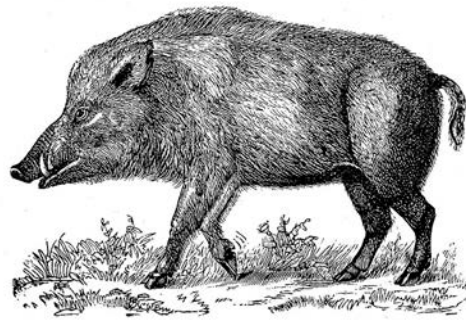




The life of - Pigs

The domestic pig of today originates from the European wild boar, although there are still wild boars today¹. The domestication of pigs is thought to have started about 7000 to 8000 BC^{2 3}. The modern domesticated pig has a smaller head in proportion to the body, a mostly curled tail, less hair and a thicker layer of fat than wild boars. They now breed at any time of the year with more than one litter annually⁴. While the physical appearance has changed, the domesticated pig still has most of the behavioural repertoire of the wild boar^{5 6 7}. Until the 1950's, farming was often mixed (crops and livestock) with only a few pigs. Female breeding pigs were kept outside in the summer, with a wallowing pit and shade. Animals kept indoors were housed in loose pens, normally bedded with straw⁸.



Left: Large White sows. Right: Wild Boar. Modern pigs have very different body shape to that of their ancestors, but pigs have retained many of the behaviours of their wild counterparts

Wild boars are found in a range of habitats, often close to wooded areas and river valleys. They live in small family groups consisting of 2-4 sows and their young. The group ranges over hundreds of kilometres. Pigs are very intelligent, highly sociable animals. They are omnivores, having a varied diet, mostly high in fibre. Normally pigs spend much of their time foraging and rooting for food. Pigs make nests for sleeping and huddle together for warmth. Sows construct elaborate nests prior to giving birth. They frequently wallow in mud for cooling and skin care (skin parasites get rubbed off with the mud). Designated 'toilet' areas in their territory are used for dunging. Studies of domestic pigs that have either escaped (called feral pigs)⁹ or pigs kept in semi-natural enclosures have shown that they display the diverse behavioural repertoire of their wild ancestor¹⁰.

Modern pigs

Today, more than a billion pigs are slaughtered in the world each year for meat, making them the most common mammal farmed for meat¹¹.



Over 1 billion pigs are slaughtered in the world each year.

Housing

Throughout the world, over half of commercial pig farming is highly intensive¹². This takes place indoors and is also known as industrial pig production or 'factory' farming. Adult female pigs are kept in close confinement systems throughout their lives. Their offspring are kept in barren pens at high stocking densities (expressed as the available floor area per animal), until they are ready to go for slaughter.

Several alternatives to intensive farming systems have been developed to overcome welfare concerns associated with intensive farming. Most are based on traditional farming systems that were commonly in use before industrialisation took place in the 1950s. Some use modern technology to achieve better welfare.

Breeding and rearing animals

There are a number of different types of pig kept in farming systems. The animals used for **breeding** include:

1.



2.



3.



4.



- 1. Gilts:** young adult female pigs that have not yet produced a litter of piglets (called farrowing)
Sows: adult female pigs that have farrowed one or more litters.
- 2. Dry sows:** adult female pigs from weaning (separation from piglets) until farrowing. They are called 'dry' because they are not producing milk to suckle piglets.
- 3. Farrowing sows:** adult female pigs from farrowing until weaning.
- 4. Boars:** adult male pigs used for mating with sows and gilts.

The animals **reared for meat** include:

1.



2.



3.



4.



Piglets: pigs from birth until weaning (at 2-4 weeks).

- 1. Weaners:** pigs from weaning until the age of 10 weeks.
- 2. & 4. Rearing pigs:** pigs from 10 weeks until slaughter age at about 6 months.
- 3. Growers or growing pigs:** pigs in the early stage of rearing.
- 4. Fatteners or finishing pigs:** pigs in the latter stage of rearing.

Intensive and alternative pig farming

Pigs are kept in a variety of farming systems:

Intensive

Breeding animals are kept indoors in close confinement systems throughout their lives. Rearing animals are kept indoors in groups in barren pens, at high stocking densities. Temperature and ventilation in the buildings has to be closely controlled as the animals are unable to easily maintain body temperature by using pig-specific behaviour such as wallowing in mud.

