Smallholder Pig Production

Technicians' Manual | Last updated August 2020

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Preface

Smallholder pig production plays an important role in Timor-Leste's livestock sector and is key to increasing domestic pig production and the overall pig population in the country. Pigs have very high social, cultural and economic value for Timorese families in a predominantly agrarian society. Sociocultural commitments related to funerals and marriages in particular oblige households to raise pigs, although this is done under a variety of conditions depending on the capacities and resources that farmers have. Outside of the cultural sphere, domestic consumption of pork products offers further opportunity to increase pig production. To do this, it is necessary to improve the husbandry practices of smallholder pig farmers through targeted technical support.

Supporting improved smallholder pig production requires implementation of production systems that include aspects of improved pig management, technical assistance, advocacy, monitoring, quality control, evaluation and reporting. Technicians require resources about pig production that reflect local conditions and are relevant for rural Timorese communities. As such, this technical manual was prepared by the Ministry of Agriculture and Fisheries' Livestock and Veterinary Department in collaboration with the University of Queensland, the Australian Centre of International Agriculture Research (ACIAR) and the TOMAK Program (an Australian Aid initiative).

The manual is intended as a guideline for livestock and veterinary technicians to promote improved husbandry practices with farmers and farmer groups so that they can manage their pig production independently, and increase income and wellbeing for their families. The manual includes comprehensive information relating to smallholder pig production including aspects of pig selection, reproduction, diets, husbandry, housing, health and biosecurity. We hope that this information will prove useful and provide benefits for you as technicians so that you can support our farmers going forward.

Dili, April 2020

Note from the researchers

The idea of a good husbandry practices manual for pig production in Timor-Leste was conceived in the early days of the collaborative ACIAR-TOMAK-MAF project "Identifying husbandry options for smallholder pig farmers in Timor-Leste". At that time, early 2018, the focus was very much on husbandry, particularly housing and feeding using locally available ingredients. The aim was to develop a user-friendly guide that would provide useful information to technicians, teachers and students of animal health and production, and could also be a reference for farmers. Initial drafts of these sections were based largely on overseas experiences, but were updated to better reflect the Timor-Leste context as the project progressed.

Sadly, during the later stages of the project, African Swine Fever entered Timor-Leste. This disease had devastating impacts on the local pig population and smallholder pig farmers and the long-term impacts remain unknown. As a result, the manual was expanded to include information on a broad range of diseases likely to be important in Timor-Leste, including both African and Classical Swine Fever and some basic guidelines on biosecurity and restocking. At the time of writing, these additions were based on the authors' experiences from overseas and had not yet been tested in the Timor-Leste context.

The project team hopes that this comprehensive manual will be a useful resource for technicians, students and their teachers, to in turn share with smallholder farmers in Timor-Leste. In future, relevant parts of the manual could be adapted and developed into materials targeted specifically at farmers to promote key practices. We consider this manual as one step in a longer process of supporting improved smallholder pig production in Timor-Leste. As new knowledge is acquired by other researchers and practitioners, we hope that this manual could be updated, improved and recirculated to key stakeholders.

Dr Tamsin Barnes (University of Queensland) & Dr Olavio Morais (MAF) on behalf of the research team – April 2020.

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1. Pig Production

1.1. Introduction

This training manual was written for primarily for veterinary and livestock technicians but should also be useful for farmers, farmer trainers, extension workers and students.

It describes several alternative methods used in Timor-Leste to manage and produce pigs.

It also provides basic knowledge on what pigs require to be able to grow efficiently and remain healthy. This includes how to care for and manage a boar and sow, as well as manage newborn pigs, and weaned and growing pigs.

As well as producing pigs efficiently, the farmer has a responsibility to provide good welfare to meet the needs of pigs. If the pigs needs are not met in terms of a comfortable adequate environment (housing and sheltered outside areas), a balanced diet that provides adequate energy and protein, clean water at all times, and good farm biosecurity which protects the pig from predators and roaming pigs that carry disease, a pig farm will not be profitable and it will fail.

The manual contains the following sections:

- Types of pig management systems used in Timor-Leste;
- Managing pigs including mating, farrowing, weaning and fattening;
- Housing and confining pigs for profit and disease control;
- Feeding pigs which includes basic understanding of nutrition and formulating diets;
- Health including control of parasites and recognising and controlling common pig diseases present in Timor-Leste.

The four key factors for successful pig production are:

- Choosing the best animals for breeding – both sows and boar;
- Providing a warm and clean environment for weaned and growing pigs;
- Feeding pigs adequate amounts of a balanced diet;
- Providing clean water for pigs to drink at all times.

1.2. Pig husbandry methods used in Timor-Leste

a) Traditional pig farming (free-roaming-scavenging)

Free-roaming-scavenging is the traditional system for raising pigs in many regions of the world. Pigs are mostly locked inside a house at night, but allowed to roam free during the day. Sometimes pigs are fed before they are released in the morning and again when they return before sunset, but not always. Diets are usually simple and not balanced.

Advantages:

- It is cheap.
- Requires little labour to care for pigs.

Disadvantages:

- Pigs spend significant amounts of energy finding food and water.

- Pigs can be in contact with other farmers' pigs that may be infected with parasites or diseases such as Classical Swine Fever/Hog Cholera.
- Pigs often have access to dog, cat and human faeces and become infected with cysticercosis or toxoplasmosis and other diseases – which make the pig meat unsafe for humans to eat.
- Pigs may eat toxic plants that cause liver damage and death.
- When sows farrow outside away from the house, piglets are more easily killed by the sow or by dogs and other predators – by the time the farmer finds the piglets, more than 50% may be dead.

b) Semi-intensive systems

The aim in both semi-intensive and intensive systems is to provide pigs with good welfare and good nutrition in a clean safe environment. In semi-intensive systems pigs are confined in pens inside a building overnight and allowed to forage in small paddocks or yards during the day. In these systems pens are mainly used for sleeping. However they still must have access to water inside the house. The outside pens, or small paddocks, can be planted with high protein pasture grasses for pigs to forage and fodder trees to provide shade and extra protein.

Advantages:

- Pigs cannot eat the faeces or dogs, cats or humans. This means they are free from cysticercosis and Toxoplasmosis and the meat is safe for humans to eat.
- Pigs are protected from dogs and other predators.
- Pigs are isolated from other farmers' pigs which reduces the risk and spread of disease.
- Access to toxic plants is prevented.

Disadvantages:

- Requires more labour.
- More investment needed for buidings and infrastructure.
- More expensive to raise pigs than free-range-scavenging systems.
- However, pigs are healthier, grow faster and the profit per pig is greater.

c) Intensive systems

The aim in intensive systems is also to provide pigs with good welfare and good nutrition in a clean safe environment. In an intensive system pigs are confined inside a building in pens. Pens are best divided into a clean dry area for sleeping and a wet area for eating and drinking (see *Housing Pigs*). Both food and water containers must provide sufficient space for the number of pigs in the pen to eat and drink (see *Housing Pigs* and *Feeding Pigs*). The containers must be solid and preferably fixed to the floor.

Advantages:

- The advantages are the same as describe for semi-intensive systems as the pigs are isolated from other animals and provided with an optimal environment for good welfare.

Disadvantages:

- The same disadvantages apply to intensive systems as semi-intensive systems – they require more labour and are more expensive than free-range-scavenging systems.
- However, pigs are healthier, grow faster and the profit per pig is much higher.

2. Managing Pigs

2.1. Sow and boar management

If pig production is to be profitable it is important that the sows and boar are managed correctly.

If the sow is not cared for and managed correctly:

- She will not reproduce regularly.
- She will have a small litter (less than 4 or 5 piglets).
- She will not feed her piglets and they not grow and may even die.

If the boar is not managed correctly:

- He will become thin and he will not be fertile (his sperm is weak and not viable).
- He may become weak or injured and not be able mate with the sow.
- The sow will have not farrow or farrow only a few piglets.

2.2. Selection of a boar and sow

What are the important points to look for in a sow and a boar?

a) Selecting a sow

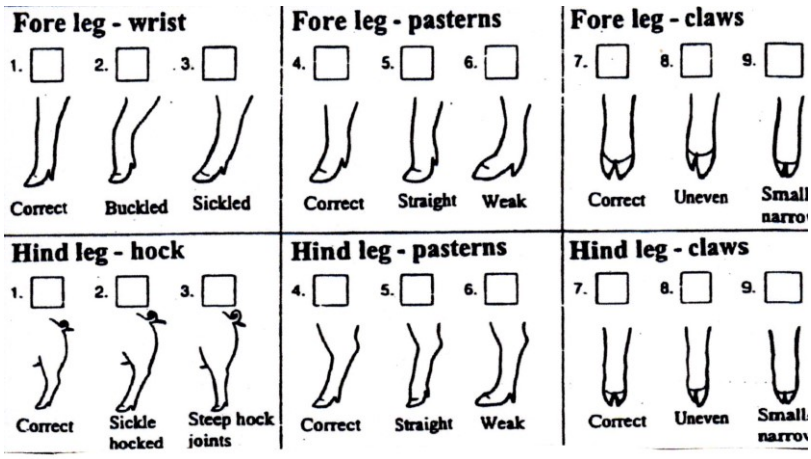
- Select gilts for breeding from litters born to the best sows in the herd.
- The best sows are the sows that farrow the most piglets/litter and their piglets are the fastest growing and heaviest piglets at weaning (5 – 8 weeks).
- Select several of the fastest growing females from the best litters at weaning.
- Ensure that they get a balanced diet during the growing period.
- Make the final selection of gilts for breeding (future sows) when they are around 6 months old.
- Excess females selected at weaning but not selected at 6 months can be sold as breeders to other farmers.
- The important selection traits are:
    - Good conformation – long body from head to tail with good rounded hams (backleg muscles).
    - Sound legs – the most important criteria for legs are:
        - The toes on each foot are even.
        - The sow does not walk on her toes.
        - The leg hits the ground at the correct angle – the correct leg shape is demonstrated in Figure 1.
    - The number of teats depends on the breed but there should be at least 10 good teats but 12 is preferable.

b) Selecting a boar

- Hili fahi aman husi hahoris moris mai to'o nia mak sai fahi aman di'ak liu iha grupu.
- Select the boar from a litter born to the best sow in the herd.
- The best sow farrows the most pigs/litter and her pigs are the heaviest pigs at weaning (5 – 8 weeks).
- Always select the fastest growing male from a litter.

- Select a male pig with good body – long from head to tail – with good rounded hams (backleg muscles) and well-formed testicles that are even in size.
- Select only males with sound gait:
  - The toes on each foot are even.
  - The boar does not walk on his toes.
  - The leg hits the ground at the correct angle (Figure 1).

Figure 1: *Recommended leg conformation traits*



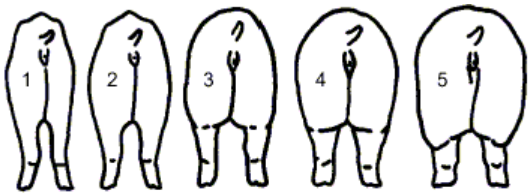
c) Factors that have a negative effect on herd improvement

- Castrating the strongest healthy male piglets from the best sows and selling them to a fresh pork market or for cultural purposes – not using them as boars.
- Selling the strongest healthiest females from the best sows to a fresh pork market or for cultural purposes.
- Keeping smaller and weaker male and female piglets from smaller sows and smaller litters for breeding.
- Breeding between male and female siblings.

d) Sow condition and body score

The condition of each sow can be assessed using a body score system (Figure 2). The ideal is between 3 and 4 – that is no less than 3 and no more than 4.

Figure 2: *Body condition score of sows*



Score	Condition	Detection of ribs, backbone, "H" bones, and "pin" bones
1	Emaciated	Obvious
2	Thin	Easily detected with pressure
3	Ideal	Barely felt with firm pressure
4	Fat	None
5	Overly fat	None

2.3. Managing gilts (unmated female pigs over 8 months of age)

a) Optimal age to mate a gilt

- Although both size and age are important – **age is more important**.
- Recommended age for mating gilts is about **10 months**.
- Depending on the breed, the body weight will vary from 60 to over 100kg. Preferably the gilt will be around 70 to 80% of her final body weight.
- A gilt that is mated too young, or too small, will stop growing and not produce large healthy litters.

b) Managing a gilt before mating

- Make first selection of females for breeding as early as weaning.
- Make final selection at 6 months of age.
- Make sure the gilt is well fed and kept away from the boar until at least 8 - 10 months of age.
- Put the gilt in a pen next to boar about 1 month before she is to be mated, or give her daily exposure to a boar.
- Observe the gilt daily and mate her on the second or third heat. This will increase the probability of a larger litter.
- Mate her twice 12 to 14 hours apart on the first day of heat.
- Gilts that do not conceive after two matings should be sold for cultural purposes or as fresh pork if there is a market.
- Likewise, gilts that have not expressed heat by 12 months of age should be culled.

Table 1: *Basic facts about sow reproduction and fertility*

Age to breed gilts	Minimum 8 – 10 months
Weight to breed gilts	70 to 80% of final mature weight
Length of heat period	2 – 3 days
When to mate	Gilts 1st day of heat Sows 2nd day of heat
Number of matings	2 matings 12 – 14 hours apart
Period between heats	18 – 24 days (21 days)
Weaning to heat period	6 – 10 days
Gestation period	114 days (3 mths/3 wks/3 days

2.4. Managing a sow and litter

a) Managing the sow between weaning and mating

- Remove the sow from the piglets when they are between 5-8 weeks of age – when piglets weigh 8 to 10 kg.
- Treat sow and piglets for parasites 7 days before weaning.
- Remove all the piglets on the same day.
- Put the sow in pen next to a boar, so that she has direct contact with boar (hear, see, smell).
- Do not feed sow on day of weaning.
- Feed sow ad-lib from day after weaning until 10 days after mating – if the sow is mated on first post-weaning heat.
- If not mated on first heat - monitor feed intake and feed to maintain good body weight until mated.

- Sows may be slow to come into heat after weaning unless they are given boar exposure immediately by housing her in a pen next to the boar. The effectiveness of boar exposure immediately after weaning was demonstrated in a series of trials carried out with smallholder pig farmers in Indonesia (Table 2). In three villages the first and subsequent odd numbered sows weaned by farmers were penned next to a boar, while the even numbered sows were penned 50m away from a boar, and behind a mound.

Table 2: *The effect of housing a sow next to the boar after weaning (boar exposure)*

	Next to boar	**50m from boar**
Number of days between weaning and mating	7.3 (1 – 31)	>18.2 (4 – 50+)
Number piglets born/sow	5.1 (2 – 8)	2.8 (0 – 5)

If a pig farm is to be profitable, it is important that the number of days between weaning and mating is less than 10 days for every sow.

Other methods used by farmers to induce heat in sows include:

- Gently stroking the sow's vagina with a freshly cut papaya stalk every morning for 3-5 days.
- Spraying the sow's (or gilt's) pen with boar urine every morning for 3-5 days.
- Stressing the sow by placing her with other sows in a pen.
- Bringing the sow to the boar – which is similar to placing the sow in a pen next to the boar.

b) Mating the sow

- Check the sow for signs of oestrus every day from 4 days post-weaning.
- Once heat is detected mate the sow at the appropriate time (see *Heat Detection* below and Table 1)
- Always put the sow in the boar's pen, or use a special mating pen. This will upset the boar less.
- It is also recommended that the sow is put with the boar before feeding.
- Mate the sow twice during her peak heat period, with an interval of about 12-14 hours between services.

c) Heat detection – common signs of heat

1st stage: Early heat signs

- General restlessness.
- Vulva turns red and is swollen.
- White mucus discharge.

2nd stage: Time to prepare to mate the sow

- Real Oestrus lasts for 40 - 60 hours.
- Vulva becomes less red and swollen.
- Slimy sticky mucus discharge - can test with finger and thumb as in Figure 3 (6).

Figure 3: *Changes to the vulva during oestrus*

The vulva swells (1) and reddens significantly in gilts (2 – gilt in centre) but only the interior tends to redden in sows (3)

Mucus discharge – clear, sticky mucus collects on the vulva of a gilt (4) and sow (5). Testing the stickiness of the mucus by 'thumb checking' (6)

- Tendency to mount and be mounted by other sows.
- The sow or gilt will stand still when pressure is applied to her back (can accept a man's weight sitting on her).

- Mate gilts and sows twice during this stage 12 to 14 hours apart.
- It may be easier just to mate gilts on first day of heat and sows on second day of heat.

3rd stage: Post-oestrus period signs

- The sow/gilt will not stand still when pressure is applied to her back.
- The swelling of the vulva disappears.

Reasons for sow not conceiving

- Both fat and thin sows may have difficulty conceiving.
- Thin sows also are difficult to breed – in fact if a sow loses more than 10% of her body weight between farrowing and weaning, she is unlikely to become pregnant gain.
- If the sow is too thin it is best to skip mate her. That is – do not mate her on the first heat after weaning but feed an extra 1 - 2 kg of feed per day until her body condition improves. Once her body condition

has improved, try mating her on the next heat post-weaning, but continue the extra food for 10 days after mating.

- Feeding the sow *ad-lib* during the month before farrowing will help prevent thin sow syndrome during developing during lactation. However reduce feed intake in the week before farrowing and ensure the sow drinks plenty of water.
- If a gilt or sow is too fat – reduce feed intake until body condition is good before giving boar exposure.
- However it may be best to cull overfat sows and gilts as they may never cycle.
- Treating the sow for internal parasites one week before farrowing will also help prevent thin sow syndrome.
- Cull sows after they have farrowed 6 litters – even if they still farrow regularly and rear large litters (9 or more piglets).

d) Sow management during pregnancy

- Feed the sow twice daily during pregnancy and gradually increase quantity of until 6-7 days before farrowing (see *Feeding Pigs*).
- Feed green leaves (e.g. high protein pasture or dadap leaves) to increase protein intake.
- Around 6 to 7 days before farrowing date reduce feed quantity by about 30%.
- It is best practice to allow pregnant sows and gilts to exercise in a large outside pen or paddock – ensure sow has access to shade and water.
- Treat the sow for internal parasites 1 week before farrowing – this will prevent the sow infecting her piglets and help prevent 'thin sow syndrome'.
- If external parasites (mange and lice are a problem treat the sow 3 and 1 week before farrowing to eliminate mites.

e) Sow management before farrowing

- Prepare a special pen (farrowing pen) for the sow.
- Build a small box inside the pen with a floor, a roof and 3 solid walls. Make an opening in the front wall large enough for piglets to go in and out. This is called a creep box and is a warm place for piglets to sleep. (see *Housing Pigs*)
- Alternatively build a small pen next to sow pen with a cover 0.6 to 1.0 m above floor. This is a special place for the piglets to sleep. (See Housing Pigs)
- Put the sow in the farrowing pen 7 days before she is due to farrow. (**Note:** *The time between mating and farrowing is 3 months, 3 weeks and 3 days. Therefore put the sow in the farrowing pen 3 months, 2 weeks and 3 days after mating.*)
- Wash the sow before putting her in the pen to remove soil and parasite eggs from her body, and then dry her.
- Watch the sow each day and reduce feed intake to 0.5 to 1kg the day before farrowing.
- The impending signs of farrowing include:
  - A reduced appetite
  - Restlessness – standing up and lying down
  - If bedding is available chewing and moving bedding around in her mouth
  - Nest building.

f) Sow and piglet management after farrowing

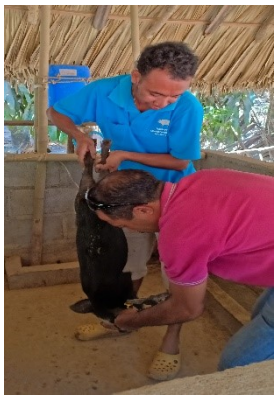
- Give the sow plenty of water the day she farrows, but do not feed her.

- Give her 30 - 50% of her normal food on the second day.
- Gradually increase the amount of food to as much as she will eat over the next 5 days.
- Feed the sow *ad-lib* from 5 days after farrowing.
- Provide clean water for the sow to drink at all times.
- Make sure that each piglet drinks milk from the sow within the first 2 hours of life – the first milk contains special proteins which help protect the piglet from infection and diseases.
- After piglets have been suckled – paint the cord with iodine solution and place the piglet in the creep box for warmth and protection.
- Castrate male pigs between 3 and 7 days old.
- Inject all piglets with iron on same day – contact Veterinary Technician if iron is to be combined with penicillin to prevent Streptococcal infection. *Note: Streptoccus spp is a bacteria that causes arthritis and can infect the brain.*
- Treat sow and piglets for parasites 7 days before weaning.

g) Managing and weaning piglets

- When the piglets weigh 8-10 kg (around 5-8 weeks) they are ready to be removed from the sow (weaned).
- Place piglets into a clean warm dry pen that has a sleeping area covered with a thick layer of dry grass and a wet area for eating and drinking or into a pen with a weaner box (see *Housing Pigs*).
- Feed piglets at least 3 times a day for the first 2 weeks after weaning.
- Once the pigs are over 12 weeks of age they can sleep in an uncovered pen, but make sure that they have plenty of dry grass to sleep on.
- Catching and weighing piglets:
  - Grab the pig by one or both hind legs and lift pig off the ground (Figures 4 & 5);
  - Raise hindlegs so that pig is at least 0.5m off the floor while assistant opens bag – may two people holding one leg each for heavier pig;
  - Open bag and place pig's head in the bag – pull opening of bag up over body and hindlegs;
  - Place hook connected to clock scales through bag;
  - Check weight of pig.

Figure 4: *Grabbing a pig by one hind leg* **Figure 5a & b:** *Grabbing a pig by both hind legs*



2.5. Managing a boar

a) Mating

- Do not use a boar to mate a sow before it is 10 months old.

- If he is too young, his sperm quality is not optimal and it will also make him less fertile when he is older.
- A boar should mate at least 2 to 3 sows per week, but no more than one mating per day.
- The boar can be used to mate one sow 12-14 hours apart and then rested for a day.
- It is best to use the boar every second day.
- Farmers with only 3-5 sows should consider sharing a boar with other farmers so that the boar has enough matings to maintain his fertility.
- It is best to bring the sow to the boar and keep her in the pen next to the boar – then move her into the boar's pen for mating.

b) Housing

House the boar in a pen inside a house, preferably with access to an outside yard, or small paddock, planted with high protein pasture grass and forage trees so that the boar can forage during the day (for more detail see *Housing Pigs*).

c) Feeding

Feed the boar *ad-lib* unless he is becoming fat. If a boar is too fat he may have reduced libido. Provide clean water at all times (for more detail see *Feeding Pigs*).

2.6. Managing weaned and growing pigs

a) Housing

- Feeding and housing weaned and growing pigs is very important.
- It is important to provide a clean warm dry environment and a balanced nutritious diet with optimal protein and energy content.
- It is also important to keep growing pigs isolated from sows and boars and pigs owned by other farmers. This helps to prevent growing pigs becoming infected with diseases such as Classical Swine Fever/hog cholera and internal parasite infestations.
- The best method for managing growing pigs is to design and build a pig confinement system.

For more information about housing weaned and growing pigs see Section 3: Housing Pigs.

b) Feeding

- Aim to feed weaned 8-10 week old pigs weighing around 10kg 0.4 to 0.5 kg food/day.
- Gradually increase the amount to 1.0 to 1.3 kg/day when the pig weighs between 20 to 30kg.
- As a general guide – aim to feed a 20 kg pig approximately 5% of its body weight – decreasing to around 4% of body weight from 30kg to sale.
- Feed growing pigs at least twice each day if feed cannot be made available continuously.
- If possible feed pigs individually or in small groups.
- Provide clean water at all times, especially at feeding time.

3. Housing Pigs

The main reasons to confine pigs inside the farm are for security and disease prevention. The reason for keeping pigs in houses is to provide good welfare and a suitable micro-climate for the pigs.

3.1. General requirements for pigs

If pigs are to grow and reproduce and remain healthy they need:

- Shelter from sun, rain and cold winds and excessive air movement.
- A place for pigs to rest that is warm and dry and that is free from draughts (no excessive air movement).
- Minimal temperature variation from day to night:
  - For adult pigs the difference between maximum and minimum temperature should be less than 5 to 8 degrees in 24 hours.
  - For baby pigs the variation should be less than 3 degrees in 24 hours.
- A special place for dunging and urinating (Figures 6, 7, 12 & 13).
- A regular supply of food - pigs must be fed at least twice each day.
- A supply of clean water available continuously (24 hours/day).
- A secure place at night.
- Protection from predators such as dogs which can kill baby pigs.
- To be isolated from pigs owned by other farmers.
- To be prevented from eating the faeces of cats, dogs and humans.

