COMPASSION IN WORLD FARMING TRUST

THE WELFARE OF EUROPE'S SOWS IN CLOSE CONFINEMENT STALLS

A report prepared for the

EUROPEAN COALITION FOR FARM ANIMALS (ECFA)

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The Welfare of Europe's Sows in Close Confinement Stalls

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1.0 What are sows stalls?

Sow stalls are a system for the housing of intensively farmed breeding sows when they are pregnant (they are also referred to as 'dry sows' or 'gestating sows'). Breeding sows are kept to produce the piglets that are reared for meat. In the sow stall system, the sows are kept individually in rows of narrow, 4-sided cages. These have been likened to 'veal crates' for pigs. The stall is typically 0.6-0.7m wide and 2.0-2.1 m long[1] (a space allowance of between 1.2 and 1.5 square metres per sow). Sometimes even the top of the row of stalls is enclosed by a rail[1]. Each stall is so narrow that the sow cannot turn round and normally has no bedding or any material for rooting or foraging. The only exercise the sow can take is to lie down and stand up, and this can only be done with difficulty.[†]

In much of Europe, sows are confined like this for the whole of their 16½ week pregnancy, and for pregnancy after pregnancy. Sow stalls frustrate the pigs' most basic behavioural needs for environmental stimulation, exploration and social interaction with their own species, as well as their physical need for exercise.

[†] Note Sow stalls are sometimes confused with 'farrowing crates' because they look quite similar. Farrowing crates are commonly used for intensively farmed sows when they are giving birth (farrowing) and suckling their piglets (lactating).

1.1 Flooring in the sow stall

The floor of a sow stall is usually made of concrete and is typically partially slatted, although fully slatted and fully solid floors are also used. In partially slatted systems the floor is solid at the front, where food and water troughs are placed, and slatted at the rear, where excreta falls or is pushed through to a tank or drainage channel beneath. Both concrete and slats have disadvantages for the sow's welfare. Slats or perforated flooring may trap the claws (feet) of pigs and cause injuries. A sow lying on slats may have only a small proportion of her body surface area supported by the floor. Cold or wet concrete may be uncomfortable to lie on and may cause the sow to slip when she is standing or moving. Often the sow has to lie on her dung.

According to the 1997 report of the European Scientific Veterinary Committee (SVC), "All pigs should be provided with a lying surface which is physically and thermally comfortable and which does not result in injuries"[1]. Pigs prefer insulated or bedded flooring. In summer, they may prefer to lie on non-bedded areas to cool themselves. They prefer to keep their feeding area, their lying area and their dunging area separate. The SVC' s recommendation is that

> Pigs should be able to choose appropriate functional conditions. Except in buildings where the temperature is adequately controlled, pigs should also be able to choose appropriate thermal conditions[1]. (Recommendation no. 12)

Sow stalls are unlikely to fulfil either of these requirements for the welfare of sows.

1.2 Tethers for sows

The tether system is a variation of the 4-sided sow stall. In this case the individual stall is open at the back and the sow is tied in position facing the front of the stall by a short chain attached to a neck collar or to a belt around her middle.

2.0 The legal situation in the European Union

Under EU law, the tethering of breeding sows is now being phased out. From 1st January 1996, no new sow units have been allowed to use tethering , and all existing tether systems must be phased out by 31st December 2005. The EU law does not, however, ban the use of the equally inhumane system of sow stalls. It is likely that many European producers are converting their tether stalls into sow stalls in response to the EU ban on tethers, rather than converting to more humane group housing or free-range systems.

Compassion in World Farming Trust is calling for an urgent phase-out of the sow stall system on a European Union-wide basis. Several countries have already taken steps towards this individually. In Sweden tethers have been illegal since the 1970s and since 1988 the use of sow stalls is not allowed except for temporary use to immobilize occasional sows. Swedish law also requires all pigs to be provided with straw or other litter material. In Finland tethers have been illegal since 1996 and from 2006 sow stalls will not be allowed except for temporary use, for example in cases of injury. The UK passed legislation which banned both tethers and sow stalls from 1st January 1999. Denmark has passed legislation to end the use of sow stalls by 2014. In 1998 The Netherlands passed new pig welfare regulations which will end the use of tethers by 2002 and also phase out sow stalls and provide group housing for all intensively kept sows by 2008. According to the new Dutch law, the minimum area per sow in the group housing is to be 2.25 m^2, of which 1.3m^2 has to be solid flooring.

These European laws have arisen because of the recognition that the sow stall system is totally incompatible with the welfare needs of pigs. This recognition is not new. In 1965 the UK government's *Report on the Welfare of Animals kept under Intensive Livestock Husbandry Systems* (Brambell Report) laid down minimum standards of housing for the protection of farm animal welfare. One of the recommendations in the report is that:

> "an animal should at least have sufficient freedom of movement to be able without difficulty, to turn round, groom itself, get up, lie down and stretch its limbs".[2]

Subsequently, in 1976, the Council of Europe's *European convention for the protection of animals kept for farming purposes* established the following principles:

> Animals shall be housed and provided with food, water and care in a manner…appropriate to their physiological and ethological needs in accordance with established experience and scientific knowledge. (Article 3)
>
> The freedom of movement appropriate to an animal…shall not be restricted in such a manner as to cause it unnecessary suffering or injury. (Article 4(1))[3]

There is abundant evidence that sow stalls violate these principles by frustrating both the physiological and ethological needs of sows and causing them both physical and psychological suffering and injury.

Recently, the Council of Europe's February 2000 proposed recommendation on pigs states specifically that:

> "Dry sows shall be group housed" and that their accommodation should allow them to have "normal social interactions and to root and play." [4]

Council Directive 91/630/EEC laying down minimum standards for the protection of pigs was due to be reviewed by the European Commission by 1st October 1997. Due to a backlog of animal welfare legislative reviews, this has not yet taken place. CIWF Trust and the European Coalition for Farm Animals (ECFA) believe that this imminent review provides the opportunity for the EU to outlaw the use of sow stalls for keeping pregnant pigs.

2.1 Temporary confinement of sows

Even where sow stalls are being banned, there is some pressure from the pig industry to allow temporary individual confinement of sows around the time that they are inseminated or serviced. The Council of Europe's February 2000 proposals envisage the temporary use of individual stalls for pregnant pigs for up to 4 weeks after service or insemination[4]. Current Swedish regulations for animal management also allow "occasional" sows to be confined for up to a week at insemination or before farrowing[5]. The 1998 Dutch regulations allow for sows to be kept in individual stalls of floor area 1.3m^2 (even smaller than some sow stalls) for 2 days before and 4 days after insemination or service[6]. The UK pig industry called for similar exceptions when the legislation banning sow stalls was passed in 1991, but Parliament decided not to allow any use of sow stalls.

CIWF Trust and the ECFA believes that the use of individual narrow stalls for sows should not be allowed in any circumstances. Good husbandry makes it simply unnecessary around the time of insemination or service, as is shown by common commercial practice in the UK.

3.0 Why and where sow stalls are used

The claims made in favour of sow stalls are that they are the most cost-efficient method for keeping pregnant pigs because they make it easier to control and supervise individual sows kept at very high stocking density with the minimum of labour and expertise.

A 1998 report in the international pig science journal *Pig News and Information* gave figures (Table 1) on the prevalence of sow stalls and tethers in the pig industries of European countries. At the time of the survey, all the major producers used these systems for at least half of their breeding sows and Germany, Spain, Denmark Belgium and the Netherlands for 70% to 96% of their breeding sows. Even some of the smaller producers, such as Portugal and Ireland, had a very high usage of stall and tether confinement. The survey found there was a trend away from the use of tethers in all the countries, presumably because tethers are due to become illegal in the EU in 2006. But

in some countries (for example, Spain, Portugal, Italy and France) the usage of sow stalls was believed to be increasing[7]. Because there is no EU legislation against sow stalls yet, some pig farmers in these countries may be changing from using tethers to using sow stalls. In other countries where there has been legislation to phase out sow stalls (for example the Netherlands and Denmark) the use of sow stalls is likely to be decreasing.

Table 1. Estimated proportion of European breeding sows kept in sow stalls or with tethers 1998 (Source: Hendriks et al., *Pig News and Information,* Vol. 19(4) December 1998[7]). Sweden and Austria were not included in the survey. Note that the source used does not specify the year that the figures on confined sows refer to.

Country	**%of sows in stalls or tethered**	% of sows tethered	% of sows in stalls	Total breeding sows (all systems) , 1997 **
Austria				379,000
Belgium/Lux.	**96**	16	80	754,000
Denmark	**80† (88)[1]**	25	55	1.2 million
Finland	**30**		30	179,000 (1995)
France	**51-62 * (63)[1]**	16-21 *	35-41 *	1.5 million
Hungary	**30**		30	350,000 [2]
Germany	**75**	10	65	2.6 million
Greece	**36**	1	35	125,000 (1995)
Ireland	**91**	60	31	174,000 (1995)
Italy	**45 (68)[1]**		45	690,000
Netherlands	**95 (90)[1]**	20	75	1.4 million
Portugal	**80**	30	50	292,000 (1995)
Spain	**72**	20	52	2.2 million
Sweden				268,000 (1995)
UK	**20 (35)[1]**	10	10	900,000

† The Danish industry association Danske Slagterier has reported that the proportion of sows in stalls and tethers fell from 80% in 1995 to 70% by 1998[8].

* the higher figures were supplied by the Institut Technique du Porc, December 1998

** 1997 figures: Meat and Livestock Commission, 'Pig Yearbook 1999'[9] except for Hungary. These sow numbers include maiden gilts. 1995 figures :Institut Technique du Porc, 'Le porc par les chiffres', 1998[10].

[1] SVC Report (1997), Appendix 6.4. Information supplied to SVC by Research Institute for Pig Husbandry (Rosmalen), Institut Technique du Porc, Associazione Nazionale Allevatori Suini, Danske Slagterier and British Pig Association.
[2] Meat and Livestock Commission, *Country Fact File: Hungary,* July 1998.

4.0 The life history of a sow

Pigs have been domesticated for at least 5000 years but the European Scientific Veterinary Committee in 1997 made the important point that:

> Although domestication and selection has altered basic aspects of the anatomy and physiology of the pigs, comparisons reveal that no major changes in basic behavioural systems have occurred during domestication[1].

As omnivores, foraging for food and exploration of their surroundings is an important part of the behaviour of both wild and domestic pigs. Even well-fed domestic pigs kept in a semi-natural enclosure are found to spend 6-8 hours a day searching for food by rooting, grazing and browsing. Studies of wild and feral pigs show that they are naturally gregarious animals, the basic social unit being the maternal group of up to around 6 individuals. Similarly, domestic pigs form stable social hierarchies based on age and size. Pregnancy lasts about 115 days (just over 16 weeks). Shortly before giving birth, both wild and domestic sows in natural surroundings choose a suitable nest site and build a nest of grass or soft materials. Free-range pigs stay in or close to the nest with the piglets for about 10 days, after which the piglets start to be integrated into the herd. In natural surroundings, weaning is completed at 13-17 weeks[1].

In commercial farming, young female pigs for breeding (gilts) are typically purchased at 5-6 months of age from specialist breeders, although they may also be reared on the farm. During rearing, they are usually kept in group housing. Gilts are usually served for the first time at their 2nd or 3rd oestrus after puberty, at 6-8 months of age. In some systems they are kept in group housing during their first pregnancy and then are moved to farrowing crates to give birth to their piglets.

