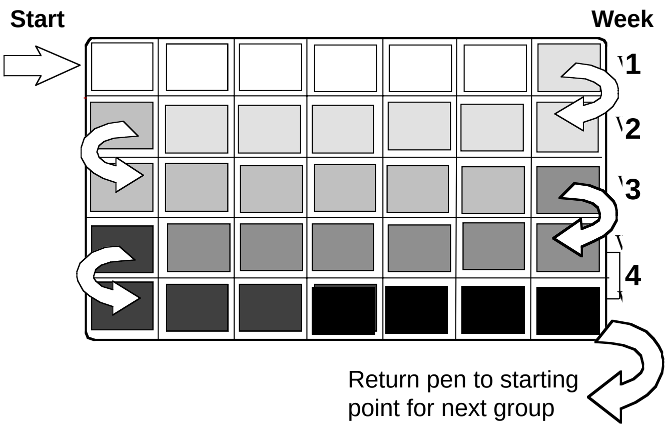
Growth experiment 2

We grew 101 straight-run Cornish-Rock cross broilers that arrived 1 day old from a second distributor and were processed 8 weeks later. The vaccination program, brooder and growing phases, data collection, and location were the same as in Experiment 1. The pen structure used PVC pipe rather than wood and was larger, 15 x 10 ft in area by 3 ft at the roof ridge, providing 1.5 ft^2 per bird (Figure 1). A commercial broiler starter ration (22% crude protein) was fed.

The environment

In Experiment 1, soil and forage tissue samples were taken before the grazing period, and more tissue samples were taken after grazing. Soil testing included pH, salinity, and extractable nutrients (calcium, magnesium, phosphorus, potassium). Forage testing included dry

Figure 2. Diagram of the 28-day grazing rotation. The pen was moved daily during the first three weeks of the grazing period and twice daily during the fourth week.



matter and crude protein analyses. Rainfall and temperature data were collected throughout the study period. In experiment 2, only rainfall data were recorded.

Processing

The broilers were custom-processed after withholding feed and water for 12 hours. Some broilers selected at random were weighed before processing. The processed carcasses (with neck, abdominal fat, and no giblets) were chilled in slush ice for about 1 hour, drained, and individually weighed.

Product evaluation

The processed broilers were distributed to cooperators for consumption. An informal survey evaluated opinions on flavor, market acceptability, and overall impression of the product.

Economic analysis

We evaluated the costs and returns. A partial-budget analysis assessed the marginal differences between two marketing structures: one method based on a fixed price per bird, and a second method based on price per pound.

Poultry growth on pasture

Data on growth for the two experiments are summarized in Table 1.

Carcass weights for the three groups in Experiment 1 averaged 3.7 pounds and varied from 1.9 pounds to 5 pounds. This represented an overall dressing percentage of about 68 percent. The birds ate about 2.7 pounds of feed for each pound of liveweight gain. The second group had poorer performance because we had to change feed type midway through the growth period, and the new feed was lower in protein. Overall, about 17 percent of the birds died, and about one-fourth of those losses occurred in the brooder phase.

Experiment 2 produced larger birds with greater carcass weights, averaging 5.5 pounds and varying from 3.5 to 7.2 pounds. The dressing percentage was about 75 percent. Each bird consumed 14 percent less feed than those in Experiment 1, about 2.3 pounds per pound

Table 1. Growth performance of pastured poultry.

	Experiment 1 (three groups)				Experiment 2
	1	2	3	All three	
Number of birds at start	99	100	73	272	101
Number of birds processed	85	79	61	225	80
Ending age (days)	54	54	54	54	56
Mortality (%)	14	21	16	17	22
Total feed offered (pounds)	1250	1199	842	3291	1350
Average live weight per bird (pounds)	5.8	4.8	5.7	5.4	7.4
Average carcass weight per bird (pounds)	4.0	3.3	3.9	3.7	5.5
Feed conversion ratio* (pounds of feed per pound of gain)					
Liveweight basis	2.54	3.18	2.43	2.71	2.30
Carcass-weight basis	3.72	4.66	3.56	3.97	3.08

*Liveweight basis feed conversion ratio was calculated from carcass weight based on a 68.3 percent dressing percentage estimated from a sample of birds.

of liveweight gain. About 22 percent of the birds died because of cold, wet weather; just under half of these losses were in the brooder.

Feed conversion ratios in these two experiments (2.3 and 2.7) are higher (or less efficient) than those expected in conventional, confined rearing systems, where only about 2.1 pounds of feed are normally required for each pound of liveweight gain.

The grazing schedule was a 28-day rotation with a total of 35 pen moves (Figure 2). The pen was moved once a day during the first 3 weeks and twice a day during the last week of the 4-week grazing period. The 10 x 12 ft pen thus used a total area of only 4200 ft^2 per grazing period, whereas the 10 x 15 ft pen used 5250 ft^2 during the grazing period. The rotation period needed before returning the pen to a previously grazed area depends on the recovery and growth of the forage, which will vary with the forage type, location, and environmental conditions. During cool seasons or dry periods, plant growth and recovery from grazing will be slow, and rotation schedules must be devised that accommodate this variation.