Semi-intensive

Both breeding and rearing animals are kept indoors in pens at high stocking densities with little or no access to bedding or litter. Farrowing sows are usually confined in crates.

Enriched indoors

Breeding animals and rearing animals are both kept indoors in spacious deep-bedded barns. The bedding may be straw, wood shavings or other material, which is replenished as needed. Farrowing sows are not confined.

Outdoors

Breeding animals are kept in outdoor paddocks. Rearing animals have access to outdoor areas. Most organic pig farming is outdoors.

Extensive

In some parts of the world, notably Spain, Sweden and Brazil, pigs are allowed to roam freely in semi-natural enclosures.



Intensive pig farming



Enriched indoor pig farming



Outdoor (extensive) pig farming

Intensive pig farming

Most pigs used in intensive systems are based on a crossing of two breeds (Large White x Landrace). The breeding animals have been selected to maximise the number of piglets they can produce in a year. On average, modern sows have 10 piglets per litter and have 2.4 litters per year¹³ but some are having 13 or 14 piglets per litter. At the end of the production period - after they have had an average of 3-5 litters - sows are culled (brought to slaughter)¹⁴, aged about 1½ to 2 years. The meat animals have been selected to have large appetites, rapid growth rates and good food conversion ratios (meaning how much of their food is converted into body weight, such as muscle and fat). Modern pigs can reach a slaughter weight of 100 kg in 24 weeks¹⁵.

Sows

At breeding time, dry sows and gilts are introduced into a small pen that contains a single boar, who then mates with them ('serving'). This may be repeated if they do not become pregnant. Pigs are examined with ultrasound to confirm pregnancy, about one month after mating. Artificial insemination (AI) can also be used whereby boar semen is introduced manually into the sow by the stockperson (caretakers). Once mated, both gilts and dry sows are kept in either 'sow stalls' or 'tether stalls' (see below) during their pregnancy which lasts for about 114 days (3 months, 3 weeks and 3 days). Stalls are used to maximise the number of animals that can be housed in a given area. Stalls also prevent the sows from fighting each other and make it easier to manage the sows (e.g. provide veterinary treatment) with fewer stockmen.



Sow stall – used for pregnant sows throughout their gestation period. A few days before they are due to give birth, they are moved to a farrowing crate.

Sow stalls

A narrow steel cage that completely surrounds the sow and does not allow for a lot of movement or turning around. Stalls have concrete floors with usually a slatted area at the rear through which dung can pass or the floors are fully slatted. Stalls are banned in the EU¹⁶, except for the first 4 weeks and then the last week of pregnancy, when the sow is moved to a farrowing crate (see below).

Tether stalls

Similar to stalls but the sow is fixed in position by using a tether or belt tied around her neck or girth. Tether stalls are less common than free stalls and banned in the EU.

Stalls have troughs at the front for the provision of food and water. Sows are fed a concentrated diet based on cereals. The ration is designed to maintain the sow's body weight and growth of her unborn piglets; the quantity of food given may

be reduced during late pregnancy to reduce the risk of obesity. This can lead to hunger.



Tether stalls where sows are kept during their pregnancy, and tethered with a chain or strap

Boars



Boars are normally penned alone.

Boars are generally kept singly in pens. This is partly to prevent aggression and partly to ensure paternity of offspring (so that the farmer knows who has fathered a litter). The pens are usually also used for mating. Bedding is often provided to ensure good foothold for the boar during mating. On some farms boars are kept in pens with slatted floors and in some countries they are kept in sow stalls and only removed for mating. Boars may have their tusks trimmed¹⁷ to prevent injuries to stockpersons and other pigs. It is recommended that this procedure is carried out by a vet using an orthopaedic saw once the boar has been sedated. However, the procedure is often carried out

by the stockperson using bolt cutters without the use of sedatives or painkillers. This can leave the trimmed tusks exposed to infection.

Farrowing sows

At 3-7 days prior to giving birth, sows are moved to farrowing crates. Like sow stalls, farrowing crates consist of a steel cage that completely surrounds the sow, not allowing her to walk more than a couple of steps or turn around. The bare concrete floors usually have a slatted area at the rear for dunging or the crates are fully slatted. In some systems, litter material such as wood shavings may be provided to reduce the risk of the sow slipping and crushing her piglets. Heated creep areas (hide areas) are usually provided for the piglets and these encourage the piglets to lie away from the sow, this prevents piglet crushing (see below).