Pregnant sows are moved from sow stalls to farrowing crates a few days before giving birth and the piglets are weaned and removed to indoor fattening units at 3-4 weeks of age in most European countries. Sows are typically served at their 1st post-weaning oestrus, which occurs 7-10 days after weaning[1].

A breeding sow in commercial production in Europe has on average 2.2 pregnancies per year and is expected to produce around 19-22 young pigs for slaughter every year. She may give birth to as many as 25 piglets a year, but at least 10% of piglets die between birth and slaughter. Around 40% of the sows in the average breeding herd are replaced per year. Typically a sow will produce 4-6 litters of piglets before being sent for slaughter at around 30-36 months of age because of reproductive failure or other health problems. An intensively kept breeding sow kept in a system using sow stalls is likely to spend three quarters of her life confined in a stall.

5.0 Welfare problems caused by sow stalls

It is generally accepted that confinement in stalls has detrimental effects on the welfare of sows both from the point of view of their physical health and equally their behavioural and psychological well-being. Well-managed alternative systems where the sows are not individually confined have a higher welfare potential in all these respects. Such alternatives include indoor group housing with straw and free-range housing outdoors

where climate and soil are suitable. A survey of pig experts' opinions published in the *Netherlands Journal of Agricultural Science* in 1999 put the stall and tether systems right at the bottom of their ranking of housing systems from the point of view of sow welfare[11].

5.1 The European Scientific Veterinary Committee's opinion

The most recent authoritative and official study of the effects of confinement in sow stalls on pregnant sows is in the European Scientific Veterinary Committee (SVC)'s 1997 report *The Welfare of Intensively Kept Pigs*. The report concludes unequivocally from the scientific evidence that sow stalls should not be used. It recommends that:

> Since overall welfare appears to be better when sows are not confined throughout gestation, sows should preferably be kept in groups[12].

According to the report, when sows are in group housing rather than in stalls:

> the sows have more exercise, more control over their environment, more opportunity for normal social interactions and better potential for the provision of opportunities to root or manipulate materials. … As a consequence, group housed sows show less abnormality of bone and muscle development, much less abnormal behaviour, less likelihood of extreme physiological responses, less of the urinary tract infections associated with inactivity, and better cardiovascular fitness.[13]

Further, the report states that sow stalls have "major disadvantages" for welfare:

> The major disadvantages for sow welfare of housing them in stalls are indicated by high levels of stereotypies, of unresolved aggression and of inactivity associated with unresponsiveness, weaker bones and muscles and the clinical conditions mentioned above. Some serious welfare problems for sows persist even in the best stall-housing system.[13]

The SVC states that it is may be necessary to keep a sow temporarily in an individual pen within a group housing system, if she is sick or has been attacked. But their recommendation is:

> No individual pen should be used that does not allow the sow to turn around easily.[12]

5.2 Food restriction and confinement

Pregnant sows are normally fed restricted rations of concentrate feeds, to prevent them from putting on weight and to economise on concentrate feed costs. According to the SVC's Report,

> The food provided for dry sows is usually much less than that which sows would choose to consume, so the animals are hungry throughout much of their lives[1].

Pigs in natural conditions spend much of their active time looking for food and eating it, whereas the commercial sow's ration of concentrate feed can be eaten in a few minutes. The sow's feed is sufficient for her bodily maintenance but does not necessarily satisfy appetite. This feeding regime has been described by a pig expert from the Scottish

Agricultural College as being at odds with the sow's feeding motivation[14]. For confined sows kept in a barren cage without straw to chew and with no opportunity to go in search of food, food restriction must be made even more stressful. A number of studies of group-housed sows have shown that the provision of some bulky food or manipulable material such as straw reduces the welfare problems caused by feed restriction[1,15].

Feed restriction and confinement can also be related to gastrointestinal problems. In Denmark, where stalls and tethers are widely used, gastrointestinal problems have become a more common cause of death on intensive sow farms, according to a 1995 survey of sow mortality. They had risen to 20% of all causes of death compared to 5% in 1975. The most common life-threatening gastrointestinal disorder was gastric dilation (bloat), which results in painful ballooning of the stomach with gas. Gastric dilation often occurred when a confined sow suddenly got free access to feed because her neck tether was loose or the feed dispenser was damaged. There were few gastrointestinal problems in farms that provided straw bedding, which the sows could use as roughage[16].

6.0 Health problems caused by sow stalls

The SVC's report and numbers of other scientific studies have noted a wide range of health problems for sows that are either caused or made worse by confinement in sow stalls.

6.1 Inactivity, lameness and injury

Lack of exercise adversely affects the bones and muscles of sows confined in stalls. A 1996 study from Cambridge University found that muscles used for walking were small in caged sows compared to the muscles of sows in group housing[17]. In addition, lack of exercise also affects bone strength; the same team found that the bone strength of caged sows was only two thirds of the bone strength of group-housed sows. The scientists conclude:

> The results indicate that confinement of sows, with a consequent lack of exercise, results in reduction of muscle weight and bone strength.[17]

Sows kept in stalls even have difficulty standing up and lying down. In an experiment at the Clinical Veterinary department at Cambridge University, they took over twice as long to lie down as group-housed sows[18]. The major reason for this difference was the space restriction in stalls but the scientists suggest it is also caused by "the chronic effects of lack of exercise and the acute effects of floor type". They conclude:

> The results indicate that sows housed long-term in gestation stalls experience difficulty of movement when standing up quickly and lying down.[18]

A German study in 1993 demonstrated how lack of exercise reduces sows' physical strength and agility; 77% of sows confined during growth chose to lie down by leaning on a wall for support, compared to only 3% of sows loose-housed during growth[19].

When the sow stall is too small for the sow, the problems are even worse. A 1991 French study of the posture of sows suggested that the narrowest crates (0.60 m) may make it difficult for sows to lie on their sides at all[20]. A veterinarian told a 1998 conference of the German Veterinary Society that it was common to find large sows crammed into stalls

measuring 1.8m long and 0.65 m wide. The stall length was as much as 18 centimetres shorter than the body length of the largest sows and the width was too narrow to allow them to lie down on their sides with their legs stretched out. They had to lie with their heads in the feed trough. These stalls led to sows having difficulty in walking, grazed skin and even broken limbs[21].

Confined sows are also more likely to suffer from lameness. Evidence for this comes from several European countries. In 1996 a French study from INRA of nearly 1600 sows from 45 commercial herds found that lameness was more frequent in stalled or tethered sows[22]. A 1995 study from Denmark (where 80% of sows were in stalls or tethered) found that leg weakness was the biggest single reason for the death or euthanasia of breeding sows (28.5%). The conditions included lameness, paralysis, arthritis and fractures[16]. UK figures from the early 1990s suggest that sows in stalls are 5 times more likely to be sent for slaughter because of lameness than sows kept outdoors.[23]

One cause of lameness is the use of concrete or slatted floors in sow stalls. This type of flooring can result in chronic painful injury to confined sows. According to a leading Bristol University veterinary scientist, compared to outdoor sows,

> Sows in stalls on concrete have a higher incidence of injuries to feet, inflammatory swellings of joints and abrasions to their skin. If these superficial abrasions become infected the infection may track down to damaged joints, set up septic arthritis and cause severe, chronic pain. [24]

If the stall is too small or the bars badly adjusted, the result can be general bodily damage. Sows can be injured by the cage fittings. A 1997 French study of 692 sows from 16 farms found that sow stalls can interfere with movement and lead to physical deformity and skin injury. Nearly 27% of sows had deformation of the shoulder and 17% had inflammation or cysts on the skin of their front legs[25].

6.2 Urinary tract infections

Urinary tract infections are also more common in caged sows. The sows' enforced inactivity is probably an important contributing factor. In France in the 1980s scientists noticed that the incidence of urinary tract infections increased at the same time as sow stalls and tethers became popular in the pig industry[26]. They also found that confined sows drink less than active sows, which could lead to concentrated urine and a greater chance for bacteria to multiply in the urinary tract. Infection can also be caused when confined sows have to lie on wet concrete in their own faeces[1].

Constipation is another effect of confinement in sow stalls, according to a 1997 publication by a German ethologist. This happens because the sows are unwilling to deposit their dung in the stall where they have to lie on it[27].

6.3 Cardiovascular health

Lack of exercise also means that confined sows use their cardiovascular systems less. As a result, they are more prone to heart problems, which are a significant cause of death when pigs are transported. British veterinary scientists at Cambridge University studying heart-rate in pigs reported in 1993 that the level of cardiovascular fitness in stall-housed sows was less than that in group-housed sows[1]. In 1997 they compared stall-housed pigs with pigs housed in a large group and in a small group. They found that the stall-

housed pigs had a higher basal heart rate and a higher average heart rate when feeding than group-housed pigs, again indicating a lower level of bodily fitness for the confined pigs[28].

6.4 Reproductive health

Breeding sows are sent for slaughter if they fail to become pregnant or have small litters. One possible cause for these problems is the sow's housing conditions. According to the SVC, there is evidence that confined sows have more problems than group housed sows in coming into oestrus, that they take longer to give birth and that they have a higher incidence of mastitis/metritis/agalactia (MMA - a syndrome affecting sows after farrowing and involving inflammation of the udder and the uterus and lack of milk)[1].

6.5 Stress and immune system function

Studies have found that confined sows have increased activity of the adrenal glands and higher concentrations of the steroid cortisol (hydrocortisone), associated with stress or activity. Stress is known to affect the immune system. Scientific results have indicated that sows who produce a greater cortisol response may also have a reduced immune response, which would make them less able to cope with infectious diseases[1].

7.0 Behavioural problems caused by sow stalls

Pigs are highly intelligent, inquisitive animals and there is abundant scientific evidence that they suffer when deprived of environmental stimulation and the opportunity to explore their surroundings.

7.1 How sows prefer to live

There is considerable scientific evidence on sows' preferences. From this it is clear that sows prefer not to be caged. According to the SVC Report, "In general, sows prefer not be confined in a small space"[1] and they "find the confinement aversive[1]. Sows show strong preferences for social companions and for rooting or bedding material. Considering the available research on sows' preferences, the SVC concludes:

> It is clear from such studies that sow welfare will be worse in conditions where exploration of a complex environment, rooting in a soft substratum and manipulation of materials such as straw are not possible, than in conditions where they are possible[1].

It has been known for many years that confinement prevents sows from carrying out important types of normal behaviour. Sows are social animals and have a need to establish a social hierarchy among themselves in order to avoid or resolve conflicts. As the SVC pointed out[13], this is usually impossible for sows in stalls. Ethological studies of sows carried out in Sweden in the 1980s, when nearly two thousand social interactions between sows were observed, found that sows need to interact in order to resolve conflicts. The study concluded:

> "Confinement [in stalls] decreased the social activity…and led to unsettled dominance relationships combined with high aggression levels… The deconfinement system

> [loose housing] provided enough area for the sows to settle dominance relationships and to keep the aggression level fairly low".[29]

Sows in stalls are confined to one spot for all their activities, which is contrary to normal pig behaviour. Another early study from the Swedish Agricultural University showed that loose-housed sows chose to move between different areas of their housing for feeding, dunging and lying. They spent only 25% of their time in their feeding stalls, then moved away. When given straw, the loose-housed sows used it for a variety of activities related to exploration, nest-building, predation and feeding whereas the sows confined in stalls could do nothing with the straw except eat it[30]. These studies as long ago as the 1980s showed that confinement in stalls frustrates basic behavioural needs of sows. Inevitably this frustration leads to abnormal behaviour.

7.2 Abnormal behaviour

Common types of abnormal behaviour shown by confined sows are stereotypies, apathy, depression and lack of responsiveness. All of these are indicators that the sow is having difficulty coping with her environment and show that her welfare is not good[1].

