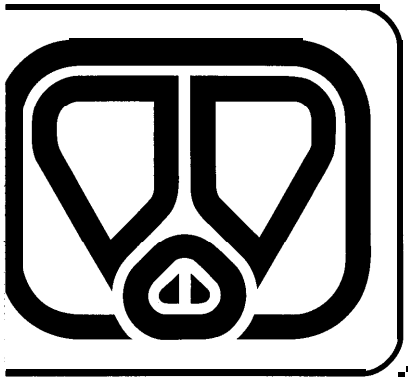
Research Reports 1999



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PREFACE

At the Research Institute for Pig Husbandry, an organization with 70 employees, applied research has been carried out in order to find practical solutions for actual and future problems and to stimulate desirable developments in pig husbandry.
In total 1200 sows and 3000 growing-finishing pigs at three experimental farms at Raalte, Rosmalen and Sterksel are available. The experiments are often multidisciplinary in nature but also disciplinary practical aspects of pig farming are investigated. This means that different aspects of pig production are under study. The experiments are financed by the Ministry of Agriculture, Nature Management and Fisheries, Product Boards, farmers organizations and private companies. The results are published in reports and articles.
This report gives an overview of all summaries of the publication in 1999.
The main topics were:

1 Economics
Farms must be economic to survive and an economically healthy pig industry has a national impact on employment
2 Health and quality
Good animal health is the most vital and basic requirement for a safe and relaible pork production
3 Environment
Environmental proctection is an important issue in the Netherlands and most of the European countries. The Institute carried out studies to lower output of minerals and emissions at farm level.

We hope that this brief overview of many of our research programmes will interest you. If you have any questions or remarks related to the articles, please do not hesitate to contact the author(s) by phone, fax or e-mail:

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Jan A.M. Voermans,
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WORKLOAD, HEALTH PROBLEMS AND SICK LEAVE FOR WORK AMONG PIG FARMERS

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In 1997 and 1998 the Research Institute for Pig Husbandry and IMAG-DL0 held a survey among pig farmers. The goal of the survey was to assess workload, health problems, sick leave and incapacity for work.

Method

The research included two phases: a reply card with several short questions and an extensive questionnaire. The reply card was sent to 2,174 pig farmers. This was one-third of all farms (with more than 75 sows or more than 500 growing-finishing pigs) which were members of the local organizations of LTO-Netherlands. Pig farmers who had indicated on the reply card to be willing to fill in a questionnaire were sent a questionnaire.
The questionnaire included questions about personal characteristics, work characteristics, symptoms of workload and its consequences.
The questionnaire was sent to pig farmers ('managers'), wives of pig farmers ('wives') and farm employees ('employees'). In all, 1,039 questionnairs were sent to 641 addresses.

Research population and response

The response to the questionnaire (after using a reply card) was 61.9% in relation to the number of addresses and 42.4% in relation to the number of respondents. The group of respondents consisted of 414 managers, 93 wives and 48 employees. Farms of the respondents were relatively big, compared to the national number of farms with more than 500 growing-finishing pigs or more than 75 sows. The percentage of specialized farms with more than 75 sows was 25.6% and the percentage of farms with more than 1,000 growing-finishing pigs and more than 200 sows was 8.9%. The percentage of specialized farms with more than 500 growing-finishing pigs was low (16.4%) compared to the national mean.

Work

The working time of managers, wives and employees was 6.8 hours, 2.8 hours and 7.1 hours per day respectively. Of the work activities which occurred at every farm type, managers and employees did all the work. Wives carried out a limited number of tasks. Of the work performed which was characteristic of farms with only sows or farms with only growing-finishing pigs, the managers performed all the tasks. At farms with only growing-finishing pigs, work by wives and employees was limited to receiving piglets or delivering growing-finishing pigs. At farms with only sows, work by wives was limited to activities with concerning piglets and transfer of sows. In general, employees carried out all kinds of tasks.
Managers of finishing farms worked, on average, 3.0 hours per day on the farm. Managers of breeding farms worked, on average, 7.2 hours per day and managers of combination farms, on average, 7.7 hours per day.
Subjectively experienced working methods, overloading the back, were mainly carried out by managers and employees of breeding- or combination farms. Managers of finishing farms and wives of all farm types hardly did any work which was experienced as overloading the back.
Physical work which was experienced as 'frequently occurring' by more than 60% of

[1] IMAG Research Institute

the workers was mainly mentioned by managers and employees. Light flexion of the trunk and pushing/pulling were physical working conditions mentioned most. Psychosocial factors were mentioned by all workers. Managers and employees mentioned e.g. 'paying attention to many things at the same moment' and 'working alone often' and wives mentioned 'being worried about the future of the company'. Working conditions with respect to climate, which were mentioned by more than 60% of all workers, were heat and fluctuations in temperature.

Symptoms of fatigue and stress, health complaints and musculoskeletal complaints

Symptoms of fatigue and stress mentioned most were 'agitation', 'being tensed-up', 'getting up tired' and 'fatigue after work'. 'Agitation' and 'getting up tired' were mentioned less often by employees (18.8% and 6.3%) than by managers (30.5% and 15.2%). The outbreak of classical swine fever and reconstruction plans for pig husbandry might have contributed to these complaints.
Coughing and sneezing fits (15-16%) were health complaints mentioned most. Low back problems were musculoskeletal complaints mentioned most.

Prevalence of low back problems among managers was 45.8%, among employees and wives 36.8% and 37.0% respectively. Prevalence of neck/shoulder complaints was as follows: 29.9% of the managers, 35.6% of the wives and 33.3% of the employees had these complaints.
Differences in prevalences with respect to musculoskeletal complaints between different types of workers were not significant. Wives and employees indicated more often than managers that the causes of neck/shoulder complaints should be found outside pig husbandry. Wives indicated more often than managers and employees that the causes of low back complaints should be found outside pig husbandry.
Sometimes certain activities were mentioned as cause of complaints. With regard to complaints of the neck/shoulder or the low back especially spraying with a high pressure spraying pistol was mentioned. Other causes of low back pain mentioned frequently were feeding by hand, lifting or catching piglets, lifting and bending.
Differences in prevalences with respect to musculoskeletal complaints between managers of different farm types were not significant. Managers of finishing farms indicated more often than other managers that cause of low back complaints should be found outside pig husbandry.

Sick leave and incapacity for work

Persons who indicated that the complaints did not have a link with pig husbandry, were excluded from analysis.
Among managers sick leave during the past 12 months due to low back complaints was highest, namely 7.7%. Among wives sick leave due to arm/hand complaints (4.2%) and leg/foot complaints (4.2%) was highest. Among employees sick leave due to arm/hand complaints was highest, namely 8.3%. Sick leave occurred in 17% of the cases among managers with musculoskeletal complaints (neck/shoulder or low back or arm/hand or leg/foot). Among wives and employees this was the case in 17.3% and 27.3% respectively. Among managers, sick leave due to low back complaints was highest, namely 21.7%.
In 17.1% of the cases managers were not fully able to work. Among wives 9.8% were not fully able to do work and 10.2% of the employees.

Relationship between physical and psychosocial working conditions, conditions concerning climate and complaints

Certain working conditions occurred more often among managers with musculoskeletal complaints compared to managers without complaints. With respect to neck/shoulder complaints a strongly significant relationship was found with flexion of the neck, posture and movement of the trunk and strenuous work. Other significant relationships were lack of work satisfaction;bad transition from training to work, too complicated work and ▶

cold.
With respect to low back complaints a strongly significant relationship was found between complaints and working conditions such as posture and movement of the trunk, flexion of the neck, inconvenient or monotonous working postures, strenuous work and lack of fascinating work. Working conditions with respect to climate which had a significant relationship with low back complaints were draught, wind and fluctuations in temperature.

Relationship between working conditions, personal characteristics and complaints

By use of factor analysis a number of variables with respect to working conditions and personal characteristics were clustered to factors. Then the relationship between the level of factorscores and musculoskeletal complaints was examined.
Workers with a high score on the factor 'breeding farm and working time' mentioned low back complaints more often than workers with a low score. Workers with a high score on the factor 'constitution, working time and age (negative)' had neck/shoulder complaints less frequently and had a tendency towards more low back complaints than workers with a low score. Workers with a high score on the factor 'duration of work history, age and labour-intensive working methods' mentioned neck/shoulder complaints more often than workers with a low score. ■

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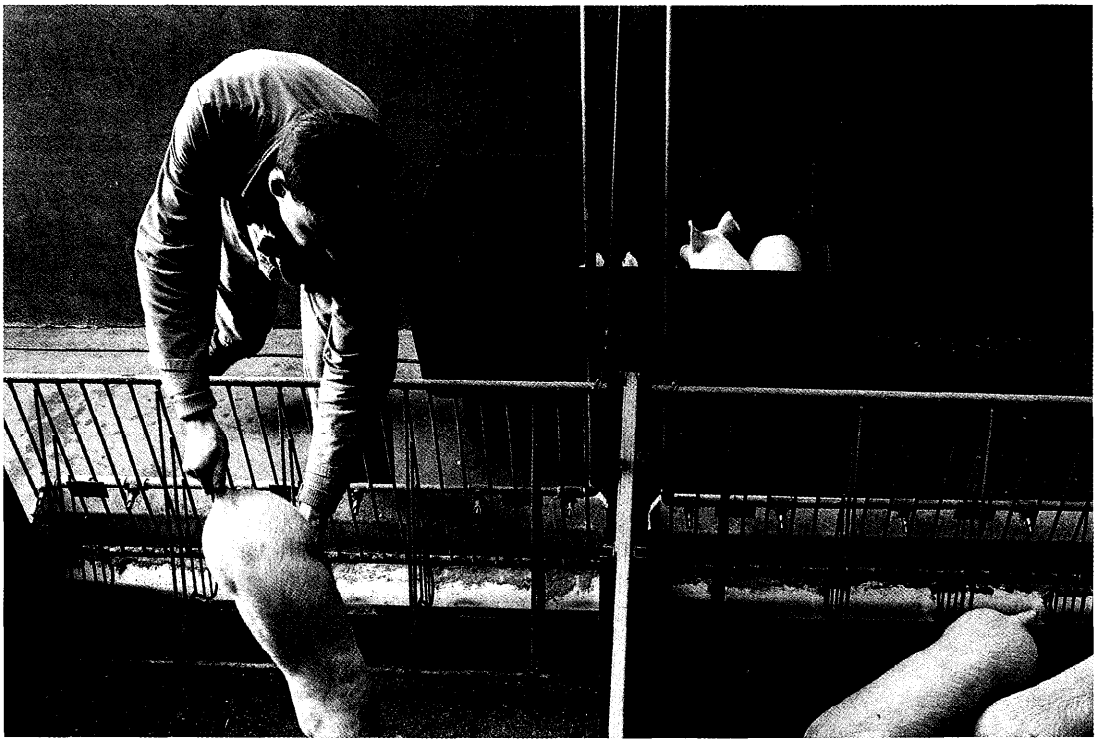

Source: EBI/Boerderij

RECONSTRUCTION FROM THE BASIS. STAGE 1: STUDIES ON THE FUTURE BY PIG FARMERS IN LIMBURG

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The changing world surrounding swine farming will have an enormous impact on the size and structure of pig farms in the Netherlands coming years. These developments should be considered in implementing the Reconstruction Act. In the short term well worked-out plans should come on the table, on the basis of which all pig farmers can make well-founded decisions for the future.

The project 'Reconstruction from the basis' is a joint initiative of the province of Limburg, the LLTB (Limburg farmers' union) and the four Limburg councils of Venray, Helden, Nederweert and Horst. The project has been divided into three stages. The first stage is a study on the consequences of the Restructure Act, developments in the society and market, and swine farming's expectations for the future.
Based on data from the Central Statistical Office (CBS), an analysis has been made of the current size and structure of swine farming in the Netherlands as well as in the four Limburg areas. After this, studies on the future have been done on the society and the market in which swine farming operates, with focus on relevant policy areas, such as animal welfare, animal health, environmental issues, working conditions and intrinsic product quality. The studies have been presented to and discussed with the reconstruction groups that had especially been established. Each of the reconstruction groups had three meetings. To conclude, a fourth meeting has taken place with the four reconstruction groups together.

Studies on the future

Pig farmers are becoming more dependent on demands formulated by retailers (large supermarket chains). This requires a change from a producer-oriented (to keep costs as low as possible) attitude to a consumer or market-oriented one (certifying end product). A larger segmentation of the market will arise, where a distinction will be made on the basis of product demands and quality. Certification of slaughterhouses, pig farms and other stages in the production chain will reveal this distinction to the customer. The Restructure Act and the draft Reconstruction Act will accelerate the decisions that have to be made by the farms due to market and society demands.

In 2010 a pig farm will look as follows. The farms employ two fte's (full-time equivalent), one of whom will operate in swine farming. The farms are certified and are closed or are part of a closed structure (set relations with minimal contacts). The contact structure can be controlled and is therefore insurable. The farms are family farms, with often hired labour, and are independent.
Only farms that have sufficient cash flow and are at such a location that they can expand the business will be able to increase to two fte's. These farms will be certified as to animal welfare, animal health, environmental pollution, use of feed and medicines and working conditions. Management Information Systems (MIS) will play an important role as a supporting tool in running the business. By making use of computer networks, an extensive exchange of data between veterinarians, extension workers, slaughterhouse or accountant can take place.