3.2. Temperature requirements for pigs

Pigs (and humans) can survive in extreme hot and cold temperatures for very short periods. However, the growth rate of pigs is reduced when pigs are kept in a hot (>32oC) or a cold environment (<20°C) for more than 4 to 6 hours. Their ability to resist infection is reduced and they are more likely to become sick. Therefore one of the aims of housing pigs is to reduce the maximum inside temperature to below 30oC and keep the minimum above 20oC.

Pigs also prefer a more even temperature than fluctuating temperatures.

- **Baby pigs or suckers (< 1 week)** – recommended temperature is 28 to 30°C – but temperature variation is more important: if variation is less than 2 – 3 degrees in 24 hours then a temperature of 24 - 26°C is OK.
- **Suckers (1 to 7 weeks)** – 24 to 28°C – temperature variation of 3 - 5°C in 24 hours.
- **Weaned pigs (7 to 12 weeks)** – 24 to 28°C – temperature variation of 4 - 6°C in 24 hours.
- **Growing pigs (> 12 weeks)** – 22 to 28°C – temperature variation of 5 - 8°C in 24 hours.
- **Sows and boars** – 20 to 28°C – temperature variation of 5 - 8°C in 24 hours.

3.3. Advantages of confining pigs

- Confining pigs in a house and/or a fenced area (yard/pen/paddock) prevents pigs having contact with other farmer's pigs – this will help control the spread of disease between farms, including Hog Cholera (Classical Swine Fever).
- When pigs are confined to a house or fenced area, and dogs and cats are prevented from entering the fenced area, pigs cannot eat cat or dog (or human) faeces – this will prevent infections such as cysticercosis and toxoplasmosis in pigs which are transmitted to humans through eating undercooked pork.

3.4. Selecting the site of a pig house

The site should be:

- Elevated so that it is not flooded in the rainy season.
- Connected to reliable water supply.
- Connected to electricity if possible.
- Protected from the sun by shade from trees.
- Have ample fresh air.
- Away from houses – at least 10m downhill and down-wind.
- Near a road that is open all-year round.
- Suitable for manure disposal.

3.5. Designing a pen

A pen must provide a choice of at least two environments for pigs.

A clean dry area to sleep on and a wet area where pigs can eat, drink, urinate and defecate (Figures 6, 7, 12 & 13).

The floor of the sleeping area can also be covered with bedding material such as dry grass or other material which is soft. It is especially important to provide a warm dry area for pigs under 12 weeks (suckers and weaners).

The water trough must be situated in the wet area as this will encourage pigs to urinate and defecate in this section. This area must have a slightly sloping floor so that water drains out of the pen. The water container can be either built into the base of the pen wall or placed at right angles to the pen wall so that pigs can drink from both sides of the trough.

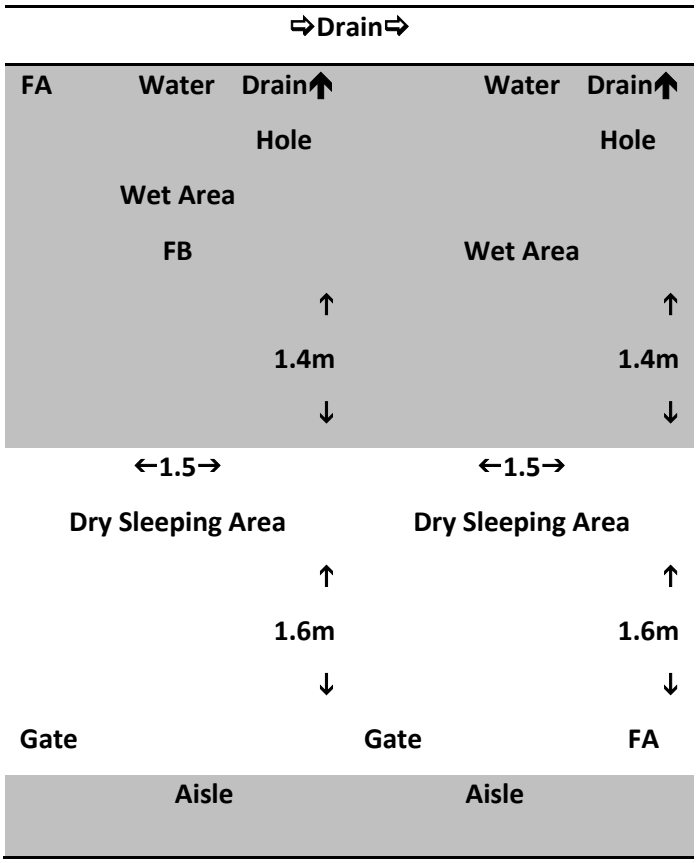
In a pig house with an aisle down the centre and pens each side, the food trough can be built into the base of the wall adjacent to the aisle next to the gate at the front of the pen (Figure 6 pen on right). This makes it easier to feed pigs but it is recommended that the food must be relatively dry to prevent the floor of the sleeping area becoming wet. If the food is very liquid, then the feed trough must be placed in the wet area of the pen.

Another alternative is to design the pens so that the drain runs down beside the aisle (Figure 12) so that the wet area is nearest the aisle. This makes feeding and providing water much easier.

Both feed and water troughs can sit on the floor but they must have a solid base so that the pigs cannot turn them over. If they are not fixed to the floor it is easier to remove them for cleaning.

Figure 6: *Alternative pen designs*

Pen size for 5 x 50kg pigs – providing 0.6m^2 / 35kg pig = 1.5m X 2m = 3.0m^2



Pen on left has water and food (FA & FB) containers in wet area.
Pen on right has water in wet area and food (FA) in dry area.
FA = food trough is attached to the floor and connected to the pen wall.
FB = food trough free standing in pen (not attached to wall or floor).

Figure 7a: *Photograph of a divided pen in Indonesia*

Divided pen with dry sleeping area at the rear and feeding area at front.

Figure 7b: Pig pens divided into dry and wet areas *(example from Timor-Leste)*

3.6. Disposing manure

Make sure that waste water and manure (effluent) from the pig house does not enter waterways and rivers.

Design the floor of the pen so that the effluent (manure and waste water) will flow from the pen into a drain along the outside of the building or down the side of the aisle (Figure 12).

Extend the drain at the end of the house to a pit or a pond. Pipes can also be used to carry effluent to a small pond. Ponds can be holes in the ground and the sides and floor may be lined with either plastic or concrete (Figure 8a).

If two ponds are built side by side, they can be used alternatively. When one is full the excess water can be drained from it and the rest of the water left to evaporate. The solid material or dry sludge in the first pond can be removed periodically and added to compost or spread directly on soil in gardens as fertiliser. The excess water can be drained into a second and or onto an area planted with forage trees that can be used to provide vegetable protein for pigs.

Figure 8a: *Effluent draining into a pond* **Figure 8b:** *Effluent draining into a snail pond to act as fertiliser*

3.7. Building a pig house

The aim of this section is to provide information required to construct a new pig house, or renovate an existing pig house. It is not intended to be used as a check list for an existing building. It aims to provide a best practice approach to improving the welfare of pigs through optimal housing standards.

A pig house must be constructed to suit the climatic conditions and according to the pig production system being practiced. Using locally available materials will minimise cost.

- **Orientation** - Situate the long axis east-west to reduce heat load inside the house. *It is impossible to keep the sun off pigs in a shed with a north-south axis.*
- **Width of shed** – 8 to 10m recommended – preferably no more than 12m.
- **Length of shed** – depends on number of pens required
- **Roof** – the roof must be water proof and can be either thatch or iron – thatch is cooler in and provides more even temperature (see table 1);
    - If shed is greater than 10m wide an iron roof with 15 degree pitch with a ridge cap is best (see figure 4);
    - If shed is less than 10m wide, either iron or thatch can be used with a lower roof pitch between 5 and 8 degrees;
    - To protect pigs from sunburn - extend the roof of the house so that sun cannot shine into pens;
    - The height of the roof above the outside wall depends on the height of the roof in the middle of the house and the slope of the roof. However, it should be between 1800 and 2000mm to allow air movement. The roof can be extended from 0.5 to 1.0m out from the wall, especially on the northern side, to prevent to sun shining onto pigs inside the shed.

Table 3: *The average temperature inside the house during day and night (based on the roof type) – Data from highlands of Propinsi Papua Indonesia*

Roof type	Average temperature during day (°C)	Average temperature during night (°C)	Difference between day and night (°C)
Grass/thatch roof	22.6 ± 0.92	19.1 ± 0.87	3.5
Tin/iron roof	26.1 ± 1.91	18.2 ± 0.92	7.9
Outside	24.8 ± 0.61	17.5 ± 1.33	7.3

Grass roof was best because it was cooler during day and warmer during night.

Figure 9a: *If shed is wider 10m, an iron roof with 15 degree pitch plus a ridge cap is required. Air is naturally extracted through the ridge vent to improve ventilation (Vietnam).*

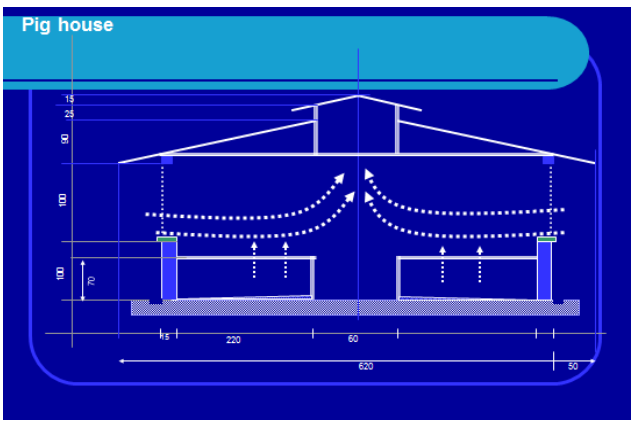


Figure 9b: Examples of sheds with grass rooves (on right with biosecurity fence)

- **Outside walls** - End walls are the walls at the narrow end of a shed and side walls are the walls along the long axis of the shed. Side walls can be called back and front if there is only one row of pens inside the shed. (Figure 10).
- End walls (walls at end of long axis) can be solid.
- Side walls – height = 1.8 to 2.4 m:
  - Build solid wall up to 1.2 m above level of floor in pen.
  - If the nights are cool or windy, a plastic blind can be used to cover the area between the top of the solid wall and the eave – the blind rolls up from the top of the sold wall to the eave (Figure 11a & 11b).

Figure 10: *The definition of end and side walls in a pig house*

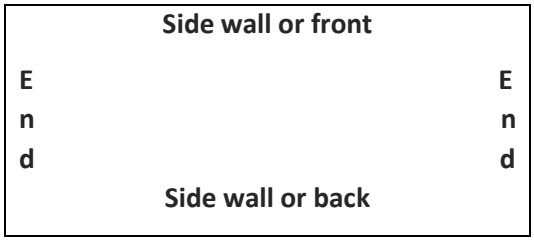


Figure 11: *A plastic sheet can be used as a blind and rolled up from the top of the solid wall to close the shed (11b right) or lowered (11a left) to allow ventilation and air flow.*

- **Pen walls** – Can be open or solid (Figures 12 & 13).
  - In farrowing pens solid walls and creep boxes are recommended.
  - For weaner pigs open mesh walls can be used if weaner boxes are provided.

- For growing pigs the side-walls between pens can be solid along the section of the pen where pigs sleep, and open mesh along the section where pigs urinate and defecate (Figures 12 & 13).
- Recommended height for dividing pen walls is 0.8 to 1m – for boars and outside walls 1.2m above floor of pen is recommended.

- **Floors** - floors can be solid or slatted.
  - A solid concrete floor with good drainage is best. A minimum slope of 1/20 is required for good drainage and slope must be from dry sleeping area to the wet area and the drain. Pigs always tend to urinate and defecate in the lowest are of the pen.
  - If wooden floor is used it is best to use a slatted floor in the area where pigs defecate and where feed and water are supplied (Table 4). However there must be a wide drain sloping to the lowest end of the shed under the slats.
  - The floor of the house must be raised about 60cm above the ground.
  - If floor is concrete it must not be slippery when wet – make the surface slightly roughened.
  - Build a drain along the side of the shed at the back of the pens (Figure 13) or front of the pens (Figure 12).

Figure 12: *Floor plan of pens for weaned and growing pig (1.0m x 1.5m = 1.5m^2 – large enough for 4 pigs weighing 50kg).*

*Note pens are a mix of solid and mesh walls up to 1.2m high

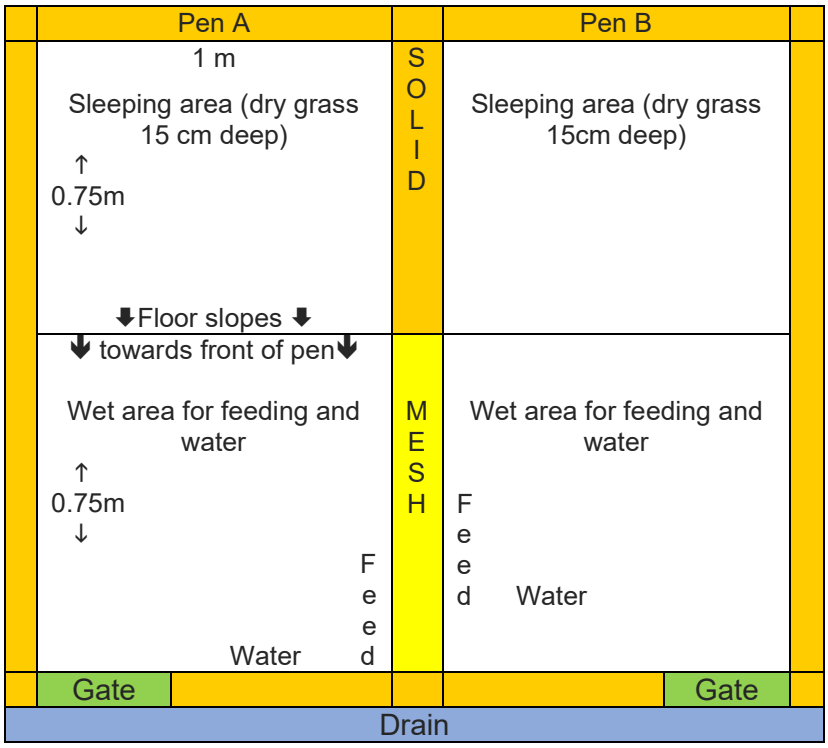
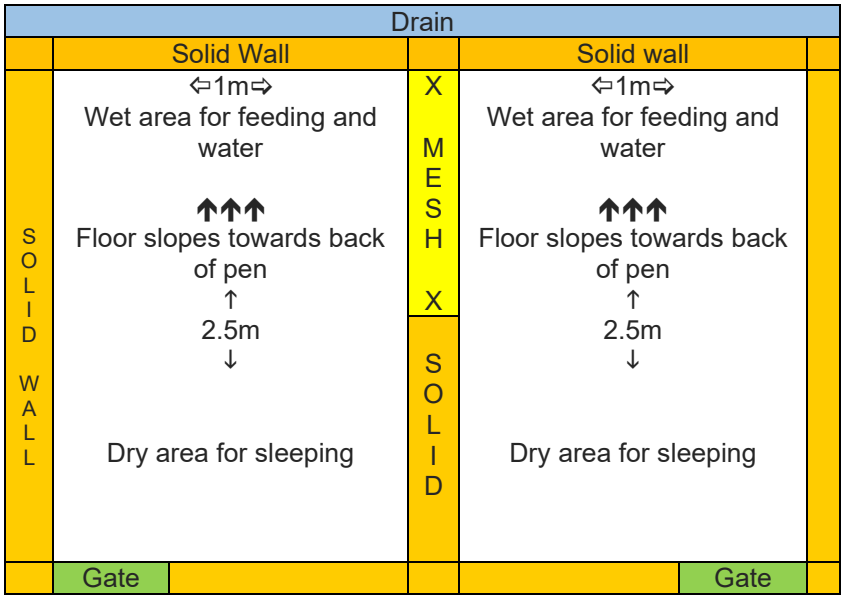


Figure 13: *Floor plan of pens growing pigs (1m x 2.5m = 2.5m^2 large enough for 5 pigs weighing 50kg)*

* Note: Solid and mesh walls up to 1.2m high



- **Pens -** The number and the size of the pens will depend on the expected numbers of pigs to be housed and the size of the pigs in each production phase.
    - Pens can be divided into two sections (Figures 6, 7, 12 & 13):
        - a well-drained area where pigs are fed and watered.
        - a dry area covered with dry grass for resting and sleeping.
        - Refer to section on housing different classes of pigs.

Table 4: *Specifications for slatted floors for different classes of pigs*

Class of pig	Maximum gap between slats (mm)
Piglets (1 – 7 weeks)	11
Weaners (7 – 12 weeks)	14
Growing (> 12 weeks)	18
Gilts, sows, boars	20
	Minimum slat width
Piglets and Weaners	50
Other pigs	80

3.8. Ventilation and air movement

Ventilation is important to help control the air temperature and air quality inside the pen.

When it is hot – open the windows or side walls as far as possible (Figure 11a) to allow as much air movement as possible. This will remove hot air, keeping the pigs cooler.

When it is cooler (e.g. at night) the shed can be closed up as in Figure 11b. This will reduce air movement and keep pigs warmer.

Ventilation is also important to reduce the build-up of ammonia and carbon dioxide gas as well as aerosols of bacteria caused by dirty floors.

If ventilation holes are inserted into solid walls the holes must be above pig height so that cool air cannot blow directly onto the pigs when they are sleeping.

3.9. Stocking rates (SR) for pigs

The recommended stocking rates are listed for pigs of different ages in Table 5. It is important not to overstock pens with too many pigs. Overstocking reduces growth rate and pens are much dirtier. Sub-standard hygiene and dirty pens increase the level of ammonia gas and airborne bacteria in the airspace. Ammonia and aerosols can cause lung damage and outbreaks of respiratory disease (pneumonia), and will also reduce the pig's ability to resist infection.

Table 5: *Recommended minimum stocking rates (square meters/pig)*

Average weight (kg)	Stocking rate (square metres/pig)
Up to 11 kg	0.17
Up to 18 kg	0.22
Up to 27 kg	0.27
Up to 35 kg	0.38
Up to 50 kg	0.49
Up to 70 kg	0.60
Up to 100 kg	0.80

Stocking rates must be based on weight of individual pigs and not age or breed.

The recommended stocking rates (Table 5) are the minimum space required to provide good welfare for pigs and maintain growth rates and hygiene standards. However adding 10% to 20% to the recommended figures will improve standard of hygiene and growth rates.

a) Calculating stocking rate

Stocking rate: Multiply length by width of pen and divide by the recommended stocking rate (m^2).

Example: Average weight/pig = 27kg; area/pig = 0.27m^2
If size of pen = 1 x 2m = 2m^2.
Number of pigs we can put in pen is 2m^2 / 0.27 = 7.4 = 7 pigs/pen.

3.10. Pen requirements for each class of pig

a) Pregnant sows

Recommended pen size – from 1 to 1.5m^2 per sow. Pregnant sows need a quiet environment. Sows can be penned individually but in many hot climates pregnant sows may be housed in groups. This requires a large pen (from minimum 3m^2 depending on number and size of sows.

b) Farrowing pens and creep boxes

Recommended pen size – 4 to 6 m^2. Only one sow/pen because lactating sows need a quiet environment.

It is still regarded as best practice to provide the sow with a farrowing crate to reduce the risk of sows lying on weak piglets. Alternatives do not provide good welfare for piglets However, farrowing crates can be expensive.

A heat lamp (or standard electric light bulb) may also be provided to keep piglets warm immediately after they are born, if electricity is available and lamps are inexpensive. They must be attached high enough not to burn piglets.

A better alternative that can be used on smaller farms is the creep box (Figures 14 & 15 below). This provides a warm dry environment for piglets as well as helping to prevent them being crushed by the sow. Creep boxes can be an alternative to an expensive farrowing crate.

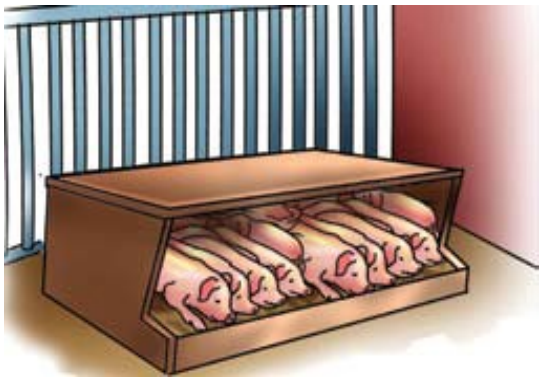
A creep box is a structure that has a floor, 3 walls and a roof. It can have a front wall with the top ¼ to ½ of enclosed, leaving the bottom ½ to ¾ open (Figure 14b, 15). But a front wall is not essential (Figure 14a). The creep box can be placed in a corner of the sow's pen (Figure 16).

Piglets should be placed in the creep box as soon as they have been suckled by the sow – so that they become accustomed to sleeping in the box for warmth and are protected from being crushed by the sow. It is best to add bedding material such as rice straw, banana leaves, dry grass or similar material to the floor of the creep box.

Dimensions for a creep box for 10 piglets:

- Height – 50 to 70cm (opening at front 30 to 40mm high)
- Depth (front to back) – 0.5 metre
- Width – 1 metre

Figure 14a and 14b: *Two different styles of creep boxes used in Asia.*



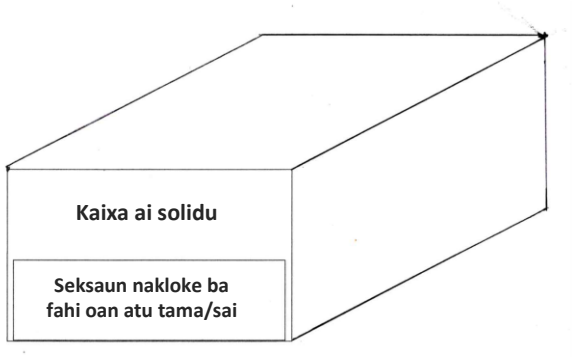
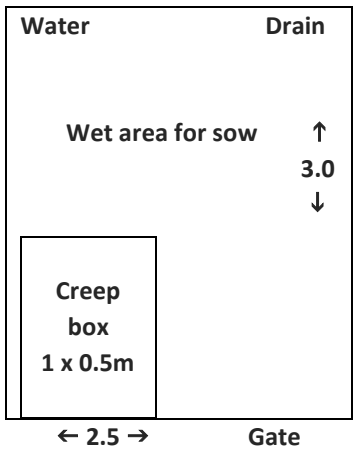


Fig 14a. No front wall Fig 14b. Enclosed creep box with opening along front wall.

Figure 15: *Example of a creepbox from the Philippines*

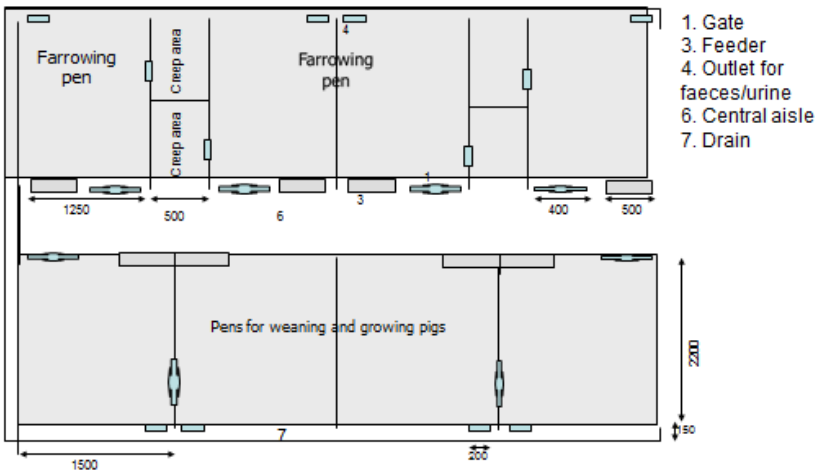
Figure 16: *Floor plan for a sow pen with creep box in corner – feed sow near gate or in wet area*



Creep boxes can also be built into the design of the building (Figure 16). The design is similar to a creep box with 3 solid walls, a floor and cover (roof). If the pen is 3m x 2m then the creep area is 1.5m x 0.5m built along one side of the pen, leaving 3 x 1.5m for the sow. The adjoining pen has the same sized creep area (Figure 16) that fills the other half of the space between pens.

It is important that the floor of the farrowing pen is kept as clean and dry as possible.