7.2.1 Stereotypic behaviour

Stereotypic behaviour is highly repetitive behaviour carried out for no apparent purpose. It includes bar-biting, chain-biting, sham-chewing (chewing air), pressing the drinker, nosing in the feed trough, tongue-rolling, head-weaving and attempts to root on the concrete floor. Stereotypies are very rare in sows kept in complex environments. Although they do occur among group-housed sows (especially when feed is restricted and no straw or similar material is provided), this is much less common than among confined sows[1]. Unsurprisingly, sows spend more time on stereotypical behaviour when their food is restricted as well as their ability to move[31].

When sows are first confined they show no stereotypies immediately. The sows at first try to escape. They then appear to quieten down and may become inactive. Stereotypies only become frequent after several weeks of confinement, according to scientists in the Netherlands[32] who studied the behaviour of confined sows in the 1980s. Sows do not become well-adjusted to living in sow stalls. On the contrary, studies have found that the amount of stereotypical behaviour increases with the length of time the sow is confined over several pregnancies.

Stereotypies in confined sows have been reported from several European countries. A 1995 report from INRA/CNRS in France, for example, found that over 90% of stall-housed sows carried out apparently pointless tongue-rolling, bar and trough-biting, bar-licking and vacuum chewing[33]. Another 1995 study from Cambridge University observed sows over 4 pregnancies. They found that by the 4th pregnancy stall-housed sows on average spent 14% of their time on activities that were clearly stereotypic and another 36% of their time on activities that were arguably stereotypic (such as rooting or chewing at pen fittings). In total, 50% of the sows' time was spent on acitivities that were clearly or arguably stereotypic. The total average time spent on clearly stereotypic activity increased almost 12-fold between the 1st and the 4th pregnancy, showing that the problem got worse the longer the sows were confined. One particular sow spent over 40% of her whole time on clearly stereotypic activity[34], a sad comment on her welfare. Group-housed

sows in contrast spent only one fifth as much time as the stall-housed sows, or less, on stereotypic activity.

The SVC Report points out that other studies may have missed stereotypies because they did not observe sows over a long enough period of time. The scientists conclude:

> However, in every detailed study of sows in stalls or tethers, a substantial level of stereotypies have been reported indicating poor welfare in the sows.[1]

Although the evidence is not yet entirely clear, scientists believe that stereotypies may have the function of reducing the level of stress hormone, cortisol, and that they may be associated with the release of endorphins (natural narcotics) in the sow's brain[1] as a way of coping with the stress of confinement.

7.2.2 Apathy and depression

Abnormal inactivity and unresponsiveness are very widespread among confined sows[1]. Studies have shown that sows in stalls are much less responsive than group-housed sows to any stimulus except food. Confined in a barren cage, their level of activity has been found to be very low – only about a quarter of that of sows with the opportunity to move and explore the environment[1].

The Scientific Veterinary Committee comments that since this inactivity and unresponsiveness is abnormal, it is likely that the sows are clinically depressed. Their behaviour is similar to depression in humans or to 'learned helplessness' which has been experimentally induced in animals[1].

8.0 The need for environmental enrichment

In 1997 the Scientific Veterinary Committee considered environmental enrichment to be so important that they stated in paragraph 73 of their Conclusions and Recommendations:

> All sows should have access to soil for rooting or manipulable material such as straw[1].

A 1994 study of sows' preferences found that their demand for access to bedding materials was second only to their demand for food[35]. Straw or other manipulable material is important for pigs' welfare in various ways; to provide a comfortable surface for walking and lying on, for thermal insulation, for rooting, for carrying and other manipulation and for chewing and eating. The fact that pregnant sows are feed-restricted makes it more important for them to have access to these materials.

A number of studies in Germany, the UK and Switzerland have shown that providing sows with straw can reduce stereotypies and aggression at feeding time in all housing systems, especially when sows are feed-restricted[36-39]. Straw can also be a useful feed supplement[40,41]. Scientists in The Netherlands[42], Germany[41,43], Sweden[44,] Norway[45] and the UK[14] have also reported improvements in the welfare of the sows when straw is used in group-housing systems. In the UK, studies have shown that an allowance of only 200g of straw per day for each pig (used in the Straw-Flow® system) resulted in fattening pigs spending nearly 30% of their time occupied with the straw and only a few percent of the time on negative interactions with other pigs[46]. Experiments in Northern Ireland showed that sows benefit from being provided with recycled mushroom compost. The

compost was not provided as bedding but was put in racks that the pigs could reach. The sows given compost were less likely to be aggressive and had very many fewer injuries than sows in a barren pen[47].

9.0 Alternatives to sow-stalls

There are two types of housing system which are proven to be practical and successful alternatives to the sow stall system:

1. indoor housing of sows in groups (group-housing)
2. outdoor breeding herds (free-range)

Even in countries where the stall system still predominates, it is now widely accepted that sow welfare is better in alternative systems. A 1999 survey of the opinions of 11 pig welfare experts from 6 European countries, who had all been involved in the development of housing systems for pigs, showed a "substantial degree of consensus" in their welfare rating of different housing systems for pregnant sows. They gave consistently the lowest welfare rating to the tether system and the stall system. Stalls and tethers "scored significantly lower" than indoor group housing systems and were "clearly 'poor' welfare systems" [11]. The experts gave the highest welfare ratings to outdoor extensive systems and to the family pen system*. The experts' scores for the different systems were, from lowest to highest:

> Tethers, 1.8 points; sow stalls, 2.3 points; indoor group housing, 5.4-6.2 points; outdoor housing with huts, 8.0 points; family pen, 9.1 points. [11]

* The 'family pen' is an experimental system for housing groups of 4-5 sows and gilts and their piglets together indoors. The pen includes nest areas with straw, activity areas, feeding areas and an outdoor yard. The piglets are reared in the family group up to slaughter weight. The system has been tested successfully on a commercial farm[48].

9.1 Indoor group housing

Table 2 shows the estimated percentage of all sows that are housed indoors in groups according to a 1998 survey published in *Pig News and Information*[7]. It also shows the percentage housed indoors in groups with straw bedding (this figure is included in the total).

The figures in Table 2 are probably not definitive, but nevertheless they show that in 1998 group housing indoors was a minority system in most EU countries. According to the SVC report, this may be partly because the group housing system has had a shorter development period than the stall system and so suffers from prejudice from some farmers[1].

Table 2. Percentage of breeding sows kept in group housing indoors and percentage given straw bedding, 1998.
(Source: Hendriks et al., *Pig News and Information,* Vol. 19(4) December 1998[7]. Sweden† and Austria were not covered by the survey). Note: the source does not specify the date that these figures apply to.

Country	*% of all sows in indoor group housing*	*% in group housing with straw bedding* **
Belgium	4	0
Denmark	14	4
Finland	70	70
Hungary	70	10
France	25	19
Germany	25	17
Greece	64	0
Ireland	9	3
Italy	55	3
Netherlands	5	1
Portugal	10	0
Spain	20	0
UK	60	60

** This includes only sows given enough straw for bedding. Other sows, not included here, may be given smaller amounts of straw for roughage feed and exploration[49].
† All pigs in Sweden are required to be given some straw according to the Animal Protection Ordinance 1988 (Section 16), although in practice the quantities may be small.

9.1.1 Types of indoor group housing systems

In group housing systems the sows typically have separate lying areas, dunging areas and feeding areas. Straw for bedding may be provided, although in several EU countries this is not the norm (Table 2). The most traditional loose-housing system is that of a small group of around 6-12 sows in a yard with kennels for shelter. In this case each sow will have an individual feeder. As groups become larger, the system needs to be designed and managed to ensure that all sows get their ration of feed and to avoid conflicts between the sows.

Floor feeding

The lowest-cost housing systems for larger groups of indoor sows are covered strawed yards or uninsulated general purpose buildings where the sows are all kept together and fed together on the floor. Several small groups of up to about 30 sows may be held in separate pens in one large building. Food can be given using dump-feeders (the feed is dropped in a heap onto the floor) or by spin-feeders (the feed is dispersed over the floor).

Trickle feeders (Biofix)

Instead of putting feed on the floor, feed may be delivered slowly to individual feeding troughs (Biofix or trickle feeders). The object of this is to allow the sows to feed as a social group but to prevent some sows from eating quickly and then leaving their own troughs and displacing other sows[50].

Individual feeding stalls In other systems, the sows have individual feeding stalls as well as a communal lying area and a communal dunging area. Each pen contains enough feeding stalls for all the sows so that they can be fed at the same time. An advantage of

individual feeding stalls is that the sows can be locked into the stalls while they are feeding, to protect them from interference by other sows. The stalls can also serve as lying areas or quiet areas for individual sows.

Free-access stalls

The 'free-access stall' system consists of a feeding/lying stall for each sow and a communal dunging passage. The sows can go in and out of any of the stalls (although they may be shut in for protection at feeding time). Because the sows have access to the whole pen area they have more room to move than in the conventional sow stall system. However, the space is limited, the pen is often barren and the welfare potential of the free-access stall system is lower than the other group housing systems.

Electronic sow feeders

Inevitably the housing systems that require individual feeding stalls as well as communal areas are more costly to build than housing without individual stalls. To avoid the cost of individual feeding stalls, larger groups of up to 200+ sows are usually managed using computerised electronic sow feeders (ESF). In this system the sows go to a feeding station one after another. Each sow wears a transponder in an ear tag which identifies her when she goes to the feeding station. She is delivered an individual daily ration of feed and the stall is locked behind her while she is feeding to protect her (this normally takes about 20 minutes). Her feeding record and other information about her are stored on the system computer. One feeding station is needed for about 30-40 sows, so only a few are needed for the whole group. The housing may also contain capture pens and pens for boars. The cost of the ESF system is likely to be intermediate between floor-feeding systems and free-access stall systems[51].

9.1.2 Management of group housing

Group housing requires different management from sow stalls systems and this has raised concerns within the European pig industry. However, there is abundant evidence that well-designed and well-managed group housing works well. The fears that are raised about group housing are often due to lack of familiarity with the system and are not well-founded.