Discussions with the reconstruction groups

Due to the lack of a rational basis, the reconstructions groups do not support clustering and pig free zones. During the discussions there was a constant search for evidence. From the animal health point of view, argumentation to opt for these solutions could ▶

not be found. The farmers consider measures at farm level and limiting contacts more effective in limiting the risk of disease. The regulation 'Hygiene instructions contagious animal diseases' is not considered an impediment. The pig farmers have the opinion that firm action should be taken against colleagues who act irresponsibly as to prevention of animal disease.

Most pig farmers are of the opinion that requirements as to welfare should be considered in certification and that the exact application of animal welfare at the farms should be dependent on the demands set by the market segment for which is produced. Regulation by the government is only acceptable if it is done at European level.

In the future, working conditions will increase in importance. Pig farmers increasingly work with hired labour and also insurance premiums for themselves are very high. The requirements as to animal welfare that result from the Restructure Act and the Pig Order (i.e. minimum requirements for space per animal) have negative consequences for the working conditions, according to the reconstruction groups.

Pig farmers also find the environment an area for special attention. Energy use should be optimized and introducing and developing emission-poor barns, mineral-poor feed and alternative energy sources are seen as positive developments. The removal of manure should be tailored to the needs of the market, by which manure processing at farm level will be further promoted.

Legislation and rules are considered badly geared to each other. Measures as to animal welfare and working conditions conflict with each other, as are the animal health, welfare and environmental measures. These three regulations counteract one another at farm level as well as at sector level. More space for the animals leads, for example, to a higher ammonia emission; diminishing pig rights at removal hinders farmers from making their farms closed ones. Another bottleneck is the tension between animal health policy, local environmental policy and landscape planning. This shows up, for example, in establishing depots for dead animals beside public roads.

The meat quality is considered of paramount importance. Particularly with respect to antibiotics the sector is aware of the need for changes.

Conclusions

The sector will operate at a larger scale and the number of farms will decrease considerably. As a result of the 10% generic reduction per farm the financial-economie situation will worsen. Particularly the smaller farms will go out of business, which will have a great impact on the location of pig farms in the countryside.

The Reconstruction Act is related to the layout of the countryside. By interpreting and implementing this Act, not only the interpretation of the Restructure Act, the renewed Pig Order and the 'Regulation on hygiene contagious diseases' should be taken into account, but also autonomous developments. The reconstruction groups advise to distinguish three target groups in reconstructing the sector: stayers, pushers and yielders. For all groups separate plans should be made. The reconstruction groups strongly advise not to take half measures in reconstructing the sector. It should be prevented that farms in areas without any future prospects for swine farming die a slow death. Give these farms a fair chance either to go out of business or to start elsewhere. ■

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MODEL MINERAL FLOW

drs. C.P.A. van Wagenberg, dr. ir. G.B. C. Backus

On January 1st a new environmental legislation, the Mineral accounting system or Minas, became operative in the Netherlands. Individual farms have to comply with the standards in Minas when they exceed a certain cattle density per hectare. Within Minas these farms are evaluated as to their mineral loss. This is the difference between the amount of minerals brought on the farm and the amount removed from the farm. If the mineral loss exceeds a certain standard, the farmer has to pay a levy. From 1998 to 2008 the standards and levies within Minas will gradually be tightened. An individual pig farmer can limit the mineral loss by taking a number of measures. The model MINERALFLOW has been developed to gain insight into the economic prospects of (combinations of) these measures. The measures included in MINERALFLOW are: lowering mineral content in the feed, adjusting feeding strategy and slurry treatment.

Model MINERALFLOW

MINERALFLOW is a deterministic mixed integer optimizing model. The goal function is labour income. The model is solved using the "Branch and Bound" method. The decision variables are the phosphorus (P) and nitrogen (N) contents in the feed, the slurry treatment system, the amount of slurry treated and the application of the slurry fractions. The values of the decision variables at maximum labour income are called the optimal values.
The mineral flow on the farm is modelled from the moment minerals arrive on the farm (feed, animals) until they leave the farm (dead animals, animal products like meat and piglets, slurry application/removal (on the farm's own land, other land, distributor or discharging into sewage system) and emission). The decision variables influence the mineral flow.

The best measures an individual pig farmer can take to improve the quality of the manure can be determined with MINERALFLOW. Furthermore, the economically optimal slurry application within the legislation of Minas can be determined. The influence of different farm characteristics on the optimal mineral management and the optimal slurry application can be determined as well. Some examples are considered in the following.

MINERALFLOW is not validated. Validation is recommended to increase the value of the model.

Examples

Four different growing-finishing farms and four different sow farms have been considered. The farms have been classified according to small size (400 growing-finishing pigs or 100 sows) and large size (2,500 growing-finishing pigs or 400 sows) and favourable performance (low feed intake and high production) and unfavourable performance (high feed intake and low production). All farms own 14.4 hectares of land. In the calculation slurry prices of Dfl 1.5 (KWIN-V 1997/1998) and Dfl 25.- were used, as well as the Minas standards of 1998.

In table 1 the optimal value of the decision variables for the examples with favourable performance are given.

For small growing-finishing farms the optimal P content in the feed is lower than for the large ones. The N content in the feed for the growing-finishing farms as well as the P and N contents in the feed for the sow farms are equal for the small and large farms. Only for the large sow farm slurry treatment (sedimentation) is economically attractive. The percentage of total slurry produced which is ▶

applied to the farm's own land is considerably larger for the small farms. None of the farms has to pay a levy.

In determining the optimal measures, pig farmers have to consider the extra costs of such a measure and the reduction in slurry disposal costs (including a Minas levy) caused by this measure. For example a lower P content in feed implies higher feeding costs. A lower P content leads to a lower P loss and, with the same volume of slurry produced per pig, a lower phosphate content in the slurry. A lower phosphate content in the slurry implies that more manure can be applied to the farm's own land, thus reducing the amount of slurry which has to be sold to a distributor or to an arable farmer. The costs per cubic metre of slurry when selling to a distributor or an arable farmer are higher than the application costs for application to the farm's own land. Thus every cubic metre of slurry which can be applied to the farm's own land instead of being sold to a distributor or an arable farmer reduces total slurry disposal costs. The extra feeding costs are compensated for by the lower slurry disposal costs. The optimal P content in the feed is reached when the sum of the feeding costs and slurry disposal costs (including levies) is minimal. A similar argumentation holds for the N content in the feed, the feeding strategy, slurry treatment or combinations of these.

Model calculations show that the phosphate standard in Minas is more restrictive than the nitrogen standard. For most situations the optimal N content in feed is the maximum defined in the model. For many situations the optimal P content in feed is lower than the maximum defined in the model. Pig farmers will have to adjust particularly the P content in feed.

Optimal P content in the feed in relation to the amount of farm's own land

Lowering the P content in the feed is economically not attractive if a pig farm does not possess land and the slurry price per cubic metre is fixed. A lower P content will only lead to higher feeding costs and not to lower slurry disposal costs (the same amount of slurry has to be sold). If part of the slurry produced by the pig farm can be applied to

Table 1: Optimal value of the decision variables for the examples with favourable performance

	growing-finishing pigs		sows	
	400	2,500	100	400
P content in the ration (g/kg)	4.92	5.12	5.08	5.09
N content in the ration (g/kg)	27.36	27.36	27.00	27.04
slurry treatment	no	no	no	sedimentation
slurry production				
- slurry (m^3)	440	2,580	451	
- thick fraction (m^3)				527
- thin fraction (m^3)				1,324
application/removal				
- slurry own land (%)	76.0	12.7	100.0	
distributor (%)	24.0	87.3	0.0	
- thick fraction own land (%)	-			23.8
distributor (%)	-			76.2
- thin fraction own land (%)	-			100.0
distributor (%)	-			0.0
phosphate and nitrogen levy (Dfl/year)	0	0	0	0

its own land and part has to be sold, the optimal P content in the feed is lower. The lower P content in the feed leads to a lower phosphate content in the slurry. Thus, more slurry can be applied to the farm's own land and less slurry has to be sold. This reduces total slurry disposal costs. The reduction of slurry costs is higher if a farm owns more land and so the farmer has a bigger financial incentive to take measures. More land of one's own leads to a lower optimal P content in the feed. This continues until the total phosphate production in the slurry is equal to the total application space for phosphate on the farm's own land and the lowest optimal P content in the feed is reached. For the example with 400 growing-finishing pigs the lowest optimal P content of the feed is reached at 17 to 19 hectares of grass depending on the performance. The optimal P content is higher for a different amount of farm's own land. Farms with 100 sows reach the lowest optimal P content at 8 to 12 hectares grassland of its own. If a farm possesses more land, the optimal P content in the feed is higher. At this optimal P content, the total production of phosphate in the slurry is equal to the application space. The more animals a farm has, the more land of its own is needed to reach the lowest optimal P content in the feed.
If not considering revenues from its own land, the optimal labour income is higher if a farm owns more land.
Tightened standards for mineral losses decrease the application space for phosphate on farm's own land and could lead to a higher optimal P content in the feed. The farm must possess less land than the amount at which the lowest optimal P content is reached.

Optimal P content in the feed in relation to the slurry price

A higher slurry price (at a distributor or an arable farmer) leads to a lower optimal P content in the feed. Because the difference between the costs per cubic metre with application on farm's own land and the costs when selling to a distributor or arable farmer is larger, savings per cubic metre are larger. Thus the financial incentive to reduce the P content increases and the optimal P content is lower. An increased slurry price leads to a decreased optimal labour income.

Optimal P content in the feed in relation to water consumption

Water consumption has little influence on the optimal P content in the feed. Due to increased water costs and slurry disposal costs (larger slurry volume) the optimal labour income is lower with a higher water consumption.

Slurry quality approach

Slurry quality within MINERALFLOW is determined by the ratio between P, effective N, potassium (K) and organic matter in the slurry on the one hand and the ratio between these elements as is needed according to fertilizing advice[1] on the other. Slurry price is higher if the difference between the ratio in the slurry and the ratio needed is larger. The optimal P content in the feed is lower when slurry is sold at the price determined by this quality approach. For most crops pig slurry, if slurry quality is not considered, contains relatively much phosphate. A lower P content in the feed improves the ratio in the slurry between phosphate and the other elements. This lowers the slurry price.
Application in autumn instead of in spring leads to an increased slurry price and a lower optimal P content in the feed. Due to the lower N effectiveness with application in autumn, the ratio between effective N and P is lower and does not reach the ratio needed. Thus the slurry price is higher. A higher slurry price leads to a higher financial incentive to take measures. As shown before this leads to a lower optimal P content in the ▶

[1] In MINERALFLOW slurry quality concerning phosphate and nitrogen is determined using crop uptake and standards for mineral losses if the standards for mineral losses apply to arable farmers.

feed when applied in autumn.
The type of pig house has little influence on the optimal P content of the feed and the slurry price. A traditional pig house leads in some cases to a higher slurry price and a lower optimal P content in the feed compared to a Green Label pig house. Due to higher ammonia emission from a traditional pig house, less nitrogen remains in the slurry. The ratio between effective N and P is lower for a traditional pig house and the slurry price is higher. As shown before this leads to a lower optimal P content in the feed for slurry for a traditional pig house.
Tightened regulations in Minas lead to a higher estimate of slurry price. In MINERALFLOW the slurry price for 1998 is estimated at Dfl 15.- to Dfl 20.- per cubic metre and the slurry price for 2008 at Dfl 25.- to Dfl 30.- per cubic metre. Sampling costs are not included. The slurry price for application to crops with a fixed mineral uptake per hectare is estimated to be lower than the price for application to crops with the real mineral uptake.

When is slurty treatment economically attractive?

Slurry treatment is economically more attractive with a higher slurry price or lower slurry treatment costs. How much can be saved differs between slurry treatment systems because of different separation results. With MINERALFLOW the maximally allowable slurry treatment costs (excluding disposal costs) for the slurry treatment systems have been determined (table 2). If the real treatment costs are higher than these values, slurry treatment is economically not attractive. The slurry price is assumed to be fixed at Dfl 30.-, Dfl 25.- and Dfl 20.- for the thin fraction, the slurry and the thick fraction respectively. The farm owns the amount of land the whole thin fraction can be applied to without a levy.

The real treatment costs for sedimentation of sow slurry for example are estimated at Dfl 2.- per cubic metre (table 2). The maxi-

Table 2: Maximally allowable and estimated real slurry treatment costs for pig slurry at a slurry price of Dfl 25.- per cubic metre (Dfl/m³)

	maximal costs		estimated real costs	maximal costs		estimated real costs
system	100 sows	400 sows	for sow slurry	400 growing-finishing pigs	2.500 growing-finishing pigs	for growing-finishing pig slurry
sedimentation with pe[1]	3	8	2	-[2]	-[2]	
screen,, augur, belt press	-[3]	-[3]	5, 5, [4]	-[3]	-[3]	2, [3], 7
centrifuge, belt press with pe[1]	2	7	11, 14	0	6	6, 8
evaporation	18	18	51	14	14	32
composting	6	12	5	-[3]	0	5
microfiltration	3	9	31	1	8	15
reverse osmosis	14	14	27	3	8	17
flushing with aerated slurry	7	12	31	1	6	24
granules[5]	37	32	24	-[2]	-[2]	

[1] poly-elektrolyte
[2] not (yet) applicable in practice on farm level
[3] a dash means that even at Dfl 0.- treatment costs slurry treatment is not attractive
[4] for the screen, augur and belt press respectively
[5] selling price of the granules is set at Dfl 45.- per cubic metre

mally allowable costs for sedimentation of sow slurry for the farm with 100 sows was calculated to be Dfl 3.- and for 400 sows Dfl 8.-. Sedimentation is attractive to both farms. Considering the maximally allowable and real treatment costs, most slurry treatment systems are too expensive in practice. Exceptions are sedimentation, composting and producing granules for sow farms and centrifuging for the large growing-finishing farms. On average, slurry treatment is less attractive for growing-finishing pig slurry than for sow slurry.