Figure 17: *Creep areas constructed between each farrowing pen*



c) Weaning pens

The target weight to wean pigs is around 8 - 10 kg at 5 to 8 weeks of age. BUT weight is more important than age. Pigs can be weaned into conventional pens (Figures 6, 7, 12, 13 & 20) or weaner kennels (Figures 18 and 19).

Kennels for weaner and growing pigs

The best way to house weaner pigs is in a weaner box, which is similar to a creep box, but larger. Place the weaner box at the end of the pen opposite to the end with the drain, or build as a separate box with an outside area (Figure 18a) where pigs eat and drink and urinate and defecate.

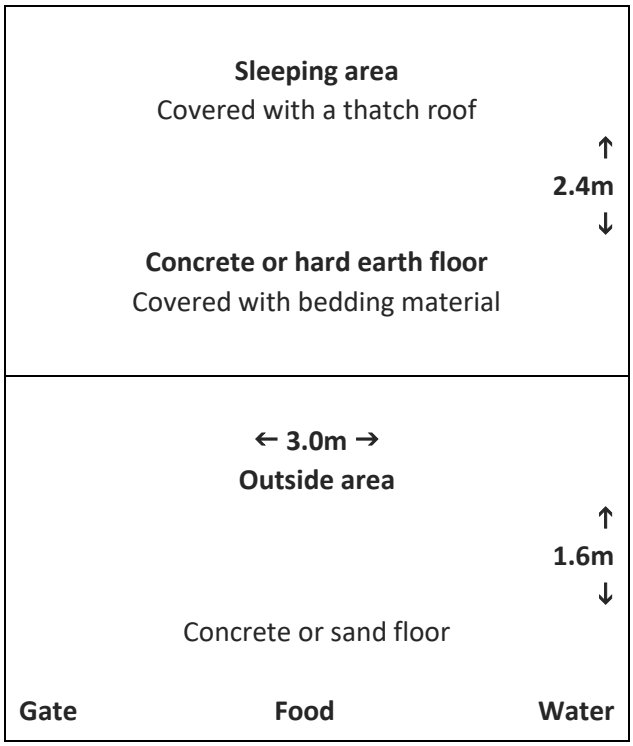
Structures similar to the weaner boxes in figures 18a and 18b can be built at the back of a pen inside a house to provide a good environment for weaner and growing pigs.

They can also be built as a free standing unit (Figure 19) with the sleeping area covered with a thatched roof and the floor made of either hard dirt or concrete and covered with bedding (dry grass or straw). The open area, where pigs eat and drink, can either have a sand or concrete floor. Sand will absorb water and urine and if the whole area can be covered with an iron roof around 1.5 to 2 m above the ground, the pigs will be protected from sunshine and the outside pen will not become wet and muddy when it rains.

Figure 18a & 18b: *Weaner kennels with an outside area where pigs eat, drink, defecate and urinate*

Figure 19: *Floor plan for a kennel for weaner and growing pigs – the whole area is covered with an iron roof.*

(Sleeping area is 2.4m x 3m = 7.2m^2 large enough for 14 pigs weighing 50kg or 18 pigs weighing 25kg)



Conventional weaner and growing pens

An alternative for weaner pens is to divide pen into 2 areas (Figures 12 & 13). The front area is for food and water and urination and defecation. The back area is where pigs sleep and is covered with a thick layer of bedding material such as rice hulls or dry grass. Fresh material can be added weekly and replaced when it becomes dirty.

The size of a weaner pen depends on the number of pigs to be housed. Each 10kg pig requires minimum 0.15m^2, so 10 pigs will require 1.5m^2 – (pen dimensions = 1m x 1.5m). However when the pigs weigh 20kg they will require 0.22m^2 each and the pen will house only 7 pigs.

Providing a weaner area in an existing piggery

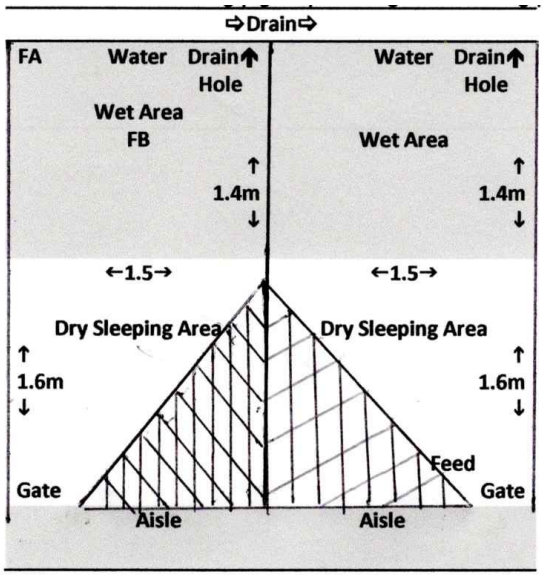
The easiest approach with an existing pen with gate at front (near aisle) and drain at back is to use a piece of plywood, or similar material, cut into a triangular shape.

One base of the triangle is attached to the front wall from the edge of the gate to the corner of the pen and the other base of the triangle attached to the side wall from the corner to about ¾ the way along the side wall towards the drain. This will make a triangular shaped covered area for the pigs in the corner of the pen, next to the aisle (Figure 20).

If the walls are solid and not open rails or mesh, it will provide a sheltered area where the pigs can sleep in a warm dry draught-free environment. If the walls are mesh or rails, then the pen wall would need to be covered with hessian bags or more plywood to stop draughts.

Place the water and food containers in the opposite corner near the drain to encourage pigs to defecate and urinate close to the drain.

Figure 20: *Covered area in an existing pen*



Pens need a slightly sloping solid floor made from concrete (but not too smooth). A wooden platform with 14 to 16 mm between each slat can be used in the wet area (Table 4). The floor where pigs defecate should be sloping towards a drain which makes cleaning easier. The slope needs to be a minimum of 1/20.

The most common type of pen is a pen with a concrete floor that slopes to a drain at the back of the pen (Figures 6, 13 & 20). If the feed trough and drinker, or water container, are placed at the back of the pen near the drain the pigs will be encouraged to defecate and urinate at the back of the pen. The aim is to keep the floor at the front of the pen clean and dry for sleeping.

The best practice is to make the side walls solid along the section where pigs sleep and to use open mesh along the section where pigs drink, urinate and defecate (Figures 12 & 13).

d) Growing pigs

A growing pig needs around 0.22m^2 when it is 25kg and about 0.5 m^2 when it is 50kg.

The size of the pen depends on the number of pigs and the maximum weight they will reach before selling the pigs or moving them to another pen.

Example: If the number of pigs in a pen is 10 and the maximum weight they will reach before moving is 50kg, then the pen must be big enough for 10 pigs weighing 50kg.

To calculate the size of the pen multiply 10 (pigs) x 0.5 (area required for 50kg pig) = 5.0m^2.

The alternative is to have 2 pens, each 2.5m^2, but to use only one pen until the pigs weigh 25kg. Then move 5 pigs into the second pen.

Examples of pens for growing pigs can be found in Figures 6, 7, 12, 13 & 19.

Kennels similar to those used for weaner pigs can be used for growing pigs as well. In fact pigs can be grown from weaning until sale if the kennel is large enough for the size of the pigs when they are ready for market. Alternatively 2 smaller kennels with runs can be built and half the pigs moved out when they reach the maximum weight for the space available.

e) Boars

A boar needs between 5 and 8 m^2 depending on its size.

Special care is required to prevent boars from escaping when gilts or sows are on heat.

The pen requires strong walls approximately 1.2m high.

Use the pen next to the boar pen for sows that have just been weaned. Moving a weaned sow to a pen next to the boar will encourage them to come into oestrous. It helps to make one half of the wall between the pens of mesh.

3.11. Putting the specialist pens into a piggery plan

On smallholder farms there will only be one boar pen and a maximum of 3 farrowing pens, depending on the number of sows in the herd.

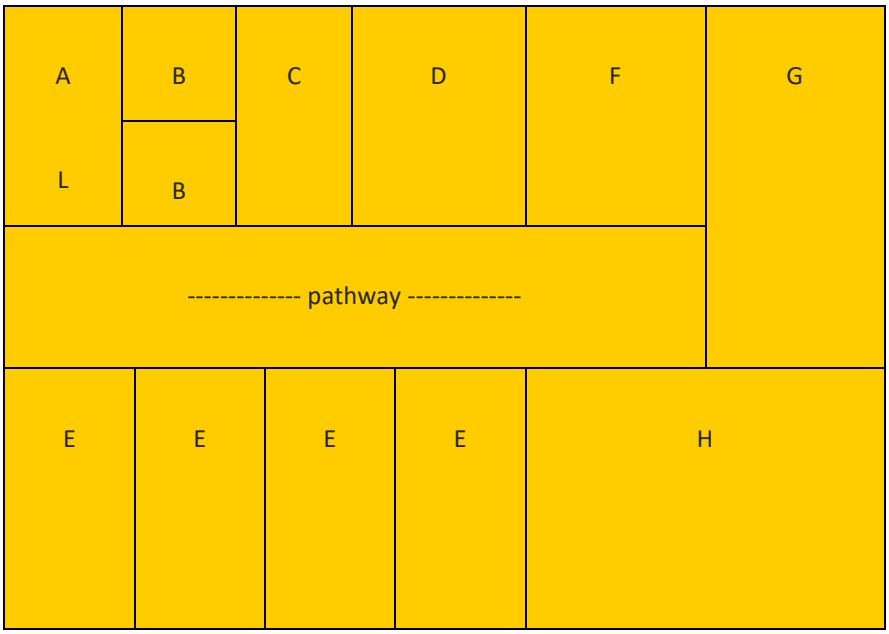
The boar pen must be strong with 1.2 metre high walls to stop the boar escaping to mate with gilts when they are in oestrous the first time. The pen next to the boar pen should be kept vacant for sows immediately after they have been weaned. This will encourage the sow to come into oestrous within 6 to 8 days of being weaning.

The farrowing pens can be situated along one side of the house, with weaned and growing pigs across the aisle in specially designed pens.

However, if weaner boxes are being used, they can be placed in an outside area where the pigs have access to an outside run (Figure 18a & 19). As the size of the herd grows separate buildings can be used for adult pigs (boars and pregnant and farrowing sows) and gilts when ready for mating. Weaned and growing pigs can be housed in another house or in outside runs with a weaner box.

An example of a completed plan is included in Figure 21. However the plan must be compatible with the available space and fit with other farm buildings.

Figure 21: *An example of a plan for a building for a boar, plus sows, litters and weaned pigs*



A. : Sow farrowing pen (Pen size: 1.5 x 2 = 3m^2)
B. : Piglet creep boxes with entry form each farrowing pen (Pen size: 1.5 x 1 = 1.2m^2)
C. : Sow farrowing pen (Pen size: 1.5 x 2 m^2 = 3m^2)
D. : Pregnant sow/sow with litter greater than 3 weeks old or weaned pigs (Pen size: 2.0 x 2 = 4.0m^2)
E. : Weaner and grower pigs (1.6 x 2.5 = 4.0m^2)
F. : Weaned sows or growing pigs (3.0 x 2.5 = 7.5m^2)
G. : Boar (Pen Size: (3.0 x 2.5 = 7.5m^2)
H. : Feed preparation and storage

4. Feeding Pigs

4.1. Feeding guidelines

a) Nutrients required by pigs

Pigs need 6 kinds of nutrients to grow and reproduce:

Protein

Protein is needed for growth, especially muscle (meat), reproduction and growth of foetus in female pigs, and production of sperm in male pigs.

Protein is made up of chemicals called amino acids and the types and quantities of the different amino acids vary between plant and animal protein. Pigs can be fed both plant and animal protein but they will grow faster if some animal protein is added to the diet. This is because pigs require quantities of two special amino acids called lysine and methionine to grow, reproduce and remain healthy. Significant amounts of these two amino acids are only found in animal protein and this is why pigs will grow faster on diets that contain dried fish, meat meal or snails.

Protein is measured in feed as a percentage of the dry matter weight of the diet. It can only be accurately measured on a dry weight basis. Dry matter means that the majority of moisture has been removed from the ingredient (e.g. pumpkin) before protein and energy content is estimated. It is used to provide a very accurate estimate of protein and energy and as a guide to formulating rations. However, corrections can be made in a diet to compensate if the ingredient (e.g. pumpkin) has not been dried.

The aim in preparing diets is to provide the best protein level from available feed ingredients.

The amount of protein required for native breeds found in Timor-Leste and crossbred pigs is lower than the level required for exotic European breeds.

The amount of protein required in pig diets decreases as pigs grow bigger.

- A 10 kg pig (local breed) requires around 16 to 18% protein in its diet.
- A 20 kg pig (local breed) requires 16% - reducing to 12% at around 35 kg.
- Older pigs need at least 10% protein in their diet.

Sources of protein – some examples of protein sources for pigs are fish, snails, tofu waste (soybean curd), peanuts, high protein pasture grasses, and forage trees (gammal/sesbania/leucaena leaves).

Carbohydrate

Carbohydrate is the main source of energy. Protein can be used for energy but it is not an efficient energy source. However, diets that have too much carbohydrate can result in fat pigs.

The level of carbohydrate or energy in a diet is measured in megajoules (MJ)/kg on a dry matter basis. It can only be accurately measured on a dry weight basis.

Megajoule is an international unit for measuring energy and provides us with a good guideline to the amount of carbohydrate in a diet that will provide the pig with energy. The target level of energy for all sizes and classes of pigs is 13-15 MJ per kg feed based on dry matter (with moisture removed).

Sources of carbohydrate – examples of crops high in carbohydrate include corn, rice bran and various root crops (cassava, sweetpotatoes, taro and others).

Fat

Fat is needed for growth, milk production in sows, and fertility in male pigs.

Sources of fat – examples of fat sources are oil in plant tissues such coconut oil and palm oil.

Vitamins

Vitamins are needed for the maintenance of health, metabolism (chemical processes that take place in the body) and bones.

Sources of vitamins – examples are plant oils, green leaves from vegetable crops, and foliage from trees such as gammal.

Minerals

Minerals are needed in small amounts for bone growth, digestion and transporting other nutrients around the body.

Sources of minerals – examples of sources of minerals are fish, bone meal (for example roasted cattle bone meal), snail shells, limestone soil, banana stem, and deposit of dicalcium phosphate (found bird droppings).

Water

Water is an important nutrient for all animals.

Over 70% of the pig's body is made up of water.

If animals are not given enough water they will not grow or reproduce.

If pigs have no water for 24 to 48 hours, they can develop salt poisoning and die.

Water quality will affect pig health and production. Water should be clean, cool, odourless and tasteless, and not salty.

Water is also a source of minerals such as Na, Mg and Sulphur.

Water which is suitable for human consumption will be suitable for pig consumption. Sows and boars may drink up to 20 litres of water per day or more. Growing pigs can drink 5 - 10 litres or more.

Sources of water – examples of water sources used for pigs are springs, mountain streams, underground wells, and rainfall collected and stored in tanks or containers. NEVER give pigs water from irrigation water from rice paddies, roadside or drainage ditches or stagnant pools or ponds.

b) Range of foods eaten by pigs

Pigs are omnivores and they eat the same foods as humans, chickens and rabbits. A list of crops and other food types available for pigs in Timor-Leste is presented in Tables 4, 5 and 6. The best pig feeds contain significant amounts of energy and protein, as well as sufficient quantities of vitamins and minerals. Proteins are made from amino acids and the most important amino acids for pigs are methionine and lysine. Hence feeds that are high in lysine and methionine are essential for optimal growth of young pigs. Crude fibre is also required for a balanced diet but too much crude fibre may reduce the growth rate of pigs.

c) Feeding requirements for each class of pig

Weaned and growing pigs

The best method is to feed growing pigs *ad-lib*, that is to have feed available for the pigs to eat whenever they feel hungry. However, if this is not possible for a smallholder farmer, pigs should be fed 2 or 3 times each day and the recommended daily amount divided into 2 or 3 equal amounts.

When feeding pigs at set times (2 or 3 times) during the day allow approximately 150mm feeder space/pig at 20kg increasing to 200mm feeder space/pig by 60kg and 240mm feeder space at 100 kg pigs. If pigs are fed ad-lib the amount of feeder space/pig can be reduced by 50 – 70%.

The amount of feed is calculated on the weight of the pig rather than age.

The weight or amount of feed is based on dry matter content – that is food containing no or little moisture. However as long as the food is soft like a thick paste, and not liquid, the amount recommended should be adequate for growing pigs.

An example is pumpkin which contains 90% water. If the pumpkin is mixed with dry food it will provide moisture to the diet and make it more palatable. However the estimated protein content of pumpkin will have to be reduced when calculating the protein content of the diet.

Farmers also need to monitor the way the pigs grow by observing the pigs. If the pigs are growing slower than expected, then increase the amount of food given at each feeding by 5% and observe the results until the required growth rate is achieved.

Weaned pigs weighing around 10kg need to be fed around 0.4 to 0.5 kg of food/day.

Gradually increase the amount of food to 1.0 to 1.5 kg/day when the pig weighs between 20 to 30kg.

As a general guide – aim to feed a 20 kg pig approximately 5% of its body weight – decreasing to around 4% of body weight from 30kg to sale (Table 6).

Table 6: *Pig weight and daily feed targets*

Pig weight (kg)	Kg feed/day
10	0.5
15	0.8
20	1
25	1.1
30	1.3
40	1.6
50	2.0
60	2.4
70	2.8
80	3.2

Sows

As a general rule feed sows *ad-lib* during pregnancy. Target levels for sows will depend on the size of the sow. Large sows (140kg plus) will eat from around 3 to 4 kg of food each day. Smaller sows will eat between 2.5 and 3 kg/day on average.

Increase feed intake by 30 to 40% during lactation to maintain body weight so that the sow will mate soon after weaning.

Give the sow plenty of water the day she farrows, but do not feed her. Then give her 30 - 50% of her ration on the second day and gradually increase the amount of food to as much as she will eat over the next 5 days.

Feed the sow *ad-lib* from 5 days after farrowing.

Do not feed a sow on the day she is weaned of weaning, but feed her as much as she will eat (ad-lib) from the day after weaning until 10 days after mating.

It is important to mate a sow as soon after weaning as possible. The ideal is for a sow to be mated between 6 and 10 days after weaning. This will make the farm more profitable.

If the sow is thin at weaning, mating can be delayed until the second post-weaning heat. In this case monitor feed intake and feed extra to increase body weight until she is mated.

Boars

Feed as much as they will eat in two divided meals each day.

General comments

The diet fed to pigs should contain as little water as possible to avoid the pig filling its stomach with fluid and not food. However, ensure water is present in a separate container at all times. If pigs are fed with feeds which contain too much water, then the pig's growth rate will be reduced. An alternative is to feed the liquid part of the diet (e.g. liquid tofu waste) in a separate trough instead of providing water during feeding. However be sure to provide water when the liquid food has been consumed.

If there is a significant variation in the size of growing pigs, it is best to feed pigs individually to avoid competition between pigs. In a series of trials on smallholder pig farms, the benefit of individual feeding was demonstrated (Table 7).

Table 7: *Value of individual feeding when pigs of varying weight are grouped together*

Manner of feeding	Average growth rate of pigs (g/day)
Pigs fed individually	224
Pigs fed in group (8 pigs inside pen)	151
Pigs fed in group (8 pigs outside pen)	144

Providing water

Provide drinking water for pigs at all times. The key points are:

- Provide clean water at all times.
- Prevent pigs drinking water from ditches, especially beside road.
- Clean water container every day.
- A nipple drinker can be mounted to provide pigs continuous access to clean water (Figure 22).

The range of water requirements for all ages of pigs are provided in Table 8. However, daily consumption for individual pigs can vary 50% from the average.

Table 8: *Average daily water consumption for pigs*

Weight of pig	Daily water requirement (L/day)
10 – 20 kg	3 (1.5-4.5) *
20 – 50 kg	5 (2.5-7.5)
50 – 80 kg	6 (3-9)
Dry sow and boar	11 (5.5-16.5)
Lactating sow	17 (9.5-24.5)

*Average daily consumption for individual pigs can vary 50% from the average

Figure 22: Nipple drinkers mounted in pig pens provide clean water

d) Sources of carbohydrates and protein for feeding pigs

Table 9: *Sources of carbohydrates available for pigs in Timor-Leste in descending order of carbohydrate*
(Figure quoted are based on dry matter basis and are the average of several reference sites such as Feedipedia)

Resources	DE MJ/kg	CP %	Comments
Banana fruit	31	3	Need to define availability
Brewer's grain dried	20 - 24	28 – 30	Max 10% in diet
Rice bran	20	14	Not available year round
Sorghum grain	19	11	Maximum 50% of energy source
Broken rice grain	18	9	Not available year round
Maize	18	8	Not available year round
Soybean hulls	18	13	Supply problems due to disease
Banana leaf	17	7	Need to define availability
Taro	17	8	Dried roots (Protein <3% fresh)
Sago	17	2	
Rice hulls	16	4	Not available year round
Cassava	16	4	May need to be dried/cooked/ensilaged
Mucuna pruriens (seed)	15-16	22-29	Ant-nutritional factors present
Mung bean	15	24	Limit to 10% diet
Brewer's yeast	15	60	Local source only
Sago	15	11	Appears to be available year round
Wild taro	14	5	Lower than commercial species
Sweetpotato	12	5	Lack of availability

Table 10: *Protein sources for pigs available in Timor-Leste in descending order of protein content (does not include forage pastures and fodder trees such as gammal)*

(Figure quoted are based on dry matter basis and are the average of several reference sites such as Feedipedia)

Resources	CP %	DE MJ/kg	Availability
Dried fish	60	3	Need to do feasibility survey
Soybean meal	50	20	Can be imported if price is right
Brewer's yeast	50	15	Localised source
Peanuts	43	14	Expensive source of protein
Golden snails	40	6	Found only in certain areas
Soybean	38	19	Must be heat treated
Cassava leaf	28	7	Fresh or dried
Brewer's grain dried	28 – 30	20 – 24	Max 10% diet
Mucuna pruriens (seed)	22-29	15-16	Ant-nutritional factors present
Mung bean	24	15	Limit to 10% diet
Tofu waste	24	2	CP approx. 4% if no water removed
Copra	22	12	Availability localised
Coconut	20	16	Availability localised
Sweetpotato vines	16	14	Freshly harvested / availability
Pumpkin	16	5	Need feasibility survey but widespread
Rice bran	14	20	Not available year-round
Soybean hulls	13	18	Supply problems due to disease

Table 11: *Forage and foliage sources of protein for pigs which may be available in Timor-Leste*

(Figures are based on analysis of pasture and fodder trees collected in Eastern Indonesia and Timor-Leste)

Resources	CP	DE MJ/kg	Comments
Legume pasture			
Centrosema sp	15 – 25	3 – 5	
Calopogonium sp	13 - 24	3 – 5	Need to survey what grasses are available and
Puerasia cephaloides	12 - 20	3 – 5	what grows well in T-L.
Stylosanthes guianensis	12 – 18	3 – 5	
Fodder trees			
Leucaena	24 – 36	4 – 5	Use fresh or as dried meal - 10% of diet (limit 15%)
Gliricidia sepium	18 – 30	4 – 5	Wilting may improve intake Gliricidia
Erythrina variegate	25 – 35	2 – 3	Erythrina least palatable for pigs
Moringa spp.	22 – 24	3 – 4	Moringa has high lysine and methionine
Sesbania graniflora	25 - 30	3 - 5	Easier to establish than Leucaena
Foliage crops			
Lablab - leaf only	22	11	
Lablab - stem only	10	8.5	
Lablab - whole plant	18	9.0	

4.2. Example diets using local ingredients

The following section gives a few example diets that were trialled during the ACIAR/TOMAK/MAF project "Identifying husbandry options for smallholder pig farmers in Timor-Leste". Rice bran and milled corn are used as core ingredients as they are readily available for most of the year. There are some suggestions about how one ingredient can be substituted for another depending on seasonal availability and price.

Usually it will not be possible to get an accurate weight for the pig(s) so it is important to learn how to estimate weight roughly by looking at the pig(s). It is also not likely that farmers will be able/want to weigh out each ingredient using scales. It should be possible to calibrate whatever measuring options the farmer has available (e.g. small tin, scoop, bucket), then to provide them with feeding guidelines using those measures (e.g. if you identify that one small tin filled with rice bran contains 100g of rice bran and the guidelines say to feed 197g then the farmer should feed two small tins full of rice bran). It is also not necessary to be extremely precise about the amount fed – just to measure feed as practically as possible.

