

Precision Animal Production

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Introduction

Animal production has moved quite rapidly to a consolidated structure of fewer, larger farms, ranches, and animal feeding units in both developed and developing countries. Driven by economies of scale arising from steady advances in technology, the trend shows no sign of slowing. This new structural concept and features increased concentration of large-scale livestock and specialty crop production in fewer, scattered pockets surrounding existing or emerging marketing and processing centers.

Industrialization refers to the movement toward more direct production and marketing relationships between producers and processing. This trend is most fully advanced in the broiler industry. Under industrialization, processors attempt to secure a stable supply of a consistent product while exploiting the economies of scale in new production and processing methods. As production shifts to bigger firms and clusters around processing plants, the result is a further concentration of production

Although consolidation and industrialization have been long-standing trends, the recent acceleration in the growth and concentration of large farms presents significant challenges for natural resource management. These changes also have important social consequences. New forms of organization and control also present new opportunities and complexities for public agencies endeavoring to provide technical assistance in natural resource management to large-scale agricultural operations. However what is seen is initiative in private organizations to propose policies of protection of natural resources and linking the producers attitude to the farmer's product (THOMAS et al, 1996).

At the same time there is an increasing demand for good quality meat in the global economy and it is proportional to the economy growth in the emerging countries. The consumer's need and ecological conscience has changed for a more demanding taste. The largest consumer markets are the United States and Europe, as well as China. Figure 1 illustrates the demand for beef cattle, pork, poultry, sheep and others, considering the overall production.

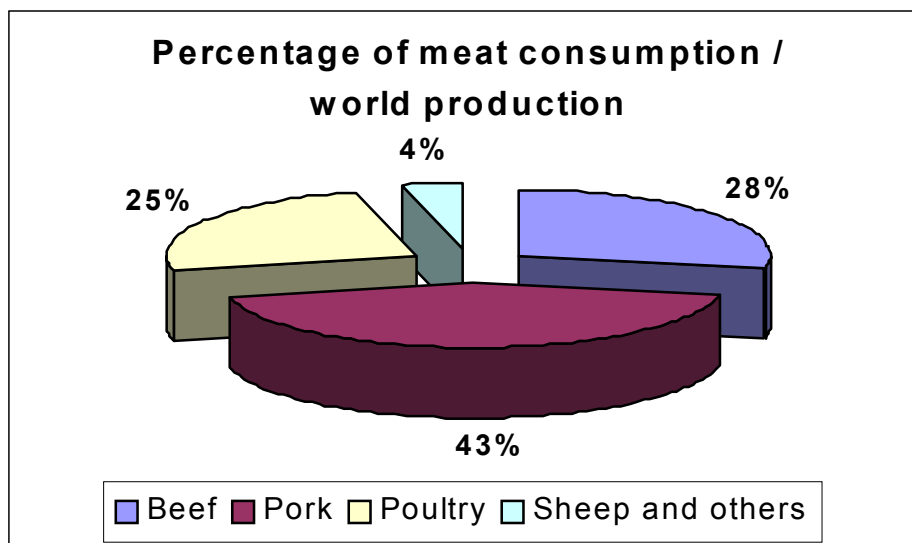
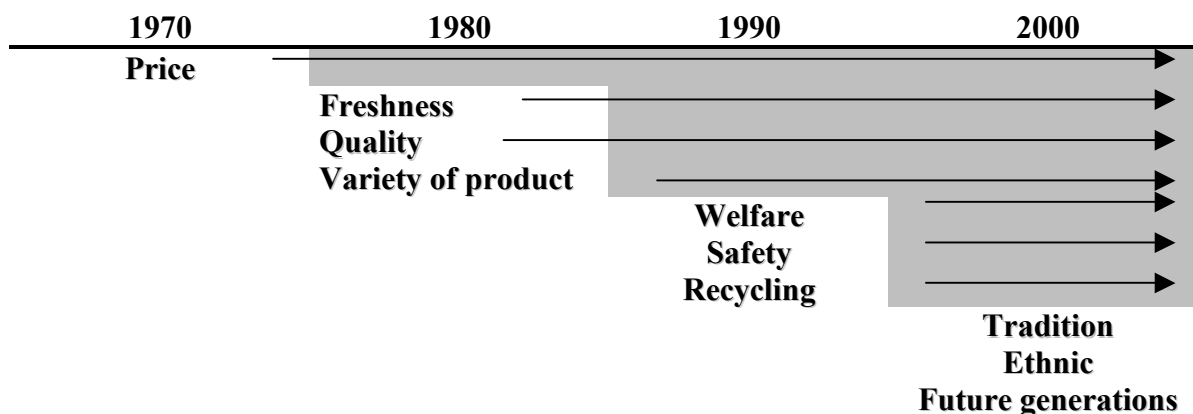


Figure 1. Percentage of meat consumption per world production

Since the 70's the consumers' need changed all over the world, and communication made the interaction between cultures a reality. This led to a certain standardization in demands and the consumer is now aware of his needs, demanding better quality food. Table 1 shows the increase in the consumers' priorities.