Table 2 also shows that the maximally allowable costs are higher for large farms than for small farms. Other calculations show that performance also influences the perspective of slurry treatment. In general, the perspective is better when the amount of slurry produced is larger.

Furthermore, the allowable costs of treatment systems creating a water-like thin fraction (evaporation, microfiltration, reverse osmosis, flushing) are higher than those of simple (mostly mechanical) separators.

It should be noted that the maximally allowable treatment costs are lower at a lower slurry price than Dfl 25.-.

The perspective of slurry treatment is also determined by the slurry price. At the slurry treatment costs estimated, slurry treatment is attractive at a slurry price of Dfl 30.- and Dfl 40.- or higher for the large sow farms and growing-finishing farms respectively. For the small sow farms and growing-finishing farms this is at a slurry price of Dfl 40.- and Dfl 60.- respectively. Exceptions are sedimentation for sow farms, attractive at a slurry price of Dfl 12.- for large farms and Dfl 20.- for small farms, and the centrifuge for growing-finishing farms, attractive at a slurry price of Dfl 15.- for large farms and Dfl 30.- for small farms.

In general, slurry treatment systems with a low separation result are barely attractive. For those systems most of the phosphate and/or nitrogen ends up in the thin fraction. A large amount of land of its own is needed to apply this fraction to without a levy. With a large amount of land reducing the mineral content in the feed is economically more attractive than slurry treatment. With this lower mineral content, application of all the slurry on the farm's own land without a levy is possible. ■ -

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TECHNICAL AND ECONOMIC PERFORMANCE OF GROWING-FINISHING PIG FARMS IN 1997

ing. L. M.C.J. Kuunders, ir. F. Mandersloot, ing. J. Lubben[1]

After removing the finishing farms with direct consequences of the classica1 swine fever outbreak in 1997, 509 growing-finishing farms remained in the Siva-file of 1997. Gross margin per average pig present was Dfl 210.-, for a farm with 716 growing-finishing pigs, on average, which was Dfl 69.- more than expected on the basis of the 6-year average. In 1996, average gross margin was Dfl 161.- per average pig present. Of farms with direct consequences of the classica1 swine fever outbreak, gross margin was not calculated, but surely most of these farms have had a bad year in 1997 financially.

Depending on farm size, gross margin varied from Dfl 187.- to Dfl 237.- per average pig present for the smallest farms (fewer than 336 pigs on average) and the largest farms (more than 936) respectively.
The historically high gross margin of 1997 is based on the following economic and technical performances:

- In 1'997, the average price of pork was Dfl 3.50 per kg of slaughterweight. The smallest farms received Dfl 3.44 per kg of slaughterweight; the largest Dfl 3.54. In 1996, the average price of pork was Dfl 3.34.
- Weight gain per pig per day remained the same as in 1996, ie, 737 grams per day. Also between large and small farms there was little variation. To realise this unchanged weight gain the pigs needed 10 grams of feed less which means an improvement in feed conversion of 0.01 kg of feed per kg of weight gain compared with 1996. The smallest, average and largest farms realised a feed conversion of 2.84, 2.79 and 2.69 respectively. Mortality rate was 2.4%, 2.4%, and 2.2% for the above farms respectively in 1997. On average, mortality remained the same as in 1996.
- In contrast to the high prices of pork, piglet prices decreased a bit. The average piglet price was Dfl 116.36 in 1997 and was Dfl 2.- lower than in 1996. The adjusted piglet price was Dfl 111.71. In 1997, the smallest farms paid Dfl 0.32 less per pig, whereas the larger farms paid Dfl 1.50 more per pig.

Differences between regions are shown in the parameters farm size, weight gain per day, feed conversion, mortality rate, piglet price and feed prices. However, the effect of the region is linked to farm size, which makes comparison between regions inaccurate. Also the relative small number of participants in the south of the country due to the consequences of the swine fever outbreak would result in an inaccurate comparison.
In 1997, farms feeding by-products realised a higher gross margin than farms only feeding concentrates due to better growth, feed intake and lower feed prices.

For the farms without direct consequences of the classical swine fever outbreak, 1997 was a good year financially. Technical performance was slightly better than in 1996. Particularly, the high prices of pork and the slightly lower piglet prices compared with 1996 resulted in a historically high gross margin of Dfl 210.-. ■

Report Pl.225

[1] Siva-software B.V., Wageningen

TECHNICAL AND ECONOMIC PERFORMANCE OF SOW FARMS IN 1997

ing. L.M.C.J. Kuunders, ir.F. Mandersloot, ing. J. Lubben[1]

In 1997, the results of the farms with direct consequences of the classical swine fever outbreak were not included in the file of Siva-Software B.V.. So, the results only give a picture of farms without or with fewer direct effects of the swine fever outbreak. In 1997, for these sow farms, average gross margin per sow per year was Dfl 1,088.-. This was about Dfl 290.- per sow per year more than was expected on the basis of the six-year average calculated. Depending on farm size, gross margin ranged from Dfl 980.- per sow per year for the smallest farms (fewer than 110 sows averagely present) to Dfl 1,168.- per sow per year on the largest (more than 237 sows averagely present). In 1996, average gross margin was Dfl 1,222.- per sow per year. Gross margins mentioned above are based on the following technical and economic performance parameters:

- In 1997, the prices of piglets of 23 kg were Dfl 107.-. This is nearly Dfl 5.- lower than in 1996. In 1997, the smallest farms realised a price of Dfl 104.- per piglet. The largest farms realised an average corrected piglet price of Dfl 1 10.- per piglet.
- The number of weaned piglets per sow per year in 1997 was 21.5. This number ranged from 21 .0 to 21.9 piglets per sow per year for the smallest and largest farms respectively. In 1996, the average number of weaned piglets per sow per year was the same as in 1997.
- In 1997, prices of sow feed and piglet feed were almost the same as in 1996 (Dfl 41.91/100 kg and Dfl 62.28/100 kg respectively). The smallest farms paid Df10.34 per 100 kg more for sow feed and for piglet feed Dfl 1.09 per 100 kg. The largest farms paid Dfl 0.13 per 100 kg less for sow feed and for piglet feed Dfl 0.30 per 100 kg.
- In 1997, the costs of heating were Dfl 58.- per sow per year and compared with 1996 had decreased by Dfl 8.- per sow per year. On the smallest farms, the costs of heating were higher than on the largest farms, Dfl 60.- and Dfl 56.- per sow per year respectively. In contrast to the other costs, the costs of health care were Dfl 6.- lower on the smallest farms than on the largest farms, where these costs were Dfl 88.- in 1997.

In 1997, differences in sow farming between the north and south of our country were great, due to the classical swine fever outbreak mainly in the south. There were also the normal differences in performance parameters, such as feed prices, piglet prices, costs of herdbook and artificial insemination. In 1997, the difference in the piglet production per sow per year was 0.5 pig and 0.3 in grown piglets per sow per year, both in favour of the north. In 1997, feed intake for sows in the north was 38 kg higher. The effect of these technical parameters and the normal price differences on gross margin was Dfl 157.- in favour of the north.

All in all, 1997 was an above-average pig year, at least for the farms without a clear effect of the swine fever outbreak. Technical performance was the same or a little less than in 1996, the same holds for the economic results. This resulted in a little less gross margin than in 1996, but gross margin of Dfl 1,088.- is still much higher than average. There were striking contrasts between the results of farms without or with fewer direct effects of the swine fever outbreak, and ▶

[1] Siva-software B.V., Wageningen

farms with direct consequences. Farms without direct effects of the swine fever outbreak had a good year financially, while particularly the farms that had not any pigs temporarily had a bad year, as far as finances are concerned. ■

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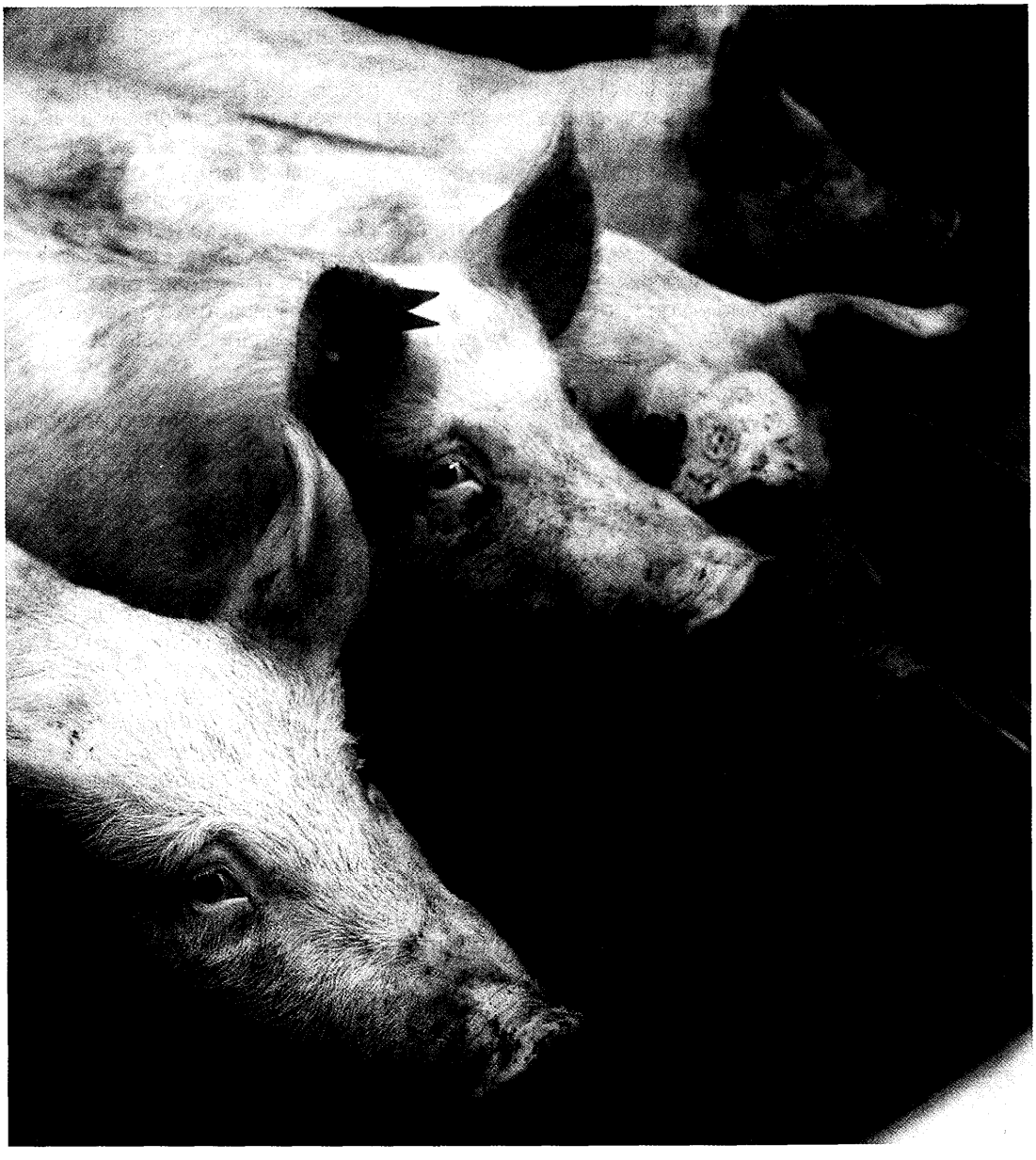
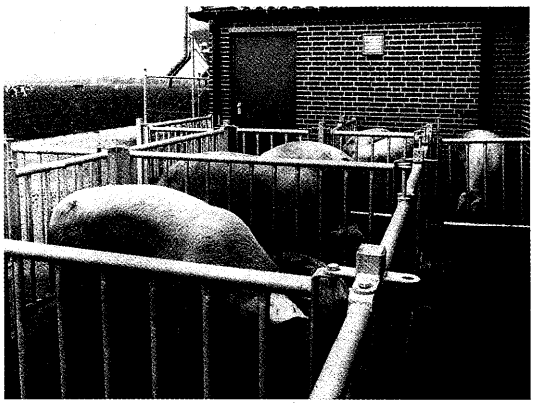


THE VALUE OF A SOW REPLACEMENT INDEX FOR THE CULLING STRATEGY

drs. ing. H.J. t? M. Vos, ir. E. R. ter Elst- Wahle, dr. P.C. Vesseur

In 1993 the Research Institute for Pig Husbandry developed the Sow Replacement Index. This Sow Replacement Index is based on CHESS-RO (Computerized Herd Evaluation System for Sows, Replacement Optimization), developed by the Farm Management Group of the department of Economics and Management of the Wageningen Agricultural University (Huirne, 1990). Based on the expected long-term prices of, for instance, feed and meat, the average performance data of the farm and individual production characteristics of the sow, the Sow Replacement Index can be calculated. If the value is less than zero, a replacement gilt is expected to return a higher yield.
The Sow Replacement Index consists of two parts. First an index is calculated, using Dynamic Programming, the so called DP-index. Market prices and average farm performance data are used to compile a table with index values. For almost every possible combination of five sow production characteristics, a computed DP-index figure is present in the table. Based on (1) parity, (2) the weaning-to-first-service interval in the last or previous production cycle, (3) the number of returns to service in the current production cycle and (4 + 5) the number of live born piglets in the last and last but one farrowing, for each sow to be judged, a DP-index figure can be found in the table. Other sow characteristics like mothering characteristics, mammary quality and uniformity of the litter are used to compute the ES-index. The ES-index is an index based on expert knowlege, hence the name Expert System (ES) Index.



