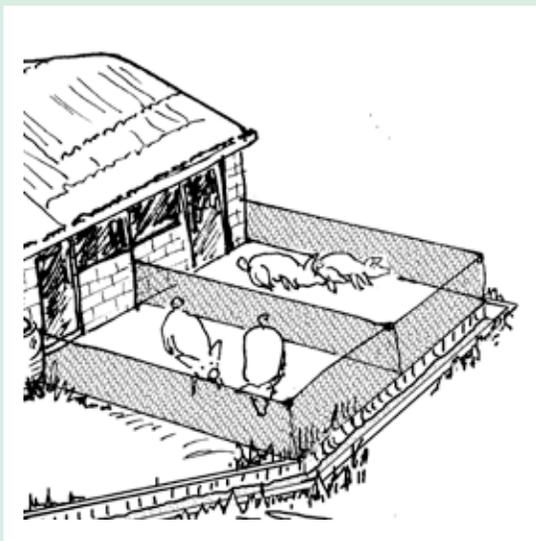
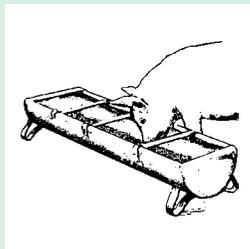
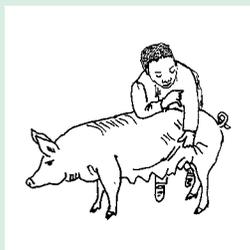


Pig farming in the tropics

From free range to small-scale intensive production systems



Agrodok 1

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From free range to small-scale intensive production systems

Johan van 't Klooster
Arie Wingelaar

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Foreword

Research and development organisations are currently showing increasing interest in smallholder pig keeping. The rationale underlying this is the hope that pigs may offer a way of improving the well-being of many small-scale farmers. Smallholders, however, have never lost interest in their pigs, and these animals remain a highly appreciated secondary activity on mixed farms worldwide. I am therefore very happy that Agromisa and CTA have updated and revised this popular Agrodok 'Pig Keeping in the Tropics'.

Good pig farming relies on a combination of inter-connected aspects, such as housing, breeding and reproduction, nutrition, disease prevention and control, and management. This practical booklet focuses on all these subjects and links them to the three main smallholder pig production systems: free-range scavenging, semi-intensive, and small-scale intensive pig keeping.

This Agrodok aims to provide information for farmers and those who advise farmers involved in pig keeping. I trust that it will be of practical value to everybody who cares for pigs.

Henk Udo, Animal Production Systems, Wageningen University

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The Agromisa team

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1 Introduction

Pigs are kept in one form or another almost everywhere in the world. In rural areas of many parts of the world, it is still common to find pigs rooting and roaming freely around communities, which are sold or slaughtered when household needs require. Pig-keeping enterprises are also found in and around towns and cities, and they play an important role in feeding urban populations.

This Agrodok describes three typical pig-keeping systems:

➤ *Free-range scavenging pig keeping*

A more or less extensive system that provides a household emergency fall-back fund, whilst also supplying it with a little meat from time to time, with little investment of time or money. This domestic scale is typical of small farmer mixed holdings.

➤ *Semi-intensive pig keeping*

In this system the animals are housed and more attention is paid to their health and feeding. The aims are partly the same as those of domestic pig keeping, but with modest inputs. Production is higher and the pigs are also marketed.

➤ *Intensive pig keeping*

This system aims at producing meat for the market efficiently and profitably, usually with larger numbers of pigs. It requires significant inputs of time and money, with careful calculation of the costs and the resulting benefits.

We consider the main characteristics of each of these systems, the purposes they serve, and the methods employed, as well as noting their limits and ways of improving them. There are of course many systems of pig keeping. The three models we describe give an idea of the options available and ways to make the transition from extensive to intensive management, noting the points that need special attention.

This book is intended for those who advise farmers involved in pig keeping. It will also be of use to farmers themselves who want to set up or make changes to an existing system. Anyone who is considering keeping pigs, or improving an existing system, needs first to be clear about the existing situation, the resources available and the constraints faced, in order to decide which type of system is most appropriate to introduce.

It is very important that farmers who are new to pig keeping build up their enterprise gradually. They would be best advised to start with a semi-intensive approach, concentrating on establishing good housing and proper feeding routines for a small group of healthy animals, taking proper advantage of all locally available resources.

Agrodok summary

The three systems of pig keeping are presented in Chapter 2. Chapter 3 looks at housing: why this is such an important element in the system, and what makes for good pig housing. It outlines the various parts of a piggery and deals with the installations required for feeding and farrowing. It also considers the housing requirements of the sow and her piglets, and of the fatteners. Chapter 4 addresses the management of sows and boar(s), birth of piglets and potential problems, care of piglets (including teeth-trimming and castration). The signs of oestrus and fertility disorders are also dealt with. Chapter 5 covers nutritional requirements and practical aspects of feeding the different categories of pigs. Chapter 6 describes the main diseases that affect pigs, the symptoms and treatments. Preventive measures are described in detail, and general remarks on the use of medicines are made. Chapter 7 covers the important question of keeping management records and basic financial management.

2 Pig-keeping systems

2.1 Free-range 'scavenging' pig keeping

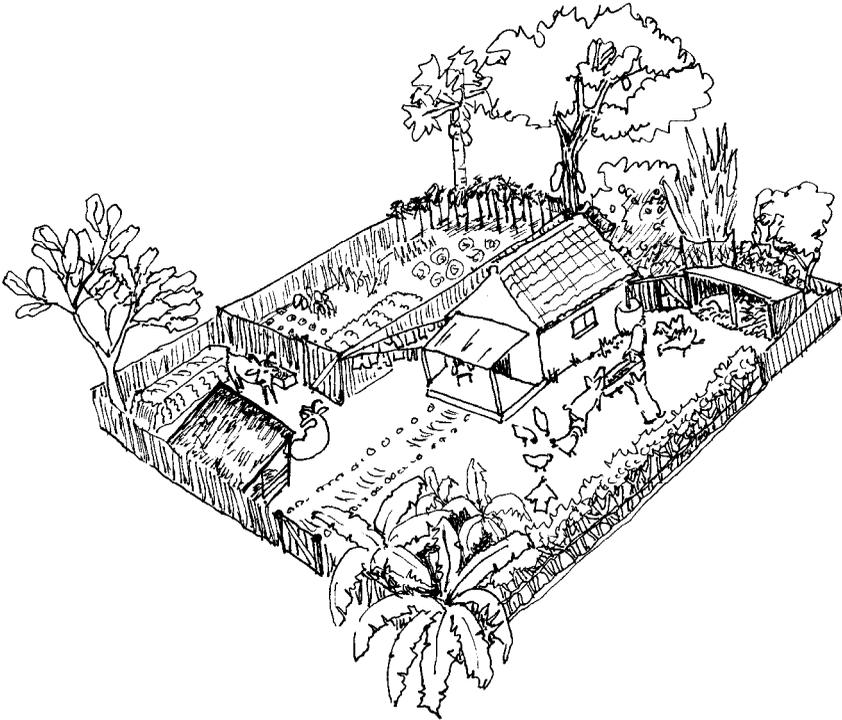


Figure 1: Free-range pig keeping

Main characteristics

The main characteristic of this system is that the pigs move freely around the house and surroundings, scavenging and finding most of their food themselves. This is supplemented with kitchen refuse or agricultural waste products.

At night the pigs are kept in an enclosure surrounded by a fence of sticks, and a simple roof provides some shelter. Little or no money is invested in food or medical services.

Local breeds are commonly used, since they can manage with low-quality feed and are more resistant to diseases. In general there is no attempt to improve production by selective breeding or any other means.

In some cases the pigs are not bred on the farm: piglets are bought from a breeder and are fattened during a season when food is plentiful, to be sold at a later date.

Production goals

In most cases the pigs are not kept to provide meat for the household, or as a regular source of cash income (if there is any regular cash income, this comes from other activities). Scavenging pigs are kept as a 'savings account' or 'insurance policy': they are only sold when extra cash is needed, e.g. for buying seeds or fertiliser, at times of illness or family festivity, to pay school fees, to make up for a lost harvest, etc. In this way loans (and the associated problems of high interest rates and repayment) can be avoided. Pigs may also play a specific role in social life, for example when they are presented as gifts or offered as food at weddings and other festivities.

First steps to improving productivity

The main constraints of free-range pig keeping are the high rates of piglet loss and slow growth rates. The pigs do not grow quickly because they spend a lot of energy on their scavenging activities. Worm infestation is also an important problem that results in slower growth rates.

Enclosing the pigs

Improving management should be done step by step. It should be realised that extra inputs are needed to increase the productivity of the pigs. Putting pigs in an enclosure means that water must always be

available and feed must be supplied twice daily. If not, the productivity will be even lower than in the free-range system. To improve results it is necessary to separate the enclosed area into 2 or 3 parts for different pigs. Animals that weigh more than 40 kg and are in good condition can be given a simple shelter (just a roof), and their additional feed can be of lower quality. Growing pigs (10-25 kg) need better protection and better feed. Lactating sows with piglets need the best protected place and the best feeds. It is advisable to give suckling piglets their own separate corner where they can eat as much as they like and where they can rest.

If raised in a separate enclosure, the piglets can be weaned (separated from the mother) at about 5-8 weeks of age. This is better for the sow's condition. She will come on heat sooner and controlled breeding is possible, which will result in more and better litters.

If all this work (fencing, better roofs/pens, daily feeding, watering, deworming, etc.) is done, and more money is spent on feeding and health care, productivity **must** improve.

The quality of the pigs can be improved gradually by selection and/or by buying a (slightly) improved boar. To make sure the right things are done at the right time, recordkeeping becomes more and more important.

On small farms, with fewer than 3 sows, the pigs can still go out during the daytime to find their own food. But in many rural areas this leads to problems as pigs may damage crops and vegetables. Also, scavenging pigs increase the risk of spreading certain diseases like African swine fever.

Improved pigs are generally less resistant to several diseases and therefore also health and hygiene need more attention.

How to make a good fence

Strong wire netting is ideal, but local materials like bamboo, thorny shrubs and tree trunks can be used. Make the fence in such a way that small piglets cannot escape. Shade is essential. Even if there are trees, a small shelter must be provided so the animals have a dry sleeping place. A simple structure can be made from four solid tree trunks with a roof on top. For lactating sows with piglets, it is advisable to make a simple pen with at least 2 closed sides, about 60 cm high.

Feeding the pigs

Providing scavenging pigs with extra feed will improve their growth. Root crops or their peelings, vegetables or fruits and almost any village refuse can be fed. Young pigs, pregnant pigs in the last month of pregnancy and lactating sows with piglets can be given cheap by-products such as wheat bran, coconut cake, rice bran or fish offal. If the pigs are enclosed, part of the land can be used for growing green fodder or other food crops. In the dry season, when there is little to scavenge, additional feed must be given. The pigs must always have an adequate supply of fresh drinking water.

Hygiene and prevention

Parasites pose a serious problem to pigs whether kept outside or inside, as the wet tropics provide ideal breeding conditions for them. Worms are the most common parasites. A pig infected with worms will be in poor health and will grow very slowly. If the pigs are kept in an enclosure, measures must be taken to control the levels of worm infestation. This is explained in Chapter 6.

2.2 Semi-intensive pig keeping

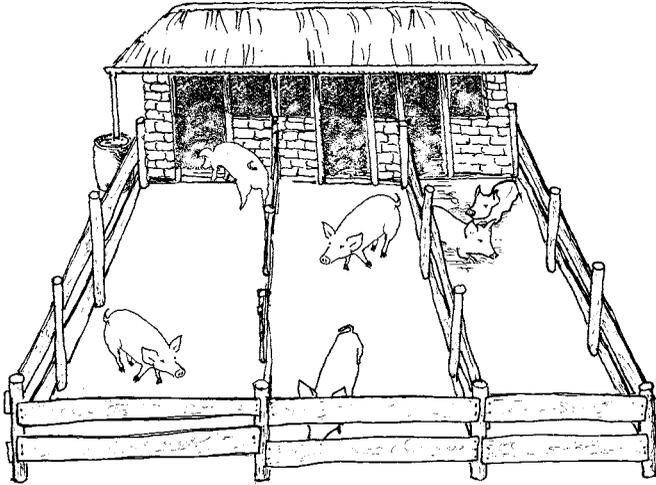


Figure 2: Semi-intensive pig keeping

Main characteristics

In semi-intensive systems, pigs are normally confined to a limited space. This means that most (or all) of them cannot gather their own food and are completely dependent upon their keeper. Once or twice a day, fresh water and feed (usually kitchen refuse or agricultural waste) have to be brought to the pigs. This system of pig keeping opens up possibilities for improved feeding and disease control, which in turn can result in faster growing and healthier pigs and/or larger litters.

Apart from the economic reasons there are also some practical reasons for keeping the animals tethered or enclosed. It prevents crops from being damaged by the pigs, it reduces the risk of the pigs being stolen and spread of diseases and parasite infections is reduced.

Although this system of pig keeping only requires a fairly low or medium level of financial inputs, more time and effort needs to be spent on the pigs. More technical knowledge is also required.

Production goals

The creation of a ‘savings account’ or ‘insurance policy’ still plays a role in this form of pig keeping. Nevertheless, in areas close to urban centres or on main traffic routes or any place where it is possible to sell pigs, smallholders can use their intensified pig enterprise to produce pigs for the market. In other words, the pigs are kept to generate income. That means that the business must be profitable.

Potential for improvement

Improvements to semi-intensive systems are made by focusing attention on feeding and health care practices, and by selective breeding. Housing, in particular of lactating sows and young piglets, also needs attention. Economic and technical results start to become important and therefore records must be kept.

Feeding

A first, simple step is to make sure that the available feeds are properly distributed. It is important that the best of the feeds are given to the nursing sows and the suckling piglets, and also to the piglets that have just been weaned to give them a good start. Sows in the last month of pregnancy also need better feed.

A further improvement is to raise the quality of the feed. If this means buying in additional feed, consider carefully whether the advantages really justify the cost. This will depend on several factors, such as the quality and the price of the feed, the transport costs of the feed, the price obtained for the pigs that are marketed and the improvement of productivity as a result of these better feeds. It is important to understand that better results obtained from improved feeding will be even greater if the quality of the pigs is also improved. Chapter 5 covers nutrition issues.

Breeding

Farmers can improve the quality of new stock by using their best animals for breeding (selective breeding). If nursing sows and their piglets are kept separate from the others, it is easier to select the stronger

piglets for breeding. Records will show the best mothers, whose piglets can be selected. The remaining piglets can be sold or fattened for slaughter. A quick way to improve the quality of the breeding animals is to buy a (slightly) improved or upgraded boar. As a boar is costly, a few farmers might want to buy one together. Make sure that the boar is not related to the sows on the farm. If your aim is to produce weaners for fattening, it is advisable to do crossbreeding. That means that the boar is a different breed from the sows. Also, crossbred sows are normally more productive than pure-line sows. This level of management however demands more knowledge, experience and time. See Chapter 4 for more information on improved breeding.

Health and hygiene

When pigs are improved and given better feeds, we expect better results. Improved pigs are less resistant to diseases and parasites. This means more attention must be paid to preventive health measures. Visitors must disinfect their shoes before entering the farm. Or even better, supply visitors with boots (and outer clothing) and let them wash their hands. It is important to keep the farm as clean as possible. If the pigs are on a mud floor, it is advisable to shift the whole unit at least once a year to a different place and follow a kind of rotation. This is a lot of work, so concrete floors that slope towards the back side of the pens are becoming popular. This makes worm control and hygiene much easier (more information in Chapter 6).

Pigs kept outdoors must not eat human excreta as they may be contaminated with *Cysticercus*, the larval stage of tapeworms (*Taenia*), which grow in pigs' muscles. The pigs show no signs of illness, but if humans eat infected pig meat that has not been properly cooked, the tapeworms can grow in the human body, leading to serious brain and muscle damage.

Use of pig manure

It is a good idea to use pig fields occasionally for crops, as the pig manure fertilises the soil. Doing this also clears the soil of parasites and, after one or two years' cropping, the land will be safe again for

pigs. Pigs that are kept indoors or confined in a small area need to be cleaned daily. Store the manure so that it is protected from sun and rain. The nutrients will not be washed away and the pig manure makes a good fertiliser for crops and vegetables. The liquid manure can also be used as a fertiliser, but should be applied during rainy weather, to prevent the crops from burning.

2.3 Small-scale intensive pig keeping

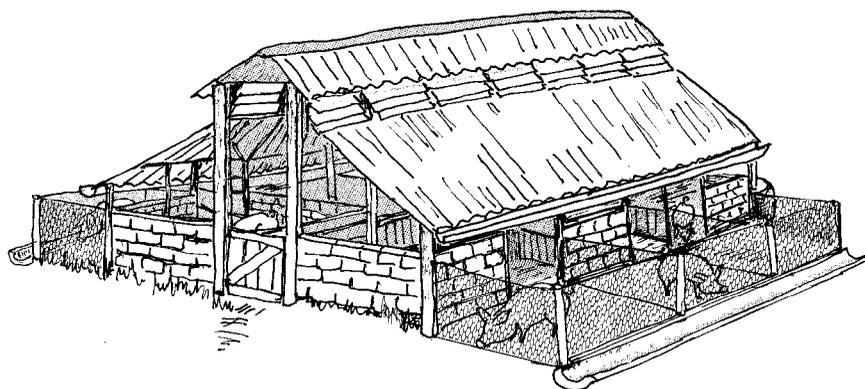


Figure 3: Small-scale intensive pig keeping

Main characteristics

The main characteristic of an intensive pig-keeping system is that pigs are kept to generate income. Generally pigs are kept indoors, although pregnant sows may be allowed outside to graze in a field. Pig houses are built with concrete floors, proper roofs and separate pens for lactating sows, weaned piglets, pregnant sows, boars and fatteners. On bigger farms it is even advisable to keep weaned piglets and fatteners in different buildings. In this system housing means much more than providing a simple shelter. Larger numbers of pigs are kept and the pigs must be well managed because commercial commitments have been made. Know-how is required to make the right decisions at the right time. The following chapters in this book provide information on small-scale intensive pig keeping.