Table 1. Priorities in consumers demands



Adapted from HOLROYD, P. (2000)

In order to supply the market's demand, the food chain has to provide answers for each channel. Figure 2 shows the food chain links and interactions.

The food chain

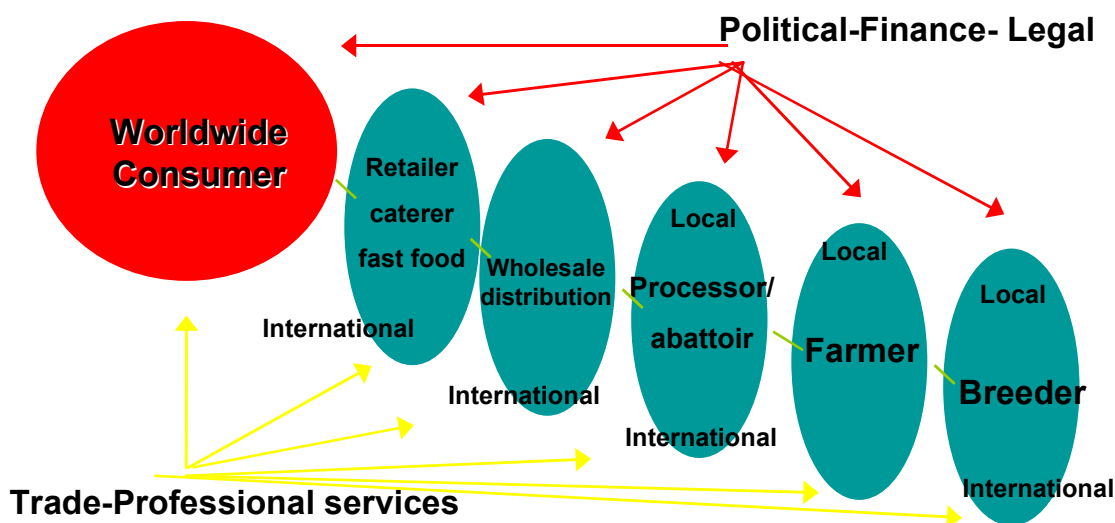


Figure 2. Food chain interactions

The consumer now expects: safety, environmentally non-aggressive products and safety for the animal production.

In each product bought the consumer needs to feel that:

- his money is well invested,
- the product has quality,
- the product can be purchased easily,
- the product is handled easily and has a known expiration date,
- and he needs to appreciate his purchase.

According to HOLROYD, P. (2000), the future of meat commerce depends mainly on an industry reacting towards the following concepts: honesty, openness, detailed information available, traceability, assurance of quality, and flexibility for changes. For the retailer or fast food buyer, it is only possible to build up a business when quality is always renewed, when final design is correct, and it is always available in the right place at the right time.

Animal production pattern

This new shift in the industry's structure called "industrialization" - is tightening the industry's marketing links, creating a more integrated industry from farm to the markets and the worldwide consumers. The characteristic of the industry's emerging structure is a shift toward contract production and vertical integration.

Vertical integration is a pattern of organization where various stages of the production process - genetics, feed, grow-out, processing, and distribution - are controlled by a single company. The system is linking farmers, food processors, breeding companies, and other agribusiness and are changing the way the industry does business in a fundamental way.

Consumer economies are also changing in the global market and there are several countries emerging and adapting for new diet. Poultry consumption is an example of this in the Americas. The expansion of fast food restaurants increased the consumption of ground beef and processed poultry meat as well.

Larger producers are the most likely to benefit from contractual arrangements to produce specialized products for food companies in the worldwide market chains. The industry's new structure will link these farms more closely to the growing market for value-added food products. In the other hand smaller farmers may face a declining market for their generic production. At best, they may become residual suppliers to the specialty product market. (BARKEMA & DRABENSTOTT, 1996).