The Sow Replacement Index is computed as:
Sow Replacement Index = DP-index + ES-index.
In this study, the Sow Replacement Index is tested for its value for the future culling strategy at pig farms. It has been concluded that the Sow Replacement Index is a useful tool. The ES-index has only a small impact on culling decisions. ■

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TASKTIMES IN PIG HUSBANDRY

ing. P.F.M. M. Roelofs, ing. M.G.A. M. van Asseldonk, ing. M. van der Schilden'

Since 1987 the Research Institute for Pig Husbandry has measured working times in several studies. The measurements were taken in time and motion studies and derived from farmers registration of working time. From these data task times (standard working times) have been calculated, which are presented in this report.

Task times indicate how much time is needed for a particular activity according to a specified method and under given conditions. The work was done by experienced people, working at a normal speed. Time for resting and personal care, additional activities and interruptions was included.

The task times which are presented are based on registration of working time, time and motion studies and the literature. They can be used to calculate working time needed for certain activities on pig farms.

Moreover, labour estimates can make the effects of changes in the organsation of the farm on total labour requirements visible. For estimating labour requirements, task times have to be multiplied by large numbers of animals and frequencies. That is why task times are mostly calculated to two decimal places.

This research report also describes the procedure for calculating on-farm labour requirements. Since the variation in labour requirements among farms is wide and measurements were done at a relatively small number of farms, the task times must not be used for judging the effectivity of labour on individual farms. They give an indication of total labour requirements and can be used to calculate the effects of changes in farm equipment on labour requirements. ■

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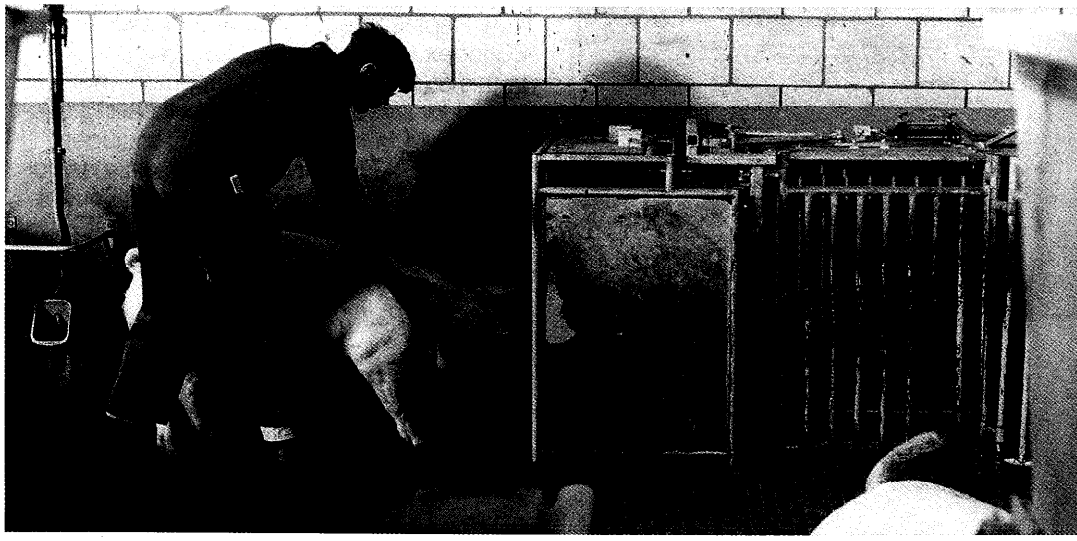

Source: EBI/Boerderij

[1] IMAG Research Institute

MANGE ERADICATION ON PIG FARMS

dr.P.C. Vesseur (Ed.), ir. M.H. Bokma-Bakker, drs. P.G. M. Rambags[1], dr. W.A. Hunneman[1], H.M. J.F. van der Heijden[1], ir. T. Smeding[2], drs. E. Pieke[3], ing. G.P. Binnendijk

The project "Eradication of Mange on pig farms" was financed by "Diergezondheid in Beweging" (a cooperation between the Ministry of Agriculture, Nature Management and Fisheries and the Product Boards for Livestock, Meat and Eggs). This mange eradication programme should be feasible for Dutch pig farms and offer possibilities of maintaining the mange-freestatus obtained. The study focussed on the following questions:

1 Is it possible to develop an ELISA (Enzyme Linked Immuno Sorbens Assay) to detect antibodies against mange (*Sarcoptes scabieivar. suis)* in the blood which is suitable for routine laboratory use?
2 Is it possible to eradicate mange completely on mange-infested pig farms, by giving all pigs present on the farm two ivermectine injections with a fourteen-day interval, but whitout treatment of the housing and environment of the pigs?
3 Is it possible to keep mange-free farms free of the disease for at least one year by only hygiene measures?
4 What is the economic effect of mange eradication on a pig farm?

ELISA development

Because the existing methods to diagnose mange on pig farms are expensive and insensitive, the possibilities of developing an ELISA were investigated. To make a test suitable for general use, it had to be developed and validated. To determine the value and potential for practica1 use, three questions applied:

a What is the sensitivity of the ELISA?
b Do sows still show a positive reaction one or more years after successful eradication?
c How long is it possible to measure maternal immunity in piglets?

With the ELISA as developed within this project, it was possible to classify farms accurately according to their mange status. With using 50% OD (optical density) as cut-off value and 10 blood samples per farm, the specificity and sensitivity of the test are good enough to classify farms as mange-free or mange-infested.

The level of antibodies against the mange mite decreased rapidly after mange was eradicated and within one year sows were negative in the ELISA. Before eradication, 28% of the sows showed a positive reaction and 12 months after eradication no sow was classified as positive. This means that after one year, sows as well as pigs born after eradication that have lost their maternal immunity, can be sampled to check the mange status.

The maternal immunity against mange in piglets decreased to a level which was low enough for not causing false-positive test results within 5 to 6 weeks. Until one year after eradication, only pigs older than at least 6 weeks should be sampled to prevent false-positive test results.

For routine use of the ELISA developed it is important to have sufficient antigens of the mange mite of the pig *(Sarcoptes scabiei* var. *suis).* It is not possible to cultivate this mite *in vitro* and the number of naturally infested pigs will be reduced as a consequen- ▶

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ce of the eradication programme in the near future. Antigen for the production of ELISA kits has to be produced under controlled circumstances, using live pigs. In the future the production of antigen using recombination DNA techniques may become an alternative. To this end, research should be started.

Eradication method

The theoretically most simple but still effective way to eradicate mange on a pig farm, based on the literature available, was formulated and subsequently tested on 5 farms infested with mange (live mange mites detected in one or more pigs). Twice, on day 0 and 14 days later, all pigs present on the farm were treated with ivermectine per injection. Additionally, piglets born after the first treatment on day 0 up to day 7 were treated on day 7. The environment of the animals was not treated with acaricide products.
Prior to the treatments and during 12 months after the eradication, the mange status of the farms was checked on the basis of clinical signs, results of a microscopic check of ear scrapings (direct method on live mites and after floatation on live and dead mites) and scratching indices. After the ELISA was developed and validated, blood samples collected before eradication and 12 months after eradication were analysed. A summary of the results is presented in table 1.

Mange mites in ear scrapings
Before eradication live mites were found on each of the five pärticipating farms. After eradication no live mange mites were detected on the farms. However, using the floatation method on one of the farms, mange mites were found 3 and 6 months after eradication in two different sows. It is not possible to differentiate between live and dead mites when using the floatation method, since this kills all mites. Samples taken within a month from the same and contact sows were all negative. Based on the absence of clinical signs, the SI's and the results of the ELISA, mange mites are not likely to be still present on the farm. An explanation for these results is that there was still some material of dead mites present in the ears at the moment of sampling. The literature supports this theory.
Using the floatation method, mites were detected in ear scrapings of two finishing pigs on one of the farms, whereas samples taken from the same and contact animals within one month were negative as to mange mites. In the literature it is indicated that if a

Table 1: Summary of results of ear scrapings (% positive, live and/or dead mites), scratching index (SI) and ELISA results: relative OD-values (%OD) and % positive pigs (OD > 50%)

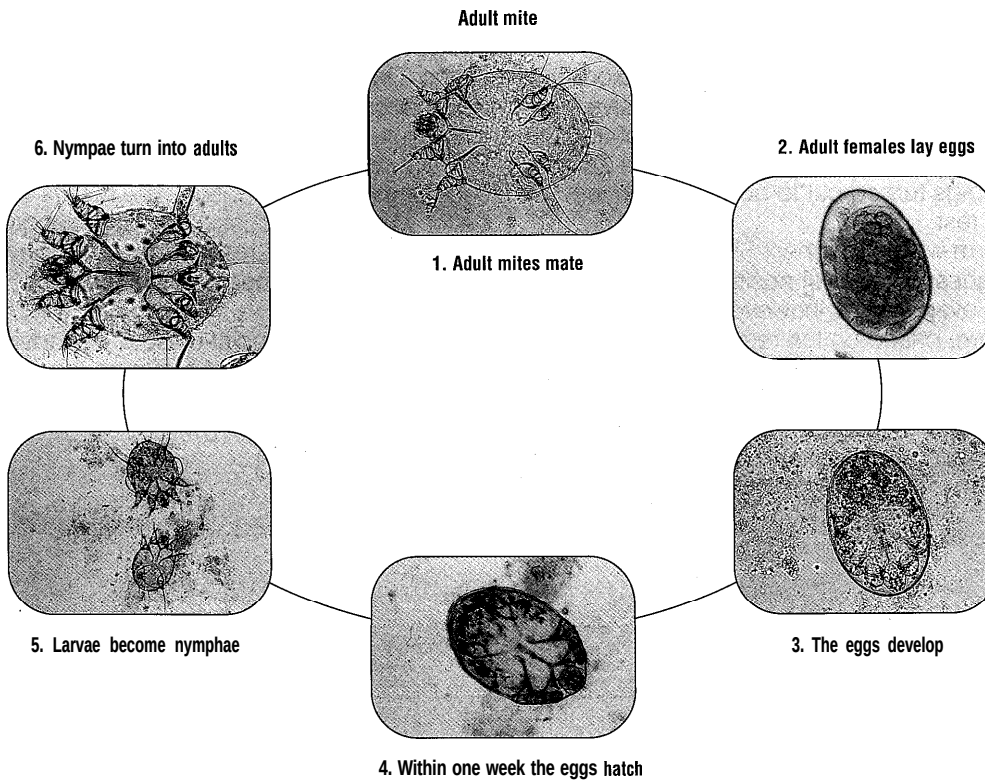
	before eradication				after eradication			
	ear scr. % pos.	SI average	OD %	ELISA % pos.	ear scr.[1] % pos.	SI' average	OD[2] %	ELISA2 % pos.
sows								
average	9.3	0.80	37	28	0.3	0.13	7	0
sd	12.0	0.38	29	29	0.4	0.05	3	0
Finishing pigs								
average	23	0.46	39	32	0.2	0.04	7	0
sd	28	0.55	25	29	0.4	0.03	3	0

[1] the % positive ear scrapings and average SI are given as an average of the values found during the 12-month period after eradication
[2] the average relative OD (%OD) and the % sows positive in the ELISA (cut-off value: OD 50%) are the results found 12 months after eradication

small or not detected mange infestation in finishing pigs is not treated, this will result in a high prevalence of mange mites at slaughter. In view of the clinical signs, the SI's, the results in the ELISA and the results of ear scrapings taken later on, these pigs were not likely to be infested with mange and hence showed a false-positive reaction. Since no good explanation could be found for the mites, unless other mites are held for *Sarcoptes* scabieivar. *suis,* it is advisable to train laboratory personnel to be attentive to other mites, like *Acarus siro* (meal mite), for these mites may be held for mange mites.

Scratching indices

The scratching indices (SI) before eradication were significantly higher than those found after eradication (0.63 and 0.08 respectively; $P < 0.01$). The SI's in this trial were very low, compared to values found on mange-infested farms described in the literature. On only one farm, a farm with severe mange problems and heavity infested pigs, SI's of around 1.5 (according to the literature: when the SI is above 1.5 it is likely that mange is present the farm) were found (in sows the SI was 1.44 and in finishing pigs 1.54). This may be a result of the definition of "scratching incident" used. In this research a maximum of 10 seconds of continuous scratching was applied, after which a new incident was counted. If a scratching incident is defined as a movement to scratch, the SI's will be much higher. In the literature exact definitions could not be found. Much variation in SI's between farms was found: before eradication the SI of sows varied between 0.33 and- 1.44 and of finishing pigs between 0.07 and 1.54. These results show that only SI is not suitable to determine the mange status of a farm and ▶



The live cycle of the mange mite (*Sarcoptes scabiei* var. *suis)*

that the SI has to be interpreted with great care. Before eradication SI's of sows were higher compared with those found in finishing pigs (0.80 and 0.46 respectively). The percentage of positive ear scrapings before eradication, however, was higher in finishing pigs. Both effects may be caused by a higher immunity in sows, compared with finishing pigs.

