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Animal production systems in the industrialised world

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Summary
The production of food from animal origin is relatively stable in the industrialised world. However, animal production systems are changing dramatically with respect to location, herd size and specialisation. Increased pressure from a critical public is moving animal-based production towards systems such as organic production and loose-housing systems which allow the animals to better express normal behaviour. The focus on food safety promotes systems with a high degree of biosecurity, often associated with an increase in herd size and self-containment. The globalisation of agricultural trade and increased competition also favours an increase in herd size and specialisation. These trends also lead to regions with livestock-dense areas, giving rise to environmental concerns. Therefore, good farming practice regulations and systems to provide a higher level of transparency, such as quality risk management programmes, are being developed.

Keywords
Animal production system – Cattle – Goat – Pig – Poultry – Sheep.

Introduction

Livestock production has been called the next food revolution (13), addressing the massive increase in world demand for food of animal origin. Although this increase is seen especially in developing countries, it also has a major influence in the industrialised world through the global economy.

Livestock production in the industrialised world is under pressure from two sides (46). On the one hand, the increased competition in the global market may decrease farmers' income through a decrease in product prices and increased costs; this encourages farmers to switch to more intensive production systems. Intensive animal production systems, on the other hand, often raise public criticism regarding their impact on the environment, and the public are worried about how such production affects animal welfare (4) and food safety. Food-borne diseases are a significant source of morbidity and mortality in the developed world (47). A current review of research in the field of livestock systems identifies a greater focus on integrated livestock systems such as organic livestock systems (38). In the European Union (EU) there has been a 25% to 30% growth in organic livestock systems during the last decade and by 2001 there were 142,000 organic farms (53).

A large number of the animal production facilities in North America and in Europe are currently changing in location, size, and in the degree of specialisation. The overall production in the industrialised world is expected to increase very moderately (13). The enlargement of the EU from 15 to 25 countries in 2004 is expected to have a major effect on livestock farming systems in the former communist countries of Central and Eastern Europe. Since the collapse of the political system in these countries in 1989, livestock production in this area of the world has

decreased to less than 50% (28). This shrinkage is due to changes in subsidies and a decrease in consumption.

The objective of this article is to describe current animal production systems in different regions in Europe, North America and Oceania, and also to assess the expected trends in development.

Cattle production systems

Dairy cattle production systems

Dairy cattle production systems in the industrialised world are generally characterised by a high level of specialisation and a relatively high milk yield. Large differences exist, however, in farming goals and management orientation, as well as husbandry methods, managerial skills and knowledge.

In Western Europe, a large proportion of the dairy production is concentrated along the coastal areas. Other areas with concentrated milk production in Europe are in southern Germany and in the Po-valley in Italy (9). Dairy farms in the Netherlands, Germany, Denmark and Sweden are typically intensive, whereas in the United Kingdom (UK) and Ireland the production is grassland-based and more extensive. More than 80% of all robotic milking farms in the world are located in North-Western Europe (12). Herd sizes in the 15 Member States of the pre-enlargement EU (EU-15) vary from 115 cows per herd in the UK to 15 cows per herd in Greece (Eurostat – http://epp.eurostat.cec.eu.int). In the new EU Member States (countries in Eastern and Central Europe) smallholder dairy farms with between one and 15 cows predominate. In the United States of America (USA), milk production is shifting to the western half of the USA. In recent years there has been a substantial increase in milk production in California, Idaho and New Mexico. In 2001, 39% of all the milk produced in the USA was from dairy cattle herds with more than 500 cows (50).

Dairy production in New Zealand differs from other parts of the industrialised world by being very extensive and almost purely grassland-based, with seasonal calving and a low rate of milk production per cow. Herd size is relatively large and the cows are often milked by carrousel systems. In recent years one-day milking has been introduced as a means to reduce production costs.

Diseases in dairy cattle can be classified as notifiable and/or epidemic in nature like foot and mouth disease, or as endemic in nature like mastitis and bovine herpes virus 1-infections. Examples of epidemic diseases which constitute a known public health hazard include brucellosis, bovine spongiform encephalopathy (BSE) and tuberculosis (8).

