C. Technical Guidelines on Animal Husbandry Activities

C-1 Technical Guideline on Cattle/Buffalo raising by use of stable

1. Introduction

(1) Why you should use a stable?

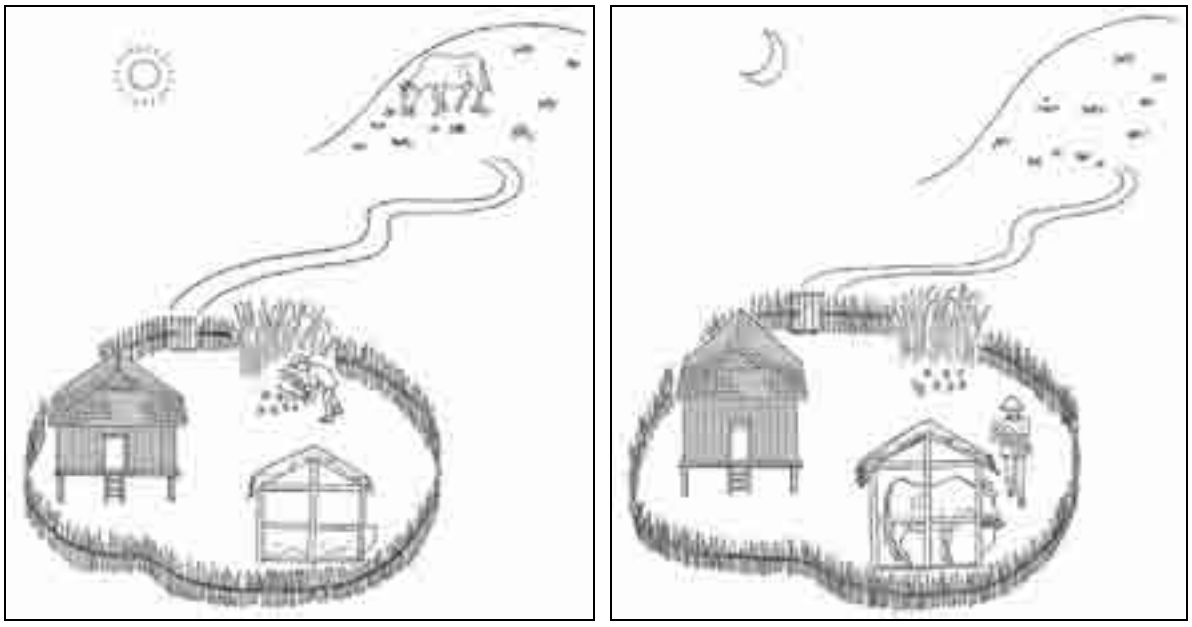
We, human beings live in house and feel very comfortable because we are protected from cold wind, strong sunlight and rain. In addition, we feel very happy and stay healthy if we eat good food.
Cattle and buffalo feel the same. If they are in a stable, they are protected from harsh weather. If they eat enough good feed and fresh water, they can;

- ✓ stay healthy and not so often get sick or die,
- ✓ produce more calves and the calves grow faster,
- ✓ produce more milk and meat.

This is why you should use a stable to raise cattle and buffalo.

(2) What is "Cut and Carry system"?

There are various ways to raise cattle and buffalo, and "Cut and Carry" is one of them. In Cut and Carry system, animals usually graze during the daytime and stay in a stable during the night. Forages (normally improved grasses, crops) are grown by the owner farmer and these forages are cut, carried and fed to the animals.



Some of the merits of "Cut and Carry system" are:

- ✓ You don't need a large land for grazing.
- ✓ You don't have to take your animals a long way to feed enough grass.
- ✓ Animals would grow faster, not get sick or die so often because they are fed more nutritious grass than natural grass. In addition, they don't have to graze whole day in cold/hot weather.
- ✓ Cheaper cost, less labor than "Intensive system" (another way to raise cattle: animals confined in the stable all the day and fed with grass and concentrates.)

- ✓ Compared to the “Extensive system” (another way to raise cattle: animals graze whole day and sleep outside, no feed and water, not much care are given to the animals), the animals produce more calves, milk and meat if they are adequately raised.

As looking at the merits of Cut and Carry system and the situation of cattle/buffalo husbandry in the villages, Cut and Carry system is considered the most practical way to improve your cattle/buffalo production. It is worth trying this system.
This manual has many tips that you can refer to carry out the Cut and Carry system. Make use of this manual and make your cattle/buffalo raising more successful! .

(3) What you need to do to apply Cut and Carry system

- First of all, build a stable for cattle/buffalo and feeder and drinker.
- Grow grasses (Elephant grass etc) at the back yard, around the house or along the fence.
- Cut and carry the grasses to your stable and feed them when the animals are in the stable.
- Take good care of your animal.

How to cut the grasses

- ✔ Cut the grass when it is 90-120cm high. Begin at one end of the row.
- ✔ Cut enough grass to feed your cattle for 1 day.
- ✔ The next day, cut the next grass along the row.
- ✔ Carry until you reach the end of the row.

(* For “how to plant elephant grass”, you shall refer to D-3 Technical guideline on Planting elephant grass for fodder.)

2. Building a stable

(1) Location

Choose good location carefully. The location should have good ventilation, good drainage, some shadings (direct sunshine onto the animals should be avoided), protected from cold north wind and not far from your house.

(2) Size of stable

A stable with 3m x 6m (with two sections) is large enough for a cow with a young and a breeding bull. In general, following sizes are applicable.

Number of matured cattle (cow)	Size of stable (minimum)
1 - 2	2m x 2m or 2m x 3m (4 – 6 m^2)
3 - 4	2m x 4m or 3m x 4m (8 – 12 m^2)
5 - 6	3m x 5m or 3m x 6m (15 – 18 m^2)

(3) Roof

You can use corrugated sheet, grass, bamboo etc for the roof.

A stable with corrugated iron roof

A stable with grass roof

(4) Floor

Floor of the stable can be either earth floor or concrete floor. If you want to utilize dung and under the wet climate, concrete floor is preferable. Concrete floor is more durable, easier to clean and keep dry than earth floor

A stable with “muddy” earth floor

If you want to make the floor with concrete, there are 2 ways to make:

a. Make concrete floor with cement, sand, gravel and water.

b. Use ready-made concrete blocks.

A stable with cemented floor

A stable with concrete block floor

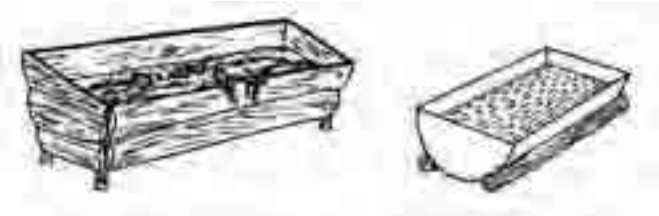
Build a pit to store dung and utilize it for compost making.

Clean the stable everyday; you need to get rid of the dung from the floor and the pit. Keep the stable always dry. Otherwise your cows/buffaloes will be sick.

⇦ A shed traditionally used for buffalo. Full of muddy dung.

(5) Feeder and drinker

Make feeder and drinker; which should be easy to clean.



3. Feeding your cattle

Give your animals with enough feed and clean, fresh water every time when the animals return from grazing.

(1) Feed sources

- Feed your cows/buffaloes various kinds of plants, such as grasses, leaves, straw, etc.
- Buffaloes can eat more coarse feed than cows.
- Plant forages: elephant grass is nutritious and relatively easy to grow.

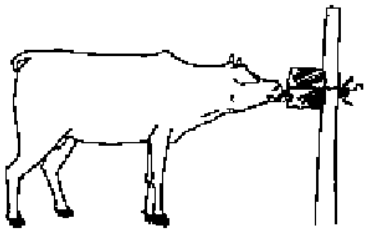


(2) Water

- You MUST always give your cows sufficient fresh and clean water. Never dry up the drinker!!
- Give buffalo more water than you do to cattle (buffalo is weaker than cattle to the heat).

(3) Minerals

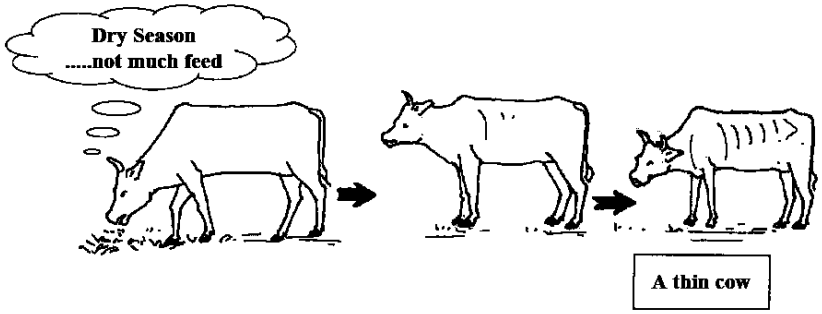
- Put some salt in the feeder every time when you feed the cows.
- Place "Mineral block" in a stable, if available.




4. Advanced feeding: Feed processing and preservation

After getting used to practice the Cut and Carry system, try the following feed processing and preservation. Processing is good because:

- ✓ Raw plants and materials can be stored long time if they are processed. It means you can feed it in the times when the green forages are scarce (e.g. dry season, cold season).
- ✓ Improve the nutritional values of the feed.



There are some methods of feed processing that many people do:

(1) Sun drying (making hay)

Materials: Grass, Rice straw, Cassava leaves, Bean leaves

Cut grass when 10-20% are flowering.

Spread the cut-grass on the ground and turn it once a day. Dry it about 3 days. Take some from inner layers to check: if it breaks a little when twisted and if slightly brown color, it must be OK.

Storing rice straw on a tripod:

If you use bean leaves or cassava leaves, you will put the dried leaves in plastic bags and store them under the dry place.

(2) Urea treatment of rice straw

Materials: Rice straw, Elephant grass, Grass

Urea treatment is usually applied to dried rice straw. Some merits of Urea treatment are:

- Straw can be more nutritious (it increases the protein content)
- Straw can be more digestible

How to do the urea treatment:

1) Prepare the materials shown in the below. You can use salt and lime, if available.

Materials	Method-1	Method-2
Dried rice straw	100kg	100 kg
Clean water	80-100 liter	80-100 liter
Urea	4 kg	3kg
Salt	-	0.5 kg
Lime powder	-	0.5 kg

2) Mix Urea, salt, lime powder with water.
3) Spread this liquid over rice straw and mix it thoroughly.
4) Cover the treated straw with plastic cover or put the treated rice straw in the plastic bags when the amount of straw is small.
5) You can feed it 7-10 days after treatment.

* For more details of how to treat, you shall refer to ‘D-4 Technical guideline on Urea treatment of rice straw’.