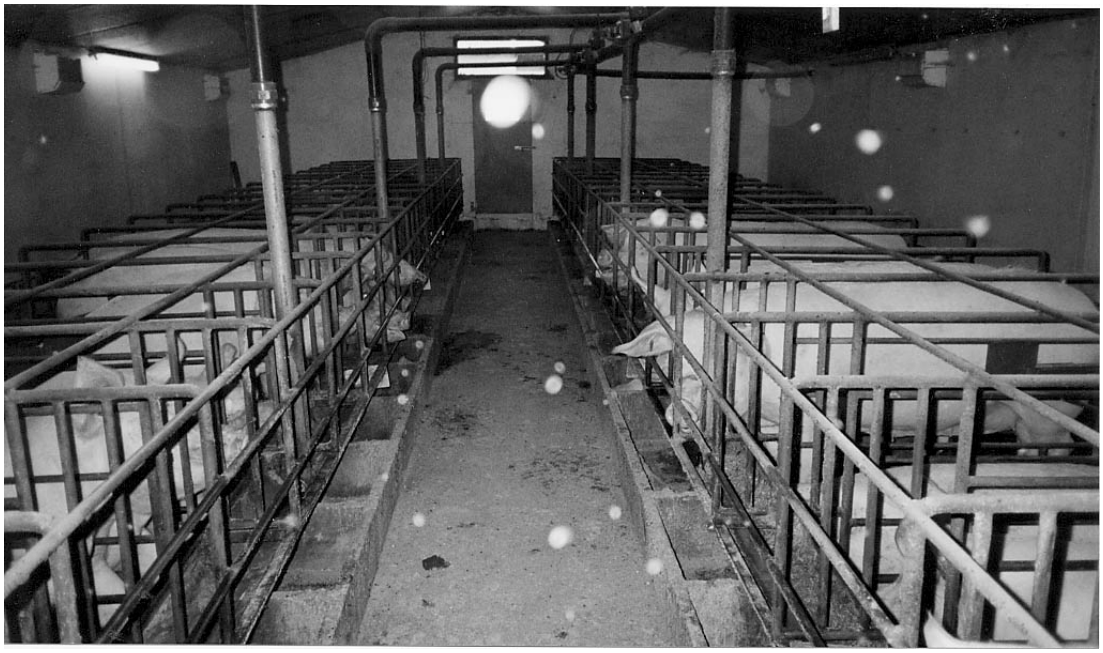
In fact, the evidence is that sows suffer less stress in group housing than in sow stalls. A 1993 UK study of the behaviour, pituitary-adrenal function, immune system function and reproduction of sows in groups over their first and fourth pregnancies found that the group housed sows had established a stable social hierarchy by the fourth pregnancy whereas the stall-housed sows still had relatively high levels of unresolved aggressive encounters. The scientists conclude:

> In the long term, therefore, housing pregnant sows in groups would appear to be no more stressful than housing them in stalls. In fact, the behaviour data point to considerably more long-term problems for stall-housed sows.[52]

Research results from a number of countries all show that the a sow's productivity is equally good in group housing. In the UK, the MLC found in 1994 that the number of pigs reared per sow per year in the ESF systems was actually higher (22.2) than in sow stalls or tethers (21.7)[8]. In 1998, when the majority of UK pig farmers had changed to group housing, the number of pigs reared per sow per year in the UK was equal to that in the Netherlands, Denmark and France, where sow confinement is still widespread[53]. Similarly, a 1997 report from INRA Pig Research Station in France found that the reproductive performance of small groups of 8 sows was comparable to the performance of stall-housed sows[54]. A detailed comparative study of housing systems carried out by

the Research Institute for Pig Husbandry in The Netherlands has also reported that the same number of weaned piglets per litter are produced in group housing as in stall housing[55].

Pregnant sows in group housing with straw



Pregnant sows in sow stalls

One of the concerns raised by pig farmers who defend sow stalls is about fighting, fight injuries and biting in some group housing units. If there are fights at feeding time, the less dominant sows may not get enough food and lose weight. The industry is worried that stress and fighting can reduce reproductive performance, although as we have mentioned the evidence is that performance in group housing is equal to that in sow stalls.

However, pig experts are clear that serious fighting within groups can be prevented by protecting sows when they are feeding, by managing the introduction of unfamiliar sows and by well-designed positioning of feed and water. This is illustrated by the following recent studies from Europe.

In the UK, the University of Bristol recently surveyed the problem of vulva-biting on 83 sow farms, most of them using indoor group housing. Vulva bites are painful and potentially damaging to sows and are a concern to farmers. The survey found that although vulva-biting was common it usually had no long-term effects and did not affect the sows' reproductive performance. The authors suggest that management changes such as letting the sows feed twice daily and ensuring easy access to water could reduce the incidence of biting. There were no reports of deaths as a result of vulva-biting[56]. Another 1998 report in the *Veterinary Record* found that groups of up to 70 sows kept in straw-bedded group housing had "very low" levels of injuries from fights over an 18 month period and conclude:

> The results demonstrate clearly that sows kept in a dynamic group in a commercial unit can coexist without sustaining serious levels of injury.[57]

A 1999 study of social organisation of sows from the Scottish Agricultural College found that aggression that arises when sows are mixed or re-grouped declines rapidly after mixing, unless the sows had to compete for food[58]. Observations of the ESF system in Poland have also confirmed that it allows low-status sows to feed and reproduce as successfully as dominant sows[59]. In the UK it is found that sows in the ESF system quickly learn a feed order and quietly wait their turn to go into the feeder.

Sows also need to be given enough space in group housing, as was shown in trials done by researchers for the Danish Agriculture Ministry in 1998[60]. They found that sows with the smallest area per sow had the most fights at feeding time and that aggression decreased as the sows were given more space. The number of confrontations was almost halved by increasing space from 2.2 m^2 to 4.5 m^2 per sow, and aggression was reduced by 37% when sows were given 3.0 m^2 instead of 2.2 m^2. However, the scientists also concluded that if sows are feed-restricted, floor-feeding is likely to lead to fights over food[60].

The SVC report concluded in 1997 that:

> Many farmers can successfully manage sows in group-housing systems without much aggression provided that the group is kept relatively stable, ….mixing is managed carefully, the feeding system minimises competition situations and there are adequate degrees of environmental complexity and alternative low density food source.[1]

9.1.3 Swedish farmers' experience

Sweden decided to ban sow stalls in 1988 when 80% of pregnant sows were kept in stalls. The ban has been in place from 1994, with an additional 2-3 years allowed for changes to

buildings. According to the Federation of Swedish Farmers, group housing needs good management and stockmanship but does not increase the overall labour required. The advantages are improved health and fertility in the sows, including improved longevity, fewer leg problems, better condition before farrowing, easier farrowing, fewer piglets born dead and less mastitis and agalactia[61].

9.2 Outdoor breeding herds

Pig experts surveyed for the *Netherlands Journal of Agricultural Science* in 1999 put outdoor housing in huts at the top of the welfare rating for commercial sow husbandry[11]. In outdoor systems the breeding sows are kept in free-range conditions in fenced paddocks for gestation, farrowing and lactation and the piglets are usually removed to indoor units when they are weaned at around 21-28 days old. Accommodation for the pregnant sows can be in communal shelters and there are smaller individual huts for when the sows give birth. Both types of huts are often wood or corrugated-iron 'arcs' or may be made of straw bales. Typically in the UK around 5-6 pregnant sows share a hut and each paddock holds a group of 5-20 sows. Stocking density is around 15-25 sows per hectare (6-10 sows per acre)[62]. This is equivalent to a minimum of 400m^2 per sow, an enormous increase on the 1.5m^2 allowed per sow in a sow stall. Outdoor systems are most practical on free-draining land (for example sand or chalk) in temperate climates. According to *Pig News and Information* in 1998, sows are kept commercially outdoors in the UK (about 25% of sows), France (around 10% overall), Spain (8%), Portugal (10%) and Denmark (4%). In most other EU countries fewer than 1% of sows are kept outdoors[7].

Outdoor accommodation has the advantage of low capital costs, perhaps 30% of the costs for indoor housing. An estimate for the UK in 1997 is that investment costs for huts, fencing and water may be as low as £60 per sow[62], compared to around £500 per sow for indoor housing[53]. Because the sows live in more natural conditions, it is sometimes the case that they produce slightly fewer pigs per sow per year than indoor systems[1] and also require more feed per sow[63,9], as the sows need to eat to maintain body temperature outside. The UK's Meat and Livestock Commission reported that for 1997 the number of pigs raised per sow per year was 21.9 for outdoor herds and 22.2 for indoor herds[9]. In France, the Institut Technique du Porc (ITP) reported that in 1998 the average number of piglets weaned per productive sow per year was 21.7 outdoors compared to 24.0 indoors. However, the most productive outdoor herds produced 23.6 weaned piglets per sow per year[10]. In Denmark it has been found that the best outdoor herds are equal to the best indoor herds, and in addition the capital costs of outdoor production are only one third of the costs of indoor production[64].

There are a number of reports of successful commercial outdoor breeding herds in France[65-67]. In some areas of central France over 20% of sows are kept outside, although in the most intensive region (Brittany) less than 5% are outside[10]. A survey of costs in French herds from the ITP in 1998 concluded that the fact that initial investment is low can compensate farmers for the lower productivity of outdoor herds. The survey found that outdoor pig farmers varied very widely in efficiency, leaving considerable room for improvement in productivity[68]. It seems likely that factors such as the relatively high mortality of piglets could be improved by better management, for example the provision of more straw for nesting, according to another report in the *Annales de Zootechnie*[66]. There are also advantages for small farmers. A report in *Techni-Porc* notes that the number of outdoor breeding farms increased from 209 to 1608 between 1984 and 1994 in

France and concludes that outdoor systems enable farmers with small capital resources to enter pig production with little risk[67].

German reports also emphasise the advantages of the low investment and running costs required for outdoor herds[69], as well as benefits for the sows' welfare and good farrowing results[70]. A study of a 200 sow herd over 3 years, published in 1997, concluded that reproductive performance was equal to that of indoor sows (22 weaned piglets per sow per year), making outdoor management of breeding sows "an attractive option"[71].

In Denmark the number of outdoor sow herds has increased in the last decade, according to a report from the Danish Agriculture Ministry in 2000. The reason given for this is the public recognition that outdoor sows have more possibilities for natural behaviour. The study concluded that with good management the outdoor option has the potential to give "satisfactory production results" in commercial use in Denmark[72].

10.0 Flooring and bedding for sows

10.1 Why sows need bedding

Flooring in group housing systems may be wholly or partially slatted, or all solid concrete or solid concrete bedded with straw or other material. In many EU countries the use of straw-based dunging systems or the use of straw for bedding is not common practice in intensive pig farming. Some in the pig industry argue that bedding is not necessary for thermal insulation in controlled-environment building (however, this ignores the other important function of bedding, which is environmental enrichment). It is also sometimes argued that many existing systems have slatted floors for dung disposal and that straw would cause problems by blocking the slats.

However, there is strong evidence that pigs should be provided with straw or other litter material for bedding, from the point of view of physical comfort, safety and environmental enrichment. According to UK's official Pig Welfare Advisory Group, which surveyed group housing systems for sows in 1997, slatted flooring should not be used:

> Experience suggests that slatted flooring does not generally work well for loose housed sows. Levels of lameness and leg damage can be high.[51]

A report from the Swedish University for Agricultural Sciences in 1992 agrees that:

> Leg problems and foot injuries may be a serious problem where there is partly or fully slatted floors and a minimum usage of straw.[73]

Sows try to avoid slatted floors. A study of 64 sows in Northern Ireland in 1994 compared their activity level on different floor surfaces and found that they moved around relatively little when they were kept on slats. They spent twice as much time in their feeding stalls as in their slatted lying area, probably because they were more comfortable on the drier floor. When the sows were given solid floors and straw, the situation was reversed[74]. A similar conclusion was reached by the 1998 study from the Danish Ministry of Agriculture, which showed that sows were less active in those areas of their housing that had slatted floors and avoided lying on them[60].

Even when sows are given solid concrete flooring, they still need straw or other litter for their welfare. The UK Pig Advisory Welfare Group recommended in 1997 was that straw should be used in sow housing, adding:

> In solid floored unbedded housing, lameness can also be a problem caused by sows slipping on unsuitable floor surfaces.[75]

On the other hand, where sows have deep straw bedding, "leg injuries and locomotor disorders are seldom observed", according to a 1992 report from Sweden[73].

Sows dislike wet concrete floors. A 1993 study in *Applied Animal Behaviour Science* found that sows spent 80-90% of their time on dry rather than wet concrete floor and did not sit, kneel or lie on the wet floor. The study concluded:

> at 20 deg C a wet concrete floor is an aversive environment for sows.[76]

Group housing systems where sows have a solid straw-bedded floor are practical and economically viable. The industry journal *Pig Progress* recently reported on a pig farm in eastern Netherlands that has successfully converted from the stall and tether system to group housing using the ESF system with a solid concrete straw-bedded area for 100 sows. The dunging area and passageways are slatted, so this farm combined straw bedding and slurry management successfully. Contrary to common belief, the straw does not block the slats. In fact the sows eat much of the straw provided in their lying area. Straw supplies and management are not seen as a problem in this case, as the farm produces its own straw or can easily obtain it from neighbouring farms[77].