Endemic diseases commonly have multiple causes and, because the contributing causal factors differ between regions and farms, the prevalence of endemic diseases also varies greatly between regions and farms (48, 49). The probability of human health problems originating from cattle diseases is low in the industrialised world. The most predominant ones may cause occupational diseases in farmers, veterinarians or artificial insemination technicians (43).

For several zoonoses, eradication, prevention and control programmes are in place, e.g. blood or milk testing for salmonellosis (52), skin reaction testing for tuberculosis and slaughterhouse testing for BSE. Outbreaks of zoonoses can hence be considered as accidental. Most of the above-mentioned zoonoses will also cause disease signs in cattle. However, a disease caused by *Escherichia coli* O157:H7, a virulent serotype of verocytotoxigenic *E. coli* (VTEC – also known as Shiga toxin-producing *E. coli* [STEC]), represents a public health hazard for humans while the infection does not cause any signs of sickness in cattle (11, 45). The carrier-state of the animal should be detected in order to be able to effectively impose an eradication and control programme (10).

The predominant food safety concerns for the dairy cattle production industry are the contamination of milk, and, to a lesser extent, problems of meat/beef from culled dairy cows (11, 36). Contamination of milk may be (micro-) biological (bacteria, toxins, high somatic cell counts) or chemical (residues of anti-microbials, anthelmintics, chemicals such as disinfectants). Already, for a long time, formally imposed quality control programmes for milk involving laboratory testing have addressed these types of quality failures. Milk bulk tank samples testing positive for these failures will be rejected and will not be used in products destined for human consumption; moreover, the treatment of milk during processing will additionally eliminate certain problems, e.g. bacteria will be killed by pasteurisation. Farmers are required to respect withdrawal periods when they have used anti-microbials, for example to treat clinical mastitis cases, and to implement measures to maintain high standards of hygiene.

Trends in dairy cattle production systems

Milk production from cattle is stable in the industrialised world, and this situation is expected to continue in the future. However, it is also expected that farm size in general will increase and the number of holdings with dairy cows will decrease. In the EU-15, the number of holdings with dairy cows decreased by 31% between 1995 and 2001 (Eurostat), whilst the number of dairy herds in the USA decreased by 21% between 1997 and 2001 (50). It can be expected that many smallholder farms in Eastern and Central Europe will disappear.

Organic milk production has expanded during the last decade, especially in the EU. In Denmark more than 25% of all milk sold in shops is organic (3). In some regions, some dairy farming has a multifunctional operation, i.e. it provides recreational activities for civilians, or opportunities to involve mentally disabled people in farm work.

Beef production systems

Beef in the industrialised world derives from two production systems (35), namely, beef from dairy herds as a by-product and beef from suckler herds. Beef from dairy cattle herds is the main source of beef in Europe. Bull calves are traditionally used in young bull production, production of steers or in veal calf production. Veal is a pale meat from calves kept pre-ruminant on milk replacer until slaughter at 120 kg to 140 kg. Veal, which is traditionally used in France, Italy, Belgium and Switzerland, currently plays only a minor role in European beef consumption. In the UK and Ireland, most male dairy calves are reared as steers. They are produced on pasture until they are two years old. Dairy steers are also produced in the USA and in New Zealand. The predominant beef production from dairy cattle is young bull production (typically intensively fed on grain until they reach a carcass weight of 250 kg to 350 kg) and cull cows.

In beef production from suckler herds, cows are bred only to produce calves that are weaned at six to ten months of age. Suckler herds typically live on marginal land such as unploughable pastures. This type of production is the predominant source of beef in North America. Calves are typically sold after weaning and finished in feedlots on high energy diets.

The USA has 9.7% of the world cattle inventory; in 2004 it produced 12 million metric tonnes (Mt) of beef (the EU produced 8 million Mt in that same year) (51). Australia produces only 2 million Mt, but it has the highest proportion of exports – 22% of all the beef traded in the world is produced in Australia (29).

Organic beef production plays only a minor role in the EU, e.g. in Denmark the market share of organic beef is less than 2% (40).