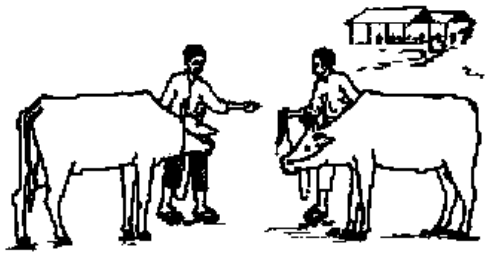
5. Managing the reproduction

(1) Reproduction of cattle

a. Selection of cows and bulls for breeding

A good breeding cow gives a calf every 1-1.5 year. A good breeding bull can mate with 10-15 cows.
Good cows and bulls (both in cattle and buffalo) for breeding should:

- ✓ be healthy and strong
- ✓ have a large brisket
- ✓ have strong bones
- ✓ have a shiny skin
- ✓ show good mating behavior



- ➢ Don't breed a bull with a cow from same family.
- ➢ Change breeding bulls every 3 years to avoid inbreeding.

b. Mating of a heifer

Don't let your heifer (a young cow/buffalo which has never bred) mating before she is over 10 months old and has 1-2 times of heat.

c. How to detect a cow in heat

Check your cow everyday and find the signs of heat, not to miss the best time for mating.
Signs of heat are:

- ✓ Not eating very much
- ✓ Keeping away from the rest of the herd, seeking out for bulls
- ✓ Raised head, constant moo, tail raised to one side and urinate frequently
- ✓ Mounting another cow or letting her mounted by another cow
- ✓ Shiny, swollen, pinkish brown vulva, wet on two sides, with some discharge

Heat comes about every 21 days (depending on the cows' condition). Heat lasts for very short time (about 16-36 hrs), and during this short time a cow must be mated to be pregnant. This is why you need to check your cow everyday to decide the best timing for service. If there is no heat after 21 days from the last heat, your cow must be pregnant.
Simple rule to decide the time for mating:

Time you find the heat		Mating time
Morning	➔	Afternoon
Afternoon	➔	The following morning

(2) Reproduction of buffalo

- The first heat in buffalo depends on the body weight (about 340kg), rather than her age.
- Check your female buffalo very carefully to find whether she is in heat or not, because in buffalo, the sings of heat are weak, often short, and often occur in the night.
- Gestation period of buffalo is longer than the cow's. It is 310-340 days.
- Period from the day of calving to next calving is much longer than the cow.

6. Care of calving cow and newborns

(1) Care of calving cow

a. How to take care of cows before calving

- Take good care of pregnant cow, treat her gently and never use the cow for drafting.
- Cow normally calves 281 days after mating.
- Place your pregnant cow in a warm, quite stable and put some straws on the floor.
- When you see the following signs, the cow would calve soon:
  - ✔ Scratching on the ground, exerting herself.
  - ✔ Expressing pains in the belly, constantly standing and sitting.
  - ✔ Mucus and amniotic fluid coming out from the vulva etc.

b. Assisting calving

Calving normally finishes within 1 hour after the amnion comes out. But if it takes longer, you need to help your cow.

- Wash your hands with soap before helping.
- Pull out the calf carefully and gently.
- Clean the mouth of the calf and let the cow lick the calf. If the cow is too tired to lick the cow, you have to clean the calf.
- Put the calf to breast and drink the first milk. Letting the calf drink is very important because First milk has very nutritious, and helps the newborn calf to grow fast, healthy and strongly.

c. Care of the cow after calving:

- Let the cow rest in the stable for the first 15-20 days from calving.
- Feed her 1kg of watery rice soup or concentrate a day and fresh green grass.

(2) Care of calves

a. Newborn calf (up to 2 months old)

- Don’t feed grass and leave to newborn calves.
- If the mother doesn’t let the calf suckle, pour enough milk of the mother’s into a bucket and give the milk to the calf with the bucket.
- If the cow has problem with the udder and cannot breastfeed the calf, feed it with cooked watery cereal soup.
- Let the calf out of the stable to bathe in the sun, play around and learn to eat grass.
- In cold weather, put straw in the stable to keep the calf warm.
- Always clean up the stable, the feeder and drinker. In this time, the calves can be easily get sick or die if the stable is always dirty.

b. Care of calves (2 to 5 months old)

- Let the calf put to pasture on green grass and green vegetation. A calf of this age still depends on the milk from the mother, but the calf can digest some of the legumes and fresh green grass.

- Put some soft legumes in the feeder for the calf everyday.
- Let the calves out of the stable during the daytime. They need sun bathing to grow normally.

c. Care of calf (6 to 24 months old)

Feed the calf with green coarse roughage. At this age, they can eat the feed as mature cattle do and needs to develop the rumen, stomach and intestines.

(3) Care of buffalo

- Take your buffaloes to the river, empty paddy field, pond etc to bathe and cool down. Buffaloes are very weak to the heat.
- Don't tie your buffalo with a tree where there is a strong sunlight.
- Give plenty of water when they are in the stable.
- Don't force to wean calf from mother. Buffaloes are very intelligent and have strong bond between mother and calf.
- Take good care of your buffalos, even though they are more hardy and resistant to diseases than cattle.

7. Disease prevention

Treating sick cattle would cost you a lot of money, and sometimes it takes a long time to recover completely. Prevention is the best and the cheapest way, and you need to take the best measures including vaccination to prevent diseases.

- Check your cattle carefully every morning and afternoon.
- If you find the sick cattle, separate it from the healthy ones. Give the special care.
- Vaccinate your cattle twice a year in accordance with the season against infectious diseases such as cholera, congestion, foot and mouth. Timing of vaccinations are:
  - First shot: March to April
  - Second shot: September to October

- When you find that your cattle may be having a disease, report as soon as possible to the veterinarian and local authorities.
- Don't kill the sick animals for meat or sell it.

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Additional information on Cattle/Buffalo raising by use of stable for extension staff

1. Treatment of some common diseases

(1) Ruminant bloat

Symptoms:

- Pain in the belly, difficult breathing, tongue sticking out with saliva dropping,
- Not eating,
- Finally, the animal seems to be in poisoning state, faint and die.

Treatment:

- Massaging with straw on the abdomen from left to right, from front to rear for about 10-20 minutes.
- Shower the animal with cold water to increase the movement of the rumen.
- Give salt water and ground ginger.
- Do not feed the animal with rotten or spoiled feed, and keep it away from any thing that may cause the problem.
- After feeding, cows must rest.

(2) Foot and mouth disease

If you suspect that your cow get Foot and Mouth disease, you have to:

- ✓ Isolate infected animals,
- ✓ Notify veterinary authorities as soon as possible to deal with the problem,
- ✓ Don't kill the animals for meat without consultation of the veterinary authorities.

Cause:

Your cattle can be infected when they contact directly with infected animals or through carriers, implements and other materials (e.g. transportation of infected animals and meat from infected animals, etc.)

Symptoms:

- Painful blisters on the tongue, lips, other tissues of the mouth,
- Foamy salivation, smocking of lips,
- The animal would keep chewing, grinning; staggering gate and lameness, difficulty to digest feed.

Prevention:

- Vaccinate animals against foot and mouth disease as instructed by the Veterinarian of the Department of the Province.
- Isolate the cows showing some of the symptoms above from other cows.

Treatment:

- No medicine to kill the virus,
- Increase the feed for rapid recovery,
- Wash the mouth and hoofs of the cows with methylen, juice of star fruit or lemon,
- At the moment, there is Foot and Mouth Disease in Kon Tum Town. Therefore, absolutely no

cattle are allowed to be bought from other localities without having been through quarantine and certification for immunization.

(3) Hemorrhagic septicemia

Symptoms:

- High fever with temperature, looks dull, doesn't eat very much, loss of appetite,
- Difficult to breath, tearing, salivation and nasal discharge.

The disease may be acute, chronic or in some other forms (nervous).

- If the infection is in the lung, the lung will swell and the animal will have difficulty in breathing.
- Inflammation of intestine, diarrhea with mucus blood.

Prevention and treatment:

- Vaccinate the animals 2 times a year (2ml/head).
- Provide good care, keep clean and dry the stable, give enough nutritious feeds.

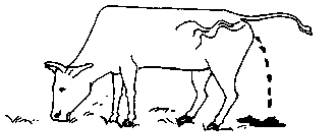
Treatment:

- If not treated in time, 95% the infected buffalo will die; for cow, the certainty of death is 50% within 24 to48 hours,
- Consult with the vets,
- Give special care to the sick one,
- Use the following antibiotics if available:

  Penicillin: 10.000 UI/kg p.o. + Streptomycin 10mg/kg p.o.

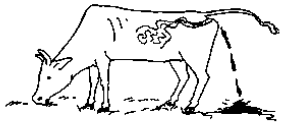
  Tetracycline: Kanamyvine, Gentamycine: 10mg/kg p.o.
- Reduce the temperature and increase resistance by Analgin, Vitamin C, and Vitamin B if available.

(4) Parasitic diseases



Check the dung of your cows carefully for worm eggs, to know whether the cows have internal parasites or not.

Symptom:



- High temperature, fatigue, thin, diarrhea, ruffled hair (if your cow has Tape worms),
- Tired, slow, ruffled hair, big abdomen, white eyes, watery excrement white in color with bad smell (if your cow has Round worms).

Treatment:

- Deworm regularly during the autumn-winter crop.
- Compost the dung to get rid of worm eggs.
- Use the following medicine:

  For Tapeworms, use "Ecl (Tetracloruacacbon)" or "Freon", or "Fascinex 1" tablet/75kg liveweight.

  For Round worms, have the animal drink mix with water and crushed betel nut (30g). After 3 times, have it drink 20g of sulphur.

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C-2 Technical Guideline on Pig raising by use of stable

1. Introduction

In ethnic minority villages, many people raise pigs extensively but their productivity is low. For example, many pigs are thin, grow slowly and often get sick or even die. There are various ways to improve your pig production, and using a pigsty is one of them.
This manual shows many tips to improve your pig production by using a pigsty. Make use of this manual and make your pig raising more successful!

(1) Benefits of using a pigsty
Benefits of using pigsty are:

- ✓ Pigs are protected from rain, strong sunlight, and cold/hot weather.
- ✓ Pigs don't get sick or die so often.
- ✓ Pigs grow faster and produce more meat, if you feed them well.
- ✓ Sows produce more piglets.

(2) Can you raise pigs with pigsty?
At first, you have to think whether you really want to raise your pigs with pigsty or not, and whether you can do it or not. Because raising pigs in pigsty needs a bit more money, labors and feed resources than raising them extensively. The followings are examples of extra resources and works you are required when you raise pigs in pigsty.