Leaves are a key ingredient in all of these diets. Leucaena, sesbania, gammal and moringa all have a high protein content and can be used in diets. Most pigs will eat fresh leucaena and moringa readily. Some pigs will eat fresh sesbania and gammal, but other pigs will not. Leucaena should not be fed as more than 15% of the diet as it can be toxic in larger quantities. Leaves can be fed fresh, in which case they should be provided ad lib so the pig always has leaves available to eat. They can also be made into silage (see section 4.3 on Silage). Less palatable leaves that are readily available can be included in silage in moderate quantities. Leaf silage can be prepared in the rainy season, when lots of fresh leaves are available, then used in the dry season so it is not necessary to travel long distances to find leaves.

a) Diet 1: Using rice bran, milled corn, dried fish and fresh leaves

One example diet using rice bran, milled corn, dried fish and fresh leaves is presented in Table 12. This diet has an estimated ME of 13.6 MJ/kg, and CP of 16%. The rice bran, milled corn and dried fish can be premixed and stored as "dry mix" so it is not necessary to weigh out the ingredients separately at each feed. The recommended quantities for feeding one growing pig of a given weight are shown in Table 13. This amount should be fed in the morning, then again in the afternoon/evening. If the dry mix is prepared in advance using the dry mix column, otherwise use the three separate columns for rice bran, milled corn and dried fish.

Table 12: *Diet using rice bran, milled corn, dried fish and fresh leaves*

Ingredient	Amount in diet (%)	Dry mix
Rice bran	45	Yes
Milled corn	20	Yes
Dried fish	5	Yes
Fresh leaves (leucaena, sesbania, gammal, moringa)	30	No

Table 13: *Recommended quantities for one growing pig for each feed (twice a day) using a diet of rice bran, milled corn, dried fish and fresh leaves*

Average pig weight (kg)	Total feed per pig (g)	Total dry mix (g)	Rice bran (g)	Milled corn (g)	Dried fish (g)	Fresh leaves
6	150	105	68	30	8	*Ad lib*
8	200	140	90	40	10	*Ad lib*
10	250	175	113	50	13	*Ad lib*
15	375	263	169	75	19	*Ad lib*
20	500	350	225	100	25	*Ad lib*
25	625	438	281	125	31	*Ad lib*
30	750	525	338	150	38	*Ad lib*
35	875	613	394	175	44	*Ad lib*
40	1,000	700	450	200	50	*Ad lib*
45	1,125	788	506	225	56	*Ad lib*
50	1,250	875	563	250	63	*Ad lib*
55	1,375	963	619	275	69	*Ad lib*
60	1,500	1,050	675	300	75	*Ad lib*

b) Diet 2: Using rice bran, milled corn, fresh snails and fresh leaves

Another option is to swap the dried fish for fresh snails (Table 14) (See section 4.4. for guidelines on managing a snail pond). This diet has an estimated ME of 13.8 MJ/kg, and CP of 15%. The rice bran and milled corn can be premixed and stored as "dry mix" so it is not necessary to weigh out the ingredients separately at each feed. The recommended quantities for feeding one growing pig of a given weight are shown in Table 15. This amount should be fed in the morning, then again in the afternoon/evening. If the dry mix is prepared in advance using the dry mix column, otherwise use the three separate columns for rice bran and milled corn. The quantity of snails is much greater than the quantity of dried fish because of the shell and the high moisture content.

Table 14: *Diet using rice bran, milled corn, fresh snails and fresh leaves*

Ingredient	Amount in diet (%)	Dry mix
Rice bran	45	Yes
Milled corn	20	Yes
Fresh snails	5	No
Fresh leaves (leucaena, sesbania, gammal, moringa)	30	No

Table 15: *Recommended quantities for one growing pig for each feed (twice a day) using a diet of rice bran, milled corn, fresh snails and fresh leaves*

Average pig weight (kg)	Total feed per pig (g)	Total dry mix (g)	Rice bran (g)	Milled corn (g)	Fresh snails (g)	Fresh leaves
6	150	98	68	30	39	*Ad lib*
8	200	130	90	40	52	*Ad lib*
10	250	163	113	50	65	*Ad lib*
15	375	244	169	75	98	*Ad lib*
20	500	325	225	100	130	*Ad lib*
25	625	406	281	125	163	*Ad lib*
30	750	488	338	150	195	*Ad lib*
35	875	569	394	175	228	*Ad lib*
40	1,000	650	450	200	260	*Ad lib*
45	1,125	731	506	225	293	*Ad lib*
50	1,250	813	563	250	325	*Ad lib*
55	1,375	894	619	275	358	*Ad lib*
60	1,500	975	675	300	390	*Ad lib*

c) Diet 3: Using rice bran, milled corn, pumpkin, dried fish and fresh leaves

If pumpkin is available it can be used to replace some of the rice bran (Table 16). This diet has an estimated ME of 12.1 MJ/kg, and CP of 16.6%. The rice bran, milled corn and dried fish can be premixed and stored as "dry mix" so it is not necessary to weigh out the ingredients separately at each feed. The recommended quantities for feeding one growing pig of a given weight are shown in Table 17. This amount should be fed in the morning, then again in the afternoon/evening. If the dry mix is prepared in advance using the dry mix column, otherwise use the three separate columns for rice bran, milled corn and dried fish.

Table 16: *Diet using rice bran, milled corn, pumpkin, dried fish and fresh leaves*

Ingredient	Amount in diet (%)	Dry mix
Rice bran	35	Yes
Milled corn	20	Yes
Dry fish	5	Yes
Pumpkin	10	No
Fresh leaves (leucaena, sesbania, gammal, moringa)	30	No

Table 17: *Recommended quantities for one growing pig for each feed (twice a day) using a diet of rice bran, milled corn, dried fish and fresh leaves*

Average pig weight (kg)	Total feed per pig (g)	Total dry mix (g)	Rice bran (g)	Milled corn (g)	Dried fish (g)	Pumpkin (g)	Fresh leaves
6	150	90	53	30	8	18	*Ad lib*
8	200	120	70	40	10	24	*Ad lib*
10	250	150	88	50	13	30	*Ad lib*
15	375	225	131	75	19	45	*Ad lib*
20	500	300	175	100	25	60	*Ad lib*
25	625	375	219	125	31	75	*Ad lib*
30	750	450	263	150	38	90	*Ad lib*
35	875	525	306	175	44	105	*Ad lib*
40	1,000	600	350	200	50	120	*Ad lib*
45	1,125	675	394	225	56	135	*Ad lib*
50	1,250	750	438	250	63	150	*Ad lib*
55	1,375	825	481	275	69	165	*Ad lib*
60	1,500	900	525	300	75	180	*Ad lib*

d) Diet 4: Using rice bran, milled corn, pumpkin, coconut, dried fish and fresh leaves

If coconuts are available they can be incorporated into the diet (Table 18). This diet has an estimated ME of 13.6 MJ/kg, and CP of 15.6%. The rice bran, milled corn and dried fish can be premixed and stored as "dry mix" so it is not necessary to weigh out the ingredients separately at each feed. The recommended quantities for feeding one growing pig of a given weight are shown in Table 19. This amount should be fed in the morning, then again in the afternoon/evening. If the dry mix is prepared in advance using the dry mix column, otherwise use the three separate columns for rice bran, milled corn and dried fish.

Table 18: *Diet using rice bran, milled corn, pumpkin, dried fish and fresh leaves*

Ingredient	Amount in diet (%)	Dry mix
Rice bran	40	Yes
Milled corn	15	Yes
Dried fish	5	Yes
Pumpkin	10	No
Coconut	10	No
Fresh leaves (leucaena, sesbania, gammal, moringa)	20	No

Table 19: *Recommended quantities for one growing pig for each feed (twice a day) using a diet of rice bran, milled corn, pumpkin, coconut, dried fish and fresh leaves*

Average pig weight (kg)	Total feed per pig (g)	Total dry mix (g)	Rice bran (g)	Milled corn (g)	Dried fish (g)	Pumpkin (g)	Coconut (#)	Fresh leaves
6	150	90	60	23	8	18	0.4	*Ad lib*
8	200	120	80	30	10	24	0.4	*Ad lib*
10	250	150	100	38	13	30	0.5	*Ad lib*
15	375	225	150	56	19	45	0.7	*Ad lib*
20	500	300	200	75	25	60	1	*Ad lib*
25	625	375	250	94	31	75	1.25	*Ad lib*
30	750	450	300	113	38	90	1.5	*Ad lib*
35	875	525	350	131	44	105	1.6	*Ad lib*
40	1000	600	400	150	50	120	2	*Ad lib*
45	1125	675	450	169	56	135	2.2	*Ad lib*
50	1250	750	500	188	63	150	2.5	*Ad lib*
55	1375	825	550	206	69	165	2.8	*Ad lib*
60	1500	900	600	225	75	180	3	*Ad lib*

e) Diet 5: Using rice bran, milled corn, dried fish and leaf silage

Fresh leaves can be substituted with leaf silage (Table 20) (see section 4.3 on Silage). This diet has an estimated ME of 13.6 MJ/kg, and CP of 16%. The rice bran, milled corn and dried fish can be premixed and stored as "dry mix" so it is not necessary to weigh out the ingredients separately at each feed. The recommended quantities for feeding one growing pig of a given weight are shown in Table 21. This amount should be fed in the morning, then again in the afternoon/evening. If the dry mix is prepared in advance using the dry mix column, otherwise use the three separate columns for rice bran, milled corn and dried fish.

Table 20: *Diet using rice bran, milled corn, dried fish and leaf silage*

Ingredient	Amount in diet (%)	Dry mix
Rice bran	45	Yes
Milled corn	20	Yes
Dried fish	5	Yes
Leaf silage	30	No

Table 21: *Recommended quantities for one growing pig for each feed (twice a day) using a diet of rice bran, milled corn, dried fish and leaf silage*

Average pig weight (kg)	Total feed per pig (g)	Total dry mix (g)	Rice bran (g)	Milled corn (g)	Dried fish (g)	Leaf silage
6	150	105	68	30	8	45
8	200	140	90	40	10	60
10	250	175	113	50	13	75
15	375	263	169	75	19	113
20	500	350	225	100	25	150
25	625	438	281	125	31	188
30	750	525	338	150	38	225
35	875	613	394	175	44	263
40	1,000	700	450	200	50	300
45	1,125	788	506	225	56	338
50	1,250	875	563	250	63	375
55	1,375	963	619	275	69	413
60	1,500	1,050	675	300	75	450

f) Other substitutions

Sweet potato, cassava, taro, wild taro, yam, and sago could all be used as replacements for the 10% pumpkin in Diet 3. These ingredients are all reasonably good carbohydrate sources, but are much lower in protein than the pumpkin or rice bran they are replacing. Growth rates will be lower, but this still be a good choice to include in the diet depending on availability and price of different ingredients.

If using 5% dried fish is prohibitively expensive, using 2.5% (half the amount recommended above) will still provide significantly more protein than a diet that does not contain dried fish or fresh snails.

Tofu waste could be used as a replacement for dried fish or snails. This has a high moisture content so if used feed the same quantity of tofu waste as recommended for snails in Diet 2.

g) Sow diets

Sows require different amounts of feed at different stages of the reproductive cycle (Table 22).

Diet 1 for growing pigs has been successfully adapted for feeding to sows. The relative quantities for each ingredient for each feeding amount listed in Table 22 is shown in Table 23.

Table 22: *Recommended quantities to feed a sow each day (excluding leaves) during different stages of reproduction*

Recommended sow feeding program for pregnant sows	
Mating to 5 weeks gestation	2.5 kg / day (split into 2 feeds, morning and afternoon)
5 weeks to 8 weeks gestation	3.0 kg / day (split into 2 feeds, morning and afternoon)
8 weeks to 13 weeks gestation	3.6 kg / day (split into 2 feeds, morning and afternoon)
13 weeks gestation to 5 days pre-farrowing	4.0 kg / day (split into 2 feeds, morning and afternoon)
5 days pre-farrowing to day pre-farrowing	2.6 kg / day (split into 2 feeds, morning and afternoon)
Day pre-farrowing to day of farrowing	1.0 kg / day (split into 2 feeds, morning and afternoon)
Recommended sow feeding program for lactating sows	
Day 1 (farrowing)	No food
Day 2	0.8kg
Day 3 to day 8 post-farrowing	Increase by 0.8 kg / day to 5.6 kg/day
Day 9 post-farrowing to weaning	Feed at least twice daily - aim to average 5 to 7 kg / sow / day depending on sow size and litter size
Recommended sow feeding program for weaned sows	
Weaning to mating	3kg plus / day depending on sow size

Table 23: *Recommended quantities for one sow for each day using a diet of rice bran, milled corn, dried fish and fresh leaves, based on the recommended total feed quantities in Table 22.*

Total dry mix (kg)	Rice bran (kg)	Milled corn (kg)	Dried fish (kg)	Fresh leaves
0.8	0.51	0.23	0.06	*Ad lib*
1	0.64	0.29	0.07	*Ad lib*
1.6	1.03	0.46	0.11	*Ad lib*
2.4	1.54	0.69	0.17	*Ad lib*
2.5	1.61	0.71	0.18	*Ad lib*
2.6	1.67	0.74	0.19	*Ad lib*
3	1.93	0.86	0.21	*Ad lib*
3.2	2.06	0.91	0.23	*Ad lib*
3.6	2.31	1.03	0.26	*Ad lib*
4	2.57	1.14	0.29	*Ad lib*
4.8	3.09	1.37	0.34	*Ad lib*
5	3.21	1.43	0.36	*Ad lib*
5.5	3.54	1.57	0.39	*Ad lib*
5.6	3.60	1.60	0.40	*Ad lib*
6	3.86	1.71	0.43	*Ad lib*
6.5	4.18	1.86	0.46	*Ad lib*
7	4.50	2.00	0.50	*Ad lib*
7.5	4.82	2.14	0.54	*Ad lib*

4.3. Silage

Silage is commonly known as fermentation feed and is prepared by farmers to feed livestock including pigs. Farmers usually combine leaves, vines, grains and tubers with sugar, salt, molasses or EM4 (effective microorganism) and store the mixture for a couple of weeks until all the components have been fermented. Silage is mostly often used to feed cattle rather than pigs as pigs are monogastric animals and can eat most types of food like humans. That is why people prefer to feed pigs fresh food or leftovers. But in situations where farmers can harvest a lot of feed at a certain time (due to harvest seasons) and it is difficult for them to store food and/or find fresh leaves during a long dry season, the addition of silage in pig diets can be a good option. Leaf silage in particular is recommended when fodder trees grow naturally around the farm or where they are used as a 'living fence' for livestock. The reason to prepare silage from leaves rather than from other types of food is that leaves are usually the most difficult for farmers to find in the dry season (compared to other feed ingredients such as rice bran and maize which are easier to dry and store).

Objectives and advantages of using silage in pig diets

- To conserve excess food for a long dry season
- To increase the palatability of foods which might be less appealing to pigs despite having a high protein value
- Can reduce the cost of food
- Can reduce the time needed to prepare feed and feed pigs

Disadvantages of using silage in pig diets

- Needs to be stored well to prevent early spoilage
- Needs to be prepared early (before stock is reduced or finished)

a) Preparing to make silage

Before making silage, farmers should identify the ingredients they plan to use and decide on a recipe to prepare the silage. There are two main options for silage – silage made from leaves and vines; and silage made with leaves and other feed ingredients (rice bran, maize, cassava, sweetpotato, etc.). After identifying ingredients, farmers need to calculate the nutrition content of the silage before preparing and mixing the ingredients, wrapping and storing to ferment for two weeks.

Equipment and materials

Equipment and material needed to make silage include: a scale, small and medium buckets for measuring ingredients and a larger bucket with lid for storage, tarp, machete, knife, marker, tape, and a large plastic/trash bag. Ingredients required to make the silage include **leaves** (moringa, sesbania, leucaena, gammal, sweet potato leaf), **tubers** (cassava, taro, sweetpotato, etc) and milled **grains** (milled corn, rice bran). These materials should be easy to access and affordable for most farmers.

b) Example silage recipes

Recipe 1

Ingredient	Amount in silage
Gammal (*glicidia sepium*)	45%
Sesbania	10%
Moringa	10%
Sweetpotato (root + leaves)	10%
Sweet potato (flesh)	10%
Rice bran	5%
EM_4 (L)	1

Note: Quantity of EM_4 (3-5% * 20 kg)
5% X 20 kg = 1 L

Recipes 2

Ingredient	Amount in silage
Gammal (*glicidia sepium*)	50%
Sesbania	10%
Moringa	5%
Taro	10%
Cassava	10%
Rice bran	15%
EM_4 (L)	1

Recipe 3

Ingredient	Amount in silage
Gammal (*glicidia sepium*)	20%
Sesbania	30%
Leucaena	50%
EM_4 (L)	1

c) How to make silage

Figure 23: *Process of making silage*

1. **Chop** leaves, stems and vines into small pieces

2. **Weigh** each ingredient on the scale

3. **Mix together** then pour over rice bran and maize and mix again

4. **Spray** with EM_4 and mix up gently

5. **Put** the mixture in a large plastic bag and place inside a plastic container. Remove all air before closing the bag.

6. **Close** gently and seal the container. Leave to ferment for at least 14 days.

7. **Open** after 14 days

8. **Evaluate** the progress of fermentation

9. **Take** a sample to feed the pig

FINAL RESULT

Note: 1. If opening the plastic container for any reason, don't forget to tighten the bag and remove all air before closing it again.
2. Silage can be used as feed as long as it is still in good condition (no mould) and based on the percentage required in diet.

d) Observations and lessons from the research

Experiments showed that pigs prefer eating leaf silage to 'complete' silage using other feed ingredients. The combination of different leaves in silage can be a challenge, as the silage may become unpalatable with larger portions of particular leaves (e.g. gammal). It is recommended that silage is prepared with younger gammal leaves as older leaves are tougher and have a stronger flavour. Silage recipe 3 uses one combination of gammal, sesbania and leucaena (20% : 30% : 50% respectively) but other combinations (e.g. 30%: 30%: 40%) are also palatable. Given the potential for gammal leaves to be less palatable for pigs, it is important that these leaves are combined with other more palatable leaves such as sesbania and leucaena.

Apart from leaf silage, another option is to prepare a more complete silage by combining and fermenting other feed ingredients, particularly those which may be in excess after harvest. Recipes 1 and 2 included here were tested by farmers with mixed results – some pigs liked eating the silage while others did not enjoy it. It is important to consider the percentage of each ingredient in the silage and to check the response of pigs to the new feed.

To ferment the ingredients, it is necessary to use a fermentation liquid. In this research, we used EM_4 (effective microorganism). EM_4 is used by farmers for fertilisation and other purposes but can also be used effectively to make silage. Using EM_4 allows ingredients to ferment quickly. This product can be found in agricultural stores in Dili and in certain municipalities at an affordable price for farmers.

Silage should be fed to pigs at a suitable percentage of the diet. For example, if the pig diet contains 30% fresh leaves, then pigs could be fed 30% of their diet as leaf silage. Silage should not be fed separately to pigs but rather mixed together with other feed sources in the food trough at each feeding. Not all pigs eat silage well, so it is recommended to introduce silage over time, increasing the amount provided slowly until the pigs become familiar with the smell and taste of silage and accustomed to eating it. Avoid silage going rotten by tightening the bag and sealing the container straight away after using.

Figure 24: *EM_4 (left) and molasses (used in Indonesia, right)*

4.4. Snails

The use of snails in pig diets is new for Timorese pig farmers although this practice is already used by livestock farmers in neighbouring countries such as Indonesia. Snails are a good source of animal protein for pigs and other livestock. The snails used in this diet are golden/water snails and not dry land snails (as these have not been tested in a laboratory setting). Golden snails are considered a pest by rice farmers and can destroy hectares of paddy field, costing farmers profit from their rice harvest every season. Using the snails as pig feed provides another use for a pest that farmers are keen to remove from their fields, although their use must be carefully controlled (especially if establishing a snail pond).

a) Objectives and advantages of using snails in pig diets

Using snails in pig diets can reduce the cost of the diet, especially as protein foods can be more expensive than other ingredients. It can reduce the number of snails in an area (where snails are already a pest for farmers) and can be a way to complete the diet using locally available ingredients.

Sources of snails

- Living already in rice fields (not in every place)
- Snails can also be found living in drains, trenches, irrigation canals, waterways, rivers, etc.
- Can be purposefully raised in a snail pond

How to feed snails to pigs

- Gather the snails and feed them raw with the shells on
- Feed as snail meal (not yet available in Timor-Leste)

Quantity of snails to feed pigs

- Fresh snails can be offered at 400g fresh snails per 1kg dry mix
- Snail meal (% snail meal to mix with other ingredients) – not currently available

b) How to grow snails

Natural environment

Golden snails will grow naturally in lakes, rivers, fields including rice fields, trenches, drainage and other similar environments. These places usually have plenty of water for the snails to live and reproduce. If conditions become too dry, the snails may die although they can sometimes survive in muddy conditions.

Adult golden snails lay their eggs at nighttime in dry places such as: walls, sticks, branches, leaves or grasses. The eggs are typically pink in colour and shaped like mulberry fruit. During their lifetime, golden snails may lay 15-20 groups of eggs, where each group has around 500 eggs. Approximately 85% of these eggs will hatch.

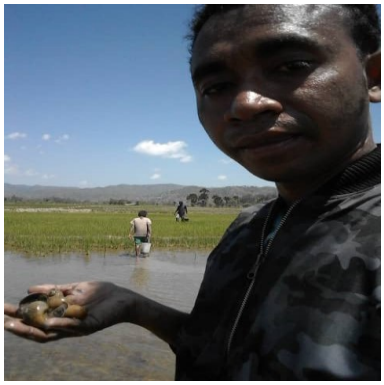
Golden snails have a short life cycle. After an adult snail first lays eggs, a further 2.5-3 months is needed before their next laying. Fifteen days after hatching, the snails are 5.8mm high and 4.1mm wide. After 3 months, the snails have become adults and are ready to reproduce (at 3-4cm, 10-20g).

Complete life cycle:

- Snail lays eggs
- Incubation (7-14 days)
- Hatching
- Developing stage (15-25 days)
- Puberty (49-59 days)
- Reproduction starts from 60 days to 3 years

Snails can survive in extreme environments in water and also when there is no water and less oxygen. Golden snails normally eat algae, water hyacinth, young paddy leaves and branches and other leaves they can find. The type of snails used to feed pigs can be seen in the following images.

Figure 25: *Golden snails in rice fields and ponds*



a. Gathering snails in a rice field

b. Snails collected to raise for pig food

c. Snails placed inside a snail pond

Artificial environment (snail pond)

As snails are considered a pest (especially for rice farmers), farmers need to take appropriate steps when growing snails in a snail pond. The snails must be secure in the pond to prevent them from escaping and spreading into fields and farming areas. Farmers who wish to raise snails must understand the risks, especially to rice production, and take the necessary steps to ensure fields are free from snails.

c) Materials to make a snail pond

- Net with very small holes (such as a mosquito net) to prevent snails from escaping through the holes
- Stick/bamboo (to use as poles to support the net)
- Bricks/blocks
- Sand (place around the pond so that snails cannot escape) – minimum 50cm
- Cement
- Stones
- Rice husk (place around the pond so snails cannot escape) – minimum 50cm
- Branches/sticks (for snails to lay eggs)
- Adult snails (taken from rice field or river)
- Leaves (to feed snails, also a place where snails can lay eggs)
- Rice bran (to feed to snails) and other food

d) Guideline to establish a snail pond

1. Identify an appropriate place to set up the pond.
2. The area should be somewhere that has easy access to water, even in the dry season.
3. Prepare the materials and equipment needed.
4. Measure the size of pond required based on the volume of snails to be bred. This will depend on the number of pigs and the percentage of snails in the diet. For example, if there are 5 pigs in the pen, we need at least a 3m x 3m pond ($3m^2$).
5. Dig the hole for the pond approximately 60-100cm deep.
6. Concrete can be used on the floor or just left as soil/mud. Wall up the sides with cement (completely concrete).
7. Cover the snail pond area with a net to prevent any snails from escaping.

8. Place rice husks around the concrete walls approximately 30-50 cm thick for the first line, then use sand for 30-50cm as a second line protection to prevent snails escaping.
9. Snails pond need shade during extreme heat. Make a roof using coconut or palm leaves to provide shade for the snails when it is hot and sunny.
10. Add water, cow manure and soil to the pond and leave for 1-2 weeks.
11. After leaving the pond for 1-2 weeks, snails and water can be added to the pond.
12. Collect snails from the rice field or river and release them into the pond.
13. Put a few branches and sticks in the pond for the snails to lay their eggs.
14. Feed the snails with leaves, manure, and rice bran (tested by some farmers) every 2 days.
15. To maintain snail health and increase production of snails, change the water every 2-4 weeks.
16. Keep the water temperature under 31 ^{o}C.
17. When starting production, collect a few larger snails and try feeding them to the pig. Keep topping up the snails from the source to maintain breeding.