ELISA

Before eradication 30% of the blood samples was positive as to mange (cut-off value of the relative optical density (%OD): 50). After eradication the average relative OD was much lower and no pigs were found positive. The results found with the ELISA lead to the conclusion that 12 months after eradication, all farms within the programme were still mange-free.

General conclusions

The chance of detecting mange mites in ear scrapings is not high. On one of the farms no sows were positive in ear scrapings, whereas in the ELISA test 6% of the blood samples of the same sows were positive. On another farm, the ear scrapings of the finishing pigs were negative, whereas 28% of the pigs turned out to be positive in the ELISA test.

The farm with the highest SI's also showed the highest number of positive ear scrapings. Several farms, however, had low SI's, but were, based on the results of the ear scrapings, diagnosed as infested.

It can be concluded, therefore, that even a combination of clinical inspection, SI's and ear scrapings are not enough to classify farms as mange-free. When these parameters are used after a mange eradication programme was run, in combination with a statement that no acaricide products had been used since the eradication programme, they will give a good indication whether the eradication has been successful or not. In the future, the ELISA will be the best method for checking the mange status after eradication has taken place.

Economic effect

Using the partial budgeting method, the economic effects at farm level were evaluated. The costs of mange eradication, following the protocol as described in this trial, were calculated. Labour showed to be an important part. The effect of a mange-free status on the production results was calculated according to the estimated effects on the production figures. The effects on production figures were based on the literature and estimated for three levels; a moderate, a high and a low effect of the mange-free status. On mange-free farms the routine treatment against mange was stopped and this resulted in lower costs to the farm.

The simulations resulted in positive results in case of mange eradication. The results were better when it was possible to buy mange-free gilts, which is a result of the reduction in costs due to not needing a quarantine house.

From an economic point of view, it is advisable for all farms to start the mange eradication programme. ■

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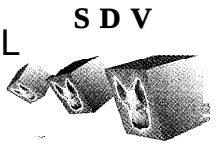
AIMS, STRUCTURE AND PHASING OF THE ANIMAL SAFETY INDEX



ir. M.H. Bokma-Bakker, dr. P.C. Vesseur

By order of the 'Stichting Dierveiligheid Varkens (SDV)" (Organisation of Promoting Animal Safety for Dutch Pigs), the Research Institute for Pig Husbandry has described the aims of the Animal Safety Index (ASI) for each ASI-level. The ASI prototype 05.98, a result of the work of several working groups directed by the SDV, was worked out further. The aim of the Safety Index is to faster reduce the risks of introduction and spread of infectious diseases on and between pig farms and to increase the level of animal welfare. Early adapters (top-25% of the farms) should be stimulated by the ASI to develop (faster) towards higher levels of animal health and animal welfare, by which, eventually, higher levels of animal health and animal welfare can be realised sector-wide.

Relation between Animal Safety Index and other developments

The SDV expressly tries to gear to other developments in the field of certification. In April 1998 LTO-the Netherlands and the SDV agreed upon the position of the latter. The SDV will be a Research & Development group within the project "Column certification", an initiative of the organised Dutch pig farmers (LTO) in which certification of the pig farm is an important aspect. The Animal Safety Index will be the "animal health and welfare module" of the certification system for the pig farm. Besides that there is co-operation with developers of "Extended Green Label" (Ministry of Agriculture, Nature Management and Fisheries/CLM and others), the "Quality Index" (Product Boards for Lifestock, Meat and Eggs) and other initiatives working on certification of pig farms.

Conditions for sector-wide implementation

Several conditions which must be fulfilled for sector-wide implementation of the Animal Safety Index are described. First condition is that the sector accepts the Animal Safety Index as a general basis for a phased improvement in animal health and animal welfare on pig farms. The Ministery of Agriculture, Nature Managament and Fisheries has stated that differentiation in the levies for animal health costs (stamping out costs) in the future can be based upon the Animal Safety Index. As to animal welfare policy, instruments such as subsidies should be available to stimulate early adapters to invest in higher ASI-levels.

Structure and content

The Animal Safety Index consists of four ASI-levels increasing in importance. Three areas for special attention have been distinguished.

Contact structure

The aim of this is to realise a contact structure on pig farms which will decrease the risks of introduction and spread of infectious diseases to a minimum. Existing legislation on this matter is the point of departure. There are additional requirements as to:

- isolation of the farm
- access of visitors
- supply and removal of animals
- delivery and removal of feed
- delivery and removal of materials
- manure transport
- transport of dead animals
- vermin control and eradication

Several developments wanted, such as short distances for transport, farms breeding their own replacement stock or piglets for fattening and closer co-operation between farms cannot be required directly. To stimulate such developments a scoring system has been introduced. For a certain ASI-level, a minimal number of points is required. ▶

On-farm animal health care

The aim of this is to improve health status and health management on the farm, including farm support, and to bring down the amounts of medication and feed additives used on the farm to a responsible level. Participation in the Dutch Integrated Quality Control-system forms the basis. Additional requirements concern:

- health management and its systematic approach;
- certification of services;
- eradication of several infectious diseases (including the corresponding ASI-targets);

Scheme 1: Feasibility scheme

ASI-level and aims summarised	% farms that can comply			
	at start ASI	in 5 years	in 10 years	in 15 years
ASI-1 (basic level): *Comply with exis ting legisla tion including periods of transition + Integrated Quality Control; systematic approach to health care; certified services; free of Aujeszky's disease.*	80%	100%	-	
ASI-2: *Remove the greatest veterinary risks (contact structure);* separation of "clean and non-clean *routes"; stimulate structures desired, co-operation and logistics (scoring system); antibiotic-free feed for sows and fattening pigs; responsible use of medication; disease-free status for several diseases; quicker realisation of requirements in the Pig Regulation 1998 except group housing, improving environment; certain level of health and welfare parameters on the farm.*	25%	80%	100%	
ASI-3: *Further stimulation of structures desired, such as farms breeding their own fattening pigs (scoring system), decreasing frequency of contacts, production of medicine-poor and additive-free pigs, disease-free status for several diseases, quicker implemention of group housing sows (Pigs Regulation 1998), farm systems with higher welfare levels and possibly quicker introduction of housing systems tested in advance.*	10%	*50%*	*80%*	*100%*
ASI-4: *The farm of the future: new developments in animal health/welfare; production systems in balance with market demands, public health, animal health, animal welfare and perception of the society*			25%	*80%*

- a responsible use of medication and feed additives.

Animal welfare

With regard to animal welfare, the Animal Safety Index has the following aims: a) quicker decrease in harmfull effects in animal welfare within the existing housing systems and b) to stimulate the development of housing systems, or parts of it, that contributes to an improved adaptation ability of the animals and perception of the society. The existing legislation forms the basis (in particularly the Regulation on Pig Housing and Care 1998). The Animal Safety Index intends to increase the rapidity of implementation of items in legislation for the higher levels. Besides that there are additional requirements in the fields of housing (improving the quality of the environment of the animals) and care (water and feed intake, climate, group housing et cetera). For this, also a scoring system is used. Besides definite rules, there is an immediate assessment of animal welfare by several health and welfare parameters which can be measured on the farm. This scoring system was introduced to guarantee a correct use of the housing system and to assure that the system leads to the animal welfare level desired.

It is possible to obtain separate certificates for Contact structure, Internal Health Care and Animal Welfare, to stimulate a phased development to higher ASI-levels.

Indication of the feasibility track

In combination with the available stimuli for the pig farmer to realise a certain level, the different ASI levels should be organised in such a way that roughly the feasibility scheme (scheme 1) can be realised.

Continuation

Following this report the checklists with requirements for each ASI-level have been developed further. Recently they were tested in a pre-pilot study with twelve farms (October-December 1998). From this pilot study we will get a good impression of which requirements belong to which ASI-level and which phasing will possibly be necessary. In 1999 an adjusted Animal Safety Index will be tested on approximately 150 farms. ■

Report PI.222

FREE-RANGE PIGS WITH DIFFERENT HUSBANDRY SYSTEMS, PEN DESIGNS AND GROUP SIZES

ing. J.H. Huiskes, ing. P.F.M. M. Roelofs, ing. H. Altena, ing. J. G. Plagge, ir. R. H. J. Scholten

Research has indicated that there is a need for pork produced in an animal-friendly and environmentally-friendly way. In 1987 so-called "free-range" pig husbandry was started on the initiative of participants of the pork production chain and social organizations. Basically, free-range pork production is directed at a market segment where extra attention is paid to an animal-friendly way of housing and managing of pigs. Farms that want to participate in this market segment have to comply with requirements concerning, for instance, space per animal, use of litter, outdoor possibility and use of medicines. The main bottlenecks here are profitability (technical results and costs of production), labour conditions and feasibility of requirements/desires as to husbandry and environment.

To investigate the effect of management measures on technical results, working hours and conditions and hygiene of the pens, research has been done on free-range pigs at the Experimental Farm for Pig Husbandry at Raalte.

Stage I was aimed at comparing free-range pigs and regular growing-finishing pigs with and without straw litter. In this stage three husbandry systems were compared. These systems were: a) growing-finishing pigs kept according to free-range standards for housing, litter and feed in so-called Danish pens with outdoor space (free-range pigs), b) growing-finishing pigs kept inside in Danish pens similar to group a with litter and feed according to free-range standards (regular pigs with

litter); and c) growing-finishing pigs kept inside in traditional pens with partially slatted floors, without litter and fed with a usual commercial feed compound with the same nutritional components compound as feed for free-range pigs (regular pigs without litter).
Stage II of the research focused on free-range pigs only. Three pen designs and three group sizes were compared, where technical results were important aspects. As to group sizes (8, 16 and 24 pigs per pen) attention was paid to the use of the pens by the pigs.
It was supposed that with larger groups or in pens (with the same amount of space per pig) a better use of the lying-down and defecating areas would be made. This could result in more hygiene and decreased working hours and amount of straw.

Growing-finishing pigs kept according to free-range standards in Danish pens with outdoor space showed a similar growth (757 and 769 grams), feed intake (2.32 and 2.35 kg per day) and feed conversion (3.07 and 3.05 kg of feed per kg of weight gain) as pigs with the same housing, feeding and care but without outdoor space. Also the meat percentage and fat layer of the pigs with outdoor space were not significantly different from pigs without outdoor space (52.0% and 51.3% and 18.9 and 19.7 mm respectively).
Pigs kept in traditional pens with usual feed and care showed a similar growth (773 grams) with a lower feed intake (2.19 kg per day) and a lower feed conversion (2.84) compared with both other systems.
Pigs kept on straw and fed concentrates ad libitum showed hardly any interest in roughage.
Using similar indoor pens and straw litter, the possibility of going outdoors had a positive effect on health of the pigs: fewer medical treatments (12.5% and 26.7%), especially for leg problems (10.8% and 22.5%).
However, compared with conventional pens without straw (16.7% and 9.2% respectively) such effects have not been found. Hygiene of the pen floors may play a role in this.
The use of cut straw as litter resulted in a higher concentration of dust than uncut straw. The average 24-hour concentration of inhalational dust was 4.6 mg/m^3 for cut straw and 3.1 mg/m^3 for uncut straw. The concentrations of respirable dust were 0.5 and 0.3 mg/m^3 respectively.
To reduce health risks for pig farmers and farm hands, the use of good dust masks/ caps is recommended.
The extra amount of labour required for mucking out, giving straw and roughage and periodically cleaning of the Danish pens with outdoor space was 1.4 hour per pig place per year compared with conventional pens with half-slatted floors. Forty percent of these extra hours of labour are due to mucking out the outdoor space with a solid floor. If this task was not to be done by having slatted floors outside, still 0.85 extra hours per pig place per year would remain for the other tasks considered in this research.
Weather conditions play a role in the extend to which the outdoor space is used. Especially the defecating behaviour can be used for optimising the situation.
Besides a single inexplicable difference, no effects were found of group size and pen design on performance and health of the pigs. The farm hand preferred group sizes of 8 pigs to 16 or 24 because these can be checked on more easily as to feed intake and health and result in less dirty pens.
The prevalence of condemned and affected livers appeared to be well-controllable under free-range conditions during the research period with the protocol for endoparasites applied at the experimental farm and could be considered low compared with national figures. ■