- ✓ A small piece of land to built a pigsty at nearby your house where has water source (the amount of water must be enough for pigs to drink, to grow feed resources, to clean pigsty, etc)
- ✓ Land to grow feed crops, not far from your house (100-200 m^2 of land to grow sweet potato even in the dry season).
- ✓ Materials and money to build pigsty and buy commercial feed, medicine, lime etc.
- ✓ You have to cook and give enough feed and water everyday（pigs are confined all day and can't wonder about to look for food by themselves）.
- ✓ You have to clean the pigsty everyday.
- ✓ You have to store feed for dry/cold season.

Do you have the resources mentioned above? Can you do the extra works mentioned above?
Most important point to consider is whether you can get enough feed or not. If you think you can have enough feed resources and can take care of your pigs well, try using pigsty. If not, don't raise pigs in a pigsty because you will definitively fail.

When you make your mind to use a pigsty, what you need to do are:

1. Choose suitable breed
2. Choose good location and build a pigsty
3. Give enough feed and water everyday

4. Grow feed crops
5. Check your pig everyday to know whether your pigs are in good health, sow in heat or not etc
6. Preserve feed (make hay or silage) to have enough feed for dry/cold season

2. Variety of pig breed

There are many varieties of pigs (= breed), and each breed has different characteristics, advantages and disadvantages. Choose the most suitable breed by looking at these points and the conditions around you.

(1) Domestic breed

a. Local (indigenous) breed

This type of pig is very common in the villages of Vietnam.

Advantages:

- It has been reared for long time in villages; therefore they have adjusted to village conditions.
- Hardy and adjusted to local conditions; they can live in harsh weather and on poor feed.
- More resistant to diseases than Exotic (imported) breed.
- Need less feed.
- Meat price is higher than other breed.

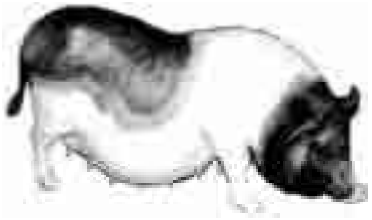
Disadvantages:

- They grow slowly.
- Less number of piglets at birth.
- Small body, less meat, much fat.

b. Mong Cai

Advantage:

- More number of piglets at birth (12 piglets on average).
- Easy to raise.
- Suitable to local conditions (climate, feed, management etc).
- More resistant to diseases than Exotic breed.



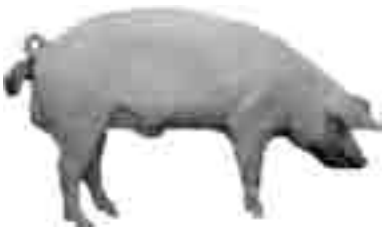
Disadvantages:

- Need more feed and care than the local breed needs.
- Smaller body, less lean meat than exotic breed.

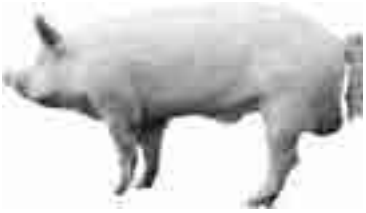
(2) Exotic (Imported) breed (called "White" in Kon tum)

a. Landrace

Originated from Scandinavia. It produces excellent lean meat. This breed is prolific and has excellent mothering ability. Mature boar weighs 330kg and mature sow weighs 270kg.



b. Yorkshire (Large White)



Originated from England. Yorkshire is more common than Landrace. This breed grows fast and produces good lean meat. Yorkshire can adopt itself to the conditions in Vietnam, therefore commonly used to produce F1. Mature boar weighs 370kg and mature sow weighs 340kg.

These imported breeds need more feed and care than local breeds do, and they cannot adopt themselves to the harsh conditions. Therefore, raising exotic breeds in villages is not recommended.

(3) Cross-breeding

"Cross-breeding" is a breeding technique to have improved piglets (called "F1"); local/domestic breed sow is mated with exotic breed boar.

This technique has some advantages and disadvantages as mentioned below, compared to "Pure-breeding". In addition, raising F1 needs a bit more resources than raising the ones of local breed. Therefore, try this technique when you become familiar with pig raising and able to raise local pigs without any problems.

Examples of cross-breeding (Yorkshire boar x Mong Cai sow)

Advantages (if exotic breed is used):

- Larger body size, more meat, less fat than local/domestic breed
- Grow faster
- More number of piglets

Disadvantages:

- Need exotic breed in good condition.
- F1 are less hardy and resistant to diseases than local breed; they cannot live in harsh conditions.
- Need more feed (both in quality and quantity) than local breed etc.

(4) Which breed should be chosen?

Following table shows about which breed to choose based on the resources and skills you have. Refer to the table to choose the right one for you.

Amount of resources, feed and labor you have	Your skill level	Breed for sow raising (reproduction purpose)
Limited	Beginner	⇒ Local breed
Fairly enough	Intermediate	⇒ Mong Cai
Abundant	Intermediate to Advanced	⇒ F1

3. Pigsty and equipments

(1) Location

Before building pigsty, choose the good place with the following conditions:

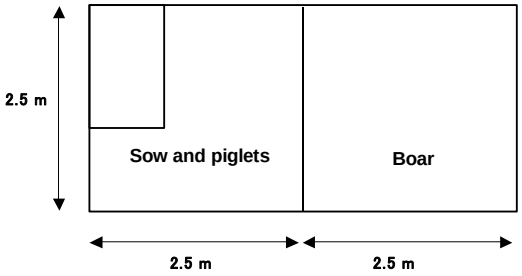
- Never be flooded, and good drainage
- Good ventilation
- Flat or gentle slope
- Some shading to avoid direct sunlight; especially if you use iron sheets for roofing
- Near the water source
- Near your house to give well care
- There is no shed of other livestock (cow, buffalo, chicken etc) nearby to avoid diseases

(2) Size and basic design

a. Floor

Use cement, concrete blocks, slat wood etc for flooring. Using cement or concrete blocks is recommended because they are durable and easy to clean. Floor should be a bit sloped to drain urine and water.

Determine the area of floor in accordance with the number of pigs and their age (body size). If you have 1 boar and 1 sow with piglets (up to 6 weeks of age), 2.5 x 5 m of floor (separated in 2 pens) is large enough. Remember that you have to separate a bore from sow and piglets in the pigsty.



Space requirement per pig after 6 weeks of age is 0.5-1.0 m^2 per pig, therefore:

If you raise 3 pigs with 60kg of body weight ➔	You need 1.5 - 3.0m^2 of floor space
If you raise 6 pigs with 60kg of body weight ➔	You need 3.0 - 6.0m^2 of floor space

b. Wall and Roof

Use bricks, wood, bamboo, etc for making the wall and partition.

Round poles | Wooden slats | Brick wall

- Make wall strong, and poles must be anchored in the ground. Otherwise especially mature boar or sow would easily escape from the pigsty.
- Height of partition wall is about 1m; don't make it too high or low
- Make roof with straw/grass/leaves or corrugated iron sheets or bamboo etc.

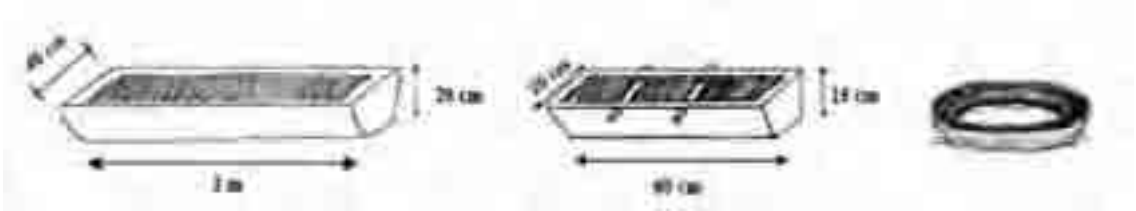
Pigsty with corrugated iron sheet roof, cement floor and wall

(3) Other requirements on pigsty

Cover the pigsty to keep inside warm; with bamboo, grass mat, plastic sheet during the cold season, especially nighttime and when there is strong cold wind.

(4) Equipments

Make feeder and drinker and place both in each pen. It is better to anchored it to the floor to prevent overturning and wasting feed. Use wood, cement, used tire etc to make them.



Feeder for matured pig
width = 35-40cm
length = 40-50cm per pig

Feeder for young pig
width = 20cm
length = 20-35cm per pig

Feeder/drinker made
with a used tyre

4. Daily management

(1) Cleaning

- Clean the pigsty everyday to keep it clean and dry. If it remains dirty and wet, your pigs will be sick very easily.
- Using straw as litter is recommended. It absorbs urine and keeps the floor warm. Spread straw on the floor of the pen with at least 5cm height. When you have piglets, putting litter is a MUST to keep them warm.
- But you have to change the litter as soon as it gets wet and dirty. If you have concrete floor and don't have time to change it, putting litter is no use. No litter is far better than dirty litter remaining on the floor.
- Wash feeder and drinker once in a while and dry them under the sun

(2) Feeding

- Give your pigs enough feed at least twice a day (morning and evening). Your pigs are confined all the day, and if you don't give enough feed, they will be weak or even die. Remember that your pig cannot wander about to look for foods.

- Don’t give molded feed.
- If you have plenty of green leaves, give them as much as pig can eat.
- Always give your pigs plenty of clean and fresh water.
- It may hard to tell whether the pigs get enough feed or not. You can decide the volume of feed by referring the figures shown in the next table.

Age	Body weight (kg)	Feed volume per day (kg, dry matter)
At birth	1	---
2 months old	15	0.8
3 months old	22	1.1
4 months old	32	1.6
5 months old	45	1.8
6 months old	60	2.4
7 months old	75	3.0

- If you want to use your piglets for breeding in the future, give them a handful of commercial concentrates everyday.

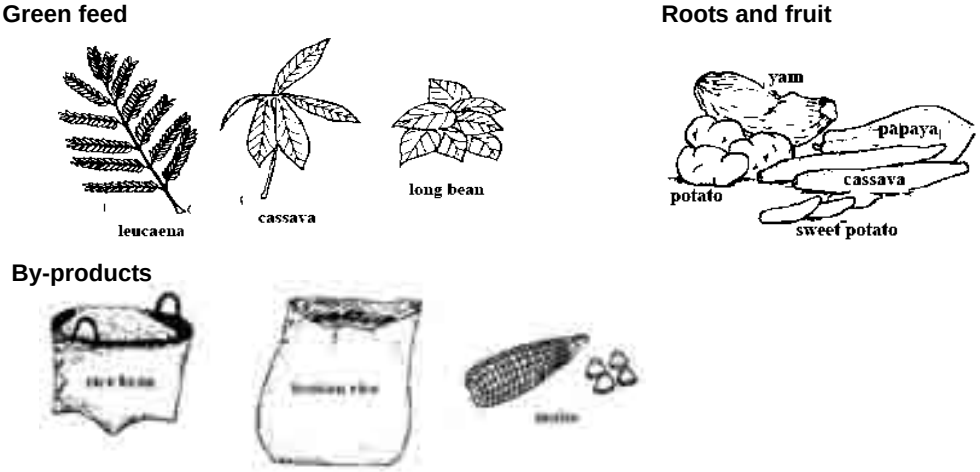
5. Feed resources and processing

(1) Feed resources

You can feed the following materials:

- Leaves (Leucaena, cassava, sweet potato, taro etc)
- Vegetables (Cassava, sweet potato, yam etc)
- Kitchen waste
- Agricultural by-products and others (rice bran, broken rice, maize cob, alcohol residues*, earth worms, etc)

* Note : Don’t feed piglets, pregnant sow and lactating sow with alcohol residues.