The problem of feed supply we experienced with one of the groups of birds underscored the critical need for commitment from the feed dealer before starting a project. These hybrid meat birds grow rapidly and need a consistent feed supply. Changing from a finisher feed with 21 percent protein to an all-purpose feed with 15 percent protein had a serious effect on bird growth.

Losses of birds

Bird mortality can have a major influence on financial success and thus should be a major concern. In the conventional broiler industry, the maximum mortality tolerated is 7 percent. We were concerned by the losses we experienced, which we thought were high. We grouped them into three main causes: weather, management, and predators.

Weather. The weather was sometimes cool and it rained daily. Experiment 1 was done from early spring to mid-summer, under temperature ranging from 45° to 85°F and a total of 60 inches of rain. In Experiment 2, the temperature ranged from 51° to 71°F, and late spring rains brought 16 inches in two months, more than half during the grazing phase. We believe that mortality was high and growth was limited by the wet conditions caused by rain, fog, and mist, compounded by cool temperatures. We noticed crowding behavior in the pen corners, indicative of hypothermia. During such cold and wet periods, installing a low-energy radiant heater within the pen might reduce losses and improve production.

Management. We estimated that 2–3 percent of the mortalities were due to management mistakes. More care when handling the young chicks in the brooder and moving the pasture pen would have reduced these losses.

Predators. We had planned to raise two groups in the larger pen, but during the first attempt the entire flock was killed in the brooder by mongooses. Although the walls of the outdoor brooder were embedded in the ground, the predator managed to burrow beneath them. Subsequently, we installed a solid floor for the brooder and we set two traps with spring-loaded doors along the exterior walls. In the first two weeks of the next brood, we trapped 16 mongooses. Placing such traps next to brooders is highly recommended to reduce predator damage. Some poultry producers believe that the chirping of young chicks attracts mongooses, but once the birds are 4–5 weeks old, the pest does not appear to be so attracted.

We did not experience losses from carnivorous predators during the grazing phase, but such losses are possible and must be guarded against. A fairly level pasture is needed to prevent mongooses, cats, or dogs from burrowing into the pen. The pen cover should be secured to exclude these animals as well as predatory birds.

Product evaluation

The responses to the meat produced were very positive overall. Comments describing the product included "moist," "not filled with fat," "no excessive fats remaining after cooking," "meat was firm yet tender and succulent," and "very good—moist and tender." Samples from Experiment 2 were distributed to local restaurant chefs, who responded positively and expressed interest in purchasing the product if there were a consistent supply.

Economic analysis

The economics of our experiments in pastured poultry production are summarized in Table 2. The start-up cost for the system is relatively low. The main operational costs were incurred in feed (50–57 percent) and livestock purchases (17–21 percent), accounting for an average of 73 percent of the total cost of production. In a comparison of two possible marketing methods, when

Table 2. Economic summary and marginal analyses of pasture poultry production and marketing.

	Experiment 1 (three groups)				Experiment 2
	1	2	3	All three	
Expenses					
Birds	111.00	111.00	81.00	303.00	113.70
Feed	273.59	256.50	185.24	715.33	369.69
Feed supplements	5.00	5.00	5.00	15.00	30.00
Portable pasture pen[1]	36.85	36.85	36.85	110.55	26.40
Supplies[1]	16.55	16.55	16.55	49.65	
Brooder bedding	18.09	18.09	18.09	54.27	25.10
Marketing	16.79	16.79	16.79	50.37	
Processing supplies	42.93	42.93	42.93	128.79	80.00
Subtotal	520.80	503.71	402.45	1,426.96	644.89
Income					
Method 1, number of birds	85	79	61	225	80
Priced per bird @ $8.00	680.00	632.00	488.00	1,800.00	640.00
Method 2, total weight (pounds)	336	257	236	829	438
Priced per pound @ $1.89	634.49	485.90	446.74	1,567.13	828.59
Net returns ($ return to labor)					
Method 1					
Per cycle	159.20	128.29	85.55	373.04	(4.89)
Per bird	1.87	1.62	1.40	1.66	(0.06)
Method 2					
Per cycle	113.69	(17.81)	44.29	140.17	183.70
Per bird	1.34	(0.20)	0.72	0.62	1.66
Break-even price ($)					
Method 1, per bird	6.13	6.38	6.60	6.34	8.06
Method 2, per pound	1.55	1.96	1.70	1.72	1.47

[1]Amortized over 10 production cycles.

using a fixed price per pound, profit per bird marketed ranged from a loss ($–0.20) to a gain of $1.66 (average $1.05). With a fixed price per bird, the range was from a loss ($–0.06) to a gain of $1.87 (average $1.22). Profits reported by producers in the Midwest and East Coast USA range from $1.00 to $3.00 per bird across both marketing methods.

The per-bird pricing structure may be more profitable, but a strict quality control program that ensures product consistency will likely be essential to gain consumer confidence. The per-pound pricing method offers the consumer a fair and understandable pricing format, but it forces the producer to optimize production efficiency. We believe that Hawaii has both a suitable niche market and a price tolerance for high-quality, locally produced broilers. In the Honolulu Chinatown market, the price for locally produced broilers ranges from $1.99 to $2.65 per pound for a 2½–3 pound carcass (including head, neck, and shank).