Figure 26: Example of how to breed snails in a pond

a. Prepare the pond

b. Fill with snails and feed

c. Snail eggs in a fish pond

d. Collect snails

e. Feed pigs with fresh snails

e) Feeding pigs with snails

Snails can be fed to pigs fresh (complete with shell) after collecting from the ponds or dried and milled then mixed with other ingredients in the diet. Farmers in Timor-Leste have observed that pigs enjoy really eating fresh snails. Pigs should be fed with fresh snails twice a day (rate: 400g of snails per 1kg dry mix).

5. Health and Disease

The Health and Disease section of this manual is divided into four parts :

- In section I we describe the common **clinical signs** recorded in pigs in Timor-Leste and we provide brief notes about the possible diseases and conditions that commonly cause these clinical signs.
- In section II we describe some of the **major pig diseases** present in pigs in Timor-Leste, how they affect pigs and how to control each disease.
- In section III we describe the most important **parasites** affecting pigs in Timor-Leste and how to treat and control them.
- In section IV we describe several **Zoonoses** which are diseases that can be transmitted from pigs to humans and humans to pigs.

5.1. Clinical signs

a) Diarrhea in piglets still being suckled by the sow (pre-weaning)

Diarrhea is one of the most important causes of deaths in piglets that are still drinking milk from the sow.

The impact of diarrhea varies from rapid death, to weight loss and dehydration (loss of fluid from the body). Piglets that recover from diarrhea will grow more slowly than pigs that remain healthy.

Management is very important in preventing diarrhea in piglets.

A sub-optimal environment (see section on Housing Pigs) and sub-optimal nutrition (see section on Feeding Pigs) will predispose piglets to diarrhea.

Avoid cold draughts, fluctuating temperatures and moist pens. These conditions will increase the severity of diarrhea.

Anaemic pigs that do not receive an iron injection are more likely to develop diarrhea.

Reduced milk production or failure to drink colostrum will increase diarrhea problems.

Diseases that cause diarrhea in piglets

i. Coccidiosis

Coccidia are a common cause of diarrhea in piglets up to 4-weeks of age. Signs of diarrhea will first appear in piglets between 7 and 14 days of age, but few deaths occur unless the level of hygiene and the environment are sub-optimal.

ii. Trichuris (Whipworm)

Whipworm can cause diarrhea in piglets from around 6-7 weeks of age. The faeces may be blood stained and piglets can rapidly lose weight and may even die around 8 weeks of age.

iii. E. Coli (a common bacteria that causes diarrhea)

E. coli diarrhea usually starts within the first 24--48 hours, but can occur in 5-day-old piglets. *E. coli* diarrhea is more prevalent in piglets that do not drink colostrum (the first milk from the udder). Pigs with *E. coli* diarrhea often die. Affected pigs lose a lot of fluid, and may quickly become dehydrated and weak. Weak piglets are

unable to suck and move away when the sow lays down – hence they are prone to overlay. *E. coli* can also cause diarrhea at 10- 14 days (often associated with coccidia).

iv. Other causes of diarrhea in piglets

Other causes of diarrhea in piglets include Rotavirus and Clostridial bacteria.

Prevention and control

- **Observations** – record the age of the pigs when diarrhea is first observed, and estimate the number of pigs/litter and the number of litters affected.
- **Housing** – provide a warm dry creep area (3 walls and a roof) free of draughts. Provide extra heat (a small light) for piglets if possible, immediately after farrowing. Make sure there is **no** cold air blowing on piglets or moist areas on pen floor where piglets sleep. Prevent sudden changes in temperature as that is a major cause of diarrhea in piglets. Ensure poultry birds do not enter pig pens.
- **Hygiene** – make sure farrowing pen is clean and dry before farrowing starts.
- **Nutrition** – make sure all piglets have a drink of colostrum (first milk from sow) within 12 hours of birth as this will help protect piglets from diseases carried by sow.

Treatment

Piglets need to be supplied with electrolytes in the drinking water or products that acidify the water.

Treat pigs orally in water or by individual dosing or inject pigs with antibiotics.

Neomycin or apramycin are recommended and must be used according to directions on the label.

Other medicines which can be used include Trimethoprim (often combined with sulfamethoxazole or dapsone), Penicillin and Tetracyclines (Oxytetracycline).

DO NOT use Cephalosporins.

b) Diarrhea in pigs after weaning

Diarrhea in recently weaned can be a major problem. It requires urgent action and pigs may die very quickly. The most common cause is the bacteria *E. coli*, especially within 3 weeks of weaning. Most other diseases are uncommon in pigs younger than 8-10 weeks. Pigs weaned at 8 weeks or older are unlikely to be affected by *E. coli* diarrhea. The best guide for weaning pigs is weight and it is recommended that pigs are weaned when they are 6-8 kg in weight.

Diarrhea also reduces growth rates in weaner and growing pigs. Pigs eat less during an outbreak and even when they have recovered, their intestine cannot process food as efficiently.

Diseases that cause diarrhea in weaned pigs

i. Whipworm (Trichuris)

Whipworm is commonly seen in pigs weaned on dirt. Pigs pass green soft faeces that may contain blood.

ii. Oesophogostomum (nodule worm)

Nodule worm may cause diarrhea in older weaned pigs and growing pigs and but more commonly reduces growth rate.

iii. E. coli bacteria

E. coli usually causes diarrhea between 4 to 10 days after weaning when pigs are weaned (removed from the sow) before they are 6 weeks old. It is commonly triggered by cold or fluctuating temperatures, draughts, moisture, incorrectly formulated diets, poor hygiene, and low weaning weight. Toxins produced by the *E. coli* bacteria can cause rapid or sudden death or severe diarrhea.

iv. Swine dysentery

Dysentery can also cause diarrhea 3-4 weeks post-weaning, but is more common in older pigs.

v. Salmonellosis

Salmonellosis can cause diarrhea from 3-4 weeks post-weaning and also in older, growing pigs.

vi. Ileitis

Usually affects pigs older than 3-5 months.

vii. Classical Swine Fever (CSF)

See Section II.

Prevention and control

- **Record** the age of pigs affected, the colour of the faeces, the number of pigs with diarrhea and the number of dead pigs.
- **Environment** – make sure that cool air (draughts) are not blowing on pigs when they are sleeping and keep pen floors as dry as possible.
- **Housing** – weaned pigs need a warm, dry environment with a constant temperature (26- 28°C). The temperature can be reduced 22- 24°C provided that it is remains constant over a 24-hour period. Keep pens clean and dry.

Avoiding diarrhea in weaned pigs **– main points**:

- Keep weaner accommodation warm and dry.
- It is best to wean pigs when they are more than 6-8 kg.
- Provide clean, fresh water.

Treatment

- It is a good practice to provide electrolytes in drinking water to pigs with diarrhea if they are available.
- Treat pigs with antibiotics:
  - Use Apramycin or Neomycin in younger recently weaned pigs.
  - Other medicines which can be used in younger pigs (less than 12 weeks) include Trimethoprim (often combined with sulfamethoxazole or dapsone), Tribactril/trivetrin, Penicillin and Tetracyclines (Oxytetracycline).
  - Use Lincomycin, Tylosin, Olaquindox, Tiamulin, or Tetracyclines in older pigs (greater than 12 weeks old.

c) Diarrhea in older growing pigs (grower pigs)

The more common causes of diarrhea in growing pigs are internal parasites (whipworm – trichuris, and nodule worm - oesophagostomum), swine dysentery and Ileitis. Salmonellosis (caused by the bacteria Salmonella) is

also a possible cause of diarrhea in older growing pigs. Gastric ulcers may also confuse the diagnosis as the faeces may appear soft and dark due to haemorrhages in the stomach.

Diseases that cause diarrhea in older growing pigs

a. Internal parasites (whip worm and nodule worm)

Cause greenish soft faeces or diarrhea and sometimes blood and mucous is present.

b. Swine dysentery

The first signs of swine dysentery are soft, pale, yellow-grey faeces. Later there are often large amounts of mucus and flecks of blood. The color of the diarrhea varies. It can be grey or reddish brown. In severe cases porridge-like dung dribbles intermittently.

c. Ileitis

Ileitis may also slow growth rates and cause 'razor-back' pigs (the back of the pig is like a mountain as the pig is emaciated. Diarrhea may be mild or severe, with loose or normal faeces. Some pigs become pale before developing a greyish brown, liquid faeces which can be blood-stained.

d. Colitis (inflammation of the colon)

Colitis can also be caused by spirochaetal bacteria similar to the agent of swine dysentery.

e. Salmonellosis

Salmonellosis is associated with sudden deaths and reddish-purple skin discolouration. Faeces are usually dark brown and watery (unlike swine dysentery), and pigs may become nervous.

f. Classical Swine Fever (CSF)

See Section II.

Prevention and control

- **Record** the age of pigs affected, the colour of the faeces, the number of pigs with diarrhea and the number of dead pigs.
- **Hygiene** - Good hygiene is essential. Clean pens between each batch of pigs. Remove food and water troughs and clean them thoroughly.
- **Control rodents** and other pests as they can spread disease, especially swine dysentery.

Avoiding diarrhea in weaned pigs – the **main points**:

- Keep pens and accommodation warm and dry.
- Provide clean, fresh water.

Treatment

- It is a good practice to provide electrolytes in drinking water to pigs with diarrhea if they are available.
- Inject pigs with antibiotics according to directions on label
  - Use Lincomycin, Tylosin, Olaquindox, Tiamulin, or Tetracyclines in older pigs
  - Trimethoprim (often combined with sulfamethoxazole or dapsone), Tribactril/trivetrin, Penicillin and Tetracyclines (Oxytetracycline) may be more readily available in Timor-Leste.

d) Udder problems and milk production

There are a range of causes of mastitis and lactation failure (agalactia) in sows.

The piglets of sows with udder problems receive inadequate colostrum, are likely to suffer diarrhea and overlays, have reduced viability and poorer growth. Examine the udder 12 hours after farrowing to detect for areas of hardness or heat.

The main causes of poor milk production are genetics, mastitis, farrowing, udder congestion, stress and poor feed intake. This includes inadequate water, inadequate or stale feed, sow is too fat, or weather too hot.

Failure of the piglets to settle on teats, excessive fighting, and poor condition all indicate inadequate milk production. Sows with sore udders lie on them to deny piglets access to teats, and overlays are more likely.

If you suspect a problem with milk production, examine each teat to see if milk can be obtained. Ensure that there are adequate functional teats for the number of piglets.

Also examine if the udder is hot or painful or if teats are damaged.

Very lean sows have inadequate body reserves and a low appetite and cannot rear a good litter.

Conditions and diseases that cause problems

i. Mastitis

If parts or all of the udder become hot, hard and swollen and the sow is not eating, squeeze the affected area gently to see if she is in pain.

Mastitis is usually caused by bacteria found on the skin or dung. Rough floor surfaces, badly drained areas, or bedding (dry grass) soaked in urine can lead to mastitis. Prevent leakage from taps, and teat damage caused by rough concrete.

ii. Farrowing fever

Also known as mastitis/metritis/agalactia (MMA), farrowing fever is typified by poor milk production after farrowing. The udder may be hard or shrink and dry up. The sow's temperature may exceed 40 °C, she may be constipated, or there may be a vulval discharge. Over-fat sows are more prone to farrowing fever. The condition also often occurs after long farrowings, assisted farrowings, retained afterbirth and uterine infections.

iii. Udder congestion (edema)

This is more common in gilts, and likely to affect the whole udder. The gilt may show discomfort and reluctance to let pigs suckle. Press your finger firmly into the swollen area and it will leave an imprint. Make them stand and measure their temperatures and udders if piglets look hungry.

iv. Poor food intake

Feed intake depends on water intake. Ensure that flow rates of sow drinkers deliver at least 2 litres / minute. Also feeding less 3.0 kg/ day will reduce milk production. Sick sows will eat less, so measure the sow's temperature.

v. Stress

Stress before farrowing can reduce milk production. This can be caused by changing diet and moving sow into pen after farrowing has started.

Prevention and control

The main points:

- Clean and disinfect farrowing pens or crates between sows.
- Increase roughage to 50% of the diet before farrowing by adding rice bran or similar products.
- Avoid stressing the sow before farrowing.
- Give the sow adequate feed to maintain good body condition.
- Provide fresh water at all times.
- Reduce the amount of feed that is fed to sows if they are too fat (body score greater than 4) during pregnancy.
- If sow has no milk piglets must be fed with alternate source – either placed on another sow or fed milk from cow or goat. Milk replacers can also be used if available or even powder milk mixed as recommended for children.

Treatment

- Inject sows with mastitis and farrowing fever with antibiotics – either oxytetracycline or long acting penicillin. Combinations of Penicillin and Streptomycin may also be used.
- Treat udder congestion with oxytocin.

e) Pre-weaning deaths

Most liveborn pigs that fail to reach full size, die in the first week of life. More than 80% of pre - weaning deaths occur before day 3.

Causes of pre-waning deaths

i. Infections

- Internal parasites
- *E. coli* diarrhea and other causes of diarrhea such as coccidiosis, clostridia, rotavirus
- Septicemia
- Greasy pig disease
- Joint infections
- Sow infections – piglet starves
- Leptospirosis
- Classical Swine Fever
- African Swine Fever
- Japanese Encephalitis virus (JE)

ii. Environment

- Chilling
- Overlay
- Trauma
- Suffocation
- Low-viability piglets: low birth weight, slow birth, weak piglets, splayleg, anaemia at birth and premature piglets

iii. Nutrition

- Starvation
- Iron deficiency
- Vitamin E deficiency
- Lack of colostrum

iv. Genetic

- Bleeding from the umbilical cord
- Splayleg pigs

Diagnosis

The best way to diagnose the cause of deaths in pigs is to perform a post-mortem on all dead pigs.

It is important to realise that pre-weaning deaths often involve more than one factor.

Deaths from chilling, starvation, lack of colostrum, overlays, trauma, suffocation, low birth weight, slow birth, or infections during pregnancy (e.g. leptospirosis) occur within 48 hours of farrowing. Overlaid piglets usually die with their tongues protruding. *E. coli* infections are associated with acute outbreaks of diarrhea, usually within the first few days of life. Less common causes are coccidiosis and Clostridial bacteria.

i. Coccidiosis

Not usually associated with deaths, but deaths can occur.

ii. Clostridial infections

Rare, but cause severe bloody diarrhea in pigs aged 0-14 days.

iii. Internal parasites

Whipworm is the most important as it can cause diarrhea, as well as reduced growth rates.

Ascarid worms can cause liver damage from migrating larvae and both ascarids and lung worm can be associated with respiratory disease complex resulting in mortalities.

iv. Greasy pig disease

Can occur as a result of high humidity, poor mange control, injuries and wounds resulting from unclipped eye teeth, excessive fighting. It commences with reddened spots or lesions on skin and the key clinical signs are dark patches of flaking, greasy skin caused by bacterial infection. Pigs appear as though they have been rubbed with oil or grease. Pigs are often dehydrated (with sunken eyes) and may become thin and die. Greasy pig disease mainly affects piglets and weaners and spreads from pig to pig. It is sometimes associated with untreated mange or results from skin abrasions due to rough surfaces or fighting. Deaths occur from 7 days old.

v. Deficiencies of iron, vitamin E and selenium

Can cause poor growth and increase pre-weaning deaths.

vi. Anaemia

Can occur at birth because of iron deficiency or navel bleeding. The latter can be genetic, but is also linked with vitamin K deficiency, or using wood shavings and sawdust.

Prevention and control of preweaning deaths

- Record all pre-weaning deaths – note age and signs (diarrhea/ vomiting/ shaking/ skin infection and so on).
- If most piglets die before days 3-4, record farrowing times and duration, birth weights, milk let-down, signs of chilling (huddling/ shivering), starvation (either no milk or piglet cannot suck), trauma and overlay. About 60% of pre-weaning deaths are the result of low birthweight.
- Birth weight is a crucial factor – piglets from exotic and Macau sows that weigh less than 0.8 kg and piglets that weigh less than 0.5 kg from native breed sows may not viable.
- Nutrition – inject piglets with 200mg of iron between day 4 and day 7 after farrowing. Inject into the muscle behind the ear. Pigs can also be given access to soil in a clean container (food trough).
- Overlays-can kill 30% - overlays occur more with weak, cold, starved piglets, but the litter is always at risk when the sow gets up to eat and then lies down.
- Ensure the sow has plenty of cool, fresh water with a flow rate of at least 2 litres/minute from a nipple.
- Provide a dry area (creep box) in the pen with three walls and a roof.
- Keep the creep box moderately warm (not hot) – cold piglets huddle against or on top of the sow, increasing the risk of overlays. When it is too hot, the piglets lie outside the creep box and are in danger of being trampled on by the sow.
- Infection/septicaemia/greasy pig - most infections in piglets are caused by fighting; knee and toe abrasions from rough floors; injuries from sharp objects; teeth clipping wounds, or contamination of the umbilical cord.
- Infections can be local (around the face or in the joints) or general (when bacteria get into the blood and causes septicaemia). Greasy pig disease often follows mange, skin wounds, or continual wetting of the skin.
- To prevent greasy pig – treat sow for mange pre-farrowing. It is also possible to clip the needle (eye) teeth after farrowing is finished – this will reduce injuries. *However, you need a sharp pair of clippers and need to be shown how to do these procedures.*
- Make sure equipment used for teeth clipping is clean and sterilised.
- Mend rough floors with a coating of concrete.
- Ensure that sows are treated for parasites before farrowing.
- Sow infections and disease – it is possible to vaccinate sows and gilts for leptospirosis, erysipelas and parvovirus if indicated, but vaccines may not be available in Timor-Leste.
- Bleeding from the umbilical cord – If piglets continue to bleed after birth, tie the cord with a piece of nylon cord (or light fishing line). An injection of vitamin C may help.
- Splayleg – Tape the legs about 4-5 cm apart. In severe cases, extend the tape up, over and along the rump (see below). The procedure works well if done soon after birth and not a day or two later.

Avoiding preweaning deaths – the **main points**:

- Keep piglet accommodation warm, dry and free of draughts.
- Provide a warm dry area or box.
- If birth weights are low, examine sow diet.
- Inject piglets with iron in first week of life.
- Ensure sow has adequate good quality water.
- Examine sow and piglets for signs of ill health.
- Treat piglets with diarrhea.
- Keep all equipment clean and sterile.

Figure 27: *Examples of iron treatments to prevent anaemia in piglets*

f) Weaner deaths

This section covers common causes of deaths in pigs that have been recently weaned. Sudden deaths without clinical signs are the most common. This means that it is important to conduct a post-mortem to diagnose the problem.

Common causes of death in weaned pigs

i. Infections

- Internal parasites
- *E. coli* diarrhea
- Ileitis – inflammation of the intestines
- Meningitis – inflammation of the skin around the brain.
- Edema Disease – a disease caused by specific strains of E. coli bacteria/
- Erysipelas - a bacterial infection
- Coughing pigs (Respiratory disease complex)
- Greasy pig disease – a severe skin disease
- African Swine Fever – see Section II
- Classical Swine Fever – see Section II

ii. Nutrition

Vitamin E deficiency

- Salt poisoning (water deprivation)
- Gastric ulcers (in stomach)
- Plant poisoning

Diagnosis

i. Internal parasites

Whipworm is the most important as it can cause diarrhea, as well as reduced growth rates. Ascarids can cause liver damage from migrating larvae and both ascarids and lung worm can be associated with respiratory disease complex resulting in mortalities..

ii. E. Coli

Diarrhea is most common sign.

iii. Ileitis

Death without clinical signs can occur. Black tarry faeces may also occur or pigs may just grow more slowly.

iv. Meningitis

Signs of nervous problems, e.g. staggering, pig cannot stand, lying on the ground and paddling.

v. Edema disease

Pigs appear blind, their front legs knuckle under and they have a muted squeal. Some pigs have swollen eyelids.

vi. Erysipelas

Red spots or patches on the skin are common with erysipelas. Size from 1-5 cm and may be diamond-shaped and raised, and become red or plum-coloured. Some pigs may be depressed, lame and stiff and have a fever.

vii. Coughing pigs

Coughing and rapid uneven breathing (thumping) are main signs of respiratory disease complex which can include pleurisy, pericarditis and lung worm infections. Pigs become depressed and stop eating. Measure body temperature as it may be elevated.

viii. Greasy pig disease

It commences with reddened spots or lesions on skin and the key clinical signs are dark patches of flaking, greasy skin caused by bacterial infection. Pigs appear as though they have been rubbed with oil or grease. Pigs are often dehydrated (with sunken eyes) and may become thin and die. Greasy pig disease mainly affects piglets and weaners and spreads from pig to pig. It is sometimes associated with untreated mange or results from skin abrasions due to rough surfaces or fighting.

ix. Vitamin E

Sudden death with hemorrhages and raised round bruises on the heart muscle.

x. Salt poisoning

Occurs when pigs are without water for several hours. Signs are twitching, dog-sitting, falling over and paddling. Pigs recover, with signs recurring at decreasing intervals.

xi. Gastric ulcers

Pigs become weak and white pigs become pale.

Prevention and control

- Remove dead pig from the pen immediately and note any signs (coughing, lameness, diarrhea etc.) present in other pigs in pen
- Bury (or burn) dead pigs as soon as they have been examined.
- Treat pigs for internal and external parasites at weaning.
- Make sure that water is in trough and water flowing from nipple drinker.
- Make sure that all pigs get up to eat, and monitor feed intake daily.
- Inspect water daily and make sure flow rate from nipple is adequate (0.5 litres/minute).
- Observe sick pigs, record signs and remove sick pigs to an empty pen and treat them.
- Make sure that hygiene, housing and nutrition are adequate.

Avoiding deaths in weaned pigs – the **main points**:

- Examine all pigs daily and ensure that they get up and feed.
- Ensure water daily and ensure flow rate is adequate (0.5 litre/minute).

- Inspect sick pigs and note their symptoms.
- Put all sick pigs in another clean pen as soon as detected.
- Treat sick pigs immediately – if not sure of problem contact Veterinarian.
- Treat pigs for external and internal parasites at weaning.
- Examine all dead pigs.

g) Deaths in older growing pigs

This section covers common causes of deaths in older growing pigs and young gilts and boars.

Often pigs die suddenly without clinical signs. This means that it is important to conduct a post-mortem to diagnose the problem.

The most common causes of deaths in growing pigs

i. Infections

- Parazita internal parasites
- Erysipelas
- Glasser's disease
- Coughing pigs (Respiratory disease complex and pneumonia)
- Pasteurella pneumonia
- Ileitis
- Swine dysentery
- Endocarditis
- Edema disease
- Salmonellosis
- Classical Swine Fever
- African Swine Fever

ii. Nutrition

- Vitamin E deficiency
- Twisted bowel
- Mycotoxicosis
- Plant toxins

iii. Other

- Gastric ulcers
- Heat stress

Diagnosis

- Pigs can die suddenly from Classical Swine Fever, African Swine Fever, erysipelas, Glasser's disease, Pasteurella infection (acute pneumonia), vitamin E deficiency, gastric ulcers and twisted bowel.
- A correct diagnosis requires a post mortem and laboratory diagnosis as many diseases can appear quite similar. We only describe common signs in this section. Before performing a post-mortem please read section on post-mortems.
- African and Classical Swine Fever – see section II.
- Erysipelas – signs are red blotches on the skin, fever, stop eating.

- Pasteurella pneumonia – pigs cough when moved, breathing may be rapid and chest may thump.
- Ileitis – pigs become pale and produce black, tarry dung. Some pigs may eat less food and grow more slowly, others may be found dead.
- Swine dysentery – signs range from pale, soft dung, diarrhea and deaths.
- Twisted bowel (intestinal torsion/red gut) – pigs are usually found dead with a full stomach and extremely bloated.
- Gastric ulcers – pigs may stop eating and lose weight. Others have black, tarry dung and are very pale. Others become weak and die.
- Coughing pigs – pneumonia or respiratory disease complex is the main cause of coughing in pigs. This can be caused by infections with lungworm and ascarids as well as a range of bacteria.