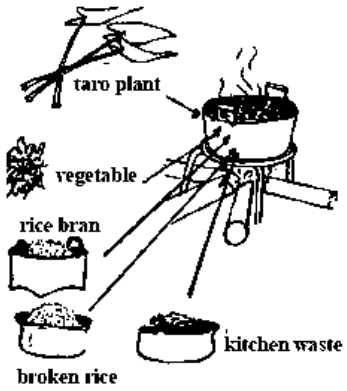
(2) Feed processing

Wash and cut leaves and vegetables before feeding.

Mix and cook all the materials to make the feed more balanced and digestible, and get rid of toxins.

Add a bit of salt, grinded bone or shell when you cook.

You may grind or smash the whole grains such as maize to make much easier for pigs to digest. If possible, buy commercial feed and/or Vitamin & Mineral Premix to mix them with other local materials.



An example of feed ration with local materials

Age	Live weight (kg)	Feed volume for 30 days (kg)	Ration (kg in dry matter)					
			Soy bean	Rice bran	Broken rice	Maize	Cassava roots	Green leave
2 months	15	23	5.6	5.6	1.1	4.5	4.5	1.1
3 months	22	33	8.3	8.3	1.7	6.6	6.6	1.7
4 months	32	48	12.0	12.0	2.4	9.6	9.6	2.4
5 months	45	54	10.8	16.2	2.7	13.5	8.1	2.7
6 months	60	72	14.4	21.6	3.6	18.0	10.8	3.6
7 months	75	90	13.5	31.5	4.5	27.0	9.0	4.5

6. Breeding

(1) Selection of young boar and sow for breeding use

a. Boar

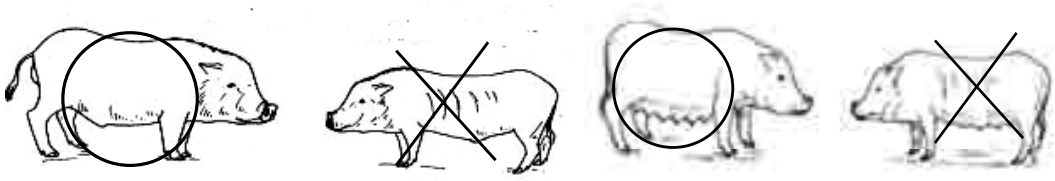
When the piglets reach 7-8 months, choose one for breeding with the following criteria:

- ✓ Look healthy and has strong body and legs, sparse hair, bright eyes.
- ✓ Reproductive organ is well developed.
- ✓ Select one from the sow-pig that has consistently farrowed and weaned many piglets.
- ✓ Select one from the sow-pig that has a good size and not less than 12 nipples.

b. Sow

Selection criteria:

- ✓ Healthy and she has good body size, strong legs, bright eyes and sparse hair.
- ✓ She has 12 nipples and good reproductive organ as her mother has.
- ✓ She should be docile and calm.
- ✓ Select one from the sow-pig that consistently farrowed and weaned many piglets. (desirably at least 9 piglets/wean).



Never select the thin or unhealthy one for breeding use

(2) Mating

a. Detecting the heat

Check your sow carefully every early morning or late evening when you give feed, not to miss the signs of heat. Heat lasts only 1 day.

Usually a sow comes in heat every 21 days. Followings are the signs of heating:

- swollen vulva
- restless and roaming
- frequent urination
- not eating very much
- mounting
- discharge from vagina

If you see the signs, push on the back of sow to find the right time for mating. When you push her back and the sow doesn't run away, it means she is ready for mating. Put the sow and the boar together in a pen for mating.

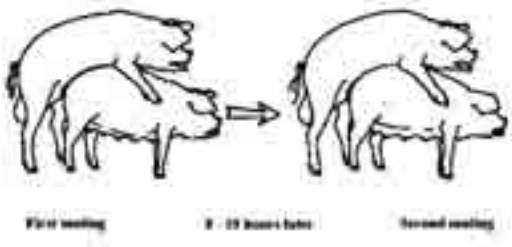
b. Mating management

Don't let the boar and sow mate with same family to avoid inbreeding.

Don't use boar/sow that is too big or small for each other.

Let the boar and sow mate twice at 8-10 hours interval; this will increase the chance of getting the sow pregnant and having many piglets.

Boar and sow should be similar size



Let them mate two times

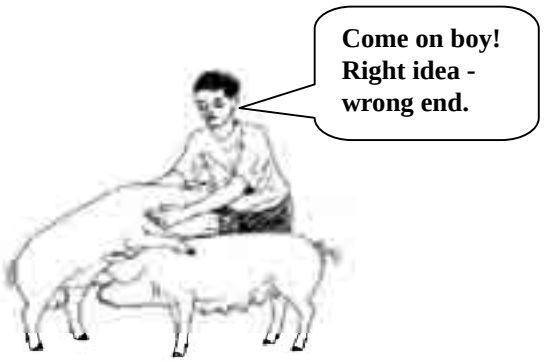
Check 18-24 days after mating and check again after 6 weeks to make sure whether the sow is pregnant or not. Sows that fail to get pregnant will return into heat 3 weeks later.

c. Training of young boar

Sometimes young boar needs training for mating since if a boar fail to mate successfully at first time, he would be reluctant to mate. The training should start when boar reaches sexual maturity (around 7-8 months old).

The followings are some points to remember for the training:

- ✓ Do the training at the pen of the boar.
- ✓ Use a mature sow that is strongly in heat with right body size.
- ✓ Give them enough time to get used to each other and don't rush them to mate.
- ✓ Don't allow the boar to mount the sow in front.
- ✓ You can help the boar to insert the penis into the vagina at the beginning.
- ✓ Don't disturb while they are mating.



d. Management of boar

Don't over-use boar for mating. If he is over-used, the sow farrow less number of piglets than usual farrowing or even won't be pregnant. Boar can mate:

- 1-2 times per week, if the bore is 8-12 months old.
- 3 times per week, if the bore is over 12 months old.

Try to increase the amount of feed for breeding. If boar is not fed enough, you will not get many or even none of piglets.

(3) Farrowing

The pregnant sow will farrow 114 days (**3 months, 3 weeks, 3 days**) after mating.

a. Prepare for farrowing

- Clean the pen and put some straws on the floor (about 10 cm in height) at least 5 days before farrowing. The straw always must be dry; change it if it gets wet or dirty.
- The pen where the sow to farrow must be quite and warm.
- Give pregnant sow with more fresh feed, especially from 85 days after mating (if the pregnancy is confirmed) to delivering day. In this period, the fetus grow rapidly and the sow needs more feed.
- Try to give many varieties of feedstuff to make balanced feed.
- Give pregnant sow plenty of fresh water.
- Prepare clean cloth to wipe newborn piglets and a clipper to cut their teeth.

b. Manage farrowing

- When the farrowing is near, the sow will be distress. Press the nipples of the sow very softly, and if the milk comes out, it means she will farrow shortly.
- Clean the nipple and udder of the sow with wet cloth.

- Normally, each piglet comes out from uterus approximately every 10-15 minutes. If the next piglet doesn't come out within 1 hour after the previous one was born, you may need to help the sow.
- In this case, piglet may be stuck in the vagina, and you have to check as follows:
  - ✔ Wash your hands thoroughly with soap before checking.
  - ✔ Put your hand into the vagina of the sow slowly.
  - ✔ If you feel something (it may be a piglet), pull it out slowly and gently.

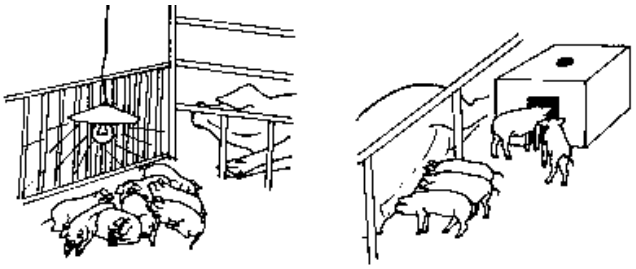
- Clean the nose, mouth (inside and outside), body and feet of newborn piglets with clean cloth.
- If piglet is not breathing or suffocated, put your mouth to the piglet's mouth and blow the air into it.
- Clean the placenta in the pen as soon as farrowing is finished.

7. Special care for piglets and sow

(1) Special care for piglets

- Make sure that all the newborn piglets are suckling and drinking first milk immediately after farrowing. If some cannot suckle, hold them gently and put them to the nipples available for them.
- Keep newborn piglets very warm; they cannot survive in cold weather. Use electric bulb (if affordable) or make a box (60 x 60cm, straw inside) to keep them warm until they get 3-4 weeks old.
- Always keep the pen clean and dry. Especially newborn piglets easily get sick and die if the pen is dirty and wet.

Make sure all newborn piglets drink first milk



Keep newborn piglets very warm

<u>a. Teeth clipping</u>

Clip the teeth of all the newborn piglets immediately after farrowing. If you don't clip the teeth, the piglets will hurt the mother's udder. As a result, the mother will not let the piglets suckle and the piglets will not grow properly.

Tools & medicines you need:

Nail clipper, Disinfectant solution (Nuoc Oxy-Gia)

How to clip the teeth:

1. The sow and the piglets should be separated for short time.
2. Scrub and wash your hands with soap.
3. Wipe the blade of the clipper with disinfectant solution, and check whether the clipper is clean.
4. Hold the head and press the corner of the piglet's mouth so that the jaws open.
5. Place the clipper on either side of one pair of teeth. Make sure that the tongue is not in the way. Tilt the head so that the pieces of the teeth will fall out of the mouth.
6. Cut the teeth as close as possible to the gums.
7. Clean the clipper before using them on another piglet. Cut all the litter's teeth and when you have finished, put the piglets back with their mother immediately.
8. Keep young piglets warm.
9. Wash the clipper.

b. Iron injection

Piglets need "Iron injection". Without iron injection, they would suffer from diarrhea, pneumonia etc. Do iron injection when the piglets get 1 week old.