Pig production systems

The major pigmeat producing countries in the world are as follows (the production figures for 2004 are given in brackets):

– the People's Republic of China (48.3 million Mt)

– the EU (25 Member States) (21.6 million Mt)

– the USA (9.3 million Mt)

– Brazil (3.1 million Mt)

– Canada (1.9 million Mt).

However, if one considers industrialisation as the production relative to the size of the human population it is apparent that EU countries predominate (production figures per 1,000 people in 2004 are given in brackets):

– Denmark (327.8 Mt)

– Belgium (101.6 Mt)

– Austria (80.5 Mt)

– the Netherlands (79.3 Mt)

– Spain (77.6 Mt)

– Canada (60.8 Mt)

– Poland (54.5 Mt)

– Germany (52.4 Mt) (FAOSTAT, 2005 – http://faostat.fao.org/).

Intensive production systems

A high level of intensity and management control generally characterises pig production systems in the industrialised world. They have historically been located in regions of high grain production, such as the American corn belt states and Canadian prairie provinces, or the major arable areas of Europe. However, significant concentrations of pigs can also develop around areas where cheap industrial by-products from human food processing are available for feeding, as seen in the Netherlands, or in regions where the activities of large integrator companies have stimulated growth, for example in North Carolina. Within the EU the major pig producing countries are Germany, Spain, Denmark, France and the Netherlands. Pig production has increased most in recent years in Spain, and is expected to increase again in the former communist countries in Central and Eastern Europe, which showed a big decrease in production during restructuring, whilst production in Western Europe is likely to fall. In all countries, economies of scale in production have resulted in a consistent decrease in the number of pig farms over recent decades, whilst the number of animals per unit has increased to compensate for this. Large concentrations of pigs in certain geographic areas have raised major concerns about waste management and the risk of adverse environmental impact from groundwater pollution, gaseous emissions and odour. Public concerns about animal welfare in large industrialised enterprises have also been growing. As a result, there is increasing legislative control on production in both Europe and North America.

The production of pigmeat involves breeding, nursery (newly weaned piglets) and finishing phases. These may all take place on the same farm (so called farrow-to-finish operations), or may be split between different farms each specialising in only one or two phases. This latter strategy has become more common as herd size has increased, and as the advantages of split-site production for the control of disease spread have been demonstrated (32). For example, the proportion of total slaughter pigs produced from farrow-to-finish operations in the USA fell from 65% to 38% between 1992 and 1998 (37). Whilst this trend is not yet as pronounced in Europe, similar changes are taking place. There has been an associated increase in the number of pig-producing companies that contract out the nursery and finisher phases of production.

In intensive pig units biosecurity and health management are major priorities. Many intensive farms have a high health status, barrier fencing and restricted access. However, disease control is difficult in areas of high pig density and, once endemic diseases such as enzootic pneumonia, porcine respiratory and reproductive syndrome or postweaning multisystemic wasting syndrome arise within a herd, they can only be eradicated by full or partial destocking and repopulation, or controlled by the development and systematic use of vaccines. It has been common practice in the past to use in-feed antibiotics as a prophylactic and/or growth-promoting aid. However, whilst this practice is still common in the USA, EU legislation requires the removal of non-prescription antibiotics from feed from 2006.

The majority of pigs in industrialised countries are housed in buildings with fully or partially slatted floors and liquid manure (slurry) handling systems. Pregnant sows are most commonly housed in individual gestation crates, but animal welfare concerns have resulted in the requirement to phase out such systems within the EU by 2012 for all but the first four weeks after service, with some Member States already unilaterally imposing a complete ban. Whilst such legislation does not yet pertain in the major pig-producing states of North America, similar consumer pressures are growing. Alternative systems involve either group feeding, the use of temporary confinement in individual feeding stalls or automated systems using transponder identification and computer controlled feeding stations (17). From shortly before giving birth, and for the lactation period, sows are commonly housed in farrowing crates. Whilst animal welfare concerns are also expressed about the confinement during this period, the benefits of such systems for piglet survival in large-scale industrial units cannot yet be matched in higher welfare alternatives (19). In the EU, legislation specifies that piglets cannot be weaned at less than 28 days of age unless all-in all-out batch systems are employed to aid health management, in which case some litters may be weaned up to seven days earlier. However, in North America earlier weaning, sometimes with piglets of less than two weeks of age, is commonly employed in some large enterprises as part of a veterinary strategy to break the infection cycle from sow to piglets (32). Weaned piglets and growing and finishing pigs are housed in groups varying in size from a single litter to several hundred animals, and are typically fed *ad libitum* until slaughter at five to six months of age. Whilst fully and partially slatted, unbedded systems are most common, other types of housing may be adopted depending on regional climate, availability of bedding materials such as straw, and legislation relating to animal welfare and environmental emissions which is in place in a number of different individual countries in Europe (27).