Prevention and control

Avoiding grower/finisher deaths – the **main points**:

- Examine pigs daily. Ensure that they get up, and that they eat.
- Note those reluctant to move, lying in drains or away from others.
- Remove sick pig to a new clean pen.
- Vaccines are available for Classical Swine Fever in Timor-Leste.
- Vaccines are also available for Erysipelas but they may not be available in Timor-Leste.
- Examine all dead pigs.

Treatment

- *Erysipelas* – inject pigs with a long acting penicillin
- *Coughing pigs* – treat pigs with injectable Oxytetracycline and treat also with Ivermectin for lung worm and ascarids
- *Pasteurella pneumonia* – inject with oxytetracycline
- *Swine dysentery* – inject pigs with oxytetracycline
- *Glasser's disease* – inject with long acting penicillin

h) Growing pig problems

Reduced growth rates (slow growth) and feed efficiency in the growing pigs, while less obvious than deaths, can reduce profits significantly.

Causes of reduced growth rate growing pigs

i. Housing/management

- Overstocking
- Deficient water
- High environmental temperature (above 28^{o}C)

ii. Nutrition

- Energy deficiency
- Amino acid deficiency
- Parakeratosis
- Mineral/vitamin deficiencies
- Mycotoxins

- Plant toxins

iii. Infection

- Internal parasites
- Coughing pigs (respiratory disease complex)
- Mange
- Ileitis
- Swine dysentery
- Arthritis

Diagnosis

- Causes of reduced feed intake (small appetite) include high shed temperatures (exceeding 28°C), poor air quality (high dust and gas levels), reduced water intake, not enough feed space and poor-quality feed.
- Poor diet formulations create deficiencies in energy, amino acids, minerals and vitamins, and growth rate problems.
- Internal parasites can reduce growth rates in growing pigs and also cause diarrhea in younger pigs.
- Overstocking will reduce growth rate, worsen respiratory disease and lead to tail biting and chewing of the umbilicus and ears.
- Mycotoxins (from mould) and plant toxins such as pyrrolizidine alkaloids in heliotrope seeds, can cause sudden drops in growth rate.
- Rubbing is the main sign of pigs with mange. Other signs are slow growth rates and poor feed conversion rates. Rubbing is accompanied by red skin spots, hair loss over the flanks and crusty scabs inside the ears and along the neck and back.
- Coughing is a sign of pneumonia and/or Respiratory disease complex. It often involves mixed infections with lung worm, ascarids, Mycoplasma hyopneumoniae, Pasteurella multocida, Streptococcus suis and other bacteria. High levels of dust, ammonia and bacteria), and temperature fluctuations of 6°C or more over a 24-hour period, can contribute to outbreaks of coughing in pigs.
- Diarrhea can be associated with a number of diseases. These include:
    - Ileitis – reduce growth rates and produce 'razor-backed' pigs without significant deaths and diarrhea.
    - Swine dysentery is usually associated with a range of signs such as pale, soft dung, a reddish-brown (bloody) diarrhea, and perhaps deaths.

Prevention and control

Avoiding growth rate problems – the **main points**:

- Inspect pigs daily and ensure that each pig gets up and eats.
- Ensure pigs have access to a continuous supply of clean cool water.
- Note unhealthy pigs and pigs growing slower than mates need to be removed from the group – measure body temperature and examined pigs for clinical signs and feed separately.
- Investigate reduced growth rate.
- Keep records on feed consumption – slow growing pigs tend to eat less food and a drop in appetite may indicate sickness.
- Move sick, lame or injured pigs to a new clean pen.
- Treat pigs for mange.

- Monitor coughing by counting the number of coughing episodes over a 5-minute period and dividing the number by the number of pigs. A score of less than 3 is ok and a score of greater than 5 indicates a problem. The level of coughing is a good indicator of the severity of lung damage in respiratory disease.

Treatment

- Internal parasites – treat pigs with Ivermectin or similar product (see Section 4 Managing Sow and Litter)
- Coughing pigs – inject with oxytetracycline and ivermectin
- Mange – treat pigs with Ivermectin or similar product.
- Ileitis – pigs mostly found dead so treatment not possible but inject pen mates with oxytetracycline or lincomycin
- Swine dysentery – inject pigs with oxytetracycline
- Arthritis – inject pigs with long acting penicillin or oxytetracycline

i) Skin disease

There are a number of important skin diseases in pigs.

Common causes of skin diseases (lesions)

i. Common infections and diseases that cause skin lesions

- Mange
- Greasy pig disease
- Swine pox
- Infected wounds

ii. Less common diseases that may cause skin lesions

- Classical swine fever
- African swine fever
- Erysipelas
- Salmonellosis
- Other general infections (septicemia)

iii. Non-infectious causes of skin lesions

- Pityriasis rosea
- Parakeratosis
- Sunburn
- Tail and flank biting
- Insect bites
- Teat, tail and ear necrosis (newborn piglets)

Diagnosis

- Mange – rubbing and scratching are the most common signs of mange in growing pigs. Mange-free pigs seldom rub or scratch. Older pigs may develop chronic mange. Dry, greyish scabs are found on the body, associated with rubbing, especially sows and boars. They will also have scabs inside the ears or extending along the neck, back and rump and down the flanks.

- Parakeratosis – signs are thick scabs on the legs and lower parts of the body, without rubbing. It is caused by zinc deficiency, or high levels of calcium in water or feed which increases the need for zinc.
- Greasy pig disease – It commences with reddened spots or lesions on skin and the key clinical signs are dark patches of flaking, greasy skin caused by bacterial infection. Pigs appear as though they have been rubbed with oil or grease. Pigs are often dehydrated (with sunken eyes) and may become thin and die. Greasy pig disease mainly affects piglets and weaners and spreads from pig to pig. It is sometimes associated with untreated mange or results from skin abrasions due to rough surfaces or fighting.
- Swine pox – signs are small, crusty lesions seen mainly in piglets and weaners. The lesions can be confused with insect bites. Outbreaks of swine pox may accompany mange and greasy pig disease.
- Classical Swine Fever – reddened skin along with other signs (see Section II).
- African Swine Fever – reddened skin along with other signs (see Section II).
- Erysipelas – signs are red skin patches on skin and pigs often reluctant to move or eat.
- Sunburn or sunstroke – pigs reluctant to stand and walk with an unsteady gait (while dropping their shoulders) are signs of sunstroke. It occurs when housed pigs are exposed to sunlight for long periods. White-skinned pigs look reddened.
- Teat, tail and ear necrosis in newborn piglets can be caused by cold, wet concrete farrowing pen floors and mycotoxins (fungal toxins). It causes loss of nipples and affected gilts need to be culled. Wounds or injuries may not be obvious until surrounding skin reddens and swells, and lameness is apparent.
- Pityriasis rosea – signs are raised red rings on the belly and flank and the rings tend to expand and join up.
- If rubbing is absent, bacterial infections are the most common cause. Always measure the body temperature if the skin is red (normal is less than 40°C).
- Generalised infections - blue ears, or purple bluish blotches on limbs and belly are a sign of generalised infections.
- Tail-biting and flank-biting – can be a sign of overstocking, sudden changes in temperature, dirty sheds and high gas levels.

Prevention and control

- Regularly inspect growing pigs for rubbing and scratching. While observing rubbing, watch for red spots, blotches or ring. Red spots (3- 5 mm across) and hair loss indicate mange. If mange present in piglets or weaners, treat the sows as well as growing pigs.
- Look for injuries caused by rough floors, sharp fences or teeth, and note if affected pigs are eating.
- Clip eye teeth of baby piglets, after they have had a feed of colostrum, to prevent injury to litter mates and skin wounds at weaning.
- Inspect farrowing pens and weaner pens for damaged floors and protruding objects (for example, wire) to prevent injuries which could lead to greasy pig disease or other infections.
- Maintain floors in good condition and keep them clean and dry.
- Erysipelas - it is possible to vaccinate pigs if indicated, but vaccines may not be available in Timor-Leste.

Avoiding skin problems – the **main points**:

- Inspect ears of dry sows for scabs (sign of mange).
- Treat all sows for mange before they enter clean farrowing crates.
- Inspect crates and weaner pens for damaged floors or sharp objects which could injure.
- Inspect piglets, weaners and growers for red pimples and rubbing.

- Prevent injuries and provide good ventilation.

Treatment

- Treat sows for mange 1 week before farrowing and treat sows and piglets at weaning.
- Inject pigs that are infected with either Greasy pig disease or Erysipelas with Penicillin as recommended on the label.

j) Lameness

The causes of lameness can be disease and infection, as well as the standard of flooring in pig pens. The causes can also be age specific.

Main causes

i. Baby pigs still being suckled

- Splayleg
- Arthritis
- Abrasions

ii. Growing pigs

- Arthritis:
- Glasser's disease
- Erysipelas
- Streptococcus suis
- African swine fever
- Mycoplasma hyosynoviae
- Fractures
- Calcium/phosphorus deficiency
- Spinal abscess
- Osteochondrosis:
- Degenerative joint disease

iii. Sows, gilts and boars

- Trauma
- Fractures
- Calcium/phosphorus deficiency
- Leg weakness syndrome
- African Swine Fever

Diagnosis

i. Piglets

- Splayleg – obvious soon after birth. Piglets are unable to control their hind legs and adopt a dog- sitting position. Front legs are affected in severe cases.
- Abrasions – occur any time from birth, often on the toes and legs of piglets housed on cement. The hoof can be affected at the toe or on the sides. Legs commonly have abrasions at knee or knuckle joints.

- Arthritis – the joints are swollen and they may be hot and painful. One or more joints (polyarthritis) may be affected. The condition may be triggered by wounds and skin abrasions, or an infection via the umbilical cord.

ii. Growing pigs

- Injuries and skin wounds – rough slippery cement floors can lead to a variety of injuries, resulting in skin wounds and muscle and tendon damage. The latter are difficult to diagnose and harder to treat.
- Measure the body temperature of any lame pig – if elevated pig needs to be injected with an antibiotic such as oxytetracycline immediately.
- Infected wounds and abrasions around the joint can trigger arthritis in older pigs. Wounds from biting and injuries from damaged pens can also lead to arthritis.
- Glasser's disease and erysipelas – often cause acute lameness and pigs stop eating and are reluctant to move. Increased body temperature is common.
- Osteochondrosis – is a group of syndromes causing limb deformities or joint problems in young, fast-growing pigs. Degenerative changes in the joint cartilage and adjacent bone may eventually lead to fractures. The condition causes leg weakness, fractures of the head of the femur (ham bone) and separation of the ischial tuba (hip bone). It can affect the stifle, shoulder and elbow joints. Pigs aged 4-6 months are prone to lameness caused by osteochondrosis.
- Fractures of the head of the femur or the hip – cause severe lameness. Pigs are reluctant to move and may refuse to stand. Can be caused by calcium or phosphorus deficiencies.
- Spinal abscesses – usually associated with tail biting or other wounds and leads to progressive lameness in the hind limbs. Affected animals may eventually be unable to stand.
- African Swine Fever – swollen joints and lameness are common findings in more milder forms.

iii. Sows

- Fractured hip or pelvis – often occurs when newly weaned sow slips on wet smooth cement floor. Can also occur at mating. Often associated with a calcium or phosphorus deficiency.
- Injuries, pressure sores on shoulders and hips, damaged dew claws – can all affect mobility and lead to lameness and joint problems.
- Measure the sow's body temperature and inject with oxytetracycline if temperature is elevated.

Prevention and control

Avoiding lameness – the **main points**:

i. Piglets

- Record the number of piglets with splayleg per litter. Cull sows that farrow more than one piglet with splayleg in the same litter or farrow piglets with splayleg in successive litters. Treat piglets with splayleg with bandages as per diagram. Provide some floor traction
- Where abrasions are a problem - repair roughened cement floors or cover with rubber matting, treat abrasions with an antiseptic wash and spray-on antibacterial; provide soft matting for hoof abrasions.
- If arthritis is a problem, look at the level of hygiene in the farrowing house.
- Treat arthritic pigs with an injectable antibiotic.

ii. Growers

- If leg injuries are common, examine floors for damage and also recalculate pen stocking rates (see Housing section).
- Make sure diets have sufficient calcium and phosphorus.

- Determine the cause of arthritis to help decide on prevention strategies.
- Control Glasser's disease and Streptococcus suis with better housing, lower stocking rates.
- Inject sick pigs with long acting penicillin as recommended on the label.

iii. Sows

- Keep heavy sows off slippery surfaces.
- Make sure diets contain sufficient calcium and phosphorus.
- Examine floors in farrowing pens for cracks and damaged or roughened areas.

Treatment

- Inject piglets swollen joints as soon as they are detected with Penicillin (as recommended on label) to prevent irreparable joint damage. Once the swelling around the joint has hardened, it is unlikely that the piglet will recover and piglets with severe joint damage should be destroyed, as these animals are a welfare problem.
- Inject growing pigs and sows and boars with hoof injuries and lameness with a long acting Oxytetracycline (Terramycin LA - 1ml/10kg IM), If Flunixil is available then inject (2.2 ml/45 kg IM for up to 3 doses) to reduce pain and lameness. However, once inflammation becomes chronic, it is unlikely that the pig will fully recover. Hence it is important to treat as soon as signs are noted. Pigs that fail to respond to treatment must be culled while they are still mobile to avoid creating an animal welfare problem.

5.2. Main diseases affecting pigs in Timor-Leste

In this section, we describe three major viral diseases present in pigs in Timor-Leste. These include Classical Swine Fever, African Swine Fever and Japanese Encephalitis Virus.

a) Classical Swine Fever (CSF) or Hog Cholera

Classical Swine Fever is caused by a virus and is mainly caused by nose to nose contact or by feeding pigs parts of dead pigs. The virus can also be transferred from farm to farm on boots or on clothing and equipment.

The disease has acute and chronic forms, and can range from severe, with high mortality, to mild or even unapparent.

Clinical signs

- The most important clinical signs are fever, reddening of the skin, convulsions and usually (particularly in young animals) death within 15 days.
- In the acute form of the disease, in all age groups, there is fever, huddling of sick animals, loss of appetite, dullness, weakness, conjunctivitis, constipation followed by diarrhea, and an unsteady gait. Several days after the onset of clinical signs, the ears, abdomen and inner thighs may show a purple discoloration. Animals with acute disease die within one day to 2 weeks. Severe cases of the disease appear very similar to African Swine Fever.

Post-mortem findings

- The key post-mortem findings are petechiae (pinpoint haemorrhages) in the kidney, larynx (throat), bladder, mucous membranes, infarcts in the spleen and haemorrhages in the lymph nodes.
- The post mortem signs are indistinguishable from those of African Swine Fever.
- Samples must be analyzed by a laboratory to confirm a diagnosis.

Prevention and control

- Classical Swine Fever can be controlled in a district by having all pigs on every farm vaccinated. (See Vaccination Program for Classical Swine Fever)
- New pigs, purchased from other farmers must have been vaccinated before they arrive on the farm.
- The key to prevention is maintaining strict farm biosecurity.
- This means building a fence around the outside of the farm that prevents your pigs having nose to nose contact with other famer's pigs.
- It also means not feeding products to pigs that may be contaminated with the virus. This includes blood and meat from dead pigs.
- It also means that you do not wear boots or clothes inside your own piggery or pig pens that have been worn outside your farm. If you do wear boots that have been worn outside – they must be washed thoroughly, disinfected and dried before wearing them inside your farm.

b) African Swine Fever

African Swine Fever (ASF) is a severe viral disease affecting domestic and wild pigs;

It is responsible for severe mortalities and serious production and economic losses.

The virus can be spread by live or dead pigs, domestic or wild, and pork products;

transmission can also occur via contaminated feed and fomites (non-living objects) such as shoes, clothes, vehicles, knives, equipment etc., due to the high environmental resistance of ASF virus.

Like Classical Swine Fever there are acute and sub-acute and chronic forms of African Swine Fever and clinical signs and mortality rates can vary according to the virulence of the virus and the type/species of pig.

Clinical signs

i. Acute forms of ASF

- High fever, depression, anorexia and loss of appetite,
- Haemorrhages in the skin (redness of skin on ears, abdomen and legs),
- Cyanosis, vomiting, diarrhea and death within one to 20 days.
- Pigs may develop high fever with no other signs being present for a few days.
- In white-skinned pigs, the extremities turn blueish-purple and haemorrhages become apparent on the ears and abdomen.
- Groups of infected pigs lie huddled together shivering, breathing abnormally, and sometimes coughing.
- If pigs are forced to stand, they appear unsteady on their legs.
- After a few days they appear asleep and die soon afterwards.
- Spontaneous abortions occur in pregnant sows.
- Mortality rates may be as high as 100%.

ii. Sub-acute forms

- Clinical signs less obvious
- Pigs survive for longer periods.
- Affected pigs lose weight, become thin, and develop signs of pneumonia, skin ulcers, and swollen joints.
- Mortality rates are lower, but can still range from 30-70%.

iii. Chronic forms

- Loss of weight, intermittent fever, respiratory signs, chronic skin ulcers and arthritis.

Post-mortem findings

Samples must be analyzed by a laboratory to confirm a diagnosis of ASF.

i. Acute, sudden or rapid deaths

- Bluish-purple discolouration of the skin of the legs, ears, chest and abdomen, sometimes with multiple haemorrhages common, especially in white skinned pigs.
- Bloody froth around the nose and mouth.
- Pus around the eyes may be present.
- Bloody faeces around the rump and hind legs.
- Fluid in the chest and abdominal cavities - may be blood-stained.
- Most organs will be congested and there may be widespread bleeding over organ and body surfaces;
- Enlarged spleen.
- Enlarged lymph nodes containing blood - may resemble blood clots.
- The lungs are not collapsed and appear shiny, with prominent divisions between lobules – moisture and froth will ooze from the lungs when cut.
- Pinpoint haemorrhages on the surface of the kidneys.
- Haemorrhages and sometimes ulcers in the stomach lining.
- The intestines may be congested and the contents may be bloody.

ii. Sub-acute forms – death may take several days

- Fluids may be present in body cavities (heart failure);
- Lymph nodes are enlarged and often haemorrhagic;
- Fibrin may be present on the surfaces of the lungs and the heart;
- Lungs may be firm with a mottled appearance, due to pneumonia;
- Joints may be swollen with accumulated fluid and fibrin.

iii. Chronic form of the disease

- Emaciation;
- Sores and ulcers over bony points;
- Lymph nodes are enlarged and firm;
- A layer of fibrin may be present over the lungs and heart;
- Swollen joints.

Prevention and control

- There is no vaccine for African Swine Fever.
- The key to prevention is maintaining strict farm biosecurity.
- This means building a fence around the outside of the farm that prevents your pigs having nose to nose contact with other famer's pigs.
- It also means not feeding products to pigs that may be contaminated with the virus. This includes blood and meat from dead pigs.

- It also means that you do not wear boots or clothes inside your own piggery or pig pens that have been worn outside your farm. If you do wear boots that have been worn outside – they must be washed thoroughly, disinfected and dried before wearing them inside your farm.

c) Japanese Encephalitis Virus

JE is commonly is caused by a virus which is spread by mosquitoes. It affects a wide range of species including pigs, humans, horses, goats, dogs and cats.

Waterbirds (herons and egrets) serve as the main reservoir for the virus and both pigs and waterbirds are important for virus replication (producing more virus).

Clinical signs

- Japanese encephalitis is mainly a reproductive disease of pigs
- It causes abortion in sows, or an increase in stillborn pigs (born dead) and mummified foetuses. A mummified foetus has skin like leather and died long before farrowing.
- Abortions usually occur close to farrowing.
- Infection in boars causes lower fertility due to a reduction in the number of sperm produced and sperm is also less mobile (cannot swim strongly).
- Neurologic (nervous) signs including tremors and convulsions are common in newborn piglets with increased mortality in 1-3-day old pigs. Mortality in non-immune, infected piglets can approach 100%.
- Often the only sign observed in non-pregnant sows is a mild febrile reaction.
- Natural infection results in long lasting immunity and the mortality rate in boars and sows is almost zero.

Prevention and control

- A vaccine is available for pigs, horses and humans in many countries but may not be available in Timor-Leste.
- It is also important to reduce and eliminate breeding sites for mosquito vectors
- Humans should protect themselves from mosquitoes by using of mosquito repellents, mosquito nets and other methods.

d) Vaccination program for Classical Swine Fever/Hog Cholera

There were many pig diseases that exist in Timor-Leste but only one type of pig vaccine is currently available either in the government or private sector.

The vaccine that is used is based on a priority disease that the government has determined.

Classical Swine Fever vaccine is a live vaccine in a freeze dried form that is used to protect pigs against Classical Swine Fever (Hog Cholera) that is endemic in Timor-Leste.

Vaccination program

- Primary (first) vaccination is recommended at 6-7 weeks old (pigs can be vaccinated earlier depending on maternal immunity and environment).
- Second dose (revaccination) is at 9 – 10 weeks old.
- A gilt should receive the first 2 doses and get a booster dose of vaccine at 7-8 months of age or before mating.

- Boars and other adult pigs need to be vaccinated once a year.
- Vaccine dose = 1 ml injection is given into muscle (intramuscular).

Vaccination program procedures

- Consult the veterinarian/livestock technician before vaccinating the pig to make sure of its health status.
- The vaccine must be reconstituted before use. Dissolve the vaccine with the diluent provided (pre-chilled) to obtain 1 ml per dose of the vaccine. Use the vaccine immediately. Keep the vaccine cold throughout the vaccination procedure.
- Mix the vaccine with the pre-chilled diluent properly.
- 1 ml (1 dose) of reconstituted vaccine administered by intramuscular injection preferably in the neck muscle.
- Use a sterile syringe and needle.
- Only vaccinate healthy pigs.
- Use sterile injection equipment, clean and disinfect instruments properly after use.
- Discard any unused vaccine (live vaccines must be used within a few hours after being reconstituted.)
- Pigs cannot be placed in a dirty area before and after vaccination.
- It is better to vaccinate the pigs in the morning or afternoon to avoid heat stress.
- Store the vaccine at temperature 2oC - 8oC.
- Keep the vaccine away from direct sunlight.
- Use the vaccine before the expiry date.
- While carrying the vaccine in the field the vaccine needs to be transported in a cool box with icepacks.

5.3. Parasites

a) Definition

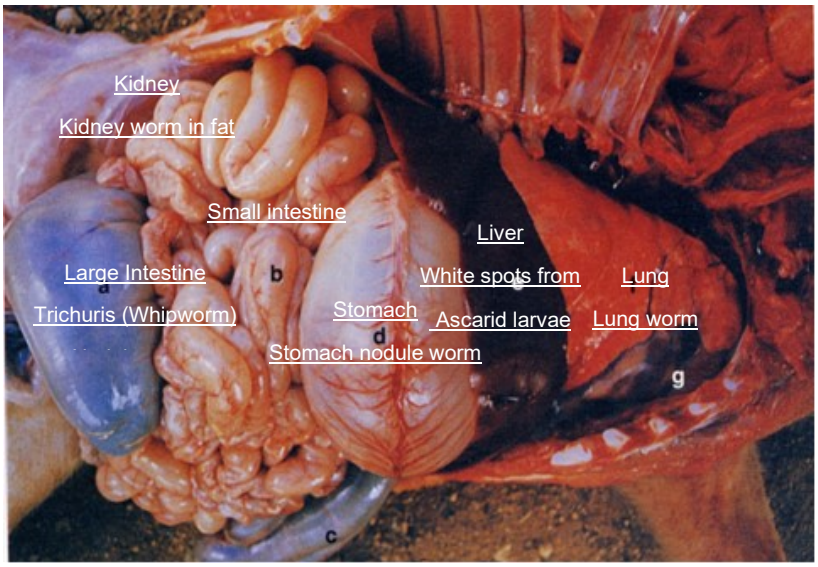
- A parasite is an organism that lives in or on another animal (called the host animal).
- Most parasites can only live for a short time away from the host animal.
- A parasite gets its food and shelter from the host animal.
- Many parasites can infest pigs.
- Some parasites live inside the pig. e.g. internal parasites – often called worms.
- Some live on the outside (on the skin) and are called mites and lice.

b) Internal parasites

Many internal parasites are found in pigs (Table 24).

Parasites are found in the stomach, small and large intestine, lungs and in the fat around the kidney (Figure 28).

Figure 28: *Stomach, intestines, lung and liver of a pig*



Life cycle of parasites

The life-cycle of a parasite starts when a female parasite lays an egg. The lifecycle ends when that egg is a mature adult female and also starts to lay eggs.

Parasites have 2 types of life cycles, direct and indirect.