High investments are required to provide improved buildings, and to buy in feeds and medicines. These are absolutely necessary if the change towards improved breeds is to be made. And improved breeds are needed to obtain satisfactory results.

In this system of pig keeping, kitchen waste and agricultural waste products will generally not be enough to feed the animals. Moreover, these feeds are not sufficiently balanced to supply all the necessary proteins and minerals. So certain feeds will have to be bought. Buying in extra feed, in order to obtain a higher number of piglets per sow per year and to obtain better growth rates, only makes sense if the extra income exceeds the extra expenses. To know whether this is the case it is necessary to keep records and analyze them.

Local breeds are often considered to be the reason for low productivity (small litter sizes and slow growth rates). In general, however, these breeds are very well adapted to the local conditions. Although 'improved' breeds have great potential, they require high feed quality and good husbandry. High growth rate is not the only aim to consider. If very cheap by-products are available and the ingredients to make a well-balanced feed are very costly or far away, it may be advisable to keep local or slightly improved pigs, which can be fed on cheap local feeds. The productivity will be fairly low, but good profits are possible.

Production goals

The aim of intensive systems is to provide a major source of income for a group or household. The animals no longer function as a savings account but are raised to be sold. This means that regular access to a market is needed. In some countries farmers depend on a middleman, but by organising themselves, the farmers can bypass the middleman or place themselves in a stronger position to bargain with these middlemen.

Potential for improvement

Improving small-scale intensive systems needs specialised know-how. Progress can be achieved particularly by paying attention to the animals' health and housing conditions. The stability of the undertaking depends on adopting a new approach to production. The farmer has to start thinking more and more in terms of the market and higher and more efficient productivity.

Marketing

To make an intensive system economically viable requires a completely different approach to keeping pigs. The animals have to be brought to the market when they have reached the desired weight. A strategy for optimum buying and selling has to be developed, which requires the presence of regular transport and dependable sales outlets.

A farmer has to decide what type of pig enterprise is most suitable for his/her circumstances. We list the following possibilities:

➤ *Keeping sows only for breeding or multiplication*

The piglets are sold at the age of 2-3 months to fattening farmers. This is advisable in a situation where there are many smallholders who want to fatten just a few pigs. There will be good demand for piglets, which can be sold for a good price. The farmer can start to become a specialist on breeding issues.

Farmers with very good quality pigs and a lot of experience can also produce new breeding stock. Then, farmers who keep sows only to produce piglets for fattening can buy their replacement sows and boars from a very good breeding farm. Young sows (gilts) and boars can be bought at the age of 2-3 months, but also at an older age, up to about one month before the first mating.

➤ *Keeping only fattening pigs*

Piglets are bought at the age of 2-3 months, at a weight of 15-20 kg. This can be done on a very small scale, even with just one pig.

Farmers can gradually gain experience and then expand their farm or start breeding as well.

Fatteners must be sold at the right weight. For local or crossbred pigs this may be around 50-80 kg live weight. For improved pigs this can vary from 80-110 kg. In hot countries pigs are normally sold at around 80-90 kg, as it is difficult to get fatteners to eat enough feed when temperatures are high.

It is very important to know what buyers want. Pigs sold in local markets may have more fat than pigs destined for restaurants or shops in bigger cities. Buyers may also have different wishes concerning the slaughter weight.

➤ *Having a closed farm*

This means keeping sows *and* fattening the piglets on the same farm. Farmers with enough experience can keep control over the whole cycle: the breed used, quality of fatteners and health status of the animals. Another advantage is that fewer pigs move from one farm to another, which prevents spread of disease.

However, if problems (e.g. disease or accident) occur, an extra source of finance must be available to keep the unit in operation. In some countries, African swine fever can kill a whole herd. Therefore it is always risky to rely on pigs as a sole enterprise.

Technical knowledge

A local extension service is an important source of support and technical advice. Veterinary services should also be available when required. On bigger farms the owner or manager should have some training in pig management and, where possible, will be able to find considerable information on the internet. Once again, it is very important to keep careful detailed records for correct management of an intensive pig farm (see Chapter 7).

Disease control

Where many pigs are confined together there is a higher risk of infection spreading quickly among the animals. In the case of African swine fever, very strict isolation measures must be taken. Even if your own farm is not infected, other nearby farms with infected pigs pose a risk of contamination. Therefore, when starting an intensive pig farm, it is advisable to look for a place at a reasonable distance from other pig farms. All it takes is one visitor who does not follow the guidelines to contaminate your animals, which can result in the death of the entire stock. See Chapter 6.

3 Housing

Improved housing is an essential factor in the conversion to commercial pig keeping. This chapter addresses the technical aspects of good pig housing.

There are numerous advantages to keeping pigs inside:

- The animals conserve energy, as they do not have to seek food and shelter.
- Pigs are protected from sun and rain.
- More piglets will survive if they are born in safe, warm and healthy surroundings.
- Housing makes good hygiene maintenance easier and contributes to the health of the pigs.
- Feeding routines can be more carefully controlled, especially when they are adjusted for different categories of pigs.
- Weaning, heat control and service management can be done at the right time and in the right way.
- Record keeping and management are easier.
- Manure can be easily collected and used for fertilising land.

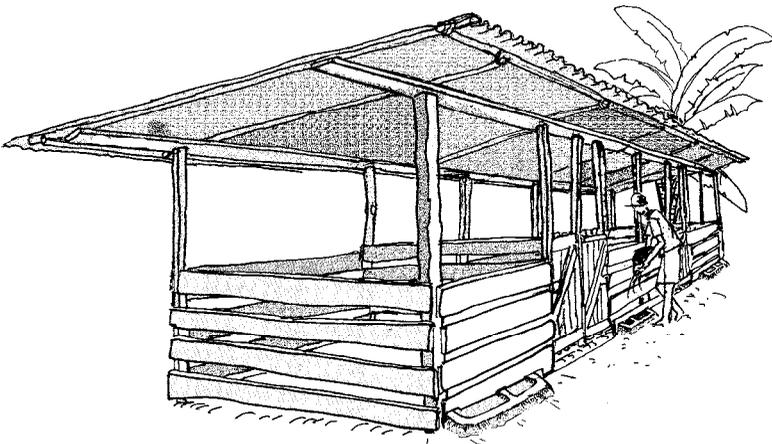


Figure 4: Simple pig house

However, advantages can easily turn into disadvantages when standards are not maintained.

Where many pigs are kept together in a small space, infectious diseases can spread rapidly and therefore hygiene must receive top priority. If living conditions are not good, a pig house can become a place of torture for the animals as disease outbreaks will be frequent and can cause high mortality.

A free-range pig has a certain amount of freedom to search for the optimum micro-climate. In confined systems, we force the animals to stay in a limited space, and they no longer have any influence on their living conditions. Farmers are entirely responsible for providing their pigs with the most appropriate housing. The piggery should be well designed. The farmer should inspect it at least twice a day, to check that the pigs are healthy and the pens are clean.

3.1 Climate

The climate to which a pig is exposed is very important. If a pig is housed this can be controlled to some extent. Pigs, and young pigs in particular, are very sensitive to sudden changes in temperature. They cannot stand heavy rain or draught. Strong sunlight is bad for them, as it causes their skin to dry out. Pigs kept for optimal production should therefore be protected from climatic stress. This is only possible by ensuring that the animals are well housed.

One of the most important factors to consider when creating proper housing is **temperature**. In tropical countries it is important to construct the houses in such a way that daytime temperatures are as low as possible, and that young pigs can be kept warm enough during the nights and cool periods.

Body temperature

The normal temperature of an adult pig is between 38 and 39 °C. For piglets this is 39-39.5 °C. A sick pig's temperature rises above 40 °C.

Heavier fattening pigs, but also pregnant and farrowing pigs, have difficulties regulating their body temperature if the air temperature is too high. If this happens they eat less, which results in lower growth rates and/or lower milk production. Pigs become less fertile when temperatures are above 32 °C. Pigs cannot sweat and therefore the temperature must be below 35 °C in tropical pig houses. However, it must be warm enough for young pigs, especially newborn piglets.

Ideal temperatures for pigs

The temperature at which optimum growth and food conversion is achieved differs with the weight of the pig:

- piglets 1 day old 35 °C
- piglets 1 day-1 week old 30 °C
- piglets 1-6 weeks old 30-24 °C (2 degrees less per week)
- pigs from 20-60 kg 26-20 °C
- pigs from 60-90 kg 22-18 °C
- adult animals 18-22 °C

3.2 Technical requirements for good housing

The construction of pig pens and houses depends to a certain extent on the climate and how many pigs are to be kept. Local conditions are also important when considering the construction site (waterlogged, exposed to wind, etc.), materials and skills available for building the housing.

In hot, humid or damp areas, breeze and shade are important factors. The buildings should be as open and airy as possible. The walls of the pens should be constructed so that the wind can pass freely through for good ventilation.

Important requisites for the pen:

- It should not be draughty.
- Bright sunshine and rain should not be able to enter.
- Temperature inside the pen should not vary too much.
- It should be easy to clean.

- The floor must be sloping but not slippery.
- Work and management should be easy.
- Provision should be made for storing manure, litter and run-off for later use.

A pen that satisfies these requirements will make a major contribution to the good health of the herd, lower piglet mortality, faster growth and increased feeding efficiency.

The most suitable housing for less intensive holdings in tropical regions consists of a walled and roofed pen with a yard or run. Bedding material can be provided in the covered part and the run should contain a trough.

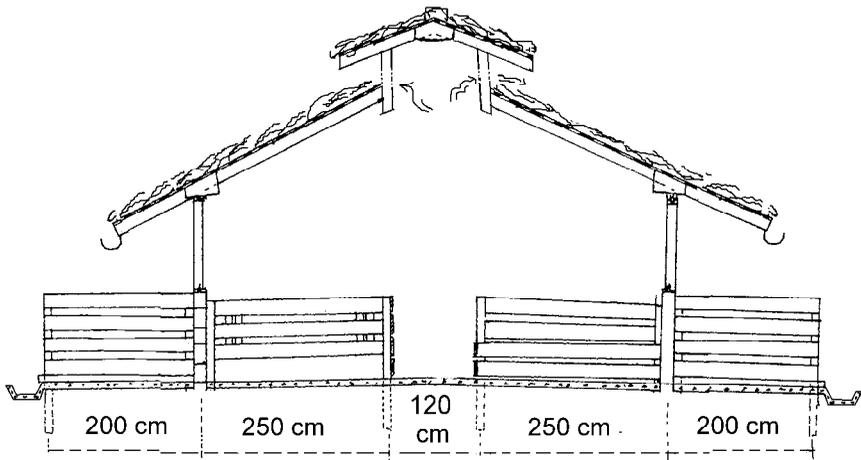


Figure 5: Cross section of a pig house

Siting

When building a house, choose the site carefully. In hot areas the best orientation of the building is east-west. A group of trees can provide shade, as trees absorb and screen a good deal of heat. The pen should be near a water supply, so that water is readily available for the animals and for cleaning.

The roof

The first essential is a roof, which can be made of various materials. The most practical approach is to use a local roofing material. A roof of leaves insulates well against heat and cold, but it has the disadvantage of rotting quickly and will be destroyed by strong winds. A roof made of leaves has to be renewed every 2-3 years. Corrugated iron or aluminium sheets covered with leaves last longer, but are more expensive. Corrugated iron only is not recommended, because of its bad insulation properties (hot in warm periods and cold in low temperature periods). Moreover, it causes condensation and the drips make the floor wet.

Whatever materials are used, the roof must slope sufficiently. If possible, it should be constructed so that the longest slope faces the prevailing wind and rain direction. In most cases it is advisable to build lengthwise from east to west.

If there is an opening between the walls and the roof, make sure that the roof has enough outside overhang to prevent rain from entering. In hot countries, an open roof ridge (see figure 5) helps to keep temperatures down.

Floors and bedding

The floor of the pen should be slightly raised above its surroundings, with a slight slope to avoid flooding in wet periods. A slope of 3 cm per metre also allows the liquid manure to run off more easily. Build a drain at the lowest part of the run so that run-off and manure can be collected into a pit. Pig manure is a good fertiliser so it is important to collect it. The floor can be of compacted soil or loam; it should be kept hard and smooth so that it can be easily swept clean. Wooden floors are not advisable: they are difficult to keep clean, and the pigs chew on them. Wood rots and can be very slippery.

If cement is available a concrete floor is a possibility, and for intensive farms this is advisable. It is important to make the floor at least 10 cm thick and the ratio of cement, sand and stones should be 1:2:3 (mix 1

part cement with 2 parts sand and 3 parts stones). The concrete should not be so rough that the animals can scratch themselves on it. But a floor that is too smooth is also dangerous, as the animals may slip and injure themselves. To improve a floor that is either too rough or too smooth, throw a few shovels of soil into the pen every day after cleaning. This is not only a precaution against accidents, but it is also healthy, as the animals will absorb valuable minerals (e.g. iron) from the soil. Take care where you collect the soil from. It must be 'clean' soil, not contaminated by free-ranging pigs or wild pigs!

The disadvantage of concrete is that it is a bad insulator. In hot weather the animals can take advantage of this by lying on the cold concrete to cool down, but in cold weather they will lose too much body heat. For the younger animals it will be too cold, which increases the risk of diseases like pneumonia. The coldness of the concrete can be reduced by supplying bedding material in the pen. For young piglets a piece of cloth or some wooden planks can be put on the floor. Wet bedding material should be removed daily to keep the pen clean and to avoid any parasite build-up. Bedding mixed with dung and urine makes an excellent fertiliser for the fields, especially if it is first converted into compost (see last paragraph in this chapter).

The walls

The construction of the walls depends on the climate. In the tropics they should be left as open as possible for good ventilation. A low wall approximately 1 metre high will suffice, with an opening of at least 1 metre between the wall and the roof. The wall in a boar's pen should be at least 1.2 metres high. In windy areas, the roof (or ceiling) should not be too high; otherwise the pen will cool down too quickly during strong winds. Completely open walls, made of wire netting for example, are not recommended, as pigs like to shelter from wind and rain. In higher and colder areas, the walls should be constructed in such a way that it is possible to close the openings under the roof completely. In the daytime, when temperatures are higher, the top section of the walls can be opened, and then closed again towards evening to keep the warmth in. It should be possible to close the side exposed to the

rain completely. In places where the temperature differences are not extreme, the house can be open, but you can make a small area with a warmer microclimate by covering (part of) some pens.

If the walls are made using traditional mud and wood techniques, a protective row of hard wooden poles should line the inside. This will prevent the pig from digging into the earthen wall. The walls can also be made of boards or bamboo poles. A row of small tree trunks will provide a simple wall, even though the wind can enter more or less freely. Part should be closed, with a wooden structure where the pigs can shelter.

Cement and brick walls are most expensive, but they are stronger and last longer. They also make it easier to maintain good hygiene, as they are easy to clean. If the supply of cement is limited, priority should be given to using it for the floor.

Feeding and water troughs

Feeding can be done inside or outside. In places with long rainy periods it is advisable to feed the pigs inside. Especially young pigs tend to eat more when their feed is indoors. Water can be given outside. This forces the pigs to leave the pen and they will then excrete outside. The feed trough can be made of cement, iron, hardwood or plastic. The trough should be long enough for all the animals in the pen to feed from it at the same time. Sows need 40-50 cm of space, while fatteners weighing 90 kg need about 30 cm. Instead of a long trough, a self feeder can be used for a group of 10 fatteners or weaners. The water trough should not be too wide; otherwise the pigs may try to bathe in it. If it is large, fix an iron bar above the water trough.

Animals of different sizes (e.g. weaned piglets and fatteners) should not be kept in the same enclosure. Weaker animals may be bitten and do not get enough to eat when feeding. The stronger animals will fatten at the expense of the others.

If for one reason or another, animals of different age and size have to be kept together, precautions should be taken to ensure that they do not get in each other's way when feeding. The way to do this is to give each animal or group of animals a separate feeding space (a feeding box) by enclosing them inside railed-off sections. These sections have to be closed from behind and can be of metal or wood.

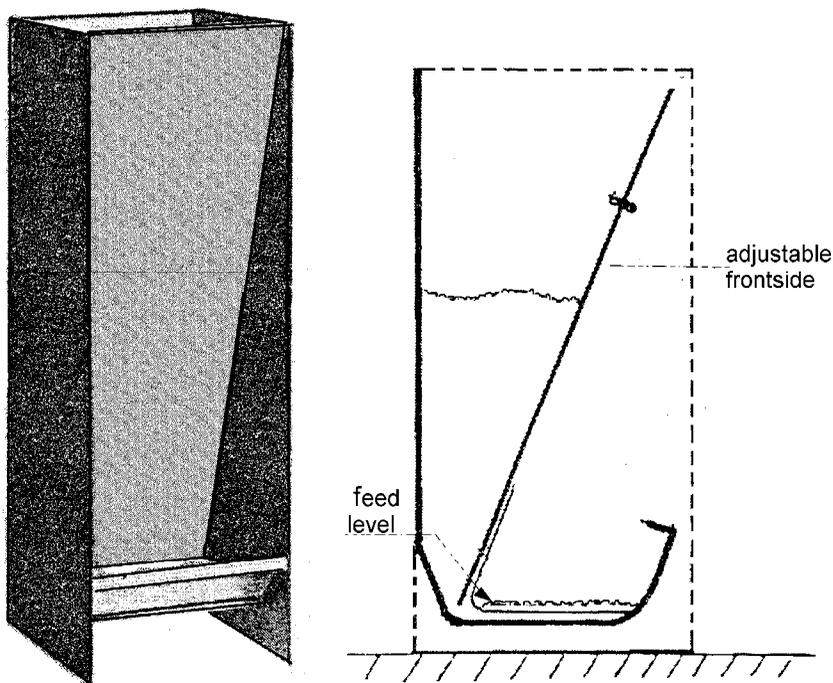


Figure 6: Self feeder

If temperatures in the pen rise too high, the pigs will suffer from heat stress. They will start to urinate and defecate in their resting places to cool themselves down in the dirt. In such cases, showers or sprinklers can cool down the pigs.