Tools & medicines you need:

Syringe and needle, Disinfectant solution (Nuoc Oxy-Gia), Clean cloth, "Prolongal", Soap

How to do "Iron injection":

1. Scrub and wash hands with soap.
2. Dip the needle in the disinfectant solution. Make sure both the syringe and needle are clean.
3. Wipe the skin over the back part with clean cloth and disinfectant solution. If the skin is very dirty, wash the skin with water and dry it before wiping with clean cloth.
4. Hold the pig tight and inject (intramuscular injection) 2cc of "Prolongal" per piglet.
5. Prepare a clean pan and boil about 500cc of water.
6. Sterilize the syringe and needle by keeping them in boiling water for more than 2 minutes.

7. Use a forceps to pick the syringes up from the boiling water. Shake the syringes to drain off the water and cool down, and put them in a new plastic bag. Seal it with a rubber band.

c. Castration

Castration is a surgical removal of boar testicles. The purposes of castration are:

- To improve the quality of meat from male pigs. The meat from male pigs that are not castrated have

odor, thus people would not buy it.

- To lower the urge to fight in a group of male pigs. If they are not castrated, they can be aggressive and hard to handle.

Do “Castration” when the piglets get 2-3 weeks old, since young pigs are easy to handle and wounds heal quickly. Don’t castrate male pig to be used for breeding.

Tools & medicines you need:

Razor blade (it should be a very sharp and clean), Disinfectant solution (Nuoc Oxy-Gia), Antiseptic medicine (Penicillin powder capsule), Cotton wool, Soap

How to do castration:

Before castration, you need to:

- Clean the operation area.
- Remove mother sow from the litter and put her where she cannot see or hear them.
- Prepare the tools and medicines.
- Scrub and wash your hands with soap. If you are the one to cut, don’t be involved in catching pigs. You have to keep your hands clean at all times.
- Ask someone to assist you. Castration should be done by 2 persons.

1. Hold the pig tight not to hurt either the pig or yourself.



2. Wipe the skin over the testicle with cotton wool and disinfectant solution. If the skin is very dirty, wash the skin with water and dry it before wiping with disinfectant solution.
3. Move the testicle into the scrotum (raise testicle to the surface) with your finger and then firmly grip the scrotum below the testicle between your thumb and index finger.


4. Make a cut 1-2 cm long in the bottom of scrotum. The testicle should pop out through the cut.
5. Pull the testicle out of the scrotum and cut through the white cord <u>leaving the red blood vessel uncut</u>.
6. Pull the testicle out slightly further and twist it around several times before cutting. If the blood vessel to the testicle is cut straight through, or pulled heavy bleeding can occur. Bleeding is reduced by pressing the twisted blood vessel with your fingers before cut through. Do not pull to break the vessel.

7. Apply antiseptic medicine (Penicillin powder, 1/2 capsule) to the castration wound. Do not put your fingers in the scrotum.
8. Remove the second testicle in the same way.

If you operate several pigs at the same time, disinfect the razor blade with disinfectant solution (Nuoc Oxy-Gia). Do not keep on using the same blade for more than 5 pigs.

Put the piglets and their mother on clean bedding. Castrated piglets may rub the wound against the floor. So, clean and dry inside (floor) of the stable. Do disinfect the floor with "Benkocid".

Watch piglets for signs of infection in the wound for the next week. Infected castration wounds swell, piglets do not want to walk or are lame.

d. Weaning

Piglets should be separated from mother sow (= weaning) when they reach at 6-7 weeks old for domestic breed and at 4 weeks old for exotic breed/F1. You have to wean the piglets otherwise mother sow would not return in heat and cannot prepare herself for another mating.

How to wean:

- Start with 30minuites separation per day, and then increase the time gradually. Separate them completely when they are at 6-7 weeks old.
- Don't wean very small piglets (about less than 5kg). Let them stay with the mother longer and then wean them when they get large enough.

(2) Special care for lactating sow

Feed lactating sow, as well as for pregnant sow as much as she wants, and always give enough fresh water. If she is not fed enough, she will be thin and cannot produce enough milk for piglets. As a result, both the mother and the piglets will be weak and some can die.

8. Disease prevention

(1) Prevention

Once your pigs get diseases, it would be very expensive and sometimes take very long to cure. Many of the disease can be prevented if you practice the followings. You can do them without spending much money and time.

Four important practices you have to conduct to prevent diseases:

1. Clean and disinfect the pen regularly
2. Give your pigs enough quality feed and water
3. Remove things that can be sources of diseases (dung, urine, dirty straw in the pen, sick or dead animal, etc.)
4. Vaccinate pigs

Cleaning is the first step for disease prevention. Clean the pigsty everyday !!!

To disinfect the pen, feeder and drinker, you apply the following ways:

- Wash and Dry feeder and drinker once in a while under the sunlight,
- Use boiling water for washing feeder, drinker and floor of the pen,
- Use lime powder to disinfect the pigsty once in a while. Put the powder over the floor (1-2kg of the powder should be enough for one pigsty).

Note: Do not use lime powder while pigs are inside the pen because it may go into nose, mouth and make your pigs harm.

(2) Vaccination

Ask veterinarian in/around your village for vaccination. Necessary vaccinations are as follows:

Under 70 days old

Age (days)	23	25	30	53	55	70
Types of vaccine	1st time Paratyphoid	1st time Congested plasmodium	Cholera	2nd time Paratyphoid	2nd time Congested plasmodium	Foot and mouth disease

Over 70 days old

Types of vaccination: Cholera, Paratyphoid, Congested plasmodium
Time: Every 6 months

- Vaccinate against other diseases (e.g. Leptospirosis) if necessary, with consultation of veterinarian or local authorities

(3) Detection

Observe your pigs carefully every time when you feed them (morning and evening), to check whether

your pigs are healthy or not. If you see that your pig show some of the following signs, that pig may be sick:

- Doesn't want to eat or eat less than usual.
- Looks tired, not very active, lying down all the time at the pen.
- Drink more water than usual.
- Glassy eye, hair stands, ears get red or violet.
- Cough, difficult to breath.
- Infectious diseases can cause skin bleeding or violet in some part of the body such as head, ear, and foot. (* If you see this sign, report immediately to veterinarian or local authorities.)

What to be done when you see pigs infected with disease or suspected to have disease:

- Ask veterinarian, veterinary health worker or local authorities for further advice or treatment.
- Isolate the sick and check it carefully.
- If pig died, take the dead body out of the pigsty and it must be buried or burned.
- Clean and disinfect the pigsty, feeder and drinker.
- Do not sell sick pig. Don't eat or sell the meat of the dead pig.
- Don't use the remaining feed from the sick pig for other pigs to eat.
- Don't let other healthy pigs use the feeder and drinker that the sick pig were using.

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- JICA Project on the Villager Support for Sustainable Forest Management in Central Highland, 2008, Paper for the participants and CFs- Management of Boar and Mating (English translation)
- JICA Project on the Villager Support for Sustainable Forest Management in Central Highland, 2007, Paper for the participants-Teeth clip, Castration, Fe injection (English translation)

Additional information on Pig raising for extension staff

1. Treatment of some common diseases

Note : Most of the treatments shown in this section should be practiced by veterinarian or veterinary health worker.

(1) Diarrhea in piglets

Many piglets from newborn to 21 days old get diarrhea and die.

Cause: Bacteria (E.coli)

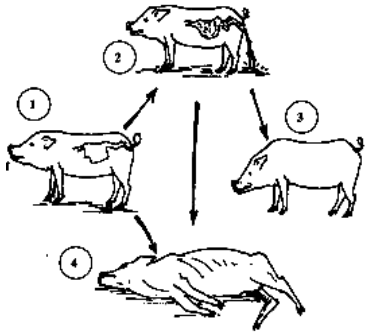
Common symptoms:

In newborn piglets

- Piglets get diarrhea suddenly.
- White and yellow watery dung, and the dung has fishy smell.
- Whole body is cold and very thin, look pale.
- Many newborn piglets die.

In piglets (to 21 days old)

- Not many piglets at this stage get diarrhea and die, compared to newborn piglets.
- Watery, very thick dung with bad, fishy smell.



Prevention of diarrhea:

- Clean pigsty before sow gives a birth.
- Keep piglet warm.
- Not change the feed for sow suddenly.
- Let piglet suck enough first milk immediately after birth.
- Inject piglet with iron substance.

Treatment:

Some farmers use some types of acrid leaves as the following method:

1. Mash the leaves and filter the leaves with water.
2. Put a coffee spoon of sugar and ½ spoon of salt in the solution and let piglet drink.

Use the following medicines according to the manufacturers instruction (if affordable):

- Tetrachloram-C (or Tetrafuzazolidon, Chlotetrasol)
- RTD and Co-lis-tin.

Note: Antibiotics should be used in combination with Vitamin B_1, Vitamin C.

(2) Foot and Mouth Disease (FMD)

Outbreak of FMD occurs in cattle, buffalo, sheep, goat and pigs. There are some reports of FMD occurrence in Kon Tum.

Cause: FMD Virus

Symptoms:

- Lesions on the feet, snout, udder and nipple.
- The infected pigs doesn't walk and lies down most of the time.
- The infected mother may not allow the piglets to suckle because of the pain.

Lesions on the feet

Lesions on the snout

Treatment:

- There is no treatment or medicine for FMD.
- If you suspect that your pigs get FMD, report to local authorities for further advice.
- The infected pig may need to be killed and burned.

Prevention:

- Vaccinate your pigs regularly.

(3) Skin disease (Scabies)

Cause: External parasites dig holes on the skin and it is itchy. The infected pig rubs against the wall, tree etc and it makes inflammation on skin.

Symptoms: Scabs on the skin

Treatment:

- Inject Ivomex (Marial pharmaceutical Co) on the skin layer of their neck (1ml/ 33 kg of their weight).
- Use Sebacill (green) to apply along the backbone.

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C-3 Technical Guideline on Goat raising

1. Introduction

Before you start raising goats, you have to see what resources are available at your hand (e.g. money to buy goats, land to grow forages, time and labors you and your family can spare for raising), and then decide how to raise your goats.

(1) Raising methods

There are 3 systems (methods) to raise goats: 1) Extensive system, 2) Semi-intensive system and 3) Intensive system. Intensive system must be hard for you to practice. So that you shall consider the extensive system or semi-intensive system.