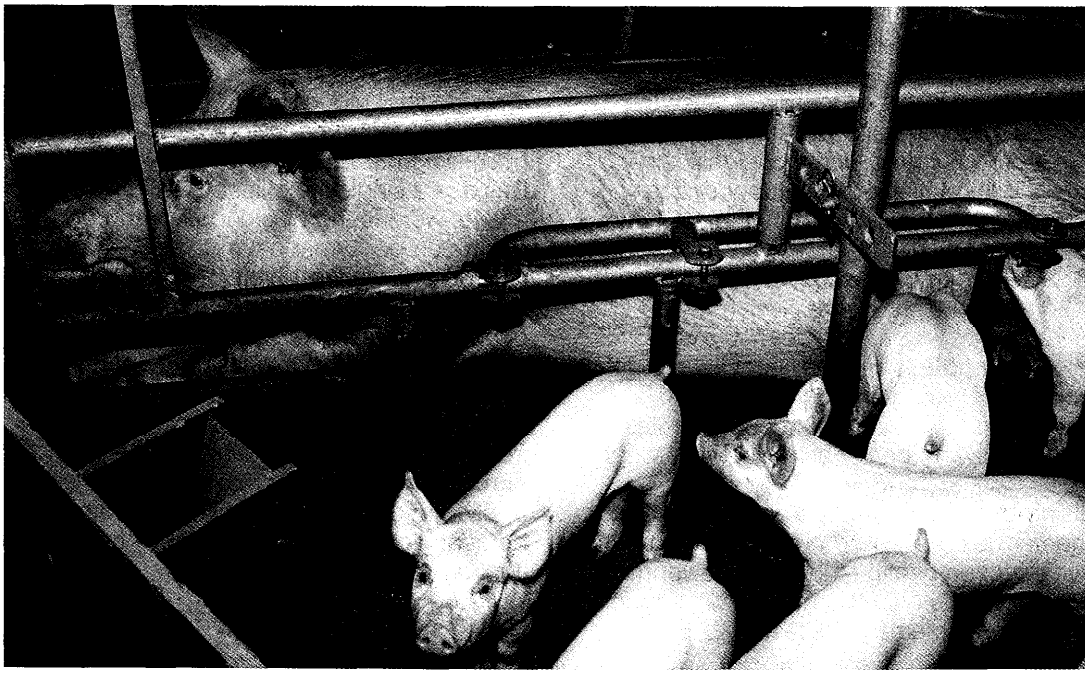
Report Pl.223

SPLIT-WEANING IN FIRSTAND SECOND PARITY SOWS

dr. P.C. Vesseur, ing. G.P. Binnendijk, ing. A. I. J. Hoofs

The effect of split-weaning on sow body weight and backfat development, weaning to oestrus interval, sow reproductive performance and piglet growth was studied in 303 first- and second-parity sows. In sows of the control group piglets were weaned at about 4 weeks of age. In the split-weaned sows the heaviest piglets were weaned at about 3 weeks, leaving 6 piglets with the sow to be weaned at 4 weeks of age. Both split-weaning and parity affected the weaning to oestrus interval; it was reduced in split-weaned sows and shorter in the second-parity sows. Differences in body weight loss and reduction in backfat may, especially in second-parity sows, explain the effects on weaning to oestrus interval as found. Second-parity split-weaned sows showed a higher farrowing rate compared with second-parity control and first-parity sows. No effect of split-weaning on the size of the next litter was found. The growth of piglets during the fourth week of lactation was higher in piglets of the split-weaned sows. Piglet growth during a six-week rearing period was worse in piglets weaned at three weeks. However, when reared up to the same age, the growth of these piglets was comparable with that of piglets weaned at four weeks.
Split-weaning in first- and second-parity sows should be considered in current sow farming to improve sow production. ■

Report PI.228



GROWING-FINISHING PIGS IN AN ALTERNATIVE HUSBANDRY SYSTEM WITH OR WITHOUT GROWTH PROMOTERS

ing. J.H. Huiskes, ing. J.G. Plagge

Research has indicated that there is a need for pork produced in an animal-friendly and environmentally-friendly way. Moreover, it should be guaranteed that this pork is free of residues of medicines or other components that could affect human health. Production systems with extra requirements as to the use of medicines, as well as housing and feeding are biological pig farming and free-range pig farming. "Free-range pork" is allowed to be produced, handled and sold only by recognised enterprises. Before October 1 1998 it was already forbidden to feed free-range pigs with a bodyweight of 35 to 45 kg and over concentrates with antimicrobial or chemotherapeutic growth promoters or other additives promoting growth and/or feed conversion in an artificial way. These additives are mentioned as so-called growth promoters. From October 1 1998 onward requirements for free-range pig farming have been made stricter: the feeds for all categories/ages of free-range pigs are not allowed to contain growth promoters. Experiments with growing-finishing pigs kept in a conventional system and according to the rules for free-range pigs respectively showed clear differences in technical results. In spite of a higher feed intake, free-range pigs did not grow faster than conventionally kept pigs. This resulted in a worse feed conversion.
Besides differences in housing and management, growth promoters added to growing-finishing feed for conventionally kept pigs may have influenced the difference in technical results.

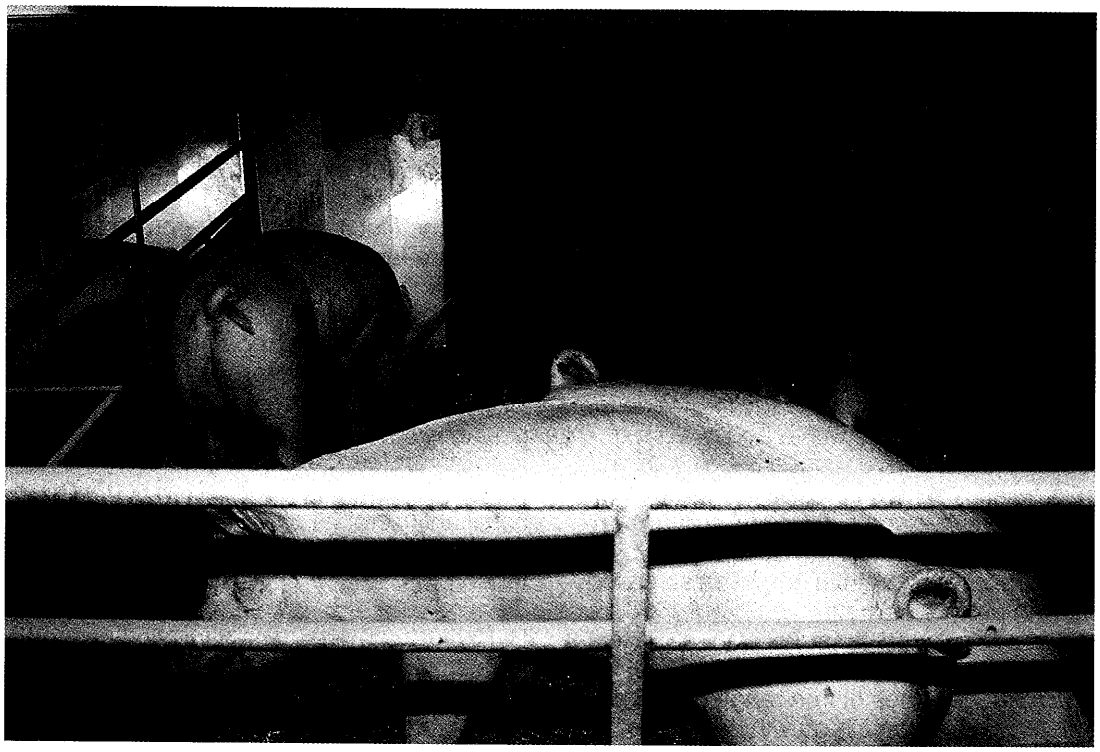
To investigate the effect of antimicrobial growth promoters on technical results of growing-finishing free-range pigs, an experiment was set up.
This experiment was performed in the free-range pig unit of the Experimental Farm "North- and East-Netherlands" at Raalte.
At entering the fattening unit at a weight of about 25 kg, the piglets were divided into two experimental groups. The pigs were delivered for slaughtering at about 108 kg of liveweight. The experiment comprised 344 animals in total.
During the first 4 weeks after entering, all pigs were fed a standard starter feed with an additional antimicrobial growth promoter. After the starter feed period, two experimental treatments were compared during the growing-finishing phase:
Treatment 1:
During week 5 there was a gradual change from starter feed to growing-finishing feed without additonal copper and without additional antimicrobial growth promoter. This feed was provided until delivering of the fattened pigs.
Trea tmen t 2:
During week 5 there was a gradual change from starter feed to growing-finishing feed without additional copper but with 20 mg of antimicrobial growth promoter per kg of feed. This feed was provided until delivering of the fattened pigs.

In this experiment no effect was found of adding an antimicrobial growth promoter on the technical results of free-range growing-finishing pigs.
The results of growth and feed conversion obtained were relatively favourable and indicated good husbandry conditions during the experiment.
The indication that the somewhat less favourable feed efficiency of free-range growing-finishing pigs may apparently be attributed to differences in husbandry systems of free-range growing-finishing pigs compared with conventionally kept pigs leads to two interpretations.
a The somewhat less favourable feed efficiency of free-range growing-finishing pigs has to be compensated for through the ▶

pricing system,

b to reduce the extra feed apparently needed, adjustments in housings should be investigated without affecting the welfare and freedom of movement for free-range pigs. ■

Report PI.229



FEASIBILITY OF DISINFECTION OF AIR BY UV-RADIATION FOR PIG HOUSES

ing. t? EM. M. Roelofs, P. J. J. M. Nooijen, dı t?C. Vesseur

A feasibility study on air disinfection in pig houses by using UV-C radiation was done, with special attention to disinfection of the air that enters the buildings. Low-pressure mercury lamps are suitable for this.
As far as is known, all micro-organisms are sensitive to UV-C radiation. However, the dose (product of radiation intensity and duration of exposure) needed to kill 90% of the micro-organisms is dependent on the species. A UV-C dose of 30 mJ/cm^2 (300 J/m^2) kills almost all bacteria and viruses in dry and 'clean' air.

Since excessive exposure to UV-C radiation is dangerous to humans and animals, direct exposure must be prevented. The most important harmful effects are erythema (red skin), keratitis and conjunctivitis (inflammation in the eyes). Normal glasses, preventing direct irradiation of the eyes, are effective to protect the eyes against UV-C. The face can be protected by a facial screen, and polyesther clothing provides sufficient protection of the skin. However, to preclude any risks it is better to prevent human exposure to UV-C completely, including exposure by reflection. Most low-pressure mercury lamps are coated to prevent ozone-production. Ozone is a toxic gas, which is very harmful to humans and animals.

There are several methods for air-disinfection by using UV-C. To prevent airborne pathogens to enter, the incoming air must be disinfected in the ventilation ducts. Using underpressure ventilation systems, which are very common in the Netherlands, leakage of air is unavoidable. Since leaked air is untreated and leakage of air is no problem in overpressure ventilation systems, the latter systems are preferred. In underpressure ventilation systems the amount of leaked air can be reduced by sealing the buildings as hermetically as possible.

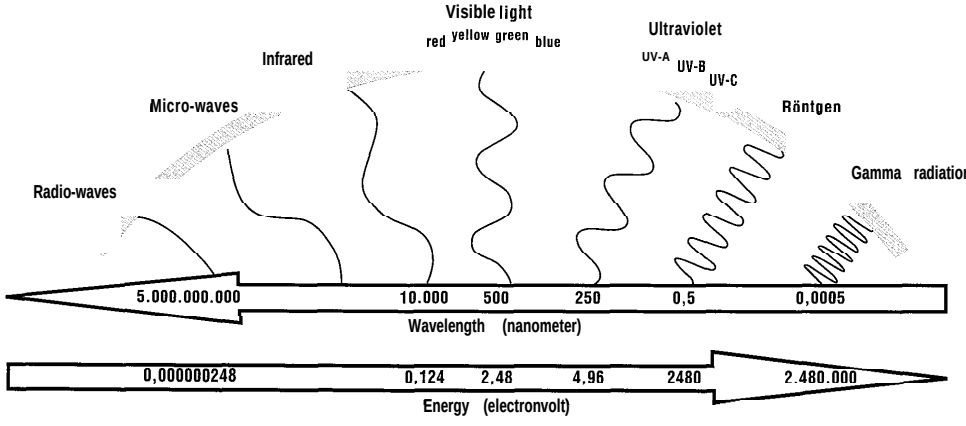
For effective air-disinfection by using UV-C, the air must contain no particles. For this reason, preceding air filtration is advised. This is easiest in ventilation systems with central air supply ducts.

It is expected that the performance of pigs which are not infected with certain common diseases is better than performance of infected pigs. As the relation between health status and performance is the subject of another study, this question has not been addressed in this study. When UV-C is not used in air ducts but inside the rooms with pigs, the goal of disinfection is not to keep the pigs free of certain infections, but to keep the level of infection acceptable. There is only literature available on this use of UV-C. In almost all these experiments, the pigs were directly exposed to UV-C radiation. The results of these experiments are not univocal: some researchers found better performance, but others could not indicate any effect. In almost all experiments erythema on the pigs was a problem. In some experiments a few pigs had to be removed from the experimental rooms, because they were too sensitive to UV-C.
At present, there is UV-C equipment that makes UV-C radiation to reach only the upper air in the room and does not directly reach the pigs. The perspectives of these systems are better, since damage of the animals by UV-C is prevented.