- **Direct life cycle** – the parasite larvae live and grow into adult worms inside the pig.
  - The adult female parasite lays eggs.
  - The eggs leave the body in the urine or in manure.
  - The eggs hatch outside the pig and develop into larvae (immature parasites).
  - The larvae are then eaten by another pig and grow into mature parasites inside the pig.
- **Indirect life cycle** – the adult parasite lives inside the pig but the larvae develop inside other hosts (secondary host) such as insects, snails or worms.
  - The adult female parasite lays eggs.
  - The eggs leave the body in urine or faeces.
  - The eggs are eaten by a secondary host such as an insect, snail, or worm.
  - The larvae develop inside the secondary host.
  - The pig eats the secondary host and the larvae develop into mature parasites inside the pig.
  - For example, Lungworm:
    - The adult female parasite lays eggs in the lung.
    - The pig coughs up the eggs and swallows them.
    - The eggs leave the body in the urine or manure.
    - The eggs are then eaten by an earthworm and develop into larvae inside the earthworm.
    - The pig eats the earthworm and the larvae burrow from the intestines through the liver to the lungs and develop into adult parasites.

Clinical signs

i. Sow and boar

- Lose appetite - do not eat

- Lose weight
- "Thin sow syndrome" – sow becomes very thin
- Do not produce milk
- Dull, thick hair – skin does not look shiny
- Worms seen in the faeces

ii. Growing pigs

- Pigs do not grow – lose weight or grow very slowly
- Diarrhea
- Blood stained diarrhea
- Coughing
- Pneumonia – often caused by secondary infections with bacteria

iii. Baby pigs (suckers or weaned pigs)

- Severe diarrhea
- Weight loss / do not grow / become thin
- Dehydration/death

Treatment

i. Anthelmintics

- Ivermectin or Dectomax - inject pigs twice 14 days apart when clinical signs are seen (1ml/33kg pig)
- Betelnut – feed growing pigs with 20g dried ground betel nut/kg once each week.
- Papaya fruit – feed pig one papaya fruit daily for 15 days.

ii. Antibiotics

- Broad spectrum antibiotic – inject coughing pig with long acting antibiotic to eliminate bacterial lung infection.

Prevention and control

- *Hygiene* – wash sow with soapy water
- *Anthelmintics* – inject sow with Ivermectin or Dectomax one week before farrowing and 7 days before weaning. Inject growing pigs with Ivermectin or Dectomax at weaning.
- *Betelnut* – Feed sow with 20g betel nut/kg one week before farrowing and at weaning. Feed growing pigs with 20g betel nut/kg weekly from weaning to sale.

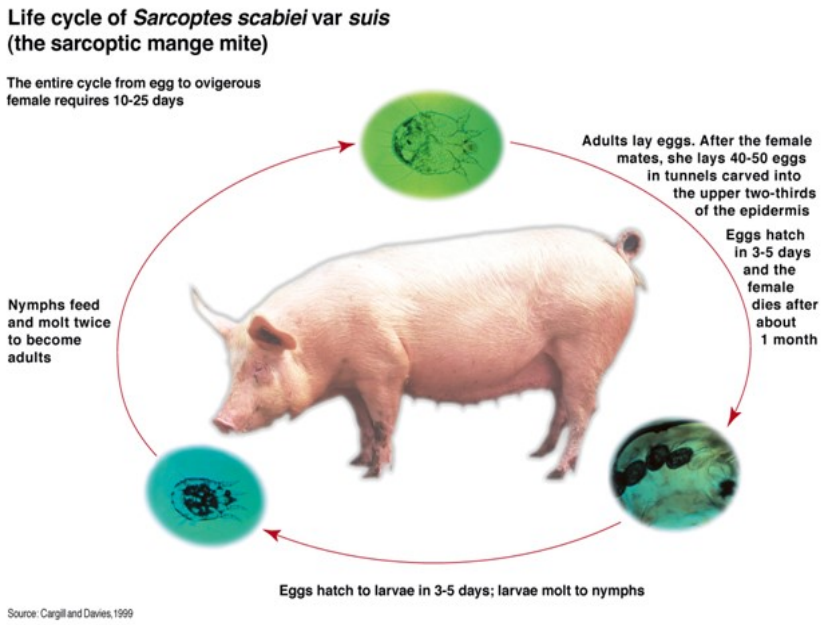
Table 24: *Important internal parasites that infect pigs*

	Time for eggs to hatch into larvae	Time larvae remain alive outside pig	Source of Infection for pig	Time from larvae being eaten and laying eggs	Clinical Signs	Post-mortem signs)
STOMACH						
H rubidus (red hair worm or stomach nodule worm)	few days	1-2 weeks	Faeces Soil Herbage	18-21 days	Do not eat Lose weight Do not grow "Thin sow syndrome"	Inflammation of stomach wall Nodules in stomach wall
Ascarops/Physocephalus (large stomach worm)	Swallowed by beetles	Survive in dung beetles for long time	Dung Beatles	1-2 months	Do not eat Lose weight Do not grow "Thin sow syndrome"	Inflammation of stomach wall
SMALL INTESTINE						
Ascarids (large round worm)	1-2 days (>15C)	1-3 months lasts 6-7 years in pasture	Faeces Soil	6-8 weeks	Reduced growth Reduced FCR	Large worms in Small Intestine White nodules in liver Pneumonia and lung damage
LARGE INTESTINE						
Strongyloides	Few days	Variable Free living larvae swallowed – found in udder	Soil	7-9 days 4-5 days from larvae in milk	Baby pigs or new born pigs Severe diarrhea Weight loss Dehydration/death Older age pigs OK	Inflammation in Large Intestine
Oesophogostomum (nodule worm)	Few days	<10 days	Faeces Soil (Herbage) Increased by humidity	3-8 weeks	Younger pigs • Reduced ADG • Reduced FCR • Diarrhea Sows • "Thin sow syndrome" • Reduced milk • Diarrhea	Colitis Nodules in wall of Large Intestine
Trichuris (Whipworm)	Few days	4-5 days	Faeces Soil	6 weeks	Sub-clinical Blood stained scour Weight loss	Inflammation of Large Intestine
LUNG						
Lung worm	Swallowed by earthworm	1-2 weeks free but may survive several years in earthworm	Earthworm	4 weeks	Reduced ADG Pneumonia	Lesions in mesenteric LN Pneumonia and lung damage
KIDNEY						
Kidney worm	In urine	1-2 weeks – destroyed by drying (Also can live in earthworm)	Soil	6-11 months	Few (Most problems caused by liver damage)	Hepatic damage Perirenal fat abscesses

c) External parasites

Mange mites are the most important external parasite. The mites complete their entire life-cycle in the skin of the pig (Figure 29).

Figure 29: *Life cycle of Sarcoptes scabeie vr suis (mange mite)*



Clinical signs

- The main clinical signs are rubbing, scratching, scabs on the skin (especially inside ear), weight loss and slow growth. Skin wounds can also become infected with bacteria.

Treatment

- 2 injections of Ivermectin or Dectomax 14 days apart.

Prevention and control

- Inject sow 3 and 1 week before farrowing and again 7 days before weaning.
- Piglets born to sows that have been treated twice should not require treatment until weaning.
- However, if growing pigs start to rub – inject them twice 2 weeks apart.

5.4. Zoonoses

In this section, we describe several Zoonoses that can be transmitted from pigs to humans.

A zoonotic disease, or zoonosis, is a disease transmitted from animals to humans and humans to animals.

The most important is Cysticercosis while Leptospirosis, Streptococcus suis infections and erysipelas may also occur in Timor-Leste.

While human health aspects of pig production are often ignored by farmers and their families, a few simple precautions such as good personal hygiene and ensuring meat is cooked properly will eliminate most problems.

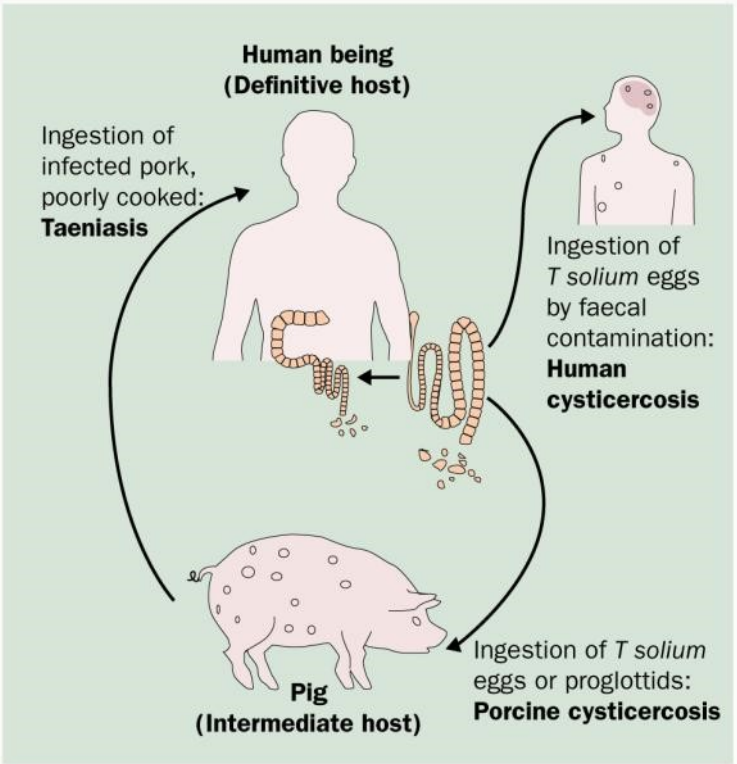
If farmers or their families are sick, they should advise the health clinic that they work with pigs and that zoonotic diseases and environmental problems need to be considered in the event of an illness.

a) *Cysticercosis*

Cysticercosis is an infectious disease caused by the presence larval cysts of the human tapeworm (cestode) within tissues of the human body. The scientific name for the tapeworm that causes cysticercosis is *Taenia solium* (*T. solium*), which is also known as the pork tapeworm.

Cysticercosis in humans usually results when a human ingests food, especially undercooked pork, contaminated with *T. solium* eggs (rather than the larvae).

Figure 30: *Simple life-cycle diagram*



Pigs ingest eggs from human faeces and the eggs enter the blood stream and develop into cysts (cysticerci) in muscle (see Figure 2). Humans ingest undercooked pork contaminated with eggs from cysts in the muscle of the pig. The eggs develop into a tapeworm in the human intestines. The when the tapeworm matures it lays eggs, which pass out of the human in the faeces. If pigs have access to the human faeces the cycle starts again.

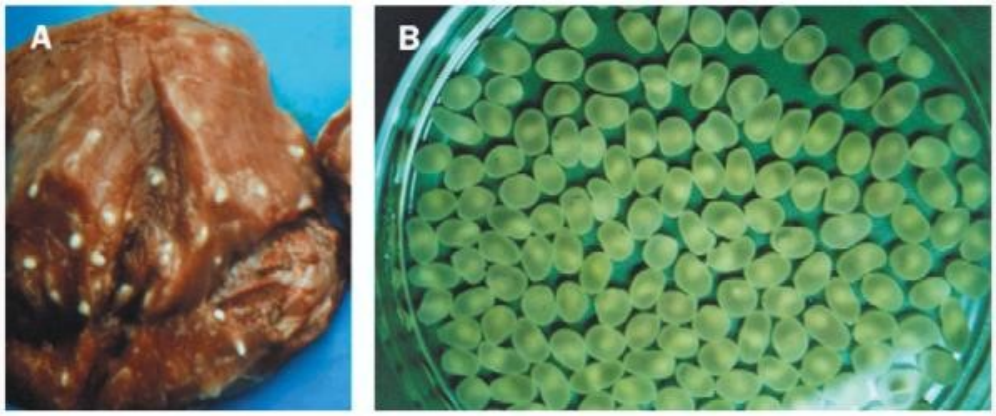
Humans may also swallow eggs from contaminated hands – if they do not wash their hands after defecating. When eggs from a human tapeworm are swallowed by a human, they enter the blood stream from the intestine and develop into larval cysts (cysticerci). The cysts remain in the body tissue indefinitely as they are unable to proceed to the next stage of their life cycle. Cysts can become enormous causing severe illness, particularly if the cysticerci are lodged in the central nervous system (brain) or heart.

Clinical signs

Symptoms in humans vary from case to case depending upon the number and location of cysticerci within the body. Cysticerci are often found in muscle tissue. If the cysts are located in the brain humans may experience

seizures and headaches. Cysts may also affect the eyes, spinal cord, skin and heart, but some individuals with cysticercosis will exhibit no symptoms (asymptomatic) or very mild symptoms. In some cases, cysts may form under the skin causing small lumps. These lumps usually do not cause any additional symptoms.

Figure 31: *Cysticerci – (A): as seen in infected pork. (B): excised into a Petri dish. The white dot in each cyst corresponds to the scolex*



Treatment

- Pigs can be treated with oxfendazole in pigs but the pig cannot be eaten for at least 2 weeks after treatment.
- Humans can be treated with albendazole, praziquantel or a combination. Anti-epileptic medicines are needed when a patient is having seizures.

Prevention and control

- The simplest way to prevent Cysticercosis in pigs and humans is to prevent pigs from eating human faeces and to ensure that all pork is well cooked. If cysts are present in the meat, it is best to discard the meat.
- Humans must also use toilets (latrines) rather than defecating outside. Even if human faeces are buried, it can be dug up and eaten by pigs.
- Confining pigs to prevent access to human faeces will prevent pigs becoming infected.

b) *Leptospirosis*

This disease is widespread in the pig industry. The people most likely to be infected are people who slaughter pigs and the farmers children if they work around pig pens without shoes or boots.

Leptospirosis is often present in a herd without producing problems. Chronic infection will be present in the kidneys of some sows and grower/ finisher pigs, but will only be observed when pigs are slaughtered. Vaccination can prevent abortions, stillbirths and other clinical manifestations but does not always prevent kidney infection and bacterial organisms in the urine.

Humans can be infected via pig urine and effluent. Urine and kidneys are the major source of infection. Avoid splashing urine into the eyes, around the face and nose and on cuts, as these are common infection routes.

An easy way to assess whether a herd is infected with Leptospirosis is to examine the kidneys of pigs from the farm when they are being slaughtered.

The pigs will have kidney lesions, and all kidneys from these herds pose a significant health risk to humans if they are splashed with urine.

Clinical signs

- The disease mostly appears in humans as a flu-like syndrome, with headaches, muscle aches and fever.
- Some people experience chills and increased sensitivity to light.

Treatment

- Inject infected pigs with Streptomycin as recommended on the label.
- Humans with flu-like symptoms should visit a Health Clinic for an examination and treatment.

Prevention and control

- Eradicating Leptospirosis from the herd is the best approach. Inject all pigs on the farm with Streptomycin – then vaccinate all pigs.
- Always wear gloves when cutting up a pig or when handling dead pigs or dead or aborted fetuses. Also protect eyes from urine splashes.

c) *Streptococcus suis* infections

Although these infections are widespread in pigs, few clinical human cases are recorded. Streptococcus suis type 2, is a common strain and has caused disease in humans in other countries. Most human infections give immunity to further infection without producing clinical signs. Humans are infected from infected pigs, their discharges and infected tissues. The organism usually gains entry to the body through cuts and abrasions.

Clinical signs

- Meningitis (inflammation of the tissues surrounding the brain) is the most common form of the disease in pigs. Other forms result in pericarditis (inflammation of the sac around the heart) and pleurisy (inflammation of the skin over the lungs and inside of the chest cavity).
- Clinical signs in humans are seldom seen, but headaches and neck stiffness are the most common signs reported. Humans acquire immunity following infection.

Treatment

- Inject pigs with penicillin as recommended on the label.
- Humans need to seek immediate medical attention at the Health Clinic.

Prevention and control

- Wash hands, especially cuts and abrasions, after handling pigs.
- Always wear gloves when cutting up or handling a dead pig.

d) Erysipelas – human erysipeloid

Erysipelas is a common bacterial infection of pigs.

Clinical signs

- Signs in pigs vary from sudden death (without evident sickness), a rapid onset with fever, depression and skin reddening, or less dramatic red, rhomboidal (diamond) skin lesions.
- Pigs with erysipelas from infected soil or effluent can infect humans.

- The organism enters a human through breaks in the skin (cuts or abrasions).
- Skin lesions (frequently on hands), mild fever and headache are often evident.

Treatment

- Inject pigs with Penicillin as recommended on the label.
- Humans need to go to the Health Clinic to be treated with either penicillin capsules or injections penicillin can be used to treat humans.

Prevention and control

- Wash hands, especially cuts and abrasions, after handling pigs.
- Always wear gloves when cutting up or handling a dead pig.

e) Human gastroenteritis

Several bacteria causing human gastroenteritis (diarrhea) may survive in pig populations. The most common are *Salmonella* sp. and *Yersinia enterocolitica*.

Although most cases in humans result from eating poorly cooked and contaminated food, it is possible to be infected by direct contact with faeces from infected pigs.

Clinical signs

- Diarrhea and/or vomiting are common signs.
- Intestinal pain and cramping in the gut may also occur.

Treatment

- Humans (especially children) should attend a Health Clinic for an examination and treatment.

Prevention and control

- Good hygiene is always important.
- Never eat or smoke when handling pigs
- Always wash hands thoroughly after handling pigs.

f) Abscesses in pig carcasses

It is best to burn a pig carcass when multiple abscesses are found inside a dead or slaughtered pig. It can be a serious danger to humans. It should not be examined and the abscesses must not be opened before the pig is incinerated.

Common causes of abscesses

Abscesses may occur when bacteria enter the body through a skin wound or damage caused by tail biting. These abscesses are not important unless they occur in the spinal cord or the lungs or liver. However abscess caused by diseases called Melioidosis and Swine Brucellosis are very important and can infect humans. Hence it is best to burn all pig carcasses with abscesses unless a laboratory analysis has been completed.

Melioidosis

This is an infectious disease that can infect humans or animals. The disease is caused by the bacterium *Burkholderia pseudomallei*. It is predominately a disease of tropical climates, especially in Southeast Asia and northern Australia where it is widespread.

Humans and animals usually become infected by breathing in contaminated dust or water droplets, ingesting of contaminated water, or contact with contaminated soil, especially through skin abrasions.

i. Clinical signs

- **Pigs**
  - Pigs often appear normal or lose weight for no apparent reason.
  - Signs may include loss of appetite and swollen lymph glands, especially the lymph glands around the mouth and jaw.
- **Humans**
  - Several types of melioidosis infection occur in humans and the disease has a wide range of signs and symptoms that can be mistaken for other diseases such as tuberculosis or more common forms of pneumonia.
  - Local infections are associated with localized pain or swelling, fever, ulceration, abscess.
  - Lung infections are associated with cough, chest pain, high fever and headache.
  - Bloodstream Infection are associated with fever, headache, and joint pain.
  - Weight loss and stomach pain can also be caused by Melioidosis.

ii. Post-mortem findings in pigs

The major findings are multiple abscesses containing thick, caseous, greenish-yellow or off-white material. Abscesses are usually found in regional lymph nodes, lungs, spleen, liver and subcutaneous tissues but they can occur in most organs. Splenic abscesses are common in pigs at slaughter.

iii. Prevention and control

- **Pigs** – Pigs become infected after contact contaminated soil or water so it is best to confine pigs on land that has been used for crops. Avoid contact with areas that have been flooded. Provide safe drinking water (e.g., by filtration and/or chlorination) in endemic areas. Dogs and other pigs should not be allowed to eat pig carcasses.
- **Humans** – Always wear gloves when slaughtering an animal or performing a post mortem. Do not open abscesses found in the major organs of a pig or under the skin of a pig if you live in an area where Melioidosis is known to occur. All dead pigs or pig carcasses with abscesses must be burnt and not consumed by humans, dogs or other pigs.

Brucellosis

Swine brucellosis is an infectious disease of swine caused by *Brucella suis*. Infected pigs develop a bacteremia (bacterial infection in the blood) which can then localize in various tissues. The disease typically causes chronic inflammatory lesions in the reproductive organs which can cause abortions, infertility and low milk production. It can also localize in joints, leading to lameness.

Pigs are usually infected by eating infected tissues (i.e. aborted fetuses, and other tissues of infected animals) or fluids (i.e. urine, semen). Infected boars may transmit the disease during mating.

Swine brucellosis is potentially a zoonotic disease and humans can be infected by handling aborted fetuses, the membranes and fluids discharged after farrowing has finished and new born piglets especially if they are born dead.

Humans can also be infected by the urine of an infected pig.

Feral swine can also provide a reservoir for infection for domestic pigs.

i. Clinical signs

- **Pigs** – common clinical signs are abortion, temporary or permanent sterility, orchitis (swollen testicles), lameness, posterior paralysis, stillborn, mummified or weak piglets.
- **Humans** – clinical signs in humans include continuous or intermittent fever, headache, weakness, profuse sweating, shivering, joint pains, aches and weight loss.

ii. Post-mortem findings in pigs

- Post-mortem will usually not aid the diagnosis of swine brucellosis – this is best done by testing blood samples from live pigs.

iii. Prevention and control

- **Pigs** – confining pigs to prevent contact with feral pigs and pigs from other farms is essential. Once infection occurs on a farm control is based on test and segregation, as well as slaughter of infected breeding stock.
- **Humans** – it is recommended to wear rubber gloves, overalls, eye protection and boots that can be cleaned and disinfected when slaughtering pigs, or handling aborted or dead fetuses, as well as the membranes and fluid discharged after farrowing, and pig semen. Wearing surgical/latex gloves to cover cuts and abrasions on hands and waterproof dressings on other areas are also recommended. If an injury occurs while handling material that could be infected, stop, wash hands in soap and water hot water and apply antiseptic cream and water proof wound covers.

6. Post-Mortem for Pigs

a) Why examine a dead animal?

The main reason for examining animals that are found dead, or that die or are destroyed after being sick, is to find the cause of illness or death so that preventative measures can be taken to protect the herd.

Dead animals can be a warning sign for an impending catastrophe. The first warning sign for many diseases may be an occasional death in the grower or weaner pigs.

Example: An outbreak of respiratory disease in animals often begins with one or two seemingly unrelated deaths in young animals. The death rate may gradually build up over a period of two to four weeks until a significant number of animals are dying each week. If we wait until several animals have died before we do something, we can expect several more animals to die before we can diagnose the problem and put the correct treatment in place. If we had investigated the first two to three deaths we could have had the treatment in place before most of the other animals had died. In this case quick action will save animals and money.

Examining dead animals will also provide information about other diseases which may be present in the herd and which limit production rather than kill animals.

Example: Sheep/goats may be dying from enterotoxaemia but we can also check for internal parasites. We may also find that some animals have not died from enterotoxaemia but from tetanus or some other infection.

b) What are the risks?

Few diseases that affect pigs can be transferred to humans. The major ones are leptospirosis, Strep suis infections, erysipelas and organisms such as Salmonella species and Yersinia enterocolitica, which cause diarrhea.

To minimise the risks:

- Always wear a pair of rubber gloves (washing up gloves).
- Don't eat or smoke until you have finished and cleaned up.
- Use detergent or disinfectants in the water.
- Don't open the kidneys .
- Don't open the urinary bladder (unless it is a sow with vaginal discharge).
- Protect any cuts on the hands before you start.
- Treat any new cuts immediately - not when you have finished.
- Work slowly and carefully and don't splash fluid around.
- Have an assistant take photos as you proceed through the post-mortem. These can be used as a record or sent to a veterinarian to examine.

6.1. Examining dead animals

The most important part of a post-mortem examination is to describe all the changes that are present. Finding the cause of death comes at the end and is only possible after all the changes have been described, recorded and considered. As you work your way through the post-mortem, don't think about making a diagnosis, but concentrate on accurately describing the changes that you observe. Many of the changes may be subtle and not easy to see. Other changes may be due to decomposition after the death of the animal. It is only by assessing the whole picture that a diagnosis is possible. Like most things it takes practice, so that the more you do the more you understand.

The key to a successful post-mortem is to obtain a clear description of the changes so that when you discuss them with your vet, they have a clear picture of what you saw.

a) Recording the information

Every death on the farm should be recorded and the information filed and shown to the vet at the next visit. As well as recording the death and details of the post-mortem findings, additional information needs to be recorded to assist the vet in interpreting the results of the post-mortem.