Although much of the European pig industry is accustomed to dealing with pigs' excreta as slurry rather than using litter, litter management need not be a problem in practice. A survey of group housing with straw bedding by the Swedish University of Agricultural Sciences in 1993 found that:

> Many farmers considered that using loading machines for manure removal and straw handling in housing with deep litter bedding required less time and was less complicated mechanically than caring for sows in conventional buildings.[44]

From the point of view of building costs, the use of straw is a good option. Uninsulated general purpose buildings of the sort often used for housing sows on straw are less expensive to build than buildings with slatted floors or for use with no straw[75].

10.2 Straw and health

As we have seen, when sows are given straw or other litter there is an improvement in foot and leg health and gastrointestinal health, a reduction in stereotypic behaviour and often a reduction in aggression and injuries. The provision of roughage (hay or straw) and straw bedding also improves the sows' fertility, according to a 4-year study of the management of 1300 sow units in Finland between 1994 and 1996[78].

However, farmers in European countries where straw is not traditionally used sometimes claim that straw increases the prevalence of infections, leading to diseases such as arthritis (often caused by bacterial infection) and coccidiosis (a parasitic infection of the gut). In piglets, coccidiosis causes diarrhoea and bacterial arthritis causes lameness and

can result in the carcase being condemned at the slaughterhouse. In reality, the spread of infectious disease depends on a range of management practices, including the cleaning and disinfecting of housing between batches of pigs, rather than on whether the pigs are housed on slats or straw.

According to studies at the Veterinary Faculty of Munich University, the prevalence of coccidiosis depends on the standard of hygiene on a farm. The scientists studied the relation between coccidia infection and management practices on 7 pig breeding farms in Southern Germany and concluded that the heaviest infections were found on farms with "poor hygiene", whereas the type of flooring (concrete, slats or straw) was not an important factor[79,80]. In the case of bacterial arthritis, a 1999 report from the Scottish Agricultural College suggested that the transmission of infection is much higher when young pigs are kept in large groups of several hundred rather than in small groups. The group size is likely to be more important than whether the pigs are kept on slats or straw[81].

The use of good quality straw in well-managed pig housing can reduce the prevalence of disease. However, intensive farming is always at risk of the spread of infection. The major outbreak of swine fever infection in 1997-1998 in the Netherlands, resulting in the slaughter of over 10 million pigs, happened in a highly intensive pig industry where straw is very rarely used.

10.3 Availability and cost of bedding/litter materials

In agricultural regions where cereals (wheat, barley or oats) are grown, straw is easily obtained and is not necessarily seen as a significant cost of pig farming. However, in some countries sufficient straw may not be easily available or may be seen as too costly, as is often the case in The Netherlands and Denmark[49], for example. In some areas straw can only be obtained by importing it or transporting it over long distances. Straw prices in Holland are reported to be 200-250 guilders per tonne, and the cost of baling and storing straw in Denmark is reported to be 3-4 pence/kg[49]. French pig experts from the ITP in 1998 also described the price of straw as high. Their estimate was that the cost of buying straw in the main pig producing areas of France is 60 ecu or FF400 per ton (their report takes 1ecu=FF6.63). They estimated the cost of straw per sow per year to be 36 ecu or around FF240, which implies the use of 600 kg of straw per sow per year[82].

The amount of straw needed per sow can vary widely depending on the housing and manure disposal system used. Some deep litter systems for pregnant sows may use as much as 1000kg (1 tonne) per sow per year but in other systems only a small fraction of this amount is used. The SVC considered the cost of providing straw in the Netherlands and assumed that one sow would need between 100g and 300g of straw a day (approximately 40-110 kg a year). The cost of this quantity of straw was estimated at a maximum of 9 ecu per sow per year. The increase in the cost price per kg of fattening pig produced due to cost of straw and cost of extra labour was estimated to be 0.006 ecu (0.4 pence)[83].

Because of the problems of obtaining straw, there have been a number of trials in France, the Netherlands, Belgium, Switzerland and Germany of alternative deep-litter systems based on waste materials such as compost, sawdust[42,84-86], wood-shavings[87] and even paper, which are found to be acceptable as bedding material, although not all are suitable as feed roughage. As these are usually waste products, they are likely to be widely available and low in cost. Peat is popular with pigs but its large-scale use would not be

ecologically acceptable. An example of a commercially available litter in the form of recycled waste pine wood pellets is 'Bio-Pig', produced in France[88]. Some alternative litters (for example, sawdust, wood shavings and peat) have been found in tests to be more effective than straw from the point of view of controlling odours and emission of ammonia[42,89,90]. As with straw, it is important that alternative litter materials remain dry and hygienic in use and do not produce excessive dust or excessive warmth from composting within the litter.

In countries where the availability of straw is seen as a problem, alternative litters may be actually an advantage for sows. A detailed 1998 study from the Agricultural Research Institute of Northern Ireland recorded the preferences of 312 growing pigs for different floor surfaces over a period of 10 months. This showed that the pigs much preferred straw to concrete, but straw only came above concrete in their ranking of preferences. They much preferred peat and spent mushroom compost (an ecologically acceptable and readily available alternative to peat), sawdust and then sand. Woodbark and straw were the least preferred flooring except for concrete[91]. The scientists suggest that pigs may be attracted to materials similar in texture to earth. They conclude:

> Providing pigs with the substrates of their choice should be one step further towards improving their welfare. [91]

Spent mushroom compost was the pigs' top choice, together with peat. Mushroom compost consists of poultry manure and straw that has been composted and pasteurised. It is readily available in large quantities as an inexpensive waste product.

10.4 Straw litter and the environment

Providing sows with straw or other litter is also environmentally beneficial. At the present, the large quantities of pig manure produced in Europe present both health and environmental risks. A dry sow produces about 4 litres of excreta a day[92], equivalent to almost 19 billion litres a year from the EU's 12.7 million sows.

Slurry is liquid manure produced in animal housing where straw litter is not used. It is collected under slatted floors or from drainage channels and is stored in tanks or lagoons before being disposed of by spreading on agricultural land. Because little straw is used in the European pig industry, the vast majority of sows in the EU produce slurry. Slurry is very high in nitrogen and potentially highly polluting to soil and water. Unlike straw-based manure, slurry has a highly offensive odour when spread. Solid straw-based manure is also safer to handle. Slurry spills and leaks from badly made or maintained slurry stores are causes of major pollution incidents in rivers.

Regions of Europe with high concentrations of pigs have serious environmental problems with storage and disposal of pig manure, mainly in the form of slurry. Pig manure can damage the environment by two main routes. The first is by emission of ammonia gas (a cause of acid rain) from animal housing and when manure is stored and spread on land. Agriculture contributes at least 80% of total ammonia emissions in Europe, with the main sources being animal housing and the storage and spreading of manure[93]. The second route for pollution is from run-off and leaching of mineral nitrates and phosphates from the soil (causes of eutrophication of rivers, lakes and coastal waters and pollution of drinking water sources). This can happen when excess quantities of manure, containing these mineral nutrients, are spread on land. Brittany, Denmark, parts of Germany, Catalonia,

Lombardy and the Netherlands currently have excess levels of manure with the result that farmers cannot spread all their manure without exceeding the limits set in the Nitrates Directive[93]. In the Netherlands, legal manure limits will be fully implemented from 2003 which are expected to have the effect of reducing the number of pigs in the national herd by at least 25%.

Well-managed straw or other litter has the potential to reduce ammonia and nitrate pollution by producing a solid waste product which contains a much lower proportion of readily available nitrogen than slurry. Solid, straw-based manure (farmyard manure) produces less ammonia than slurry during storage and spreading on land[94] and results in less leaching of nitrates than slurry when it is spread on land[95], according to recent UK experiments conducted at scientists at ADAS. In pig farms, most of the total ammonia emissions occur in the animal housing[94]. A comprehensive 1998 survey of ammonia emissions from sow housing in Denmark, the Netherlands, Germany and England found that the lowest ammonia emissions from sow housing were from sows kept on litter in England. This survey found great variation between different countries and different farms and some housing with litter emitted more ammonia than some slatted housing[96]. Numbers of other studies of manure management in animal housing similarly show mixed results but overall they suggest strongly that better management of litter-based manure in animal housing could reduce Europe's ammonia emissions considerably.

An advantage of straw bedding is that the building can be kept at a lower temperature, which reduces emission of ammonia, without making the sows uncomfortable, according to research in the Netherlands. Ten sow farms which use group housing and straw in Markelo, the Netherlands, were found recently to produce only 40% of typical ammonia emissions. The Institute for Agricultural and Environmental Engineering commented in the industry journal *Pig Progress*:

> From the research it can be concluded that welfare-friendly housing systems for sows utilising group housing, feeding stations and straw bedding can significantly reduce ammonia emissions compared to traditional housing systems. [97]

11.0 Group housing costs versus sow stalls

After the banning of sow stalls and tethers for pregnant sows in the UK in 1999, the UK pig industry tended to blame the cost of the change to group housing for its economic problems. In reality other factors, particularly the high value of the pound sterling, but also the banning of meat and bone meal from UK animal feed, the loss of markets in Russia and Asia and the Europe-wide glut of pigmeat, were more important. A major UK pig producer has estimated that a number of factors related to UK government or EU policy had added a total cost of 44p/kg to the production cost of UK pigmeat by the end of 1999 – of this, the high pound had contributed 22p/kg while the sow stall and tether ban had contributed 2p/kg[98].

In reality, the type of sow housing system is a relatively unimportant factor in determining total production costs compared to other costs such as feed or labour. The Meat and Livestock Commission (MLC) reported in 1999 that the cost of feed varied between the major pig producing countries of Europe by 14 pence per kg of pig produced and the environmental costs varied by 8 pence per kg[53] – these factors have much more impact on pigmeat production costs than the choice of sow housing system. As we shall see,

changing from sow stalls to group housing with straw adds less than 2 pence to the cost of producing 1kg of pig carcase.

The total costs of pig production can be considered as capital investment costs and running costs. Investment costs include buildings and other capital equipment (such as pens, stalls and other feeding systems and manure disposal systems). Capital investment results in ongoing financial costs to the farmer each year in interest payments and depreciation. Running costs include feed and other materials such as straw, labour, water, electricity, and veterinary costs. The MLC estimates that feed costs in the UK are around 70% of total yearly monetary costs (excluding depreciation)[53].

Table 3. Main categories of cost as percentage of total monetary costs per kg of pig carcase produced, for the UK pig industry. Depreciation is excluded. Feed costs are slightly lower for France, Denmark and Holland (62-67%). (Baldwin, *Pig Cost Competitiveness,* MLC, 1999)[53].

Feed	70%
Labour	12%
Buildings, machinery and equipment	9%
Miscellaneous and environmental	9%

All farmers have to invest in new buildings and equipment at regular intervals, whatever the housing system. Housing lifetimes are usually around 12-15 years. For this reason the UK legislation banning stalls and tethers gave a phase-out period of over 7 years and the recent Danish and Dutch legislation similarly gives generous phase-out periods so that most farmers can continue using their existing systems for the building lifetime. With a generous phase-out period for sow stalls in Europe, most if not all buildings with sow stalls would have come to the end of their useful lifetime during the phase-out period and therefore would need to be replaced. With this in mind, new buildings for group housing should not necessarily be seen as an "extra" cost for most farmers.