Size of pens and runs (dung area)

Figure 7 shows an enclosure that is suitable for all types of pig. If there is a run, the animals will get into the habit of going outside to excrete. You can encourage this by ensuring that the covered pen is not too big. Provided that the doorway is wide enough, the inside area of the pen need not be very large.

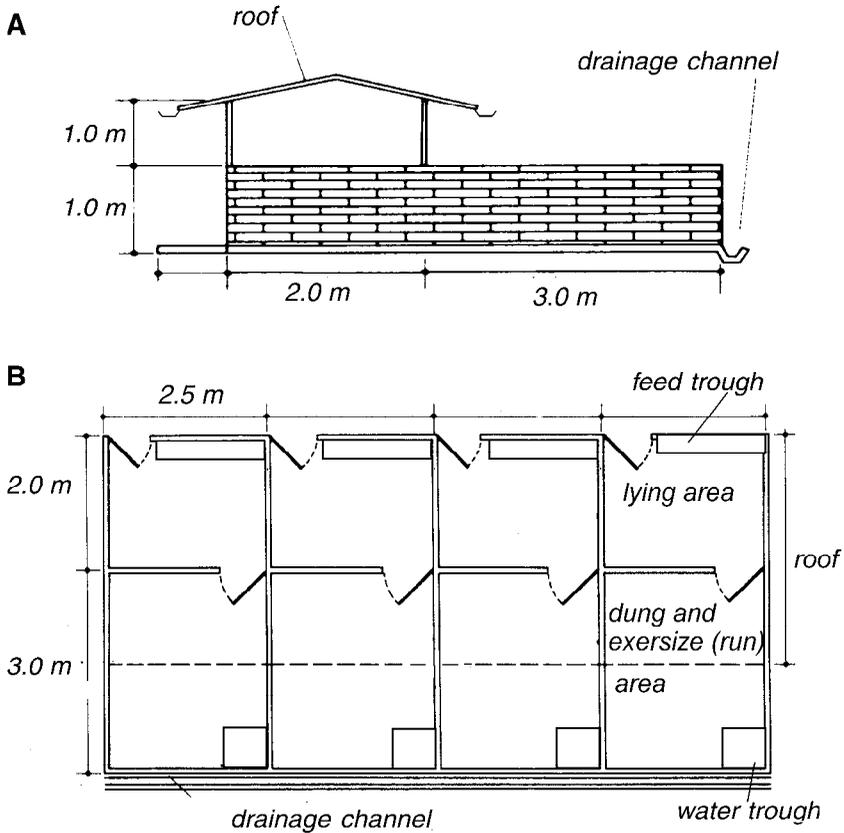


Figure 7: Pen and run for all types of pigs (A: side view; B: top view)

Pigs need three areas in their housing: a resting place with good ventilation and a comfortable temperature; a clean feeding area with a feed-

ing and water trough; and a toilet area for excretion. A pen designed in this way encourages pigs to exhibit their natural hygienic behaviour and keeps the resting and eating places clean. In large intensive pig farms, these three areas are mostly all in one room. This kind of housing often has small holes in the floor (slatted floor) so the manure drops through and is stored underneath.

A pen measuring 2×2.5 m is adequate for a sow with a litter of piglets. The run should be at least 1.5×2.0 m. A pen for 8-10 weaners should be at least 2×2 m. A pen for 10 fatteners should be about 3×3 m, depending on size and weight at slaughter. Allow roughly 1 square metre per fattener. A pen of 2×2.5 m is big enough for 2 sows. A pen of 2.5×2.5 m is suitable for 3 sows.

The pen in Figure 7 is suitable for all types of pig. For the piglets a trough in a separate corner is necessary so that they can feed on their own, away from the sow (see next paragraph).

If preferred, the troughs can be placed along the walls of the run instead of in the covered area.

Housing the sow and her piglets

Newborn piglets must be protected from cold. Plentiful quantities of good dry bedding or a piece of cloth or wood should be available to keep the piglets warm. It is also possible to cover the piglet corner with a piece of board. If this is not enough, and you have the means, a heating lamp should be installed in a separate corner of the pen for the first few weeks.

The piglets should, if possible, be given a secure place of their own in the sow's pen, but close to her. This is because there is always the risk that the sow will accidentally kill her piglets by lying on them. To make it impossible for the sow to crush her piglets against the walls, inside the pen a horizontal rail should be installed parallel to each wall, 20-25 cm away from the walls and at a height of 20 cm from the floor.

Farrowing crate

Another, even better solution to prevent piglets from being crushed during and after birth is to use a movable farrowing crate. This is a kind of cage that confines the sow and limits her movement, and is made of iron or wooden bars. There is a door at the back of the crate and in some cases there is also a door at the front. Bars across the top prevent the sow from climbing out. The crate is installed in the pen and just next to it a warm spot is provided for the piglets, so they remain in close contact with the mother but can move freely about and away from her as they please. The dimensions of the farrowing crate depend on the size of the sow. For smaller types the crate should measure about 60 × 180 cm and for the larger commercial breeds 65 × 220 cm.

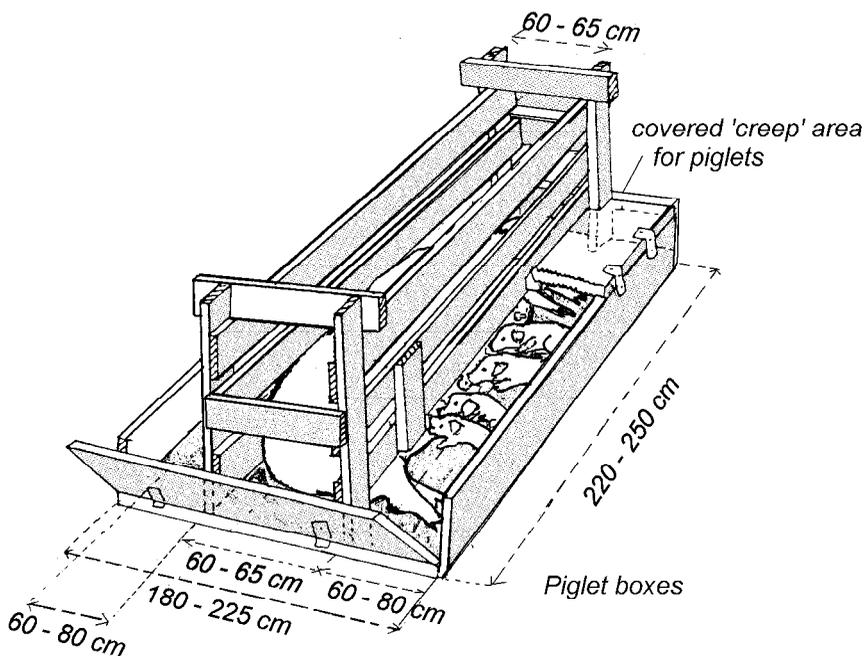


Figure 8: Farrowing crate with covered 'creep' area for piglets

Piglet boxes

Figure 8 illustrates a ‘piglet-box’. This is a farrowing crate combined with a special ‘creep’ area where the piglets are kept warm. The box allows the piglets to crawl away from the sow to a bedded area on either side of her. After a few days the extra shutters can be removed, so that the piglets can run freely about the pen. This system has proved very successful; the piglets nearly always prefer the protective ‘creep’ rather than lying against the sow. The sow should be kept in the farrowing crate for at least two weeks after farrowing. In intensive farms the sows remain in the farrowing crate until weaning.

Before using the crate for the next sow it should be thoroughly cleaned. When the sow leaves the crate, the piglets must be given a warm place. This could be in a separate corner of the pen, where they can be introduced to special piglet feed and kept safely until they are weaned.

Housing fattening pigs

Pens used for fattening pigs are simpler. You should not keep more than 15 fattening pigs in one pen, and a simple pen with or without a run will suffice. A lying area of 1 square metre per fatterer should be allowed.

Housing breeding stock

In semi-intensive systems, the breeding sows and boar can be allowed out occasionally on a fenced piece of land, as this is good for their general condition. The danger of parasite infection and disease spread must be taken into account when putting the animals out in a paddock (see Section 6.4).

In intensive systems pigs are not usually allowed outside, although there are situations where breeding animals, especially pregnant sows, are allowed to scavenge. If pigs do go outside, it is very important to follow a strict de-worming programme and, if possible, to have more than one enclosed outside area so that a rotation scheme can be used.

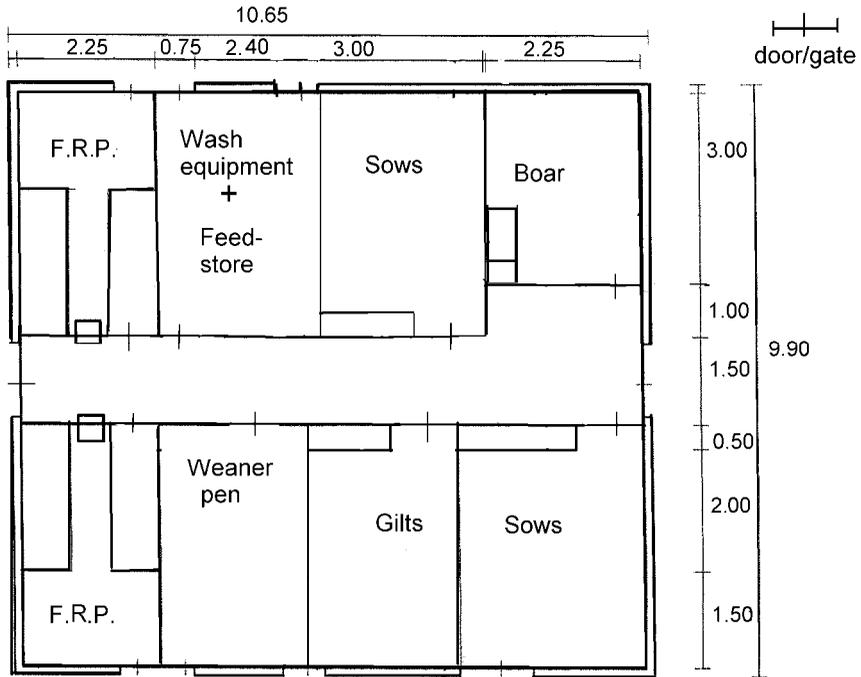


Figure 9: Layout of a 5 sow unit, FRP = Farrowing and rearing pen

Using liquid and solid manure

Pig urine and dung are good fertilisers for crops and vegetables, and can also be used on pastures, so it is wise to make good use of them. Before using the dung it is best to let it decompose first by leaving it in a heap separately. Pigs enjoy chewing their litter and playing with it, so it is good to give them plenty of any kind of organic matter for this purpose. The litter and dung should be left to rot for at least a few months. Protect the heap of waste from the sun and rain, as this will improve the quality.

Pig keeping combines well with on-farm fish culture. Apart from spreading it on the land, pig manure can be used to fertilise a fish-pond. The manure, or a small amount of the rich run-off from the pens, will stimulate the growth of natural fish food and water plants.

This increases the food available for the fish, which in turn grow faster. In addition, surface water plants such as *Ipomoea reptans* grow more rapidly and provide excellent green fodder for pigs. For further information on this combination see Agrodok No. 21: **On-farm fish culture**.

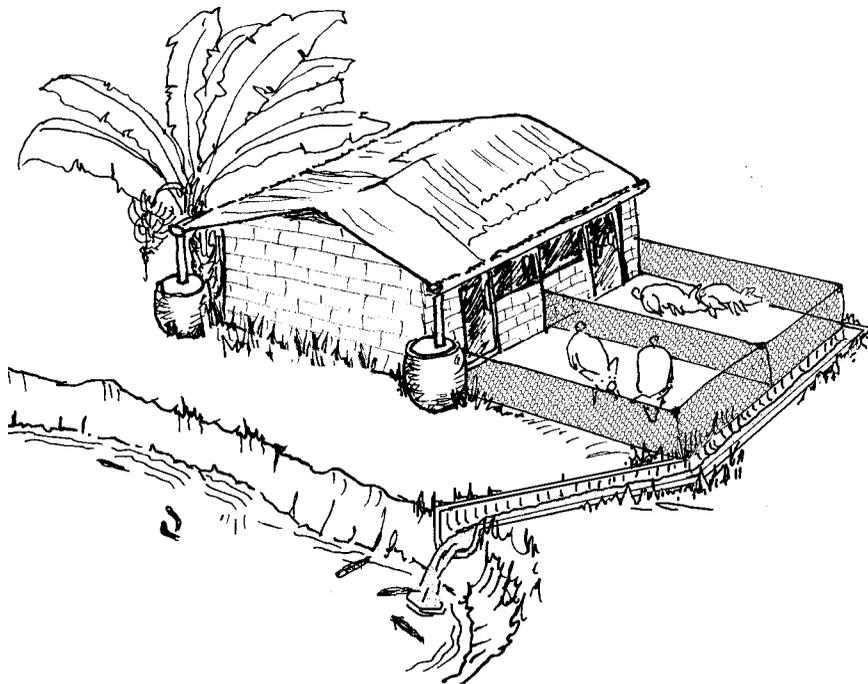


Figure 10: Pig keeping combined with on-farm fish culture

4 Pig breeding and reproduction

4.1 Breeding sows

Sows that are to be kept for breeding should be selected and separated from the other pigs at about 3 months of age. They should not be allowed to grow too fat because this will create fertility and leg problems. They should get some exercise so that they stay in good condition and particularly so that their legs develop well.

Young sows are mature enough to conceive at about 6 months of age but they should not be served (mated) too early, as it is better to wait until they reach a reasonable weight. Well-fed and healthy gilts (young females for replacement) will usually be ready at about 8-10 months, when they should have reached about 60% of their adult weight. For the large commercial breeds that is at least 120 kg. Mating too early will result in small litters, birthing problems, loss of condition and poor growth of the sow. In fact a sow that is bred too early will never reach her normal end weight.

Selecting sows for breeding

When selecting the sows to be kept for breeding, the following points should be considered:

- They should have at least 12 normal teats. In well-developed farms they should have 14 teats, preferably 7 on each side.
- They should be the biggest and the healthiest of the litter.
- They should have strong legs and walk well.
- Their parents should be good breeding animals, capable of producing good sized litters at regular intervals.

Selecting the best females for breeding and giving them good housing and proper care are the essential steps towards improved breeding practice. It is also worthwhile investing in a good boar, and this is discussed in section 4.2.

Recognising the heat (oestrus)

The sow's oestrus condition should be checked at least twice a day (in the morning and in the evening). This should be done around feeding time. Differences in breed and climatic variations in the tropics can make it difficult to recognise oestrus.

Signs that may be observed include:

- 1 Redness and swelling of the vulva, more obvious in gilts than in sows.
- 2 Sows in the pen start to mount the sow in heat, or the sow in heat tries to mount the other sows.
- 3 Sows in heat usually do not finish their feed.
- 4 Sows in heat sometimes produce a special grunting noise.
- 5 If there is a boar nearby, the sows will try to make contact with the boar. They will go to a place in the pen where they can see or smell the boar. Therefore it is advisable to house sows that are to be served next to the boar pen.

You should start looking for signs of heat no later than 3 days after weaning. If some of the signs listed above are seen, you can try to provoke the 'standing reflex' described below.

When the sow enters the boar pen, the boar will nose the vulva and prod the sow in the belly and flank. If the sow allows this, the boar will try to mount her. The sow will stand rigid, with her rear legs a little apart. Large White sows typically prick their ears. It will be difficult to move the sow to another place. The sow is now showing the 'standing reflex' and is in heat.

Even without a boar, the standing reflex can be provoked in a good oestrus sow, although it is less easy with gilts. Approach the sow quietly and prod her gently in the flanks with your hands. Then press down gently with both hands on her back. If the sow allows this, you can try to sit on the back of the sow. If the animal does not move from her position she is in heat and ready to receive the boar. If the signs of heat are obvious, but the sow refuses to show the standing reflex, put

her in the boar's pen and here it will become clear whether the sow is in heat.

Gilts coming in heat for the first time should not be served immediately. They are still too young and their bodies are not yet strong enough to carry and deliver a good litter. Gilts in good condition can be served for the first time after they have come in heat regularly at least twice and when they have reached a reasonable weight (keep records, see Chapter 7). If possible, let a young boar that is not too heavy do the job, as gilts are too small for a heavy boar.

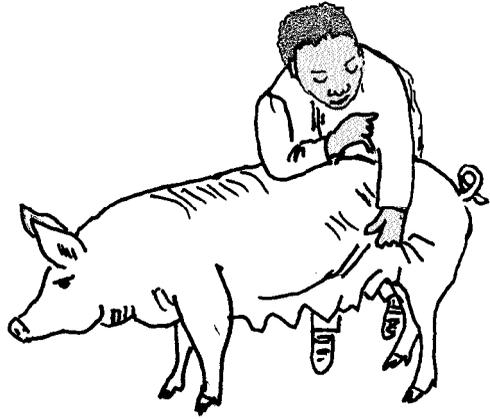


Figure 11: Standing reflex

Timing the service

Once a sow has farrowed she will not come in heat for some time. Most sows come in heat again in the week after weaning their litter and the majority will show heat 4-7 days after weaning. Therefore most farmers wean their pigs on a Thursday or Friday. Checking for heat and servicing will then take place on normal working days and not in the weekend.