Information to record

Date	*(Date animal found dead)*
Identification and age of the animal.	*(Litter number/birth date/birth week)*
Location of the animal.	*(Shed/pen number, position in pen)*
Weight of the animal.	*(Approximate weight)*
Body condition.	*(Thin, fat, bloated, normal)*
Previous health problems.	*(Clinical signs observed)*
Period of ill-health.	*(Date animal first noted as sick/off-feed)*
Medication history.	
a) Treatments (injections/dosing)	*(Medicine - name, amount/volume, date)*
b) In-feed and water medication.	*(Medicine - name, amount in water/feed, date)*
Health of mates.	*(Deaths and sick animals in same pen/paddock)*
Health of same age group.	*(Deaths and sick animals in similar age group)*
Estimated time dead.	*(Time of death/ found dead, time of post-mortem)*
Vaccination status.	*(Vaccinations - type and date)*
Reproduction status (females).	*(Date weaned/ mated/ birthed)*

b) Post-mortem information

Date (*date animal found*) ……

Identification and age of animal (*litter number, birth date, birth week*) ……

Weight of animal (*approximate weight*) ……

Body condition (*thin, fat, bloated*) ……

Previous health problems (*clinical signs observed*) ……

Period of ill health (*date animal first noted sick or off feed*) ……

Medication history

a) Treatments
Medicine name:……
Amount/volume:……
Date:……

b) In-feed and water medication
Medicine:……
Amount in water/feed:……
Date:……

Health of pen mates (*Deaths and sick animals in same pen*) ……

Health of same age group (*Deaths and sick animals in similar age group*) ……

Estimated time dead (*Time of death or time found dead, time of post-mortem*) ……

Vaccination status (*vaccinations*)
Type:……
Date:……

Reproduction status (*females*)
Date weaned.:……
Date mated:……
Date farrowed:……

c) Doing a post-mortem

Preparing for a post-mortem

Equipment

- Pen and notebook.
- Plastic bucket, (warm) water and detergent or disinfectant.
- Sharp knife and knife sharpener.
- Plastic or rubber gloves for protection.
- Wheel barrow or trolley for disposal of carcase.
- Other items that may help are sharp scissors and forceps ("tweezers").

Location

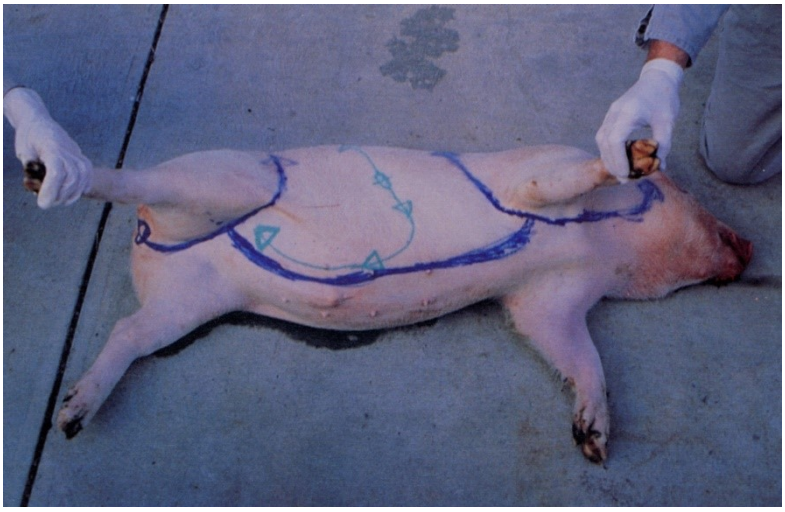
A clean area covered with concrete is best but if this is not available a nice grassy area or a plastic ground sheet should be used. Small to medium sized animals can be examined in a wheel barrow. Do not use an area where blood and fluids can drain into pens or contaminate feed and water containers. If on concrete wash the area before opening the animal. It will make it much easier to clean up afterwards.

Doing the post-mortem

i. Position the animal and observe the general appearance

- It is best to lay the animal down on the left side.
- Note the condition of the animal (i.e. thin, fat, bloated etc).

Figure 32 – *Blue lines indicate where to cut through the skin; green lines indicate where to cut to open the stomach and chest cavities.*



ii. Check the body openings, the skin, the legs, the tail and the ears

- Check the mouth and nose for discharges. These may be frothy, watery, thick, blood-stained, yellow or clear.
- Check for an anus and note any discharges or staining suggesting scours or bleeding from the anus. Are there any colour changes to the skin around the anus?
- Check the vulva or sheath for discharges, injury and swelling.
- Check the skin for cuts, bruising, discolouration and lumps. Make a note of any reddening, blotching (especially along the underneath) or pallor. If carcase is green around the belly, don't proceed. It is best to bury it.

- Check the legs for injuries, swollen joints and cracked or damaged hooves.
- Check the tail for bites and injuries.
- Check the ears for injuries and swellings and check inside the ears for scabs.

iii. Open the animal up

- Lift up the front leg and cut through the skin between the sternum (breastbone) and the front leg (Figure 33). Continue cutting between the leg and ribs until the leg can be laid back exposing the ribs. Continue the cut forward along the neck to the base of the ear. Check if the muscles are dry and sticky suggesting dehydration.

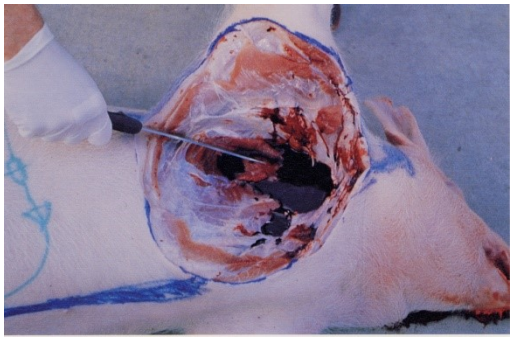


Figure 33

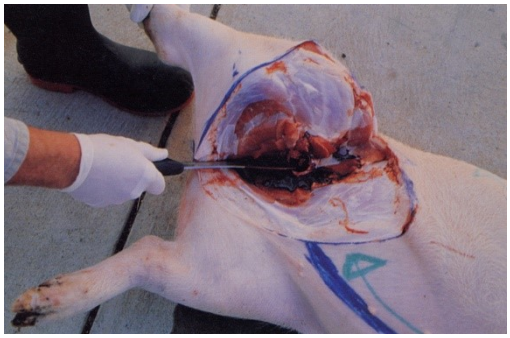


Figure 34

- Pull the hind-leg up and cut through the hip (Figure 34) joint then the muscles until the leg can be laid back. Check the colour of the muscles and note if they are red, brown or pale. Remove the skin over the stomach cavity (Figure 35) from the mid-line of the belly to the backbone. Be careful not to cut open the stomach cavity.

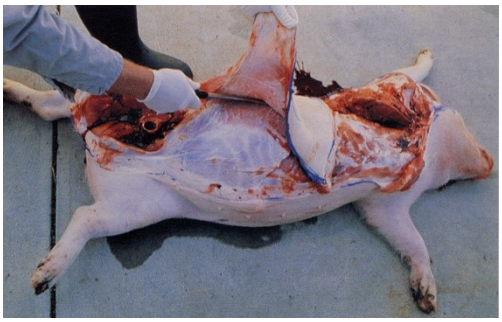


Figure 35

Figure 36

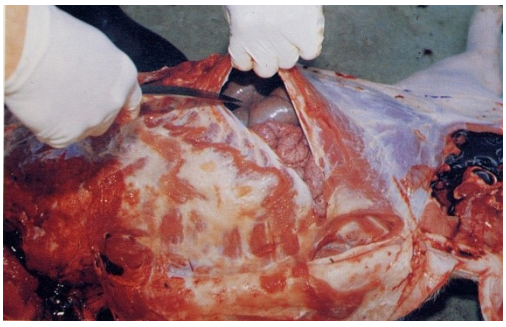


Figure 37

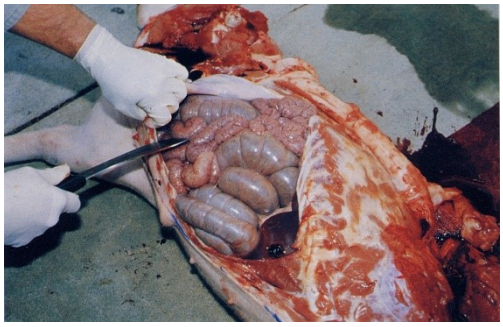


Figure 38

- Open the stomach cavity by making a small cut parallel to and beside the last rib (Figure 36). Use the fingers to lift the wall away from the contents of the stomach cavity so that the cut can be extended without rupturing the intestines or the stomach (Figure 37). Extend the cut along beside the last rib to the backbone and to the mid-line. Extend the cut along the mid-line to the pelvis and remove the muscle from over the flank (Figure 38).
- Note the position, the colour and size of the organs and gut and check for stringy creamy clots (fibrin), fluid and blood in the cavity. Note the colour and quantity of the fluid. Normally there is 2-5ml of clear fluid. Check if the contents such as the intestines, stomach, liver etc. are stuck to the wall or each other.
- Cut through the diaphragm (Figure 39) under the last rib and check if the lungs are inflated or collapsed. This is important in a newborn animal to see if it has breathed (see section Special examination of young animals).

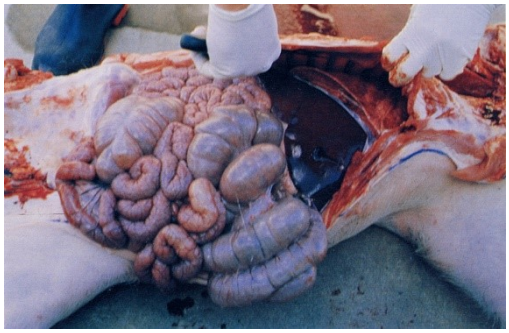


Figure 39

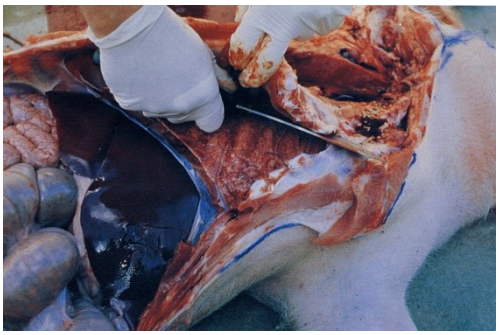


Figure 40

- Open the chest cavity by cutting through the cartilage (Figure 40) which joins each rib to the sternum (breastbone). Take care not to cut the heart sac. Bend the ribs back over the backbone to expose the lungs and heart. In older animals it may be necessary to cut between each rib (Figure 41) and break each rib individually (Figure 42) or use a pair of secateurs to cut through the ribs along the backbone. Assess the bone strength while breaking the ribs as poorly calcified bones bend rather than break. As you remove the ribs note if the lungs are stuck to the ribs (pleurisy) or if strands of fibrin are present.

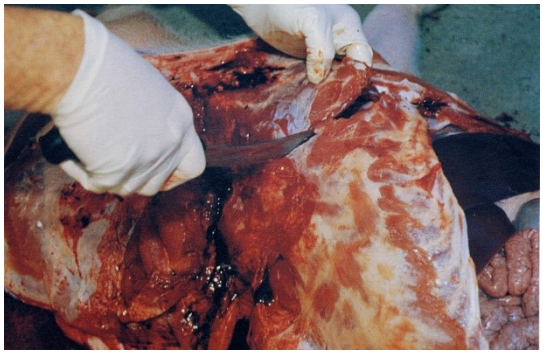


Figure 41

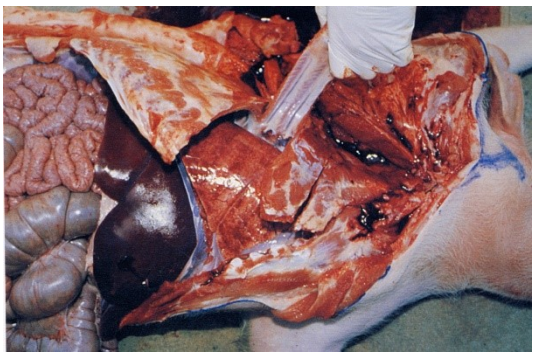
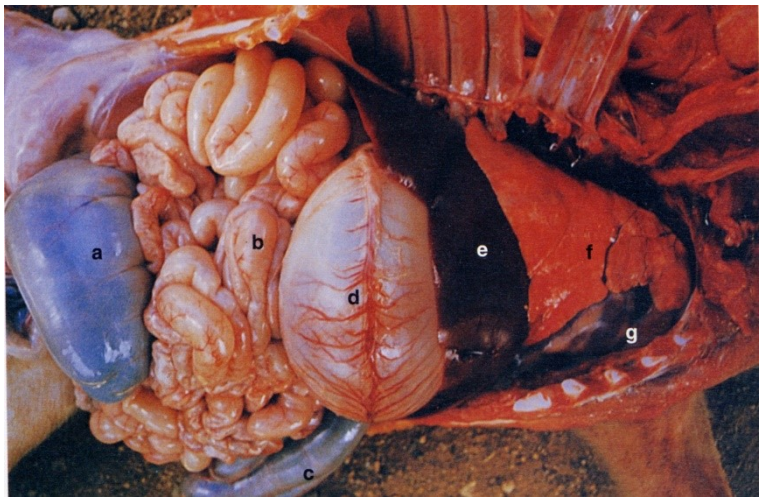


Figure 42

Figure 43: *a – large intestine; b – small intestine; c. colon; d – stomach; e – liver; f – lung; g – heart.*



- Observe the lungs and heart before touching them (Figure 43). The surface of the lung should be even and slightly moist but not wet and shiny and the colour should be pink. Note if the usually thin transparent membrane over the lungs is thickened (pleurisy) or if strands of creamy white clots (fibrin) are present. Note how much blood or fluid is present in the chest cavity and the colour of the fluid. Normally there is less than 2-5ml clear fluid.

iv. Examine the parts in detail

Chest cavity: Cut open the heart sac.

Heart sac*:* The heart sac is thin and transparent and the heart should be visible through it. It should contain a small amount of clear fluid (2-3 ml). A thickened opaque heart sac filled with fluid or stuck to the heart is abnormal (pericarditis). Note the colour and consistency of the fluid. Note the size of the heart and note any areas that appear pale or bruised (haemorrhages).

Remove the lungs and heart together by cutting through the trachea (air pipe), oesophagus (food tube) and blood vessels at the front of the chest cavity, pull the lungs and heart up by the air tube and blood vessels and then cut along between the lungs and the back bone and along between the heart and the breastbone. Pull the lungs away from the body and then cut through the oesophagus again.

Lungs: Note that the lung that is on the lower side of the animal when it dies may be darker than the other lung because it will contain more blood.

The surface of the lungs should be smooth and pink and they should feel soft and rubbery. Note if the lungs are reddish (congested with blood) or if there are discrete red patches (haemorrhages). Note any unevenness and feel for any lumps (abscesses). Note if the lobes of the lungs are stuck together (pleurisy). Note areas that are firm and not pink but dark red, brown or grey in colour (pneumonia).

Sometimes the abnormally firm parts will be towards the tips of the lobes at the front of the lung. This is typical of enzootic pneumonia. Cut off a piece of discoloured lung and place in a container of water. Note if it floats on the surface, floats like an iceberg or sinks. Haemorrhages in parts of the lung and rounded swollen areas normally indicate pleuropneumonia. Cut down the trachea into the airways of the lungs to check for frothy fluid. Note if the froth is blood stained.

Heart: Cut the heart open by making vertical cuts through the muscle on each side. Gently wash out the contents and check that the valves are thin and smooth or thickened and roughened.

Stomach cavity: The liver can be examined without being removed. However if a more detailed examination is required it can be remove by cutting through the attachments to the diaphragm and other organs. Leave the intestines intact.

Liver: The surface is smooth and even in colour. Note areas which are paler or darker than the surrounding tissue. Note any adhesions between the liver and diaphragm or stomach.

Note any fluid filled cysts but do not confuse the gall-bladder as a cyst. Squeeze a piece of the liver between the thumb and finger. It should tear without losing its shape. Note if the liver is reddened and mottled. Note if it is soft and tends to pulp which indicates the liver is decomposing after death.

Uterus/vagine: Check the uterus for foetuses. If the female is not pregnant, note if there is any pus in the uterus, vagina or urinary bladder.

Intestines: To remove the intestines, roll the animal over and let the intestines and stomach fall onto the ground Cut through the attachments between the intestines and the inside of the stomach cavity. If the animal is laying on dirt, it is best to examine the intestines without removing them from the stomach cavity.

Note the colour of the intestines (red to grey). Note if the blood vessels stand out and are easy to see. Check for haemorrhages. Select a part of the small intestine and cut it open and note if it is empty or not and if the wall is thick or thin. Note the consistency of the material present (watery, solid, pasty) and the colour. Note if the intestines are bloated and reddened. Note the coils of the large intestine and check for reddening. Open the large intestine, wash out the contents and examine the wall for thickness (it should be thin and transparent). Check for ulceration, redness, thickening of the wall and sloughing (peeling/shedding) of the surface.

If the contents of the large intestine are normal then there is unlikely to be a problem associated with the digestive tract.

Remove the stomach by cutting through the oesophagus (food tube) and the intestine where it joins the stomach.

Stomach: Open the stomachs. Check the contents and wash it out.

Joints: Open at least 5 joints. Check that the inside surfaces of each joint are smooth and check for pus or blood.

To avoid the risk of leptospirosis we suggest that you do not examine the kidney and bladder unless it is a sow with discharge. It is best to have animals monitored at slaughter for leptospirosis.

Examining the brain and spinal cord is a job for an expert so if you suspect problems associated with the nervous system, ask your veterinarian to perform the post-mortem examination.

Sometimes samples from a dead animal need to be collected for laboratory tests. Samples must be collected very carefully and in many special ways depending on which tests will be used on them. For details on how to collect and handle samples, and the special equipment that may be necessary, consult your vet.

If the farm is located in an area where there is a regional veterinary laboratory, you can send the whole animal to the laboratory for a post-mortem examination and the collection of specimens. This may be more cost effective than submitting material from an on-farm post-mortem as many laboratories offer special packages and discounts on tests done as a follow-up to a post-mortem.

6.2. Interpreting the signs

The most important changes that need recording relate to colour, texture, size and fluid.

Colour: *Red* - tells us that there has been an increase in the amount of blood in the tissue or organ. The main causes will be inflammation or congestion or haemorrhage (bruising).

Orange - in the stomach and intestines is caused by bile from the liver.

It is easily seen when the stomach is empty (the animal has not been eating). Sometimes bile will stain areas on the walls of the stomach and intestines if the animal has been dead for several hours.

Green - can also indicate bile but it also can suggest decomposition of the tissues. If a carcase has turned green on the outside around the flanks and stomach area or on the inside around the stomach, liver etc, it is not worth examining.

Size: An increase in the size of an organ does not always indicate a problem. It can mean that the organ has been called on to do more work than usual. It can mean an increase in the amount of blood (congestion) and fluid (oedema) in the organ. It may also result from damage and inflammation.

Texture:

Firm – the organ can be cut or pressed without losing its shape.
Spongy – the organ loses its shape on pressing or cutting.
Pulpy - the organ is soft and the contents have lost their shape.

The texture of a tissue will depend on the state of injury and decomposition.

Surface:

Smooth / lumpy / uneven
The surface of most body organs is normally smooth. Uneven surfaces and lumps generally indicate problems. For example areas of lung affected with enzootic pneumonia will be raised in the early stages of the disease but will sink below the surrounding areas in the latter stages. Areas of lung affected with pleuropneumonia will often be rounded, contain haemorrhages (red bloody areas) and be raised above the surrounding lung tissue.

Fluid:

Amount of fluid present needs to be estimated (1 cup etc).
Colour of the fluid is important. It may be amber (serum), red stained (blood and serum) or white to yellow (pus).

Fibrin:

Fibrin is mostly seen as fine cotton like strands in the chest or stomach cavity. The time to look for fibrin is when the cavity is first opened. It will be seen stretching from one part to another. Sometimes it will cause the fluid present to clot when the cavity is opened. It indicates injury to blood vessels and inflammation.

6.3. Special examination of young animals

Examining baby animals is similar to older animals but there are a few extra things that we need to check.

Still births

True stillborn animals are covered with a dried skin or membrane and have soft white feet (they have not walked). The lungs are plum coloured and do not float when placed in water (they have not breathed). Sometimes faecal material is present in the airways and dried mucus covers the nostrils.

If the animal has a fresh-looking appearance, often with fluid in the chest cavity, the animal died during the birth process. If the tissues have a putty like feel and the fluid is muddy, the animal probably died a few days before farrowing commenced.

Foetuses that die earlier become mummified and are dry and brown in colour.

Things to note in dead young animals

Has it breathed?	- stillborn.
Has it walked?	- stillborn or too small or weak to walk.
Is there milk in stomach?	- not sucked or no milk available.
Are the eyes sunken?	- dehydration from not drinking or from scouring.
Are the joints swollen?	- infectious arthritis
Is body condition good?	- overlay or acute disease
Is the pig pale?	- anaemia
Is body condition thin?	- poor milk supply or chronic disease.

Annex 1: Biosecurity and restocking guidelines during/after an outbreak of ASF

a) Biosecurity guidelines**

Proper biosecurity procedures reduce the risk of entering a pig farm or village pig holding.

1. Keep pigs in a pen all year round. Do not let them roam freely.
2. Make a fence around the pigs that prevents nose to nose contact with other pigs, wild boars or other animals.
3. The only people who go near the pigs should be those looking after the pigs.
4. People looking after the pigs should wash their hands with soap or clean with anti-microbial liquid before entering the fence. They should take off their shoes outside the fence and put on boots inside the fence – these boots should always remain inside the fence.
5. Keep the pigs clean and remove faeces at least daily.
6. Clean and disinfect the pens after the pigs are moved for sale or slaughter. Use a quick lime solution made by mixing 8 cups of quick lime or builder's lime, two cups of salt in a 10-litre bucket of water. The solution needs to be about as thick as paint. Brush the solution onto the concrete floor with a broom. Lime wash is cheap. Other disinfectants are available. They include Virkon S and formalin.
7. Put new pigs into a quarantine pen separate from the other pens. Keep them there for three weeks in case they are carrying the disease. If they have ASF they will get sick and die within about 10-15 days. If they are sick, because they are in separate pens, they will not spread disease to other pigs. Feed these pigs and clean their pens last each day to reduce the risk of spreading disease to the other farm pigs.
8. Feed dry-mix based diets with fresh leaves or silage as recommended in the feeding section of this manual. Do not feed any material containing or potentially contaminated with pork or other pig products
9. Buy pigs from a single source only. The risk of disease is reduced if all the people in a *suku* (village) or *aldeia* (sub-village/hamlet) buy pigs from the same suku or aldeia.
10. Carefully assess the health status of pigs for purchase. Use ASF blood tests on a sample of pigs from the suku or aldeia as proof of freedom.

b) Restocking guidelines**

Proper restocking procedures reduce the risk of African Swine Fever recurrence on a pig farm or village pig holding.

1. No pigs surviving the outbreak should remain in the area being restocked unless they have been tested negative for African Swine Fever. Kill for eating any pigs in poor condition. After the last pigs have been removed spell the pens for six weeks.
2. For pens with earth floors, remove the faeces and other organic material and spell them for six weeks. This will give time for the virus to die and for ticks that may carry the virus to die out also.
3. For pens with concrete floors sweep them clean with a broom, thoroughly remove all organic material with a scrubbing brush and wash with strong detergent solution. If available then use a quick lime white-wash solution about as thick as thick paint on the pen floors and walls. Make the white-wash by mixing 8 cups of quick lime or builder's lime, two cups of salt in a 10-litre bucket of water. If concrete is damaged the virus may persist in cracks so pay special attention to these areas – remove any loose or cracked concrete, disinfect and repair all damaged areas. Lime wash is cheap. Other disinfectants are available. They include Virkon S and formalin. Use them according to label directions.
4. Observe the new pigs carefully. If they are carrying the African Swine Fever virus they will get sick and die within about 10-15 days. If the pigs get sick make sure they are tested by MAF for African Swine Fever and Classical Swine Fever immediately.
5. Feed the new pigs dry-mix based diets with fresh leaves or silage as recommended in the feeding section of this manual. Do not feed any material containing or potentially contaminated with pork or other pig products
6. Buy pigs from a single source only. The risk of disease is reduced if all the people in a suku or aldeia buy pigs from the same suku or aldeia.
7. Carefully assess the health status of pigs for purchase. Use ASF blood tests on a sample of pigs from the suku or aldeia as proof of freedom.
8. Use only clean vehicles or vehicles that have been swept clean and disinfected with white wash to transport new pigs.

**Modified from Romano, M., Dacre I., Cutler, R. & Inui K. "Rapid response mission for African swine fever" FAO mission report 09.12.2019 – 13.12.2019 – Annexes 5 and 6.