Technically, disinfection of incoming air by using UV-C seems possible. Based on several assumptions, indicative annual costs have been calculated. For a 210-sow farm, indicative annual costs to eliminate 99% of the airborne pathogens are about Dfl 140.00 per sow. For farms with 2,600 growing-finishing pigs annual costs are about Dfl 35.50 per pig. About 66% of all annual costs are electricity costs. Unless annual ▶

costs decrease substantially, air disinfection is financially not attractive for normal sow or pig farmers.
However, many things concerning UV-C disinfection are unknown. For this reason, firm safety margins were used when annual costs were calculated. It is expected that the more is known about UV-C disinfection, the more the capacity of the equipment and with that the annual costs may decrease.
Whether or not it is economically feasible, the following questions are to be addressed: which pathogens must be kept away, what is the maximum number of these pathogens in the open air near the pig houses, dependent on size of and distance to pig farms in the neighbourhood; what is the minimum number of pathogens, needed to create an infection; how sensitive are these pathogens to UV-C; what are the effects of temperature, RH and altering of the lamps on the UV-C capacity that has to be installed; which ventilation levels will apply and what are the costs at farm level of a possible disease outbreak. ■

Report Pl.230



Wavelength and energy-content from different types of electromagnetic radiation
After: Paerels, 1998

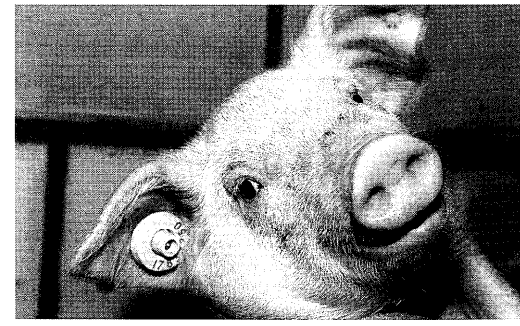
INDIVIDUAL FEED INTAKE CHARACTERISTICS OF WEANLING PIGS HOUSED IN GROUPS

ir. E.M.A. M. Bruininx, ir. C.M. C. van der Peet-Schwering

Individual feed intake characteristics of weanling pigs housed in groups were measured individually by using computerized feeding stations (IVOG® Insentec BV., Marknesse). The effects of a grouping strategy, weaning weight class and sex on performance and individual feed intake characteristics were studied. Also, the performance of weanling pigs that were fed via feeding stations was compared with the performance of weanling pigs that were fed via single-spaced dry feeders. The experiment was performed in a single nursery room, consisting of four pens with single-spaced dry feeders and six pens, equipped with a feeding station. At weaning (27 days) 310 pigs were divided into three weight classes: light (6.7 kg), medium (7.9 kg) and heavy (9.3 kg). All pens with a single-spaced dry feeder and three pens with a feeding station contained pigs of all three weight classes (heterogeneous groups). The remaining three pens with a feeding station contained pigs of one weight class only (homogeneous groups). Each pen contained barrows and sows. This experimental design was repeated three times. During the first 13 days after weaning a pelleted prestarter diet was fed, after which all pigs received a pelleted starter diet. Both diets did not contain any antibiotics, organic acids, extra copper and extra zinc. All pigs had unlimited access to feed and water. Based on this experiment the following conclusions could be drawn:

- The results of this experiment suggest that the use of feeding stations to study individual feed intake characteristics of weanling pigs is a valid model for feeding weanling pigs via a single-spaced dry feeder.
- Sex, weaning weight and -less pronouncedly- grouping strategy affect the performance of weanling pigs. Averaged over the first 13 days after weaning sows ate more and gained more weight than barrows. Averaged over days 14-34 as well as the total nursery period, heavy pigs ate more and gained more weight than light pigs. Averaged over days 14-34 after weaning, pigs in homogeneous groups are more efficient in their use of feed than pigs in heterogeneous groups.
- There is a wide variation in feed intake and feed intake characteristics among weanling pigs. These traits are particularly affected by the weaning weight of the pigs. Heavy pigs tended to a decreased feed intake during the first few days after weaning compared with light pigs. From day 8 after weaning, heavy pigs had continuously the highest feed intake. Averaged over the total nursery period, heavy pigs spent most time on feeding, had the highest feeding rate and feed intake per visit and per meal. The effects of grouping strategy and sex on feed intake characteristics are most pronounced during the first few days after weaning. Sows had a higher initial feed intake than barrows. There was an interaction between grouping strategy and weaning weight as far as the initial feed intake (= feed intake during a period of 24 hours following the first visit with feed intake) was concerned.
- The illumination schedule seemed to affect the early development of feed intake by weanling pigs. ■

Report Pl.233



THE INFLUENCE OF INDUCED PARTURITION AND THE MOMENT OF VACCINATION AGAINST SWINE ERYSIPELAS DURING LACTATION ON THE WEANING-TO-OESTRUS INTERVAL IN SOWS

ir. M.C. Vonk, ing. G.P. Binnendijk, dr.P.C. Vesseur

This experiment was carried out to investigate the effect of vaccination during lactation with Porcilis® Ery+Parvo on the weaning-to-oestrus interval and the reproduction in sows. An exploratory study had indicated that vaccination during particularly the first few days of lactation might lead to a longer weaning-to-oestrus interval. To find out whether vaccination during lactation and/or the moment of vaccination actually affects the weaning-to-oestrus interval, sows were vaccinated the first, second or last weeks of lactation with either Porcilis® Ery+Parvo or a placebo. In the same experiment the combination with induced parturition on the weaning-to-oestrus interval was examined. Also the influence of the treatments on the use of PG600® was considered, as was pregnancy rate from first insemination and litter size, and the number of stillborn piglets or born alive in the subsequent litter.

This experiment was carried out on the experimental farm of the Research Institute for Pig Husbandry, Rosmalen, the Netherlands, in the period of September 1996 until July 1998. In total 965 litters were assigned to this experiment. Sows were screened from transfer to the farrowing house until the subsequent litter. The main results and conclusions are:

- Vaccination of sows during the first week of lactation (with Porcilis® Ery+Parvo) against Swine erysipelas and Parvo has no significant adverse effect on reproductive performance.
- Induced parturition causes earlier parturition, which results in lighter piglets. Induced parturition has no effect on percentage of piglets born alive; the percentage of piglets with splayleg is significantly higher. ■

Report P5.9

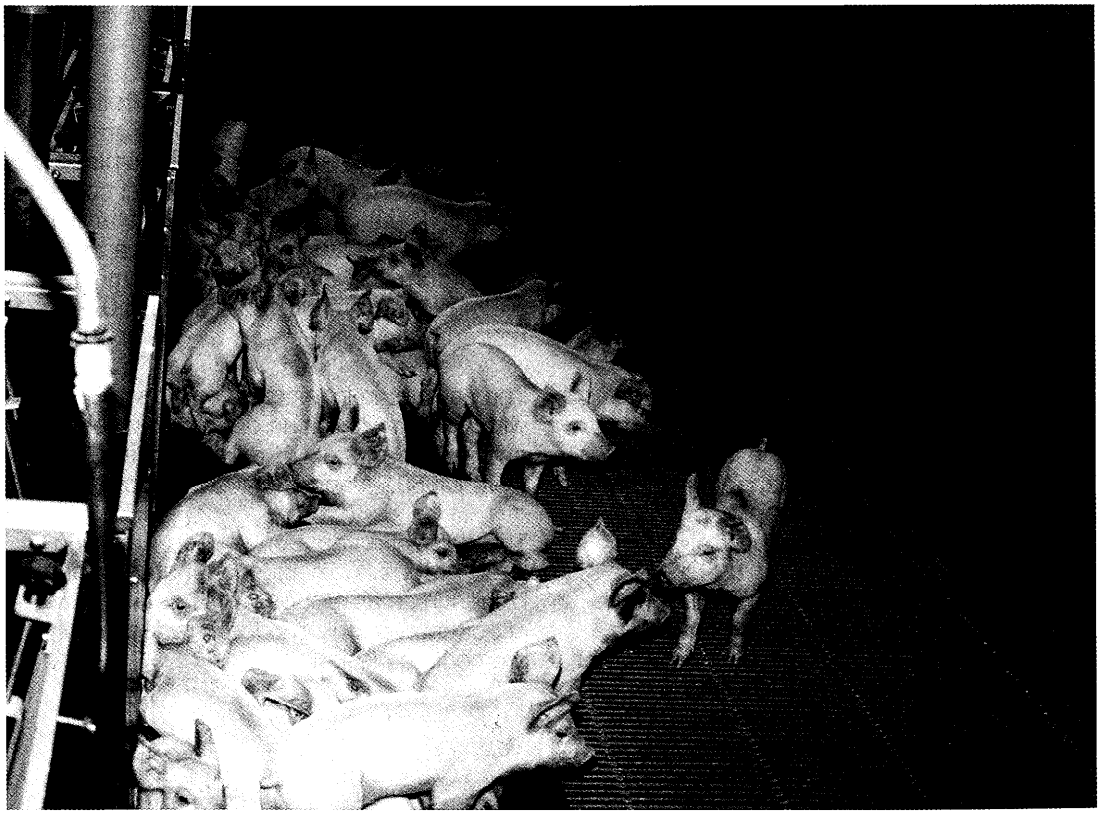
AMMONIA EMISSION OF LARGE GROUPS OF WEANED PIGLETS ON A FLOOR AREA OF 0.4 M² PER PIGLET

ing. A. J.A. M. van Zeeland, ing. G.M. den Brok, ing. M. G.A. M. van Asseldonk, ir. N. Verdoes

The latest Dutch Welfare and Health Regulations for Pigs (Anonymus, 1998) state that the minimum space for weaned piglets is to be increased from 0.3 m^2 to a minimum of 0.4 m^2 per piglet. It is still allowed to keep them on fully slatted floors until the age of 10 weeks. Furthermore, weaned piglets must be kept in fixed groups from one week after weaning at the latest, which will lead to piglets being housed in large groups more frequently. There is a growing need for a system with low ammonia emission for large groups of piglets with a floor area of 0.4 m^2 per piglet place.

At the moment most available systems with low ammonia emission reduce the ammonia emission through reducing the emitting surface of manure. The surface increase per piglet place may, if the emitting surface of manure increases, result in an increase ammonia emission.

At the Experimental Pig Farm at Sterksel a study was carried out with four systems in which large groups of piglets were housed with a floor area of 0.4 m^2 per piglet place. All rooms were equipped with shallow manure channels with a sewer system. A study ▶



was conducted on four systems:

- Two *variants of the DeLVris system*
  In these two rooms both the floor design and pit design are based on the DeLVris system with sloping walls in the manure channel (Van Zeeland en Den Brok, 1998). The first variant was a room with two pens for 27 piglets and was constructed by removing the old pen partitions of small groups except one. The second variant was a room with one pen for 70 piglets and was constructed by removing all old pen partitions of small groups. The floor area included the observation passage.
- *Fully slatted floor*
  This room did not have an observation passage and was fully slatted. A fence-line feeder split the room into two pens for 35 piglets. Based on the expected defecating area, the slurry pit had two manure channels on both ends of the room and the rest were water channels.
- *Island construction*
  In this room the solid floor was relatively wide, while the manure channel was only 0.8 m and the channel had no sloping walls. To reduce the risk of fouling of the solid floor, the room was split up into two pens (30 piglets) and on the side of the pen partitions were extra water channels, resulting in an island. Underneath the water channel was an air Channel. Fresh air came in the room through the space under de solid floor, through the air channel under the water channel and finally through a slit in the observation passage.

The costs of these rooms were compared to those of a traditional pig house (Adams et al., 1998). A standard room in a traditional pig house has six pens, each for 10 piglets, is fully slatted and has a simple sewer system. The floor area is 0.4 m^2 per piglet.

Ammonia emission in the first variant of the DeLVris system had an average ammonia emission of 0.18 kg NH_3 per piglet place per year (not corrected for background concentration). The extra investment costs and the extra annual costs compared with a traditional room and a floor area of 0.4 m^2 per piglet place were Dfl -1 .OO and Dfl -1.60 respectively. The extra annual costs are higher than the extra investment costs. This is caused by a higher percentage of depreciation of the different materials.

Ammonia emission in the second variant of the DeLVris system had an average ammonia emission of 0.25 kg NH_3 per piglet place per year (not corrected for background concentration). The extra investment costs and the extra annual costs compared with a traditional room and a floor area of 0.4 m^2 per piglet place were Dfl -9.00 and Dfl -3.20 respectively.

Ammonia emission in the room with a fully slatted floor had an average ammonia emission of 0.21 kg NH_3 per piglet place per year (not corrected for background concentration). The extra investment costs and the extra annual costs compared with a traditional room and a floor area of 0.4 m^2 per piglet place were Dfl 15.00 and Dfl 1.25 respectively.

Ammonia emission in the room with the island construction had an average ammonia emission of 0.27 kg NH_3 per piglet place per year (not corrected for background concentration). The extra investment costs and the extra annual costs compared with a traditional room and a floor area of 0.4 m^2 per piglet place were Dfl 10.00 and Dfl 0.50 respectively.

The savings in investment and annual costs with a room without an observation passage and a floor area of 0.4 m^2 per piglet place were Dfl 50.00 and Dfl 4.00 respectively.