Sows should not be served by the boar at the very beginning of the heat nor at the end, as this will result in smaller litters. There is an optimum period during the heat for service. On intensive holdings, a sow is usually served 18–24 hours after the standing reflex has been provoked (without the boar). Check for the standing reflex at least twice a day, as it is important to time servicing (or insemination) accurately. A practical guideline is: if a sow shows the first standing reflex in the morning, let her be served in the evening. If the first standing reflex is

in the evening, let the sow be served the next morning. If, one day after the service, the standing reflex is still clear, the sow can be served again. Note also the colour inside the vulva. At the beginning of the heat it will be very red. In the middle of the heat, when the sow is most fertile, the colour changes from red to slightly pale. By the end of the heat, the colour is even paler; now it is too late for the sow to be served again.

Timing of servicing requires quite a lot of experience, in particular because the heat period can vary from sow to sow. Sows with a short heat period, for example 1.5 days, must be served between 10-16 hours after the onset of the heat. So if the heat occurs the first time in the morning, it means it may have started already the evening before, and one should not wait too long before servicing. This may also be the case with gilts. When sows have a long heat period, for example 3 days, one can wait 24-30 hours (from the moment that the first standing reflex was observed) before allowing her to be served. Generally, sows that come in heat shortly after weaning (4-5 days) have a long heat period. Sows that come in heat 6 or more days after weaning have a shorter heat period.

In very hot conditions the heat period is shorter and less obvious. If there is any doubt about the best moment, or if the heat was only detected after introducing the boar, it is better to mate them twice after noticing the oestrus – preferably at the end of the first day and at the beginning of the second.

Mating should take place during the cooler hours of the day: early in the morning and/or late in the afternoon. Mating can take anything from 5 to 20 minutes. The animals should not be disturbed, but it is advisable to supervise the whole servicing operation. Heavy boars can be assisted by supporting their front leg with one's own leg. If boars are very heavy, it is difficult to use them on small sows. On bigger farms a young boar is kept for the gilts and an older boar for the older sows.

Three weeks after mating, check carefully for oestrus. If there is no sign of it, the sow is usually in-pig (pregnant).

Feeding

In the weeks before mating, gilts and sows should be well fed (if possible protein-rich feed, and/or bigger quantities), as they must be fit and strong for mating. Good feeding will also result in more eggs being available for fertilisation.

On a well-run intensive farm a lactating sow is already being fed a protein-rich ration (see 5.4) and this should be continued until she has been served. After mating, the protein level and the quantity of feed can be reduced to normal. Later on, in the final month of pregnancy, the sow will need more feed again, because the piglets will be developing fast inside her. Good feeding at the end of pregnancy will increase the birth-weight of the piglets, and piglets with a good birth-weight have a higher survival rate.

4.2 Selecting and working with the boar

Buying a boar is a serious investment, as it involves a number of costs: travelling in search of a good animal, transport costs and the purchase price. The costs can only be recovered if conditions on the farm allow. Buying a boar is therefore a project that a group of farmers may wish to undertake together. It is also very useful to exchange boars between neighbouring villages, in order to avoid the problems of in-breeding. For this reason it is better not to select a breeding boar from your own herd, as the risk of in-breeding is high. Crossbreeding is done by using a boar of a different breed than the sows. Crossbreeding makes sows more productive, and this is called the heterosis effect.

Selecting the boar

Selecting a boar is even more important than choosing the breeding sows. In choosing a breeding boar, the same factors should be taken into account as for the sows; this includes the presence of at least 12

good nipples. It is also very important to select a boar from a large, healthy and well producing sow and to select only the biggest males of the litter. Avoid choosing a too highly in-bred boar (in-bred means that the boar and sow are related, for example brother and sister) from your existing stock, as in-breeding will lead to reduced fertility, poor growth and lower levels of disease resistance.

Managing the boar

Young, healthy and well-developed boars are ready for mating for the first time when they are 9-10 months old. The first sow they serve should be of their own size or smaller. In the early stages the young boar should not serve more than 1 sow per week. The number of services can gradually be increased as indicated in Table 1. If a boar mates more often than this, his health and productivity will suffer. It is advisable to work carefully with boars, as they may be aggressive.

Table 1: Frequency of services of a boar in relation to its age

Age of the boar	Services	
8-10 months	Once per week	At this stage you should check that the boar serves properly, and that the sows served by him are getting pregnant
10-15 months	Max. 3 times per week	The number can be increased gradually to 3 per week
15 months or older	4-5 times per week	Boars need rest periods. There should be no more than 20 services per month. Older boars can occasionally be allowed to mate twice a day, but never more than 6 times a week, with a maximum of 20 times a month.

In countries with a hot climate, a single boar will suffice to serve between 10 and a maximum of 20 sows. It is nevertheless advisable to keep at least 2 boars, an older heavier boar for the bigger sows and a younger lighter one for the gilts. A boar can function well until about 4 to 5 years of age. Over the age of 2.5 or 3 years a boar may become lazy or too heavy. If this happens a younger boar should take over and a new young boar must be selected, or brought in for the young sows. If you select your breeding gilts from your own herd, it is important to realise that a boar will meet his own daughters, roughly 1.5 years after

he starts serving. A boar should not service his own daughters, so on a small farm with only one boar, this boar must be exchanged for another one. If the boar is still working well and not too heavy, he could be exchanged for a boar from a nearby farm.

It is important to record the boar's activity and the results obtained, so that his performance can be assessed. The fertility of the boar is indicated by the size of the litters he produces and the percentage of sows in-pig after a first service (insemination rate). See Chapter 7 for details on what to record and how.

On a large farm, the boar can be compared with other boars and this information can be used to make decisions about keeping or replacing him. It is important to remember however that the quality of the sows and right moment of insemination or service also influence litter size and pregnancy rates.

Care of the boar

Boars should be kept neither too lean nor too fat. They need plenty of exercise. Under very hot conditions or when suffering from fever, boars can remain infertile for a long time. A boar that is ill should rest for 1 to 2 months and another boar should do the servicing for this period. Boars should be housed in individual pens, separate from the sows. If they are housed with sows it becomes impossible to tell whether and when certain sows were served, and whether or not they are pregnant.

4.3 Birth and care of newborn piglets

On average piglets are born 113-116 days after conception (3 months, 3 weeks and 3 days). About 90% of sows farrow after 114 or 115 days. After the service, one can easily calculate the expected farrowing date by adding 4 months minus 8 days. The sow will usually farrow during the evening or night. In the last 2 weeks of pregnancy the udder will increase in size. It feels firmer and the nipples stand out more. In gilts the udder starts to develop after two months of pregnancy.

Table 2: Farrowing table

Date of mating	Expected farrowing date	Date of mating	Expected farrowing date
Jan 1	Apr 26	Jul 5	Oct 28
Jan 6	May 1	Jul 10	Nov 2
Jan 11	May 6	Jul 15	Nov 7
Jan 16	May 11	Jul 20	Nov 12
Jan 21	May 16	Jul 25	Nov 17
Jan 26	May 21	Jul 30	Nov 22
Jan 31	May 26		
Feb 5	May 31	Aug 4	Nov 27
Feb 10	Jun 5	Aug 9	Dec 2
Feb 15	Jun 10	Aug 14	Dec 7
Feb 20	Jun 15	Aug 19	Dec 12
Feb 25	Jun 20	Aug 24	Dec 17
		Aug 29	Dec 22
Mar 2	Jun 25	Sep 3	Dec 27
Mar 7	Jun 30	Sep 8	Jan 1
Mar 12	Jul 5	Sep 13	Jan 6
Mar 17	Jul 10	Sep 18	Jan 11
Mar 22	Jul 15	Sep 23	Jan 16
Mar 27	Jul 20	Sep 28	Jan 21
Apr 1	Jul 25	Oct 3	Jan 26
Apr 6	Jul 30	Oct 8	Jan 31
Apr 11	Aug 4	Oct 13	Feb 5
Apr 16	Aug 9	Oct 18	Feb 10
Apr 21	Aug 14	Oct 23	Feb 15
Apr 26	Aug 19	Oct 28	Feb 20
May 1	Aug 24	Nov 2	Feb 25
May 6	Aug 29	Nov 7	Mar 2
May 11	Sep 3	Nov 12	Mar 7
May 16	Sep 8	Nov 17	Mar 12
May 21	Sep 13	Nov 22	Mar 17
May 26	Sep 18	Nov 27	Mar 22
May 31	Sep 23		
Jun 5	Sep 28	Dec 2	Mar 27
Jun 10	Oct 3	Dec 7	Apr 1
Jun 15	Oct 8	Dec 12	Apr 6
Jun 20	Oct 13	Dec 17	Apr 11
Jun 25	Oct 18	Dec 22	Apr 26
Jun 30	Oct 23	Dec 27	Apr 21
		Dec 31	Apr 26

Preparation for birth

About a week before the expected delivery date the sow should be put in a separate pen, which has been cleaned and disinfected first. About 3-4 days before going into the pen, the sow should be de-wormed (see Chapter 6). On the day that she moves into the farrowing pen, wash her with soap and lukewarm water and treat her for lice and mange. The sow is now clean inside and outside and will not be re-infected because the pen is also clean. If there is any risk of disease for the newborn piglets, the sow and the pen should be washed and disinfected again 2 days before farrowing.

If a farrowing crate is not used, the sow should have some straw and litter to make a nest for the piglets. If she is in a crate, put bedding material or a piece of cloth in the corner of the pen, which will serve as a nest for the piglets. A box can be put in the pen to create a good micro-climate for the piglets. In (semi-) intensive units a heater or heating light is often supplied.

On the day of farrowing the sow should not be given her normal ration but only very little feed (about 0.5 kg per day) If the sow is constipated, provide laxative food (e.g. green fodder).

Birth

About a day before the birth of the first piglet, the udder will start to look much redder. A white or clear fluid can now be extracted from some of the teats. The sow will be livelier, alert and restless, and she may start to bite. She scrapes the floor with her forefeet and sweeps the straw bedding into a corner with her snout to make a nest.

Just before delivery, the udder will swell and the sow will calm down. Just before the birth of the first piglet, a bloodstained fluid oozes from the sow's vagina. In gilts the fluid may be released earlier. During the birth the piglets are still enclosed in a membrane, which will usually break open when the piglets are born. Piglets are born in the head-or-tail position. On average a piglet will appear every 15 to 20 minutes, but particularly small piglets may be born in very quick succession.

Many piglets are born still attached to the umbilical cord. This can be left, as it usually soon breaks off on its own.

The sow may expel some of the afterbirth between delivering each piglet, but it is usually expelled all at once, 30-60 minutes after the birth of the last piglet. If the afterbirth has not been completely expelled one hour after delivery has finished, seek veterinary assistance. Remove the afterbirth from the pen after it has been expelled.



Figure 12: The sow and the newborn piglets

Piglets that are born prematurely (at 110 days or earlier) have parchment-like skin, which is often very red, with no hair or only very short bristles. They may have misshapen feet, screwed-up eyes and difficulty in breathing. They wander around the pen trying to find the udder. Most of them will not survive. Normally about 5-7% of piglets are still-born (born dead). Older sows have a higher percentage of still-born piglets. Although there are normally few complications at birth, it is advisable to be present during the birth process. Problems that can occur during the birth are treated in 4.4.

Care of newborn piglets

A few minutes after the birth, pull the umbilical cord away gently or cut if necessary (to about 5 cm length). After the birth the navel of each piglet should be soaked in iodine solution to prevent inflammations.

If no heater is available, each piglet should be rubbed carefully dry with a cloth and put onto the udder. Their sucking will encourage the sow to farrow and to let down her milk. It is important that the piglets

immediately take advantage of the valuable colostrum that will protect them in the coming weeks against diseases (see 4.5).

You can help piglets that have difficulty in breathing (weak irregular breathing), or that appear to have died, by holding their hind legs up in the air. Stimulate their breathing by pressing their chest (thorax) rhythmically. Pouring a little cold water over their head and chest can help, but the piglet should be dried off immediately afterwards.

In some cases, it may be necessary to trim the piglets' teeth to prevent them biting the udder. More information about this is given in 4.6.

If the sow does not produce enough milk, the piglets should be transferred to another sow. This is only possible if there is another sow, that has farrowed within the last 3 days, and if not all her teats are being used by her own piglets. If this is not possible, they will have to be given extra food by hand (see 4.5).

Anaemia

Young piglets kept on concrete floors may quickly develop serious anaemia (a shortage of iron in the blood), because the sow's milk does not contain enough iron to cover the piglets' needs. After about one week they become pale and their rate of growth drops. They may develop a fat neck.

Anaemia can be prevented by putting a shovel of 'clean' iron-rich soil or compost into a corner of the pen every day. Clean soil is soil that has not been in contact with other pigs, so that there is no danger of worm contamination. The piglets can rummage around in it and take up some of the iron in the soil. Most red, brown and yellow soils in the tropics contain adequate iron. In (semi-) intensive farms piglets are injected with an iron preparation at the age of 1-3 days. Wood ash can also be put into the pen. This will not provide iron, but it does contain other important minerals (see 6.7).

4.4 Problems related to the birth

Although there are normally few complications at birth, it is advisable to be at hand. If the whole process of delivery takes longer than 8–10 hours, or when the period between 2 piglets takes longer than 45 minutes, there may be something wrong. In particular, the last piglets may be born in the membrane and will suffocate if they are not taken out. It is also true that sows do not pay much attention to their offspring until the whole litter has been delivered. Piglets that quickly go in search of milk may easily be crushed if the sow lies down again in the course of the farrowing.

A sow will not always accept human company while she is farrowing. Remain at some distance and be ready to intervene only if it appears really necessary.

Slow delivery

If the delivery seems to have started but the first piglet is not coming, it may be necessary to help it out by hand. For this, the utmost hygiene is essential; the sow's rear part should be thoroughly cleaned and disinfected, as should the operator's hand and arm. Grease the hand, arm and the vagina with vegetable oil (avoid soap) and work the hand slowly into the vagina with a slight rotary movement. Simply doing this may induce the sow's contractions and she will push the piglet out. If not, piglets can be pulled out by putting the middle finger in the mouth of the piglet and closing the mouth with two other fingers.

To speed up the birth process, the sow can be injected with 1-2 cc of oxytocin (depending of the size of the sow), which can be bought under different names. It is advisable to check that the birth canal is not blocked before injecting the oxytocin.

If the piglets are really too big, a caesarean operation is the only solution. If there is no vet at hand this may not be possible and the sow will have to be slaughtered.

Accidental killing of the piglets by the sow

It is quite normal for sows to try to eat the afterbirth and any still-born piglets. In general it is not advisable to let sows eat their afterbirth. Some sows, especially young gilts, can be aggressive towards their piglets. The reason for this is not clear. During farrowing an inexperienced mother may become frightened by the newborn piglets; she may try to avoid them and start biting. If this happens, the piglets should be put in a box and kept warm for some time (e.g. with a heating lamp). The mother will usually quieten down. If she doesn't, she could be given some beer (1 or 2 bottles) after farrowing. If available, a tranquilliser (or sedative) such as 'Stressnil' can be injected. If the problem occurs frequently, one can try putting a rabbit in the sow pen (only when the sow is in a cage) a few days before the farrowing date. The sow will try to bite the rabbit, but will not be able to. After a few days the sow will give up, and after farrowing she is more likely to be relaxed.

The sow becomes ill after farrowing

The most common disorder affecting sows after farrowing is an inflammation of the uterus (metritis) or of the udder (mastitis). Sometimes these are found in combination. The sow appears dazed, refuses to get up and to eat, and is feverish.

Metritis

This is recognisable by a whitish-yellow and ill-smelling discharge from the vagina (a small amount of reddish mucus is normal for a few days after the birth, and is not always very significant). At any sign of a bloodstained, ill-smelling liquid exuding from the vagina, checks should be made to see whether there are any piglets remaining inside. If so, they must be delivered as described in the paragraph above on 'Slow delivery'. Take the sow's temperature. If it is higher than 39.5 °C and if the sow is not eating well, she should be treated with oxytocin and antibiotics (see paragraph below on mastitis). If the sow does not come on heat again within about 4 weeks after weaning, then she should be slaughtered.

Mastitis

In this case one or more of the udders may become hard and swollen, turning red to reddish-blue in colour. This usually starts at the rear part of the udder. Milk production drops rapidly and the piglets become hungry, starting to squeak and screech. The sow usually has a temperature of over 39.5 °C and she must be treated at once. As soon as possible, give her a 5cc injection of oxytocin (always read the label first) and an antibiotic (penicillin, streptomycin or (oxy) tetracycline). If this treatment has had no effect after 24 hours, it should be reviewed.

Constipation

It is normal for sows to eat less or stop eating completely shortly before farrowing. This can however bring on constipation, and a constipated sow will eat even less food and neglect her newborn piglets. Constipation can be eased by laxative foods (leafy greens, fruits and high-fibre feeds, e.g. wheat bran). Oil or lard can also be mixed with the food. If the constipation persists, castor oil or Epsom salts can be given. The salts should be dissolved in a small quantity of water. In order to prevent constipation before farrowing, mix one or two table-spoons of Epsom salts with the feed each day and provide extra leafy green foods. The hungry piglets should be kept warm (with a lamp, box or bedding) and given additional feed of goat or cow's milk, or sweetened bean meal porridge. In extreme cases the piglets should be put on another sow or reared by hand.

4.5 Rearing motherless piglets by hand

If a sow dies shortly after farrowing, the piglets will have to be reared by hand, or by another sow. Rearing piglets by hand is very time-consuming and often unsuccessful. However in places where pig husbandry is well developed, special diets are available for motherless piglets. If these feeds are not available, try putting the piglets on another sow that has recently farrowed (less than 3 days ago). This will only work if that sow does not have too many piglets. Similarly, if a particular sow does not produce enough milk for her litter, some of her

piglets can be transferred to another sow. For that reason it is good, even on a small farm (e.g. with 6 sows) for the sows to farrow in pairs. If this does not work, or if no sow is available, the piglets will have to be reared by hand.