Outline of each raising system

Extensive system	- Shed is not used, goats sleep outside (e.g. under the tree), - Free grazing : goats wonder freely all day and eat grasses at any places available, - Feeds and water are not given by the owner, - Owners may take goats to the place where grasses are available for grazing, - No preventative cares are applied.
Semi-intensive system	- Shed is normally used to confine goats during the night, - Free grazing during the day-time: Owners take goats to the place where grasses and water are available. Goats wonder freely during the day-time, - Forages are grown by the owner to give as supplementary feed when the goats are in the shed, - Feed processing may be practiced. - Some preventative cares are practiced.
Intensive system	- Shed is used to confined goats all day (no grazing), - Feeder and drinker are equipped in the shed, - Forages, purchase concentrates and water are given by the owner, - Feed processing is commonly practiced to store feeds for dry season, - Good preventative cares, especially for newborns, are provided.

Extensive system

Semi-intensive system

Intensive system

Advantages & Disadvantages of Extensive system & Semi-intensive system

System	Advantage	Disadvantage
Extensive system	- No need to build a shed, - No need to clean shed, - No need to have a land to grow forages, - No need to feed goats (cut grass and carry it) - No time/labor and money is used to care goats	- Goats damage your/neighbors' crops if no fencing, - Goats get sick or die often, - Goats grow slowly, - Breeding cannot be controlled; you never know when you have babies, - Less number of newborns, - Less milk, meat produced.
Semi-intensive system	- No need to fence your garden, - Goats do not get sick or die very often, - Goat grows fast and gain more weight, - Breeding can be controlled, so that more number of newborns, - More milk, meat produced	- Need a land for shed and forages production, - Need money and time/labor to built a shed, - Need time/labour to take goats to the place for grazing/tethering everyday, - Need time/labor to feed forage and to clean shed everyday, - Need money to buy medicines, etc. - Need time/labour to care, especially for newborns.

In the extensive system, you don't use time and labor to take care of your goats, but there are high possibility of sick and death by diseases/parasites. And productivity is lower than the semi-intensive system; less newborns and goats grow slowly. Therefore, we recommend you to try the semi-intensive system if you can spare enough labor and time.

This manual shows many tips about the semi-intensive system. Make use of this manual and make your farming more successful!

(2) What you need to do to adopt the semi-intensive system

- ✓ Choose a right breed, if available
- ✓ Build a shed and make feeder and drinker
- ✓ Grow forages (Elephant grass, etc.)
- ✓ Manage the grazing properly

- ✓ Feed properly
- ✓ Give good cares

2. Breed and Crossbreed technique

(1) Dê Cỏ (grass goat)

This breed is commonly raised in the mountainous areas and highlands.

Hair color: Yellowish brown, grayish brown or black spotted with white.

Weight: Buck: 30 - 45kg, Doe: 25 - 30kg
New born kid: 1.7 - 1.9kg
6 months old: 11 - 12kg

Milk production: 250 - 370g/days

Milk producing period: 90 - 105 days

First mating age: 6 - 7 months

Gestation period: 150 days (145-157 days)

Number of kids: 1.4 litters a year and 1.3 kids per litter

Goat raising purpose: for meat

Dê cỏ (male)

Dê cỏ (female)

(2) Bach Thao

Bach Thao is currently the best breed of our country. A larger number of this breed raised in the central coast (Ninh Thuan, Binh Thuan).

Hair color: black, black and white stripes, off-white, brown etc

Ears: large drooping ears

Weight: Buck: 50 - 60kg, Doe: 40 - 50kg
New born kid: 2.6 - 2.8kg
6 months old: 19 - 22kg

Milk production: 1.1 - 1.4kg/day

Milk production period: 148 - 150 days

First mating age: 7 - 8 months

Number of kids: 1.7 - 1.8 litter per year

(3) Crossbreed technique

The kids from Bach Thao buck and local doe grow faster. They also have good characteristics of Bach Thao (e.g. they produce more milk (as 25-30 higher than native ones) and more kids). For these

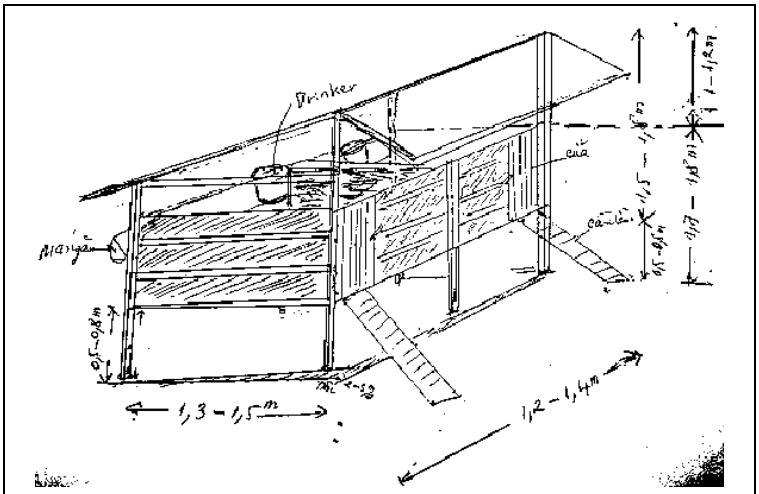
reasons, it would be a good idea to have mate your local goats with the improved ones.

3. Goat shed/stable

Choose the location carefully before building a shed. The location needs to :

- ✓ have good ventilation and drainage.
- ✓ have some shading.
- ✓ close to the place where water is always available.
- ✓ not far from your house.

Use locally available materials (bamboo, wood, grass, leaves, bricks etc) to build a shed. Try to use strong and durable materials.



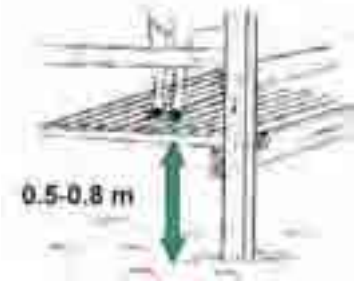
H = 1.5-1.8m, L = 1.2-1.4m, W = 1.3-1.5m

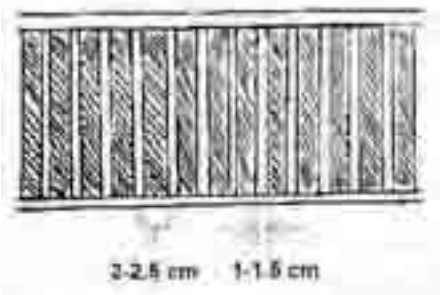
This size is large enough for 2 adult goats.

Goat shed built with locally available materials

Floor:

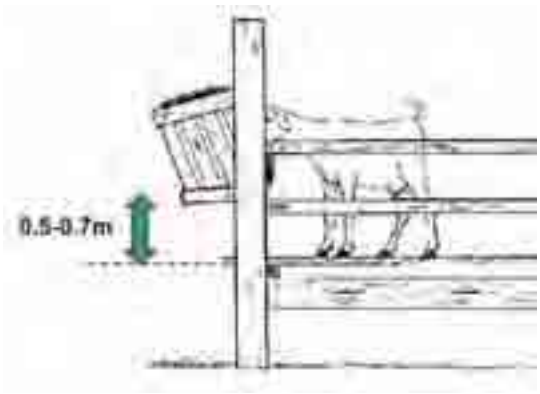
- Place the floor at 0.5 - 0.8m above the ground.
- Make the floor with straight and flat wood of 2 - 2.5cm in width. Keep the space between the wood (1 - 1.5cm) to let feces and urine fall through.





Feeder:

- Place the feeder at 0.5 - 0.7m above the floor, because Goats like to eat from the height.
- Set the feeder and drinker outside the wall.
- Make opening large enough for the goats to get the feed and drink water.



4. Feeding

(1) Feed sources

- Goats eat many kinds of plants (grasses, leaves, grains, residues of farm products etc).
- Give them as many varieties as possible.
- Goats get bored of eating when they eat the same feed everyday.

Grow some forages plants (elephant grass, etc) to feed your goats throughout the year, especially for dry season when there is not much grasses around. Otherwise, the goats do not grow; do not produce milk; become weak and sick and may die.
Utilize the available banana, sugar cane, corn cob, jackfruit trees leaves, fig leaves, cassava leaves, etc.




(2) Feed amount per day

Goat needs to eat certain amount of feed a day to keep them healthy and produce milk and meat. Following table shows the recommended amount of green roughage and concentrates to feed.

The amount of feed required per day

Goat weight (kg)	Green roughage (g)	Concentrates (g)
10	975	117
20	1950	237
30	2950	350
35	4550	540

(3) Water

Always give your goats with fresh, clean and enough water. Never dry the drinker up.

(4) Feed processing and preservation

Processing raw plants and materials is good because:

- ✓ Raw plants and materials can be preserved longer if they are processed; it means you can feed it in dry season when the forages are scarce.
- ✓ Improve the nutritional values of the feed.

There are several methods of feed processing. Sun drying (making hay) is recommended since it is simple and easy. Use rice straw, grass, cassava leaves, bean leaves, etc. Stack or put it in plastic bags to store after drying.

(5) How to make your goats eat more

Cut the grass into small pieces (5 cm)

Slice roots and fruits (1-2 cm)

5. Reproduction

(1) Managing the mating

Heat comes every 19 -21 days and it lasts about 1-3 days.

Check your goat everyday. If she has the following signs, she may be in heat.

Signs of heat are:

- pink swollen vulva, mucus discharge
- bleating, lack of appetite (giving up eating)
- mounting other goat or let herself be mounted.

- Don’t let the doe mated, if she is younger than 7 - 9 months old and weighs less than 19 - 20 kg.
- Don’t let the bucks mate before they are 11 or 12 months old.
- Don’t use big buck for small doe.

- Skip the first 2 heats and let her mated at the 3rd heat.
- Let her mated twice a day (morning and afternoon).
- Breeding does will be ready for another mating 1.5 - 2 months after delivery.
- Don’t use the doe for mating until she is totally recovered and becomes strong after delivery.
- Never use buck and doe from same family.
- Make a record of mating to plan the delivery.

(2) Kidding

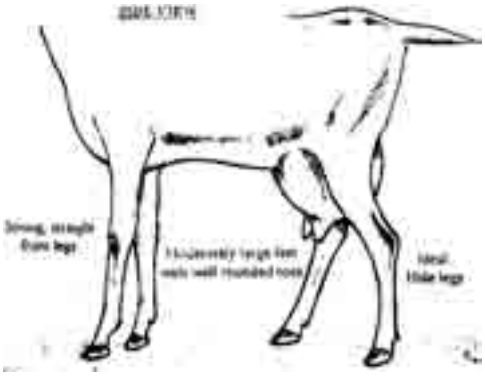
- If doe doesn’t show any signs of heat after mating (after 21 - 23 days), she may be pregnant.
- Gestation period of goat is about 150 days (145 - 157 days).
- Give pregnant doe more feed, especially for the first 2 months of pregnancy.
- Give the doe clean, fresh water everyday. Put some salt (5g per litter) in water.