Alternative systems

In many European countries, and to a lesser extent in North America, alternative, less intensive systems of production may be adopted. These include deep litter, bedded indoor systems or outdoor production systems for both sows and growing pigs. Indoor bedded systems are often combined with cheaper building structures, such as uninsulated sheds in Northern Europe, or hoop (tent-like) structures in North America (34). Such systems are perceived by consumers to provide better welfare conditions because of the availability of straw or other bedding for occupations such as rooting, but they also pose risks of poorer hygiene, greater health challenges and persistence of zoonotic organisms such as *Salmonella* (27). Outdoor pig production systems come in many forms (18). In some European countries, notably the UK, and in a few mid-western states of the USA significant numbers of breeding sows are kept outdoors and supply pigs to conventional finishing systems. During both pregnancy and lactation periods, sows are kept in groups at pasture, with simple metal or wooden shelters for protection from the weather. This conventional outdoor production contrasts in scale with a small but growing number of farms producing pigs to organic standards, where it is a requirement that both sows and growing pigs have outdoor access. Whilst sows are usually kept at pasture, their piglets after weaning at six to eight weeks of age may either remain at pasture or be transferred to housing with an outdoor run area, depending on the climate and the precise requirements of the organic certifying body. The third major type of outdoor production is the traditional Mediterranean silvopastoral system, widely seen in some Southern European countries. This system involves indigenous breeds grazed in natural forest areas for the production of high-value dry-cured hams. Whilst all outdoor systems offer the animals much greater space and environmental complexity, welfare challenges from adverse climatic conditions, parasites and less prompt disease detection can occur. Similarly, whilst the lower animal density and greater volume of fresh air reduces disease challenge within the group, the open access for humans

and wildlife can also make it more difficult to limit the spread of disease and transfer of zoonotic organisms.

Future trends in pig production

As with other livestock sectors, economic pressures will dictate the continued growth in unit size and reduction in number of units over time. However, the degree of intensification and the permitted housing systems are likely to be increasingly regulated by legislation to protect animal welfare and limit environmental impact. Such legislation is already in place in the EU, for example through Directives 2001/88/EC (24) and 2001/93/EC (23) on pig welfare, and 96/61/EC (20) on integrated pollution prevention and control, and growing public pressure is likely to lead to similar developments in North America. Whilst smaller traditional, and niche market systems are likely to grow in number to supply a high value market, they will always be a small minority of total pig production.

Poultry production systems

Broiler chickens and laying hens could be seen as two different farm animal species, although they have a common ancestor in the red jungle fowl (*Gallus gallus*). The chicken meat sector and egg sector are more or less separated in the industrialised world, with few connections except for control of contagious diseases.

Traditionally poultry production, both broiler meat and egg production, has been localised to grain-growing areas, but as trade has become more international other factors, such as access to cheap manpower, are influencing the location of the farms. The increasing farm size and flock size has raised concerns about the environmental effects of wastes from the operations. Furthermore, this development increases the risk of severe consequences should a huge farm be hit by an epizootic disease (e.g. avian influenza).

Broiler chickens

During the last two decades the annual world production of chicken meat has increased from 20 billion birds per year in 1984 to 47 billion birds in 2004 (FAOSTAT). The USA (8.9 billion), the People's Republic of China (7.2 billion), Brazil (5.3 billion), India (1.8 billion), Indonesia (1.4 billion) and Mexico (1.2 billion) are the main chicken meat producers in the world. Annually 6.4 billion broiler chickens are slaughtered in the EU (25 Member States). France, UK and Spain are the largest producers within the EU with an annual production of about 800 million each (FAOSTAT).