Put the piglets into a clean, straw-filled pen and keep them warm. If possible, hang a lamp for heating in the pen. The ideal temperature is 35 °C the first day, 30 °C during the first week (day and night), coming down to 26 °C after a fortnight. You can see whether the temperature is correct from the piglets' behaviour. If the piglets are all lying on top of each other, it is too cold and the lamp should be placed a bit lower. Throw some soil in a corner of the pen to prevent the animals from becoming anaemic, if the piglets have not had an iron injection.

Feeding orphan piglets

It is essential that newborn piglets receive colostrum straight after the birth to build up their natural resistance. Colostrum is the first milk that the sow produces after farrowing. If the sow dies whilst farrowing, the colostrum will have to be taken from another sow that recently farrowed. If the piglets get no colostrum, their chance of survival is very small.

Cow's or goat's milk can be given, perhaps sweetened with sugar or syrup, to piglets that have managed to obtain colostrum. Evaporated or condensed milk is also a good option. If no colostrum is available at all, milk can be mixed with the yolk of an egg. The milk should not be diluted, as sow's milk is very concentrated. It should be warmed up to body temperature (39°-40 °C)

If a sow dies whilst farrowing, her piglets will not have learnt to drink. The piglets can be taught to drink from a shallow trough by gently holding their snout in the milk. Clean the bowl thoroughly after every feeding. To avoid indigestion, do not give the piglets too much at one time. In order to encourage them to drink by themselves, make sure there is clean water in the pen at all times.

The feeding programme

Table 3 shows the number of feeds required each day for the first two weeks and the quantity of milk that should be given. After 14 days, increase the quantity of milk at each feeding, but start to decrease the number of feedings per day. Gradually change over to more solid feed, so that by the age of about 3-4 weeks the piglets should be able to take regular feed. If good commercial piglet rations are available, piglets can survive on solid feed from the age of 2 weeks. If no nutritious feed is available they should continue on milk for a while longer. The weaker piglets can be fed four times a day for a longer time.

The figures in Table 3 are maximum quantities – it is better to give too little rather than too much feed. Piglets should be able to finish the whole quantity in about 5 minutes. If not, reduce the quantities. The orphan piglets should move onto regular food as soon as possible. This should be of good quality, protein-rich and easily digestible. It should be remembered that, despite the amount of care they receive, hand-reared piglets will never grow as fast as those reared by a mother sow.

Table 3: Feeding programme for orphan piglets.

Age in days	Number of feedings/day	Quantity each time (ml)
1	6	30
2	5	40-45
3	4	60
4	4	70
5-7	3	80-100
8-9	3	120
10-11	3	140
12-14	3	160

4.6 Care and weaning of piglets

Teeth trimming

If the piglets prove restless or aggressive, or if the sow's teats are damaged, the piglets' tusk teeth should be trimmed. This will stop

them damaging each other as well as the sow's udder. Only the points of the teeth should be filed. If any more is removed there is a risk of damaging the mouth. In commercial units, the points are filed off with a drill. In small farms the teeth can be made blunt using a hand file or can be cut with a pair of pliers (Figure 13). If there are fewer than 9 piglets in a litter, teeth filing is normally not necessary.



Figure 13: Trimming the piglet's teeth

Castration

Male piglets are castrated to prevent their meat being tainted by an unpleasant smell. Boar taint occurs in about 2% of the male pigs that are slaughtered. However the percentage varies depending on climate and the growth rate of the pigs. In tropical countries boar taint may affect up to 5% of the pigs, and the figure may be even higher when pigs grow very slowly. End weight is also a factor: the earlier pigs are slaughtered, the lower the percentage that have boar taint.

In Europe, castration may be stopped completely in the future. At present it is only allowed under anaesthetic. Castration should be done in the first week of a piglet's life. The animals should be fit and healthy and if this is not the case it is better to postpone the operation. If slaughterhouses or butchers have no objection to slaughtering boars, it is better to fatten the pigs without castrating them.

Castration can be done by one person, holding the piglet between the knees. If two people are present, one person can perform the small operation while an assistant holds the piglet. The pen should be dry and clean. The assistant holds the piglet upside down in his hands, pulling the rear legs towards the piglet's belly.

Figure 14 shows the steps to follow:

- The scrotum is first washed and wiped with an antiseptic.
- One of the testicles is positioned against the skin and an incision is made, large enough to allow the ball to be eased out.
- The cord by which the ball is attached is then cut.

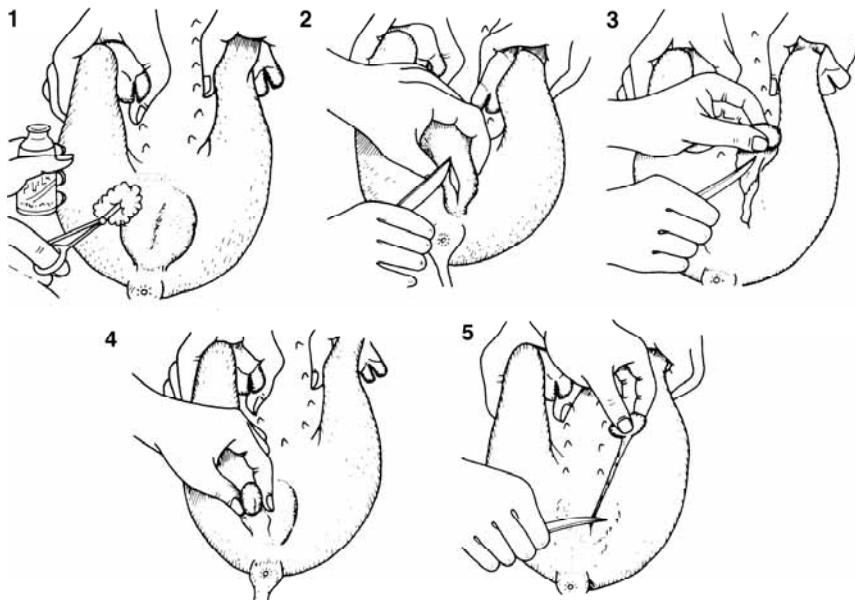


Figure 14: Castration of a young boar

The cord is cut using a special blade (or a very sharp knife) that has been thoroughly cleaned with disinfectant. Wash the wound thoroughly with disinfectant.

Weaning the piglets

Piglets should be weaned when they are between 4 and 8 weeks old. The age of weaning depends mainly on the availability of good creep feed and the weight of the piglets. Good creep feed is usually a sign that the management on the farm is also good. In this case weaning can be done at 4-5 weeks. On semi-intensive managed farms, it is bet-

ter to wean a bit later. If no good piglet feed is available, weaning should take place at 6-8 weeks.

It is best to remove the sow from the piglets, rather than leaving her in the pen and removing the piglets. This is because piglets should not be disturbed by the loss of their familiar nest. In the last few weeks that the piglets are with the sow, they should already have started getting used to eating solid feeds, and will then continue to do so. They will need protein-rich feed that is low in fibre, as they need to grow fast (see Chapter 5).

4.7 Fertility disorders

Poor oestrus show in sows

Sometimes sows do not come in heat at the expected time. Gilts should normally come in heat at 6-8 months of age, and sows should do so within 4-7 days after weaning their litter. If there seems to be no heat, it may just be that it has passed unnoticed. But it may also be a problem related to the health and condition of the animal, or a genetic problem passed down from the parents. Gilts that do not come in heat should be replaced. When selecting females for breeding, keep those that have a long and easily detectable oestrus period.

If a sow does not come in heat within 10 days of weaning, there are various possible causes:

- The suckling period has been too long and the sow is very thin. A slightly shorter period may help sows to come in heat.
- The sow is in very poor condition.
- She has been receiving low quality or too little feed after weaning. Minerals and vitamins are particularly important.
- Very high local temperatures ($> 35^{\circ}\text{C}$).
- The pen is too dark.

Oestrus can be brought on by:

- Taking the sow away from the piglets during weaning, rather than removing the piglets.

- Putting the sow in a pen next to the boar after weaning.
- Bringing her into contact with the boar regularly after weaning.
- Giving feed with sufficient protein, minerals and vitamins.
- Not feeding on the day of weaning and giving a good quantity of feed (about 2.5-3.5 kg/day, depending on the size of the sow) from the second day onwards until the day the sow is serviced. If the sow still has not come in heat 5-7 days after weaning, continue the feeding regime until day 10.
- If these measures do not work, try a hormone preparation (PG600) if it is available. This should be done in consultation with the vet or the livestock extension service.

Sometimes a sow that is apparently pregnant (i.e. no heats noticed after mating) does not give birth. In this case a problem may have occurred after mating, resulting in infertility or a miscarriage. This sow should be slaughtered.

Diseases leading to fertility disorders

Miscarriage (or abortion) is when a pregnancy ends before its proper term, and the foetus and placenta are rejected. Some sows eat this up very quickly, and as a result the abortion occurs without being noticed. Sometimes completely healthy animals will abort for inexplicable reasons, but this occurs very rarely. There is more cause for alarm if several cases of miscarriage occur on a single farm. This may indicate a disease-related problem, which could spread rapidly among the animals and to other farms. Brucellosis and leptospirosis can both result in the sow miscarrying. However, these diseases are not the only causes of miscarriage. Swine fever or swine erysipelas may be the problem. These diseases are described in Chapter 6. The vet or the livestock authorities should be warned as soon as possible. Diseases related specifically to pregnancy and fertility are described here.

Brucellosis (Contagious abortion)

Brucellosis in pigs is not caused in the same way as in cows, sheep and goats. An outbreak can result in sudden abortion by pregnant sows, followed by temporary or permanent infertility. The sows may

abort at any stage in their pregnancy. Some animals may become crippled (inflammation of the joints) and boars may develop an inflammation of the scrotum, with swelling and pain. There is no treatment for this. The disease may disappear after a while, but it often reappears. In most cases the whole herd will have to be slaughtered (and this is required by law in some countries). The entire holding should be cleaned and disinfected. No pigs should be allowed on the site for at least two months. New animals should be blood-tested by the veterinary service. An infected animal brought in from outside (such as a boar) is usually the cause. The disease can be transmitted by mating. If the sow is mated off the farm she may return with the disease. One should be very cautious when bringing outside animals onto the site: hygiene is very important. The disease can also be transmitted to humans!

Weil's Disease (Leptospirosis)

This disease is marked by sudden abortion by a number of sows, usually towards the end of their pregnancy. The piglets are often different in size. Sometimes very weak piglets are born at the normal time. After the abortion there is no loss of fertility in the sows, and the disease dies out of its own accord within a few months. During a leptospirosis epidemic, abortions can be prevented by giving all the pregnant sows two injections of dihydrostreptomycine in doses of 25mg/kg body weight, with an interval of one week in between each injection.

Smedi virus (PARVO)

Infection by the Smedi virus (PARVO) is very similar to infection by Weil's disease. Recently bought gilts in particular (who have not developed any resistance to the viruses present on the holding) may deliver a number of still-born piglets. These are often full-term or even overdue, but they will have died at different stages of the pregnancy, and will therefore vary in size. Once exposed to the disease, the animals develop resistance to it and future breeding can take place normally: these gilts should not be slaughtered

5 Nutrition

5.1 Introduction

Pigs, like humans, can eat everything, which means that their feed can be of both animal and vegetable origin. Although they accept most foods, this does not mean that the quality of their food is not important. Pigs will not thrive on grazing and fibrous feed alone. For pigs to be healthy and produce well they need to get enough to eat and good quality feed. Using a proper feeder will keep the feed cleaner and avoid spillage.

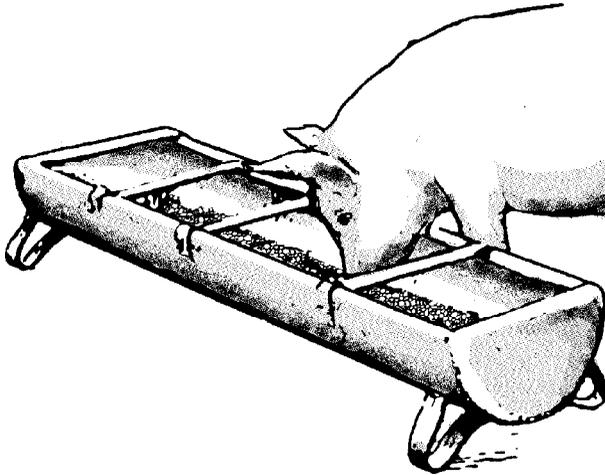


Figure 15: A good feeder avoids spillage, is easy to clean and the pig cannot lie down in it.

It is perhaps unfortunate that pigs share the same tastes and requirements as humans. This means that there may be direct competition for important elements in their nutrition: cereals, roots and tubers, milk and milk products. The best quality products should of course go to humans, and leftovers, by-products and lesser quality products go to the pigs.

In resource-poor areas, the use of good cereals, for example as pig food, should be considered very carefully. Normally pigs will have to make do with feed that is not directly useful to humans, and with waste products. These include agro-industrial by-products (bran, molasses etc.), kitchen waste, and garden or agricultural waste. The performance of the pigs, however, will depend on the quality of feed available for them.

5.2 Nutritional requirements

Water

Drinking water is the first requirement for all animals. Clean and fresh water for drinking should be available all the time. Pigs drink about 2-5 times as much as they eat, depending on the amount of moisture in the feed. Even if you feed them swill, it is advisable to have extra drinking water available. When an animal is under stress, due to heat or disease, it will stop eating but will need extra water to drink. A lactating sow with 10 piglets needs at least 25 litres of water per day!!

Clean the drinking pan or trough at least once a day. Modern drinking nipples are a lot cleaner, but should be examined daily to check that they are functioning properly. Although pigs like to wallow in water, to cool down or for fun, this is not necessary and they should not be able to lie down in their drinking water

Energy

A pig needs energy from its feed to be able to perform all its body functions and processes:

- It needs to keep its body warm (especially important in cold climates). All movement and body functions together add up to a total energy **maintenance** requirement.
- Additional energy is needed for **production**, which means growing, producing milk, developing embryos during pregnancy, etc.

Starchy and fatty products are the best sources of energy. The energy content of a feed is generally indicated in calories per kg. You can assess whether the pigs are getting enough energy by looking at their condition. When there is extra energy available, the animal will store it as body fat. If the pig is very thin, it means that there is a shortage of energy and the pig's productivity will be very low. However, if reproductive sows are too fat, their productivity will decrease.

Protein

Protein is necessary for physical development: growth, breeding and milk production. Protein is the most important nutrient in the body, because all organs, muscles and enzymes are made of proteins. In the feed, the protein quality is as important as quantity. Protein is composed of specific building blocks, called 'amino acids'. It is important that the pig gets the right type of amino acids because it uses these to build its own protein (muscle protein, milk protein etc.).

The best quality protein (and the highest protein concentration) is from animal products, like fishmeal, milk or meat meal. Some protein of animal origin should be included if possible, especially for the young animals, which need to grow a lot. (Compare with nutritional needs of children.)

By-products from plant oils also have a high protein content, e.g. soybean meal or groundnut cake. However cereals do not have enough protein and need to be supplemented with protein-rich products.

Minerals and vitamins

These play an important role in the animals' body. Calcium and phosphorus are very important minerals for building strong bones, but other elements such as iron, copper and zinc are needed in small quantities. In combination with vitamins, these are essential for all body processes and optimum production (disease resistance, energy utilisation, growth, breeding, lactation).

Naturally rich sources of minerals and vitamins are animal products and also succulent green materials, like vegetables. To make sure that the animal has no shortage of minerals and vitamins, premixes are available to supplement the pigs' diet. Commercial pig feeds also contain minerals and vitamins. Information on quantities to use (daily) is printed on the package; generally vitamins and minerals take up no more than 1% (10 g in a kg of dry feed) of the diet.

5.3 Feeding pigs according to their needs

Pigs, in contrast to cows and other ruminants, prefer feed that does not contain too much fibre. They have difficulty in digesting crude fibre, as unlike ruminants they do not have a composite stomach, in which micro-organisms can break down the fibrous materials.

When pigs have to find their own feed, they will consume the succulent parts of the roughage, but they need also to find roots or tubers, and they root up worms and insects to get the nutrients they need to survive and to reproduce. However, their productivity will depend strongly on what they find.

In pig production, the farmer is responsible for supplying feed every day. Pigs should be fed twice a day and always at the same times. The quality of the feed should be good enough to allow the animals to become strong and productive. In terms of the needs of the different pigs, this means that the young piglets require the best quality feed, especially after they are weaned off the very nutritious mothers' milk. At this stage, a lack of protein and minerals/vitamins will really slow down the development of the piglets.

Next in line for the high-quality feed are the lactating sows. They need to produce enough milk for their piglets, and can only do so if they receive enough nutrients themselves. The condition of the sow's body during the lactation period is a good indicator of whether she is getting enough feed. A sow with poor nutrition will only manage to raise a small litter of piglets, and if her condition is so bad that she has lost a

lot of weight, she will not be ready for the next reproduction cycle after weaning.