Farrowing crates are used for sows about to give birth and until weaning.

Farrowing crates were designed to restrict the sow's movement and reduce the risk of her accidentally crushing her piglets, as this is not only a welfare issue, but also an economic one for the farmer. Modern sows have been bred to have much larger litters than their wild boar relatives. As a result, the piglets tend to be much smaller and weaker at birth and therefore more prone to accidental crushing. Modern sows are much larger than their wild cousins and the size ratio between the mother and piglets is almost 100:1, further compounding the risk of piglet crushing.

Farrowing crates can lower costs, by limiting the amount of building space required and by simplifying management of sows. Any supervision or veterinary treatment to the sow or her piglets can be safely and readily given.

After giving birth, the sow remains with her piglets in the farrowing crates until they are weaned (removed), at 2-4 weeks. Most intensive farms practice 'cross-fostering' where piglets from large litters are removed and placed with sows that have smaller litters. In some systems, the sow and piglets may only be kept in the farrowing crate for the first few days when the risk of crushing is greatest. The farrowing crate may then be opened up to form a pen. Alternatively, they may be moved to individual pens or group suckling pens where a number of sows and their piglets can suckle together. After weaning, sows are returned for mating or AI to repeat the reproduction cycle or they are sent away for slaughter ('culled').

Piglets

Within a few days after birth, piglets are given a series of vaccinations. A number of mutilations are carried out without any sedation or pain relief, including:



Pigs with docked tails no longer have their curly tail. Tails are commonly docked in barren systems to prevent wounds from pig's biting each other's tails.

Tail docking

Tail docking involves the removal of up to two thirds of a piglet's tail with a hot blade or sharp pliers¹⁸. This is to try and reduce the incidence of tail-biting later in life, as this can lead to pigs being culled before they reach slaughter age. It is also a welfare problem for pigs that have been tail bitten, as their tail can bleed and become infected. The EU Pig Directive does not allow the routine tail-docking of pigs and pig farmers need permission from a vet to do so¹⁹.

Teeth clipping/grinding

The piglets' sharp corner teeth are removed down to the gums by clipping them with sharp pliers or the tip of these teeth is removed with special grinders. Teeth clipping/grinding is performed to reduce the risk of suckling piglets causing damage to both each other while fighting for the sow's teats, or damage to the sow's udder. The EU Pig Directive does not allow the routine teeth clipping of pigs and pig farmers need permission from a vet to do so²⁰.

Castration

In some countries, male piglets are castrated by removing their testes with a scalpel or sharp knife. This is to ease handling and reduce 'boar taint' which in sexually mature animals can leave an unpleasant taste in the meat. Immuno-castration is now permitted in the EU, this involves injections with a vaccine against male hormones and prevents the development of the testes²¹.

Nose ringing

Nose ringing involves the insertion of metal rings into the nose to reduce rooting activity that can cause environmental damage in outdoor adult pigs²².

Ear notching

Ear notching involves cutting several notches around the tip of each ear using notching pliers. The purpose is the permanent identification of pigs used mainly for breeding.



Ear notching involves cutting several notches around the tip of each ear using pliers. The purpose is permanent identification of pigs



A sharp blade (and no pain sedation) is used to castrate piglets when they are only a few days old.

Weaner pigs

Piglets are separated from their mothers at an age of 3-4 weeks (weaning). In the US, weaning can be done as early as 1-2 weeks. By removing piglets early, the sow can be mated again and early weaning therefore maximises the number of piglets a sow can have in a year. Natural weaning would not occur until the piglets were over 12 weeks of age. EU rules prevent weaning before 28 days for most pig-rearing

systems, except in "all-in, all-out" units where the limit is 21 days²³.

After weaning, the piglets are transferred to so-called 'flat deck' pens, which are often barren and have slatted or part-slatted flooring. The piglets are mixed into groups with different litters (this should be done as young as possible, preferably before or up to one week after weaning in order to prevent excessive fighting²⁴. The pens contain



These piglets have had their tails docked to reduce the risk of tail biting in the barren environment. Rather than enriching the environment they have mutilated the piglets.

feeders and drinkers and often include heated areas or heating lamps.