The defecating area of weaned piglets in large groups is smaller than that of weaned piglets in small groups. This has a positive effect on pen fouling and on reduction of ammonia emission. ■

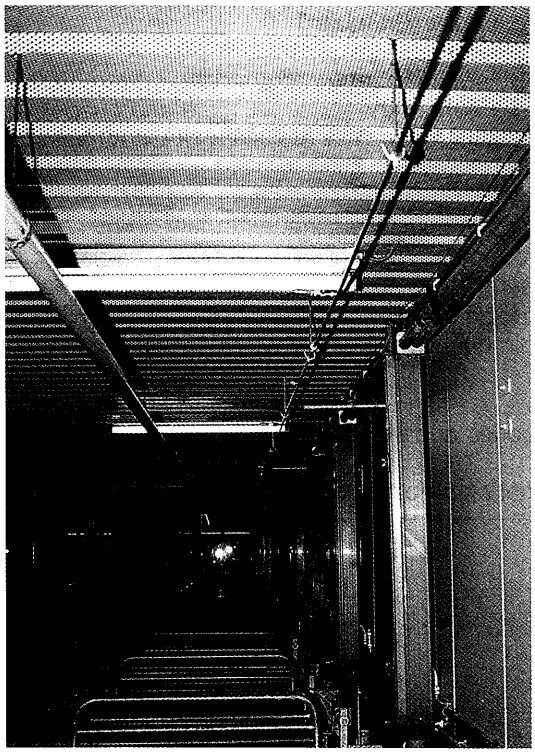
Report Pl.224

EVAPORATIVE COOLING IN PIG HOUSES

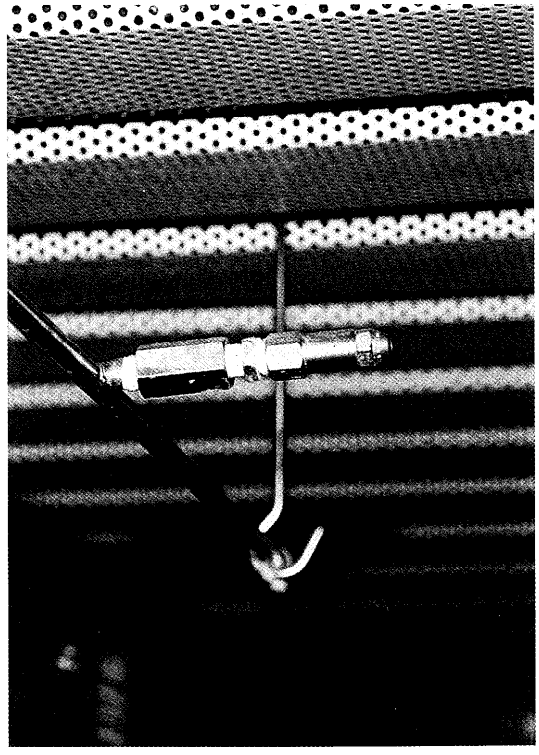
ir. A. V. van Wagenberg, ing. A.J.A.M. van Zeeland

Under Dutch conditions heat stress can be a problem among pregnant sows, lactating sows and growing-finishing pigs. Heat stress has negative economic consequences. The risk that a pregnant sow will die increases. Lactating sows and growing-finishing pigs will have a lower feed intake, which results in a lower production.
At the Experimental Farm for Pig Husbandry 'South and West-Netherlands" at Sterksel the technical and practica1 functioning of an evaporative cooler in a farrowing compartment has been studied. The installation could easily be adjusted and during hot periods the temperature in the compartment could be reduced some degrees without causing problems due to high humidity. The yearly costs of an evaporative cooler have been estimated at Dfl 17.- per pregnant sow place, Dfl 9.- per farrowing pen and Dfl 8.- per growing-finishing pig place. In an average year it seems unlikely that the yearly costs can be recovered in periods of heat stress. ■

Report PI.227



Pipe of the evaporation system in the compartment



Nozzle

EVAPORATION OF WATER FROM SLURRY; RESULTS OF MODEL CALCULATIONS

ir. A. V. van Wagenberg, ir. N. Verdoes, dr. ir. E. Vranken[1], prof. dr. ir. D. Berckmans[1]

In an integrated air-treatment installation, solutions for ammonia and odour emission and slurry problems can be combined. By creating intensive contact between ventilation air and slurry, ammonia and odour can dissolve in the pretreated slurry and at the same time water can evaporate.
The contact surface between slurry and air can be created in an air scrubber. The filling material determines the size and the shape of the contact surface in the air scrubber and the efficiency of the exchange of ammonia, odour and vapour between air and slurry. In this research only evaporation of water was monitored.

To estimate the possible amount of evaporation and what an integrated air-treatment installation would look like, a simulation model was developed. The simulation model was validated under laboratory conditions. From the measurements, it could be concluded that the model underestimated the evaporation by 16%. This can be explained by the fact that evaporation from falling drops in the evaporator was not considered in the model.

The simulation model validated was used to design simulation experiments. In the calculations a filling material was chosen, which consisted of horizontal tubes perpendicular to the air-stream direction. For determing the dimensions of the evaporator the maximum air-speed between the tubes was set at 4 metres per second.
The amount of evaporation for all animal categories was calculated. The assumptions made are described in this report. The results are in table 1.

By adding heat (energy) to the system, temperature of the slurry will raise and evaporation increase. The efficiency of extra heat input is 64%.

In this research some external energy sources were studied. With aeration, the slurry temperature will raise because of the breakdown of organic matter. Depending on the amount of organic matter in the slurry, eva-

Table 1: Evaporation for the different animal categories and percentage of slurty production

animal category	evaporation (kg per animal place per year)	% of slurry production
empty sows[1]	689	26%
pregnant sows[1]	1,073	36%
farrowing sows[1]	1,037	20%
weanling pigs[1]	243	50%
productive sows[1]	1,602	30%
growing-finishing pigs[1]	488	40%
growing-finishing pigs[2]	396	33%

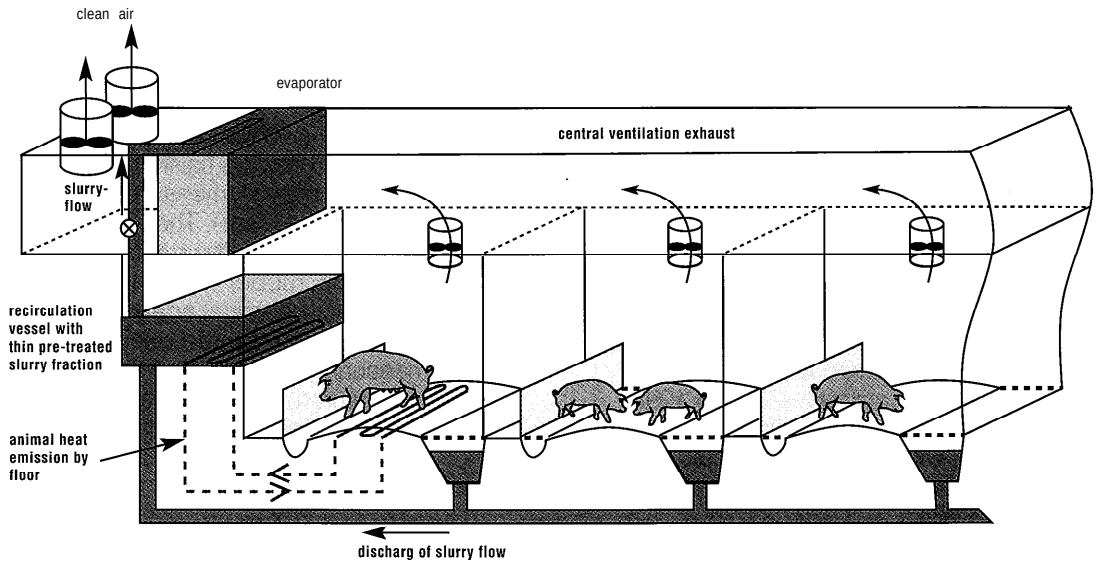
[1] static indoor climate simulation, heat production based on ANIPRO (Van Ouwerkerk, 1999)
[2] dynamic indoor climate simulation, heat production based on Bruce and Clark (Berckmans et al., 1993)

[1] Laboratorium for Agricultural Buildings Research, Catholic University Leuven, Belgium

poration may increase by 7 to 21%.
By using solar energy, evaporation can increase depending on the surface of the collector. With a collector of 25 m^2, evaporation will increase by 8,320 kg per year, a collector of 200 m^2 will increase evaporation by 66,557 kg per year. Also usage of heat from a heat-power generator will cause a higher evaporation.

Using external energy sources makes it possible to reduce the amount of slurry to a minimum. When most of the water from the slurry can be evaporated, the remaining product will be a solid mass, which can then be dried further on belts. ■

Report Pl.234



Possible design of an integrated air treatment system in a pig facility (with central ventilation exhaust)

THE EFFECT OF A CHEMICAL AIR SCRUBBER ON AMMONIA EMISSION FROM A GROWING-FINISHING PIG HOUSE

ir. N. Verdoes, ir. J.J. Zonderland

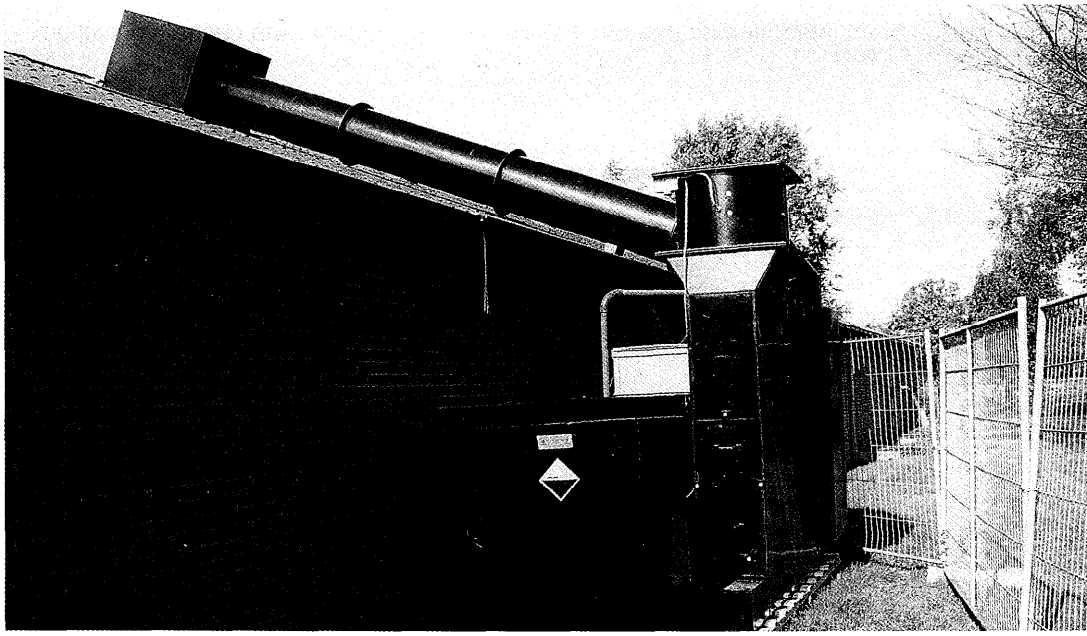
Commissioned by Bovema Inc. in Milsbeek (NL), the Research Institute for Pig Husbandry investigated the chemical scrubber as a means of reducing ammonia emission from growing-finishing pig houses. The scrubber is supposed to absorb ammonia from ventilation air into a acid solution. The acid fluid is sprayed onto a plastic filter medium, which is placed in the ventilation flow of the pig house. In pig husbandry air scrubbing is mainly applied in central extraction systems, which are often applied in new buildings.

The principal aim of this research was to determine the reduction in ammonia emission from the growing-finishing pig house where pigs are housed according to law regulations as to animal welfare in 1998 (total surface per growing-finishing pig at least 1 .O m^2 with 60% of solid floor) and when applying this air scrubbing technique (type ECO 95+).

The research was conducted at the Experimental Pig Farm at Raalte from September 21 to December 30 1998. Ventilation air from a growing-finishing compartment containing 54 animals was treated with the scrubber. During the testing period the scrubber functioned without trouble.

The average ammonia concentration in the outlet air from the growing-finishing pig house was 10.87 mg/m^3 (measured by a monitor of Bruël and Kjaer). The average ammonia concentration after treatment with the chemical air scrubber was 0.13 mg/m^3 (measured by wet chemical analysis). The reduction could be measured during 91 of the 100 measuring days. During the measuring period (autumn), reduction varied from 90.4 to 99.9% with an average of 98.7%. ■

Report P4.39



PUBLISHED RESEARCH REPORTS IN ENGLISH

P 5.1
Comparison of four housing systems for non-lactating sows. G.B.C. Backus, Vermeer, H.M., Roelofs, P.F.M.M., Vesseur, P.C., Adams, J.H.A.N., Binnendijk, G.P., Smeets, J.J.J., Peet-Schwering, C.M.C. van der and Wilt, F.J. van der, March 1997.

P *5.2*
Spray-dried blood plasma and spray-dried blood cells in diets of weaned piglets. C.M.C. van der Peet-Schwering and Binnendijk, G.P., March 1997.

P *5.3*
Research Reports 1996. May 1997.

P *5.4*
A raised soft farrowing mat during lactation. H.M. Vermeer and Binnendijk, G.P., November 1997.

P *5.5*
Research Reports 1997. March 1998.

P *5.6*
A comparison between pig farming in the European Union and North America. M.A. H. Vaessen, Bastiaansen, M.A.C. and Backus, G.B.C., March 1998.

P 5.7
Urinary pH, ammonia emission and performance of growing/finishing pigs after the addition of a mixture of organic acids, mainly benzoic acid, to the feed. G.M. den Brok, Hendriks, J.G.L., Vrielink, M.G.M. and Peet-Schwering, C.M.C. van der, January 1999.

P 5.8
Influence of benzoic acid in the diet on performance and urine pH of growing/finishing pigs. C.M.C. van der Peet-Schwering, Verdoes, N. and Plagge, J.G., January 1999.

P 5.9
The influence of induced parturition and the moment of vaccination against Swine erysipelas during lactation on the weaning-to-oestrus interval in sows. M.C. Vonk, Binnendijk, G.P., Vesseur, P.C., March 1999.

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