Nevertheless consumers are quite aware of the health problems the ingestion of unsafe food may bring to them and their families and associate this item to the animals housing and management, ingestion of drugs and ultimately the process and conservation of the product throughout the market chain. Safety is one of the most demanded quality in food products, Figure 3 points out how the food safety interacts mainly for assuring quality. It is important to meet the consumers requirements for:

- Food safety
- Traceability
- Animal welfare and health control
- Employment welfare and health
- Reduction of risk

Food chain safety interactions

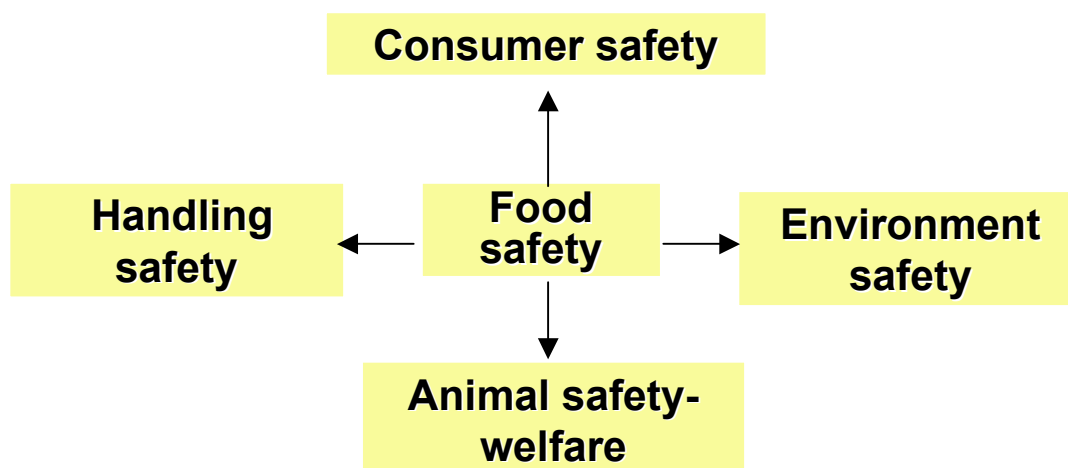


Figure 3. Food safety interactions

Precision animal production concepts

As the food marketing system evolves, it is bypassing the traditional marketing system and shifting toward contract production and vertical integration. Farmers growing animals under contract utilize facilities, feeding, and management strategies prescribed in detail by the integrator or contracting firm. The key feature of the new marketing schemes is the establishment of rigid production guidelines to help ensure that raw food products will meet food processors' and ultimately consumers' more stringent demands. In this specific case, applying the precision animal production principles as well as traceability knowledge may add special value to animal derived products, for warranting the product's origin.

The overall performance of animal production depends on the herd or flock management as well as the nutrition, sanity control and lodging facilities. The concept of this kind of production is directly related to the reduction of selected losses and process control. Each production segment is controlled for reaching optimization in the whole production system.

The concepts apply at farm level for:

- Animal management
- Building environmental control
- Disease control
- Nutrition control
- Information and identification – overall traceability

Transportation of living animal has still to be under strict supervision. The use of traceability can apply up to the slaughter processing plant and then changed to bar code in carcass and special cuts. But this technology of identification may not only be used for tracing the animal itself or its products, it can also be used as a tool for identifying specific

characteristic such as level of hormone in dairy cows as well as to control the level of mastitis by self regulating the pressure in milk line.

Use in herd management

The electronic ID systems depends on the characteristics of the transponder (SPAHR & SURBER, 1992), built with an integrated circuit or specific microchip, inserted in the ID target animal.

The animal is identified by means of miniaturized electronic circuit that offers electronic ID. The identification is proceeded by LPS or portable antenna reading, or even GPS and the signal is attached to a compatible device, (WADE & MAYHALL, 1994). Retina reading is a way to identify each individual by its unique characteristic. Other than that, the implant of microdevices is a solution for treaceability. Figure 4. shows examples of electronic ID (microchips) used in animals.