The predominant way to rear broiler chickens in the industrialised world is to keep the birds on littered floors in large window-less buildings. This system allows the farmer to house a large number of birds in an enclosed environment at a relatively low cost. The stocking density used in commercial broiler production is from about 30 kg/m^2 up to about 50 kg/m^2 (22, 44). The two predominant hybrids used in chicken meat production are the Cobb and the Ross.

In free-range broiler production the birds are typically kept indoors on a littered floor with access to an outdoor area. This can be a covered veranda (winter garden) that could be used all year round, or a free-range area. It is common that slow-growing broiler hybrids are used in free-range broiler rearing (e.g. Label Rouge in France), which means that the birds are slaughtered at 60 to 90 days compared to 30 to 50 days in conventional rearing. The market share of organic broiler rearing is still very restricted (22).

Future trends in broiler production

It seems unlikely that there will be any major change in basic housing practice in the near future, except for differences in stocking densities. The European Commission (25) is proposing that the stocking density of broilers should be restricted to 30 kg/m^2. If the farm is complying with a control programme, the stocking density may be increased to a maximum of 38 kg/m^2. Europe imports large quantities of broiler meat from other countries, e.g. Brazil and Thailand, which puts a lot of pressure on the national production within the EU. The trend has been for this trade to increase, although national concern for zoonotic diseases like salmonellosis and avian influenza may limit the import in future.

The market share for organic chicken may show a marginal increase in some countries, if challenges like the increased risk of parasitic diseases (e.g. coccidiosis) and other outdoor associated health and welfare problems can be overcome.

Laying hens

During the last two decades the annual number of laying hens has increased from 3.1 billion birds per year in 1984 to 5.4 billion birds in 2004, and egg production has increased from 29,266,307 Mt in 1984 to 58,205,376 Mt in 2004 (FAOSTAT). The People's Republic of China (2,134 million hens), the USA (344 million), Brazil (236 million), Indonesia (161 million), Mexico (154 million) and India (158 million) are the main egg producers in the world. In 2004, 407 million laying hens were producing eggs in the EU (25 Member States); France (61 million), Spain (50 million), Italy (46 million), Germany (45

million), Poland (45 million) are the largest egg producers within the EU (FAOSTAT).

Housing systems for laying hens can be categorised into cage systems and non-cage systems, as described below.

Cage systems

There are two types of cage system: battery cages and furnished cages. The battery cage is by far the most common housing system used internationally, although it is banned in Switzerland and Sweden. Battery cages are systems where a small group of hens is kept in an enclosure of welded wire mesh with a sloping floor. The system enables the farmer to keep a large number of birds in a restricted building space, but yet to keep them in small groups. The space allowance varies from 400 cm^2 to 750 cm^2 per bird (26, 33). The EU has planned to ban these battery cages by 1 January 2012 (21).

Furnished cages have the advantages of battery cages (small group size, wire mesh cage), but they also provide hens with access to important resources that enable them to express crucial behaviours such as perching, nesting and dustbathing. Usually the production results are more predictable in furnished cages than in non-cage systems. Different versions of the furnished cage have been tested, ranging from a battery cage supplied with a perch to larger cages supplied with a nest box, perch and dust bath. The cages are for five to nine birds at 600 cm^2 to 750 cm^2 of floor area per bird (26). By the 1 January 2012, the EU will only allow cages that give the birds the opportunity to perch, nest and dustbathe (21).

Non-cage systems

Non-cage systems are litter-based floor systems, usually with a separate manure area. They range from homemade simple deep litter systems, to prefabricated complex systems, where the birds are given an environment consisting of different levels of perches and nesting areas. Non-cage systems are very rarely used except in north-west and central Europe. The European Food Safety Authority categorises non-cage systems into single-tier systems and aviaries (26).

A single-level system consists of a littered floor which may also be perforated to allow droppings to pass through to a separate manure area. If a mechanical manure system is installed the manure can be cleaned out regularly during the production period. Otherwise, the manure is stored in the house and only removed between the batches. The single level system has nest boxes or colony nests for egg laying, and the birds have access to perches on a single level.