We suggest that a product label be developed for use in the evaluation and distribution of range-fed broiler products. The label could list harvest schedules to allow consumers to place advance orders.

The environment

No adverse environmental effects were observed with the poultry pasture production system. There were no odor problems from manure deposition. With the persistent rains during the study period, surface manure moved through the top layer of sod within a week. No fly breeding was observed. Regrowth of the pasture grass after poultry grazing was excellent. Within two weeks of grazing, obvious dark green regrowth patterns trailed the path of the pasture pen. However, palatability of this dark green growth appeared to be negatively affected at first, possibly due to odor. We observed that a minimum of 30 days of rest was required before other grazers (sheep and cattle) took to the lush forage.

Samples of the 4-week old regrowth showed a 37 percent increase in crude protein value of the pasture grass, a combination of kikuyugrass (*Pennisetum clandestinum*) and pangolagrass (*Digitaria decumbens*). Unfertilized by the grazing system, the forage's crude protein value was 14½ percent, compared to nearly 20 percent a month after being grazed by the poultry. Beyond the 30-day resting period, we observed that grazing animals selected the naturally fertilized forage preferentially.

Soil changes are not expected to be immediate, but over time, improvement in the soil's plant nutrient status is expected. In the test area, soil analysis results showed low levels of phosphorus (14 ppm), medium levels of potassium (180 ppm), medium levels of calcium (1600 ppm), and medium-low levels of magnesium (280 ppm). Soil pH was 5.5. Fertilizer recommendations for pasture in this area specify 1500 pounds of 16-16-16 fertilizer per acre per year.

To illustrate the potential nutrient cycling of this system, we propose the following 1000-bird scenario. Continuous operation (10 cycles per year) of 10 pens will produce approximately 11 tons of wet manure spread over 1 acre. Placing a conservative fertilizer value for the manure of 2-3-3 (percent N-P_2O_5-K_2O), its application through the poultry pasture system will have a positive impact on the pasture's mineral cycle equivalent to 112, 174, and 174 pounds per acre per year of N, P_2O_5, and K_2O, respectively. The nutrient recycling will result in enhanced forage production and quality and improved animal performance.

Conclusions and recommendations

We suggest that improvements and efficiencies can be gained in the pastured poultry system in two areas. First, reduction of death losses. To improve chances for success, increased management should reduce mortality to below 7 percent. Birds should be prevented from clustering in the pen corners, which may cause suffocation. Care when moving among the birds and shifting the pen will prevent crushing. Providing more shelter in adverse weather conditions or incorporating a low-energy radiant heat source for the birds will improve survival.

Second, options that will lower feed costs need to be investigated. Try to secure commitments from your local feed dealer for a consistent supply of the feed selected. Purchasing in bulk can reduce feed costs. Feed price for our experiments was approximately $0.22 per pound, about $440.00 per ton.

Third, our results suggest that drier environments may be better than cold, wet locations.

Another strategy that can be incorporated into the system is to stagger processing times. This can improve the efficiency of production in two ways: first, by reducing mortality risks over a shorter period, and second, by improving feed conversion. Instead of processing an entire group at 8 weeks, process half of the group at 5 weeks and the second half at 7 weeks of age, selecting the larger birds for the first processing. This strategy of "topping off" will likely lead to a reduction in total mortality by lowering the group population during the pasture phase. The second benefit relates to the bird's physiology—as the broiler matures, feed efficiency decreases. Feed-to-gain ratios for broilers have been measured with birds that were 2, 4, and 6 weeks old (Patterson et al. 1994). The amount of feed required per pound of gain increased for each age group (1.29, 1.68, and 2.41 pounds, respectively). The feed conversion ratio calculated over the entire period was 1.89, which resulted in a 4.07-pound (live weight) broiler. By processing the broilers at a younger age, the feed conversion ratio will be lower, thus increasing efficiency of the system.

Our project was on a tropical grass pasture, but other forage options can be used. Legume forages mixed with the grasses would provide higher crude protein content and increase the diversity of the feed supply. In addition to adding this system to pastures grazed by livestock, it can be used on cover crops in orchards or on crop residues within a vegetable farm rotation.

Expansion of the pasture-raised poultry market in Hawaii is limited by the availability of federally inspected slaughter facilities. The key element for any livestock meat production enterprise is the slaughter and processing facility. Without this allied industry partner, wholesale distribution of inspected meat products is not permitted under the United State Department of Agriculture, Food Safety and Inspection Service, Meat and Poultry Inspection program.

Pastured poultry production is a potential business enterprise for the small-farm entrepreneur. The demand for "Island Fresh," locally produced broilers is strong, and the potential for developing pasture-raised poultry as a premium niche-market product is high. Compared to conventional poultry broiler production methods, this broiler production system uses more "natural" methods, which may be of value to some consumers, and involves a convenient and environmentally sound waste management strategy.

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