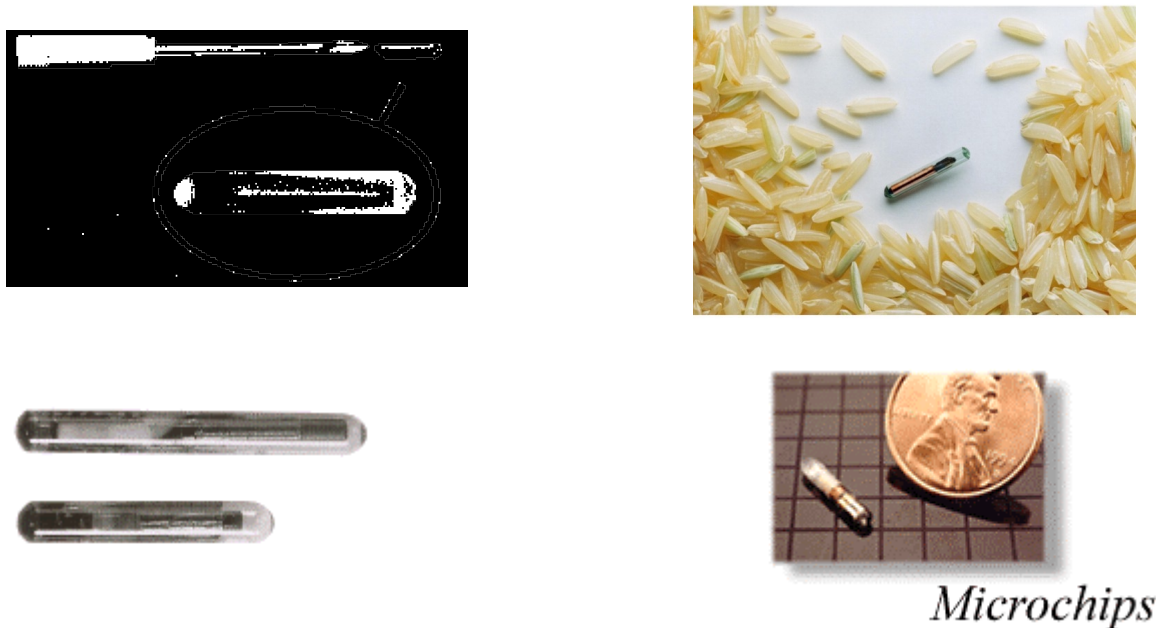


Figure 4 Examples of microchips for electronic ID.

One application as a source of information on animal behavior, results were found by NÄÄS et al (2000) when studying female broiler breeders behavior as function of environmental temperature. Data were selected in the way to evaluate the use of the nest, drinker and feeder, and their movement as they passed by the East side and West side walls. Figure 5 illustrates their path according to the environment dry bulb temperature (DBT), in

percentage of local use. It can be seen that the East wall was occupied most of the time during the day when environmental dry bulb temperature was above 20°C and below 28 °C, reaching the peak of use when DBT was above 28 °C. This was expected for the breeders tried to place themselves in an area protected from higher solar radiation and consequent high temperatures. This can be explained as for this time of the year there is a significant solar declination because of the Fall and Winter season. This can be checked when comparing with the data in Figure 6 that shows a pattern of larger placement of the birds in the East wall during the first hour of the day, and as time passes by they move against the cooler wall which is in opposite side. The use of the drinker for high temperatures seemed wrong for it was expected to be much higher, mainly at the times of high dry bulb temperatures. As the reader frequency is very low (128 kHz) and it is placed below the drinker, it may not be registering the presence of the female breeders in a proper way.

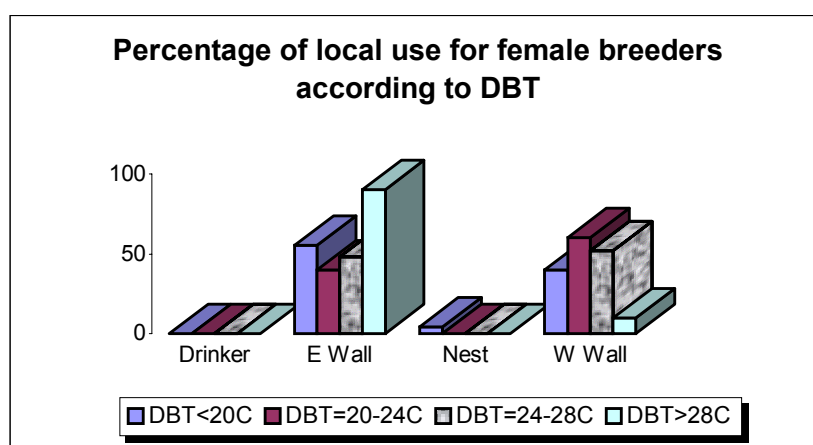


Figure 5. Percentage of placement inside the housing according to the dry bulb temperature

Figure 6 shows the female breeder path according to the time of the day. Here it can be seen that, for the first hours which were related to cooler temperatures, the breeders use the nest mainly in early morning and they placed themselves against the East wall when the sun rise probably reaching for higher temperatures. This can be checked in Figure 5 that the breeders were placed towards East wall when dry bulb temperatures were in the range of 20-24 °C. For the range 9AM to 12 AM they stay mostly towards the West wall. The pattern changes for the time between 12AM and 3PM when they use more the East wall. In the afternoon when the black globe temperature stays above 28 °C they move prefer to stay mainly at the East side wall.