The first point that needs to be stressed is that building and equipment costs for group housing can actually be lower than for the stall and tether system. The SVC's calculation based on a typical commercial farm in the Netherlands is that capital investment costs, and hence yearly housing costs, are 2% lower for group housing than for sow stalls if the Electronic Sow Feeder (ESF) system is used. The SVC report (Section 6.3.3) states "The main reason for the decrease [in investment costs] is that the expensive crates are not needed any more."

This means that if a farmer changed to group housing at the end of the natural lifetime of the existing housing system, it is perfectly possible that there would be no extra cost involved at all. As for running costs, these are likely to be the same for group housing as for sow stalls, if no straw is used. From a welfare point of view, we believe straw must be used and in that case the straw will be an extra cost (unless the farm produces the straw) and there may or may not be extra costs in labour for straw management. However, as we show below, these extra costs are small.

Several independent studies of the comparative cost of keeping sows in loose housing were published between 1997 and 2000 in the Netherlands, France and the UK by pig industry economists and academic agricultural economists. Their findings are summarised below and show clearly that a ban on sow stalls and tethers in Europe would add at most 2 pence per kg of pigmeat to total production costs.

11.1 Netherlands (SVC report)

The SVC used calculations from a computer model of different housing systems for a typical farm with 165 sows[1]. The report calculated how the housing investment costs would change for a farmer using group housing as compared to sow stalls. It also calculated the cost of providing sows with straw. The calculation assumed that running costs (apart from the cost of using straw) and production would not be affected by the change to group housing.

The SVC says that if sows are housed using the ESF system without straw, with $2m^2$ of floor space per sow (compared to around $1.4m^2$ in a sow stall) the housing cost per sow per year is reduced by 2% compared to sow stalls. These housing costs are interest payments on the original building investment and depreciation. The reduction in housing cost results in an 8% increase in overall financial return to the farmer and a reduction of 0.003 ecu (0.2 pence) in the cost of producing one kg of fattening pig (SVC report Section 6.3.3)[1].

According to the SVC's calculations, if the space allowance per sow is increased to $2.5m^2$, the return to the farmer is still 4% more than for sow stalls. If the space allowance is increased to $3.0m^2$ per sow the housing cost becomes just slightly more than for a sow stall and the total financial return to the farmer becomes 0.8% less than if he uses sow stalls (a reduction of less than 1 percent). Group housing with $3.0m^2$ per sow increases the cost of producing one kg of fattening pig by just 0.001 ecu compared to the cost using sow stalls[1]. This is about 0.06 pence per kg, a negligible amount (Table 4).

Turning to the cost of providing straw, the SVC believes that providing straw for sows will increase costs (for purchase of straw and for extra labour). The SVC estimated the costs of buying straw and extra manual labour to be 0.006 ecu (0.4 pence) per kg of pig produced compared to group housing without straw. Compared to sow stalls, group housing with 200g of straw per sow per day (around 70 kg/year/sow) would mean the yearly financial return to the farmer would be reduced by a small fraction of one percent (0.03%). Providing 300g/sow/day reduces the return to the farmer by 3% compared to sow stalls and increases the cost of producing 1kg of fattening pig by 0.003 ecu (about 0.2 pence) compared to sow stalls (Table 4).

However, the labour costs for providing sows with straw could well be lower than the SVC assumed if the sows eat much of the straw (which is what often happens in practice) or if the provision of straw could be automated[1].

Table 4. Changes in costs and financial return of group housing with ESF compared to sow stalls for typical Netherlands sow farm (165 sows) (SVC report, section 6.3.3)[1]

Group housing system	*Housing investment cost/sow/yr*	*Overall financial return to farmer/yr*	*Production cost of 1 kg pigmeat*
ESF 2m^2 / sow	2% less	8% more	0.003 ecu less
ESF 2.5m^2/sow	0.9% less	4% more	0.001 ecu less
ESF 3.0m^2/sow	0.2% more	0.8% less	0.001 ecu more
ESF 2m^2 + 200g straw/day/sow		0.03% less	0.002 ecu more
ESF 2m^2 + 300g straw/day/sow		3% less	0.003 ecu more

According to the SVC's calculations, the group housing systems that need individual feeding stalls (such as free-access stalls or trickle feed systems) come out more costly in investment than sow stalls. The building investment cost for free-access stalls is estimated to be 28% more than for sow stalls. As we have mentioned, the free-access stall system is also a less good investment from the point of view of the sows' welfare, as its potential for high welfare is comparatively low.

11.2 Netherlands (Rosmalen Institute)

In 1997 the Research Institute for Pig Husbandry (Rosmalen) published a detailed comparison of management, productivity and costs of different sow housing systems, based on trials carried out over 2-3 years[55]. The scientists monitored the costs of building and running the 4 trial systems, and the sows' health and performance. Like the SVC, the scientists found that group housing is in many circumstances economically better than sow stalls, taking into account both investment and running costs. They raised an equally satisfactory number of weaned piglets in all the systems.

The Rosmalen study found that housing investment for 170 sows was 2% less for the ESF system than for sow stalls. The study also found that total labour time on the sow farm was reduced by about 3% (and down by 28% in the pregnant sows' building itself). Feed and water usage were either the same or lower in the ESF system compared to sow stalls. The overall economic performance of the unit was nearly 48 Dutch guilders (nearly £14) higher per sow per year in the ESF system than in the sow stall system. Assuming 21.3 pigs produced per sow per year[53] and a carcase weight of 88kg[53], this would mean a cost reduction of 0.7 pence per kg of carcase compared to sow stalls.

The trickle feed (Biofix) system also resulted in an increase in overall economic performance. The free-access stall system required considerably more investment and this reduced the overall economic performance compared to sow stalls (Table 5).

Table 5. Investment costs, labour time and economic performance of different group housing systems compared to sow stalls (Backus *et al.*, Rosmalen Institute, 1997)[55]

	ESF	*Trickle feeder*	*Free-access stalls*
Labour time (whole sow farm)	3% less	No change	No change
Investment cost (for 170 sows)	2% less	4% more	29% more
Economic performance/sow/year	47.83 guilders more	5.81 guilders more	30.51 guilders less

11.3 France

In 1998 the Institut Technique du Porc (ITP) published the results of a study of the cost impact of implementing the recommendations of the SVC report in French pig farms[82]. This calculated the cost of using group housing for pregnant sows and the cost of giving sows straw, compared to the costs using sow stalls (Table 6).

The ITP report confirmed that group housing in strawed buildings involves lower investment costs than sow stalls. Buildings for group housing with straw litter cost 118 ecu (£75) *less* per sow place than housing with sow stalls. Therefore the yearly housing cost (interest payments and depreciation) would be lower for group housing in strawed buildings than for sows stalls.

The report also concluded that welfare-friendly strawed floors need less building investment than slatted floors. It estimated that buildings for group housing with slatted floors would cost 91 ecu more per sow place than buildings for sow stalls, although it does not specify what type of group housing systems (e.g. ESF, free-access stalls, etc.) this calculation applies to. As we have seen, in the Netherlands it was found that buildings for ESF were *less* costly than sow stalls, whereas free-access stalls were *more* expensive.

In terms of running costs, the ITP concludes that providing straw for sows would add 20 ecu (£13) per sow per year in labour costs and add 36 ecu (£23) per sow per year for buying the straw, using the maximum estimate for the price of straw. (In regions where straw prices are lowest, the straw cost per sow per year would be 14 ecu (about £9).) For slatted housing the labour costs would be the same as for sow stalls.

The ITP's calculations show that the overall cost impact for a farm changing from sow stalls to group housing in France is less than 2 pence per kg of pig carcase, even if the sows are given straw. The extra cost is 0.029 ecu (1.8 pence) per kg of pig carcase if the sows are kept in strawed buildings and 0.006 ecu (0.4 pence) per kg of pig carcase if the sows are in slatted buildings. Since almost half of French sows are not kept in stalls or tethers at the present time (see Table 1), the ITP's estimate of costs per pig produced are an overestimate of the cost impact of a change to group housing on the French pig industry as a whole.

Table 6. Effect of group housing on pig production costs in France, compared to sow stalls (Rousseau and Salaün, ITP,1998)[82]. 1 ecu = FF6.63

Building type *	*Building costs per sow place*	*Additional labour and straw cost/sow/year*	***Change in production cost** per kg pig carcase*
New building with straw litter	118 ecu less (£75)	20 ecu (£13) labour 36 (ecu £23) straw (maximum estimate)	**0.029 ecu (1.8p) more**
New building with slats	91 ecu more	0	**0.006 ecu (0.4p) more**
Adapt existing building with slats	302 ecu more	0	**0.02 ecu (1.3p) more**

* feeding system not specified
** comprises items in columns 2 and 3, i.e. buildings, labour and straw

11.4 Denmark

In February 1999 the UK's Meat and Livestock Commission (MLC) published a comparative study of pig farming costs in selected European countries[53]. The MLC estimates the cost of a change to group housing in Denmark to be 12 Danish kroner (£1.11) per pig produced, which is similar to the estimated cost for the UK industry. For a carcase weight of 75kg, this is equivalent to an extra production cost of 1.5 pence per kg of pig.

11.5 United Kingdom

The 1999 MLC report on *Pig Cost Competitiveness*[53] gave estimates of the cost of the stall and tether ban to the UK pig industry. The report did not give an estimate of the change in building investment costs for group housing as compared with sow stalls, but consultants at the Centre for European Agricultural Studies (CEAS) recently calculated that group housing reduces building investment costs by £2.74 per sow place[8].

For running costs, the MLC estimated that there are extra feed and management costs of £25 per sow per year for a farmer who changes from a stall and tether system to group housing[53]. This is equivalent to £1.14 per pig produced (assuming 22 pigs produced per sow per year[9]) or just 1.6 pence per kg of pig produced (assuming a 70kg carcase). However, since only 40% of pig farmers needed to change from stalls and tethers during the phase-out period[53], the additional cost of feed and management for the industry as a whole was only 46 pence per pig produced or 0.7 pence per kg of pig produced. In fact it is likely that by the late 1990s only a small percentage of UK pig farmers still used stalls or tethers.

Consultants at CEAS, as reported recently by the RSPCA, have also calculated the extra running costs of group housing with straw compared to stalls and tethers. Their estimate of the extra costs is £23.10 per sow per year or £1.05 per piglet produced[8]. This means that changing to group housing with straw adds just 1.5 pence to the cost of producing 1kg of pig carcase.

The data from the UK therefore confirms what we have already seen from the Netherlands, France and Denmark, that if the EU was to ban sow stalls, the extra production costs for EU pig farmers would be very small.

11.6 Conclusions: the cost of a sow stall ban in Europe

Contrary to the assertions of some in the pig industry that the costs of changing from sow stalls to group housing would be prohibitive, the published data from five authoritative studies show that changing to group housing with straw for pregnant sows in Europe would add less than 2 pence to the cost of producing 1kg of pig carcase.

Group housing with the electronic sow feeder (ESF), which is one of the best systems from the point of view of welfare, costs less to install than sow stalls. This means that the capital costs of changing from stalls to group housing can be practically eliminated by giving a generous phase-out period. The 1999 Hens Directive gives egg farmers 12 ½ years to phase out battery cages. An adequate phase-out period for pig farmers would mean that the majority of sow housing using sow stalls would come to the end of its normal lifetime during the phase-out period and would need to be replaced. At this point it would be cheaper for the farmer to install a group housing system than to install new sow stalls.