Rearing pigs

In intensive farming, rearing pigs are housed indoors and grouped into pens. The pigs are reared at high stocking densities with approximately 1m² of floor area provided for each 100 kg pig. High stocking densities are used to save on space and costs. The pen floors are usually fully slatted, some are part-slatted and others have solid concrete floors. Slatted floors allow urine and slurry (manure) to pass out of the pens into collecting tanks below. Straw bedding cannot be used because it would block the openings in the floor and the slurry system below.

The EU Pig Directive requires that all pigs must have permanent access to manipulable material to enable proper investigation and manipulation activities²⁵. Enrichment objects or well-designed pig ‘toys’ can be provided, if pens have part-slatted floors. Bedding (straw or other materials such as saw dust or rice hulls peat, compost, and various wood chips²⁶, has the highest potential to provide successful enrichment²⁷.



These rearing pigs are housed in pens with fully slatted floors without any enrichment, except for a single chain which is not sufficient enrichment.

In barren conditions, pigs can redirect their chewing behaviours towards pen fittings and other pigs including their tails and ears. Bitten tails can bleed and then attract other pigs so that the behaviour can quickly spread throughout the whole group. Pigs with bitten tails can suffer pain and infection. Pig’s tails are docked to help limit this (see above), but it can also be prevented by providing an enriched environment that offers stimulation.

During the growing phase, the pigs can be re-grouped into new pens with unfamiliar pigs and this can lead to further problems with aggression and tail-biting²⁸.

Alternative pig farming

Pigs can be kept in a range of alternative farming systems. Traditional breeds, such as Tamworth, Saddleback, Gloucester Oldspot, Pietrain, Iberian and Meishan, or their crosses, are often used in these systems. These breeds tend to have smaller litters of 6-8 piglets and farrow only once or twice a year. Although they have fewer litters than modern breeds, they usually have better mothering abilities. These pigs also take longer to reach slaughter weight (at 36 weeks of age), but the meat quality is perceived to be better. Modern breeds, such as the Large White and the Duroc can also be reared in less intensive systems. These breeds are bred throughout the year and will have larger litters similar to when they are kept in the more intensive systems.



Higher welfare systems for pigs provide an environment that allows pigs to perform more of their natural behaviours.

Sows

On alternative pig farms, dry sows are kept in groups in either indoor housing or outdoor systems.

Indoor housing

Dry sows are generally kept in spacious deep-bedded barns. When sows are mixed together after weaning, unfamiliar sows will fight to establish a dominance order²⁹. Aggression is reduced by providing more space, bedding material and barriers that allow weaker sows to escape behind.

At feeding time, dominant sows may bully weaker sows to gain more food. Several feeding systems have been developed to overcome this problem:

- **Feeding stalls:** allow sows to be locked up individually while being fed, they are released afterwards.
- **Electronic sow feeders:** provide one feed station for each group of sows that can be accessed by each sow in turn, using transponders fitted around the sow's neck³⁰.
- **Scatter feeders:** distribute the food over a large surface area so that sows are more spaced out and can avoid each other while eating³¹.
- **Trickle-feed systems:** release food slowly into an individual feed station and the sows learn that it is not to their advantage to leave a feed station and muscle in on another³².



A sow is entering an electronic feeder. The sow can only enter with her individual transponder attached around her neck.

Outdoor housing

Dry sows can be kept in groups in outdoor paddocks. Huts bedded with straw to provide shelter from the weather. In hot countries, shaded areas and wallows may also be provided to allow the sows to cool down. Concentrated feed is usually distributed using scatter feeders and water is provided in troughs.

Boars

On good alternative farms, boars are kept singly in spacious deep-bedded pens. On some outdoor units, 'teams' of 2-3 boars live together in paddocks with recently weaned sows.

Farrowing sows

Farrowing crates

Some farms only use farrowing crates for the first few days post-farrowing when the risk of piglets being crushed is highest. The crate may then be opened up into a pen or the sow and litter may be moved out altogether. In Sweden, farrowing crates may only be used for a maximum of one week.

Free farrowing

The 'Swedish group system' allows the farrowing sow freedom of movement at all times. Each sow has her own box to farrow in but is able to leave her piglets and carry out normal activity. Although good production figures have been attained, problems can arise with sows entering each other's boxes leading to higher piglet mortality. In a natural environment, sows would normally seek seclusion at this time.