For optimal nutrition, the feeds should be adjusted to the needs of the pig, which means that different kinds of feed are used for the different ages and production stages. A commercial feed factory will produce a minimum of 5 different feeds (see also Table 4):

- *Sow feed*: preferably 2 different ones, because the quality of the sow feed for pregnancy can be lower than the quality of the feed they should get when they are producing milk (lactating). Boars can also be given ‘pregnant sow feed’. If only lactation feed is available, add some cheaper ingredients, like rice bran, fruits or vegetables, for the pregnant sows. This reduces costs.
- *Creep feed 1*: this is the highest quality feed for the youngest piglets. It should be put in the creep area where the mother cannot reach it. Feeding can start from 7-10 days after birth.
- *Creep feed 2*: for the young piglets, starting about 2 weeks after weaning. By now the piglets no longer need the very best, so they can eat cheaper feed. In some places piglets only get one type of creep feed until they weigh about 20kg.
- *Starter feed*: for young pigs over 20 kg (they should be about 10 weeks old) up to a body weight of 35-40 kg.
- *Fattener feed*: for pigs heavier than 40 kg that are intended for the slaughterhouse as soon as they reach the marketable weight (about 90-100 kg). The slaughter weight depends a lot on the market, but the older a fattener gets, the lower the feed efficiency (feed conversion rate) becomes.

The different categories of pigs are discussed separately because, besides the choice of the right type of feed, it is also very important how much to feed during certain periods. For the adult animals, some additional green materials are always beneficial (appetite, vitamins etc.). This does require extra labour, however, especially because the leftovers have to be cleaned out of the pens.

Table 4: Recommended nutrient concentrations in pig feeds (based on 'dry' feed, about 12% moisture)

Name of feed	Feed intended for:	Digestible energy in kcal/kg	Crude protein %	Dig.CP %	Lysine %	Cr. fibre % (max)	Calcium %	Phosphorous %
Creep feed 1	Suckling piglets, aged between 2 and 8 weeks	3400	21.0	17.5	1.45	2.5	1.1	0.7
Creep feed 2 or weaner feed	Weaned piglets, from 6 weeks up to 20 kg body weight	3300	20.0	16.0	1.25	4	1.0	0.65
Starter feed	Fattening pigs and replacement stock, from 20-45 kg	3100	17.0	12.5	0.95	6	0.9	0.6
Fattener feed	Fattening pigs from 40 kg to slaughter	3100	14.0	11.0	0.7	7	0.8	0.5
Gestating sow feed	Pregnant sows and boars > 90 kg	2900	14.0	10.0	0.65	8-15	0.7	0.5
Lactating sow feed*	Lactating sows and replacement Stock from 45-90 kg	3100	16.0	12.5	0.75	7	0.9	0.6

* If only one sow feed is used, its nutritional quality should be between that of the 2 sow feeds indicated in the table, and preferably more like lactating sow feed.

Feeding pregnant sows and gilts

Until she is first served (usually the 2nd or 3rd time that signs of heat (oestrus) are seen), a gilt needs to mature so she should receive the same feed as a lactating sow. The daily feed allowance should be between 1.5 and 2.5 kg (depending on bodyweight). Feeding an extra 0.5 kg per day during the week before mating might increase the number of embryos (this is called 'flushing'), but this only works when the oestrus period can be predicted.

In the first month of pregnancy the sow should be fed conservatively (1.5-2.5 kg per day). If no oestrus signs have been noticed by 21 days

(which means that she is pregnant) feed the sow according to her body condition: 0.5 kg extra if she is too lean, but if she is too fat, nothing extra until the last month of pregnancy. In the last month of pregnancy, when the embryos are growing the most, the sow should receive about 2.5-3.0 kg per day.

A few days before farrowing (the mating date must be recorded!) reduce the sow's feed gradually, and on the day of farrowing give her only 1-1.5 kg.

Feeding lactating sows

After farrowing it is most important that there is plenty of drinking water available. A sow with 10 piglets needs about 30-35 litres of water per day. The daily amount of feed is gradually increased from 2 kg the day after farrowing, adding 0.5 kg each day for about 10 days after farrowing. The maximum amount of feed for the lactating sow is related to the number of piglets that are suckling:

About 1.5 kg for the sow's maintenance and about 0.5 kg extra for every piglet.

With 12 piglets, this means that the mother should eat $1.5 + 6 = 7.5$ kg feed per day. This is a lot of feed and many sows have problems eating enough, especially in high temperatures. Therefore, during the lactating period, the sow's feed should be of high quality, so she can obtain enough energy and protein to produce milk.

On the day of weaning give the sow only 0-0.5 kg feed to stop the milk flow, and the next day put her on the schedule for empty sows (flushing): 2.5-3 kg day.

Feeding piglets around weaning

The piglets should receive the first colostrum from their mother as soon as possible after birth, because it gives them warmth, energy and anti-bodies against diseases. For the piglets it is best not to wean them before 6 weeks of age. However to get the sow into the next reproduc-

tive cycle as soon as possible, weaning at 4 weeks is better commercially. Sow's milk has one disadvantage: it contains little iron. Commercial pig producers give piglets an iron injection during the first week, but it is also possible to put a shovel of compost in the pen every day, in which the piglets can play and search. This supplies them with the necessary extra iron. Piglets that lack iron have pale, whitish, unhealthy looking skin.

From the 3rd week on, the piglets will benefit from supplementary feed, because this is when the sow's milk production starts to decline. The creep feed must contain animal protein and an easily digestible source of energy like maize, preferably even cooked (porridge) for better digestion. This high-quality feed spoils easily, so the feeder must be cleaned every day and the feed refreshed. It should be kept out of reach of the sow; she will be fine with less expensive feed. If the piglets have diarrhoea (scouring), the creep feed should be removed for a few days.

Before the piglets are weaned from the mother, they need to become accustomed to other feed than milk. Otherwise the change will be too big for them and problems might occur. Diarrhoea, caused by Coli-bacteria in the intestines, is a frequently occurring problem in the week after weaning. Affected piglets must be treated with antibiotics, as they can die from an infection. In the period after weaning, give the piglets the same feed for at least 10 days. If there are no problems, you can start to gradually change over to a cheaper piglet feed. Changing to the next feed should take about 5 days.

Feeding piglets from 2 weeks after weaning

At about 6-8 weeks of age the piglets are still very sensitive and require feed that includes animal protein and digestible starch from maize or cassava. As they no longer get sow's milk, an additional supply of vitamins and minerals is very good for them (compare them with weaned children). Very often farmers continue to give the same creep feed until the piglets reach 15-20 kg of body weight. The quality of the available creep feed should be taken into account when decid-

ing when to wean the piglets. If there is no high quality (expensive) creep feed available, the weaning time should be postponed until the piglets are 6-8 weeks old. However, we recommend that the piglets be given supplementary feed after about 2 weeks of age.

Feeding young pigs (bodyweight 20-45 kg)

By about 10 weeks the young pigs should weigh about 15-20 kg. On an intensive pig farm they may weigh as much as 25 kg. At this age they are suitable for selling as fatteners or for rearing as replacement for breeding stock. The best ones should be selected for breeding, but the feeding method is the same for both until they reach 50-60 kg body weight.

Because this is the starting period for the fatteners, the feed is called starter feed. The pigs' growth will depend on the quality of the feed (energy and protein level), because their feed intake is still limited. They can eat about 1.0 kg (for a 20 kg pig)-1.8 kg (a 40 kg pig) per day in this period. They should be fed as much as they can eat, but it is important that no rotting leftovers contaminate the feed. It is also possible to feed them a smaller amount twice a day. This makes it easier to check the appetite and health of the pigs. It is important that the pigs finish their feed in about 15-20 minutes. It is good practice generally to keep feed wastage to a minimum.

A small amount of animal protein in the feed will still be very beneficial to the animals at this stage of their lives, so they can continue to grow more efficiently.

Feeding pigs heavier than 40 kg

Older pigs are most suited to lower quality feedstuffs and can tolerate the greatest variety in feed. Again, their growth results are directly related to the quality of feed they consume, but at this stage animal protein is not essential in their diet. The pigs' eating capacity is still increasing with age, but is generally between 2 and 3.5 kg per day. This means that if the market demands lean pork, it might be necessary to restrict the feed intake in the final period, to prevent the fatten-

ers from accumulating too much fat in the carcass. Normally, no feed restriction is necessary until the body weight has reached 70 kg. As long as fatter slaughter pigs do not command lower prices, feed restriction is not recommended because extra feed intake always results in extra body weight.

To work out the feed efficiency during the fattening period, we can determine the 'feed conversion rate' (FCR). This is the total feed amount utilised for the growth in body weight realised.

In formula:

$$\text{FCR} = \frac{\text{total kg feed utilised by the pig(s)}}{\text{total increase in kg body weight}}$$

For example:

If 210 kg feed is consumed in the period of growth from 20 to 90 kg,

$$\text{FCR} = \frac{210}{70} = 3$$

The FCR can only be calculated if the pigs are given dry feed, and when scales are available to weigh the animals. The lower the FCR, the better the feed efficiency. An FCR below 3 is considered very good, and an FCR above 4 is not good. The FCR of course depends on the quality (and health) of the pigs: if they are growing very little, the FCR will be high. Also, if the feed quality is low, more feed is needed and the FCR works out high.

However, the most critical situation is where pigs do not receive enough feed for maximum growth. Their body maintenance needs have to be fulfilled first, and only when they can eat more will they be able to grow. If this is only a little, the FCR will be high, meaning that feed efficiency is low. Since feed costs are about 50-70% of the total costs, this has a strong influence on the profitability of pork production.

5.4 Preparing rations for pigs

For commercial pig production, the easiest option for feed is to buy the different kinds of feed from a feed factory, or a sales agent. Of course you must be sure that you are using the right kind of feed for specific types of pigs, but apart from that all the farmer has to do is make sure the pigs get the correct amount at the correct times.

The feed intake can be stimulated further by pelleting the feed. However, pelleting makes the feed more costly, and not every feed factory has the equipment for it.

Feed can also be prepared on the farm itself by mixing various raw materials (feedstuffs) together, to get a balanced feed. A balanced feed has all the nutrients (energy, protein, minerals, etc.) present and in the correct proportions. The different feedstuffs (e.g. grains, cassava, wheat bran, etc.) have all the nutrients available, but not in the right proportions. For example: grains are short in protein for high production, so other protein-rich products must be added to make sure there is enough protein in the daily ration.

The feedstuffs need to be combined to achieve the right protein level in the daily ration. The choice of feedstuffs will depend mainly on what is available at what price. Prices often vary according to the season. When comparing prices check the proportion of protein and energy contents. Making up a recipe – what to mix and how much of it – is called ‘ration formulation’. One very simple ration formulation is given below.

Nutritive value of some raw materials (feedstuffs)

In order to make the right combinations of feedstuffs, you need to know their nutritive value (% crude protein, etc.). In most countries lists of the nutritional value of the most commonly used feedstuffs are available from the national research institutes.

Animal products, e.g. fishmeal, slaughter waste or milk powder, contain 50-60% protein, and oil seed meals, such as soybean oil meal or groundnut cake, have high concentrations (35-45%) of protein.

Peas, beans, lentils, china beans and vetches contain about 20% protein; orbs and chick pea about 16%; sweet lupines (must be boiled) and soya beans about 30%; shelled groundnuts contain 24% protein.

Cereals and cereal waste do not contain more than about 10% protein. Tubers and root crops are usually very poor in protein and must be supplemented with protein-rich feed (e.g. soya, animal or fish meal, or milk products).

Ration formulation

To prepare a normal protein ration of 15%, mix 1 part of beans (20- 30% protein) with 2 parts of cereals (10% protein).

If young green fodder (vegetable leaves etc.) or fruit (e.g. bananas, mangos) are available, 0.75 kg peas/beans or 0.5 to 0.75 kg soybean cake or cotton cake per day will be sufficient to supply the proteins. For the necessary energy, give plenty of fodder or fruits (less nutritious feed). Avocado pears are also very good for pigs as they supply energy, protein and vitamins.

If milk or milk products, animal or fishmeal are available, they should be fed first to the lactating sows and their piglets. Recently weaned piglets should also be given some for the first weeks after weaning. Even if very little information on ration calculation is available, it is important to know that fishmeal is one of the best ingredients for pigs. So if 2-5% fishmeal is added to a ration it will have a significant effect. For example, if you only have sow feed available, add 5% fishmeal and you can make a reasonable quality creep feed.

If a pig is fed 1 kg of a 20% protein mixture every day, the rest of the feed can be less rich in protein. If a 30% protein level is possible, then 750 g of the mix is enough, and with 40% protein level 500 g would

suffice. These mixtures must always be supplemented with other feed-stuffs, to supply the animal's energy needs.

It is advisable also to add 0.2 kg of mineral/vitamin mixture (premix) to every 10 kg of mixed feed.

Some elementary precautions

Soya beans, when used as complete beans, should be cooked before use, and shelled groundnuts must be checked for moulds before being used in the pig feed. If you are not sure of the origin or quality of certain feedstuffs, or if there is a danger that they may be contaminated, you should either discard them, or at least cook or boil them. Many poisonous agents die at very high temperatures. Suspicious feedstuffs should never be given to the young animals, but the older fatteners are much less sensitive.

Cotton seeds, safflower seeds and cabbage seeds are dangerous to pigs and should not be fed. Safflower cake can be fed, but can contain poisonous compounds. Feed this in small quantities only and observe the pigs carefully.

Kitchen waste or restaurant leftovers are often cheaply available. Although it can be very nutritious material (depending on the kind of meals prepared), it should always be boiled for at least 30 minutes and allowed to cool before feeding. This prevents the transmission of diseases like swine fever (African and Classical) and the parasite *Cysticercus*.

There are more advantages to boiling the pig feed. Vegetables in particular are difficult for pigs to digest if they are not cooked. Proteins in vegetables, often about 20%, are not very digestible at all. Boiling makes these proteins more easily digestible for the pig.

It is a good habit to set aside a pan for boiling a mix of kitchen waste and vegetables. The pigs will be grateful for a more appetising, disease-free and digestible diet and will show this by growing better!

6 Diseases, prevention and control

Local pig breeds are often more resistant to diseases. The most common problem with keeping any sort of pig in free-range or semi-intensive systems is not disease, but controlling infestation by worms or other parasites.

In intensive pig-keeping systems, disease is a greater risk because many animals are kept together in a small space. Infectious diseases spread easily and quickly among the animals. In intensive systems commercial breeds are often used and these tend to be less resistant to disease.

For information on potential transmission of livestock diseases to humans and how to reduce the risks, see Agrodok 46 – Zoonoses .

Intensive pig production is a financial undertaking. Diseases can lead to production shortfalls (slower growth rates or loss of animals) and a loss of income for the farmer. In these circumstances it is essential to take all necessary measures to prevent diseases and treat the animals if they get sick, as long as the costs of treatment do not exceed the expected loss of income.

In free-range and sometimes in semi-intensive systems, farmers do not generally have money to spend on medical treatment. Also, the pigs are probably not their only source of income. In such cases a drop in production may be considered less important, and farmers may wish to calculate whether the benefits of saving the sick animal and protecting the others justify the cost of treatment.

In terms of prevention, if there is a high risk of an infectious disease occurring, animals can be vaccinated to reduce the risk of losing them all if a disease breaks out.

There are not vaccines for all diseases. For example, there is not yet a vaccine against African Swine Fever (ASF). This disease affects local and commercial breeds of pigs equally. In fact free-range pigs make the disease spread more quickly because they move around more than pigs kept in a limited space.

Whatever the circumstances, if at all possible, seek the advice of a vet if there is disease on the farm. Despite all preventive efforts, treatment with medicines may be the only solution remaining.

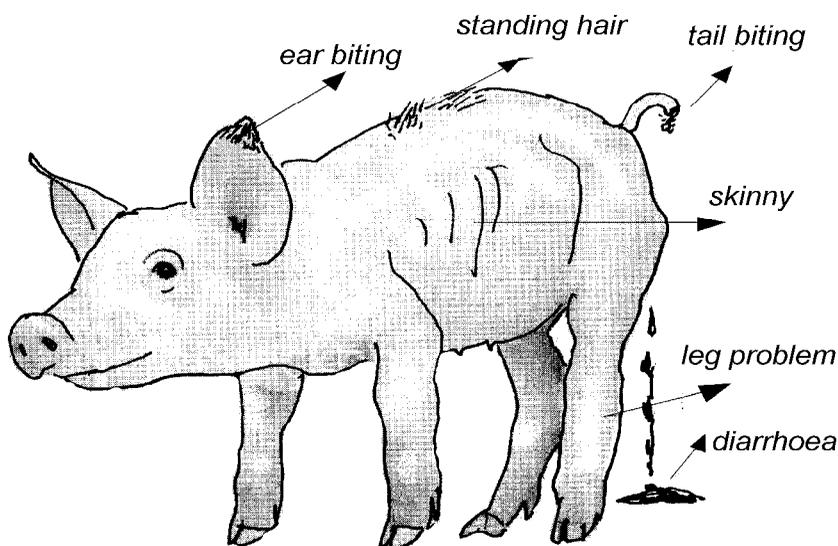


Figure 16: Different signs of diseases

If too many pigs are confined together there is a high risk of infection spreading quickly among the animals. For most diseases and infections, the organisms causing the disease (bacteria, worms etc.) are found naturally in the animal's environment. Many locally bred pigs are infected, but have enough natural resistance to stay alive and even to develop. This natural equilibrium can however very easily be disturbed, and then pigs sicken or die. The disturbance can be caused by

changes in the season (in the wet season parasites are often present in larger numbers), feed shortages (which weaken the animals) or changes in pig-keeping routines.

By ensuring that the pen is always kept clean, the chances of infection remain small. And if pigs receive the right quantity of a good quality feed, their resistance will increase. Under these conditions there is a good chance that the pigs remain healthy, and healthy pigs will grow faster than animals infected with disease.

6.1 Prevention by promoting natural resistance

Many diseases and health-related problems in animals can be linked to a loss of natural resistance as a result of feeding problems, a lack of hygiene, or sudden changes in their environment (e.g. temperature, humidity).