In addition, EU Member States and the European Commission are able to give financial help with the capital costs of the change to group housing under the EU's Rural Development Regulation. Article 4 of the Council Regulation (EC) No. 1257/1999 on support for rural development allows support for investment in agricultural holdings to be given for various objectives, including "to preserve and improve animal welfare standards". Compassion in World Farming Trust and the European Coalition for Farm Animals believe that Member States should help farmers with any capital costs involved in changing from sow stalls to more humane systems.

While the building costs for group housing are lower than for sow stalls, the running costs may be slightly higher than for sow stalls if the sows are provided with straw. However, the best estimates from the pig industry and agricultural economists of the total extra costs of keeping sows in group housing with straw turn out to be extremely small - between 1.5 pence and 1.8 pence per kg of pig carcase.

12.0 The cost to consumers

The banning of sow stalls throughout Europe would bring a huge welfare benefit to intensively kept pigs. What would the European consumer of pigmeat have to pay for this benefit? The answer is that, even if we accept the highest estimates from pig industry experts of the costs of group housing with straw, the actual cost to the European consumer of pigmeat is still very small.

Table 7 summarises the various estimates of the additional production costs of group housing and shows the approximate cost to the consumer, taking into account the average consumption of pigmeat in different countries (see Appendix 1 - for the EU as a whole, the average consumption of pigmeat is about 41 kg per person per year). The

increase in total production costs would be less than 2 pence per kg of pig produced. The increased cost to the consumer would be less than £1 per person per year. For example, even with the high consumption of pigmeat in Denmark, the cost per person would be only 95 pence (1.5 euro) a year. In the Netherlands, according to the SVC, the change to group housing would result in a cost reduction to the consumer, or a minimal additional cost of 8 pence (0.13 euro) per person per year if the sows were given straw bedding. In France, group housing of sows on straw would cost consumers 1.09 ecu (FF7.2 or 69 pence) per person per year.

Table 7. Summary of cost impact of change to group housing for producers and consumers (based on change in production costs per kg pig produced)

Country and source	**Cost change per kg pig produced**	**Added cost per person per year** (based national consumption)
Netherlands (SVC – ESF 2m^2/sow)	- 0.2p	reduction
Netherlands (SVC – ESF 3m^2/sow)	+0.06p	2.7p
Netherlands (SVC - ESF + straw)	+ 0.2p	8p (Netherlands)
Netherlands (Rosmalen - ESF slatted) [1]	- 0.7p	reduction
France (ITP - new slatted)	+0.4p	14p
France (ITP - new with straw)	+1.8p	69p (France)
Denmark (MLC) [2]	+1.5p	95p (Denmark)
UK (MLC) running costs (with straw)	+1.6p [3] (0.6p)	37p [3] (14p)
UK (CEAS) running costs (with straw)	+1.5p	36p

[1] Average carcase weight = 88kg[53], number of piglets/sow/year=21.3[53]
[2] Average carcase weight =75kg[53], consumption=63.1kg/person/year (Appendix 1).
[3] These estimates use the cost to an individual pig producer changing to group housing. For the industry as a whole, the change in costs are only 40% of these (shown in brackets), so that the cost to the consumer would be 33p/person/year for total costs and 14p/person/year for running costs only.

Exchange rates for Table 7 are taken as: £1=1.58 ecu or euro; £1=3.44 Dutch guilders; £1=11.66 Danish kroner; £1=10.25 French francs

13.0 Conclusions: group housing for Europe's sows

- Most of the major pig producing countries of the European Union use sow stalls to confine over half of their pregnant sows throughout the 16 weeks of each pregnancy. In the EU as a whole, around 6 million of the 12.7 million breeding sows are probably confined in sow stalls (the figure rises to around 8 million confined sows if we include the tethered sows). In these stalls the sows are not even able to turn around and are deprived of exercise, the opportunity to explore their environment and social interaction with other pigs.

- Sow stalls are recognised by veterinarians, scientists and many farmers and consumers to be completely contrary to the physical and behavioural needs of sows. The European Scientific Veterinary Committee stated in 1997 that sow stalls have "serious welfare problems for sows" and recommended that "sows should preferably be kept in groups"[1].

- The health problems and behavioural problems suffered by sows in sow stalls include:

  - Chronic physical discomfort
  - Increase in urinary infections
  - Increase in gastrointestinal problems
  - Reduced muscle and bone strength
  - Increased lameness
  - Injuries from pen fittings and flooring
  - Reduced cardiovascular health
  - Increased reproductive problems
  - Increased and chronic stress
  - Abnormal, stereotypic behaviour
  - Abnormal inactivity, apathy and depression

Eleven European pig experts surveyed in 1999 gave sow stalls and tethers the lowest rating of all sow housing systems in terms of welfare[11].

- More humane alternative systems such as group housing with straw indoors, or outdoor housing, are both practical and cost-effective and have been shown to improve the welfare of pregnant sows. Over 4 million sows in Europe are kept commercially in these alternative systems.

- Straw or other litter material is important for the physical and psychological health of group housed sows and can avoid the environmental problems associated with slurry management. Compassion in World Farming Trust and the European Coalition for Farm Animals believe that all sows should be provided with straw or other bedding material.

- The cost of a change from sow stalls to group housing with straw in Europe would be minimal. Five authoritative studies have shown that the increase in production costs per kg of pigmeat is less than 2p - the cost to an average European consumer in a year would be less than £1.

- Sow stalls are one of the most inhumane inventions of the factory farming system and the time has come to put an end to their use throughout Europe:

  - **Compassion in World Farming Trust and the European Coalition for Farm Animals call on the European Commission to review urgently the Pigs Directive and ensure that it includes a phase-out of sow stalls**

  - **Compassion in World Farming Trust and the European Coalition for Farm Animals call on the Agriculture Ministers of the European Union to agree an urgent phase-out of sow stalls throughout the EU**

Compassion in World Farming Trust and the European Coalition for Farm Animals
August 2000

Appendix 1. Pigmeat consumption and national self-sufficiency in pigmeat for EU countries

(Source: Eurostat, *Animal Production: half-yearly statistics, 2/1999*). Average carcase weight differs between countries and is about 70kg in the UK , 88 kg in the Netherlands, 75 kg in Denmark and 84kg in France (Brittany)[53].

Country	*Consumption, kg/person/year, 1998*	*National self-sufficiency, %,1998*
Austria	55.4 (1997)	104 (1997)
Belgium/Luxembourg	46.1	224
Denmark	63.1	508
Finland	34.1	103
France	37.5	104
Germany	55.9	82
Greece	24.8 (1997)	55 (1997)
Ireland	38.4 (1997)	171 (1997)
Italy	34.4 (1997)	69 (1997)
Netherlands	42.7	273
Portugal	38.5 (1997)	80 (1997)
Spain	64.3	108
Sweden	39.1	100
UK	23.9	82
EU average	40.7 (1997)	

References

1. Scientific Veterinary Committee, *The Welfare of Intensively Kept Pigs*, 1997.
2. F W R Brambell. *Report of the Technical Committee to Enquire into the Welfare of Animals Kept under Intensive Livestock Husbandry Systems*, HMSO, 1965.
3. Council of Europe, *European Convention for the protection of animals kept for farming purposes* (convention no 87), Strasbourg, 1976.
4. Council of Europe, Standing Committee of the European Convention for the Protection of Animals Kept for Farming Purposes, *Recommendations concerning pigs*, February 2000.
5. Animal Protection Ordinance, 2 June 1988, Section 15; National Board of Agriculture Regulations and General Recommendations concerning Animal Management in Agriculture, etc., amended 1993, Section 28.
6. Ministry of Agriculture, Nature Management and Fisheries, the Netherlands, *The welfare of pigs regulations in the Netherlands*, 1998.
7. H J M Hendriks, B K Pedersen, H M Vermeer and M Wittmann, 'Pig housing systems in Europe: current distributions and trends', *Pig News and Information* **19:**97N-104N, 1998.
8. RSPCA, *Profit with Principle: animal welfare and UK pig farming*, 2000.
9. Meat and Livestock Commission, *Pig Yearbook 1999*.
10. Institut Technique du Porc, *Le porc par les chiffres*, 1998.
11. M B M Bracke, J H M Metz, B M Spruijt and A A Dijkhuizen, Overall welfare assessment of pregnant sow housing systems based on interviews with experts, *Netherlands Journal of Agricultural Sciences* **47**:93-104, 1999.
12. Scientific Veterinary Committee, *The Welfare of Intensively Kept Pigs*, 1997, Recommendation 73.
13. Scientific Veterinary Committee, *The Welfare of Intensively Kept Pigs*, 1997, Recommendation 72.
14. D S Arey, The effect of bedding on the behaviour and welfare of pigs. *Animal Welfare* **2**:235-246, 1993.
15. H A M Spoolder, *et al.*, Provision of straw as a foraging substrate reduces the development of excessive chain and bar manipulation in food restricted sows. *Applied Animal. Behav. Sci.* **43:** 249-262, 1995.

16. G Christensen, L Vraa-Anderson and J Mousing, Causes of mortality among sows in Danish pig herds, *Veterinary Record* **137:**395-399, 1995.
17. J N Marchant and D M Broom, Effects of dry sow housing on muscle weight and bone strength. *Animal Science* **62:**105-113, 1996.
18. J N Marchant and D M Broom, Factors affecting posture-changing in loose-housed and confined gestating sows. *Animal Science* **63:**477-485, 1996.
19. H Schmid and H Hirt, Species specific behaviour of sows and piglets that prevent crushing. *Proceedings of the International Society for Applied Ethology*, ed. M Nichelmann, Humboldt University, Berlin, 465-467, 1993.
20. R Cariolet, Study of the postures of crated pregnant sows during the resting period; relationship between crate width and farrowing disorders. *Journées de la Recherche Porcine en France*, February 1991, 189-194.
21. P Egle, Erfahrungen bei der Umsetzung der Schweinehaltungsverordnung. Proceedings of DVG conference on 'Protection of Domestic Animals', 5-7 March 1998, 177-183.
22. C Vieuille *et al.*, Evaluation of welfare of pregnant sows: comparison of four housing conditions. *Journées de la Recherche Porcine en France* **28:**307-318, 1996.
23. R H C Penny, The impact of foot problems on pig welfare, Proceedings of the Symposium on the Welfare Problems of Lameness of Food Animals and Equines: The Foot, London, April 1995.
24. J Webster, *Animal Welfare: a cool eye towards Eden*, Blackwell Science, 1994, p149.
25. R Cariolet *et al.*, Évaluation du bien-être chez la truie gestante bloquée. *Journées Rech. Porcine en France* **29:**149-160, 1997.
26. J P Tillon and F Madec, Diseases affecting confined sows. *Ann. Rech. Vét.* **15:**195-199, 1984.
27. A Grauvogel, *Artgemäße und rentabel Nutztierhaltung*, BLV Verlagsgesellschaft, Munich 1997.
28. J N Marchant, A R Rudd and D M Broom, The effects of housing on heart rate of gestating sows during specific behaviours. *Applied Animal Behaviour Science,* **55:**67-78, 1997.
29. P Jensen, Effects of confinement on social interaction patterns in dry sows, *Appl. Animal Behav. Sci.,***12**:93-101, 1084.
30. P Jensen, *The effect of confinement on the behaviour of dry sows - an ethological study*. Rapport 2, Swedish University of Agricultural Sciences, 1980.
31. E M C Terlouw and A B Lawrence, Long-term effects of food allowance and housing on development of stereotypies in sows. Appl. *Animal Behav. Sci.* **38:** 103-126, 1993.
32. G M Cronin, *The development and significance of abnormal stereotyped behaviours in tethered sows,* PhD Thesis, University of Wageningen, The Netherlands, 1985.
33. C Vieuille-Thomas, G Le Pape and J P Signoret, Stereotypies in pregnant sows: indications of influence of the housing system on the patterns expressed by the animals. *Appl. Anim. Behav. Sci.* **44:**19-27, 1995.
34. D M Broom, M T Mendl and A J Zanella, A comparison of the welfare of sows in different housing conditions. *Animal Science* **61:**369-385, 1995.
35. L R Matthews and J Ladewig, Environmental requirements of pigs measured by behavioural demand functions. *Animal Behaviour* **47:**713-719, 1994.
36. J A Burbidge *et al.*, the effect of feeding regime and the provision of a foraging substrate on the development of behaviour in group-housed sows. *Proceedings of the International Congress on Applied Ethology, Berlin 1993. 3rd Joint meeting,* 104-107, 1993.
37. K Schaffer-Muller, N Reinsch, R Hartwigsen and E Ernst, Investigation about group housing of pregnant sows with special regard to the influence of offering straw on reproductive traits: behaviour of the sows. *Zuchtungskunde* **69:**62-72, 1997.
38. X Whittaker *et al*., effects of straw bedding and high fibre diets on the behaviour of floor-fed sows. *Appl. Anim. Behav. Sci.* **63:**25-39, 1999.
39. R Weber and K Friedli, Transponder feeding of breeding sows - results and conclusions. *Rapports FAT, No 410,* 1991.
40. P H Simmins, S A Edwards and H H Spechter, Growth and bodily condition of sows given different feeding regimes during the rearing stage and through 8 parities when group-housed with straw bedding. *Animal Production* **58:**271-283, 1994.
41. D Hesse, Pig keeping on straw. *Landtechnik* **48:** 541-544, 1993.
42. B van Schaijk, Sawdust-based system for pigs: development for practical solutions. *Livestock Environment IV: proceedings of conference held in Coventry, UK 6-9 July 1993*, ed. E Collins, 1993, 1240-1245.
43. K Schaffer-Muller, S Stamer and E Ernst, Behaviour and injuries among groups of pregnant sows with automated feeding, and the benefits of providing straw. *Aktuelle Arbeiten zur artgemassen Tierhaltung, 1995*, Series KTBL-Schrift No. 373, 93-103, 1996.
44. A C Olsson and J Svendsen, Group housing of sows in gestation in insulated and uninsulated buildings. *Livestock Environment IV: proceedings of conference held in Coventry, UK 6-9 July 1993*, ed. E Collins, 1993, 1232-1239.