Individual pens or 'free farrowing systems' (for example PIGSAFE³³) have been developed to overcome the problems with group systems, whilst meeting the sow's preference for seclusion at

farrowing time. The better designs have plenty of deep-bedded straw and good piglet protection devices such as piglet escape areas and anti-crush bars³⁴. Management is also key to success³⁵.

Arks/huts: outdoor systems use individual farrowing 'arks' or huts that are deep-bedded with straw. Although there can be higher piglet mortality when the weather is extremely cold and wet, UK figures show that outdoor systems can rear the same number of piglets as farrowing crates³⁶. Organic farming³⁷ is based on outdoor farrowing systems.



Free farrowing systems do not restrain the sows during or after farrowing.



Arks are used in outdoor systems and provide shelter during adverse weather conditions.

Piglets

In most alternative, higher welfare systems, piglet mutilations are not carried out. Teeth-clipping is not usually necessary because outdoor breeds tend to have smaller litters with more robust/healthy piglets so there is less competition at the udder. Tail-docking is not necessary because the pigs are usually reared in spacious pens with deep bedding offering plenty of distractions and an outbreak of tail-biting is therefore less likely to occur. Mutilations are not routinely permitted under EU organic farming³⁸. Castration of male piglets still occurs and some producers use pain killers during this procedure.

The trend in the UK and many other countries has been to delay weaning. This is because it is believed that piglets are less susceptible to diseases such as Postweaning Multisystemic Wasting Syndrome (PMWS) which causes illness in piglets³⁹. EU organic rules delay weaning till at least 40 days⁴⁰. Some organic farm schemes in the EU require weaning no earlier than 8 weeks⁴¹.

Weaner pigs



Weaners in enriched indoor systems are housed in pens with solid floors and bedding, allowing them to perform more natural behaviours like foraging and exploring.

In most alternative systems, weaners are kept in indoor pens. This is because they are less able to cope with environmental (weather) extremes. Even in organic farming, weaners are generally kept indoors. Pens usually have deep bedding. In different parts of the world, different substrates have successfully been used as bedding including straw, wood shaving, rice hulls and peanut straw.

Some systems provide indoor kennels with an outdoor run. Weaners reared completely outdoors need protection from extremes of weather and from predators such as foxes and badgers.

Deep-bedded kennels with draft excluders are used in

cold climates, shades and wallows in hot climates. Protection against predators is usually provided by electric fencing.

Rearing pigs

Rearing pigs are kept in a variety of different husbandry systems. Most rearing pigs tend to be kept indoors. This is because if they are kept outdoors on pasture, they will root it all up. Paddocks are soon turned into giant mud baths. In some countries, the pig's ability to clear the land has been put to good use. Farmers in the UK and Sweden have used pigs to 'plough' the land after harvest and also clear woodland after it has been felled.



Pigs in higher welfare systems have more space and enrichment, such as straw bedding.

Indoor housing

Rearing pigs are usually kept in large groups in spacious deep-bedded barns or 'hoop' structures such as used in the USA⁴². The type of substrate used varies from country to country depending on what is grown there. The provision of fibrous organic material allows pigs to carry out highly motivated foraging activities and prevents tail-biting⁴³. This means that pigs in these alternative systems are not tail-docked. Stocking densities tend to be lower than in intensive systems. The quality and quantity of bedding and its ability to absorb the dung is important to keep the bedding clean. Alternative deep bedded systems can work out 50% cheaper to set up than intensive systems⁴⁴. Pigs reared outdoors can also show better growth rates and lower mortality than those kept in intensive systems⁴⁵.

Outdoor housing

Most outdoor farms have deep-bedded huts or kennels with an outer court or yard which has a concrete base with further bedding on top. Many organic units are based on this type of system⁴⁶. On organic units, the space allocation from weaning to slaughter is 0.8-1.3 m² per pig indoors, plus 0.6-1.0 per pig m² outdoors. Another system is to provide mobile housing so that once the pigs have cleared the land, they can be moved on to another area. Various sheds and large tents with walls constructed from straw bales have been designed for this purpose. The pigs are usually enclosed with electric fencing.