Taking the following measures can prevent many problems:

- Ensure that the pigs receive sufficient nutritious food.
- Provide shelter to protect them from the sun and the rain.
- Regularly move the animals into different enclosures and relocate their shelters (if they are non-permanent structures).
- Provide good housing that is draught and dust-free, where temperatures are neither too high nor too low, and do not overcrowd.
- Combat anaemia (shortage of iron) by putting iron-rich soil in the pen daily or inject pigs with an iron solution. Check regularly for internal and external parasites.
- Maintain good hygiene in the pens and feeding equipment (keep them dry and clean). Always let a sow farrow in a clean disinfected pen and keep an eye on the temperature in the piglets' nest.
- Be very careful when bringing new animals onto the holding from outside, as they may be carrying disease.
- Vaccinate the animals if you know there is risk of infectious disease.
- Put a disinfectant bath near the entrance and supply visitors with clothes and shoes or boots from your own farm. Keep dogs, wild

pigs and other animals out. Build the farm at a distance from other pig farms; the greater the distance, the better.

Prevention is better than cure. Not only are sick animals less productive, but modern remedies are difficult to obtain or even unavailable in the tropics. They are often very expensive. For this reason, particular attention must be paid to the health of the piglets, which are very vulnerable to disease. A good start in life lays the foundations for pigs' ability to resist disease later on. (To a certain extent the loss of some piglets has to be seen as inevitable. In the Netherlands for example, a piglet death rate of 8-12% is considered acceptable.) On small farms in tropical countries piglet mortality should remain below 20%.

Spread of disease by infection

Upon any outbreak of disease it is essential to ensure that the disease is not passed on to healthy animals on the footwear, clothing or tools of the people working with the pigs. Even insects, wild animals and earthworms can transmit disease. Therefore take precautionary measures:

- Put the sick animal in a separate pen or house.
- Do not let people into the pig house unless absolutely necessary (they might have pigs at home and carry germs away with them).
- Feed and clean the healthy sections first, and after that enter the section where the sick animals are. Use different tools and boots in this section.

The pen should be cleaned very regularly with disinfectant or sodium hydroxide (NaOH, 5%). Avoid contact with your eyes and skin, as it is very caustic! Whenever pigs are sent to slaughter their housing should be disinfected before new pigs are brought in. Any animals that die of a disease should be burnt (if possible, after a post mortem has been done if the cause is not clear), to prevent further contamination.

Even the meat of healthy pigs may be contaminated with germs. It is therefore important to always boil or roast meat very thoroughly before eating it.

6.2 Disease-causing organisms

Diseases are caused by specific types of organisms. So to treat a particular disease, you have to know which organism is involved and choose the appropriate medicine. A badly chosen medicine is money wasted. The principle types of organism responsible for diseases are:

Bacteria

Very small and invisible to the naked eye. Antibiotics can kill bacteria, but if antibiotics are not properly used, the bacteria can become resistant to them (see 6.3).

Viruses

Also very small, invisible even with a microscope! Viral diseases are difficult to treat and there are not many medicines available. Antibiotics are sometimes effective against secondary (bacterial) infections and vaccinations can prevent some viral diseases.

Parasites

These are small animals living on or inside the pig, such as various types of worms, ticks, lice, fleas, etc. Hygiene is an important factor in their prevention. Treatment varies with each type of parasite.

Sometimes diseases are caused by a combination of harmful organisms. Pneumonia is an example: it can be caused by bacteria or viruses (and usually by both at the same time), and by parasites (lung worms and intestinal worms that have found their way into the lungs). A poor climate (for example a low temperature for piglets) and poor management can also play a role. Pneumonia is described in more detail in 6.6.

6.3 Use of medicines

Before proceeding to consider the individual diseases, some critical remarks on the use of medicines need to be made.

Treatment for natural parasites

The routine use of medicines against parasites (e.g. worms) or bacteria is common. The intention is to kill or greatly reduce in number the organisms causing disease or weakness in the animal. Mange mites (a parasite on the skin of the pig) can be eradicated completely. Most organisms nevertheless remain present in the animal's surroundings and represent a potential source of re-infection. This often means that, if no special hygienic measures are taken, repeated treatment with dewormers or other medicines becomes necessary. These repeated treatments reduce the natural resistance of the animals. Eventually damage by parasites can actually be much worse under repeated treatment than in circumstances where the animals are not treated (for financial or other reasons) and are obliged to rely on their natural resistance to their environment.

It is therefore important, before using these medicines, to first assess the losses you are likely to suffer as a result of disease or infection. Secondly the likelihood of the treatment being properly applied and succeeding (without inefficient repetitions) must be assessed. However, in more intensive farms, with improved breeds of pigs and proper housing systems that are easy to keep clean, regular dosing has become routine.

In some cases it is considered useful to treat animals only occasionally, in specific situations. For example one might choose to treat all animals arriving on the holding and not yet accustomed to the new environment, as well as pregnant sows in preparation for farrowing (de-worming), and any animals weakened for some reason and whose resistance is low.

Resistance to medicines

All disease-causing organisms are capable of developing resistance to medicines. They do so when medicines are used in the wrong doses, or too often, or without respecting the treatment times.

Antibiotics

Antibiotics are very useful medicines but they must be properly used.

- The body of a healthy animal harbours many useful bacteria; for example, the bacteria in a pig's intestines help the animal to digest its food. Antibiotics are devised to kill certain bacteria. However, sometimes they also kill the useful bacteria in the body. Unfortunately therefore when an animal is treated with antibiotics its good bacteria are also killed. Consequently, although the antibiotics may effectively arrest the disease, they may also weaken the general condition of the animal. For this reason give your animal all possible attention when it is being treated! (If you are able to, feed yoghurt to encourage the re-growth of the useful intestinal bacteria.)
- Treatment with antibiotics always takes a few days and a course of treatment must be carried out to the very end. If this is not done the disease will hit back again. There is a great temptation to break the treatment off earlier, because the benefits of the antibiotic are nearly always seen shortly after starting the treatment, and the medicines are expensive. But don't make this mistake: for ending the treatment early can leave the animal even more severely ill, and the medicines (and the money) will have been wasted.
- The meat of an animal recently treated with antibiotics must not be eaten or sold. The antibiotics enter the meat and will affect the health of the people eating it; they will get diarrhoea. If an animal is destined for slaughter you must decide whether it is useful to treat it with antibiotics, and judge the best time to slaughter it so that it can be sold with the meat untainted. Normally the waiting period is indicated on the label of the medicine.

Local medicines

There are often local medicines (medicinal plants) or treatments in use which have been developed over many years. Do not neglect these traditional practices. Several have been shown to be successful, while they are not as expensive or difficult to obtain as modern medicines. See also Agrodok 44: Ethnoveterinary medicine. Medicines that are used for human beings can also be effective on pigs, as pigs and human beings have similar digestive systems.

Products such as DDT have very dangerous side-effects for man and animals and should on no account be used.

6.4 Parasitic diseases

Internal parasites (worms)

Worms are one of the most serious threats to pig keeping; there are more than 30 types affecting the intestines. The most important of these are the intestinal roundworm, the lung worm, the kidney worm, the stomach worm and the tape worm.

Infection occurs when the worms' eggs are eaten while the pig forages for food; the eggs cannot be seen with the naked eye and are present in the soil, in the dung of worm-infested pigs, in the vegetation at the bottom of ditches, wherever pigs are found. In Section 2.2 we mentioned the importance of field rotation as a measure for worm prevention in semi-intensive systems.

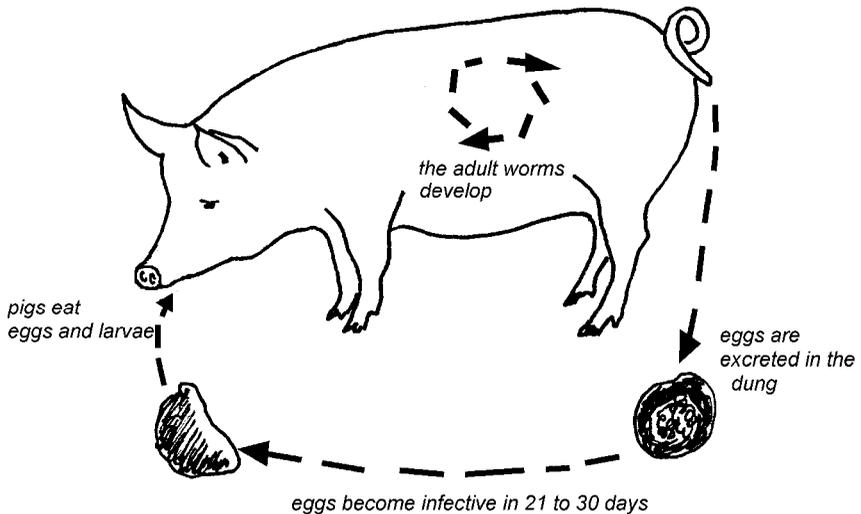


Figure 17: Life cycle of the intestinal roundworm

The eggs and the larvae in the soil can die out after a while if sufficient time passes for them to dry out under the sun. One way of reducing the risk of serious parasite build-up in the field is to regularly change the grazing area. If possible the animals should be given a fresh piece of land about every 14 days. The cycle in the pig, from egg until adult egg-producing worm, lasts about 14-21 days.

It is a good idea to de-worm the pigs, before you start the first land-grazing-rotation. The de-wormer (medicine for expelling the worms) should also eliminate the worm-larvae inside the pig. Attention: some – mostly cheap – de-wormers kill only the adult worms in the gut! Choose the right de-wormer and the pigs will not contaminate the grazing area until 14 days after de-worming.

In dry periods the animals can stay longer in the same field because the worms do not develop so quickly. After a period of grazing, the field should be left empty for a while to allow the larvae to die. In the wet season it is better to leave a field for about 2.5 to 3 months before re-using it; in the dry season when the larvae and eggs die more quickly, the field can be used again after 2 months. With this system, changing the enclosure every two weeks requires at least four different fields, which is expensive. If there is a shortage of land, in some areas a simple pigsty can be made to keep the pigs in during the wet season. By letting the pigs out in the dry season only, less land will be required.

In intensive systems prevention is achieved by ensuring excellent hygiene.
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Breeding sows kept outside will always be slightly contaminated with worms, but some infestation in older animals is not serious, as these animals usually have a measure of resistance. Young piglets however are very vulnerable. To prevent the young piglets from being infected directly after birth, the sow should be wormed about 10 days before delivering. A few days later wash the sow with soap in order to remove worm eggs from the skin.

After washing with the soap, the external parasites can be killed by spraying or washing the pig with a mange killer. Directly after these treatments, put the pig in a clean farrowing pen. She should then be kept inside for delivery. To prevent re-infestation, clean the pen well every day. This way the young piglets have a good chance of being born into a worm-free and clean environment.

A particularly nasty worm, which accumulates especially in intensive pig-keeping systems, is the *Ascaris* roundworm. Its eggs can survive for at least 5 years in the pens. Normal cleaning with disinfectants will not eliminate these eggs. Pigs do not die from this infection, but it will slow down their growth. You can check if this worm is a problem in your piggery by inspecting the pigs' livers after slaughter. If the livers show many 'white spots', you will have to introduce a good, strategic de-worming plan.

As de-wormers are dosed per kg live weight, it is better to treat young pigs before they get heavy. This is cheaper, and you also avoid the pens being contaminated. Worms are more harmful to young pigs than to older pigs. De-worming weaners at the start of fattening – before they enter the new fattening pen – should be sufficient. In very contaminated pens, a second de-worming after 6 weeks may be necessary. It is very important to choose de-wormers that also kill the worm-larvae that are developing inside the pigs. Do not use de-wormers that only kill the adult worms in the gut (e.g. Piperazine derivatives).

Ivermectin by injection is a very effective way of controlling intestinal parasites, but it is expensive. However, it also kills larvae and it kills mange mites in the skin.

Lung worms

General hygienic precautions are necessary to control this condition. Typically the infected animals cough when they are made to move around and they grow poorly. Riperol (or Levamisole) injections are used in treatment, but are probably difficult to obtain in many places.

Mange

This is a skin-irritation caused by small external mites. They provoke severe itching and irritation, and mainly affect the skin between the legs, around the eyes, ears and neck. Treatment involves removing crusts and dirt with soap and water and a stiff brush. Afterwards the pig should be washed with calcium sulphide. Repeat this treatment several times. Giving all the pigs two injections of Ivermectin with an interval of 14 days can eliminate the infection. This is an effective, but expensive treatment and no untreated pigs may be introduced (watch the boar!). Smearing the pigs with coconut oil can provide effective control in cases of light contamination.

Lice

These are blood suckers that also cause irritation of the skin. They can be kept away to a certain extent by planting a pole sturdily in the ground at an angle of 45° with an old sack wound around it immersed in crude oil or used motor oil. The insecticide benzene hexachloride is a very effective remedy (0.1-0.25% solution) against lice. The treatment for mange also kills lice.

Sand fleas

The sand flea lives on plants and dry grass and passes from these to piglets in particular. The female fleas dig into the skin of the host to lay their eggs (usually between the toes and around the jaw). The fleas should be removed from their breeding places in the skin without bursting the blisters, which are full of eggs. The best remedy is to clean the breeding places and then smear them with disinfectant.

6.5 Bacterial diseases

Enteritis or inflammation of the intestine

This is a condition that can be caused by a variety of micro-organisms or inappropriate feed. It is characterised by some of the following symptoms: loss of energy and interest, high temperature, loss of appetite, diarrhoea (sometimes bloody) and weight loss. If the problem is

food-related, starve the animal and give only clean water for one or two days. After that, gradually increase the feed to normal levels.

The cause of the problem may be a sudden change in diet, in which case the same procedure should be followed. Common intestinal problems are listed here:

Clostridium enterotoxaemia

This usually occurs in piglets that are 1-5 days old. There is no good treatment. The sows can be vaccinated, so that the piglets build up antibodies through the sows' milk. The piglets can also be given injections of ampi/amoxycilline.

Transmissible gastro-enteritis (TGE)

This can occur in pigs of all ages, and results in watery soft diarrhoea. No treatment is possible.

Dysentery (Doyle)

Variable success can be achieved with one of the following medicines: tylosine, spiramycine, organic arsenic and dimetridazole preparations.

Salmonellosis

Neomycine can be given for 3 days (20 mg/kg of body weight per day).

E. coli bacteria

Antibiotics are used – often Colistine.

Tetanus

Tetanus bacteria can develop if a deep closed wound is incurred from rusty metal (standing on a rusty nail for example). The animals finally die as a result of severe cramps. There is no treatment.

Mastitis

This affects the tissue of the udder and can result in permanent damage, so that breeding pigs can no longer be used. Infection can be

avoided to a degree by good hygiene. If mastitis is noticed, the sow must be injected with antibiotics and oxytocin as soon as possible. See 4.4 for more information.

Anthrax

This is dangerous both to humans and other animals. A blood-stained fluid will be seen coming from all the body openings. The infected animals are usually found dead in the field. The body should not be buried but burnt, as the germs can survive in the soil for years. Cattle should be kept out of all fields that have ever been contaminated with anthrax.

Brucellosis

This causes abortion in female animals and infection of the reproductive organs in the male animal. Sterility may result. Although treatment with antibiotics is sometimes possible for females, it is better to dispose of infected animals. The boars should be carefully controlled because the germs from the boar can be transmitted without the boar himself being ill. See 4.7 for more information.

Trypanosomiasis

This is transmitted by the tsetse fly. The infected animals are feverish, lack appetite and breathe very fast. Prevention is only possible by eradicating the fly from the region. Pig breeding is therefore almost impossible in tsetse infested areas. Long acting drugs could be used to protect the pigs.

6.6 Viral diseases

Swine fever

This is caused by a very infectious virus. In pigs the following symptoms may vary from almost imperceptible to very serious:

- The animal may be very ill for a few days with a high temperature and constipation, after which it recovers.

- The animal is seriously ill, runs a high temperature (41–42 °C), with diarrhoea, an unsteady walk, possibly showing signs of bruising indicating bleeding under the skin (brown blemishes).
- In addition to these symptoms, pregnant sows may abort.

In piglets the following symptoms are found:

- Chronic cases show retarded growth and diarrhoea. The piglets lose colour and slowly die.
- In acute cases diseased piglets huddle together, pale, with diarrhoea and high temperature (41–42 °C). They walk unsteadily and may have brown patches on the belly.
- Sometimes one piglet in the litter will suddenly die (pale body with skin bleeding), whilst the rest of the pigs remain unaffected.

There is no treatment for this disease; only a preventive vaccination can reduce the danger. This vaccination (the ‘crystal violet’ vaccine) is first administered at the age of 8–10 weeks, and to sows and boars twice a year thereafter.

African swine fever

This is not the same disease as ordinary swine fever. The illness starts with a rapidly rising fever. Typically the animal will remain lively in the early stages, eating normally. About 36 to 48 hours before dying it becomes restless, stops eating, loses the use of its back legs and lies down a lot. It may sometimes have weepy eyes and a discharge (occasionally bloody) from its nose; it vomits. Its skin is often reddish-blue (especially on the legs and ears). There is no treatment and no vaccine for this disease. The disease is almost 100% fatal for swine and all ages are affected. It is not dangerous to humans.

Swine Erysipelas

This disease is often confused with swine fever. The differences between the two diseases are shown in Table 5. Treatment is by penicillin injection. It is not always effective. *There is a very effective vaccine against this disease.*

Table 5: Differences between swine erysipelas and swine fever

Swine erysipelas	Swine fever
constipation or soft dung	obvious diarrhoea
pink skin, often with indented bruising (you can put your thumb in the bruise)	pale skin, bruising, not intended
lack of appetite	often abnormal appetite
stiff, limping gait	weak, meandering gait
screeches hoarsely when roused	grunts
disease manifests itself in hot weather	disease can occur at any time of year
only one or few pigs ill in the herd	several pigs ill at the same time

Pneumonia

Pneumonia may be caused by bacteria, viruses (usually by both at the same time) or parasites (lung worms and intestinal worms that have found their way into the lung). The condition is made worse by keeping too many pigs in a small space, low temperatures, draughts, insufficient air humidity, and dusty surroundings. The illness is more common in the rainy season and at this time the pigs should have dry and draught-free conditions. The animals start coughing, especially after exertion and when roused, and they breathe with convulsions. Their growth is retarded. If viruses and bacteria are the cause, treatment is by antibiotics (streptomycin-penicillin, tetracycline). Ripercol R or Ivermectine is used if lung worms are involved.