(3) Care of doe to give birth (“kidding”):

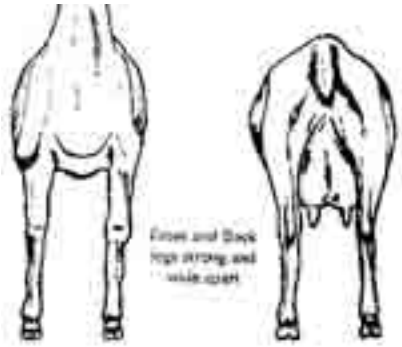
- Confine the pregnant doe in a separated pen. Pen has to be very clean, well ventilated, warm and quiet.
- 5-10 days before kidding, you need:
  - Put dry clean straw in the pen
  - Prepare some clean clothes to wipe newborn kid
- When you see the doe shows the following signs, she will start kidding soon:
  - The mother gets unease, urinating all the time.
  - Swelling udder, large red swollen vulva, discharge of thick mucus, fluid from the vulva.
- Usually kidding takes 1-4 hrs. Normally a doe gives birth to 1or 2 kids at 1kidding.
- Help the doe if a kid is coming out but gets stuck.
  - Wash your hands very well with soap before helping the doe.
  - Pull the kid out carefully by the rhythm of exertion.
- Take the placenta away from the shed when the doe finishes the kidding (cf. Placenta normally comes out within 30 minutes-4 hours after kidding).
- Give the doe water with some salt or sugar after kidding.
- Give the mother goat clean, fresh grasses everyday. Don’t feed too much roots or fruit to prevent bloat.

(4) Selection of doe for breeding use

Choose a doe for breeding use with the following appearances/features:

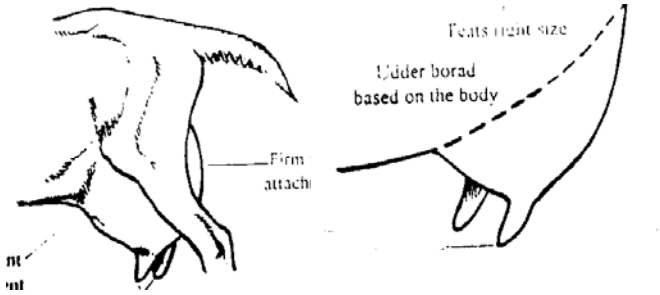


Strong, straight front legs,
Moderately large feet with well rounded toes



Front and back legs are strong and wide apart

Good doe should also have well-developed, good shaped udder and teats.



- Vaccinate and deworm the buck/doe for breeding.
- Separate the breeding bucks when they are 3 months old and keep away from the herd.

6. Management and care

(1) Principle rule

Don’t leave your goats tethered! They will definitively get tangled with rope.

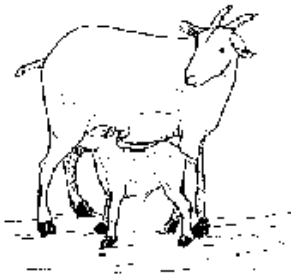
If you leave your goat tethered and walk away, they can’t wonder about to eat or drink water, and can’t move to under the shade to escape from direct sunshine or cold wind. As a result, they get weak or even die.

Poor young goat tangled with rope

(2) Care of newborn kids (to 15 days old)

- Keep putting straw in the pen until the kids reach 15-21 days old.
- Make sure that the kid suckles the nipple of the mother to drink first milk when the kid is born. First milk has plenty of nutrition, so it makes kid strong and healthy.
- If the mother doesn't want kid to suckle, hold the mother firmly and let the kid to suckle. You may need to keep doing until the mother let the kid suckle without reluctance.

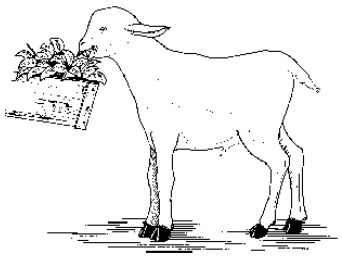
(3) Care of kids from 15-45 days old



- Let the kid be with mother and suckle all day. Train the kid to nibble green grasses, leaves etc.
- Let the kid outside of the shed or in grazing pasture near the shed. Never let the kid go far with the mother.

(4) Care of kids from 45-90 days old

- Let the kid out of the shed with mother and learn to eat the feeds (grass, leaves, etc.) that the mother eats.
- Increase the amount of feed little by little (100-500g/head) for the kid until they do not need milk from the mother.
- Give enough clean water for the goats.
- Keep the shed always clean and dry. During this time, young kid can easily get sick.
- The infected kids should be taken away and given separate care.
- Make them exercise, from 3-4 hrs a day.



7. Sanitation and disease prevention

(1) Disease prevention

Treating sick goats cost you some money and may need a long time. Preventing diseases is much cheaper than treating the sick. Do the followings to prevent your goats from getting sick:

- Clean the shed every day; keep it clean and dry.
- Disinfect the shed once in a while with lime powder; spread 1-1.5kg per shed.
- Wash the feeder and drinker every day and dry by sunshine.
- Check your goats every morning.
- If you find a sick goat, separate it from other goats and give it special care.
- Don't let the healthy goats reach to the sick as well as faces/urine of the sick.
- Feed with fresh and clean feeds and water always.
- Don't feed grasses where the ground is wet.
- Vaccinate your goat periodically.

Clean the shed every day!!

- Deworm your goat every 6 months.

If possible, apply one of the following medicines to get rid of internal parasites (Round worms, Pin worms, Fluke worms etc).

- Tetramisole 15mg/kg (body weight)
- Levamisole 7.5mg/kg
- Membendasole 15−20mg/kg
- Albendasole 10mg/kg

To get rid of external parasites (Tick, Mite, Lice), spray or dip your goats with medicine.


Louse


Tick

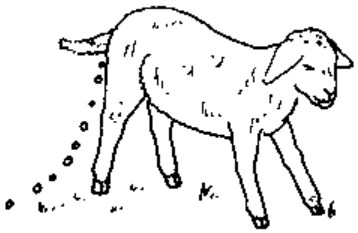
If goats get sick, ask the village vets and report the local authorities for further advice.
A goat dying of infectious disease should be buried. Disinfect the place where you bury the body with lime, Chloramine T etc.

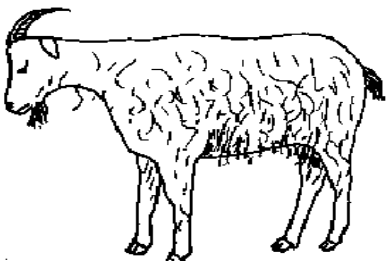
(2) Identifying sick goats

The next table shows the difference between the healthy goats and the sick ones:

Healthy goat	Sick goat
Lively, alert, eating well	Weak, head drooping
Cud chewing, normal ruminal movement (1-2 times per minute)	No cud chewing, ruminal movement becomes weak or stops completely
Smooth and shining body	Ruffle hair
Body temperature normal	Temperature up to 40-41°C or down to 38°C
Normal breathing, 12-15 times per minutes.	Difficult breathing, coughing
Hard pellet feces	Diarrhea, pasty feces, white feces, feces stained with blood


Unhealthy Newborn Kid


Unhealthy kid


Unhealthy buck

(3) Common disease

a. Bloat (Flatulence)

Bloat occurs when gas is produced in the rumen, and the gas pressures the diaphragm. This can often lead to death, thus, you should treat it as quickly as possible.

Causes: Bloat occurs when your goat eats:

- Spoiled/molded feeds
- Fresh chopped greens that contain much water
- Fermenting feeds (e.g. sweet potato plants, young corn cane, legumes)
- Much hay and then out to pasture with wet grass
- Much concentrate

Symptoms: If you see your goats showing the following signs, your goat may be having a bloat:

- Not eating very much
- Discomfort
- Swollen abdomen (high left side)

Mild bloat often occurs when goat gets a cold due to getting wet by rain, food or object is stuck in the throat, etc.

Treatment:

- If you see something in your goat's throat, remove it immediately.
- Give the goat 50-100ml of garlicky alcoholic drink.
- Give 150-250ml of cooking oil with 1 litter of warm water.
- Let the goat walk and massage the stomach to help release the gas.

b. Diarrhea

Causes:

- Diarrhea may be caused by Bacteria or sometimes combined with some viruses.
- When your goats live in bad condition (e.g. crowded, dirty, too cold/hot, damp etc), they can easily get diarrhea.
- If you give poor feeds or change the feed suddenly, it may cause diarrhea.

Symptoms:

Mild: Normal body condition but excretes watery dung

Severe: Dry mouth, not eating, too weak to stand up, pasty, watery dung with color (brown, blue, yellow), blood, and bad smell

Treatment:

- Put the goat in a warm, dry place
- Apply herbs (e.g. Leaves of guava*, tomentose rose myrtle, and apricot-tree)

  * <u>How to use guava leaves to stop diarrhea</u>

    1. Take some fresh leaves and crush them.
    2. Add a little bit of sugar and water to the crushed leaves.
    3. Let the goat open the mouth and apply the mixture.

****

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C-4 Technical Guideline on Rabbits raising

1. Introduction

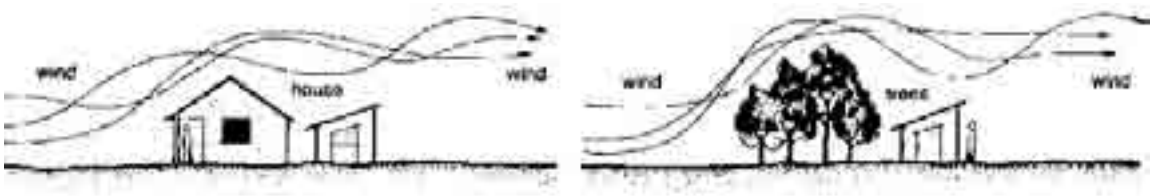
Rabbits raising requires the suitable environments and good daily cares, especially care to maintain good hygienic condition. But rabbits have a very high reproductivity: short pregnant period (30 days only) and newborn rabbits reach the mating age in 4–5 months after birth.
This manual shows practical tips on how to raise rabbits. Make the most use of this manual and make your farming more successful!

2. Making rabbits pen

To start rabbits raising, you need a rabbit pen, which is composed of 1) cages, 2) rack for the cages and 3) small shelter.