An aviary (or a multilevel system) consists of littered floor areas and tiers at different levels. Tiers consist of a perforated floor and/or perches, where the birds are offered food and water. The perforated area allows the droppings to pass through to a mechanical manure system, which allows regular cleaning out. The system has nest boxes or colony nests for egg laying. The nests can be separated from the tiers or they can be integrated within the tier system. The system makes it possible to house a large group of laying hens at a high stocking density, calculated as number of birds per unit of ground area.

In some non-cage systems hens are also given access to an outdoor environment. The outdoor area can also be combined with a covered veranda (winter garden), which can be used all year round. Sometimes the outdoor area is available all the time, but more commonly the birds are outside during a period of the day, typically the afternoon, in order to avoid mislaid eggs. In countries of the temperate or sub-arctic zone, birds in free-range systems are kept in the indoor area during the winter.

Future trends in egg production

It is reported that battery cages are probably the best choice from an economic point of view, although the feed conversion efficiency has been reported to be better in furnished cages (15, 26). Birds in non-cage systems, and in particular free-range systems, have been reported to have lower feed conversion and to produce fewer saleable eggs compared to layers kept in cages (1, 26). On the other hand, the barren environment of battery cages restricts the birds from satisfying their behavioural needs (15). The laying hens in furnished cages have improved welfare compared to battery hens, even if the furnished cages just allow the birds to express some behaviours and not others, e.g. wing flapping. The ideal situation from a welfare point of view is an aviary or a free-range system that gives the birds more opportunity to express natural behaviours, although these systems have a larger variation in productivity compared to cage systems (1). In addition to housing conditions, factors such as genetics, nutrition and rearing conditions for the pullets also have an influence on production and on the health and welfare of laying hens (26, 30, 31, 39).

In the EU, dramatic changes may occur within the next decade. Furnished cages and non-cage systems will replace battery cages, which will be banned from 1 January 2012. The replacement process will probably take two different directions. Some farmers may change to furnished cages, because they think these will give more predictable production results and require similar labour to battery cages. Other farmers may consider aviaries to be the less expensive alternative, offering more flexibility: a non-cage system can, for example, be turned into an organic farm. In future, furnished cages will probably be regarded as the baseline standard by consumers, once all battery eggs are out of the market.

The situation in North America may remain unchanged for a long time, i.e. most farmers will stick to the conventional battery cages. However, it is likely that a market-driven change from battery cages into furnished cages or non-cage systems could come. If so, the change could be more dramatic than the change in Europe. The adjustments in farming practice towards increased animal welfare in the EU are mainly driven by public and political opinions via legislation. Historically, this process has been a quite slow one (it has been going on for decades), whereas market-driven changes in animal welfare practice may happen over a couple of years.

Other animal production systems

Goat production systems

Although sheep and goats are very important livestock in the developing world, they are less important in the industrialised world (Table I). From 1993 to 2003 the world goat population increased by 26% (7). In the industrialised world, the goat population has been stable during the last 20 years. In Europe, dairy goats predominate and goat milk production has increased due to high performance in countries like Bulgaria, Cyprus, France and Spain (7). In the Mediterranean countries, goat products are associated with agrotourism in mountainous regions (14).

Table I
Number of live animals in the industrialised world in 2004 (million head) (FAOSTAT)

Type of animal	Location			
	European Union [a]	North America	Oceania	World
Goats	12	1	1	783
Sheep	103	7	135	1,059
Cattle	88	110	37	1,339
Pigs	152	75	5	948
Chickens	1,170	2,130	120	16,352

a) 10 new Member Countries joined the European Union on 1 May 2004, bringing the total to 25. Figures quoted here include information from all 25 countries

Sheep production systems

It appears from Table I, that the world sheep population is similar in number to the global cattle population. However, the world sheep population is decreasing (6). Sheep meat is still the most internationally traded type of meat; in total 15% of sheep meat production is exported. This is mainly due to export from Australia and New Zealand. In the Mediterranean countries, the production of dairy sheep is the predominant type of sheep husbandry. Wool is the main purpose for sheep breeding in Australia, New Zealand and Eastern Europe. Lamb meat is, on average, the most expensive type of meat worldwide (6). However, there are major cultural differences in the products, from 6 kg lambs in Greece to 30 kg lambs in Australia. Sheep can be fed on pastoral range land for which opportunity costs are low. However, production systems vary between countries. Bouttonnet (6) has calculated that the average number of ewes per labour unit is 1,400 in New Zealand compared to 20 in Greece. In New Zealand, 76% of sales come from wool and 24% from meat. In Greece 42% come from milk, 34% from meat and 24% direct from subsidies. In North European countries, meat has become the main product of sheep (16).