Extensive farming systems

Rearing pigs can be kept outdoors on pasture or woodland as long as there is plenty of space and/or frequent rotation. In Andalucia (Spain), the tradition of keeping Iberian pigs in extensive oak woodlands still survives. The pigs forage on acorns and benefit from living in a near natural-habitat. However, males are still castrated and many have nose rings to discourage rooting.



Extensive pig farming requires a lot of land to allow for rooting behaviour.

Transport and slaughter

At the end of the rearing period the pigs are transported to slaughter. Modern farms provide facilities such as well-designed walk-ways and loading ramps to facilitate handling and loading of pigs onto transporters. The majority of pigs are slaughtered for bacon at a live-weight of 90-110 kg,



when the pigs are 20 to 24 weeks of age. In the UK and Ireland, pigs are not castrated so they tend to be slaughtered at a lower weight to reduce the risk of boar taint flavour in the meat of adult boars. Pigs sold for pork are slaughtered at a live-weight of 55-60 kg.

Pigs are slaughtered by being individually introduced into a restraining box where they are rendered unconscious by stunning them, usually with an electric current applied by electrodes or by gas stunning (using carbon dioxide or non-aversive gas mixtures, such as argon or nitrogen)⁴⁷. Sometimes a captive bolt device (a gun that shoots a metal pin into the brain) may be used. After stunning, pigs are bled out by cutting their throats. In some countries without welfare legislation, pigs may be killed without stunning.

References

- ¹ Ekesbo I. (2011). Farm Animal Behaviour: Characteristics for assessment of health and welfare. Swine (*Sus scrofa*). CAB International Wallingford UK. Pp.17-41
- ² Clutton-Brock J. (1999). A natural history of domesticated mammals. Cambridge University Press, Cambridge
- ³ Giuffra E., Kijas J.M.H., Amarger V., Carborg O., Jeon J.-T., Andersson L. (2000). The origin of the domestic pig: independent domestication and subsequent introgression. *Genetics* 154: 1785-1791
- ⁴ Sisson (1975) in Ekesbo (2011), op. cit.
- ⁵ Stolba A., Wood-Gush, D.G.M. (1984). The identification of behavioural key features and their incorporation into a housing design for pigs. *Annales de Recherches Veterinaires* 15: 287-298
- ⁶ Stolba A., Wood-Gush D.G.M. (1989). The behaviour of pigs in a semi-natural environment. *Animal Production* 48: 419-425
- ⁷ Jensen P. (1988). Maternal behaviour of free-ranging domestic pigs. I: Results of a three-year study. Swedish University of Agricultural Sciences, Report 22 [in Swedish]
- ⁸ Ekesbo I. (2011), op. cit.
- ⁹ Kurz J.C., Marchinton R.L. (1972). Radiotelemetry studies of feral hogs in South Carolina. *Journal of Wildlife Management* 36: 1240
- ¹⁰ Stolba, Wood-Gush (1984), op. cit.
- ¹¹ FAO(2010) <http://faostat.fao.org/site/339/default.aspx> [Accessed 26 November 2012]
- ¹² Ibid.
- ¹³ BPEX (2012). Pig Yearbook. British Pig Executive, Stoneleigh, UK
- ¹⁴ Ibid.
- ¹⁵ Ibid.
- ¹⁶ Council Directive 2008/120/EC laying down minimum standards for the protection of pigs. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:047:0005:0013:EN:PDF>
- ¹⁷ Robertson J.F., Arey D.S. (1998). Pig Husbandry Guide No.2 Teethcare. SAC Publication
- ¹⁸ Simonsen H.B., Klinken L., Bindseil E. (1991). Histopathology of intact and docked pigtails. *British Veterinary Journal* 147: 407-411
- ¹⁹ Council Directive 2008/120/EC, op. cit.