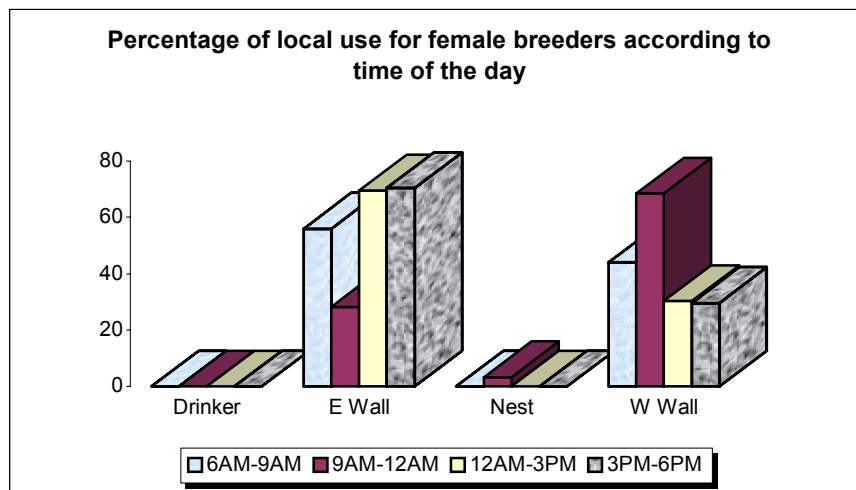


Figure 6. Percentage of placement of the female breeders inside the housing according to the time of the day

Use in nutrition

Individual electronic feeding has been used in dairy cows for nearly ten years. A transponder is placed in a necklace that opens automatically the gate and feeds individually each cow according to its milk production and need.

The use of this technology has been developed mainly for large mammals (beef cattle, dairy cows and swine breeders) and is yet in development for broilers, specially breeders. Figure 7 shows the application of individual feeding system.

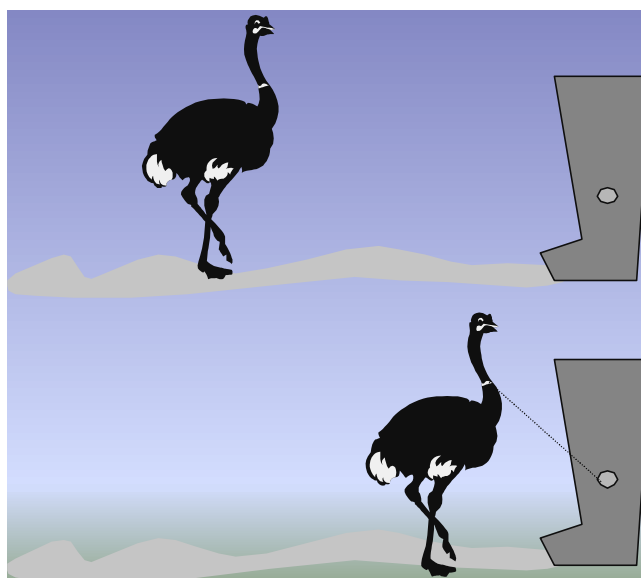


Figure 7. Individual feeding concept

Use in warranty of origin

Due to the consumers demand on requiring certain characteristics of the product including those related to sanity control up to ecological features, identifying the final product is one of the objectives on the traceability process. The traceability in this case is to assure the consumer:

- herd or flock welfare and health
- workers welfare and health
- good nutrition
- non use of antibiotics
- non use of growth hormones
- good waste management – environmentally safe

The producer follows basic standard rules, established by specialists in each area (sanity, environmental, housing, welfare, etc) and the electronic ID identifies the meat that follows the whole production and processing system.

The most important challenge in the use of this technology as well as its application in several fields of animal production remains related to the ID methodology; sampling; and intelligent and simple/friendly protocols. Being a multidisciplinary area of knowledge, it involves the work of professionals from nearly all disciplines, from Computer Engineering to Animal Physiology, but definitely under the vision of an Agricultural Engineer the success of the system interaction seems more feasible, by the simple reason that this professional is trained to see the Engineering applied to Agricultural actions in a broader way.

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