Ways to improve food safety and the health and welfare of animals in future livestock production systems

There are different ways to improve food safety, public health and the health and welfare of livestock. First of all, regulations can be defined for health promotion (e.g. EU directives and regulations). Secondly, different organisations such as national livestock sector bodies, the meat/milk/egg processing industries and retailer organisations can set rules for good farming practice and develop information systems for food safety (2) or animal welfare (5). Thirdly, different actions can be taken at the local farm level to improve the issues named above. Such actions include better training to improve skills and knowledge, e.g. with regard to health and welfare hazards and their associated risks (10). Improving farmers' observational skills so that they can properly monitor their animals and their direct environment, and correctly interpretate the findings, contributes to the early detection of health and welfare problems on livestock farms. Farmers should also be encouraged to develop an attitude of focusing on high quality production, where quality refers to both the product and the production process. Quality risk management in such operations may be executed according to principles of the hazard analysis and critical control point concept (36, 41, 42) and integrates the tactical quality approach with operational farm management issues.

Les systèmes de production animale dans le monde industrialisé

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Résumé
La production de denrées alimentaires d'origine animale dans le monde industrialisé est relativement stable. Par contre, les systèmes d'élevage ont subi des transformations radicales en ce qui concerne la localisation des élevages, la taille des troupeaux et le niveau de spécialisation. Suite aux critiques émanant de l'opinion publique, les systèmes de production animale évoluent progressivement vers des productions « bio » et des systèmes d'élevage à stabulation libre, favorisant l'expression du comportement naturel de l'animal. L'accent mis sur la sécurité sanitaire des aliments favorise les systèmes dotés d'un niveau élevé de biosécurité, souvent associé à une augmentation de la taille des troupeaux et à un système d'exploitation intégré. La mondialisation des échanges de produits agricoles et l'intensification de la concurrence sont d'autres facteurs contribuant à l'augmentation des troupeaux et à une spécialisation accrue. Ces tendances se traduisent par de fortes densités de bétail dans certaines régions, avec les problèmes environnementaux que cela suppose. Il est donc nécessaire de réglementer les bonnes pratiques d'élevage et d'établir des systèmes offrant une meilleure transparence.

Mots-clés
Système de production animale – Bovin – Caprin – Porcin – Volaille – Ovin.

Sistemas de producción animal en el mundo industrializado

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Resumen
En el mundo industrializado, la producción de alimentos de origen animal permanece en niveles relativamente estables. Sin embargo, los sistemas productivos están sufriendo cambios muy profundos por lo que respecta a su ubicación, al tamaño de los rebaños y a la especialización. La creciente presión de una opinion pública bastante crítica está reorientando la producción animal hacia sistemas que privilegien métodos como la producción biológica o la estabulación espaciosa, que inducen un comportamiento más normal de los animales. El hecho de poner el acento en la inocuidad de los alimentos favorece a los sistemas productivos que ofrezcan un elevado nivel de seguridad biológica, lo que suele ir ligado a rebaños más numerosos y a un mayor grado la autocontención. La mundialización del comercio agrícola y la creciente competencia también favorecen la especialización y el aumento del tamaño de los rebaños. Estas tendencias propician además la aparición de regiones con zonas de alta densidad ganadera, hecho que despierta inquietud por sus posibles repercusiones ambientales. En este sentido, se están elaborando reglamentos y sistemas de buenas prácticas ganaderas para ofrecer un mayor nivel de transparencia.

Palabras clave
Ave de corral – Bovino – Caprino – Ovino – Porcino – Sistema de producción animal.

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