45. H Gjein and R B Larssen, Housing of pregnant sows in loose and confined systems, a field study. 3. The impact of housing factors on claw lesions. *Acta Veterinaria Scandanavica* **36:**443-450, 1995.
46. D S Arey, Effect of straw on the behaviour and performance of growing pigs in Straw-Flow® pens. *Farm Building Progress* **112**:24-25, April 1993.
47. J Durrell, I A Sneddon and V E Beattie, Effects of enrichment and floor type on behaviour of cubicle loose-housed dry sows, *Animal Welfare* **6**:297-308, 1997.
48. B Wechsler, Rearing pigs in species-specific family groups. *Animal Welfare* **5**:25-35, 1996.
49. H Vermeer, Rosmalen Institute and B K Pedersen, Danske Slagterier, personal communication.
50. G Reibe, K Schafer-Muller and E Ernst, Comparision of the behaviour of group housed pregnant sows fed either with an electronic feeding system or with a feeding system based on biological fixation, *Current Research in Applied Ethology* **376**:167-176, 1996.
51. Pig Welfare Advisory Group, *Electronic Sow Feeders (ESF)*, MAFF 1997 (PB3092).
52. M T Mendl, D M Broom and A J Zanella, The effects of three types of dry sow housing on sow welfare. *Livestock Environment IV: proceedings of conference held in Coventry, UK 6-9 July 1993*, ed. E Collins, 1993, 461-467.
53. C P Baldwin, *Pig cost competitiveness in selected European countries*, Meat and Livestock Commission, February 1999.
54. P Cerneau *et al.*, Incidence du mode de logement et du mode d'alimentation sur le comportement de truies gestantes et leurs performance de reproduction. *Journées Rech. Porcine en France* **29:**175-182, 1997.
55. G B C Backus *et al., Comparison of four housing systems for non-lactating sows*, Research Institute for Pig Husbandry, Rosmalen, Report P 5.1 February 1997.
56. S Rizvi, C J Nicol and L E Green, Risk factorys for vulva biting in breeding sows in south-west England, *Veterinary Record* **143**:654-658, 1998.
57. N J Hodgkiss, J C Eddison, P H Brooks and P Brigg, Assessment of the injuries sustained by pregnant sows housed in groups using electronic feeders, *Veterinary Record* **143**:604-607, 1998.
58. D S Arey, Time course for the formation and disruption of social organisation in group-housed sows, *Appl. Animal Behav. Sci.* **62**:199-207, 1999.
59. J Nowachowicz *et al.,* Influence of electronically controlled individual feedng on behaviour and reproductive performance of pregnant sows, *Journal of Animal and Feed Sciences* **8**:45-49, 1999.
60. F Møller *et al., The significance of group and pen size for loose housing of pregnant sows,* DJF rapport Nr. 2, Ministeriet for Fødevaret, Landbrug og Fiskeri, June 1998.
61. G Ståhle, *Ban on stalls and tethers for sows – Swedish experience*, paper given to Eurogroup for Animal Welfare at the European Parliament. Federation of Swedish Farmers (LRF), June 2000.
62. Pig Welfare Advisory Group, *Outdoor Sows*, MAFF 1997 (PB3091).
63. C Whittemore, *The Science and Practice of Pig Production*, 2nd edition, Blackwell Science, 1998, 502-506.
64. B Mortensen *et al.*, Outdoor pig production in Denmark. *Pig News and Information* **15:**117N-120N, 1994.
65. M le Denmat *et al.*, Outdoor pig breeding in France. *Porc Nuusbrief* **1:**1-3, 1997.
66. F Berger *et al.*, Perinatal losses in outdoor pig breeding. A survey of factors influencing piglet mortality. *Annales de Zootechnie* **46:**321-329, 1997.
67. J Dagorn, B Badouard and S Boulot, Free range pig farming in France. *Techni Porc* **19(2):**7-13, 1996.
68. B Badouard and J Dagorn, Cost prices in French herds. *Pig News and Information* **19**:29N-34N, 1998.
69. K Spitschak, Fertility and rearing performance of sows with piglets in outdoor keeping. *Archiv fur Tierzucht* **40:**123-134, 1997.
70. B Oldigs, M Link, U Baulain and E Kallweit, Investigation of outdoor piglet production in relation to animal welfare. *Zuchtungskunde* **67**:230-244 1995.
71. K Spitschak and W Franke, Outdoor keeping of sow and piglets – more than only an alternative. *Archiv fur Tierzucht* **40:**35-40, 1997.
72. A G Kongsted, V A Larsen and I S Kristensen, *Frilandssohold: Resulter fra Gårdstudier – 1998*, DJF rapport Nr. 15, Ministeriet for Fødevaret, Landbrug og Fiskeri, January 2000.
73. J Svendsen, A C Olsson and L Svendsen, Group housing systems for sows; 3: The effect on health and reproduction – a literature review, *Swedish J. of Agricultural Research* **22**:171-180, 1992.
74. N Walker and D J Kilpatrick, A study of spatial behaviour of pregnant sows housed in pens with various feeding and dung disposal systems, *Animal Welfare* **3**:97-105, 1994.
75. Pig Welfare Advisory Group, *Non-straw or low straw systems for housing dry sows,* MAFF 1997 (PB3084).
76. G D Hutson, M J Haskell, L G Dickenson and D E Slinger, Preferences of pregnant sows for wet and dry concrete floors, *Applied Animal Behav. Sci.* **37**:91-99, 1993.
77. A Evans, Straw for sows makes a comeback on Dutch farm. *Pig Progress* **15**(10), 31-35, 1999.
78. O A T Peltoniemi *et al.*, Seasonal and management effects on fertility of the sow: a descriptive study. *Animal Reproduction Science* **55**:47-61, 1999.

79. A Randelzhofer, *Incidence and species spectrum of endoparasites of sows and their litters under different husbandry and management systems*. Veterinary Faculty, University of Munich, 1990.
80. T Lang, *Examination for endoparasites in domestic pigs on fattening and breeding farms*. Veterinary Faculty, University of Munich, 1991.
81. W J Smith, Arthritis in Pigs. *Veterinary Record* **145**:440, 1999.
82. P Rousseau and Y Salaün, *Bien-être en élevage intensif: incidence des recommandations des experts sur l'investissement et le coût de production du porc charcutier*, Institut Technique du Porc, May 1998.
83. Scientific Veterinary Committee, *The Welfare of Intensively Kept Pigs*, 1997, Table 6.7.
84. Texier C, Vaudelet J C and Rousseau P, Deep litter housing of pigs; temperature, composition and volume of litter at 10 farms, *Journées Rech. Porcine en France* **29**:305-310, 1997.
85. R Kaufmann, C Hartmann, D Maurer and M Schlatter, *Deep litter stalls for pigs being fattened – the overall verdict in the main positive!,* Eidgenossische Forschungsanstalt für Agrarwirtshcaft und Landtechnik, Switzerland, 1998.
86. D Marlier, B Nicks B Canart and R Shehi, Comparison of the development of bedding materials in 2 deep litter systems, deep sawdust and deep straw, for fattening pigs, *Annales de Medecine Veterinaire* **138**:43-53, 1994.
87. H Dohler, The "compost stable" – an environmentally friendly and species adapted animal husbandry method? *Landtechnik* **48**:138-141, 1993.
88. SICSA s.a., www.sicsa.fr .
89. K H Jeppsson, Ammonia emission from different deep-litter materials for growing-finishing pigs, *Swedish J. Agricultural Research* **28**:197-206, 1998.
90. S Hoy, K Müller and R Willig, Ammonia concentrations in pig hourses with different types of floors – deep-litter husbandry with bioactivator compared to fully slatted floor husbandry, *Tierärztliche Unschau* **49**:414-416,418-420, 1994.
91. V E Beattie, N Walker and I A Sneddon, Preference testing of substrates by growing pigs, *Animal Welfare* **7**:27-34, 1998.
92. J R Archer and R J Nicholson, Liquid Wastes from Animal Enterprises, in *Farm Animals and the Environment*, ed. C Phillips and D Piggins, CAB International, 1992, 325-343.
93. F Brouwer, P Hellegers, M Hoogeven and H Luisink, Nitrogen pollution control in the European Union, in *Agriculture and the Environment,* Proceedings of a conference held at University of Warwick, April 1999, ed. S T D Turner and A Alford, ADAS Wolverhampton, 1999, 64-73.
94. F A Nicholson, J R Williams and B J Chambers, Ammonia losses from straw and slurry-based pig manure management systems. Paper submitted to the 2nd International Conference on Air Pollution from Agricultural Operations, Des Moines, Iowa, 9-11 October 2000.
95. B Chambers, I Smith and B Pain, Strategies to encourage better use of nitrogen in animal manures, in *Tackling Nitrate from Agriculture,* MAFF 1999 (PB4401).
96. P W G Groot Koerkamp *et al.,* Concentrations and Emissions of Ammonia in Livestock Buildings in Northern Europe, *J. Agricultural Engineering Research*, **70**:79-95, 1998.
97. C M Groenestein, Welfare-friendly housing and ammonia emissions, *Pig Progress* **16(3)**:27-28, 2000.
98. Grampian Country Food Group, personal communication.