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- ²⁰ Council Directive 2008/120/EC, op. cit.
- ²¹ Fabr ga E., Velarde A., Cros J., Gispert M., Su rez P., Tibau J., Soler J. (2010). Effect of vaccination against gonadotropin-releasing hormone, using Improvac, on growth performance, body composition, behaviour and acute phase proteins. *Livestock Science* 132: 53-59
- ²² Studnitz M., Jensen K.H., Jorgensen E. (2003). The effect of nose ringing on the exploratory behaviour of outdoor gilts exposed to different tests. *Applied Animal Behaviour Science* 84(1): 41-57
- ²³ Council Directive 2008/120/EC, op. cit.
- ²⁴ Friend T.H., Knabe D.A., Tanksley Jr. T.D. (1983). Behavior and performance of pigs grouped by three different methods at weaning. *Journal of Animal Science* 57: 1406–1411
- ²⁵ Council Directive 2008/120/EC, op. cit.
- ²⁶ Studnitz M., Jensen M.B., Pedersen L.J. (2007). Why do pigs root and in what will they root?: A review on the exploratory behaviour of pigs in relation to environmental enrichment. *Applied Animal Behaviour Science* 107(3–4): 183-197
- ²⁷ Van de Weerd H.A., Day J.E.L. (2009). A review of environmental enrichment for pigs housed in intensive housing systems. *Applied Animal Behaviour Science* 116 (1): 1-20
- ²⁸ Schr der-Petersen D.L., Simonsen H.B. (2001). Tail biting in pigs. *Veterinary Journal* 162: 196-210
- ²⁹ Arey D.S., Edwards S.A. (1998). Factors influencing aggression between sows after mixing and the consequences for welfare and production. *Livestock Production Science* 56: 61-70
- ³⁰ Barnett J.L., Hensworth P.H., Cronin G.M., Jongman E.C., Hutson G.D. (2001). A review of the welfare issues for sows and piglets in relation to housing. *Australian Journal of Agricultural Research* 52(1): 1- 28
- ³¹ Hulbert L.E., McGlone J.J. (2006). Health and Well-Being: Evaluation of drop versus trickle-feeding systems for crated or group-penned gestating sows. *Journal of Animal Science* 84: 1004-1014
- ³² Leeb B., Leeb C., Troxler J., Schuh M. (2001). Skin lesions and callosities in group-housed pregnant sows: animal-related welfare indicators. *Acta Agriculturae Scandinavica, Supplement* 30: 82-87
- ³³ Edwards S.A., Baxter E.M. (2010). The PigSAFE Project: Developing an alternative to the farrowing crate. Recommended dimensions and details for building PigSAFE pens. November 2010.
- ³⁴ Arey D.S. (1997). Behavioural observations of peri-parturient sows and the development of alternative farrowing accommodation: a review. *Animal Welfare* 6: 217-229
- ³⁵ Baxter E.M., Lawrence A.B., Edwards S.A. (2010). Alternative farrowing systems: design criteria for farrowing systems based on the biological needs of sows and piglets. *Animal* 5(4): 580-600
- ³⁶ Meat and Livestock Commission (MLC) (2004). www.mlc.org.uk. Pig Yearbooks 2001, 2002, 2003, 2004, 2005. British Pig Executive
- ³⁷ COREPIG (2011). Final report Core organic. https://pure.au.dk/portal/files/34776853/Report_WP1_CorePig_January_2011_final.pdf
- ³⁸ Ibid.
- ³⁹ Alarcon P., Velasova M., Mastin A., Nevel A., St rk K.D.C., Wieland B. (2011). Farm level risk factors associated with severity of post-weaning multi-systemic wasting syndrome. *Preventive Veterinary Medicine* 101(3-4): 182-191
- ⁴⁰ COREPIG (2011), op. cit.
- ⁴¹ COREPIG (2011), op. cit.



⁴² Honeyman M.S., Harmon J.D., Kliebenstein J.B., Richard T.L. (2001). Feasibility of hoop structures for market swine in Iowa: pigs performance, pig environment, and budget analysis. *Applied Engineering in Agriculture* 17(6): 869-874

⁴³ Van de Weerd H.A., Docking C.M., Day, J.E.L., Edwards S.A. (2005). The development of harmful social behaviour in pigs with intact tails and different enrichment backgrounds in two housing systems. *Animal Science* 80: 289-298

⁴⁴ Arey D.S., Brook P. (2006). *Animal Welfare Aspects of Good Agricultural Practice: Pig Production*. Compassion in World Farming Trust.

⁴⁵ Meat and Livestock Commission (MLC) (2004), op. cit.

⁴⁶ COREPIG (2011), op. cit.

⁴⁷ The European Food Safety Authority (EFSA). Panel on Animal Health and Welfare (AHAW). Scientific Opinion on the welfare aspects of the main systems of stunning and killing the main commercial species of animals. *The EFSA Journal* (2004) 45: 1-29. www.efsa.europa.eu/publications.htm