6.7 Feed-related diseases

Anaemia (blood iron deficiency)

This is an important problem, especially for young piglets kept indoors. The piglets become very pale a few weeks after birth and their growth slows down. The cause is an iron deficiency in the mother's milk. This can be prevented by putting iron-rich soil (mud from the ditches, forest soil) in the pen every day, giving the pigs something to root in. This soil should not have been in contact with pigs previously, as it must not carry worms. Give soil from the very first week.

Very young pigs (0-3 days old) can be given an injection of iron-dextron if it is available. This is commonly done in (semi-) intensive systems.

Wood ash may also be put in the pen. Wood ash will not provide iron, but it provides other minerals such as calcium and phosphorus which are important for the growth of the piglets' bones.

Constipation

Constipated sows should have a 60 g dose of linseed oil in their feed every day. If this does not help, give 60 g of Epsom salts and the sow should be made to take exercise.

6.8 Other problems

Sunstroke

Cause: too much sun. Symptoms: the skin gets burned and pigs feel pain. White skinned pigs are most susceptible to sunstroke, and their skin turns red. Prevention: make sure there is enough shade available. Treatment: bathe (only) its head in cold water. If possible give it some brandy or whisky with a teaspoon. Make sure it has shade.

Skin or leg problems

Wounds or injuries

Cause: housing or fighting. Prevention: improve housing, separate pigs. Treatment: antibiotic injections for 3-5 days, clean/disinfect wound and use ointment.

Arthritis (swollen joints)

Cause: bacteria. Symptoms: one or more leg joints are seriously swollen. The pig limps, feels a lot of pain and has fever (often a body temp. > 40 °C). Prevention: disinfect umbilical cords, smooth floors. Treatment: antibiotic injections for 5 days.

7 Management and economics of pig farming

7.1 Record-keeping

For those who intend to keep a number of pigs for breeding purposes it is essential to have a good system of record-keeping. This will help to keep track of developments, make comparisons and take decisions on the management of the herd. It will also have a direct positive impact on daily management.

Good record-keeping means noting down simply and clearly all important details and events. It can also be used to provide and record information for future activities. It is important for example to calculate and note the next date for checking whether a sow is in heat or the date when she should farrow. Such information should be marked on a card, in a notebook or on a calendar, so that any necessary preparation can start well in advance (for example preparing the farrowing pen for the sow).

For a farm of up to 3 sows, a system of record-keeping requires no more than a notebook or exercise book. Use a few pages for each sow, and note down all the important events. For bigger farms it is good to use a separate farrowing card for each farrowing of a sow, and a sow card giving the details of all the litters of one sow (see Table 6). Also, the use of a boar card (see Table 7) is advisable. For fatteners, one card per pen or batch gives information about treatments, growth, feed intake and mortality.

Relevant information to record includes:

For a breeding sow:

- The name/number of the sow
- The month and year of her birth
- Her parents' names or numbers and breed

Important events:

- Date of 1st heat
- Date of 2nd heat
- Date of 3rd heat
- Date of mating, and name of the boar
- Result of the heat check 3 weeks after mating (did she come in heat again?)
If there are no signs of heat she must be in-pig, and the date of farrowing can be established (about 114 days after mating).
If she has come back in heat she will now have to be put to the boar again. Calculate the date when she might come back in heat (3 weeks after mating).
- Anticipated date of farrowing – mark this on a calendar!
- The date for putting the sow in a farrowing pen (1 or 2 weeks before farrowing). Mark this on the calendar too!
- Actual date of farrowing
- Size of the litter, number of healthy piglets, number of still-born piglets and, if possible, the weight of the piglets.
- Number and weight of piglets that have survived and have been successfully weaned (this gives an idea of the sow's mothering qualities).

Other information to note:

- Dates of illness, nature of the problem and the treatment and/or medicines administered.
- Information on the piglets, e.g. vaccination information.
- If a piglet is selected for further breeding, information should be transferred to the new page of records opened for that piglet in its new role as a breeding sow or boar.

Table 3 (Chapter 4) can be used to work out the date of farrowing, if the date of successful mating is known (date of farrowing = date of mating + 114 days)

Table 6: An example of a sow card. Particulars about the sow's health can be recorded on the reverse side of the card.

Sow number		Tattoo number:		Breed/cross:							
314		Birth date:		Mother:							
		Father:		Origin:							
		Dates of heat									
	Service date	Boar	Farrowing date	Born alive	Av. Kg	+/_ sow	Still born	Weaned	Weaning date	Av. Kg	
	1	2									
1											
2											
3											
4											
5											
6											
7											
8											

It is important to record the boar's activity and the results obtained, so that his performance can be assessed. The fertility of the boar is indicated by the size of the litters he produces and the percentage of sows in-pig after a first service (insemination rate).

Table 7: Boar card

Name/number of the boar:		Date of birth:			
Breed:		Breed of the father:			
Origin:		Breed of the mother:			
Sow number	Date of first service	Date of repeat service	Born alive	Born dead	
24	15/06/09		11	2	
36	17/06/09	09/07/09			

The information to record is:

- the date of the service
- the identification (name or number) of the sow which was served
- the date of farrowing (which indicates whether the sow was pregnant after the first service)
- the litter size; number born alive and the number born dead
- number and type of abnormalities among the piglets born

On the back of the card: record treatments, vaccinations and abnormalities.

Marking the pigs

If records are to be kept and management activities are planned, it is essential to be able to identify the pigs. If you have more than one sow, it is necessary to mark them so you can identify them.

There are various methods of physically marking animals: notching, plastic ear numbers and tattooing. We describe notching here as this is easy for small-scale pig farmers to use. However, in most countries, equipment is available to use plastic ear tags. Although more costly, tagging is easier and the numbers can be read faster. The animals should be marked when they are young.

Notching

Notching involves cutting small pieces of skin out of the edges of the ears. By varying the pattern of the cuts you can individualise the animals for identification. This is a very cheap method requiring only a very sharp knife. It is even easier if a special pair of notching pliers is available. Keep the equipment clean! The disadvantages of the method are that it takes time 'to read' the patterns (or codes), and that problems can arise if the ears are damaged.

An example of notching is shown in Figure 18. The codes used on large farms are shown. A value is assigned to each notch on each side of the ear. By adding up the values marked on the ear, you can work

out the sow's number. You can of course devise your own system of codes adapted to your particular circumstances.

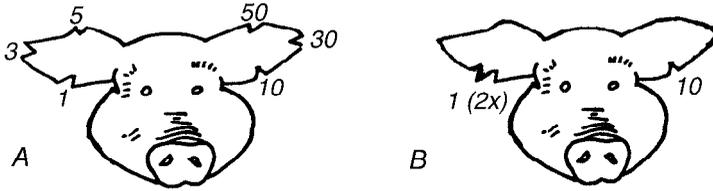


Figure 18: A - notching codes, B - an example: $1+1+10=12$

Financial records

In order to be able to analyse the economic results, all costs have to be recorded, as well as the money received from the sales of pigs and manure. Feeds that were grown on the farm and fed to the pigs must also be added to the costs.

If breeding and fattening are done on the same farm, separate calculations can be made for the breeding section and for the fattening section.

The figures can tell us the cost price of a weaner and the cost price of a fatterer of a certain weight, and from these figures we can see where most profit can be made.

7.2 Economics of pig farming

In (semi-) commercial pig farms it is very important to keep records to be able to analyse the technical results: piglets produced per sow per year, piglets born alive per litter, mortality in piglets, etc. Records of input (costs) and output (revenues) are needed to analyse the profitability of the farm.

A simple way to judge whether pig farming is likely to be profitable is to calculate the **ratio between the pork price and the feed price**.

Example

A 70 kg pig fetches about 60

70 kg live weight is roughly 50 kg dressed weight (this can vary in different countries).

So, 1 kg dressed meat fetches $60 : 50 = 1.20$

Suppose that 1 kg mixed feed = 0.15

Then the ratio is $1.2 : 0.15 = 8.0$

If the ratio is 7.5 or more, in general profit can be made. If the ratio is between 6.0 and 7.5, profit can be made if the level of management and the technical results are very good.

Suppose the feed price is 0.2 /kg

The ratio is now $1.2 : 0.2 = 6.0$

It is almost impossible to make a profit.

Conclusion: good management influences the profit, but the profit depends a lot on the prices of feeds and pork.

Cost price calculation for fattening pigs

Example

A 20 kg piglet costs about 20

The pig grows from 20-70 kg

Total gain = 50 kg

The FCR (feed consumed per kg gain, see 5.3) can vary from 2.7-4.5

Let us assume that the pig grows 440 g per day and the FCR is 4.

The pig will need $50 : 0.44 = 114$ days to reach the end weight of 70 kg.

The pig will consume 1 kg/day of feed at 20 kg live weight and 2.5 kg at 70 kg.

The average consumption per day is about 1.75 kg ($1.75 \times 114 = 200$ kg).

A fatterer will then consume 50 (kg gain) $\times 4$ (FCR) = 200 kg of balanced feed.

Feed for fattening pigs costs 0.15 per kg.

From 30-45 kg the pigs need a more expensive feed, which costs 0.20 per kg. We assume an average feed price of 0.17 per kg.

So the total costs are:

Cost of piglet	20.00
Feed 200×0.17	34.00
Others (drugs, housing)	5.00

Total costs	59.00

A pig of 70 kg fetches 60.00 (see above).

Conclusion: Just 1.00 profit per pig.

How can more profit be made?

➤ First, by achieving better technical results.

Suppose the FCR is 3.5

Now the pig will consume $3.5 \times 50 = 175$ kg of feed.

The feed costs will be: $175 \times 0.17 = 29.75$

Profit per fatterer is about 5.00

➤ By giving partly locally obtained by-products, mainly to pigs above 35 kg live weight.

Example

We give 130 kg balanced feed and make up the rest with by-products from the farm.

The balanced feed is $130 \times 0.17 = 21.00$

By-products may also have a certain value.

Roughly speaking, 4-5 kg of by-products is equal to 1 kg balanced feed.

So we need $45 \times 4 = 180$ kg

Suppose the price is 0.02 per kg (some may be free)

Total cost of by-products is $180 \times 0.02 = 3.60$

So the total feed costs are now just under 25.00

That means another 5.00 profit.

- If piglets of 20 kg can be obtained for 15.00, the profit will be 5.00 higher.
- If pigs can be slaughtered and the dressed meat is sold directly to the consumers, more profit can be made.
- In large cities higher prices are paid, but transport costs must be taken into account. Also, a larger number of pigs must be delivered at regular times, for example 20 per month.

Profitability of breeding

A medium-sized sow in the tropics consumes about 900 kg of balanced feed per year. (Bigger sows with a higher piglet production need 1000-1100 kg.) The average price of feed is 0.15 per kg. A boar consumes about 700 kg per year, which costs 105 per year. If only a few sows are present, the cost of the boar is relatively high.

We make the calculation for a farm with 2 sows and a boar. A sow can farrow between 1 and 18 piglets at one time. The average in a tropical country is between 8 and 10 (depending on quality and breed of sows, climate, feeding and management). Mortality varies from 10 to 50% (again depending on many factors). A sow can farrow between 1 and 2.4 times per year. In the tropics the figure is usually between 1.5 and 2.0.

Based on average figures for a tropical country, with well-balanced feed and slightly improved sows we assume:

Born alive/litter 9.5

Weaned 7.5×1.6 (litters/year) = 12 piglets produced per sow per year.

A piglet consumes about 26 kg of creep feed until it reaches a weight of 20 kg.

The costs are:

Sow feed $900 \times 0.15 = 135.00$

Piglet feed $12 \times 26 \times 0.20 = 62.40$

Boar $105 : 2$ (sows) = 52.50

Other costs (drugs, vaccines, housing) = 15.00

Total costs = $264.90 : 12 = \text{approx. } 22$ per piglet.

If a piglet is sold for 20, then there is no profit at all. In fact we lose 2.00 per piglet!

How to obtain or improve profit

Reduce costs for the boar

- Let neighbours with healthy sows make use of the boar and charge them for every service of the boar.
- If you can increase the number of sows to 4 or more, the boar costs per sow are much lower. (With 5 sows, the cost of the boar will be only 21 per sow, so then there is a small profit.)
- Replace the boar when he gets heavy, sell for slaughter (only if people are willing to eat boar meat).
- Buy a cheaper young boar of about 9 months of age or buy it earlier at 4-5 months but do not cull the old one before the young one can do the job.
- The boar can be partly fed on by-products.

If we can raise 14 piglets/sow/year

The feed costs will be $2 \times 26 \times 0.20 = 10.40$ higher + 3 (other costs) = 13.40 higher.

Total costs are $278.30 : 14 = 19.90$ per piglet.

Now there is a very small profit of 0.10 per piglet.

Together with the reduction of the boar costs, there is a profit of about 2.50 per piglet.

If we can raise 16 piglets/sow/year the total costs will be

$278.30 + 13.4 = 291.70$, being $291.70 : 16 = 18.2$ per piglet.

The profit is about 1.80 per piglet, or 4.00 – 4.50 with reduced boar costs.

We can also feed the sow (partly) on cheap by-products, in particular during the first 2 months of the pregnancy

Suppose we give 700 kg balanced feed = $700 \times 0.15 = 105$

By-products: $200 \times 4 = 800 \text{ kg} \times 0.02 = 16.00$

Total feed costs for the sow are 121

We can also reduce the costs for feed for the boar.

We need to take into account that, on average, a sow is replaced after 4-5 litters. Some may have 8 or more litters, but others will be slaughtered already after one litter. Also, raising a gilt (young female pig to replace an old sow) costs money. But in our calculation we assumed that the output of the culled sow would roughly balance the cost of raising a gilt.

Conclusion

It is not easy to make a good profit immediately after changing from a local to a semi-commercial system of pig rearing. Farmers have little influence over prices of pork and feeds. But the technical results depend mainly on management. In general a minimum of 14-16 piglets should be produced per sow/year. In reality, however, only 10-12 piglets are raised per sow per year in many situations where subsistence farming is replaced by commercial or semi-commercial farming.

Further reading

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Useful addresses

Zodiac

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Zodiac is the Animal Sciences Department of Wageningen University and Research Centre. The core business of the department is scientific education and research. The department aims to contribute to sustainable animal husbandry, aquaculture and fisheries.

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DIO

Foundation for Veterinary Medicine for Development Cooperation

The DIO foundation gives support and advice in the field of animal health and production to the poorer people of the world, irrespective of country of origin, beliefs or political interests. The main tool in these efforts is the Veterinary Information Service (VIS), offered free of charge to the target group. DIO also provides advice on animal diseases and other veterinary issues.

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ILRI

International Livestock Research Institute

ILRI generates knowledge and technologies designed to reduce poverty, hunger, disease and environmental degradation in developing countries, particularly in sub-Saharan Africa and South Asia. Based in Kenya and Ethiopia, ILRI works with partners worldwide to enhance livestock pathways out of poverty.

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Internet sites:

<http://pigtrop.cirad.fr>

PigTrop is an information centre about pig breeding in the tropics, hosted by CIRAD, the French Agricultural Research Centre for International Development. The website has sections on animal health, animal nutrition, genetics, environment, socio-economics, quality and food safety, and animal husbandry. The website is in French, English and Spanish.

Glossary

Anaemia	Lack of iron, piglets look pale.
Bacteria	Microscopic organisms found in all organic matter; often the cause of disease in animals and human beings.
Boar	Uncastrated male pig.
Colostrum	The first milk produced by the sow after the birth of the piglets. It is rich in nutrients and anti-bodies against diseases, and is essential for new-born piglets.
Complete mixtures	Purchased feed that is sufficiently balanced to be fed without any other feed (except water).
Cull	Select and sell or kill an unwanted animal.
Dry matter	The non-water content of feed: cereals for example consist of 20 - 30% water and 80 - 70% dry matter.
Farrow	Give birth.
Fatteners	Pigs destined for meat rather than being kept for breeding.
Gilt	A young female pig that has never had piglets.
Heat	The period of about 3 days in which a sow is fertile and ready for mating (service).
In-breeding	Excessive breeding of males with females that are closely related, resulting in deteriorating quality of offspring.
In-pig	Pregnant.
Lactation	Milk production, suckling offspring.
Litter	1: Bedding material, straw etc. 2: The group of piglets produced by a sow.
Mucus	Watery like fluid in the vulva when the sow is in heat.

Nucleus feed	A concentrated feed purchased to add to local feedstuff to raise the quality of the ration.
Oestrus	Also called heat, the period when ovulation takes place and the sow is receptive to the boar and able to become pregnant.
Parasite	Organisms that live at the expense of their host, another animal such as a pig. They live inside the body (e.g. worms) or on its skin (e.g. lice, fleas). They are often a cause of disease.
Placenta	The mass of tissue within the uterus from which the unborn animal is fed and which is expelled after the birth (also called after-birth).
Ruminants	Animals (cows, goats, sheep) with a complex stomach, which enables them to digest grasses and other plant foodstuff.
Sow	Female pig.
Still-born	Born dead, lifeless.
Sucklings	The piglets when they are still dependent on the mother's milk.
Uterus	Organ in the female in which the unborn pig develops (also called womb).
Virus	Very small microscopic disease-causing organism, smaller than bacteria.
Wean	To end piglets' access to the mother's milk, whilst simultaneously accustoming them to solid food.