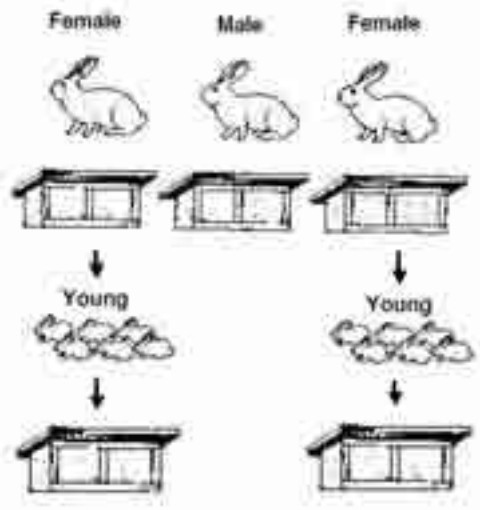
(1) Place for building a rabbit pen

You built your rabbit pen near your house. So that you can watch and take care of your rabbits easily.
Rabbits are very quiet animals and are easily frightened. If they become badly frightened, they may become sick or die. So, choose a place that is quiet and peaceful.
Wind is bad for rabbits. So, choose a place that is protected from the wind. If necessary, windshield must be installed on the wall of shelter.



(2) Number of cages you need

To start with 2 females and 1 male rabbit, you need 3 cages: one cage for one full-grown rabbit. You will need one cage for young rabbits of each female.



(3) Making cages

Wire-mesh (welded wire mesh) is the best material for making rabbit cages; since wire-mesh is widely available, easy to cut & bend, and most important reason is easy to keep clean. Size of the rabbit cage is 80cm (W) x 60 cm (D) x 55cm (H).

The frame to support the wire-mesh can be made with bamboo, tree branches or lumbers. You may use plastic string or steel wire instead of nails.

Lumber made frame, fixed with nails

Bamboo made frame, fixed with plastic strings

Feeder is on the top

Feeder is on the front-side

Important:

Bamboo or timber should be placed outside of the wire-mesh otherwise rabbits bite them.

Materials and tools to make a cage:

- Welded wire-mesh, mesh size 25 mm : 2 m x 1m (for front, back and top parts)
- Welded wire mesh, mesh size 12 mm : 2 m x 1m (for bottom and both sides)
- Steel wire to fix the wire-mesh on the frame : 0.5 kg
- Plastic strings/nails
- Tools : Pliers, Metal scissors, Saw, Knife

(4) Making rack/stand for cages

The rack keeps your cages above the ground. That way, rabbit droppings will fall to the ground. In addition, it will help to keep your rabbits safe from other animals.

Put guards to keep rats and other small animals from climbing up to your rabbits cages, if necessary.

Make a shallow pit under the cage for easy collection of droppings.


Important:

Do not make your rack very high. Keep the top of cage at around 100-110 cm above the ground. Otherwise, your hands will not reach to the bottom (floor) of cages.

(5) Building a shelter

The size of shelter (between post and post) is about 3m x 3m. Make it with available local materials. If the number of rabbits increases, you will extend the shelter.



(6) Other item

You have to make some feeders for grains and water with ceramic bowls and small amount of cement.

3. How to take care your rabbits

(1) Key points you should remember

Rabbits are easily frightened

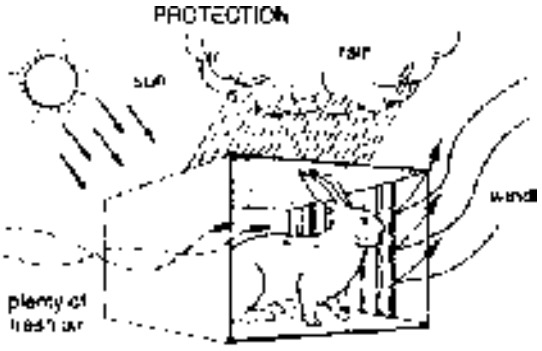
If rabbits badly frightened, they may become sick or die. You must keep rabbits away from noise, people and animals such as cat, dog, snake that may frighten or even harm them.

The same person should take care all of the time. That way, your rabbits will become used to you and will not be frightened.

Sun, wind, rain and fresh air

Rabbits may not grow well if they get too much sunshine. Rabbits may become sick or die if it is too windy. Rabbits should never be wet. And rabbits need fresh air.

So, you must give rabbits a place to live where is protected from the direct sunshine, wind and rain and yet open enough to allow for plenty of fresh air.



Keep clean

Rabbits are usually healthy and hardy animals that grow well if you are careful and give a good care. Remember, it is much easier to keep rabbits from getting sick than it is to make them well after they have become sick.

- **Rabbits should have clean and dry home. You have to clean the pen and cage every day.**
- **Rabbits should have clean fresh food and fresh water all of the time.** If food or water becomes old or dirty throw it away, clean their feeder and water container and give them fresh food and water.

(2) How to handle your rabbits

Rabbits must be handled with great care in order not to hurt them. When you pick up a rabbit hold it firmly but gently. Make no sudden movements or you may frighten the rabbit and it will begin to struggle or scratch you. Remember the following rules and ways of holding.

Never hold the legs or the ears

Full-grown rabbits

Small rabbits

Heavy rabbits

- Baby rabbits: Usually you do not to grasp baby rabbits. Only if you need to move a baby from the nest box to another nest box, you gently rub a baby rabbit with some grass in the new nest.

One very important thing is: “You never touch baby rabbits unless you wash your hands”.

(3) What can you feed your rabbits?

1) What can rabbits eat?

Rabbits eat many kind of plant/grass that is **not sour or spoiled**.

You can feed your rabbits only green plants/grass. However, if you want them to grow very well and fast you will have to feed them some richer foods such as rice bran, beans, maize, sorghum and beans.

Rabbits like fresh plants. However, during the times of year when there are few fresh plants, you can feed your rabbits dry plants.

List of foods which rabbits like to eat

Fresh plants:	- nearly all green plants - many kinds of grass and weeds - outside leaves and the tops of vegetables - tender banana, cane and bamboo leaves - cut-up pieces of the stalks of plants such as maize or banana - roots such as cassava, yams, carrots and turnips
Dry plants:	- nearly all plants dried when they are green, including grass and weeds
Rich foods:	- maize, beans, broken rice, sorghum, beans - plants rich in nitrogen; such as *Leucaena leucocephala*, Stylo, sweet potato leave, water spinach, etc.

2) Amount of food to give

Rabbits need different amounts of food at different ages or times in their lives.

Female rabbits that are going to have babies need more food, and after their babies are born they need much more food. Once you know that a female is going to have babies, give her as much food as she can eat. She will have to eat for herself and for the babies inside her. After the babies are born, she has to produce a lot of milk.

Give pregnant female as much food as she can eat

She has to produce a lot of milk

So, watch your rabbits carefully to see how much they need to eat and how they grow. You have to learn by your own experience just how much to give them.

- If you see that your rabbits do not eat all of their food, give them a little less.
- If you see that your rabbits eat all of their food, give them a little more unless they are too fat.

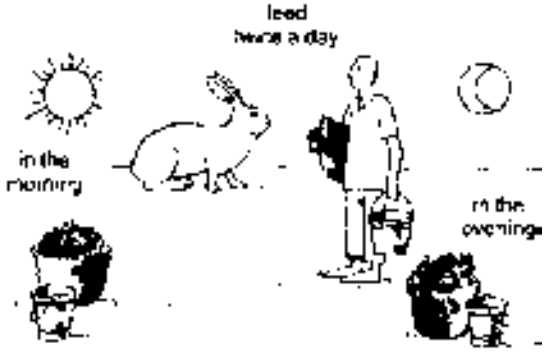
Female rabbit when she is not having babies, and male rabbit when he is not mating, need much less food. You should remember that "female fat rabbits do not have babies easily" and "Male fat rabbits that are lazy and do not want to mate".

When you give a new kind of food:

If you have a food that you think might be good but new to your rabbits, a little of it at first. If they like it, you can begin to give it to them.

3) When do you give food?

Rabbits eat at night as well as during the day. So, you must be sure that they have enough to eat all of the time. **You have to feed your rabbits twice a day**; once early in the morning and once in the evening, before it is dark. **Water as often as they need it**.



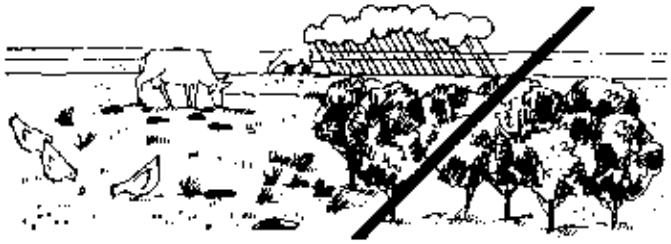
Feed once in the morning and once in the evening

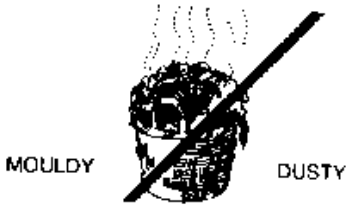
You have to be especially careful that your rabbits have enough to eat and drink at night, since they eat and drink as much at night as they do during the day.

4) Some other points that you should know about feeding your rabbits

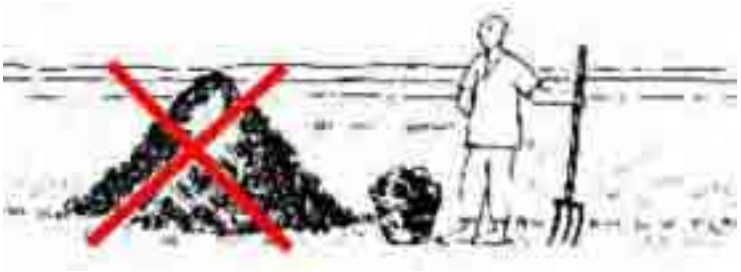
DON'T DO IT !!

- ✓ Never gather green plants from places made dirty by other animals.
- ✓ Never give your rabbits food that is mouldy or dusty food.





- ✓ Never give your rabbits the green plant/grass that has been standing in piles. Fresh green plant left standing becomes spoiled very quickly.



- ✓ Do not keep fresh plant/grass in pile or in bag. If you want to keep fresh green plant/grass, even for a few hours, spread it out and turn it over sometimes so that it will not become warm, sour or spoiled.

DO IT !!

- ✓ When the green plant is dry, you can tie it in bundles and hang it in a place where it will stay dry and clean.
- ✓ Keep feeders and water container clean. Each time you feed your rabbits, remove dirty food in the feeder; clean the feeder; then put new food in the feeder.
- ✓ Give a piece of wood or ceramic roof tile to chew, to avoid your rabbit damage the cage by chewing wood parts.

(4) Sanitary and health care

1) Cleaning the pen and cages

It is very important to keep your rabbit pen and cages clean. Your rabbits may get sick if their pen and cages become dirty.

- ✓ You have to check each time of feeding that no rabbit droppings (dung) remain on the floor of cages. If there are remaining droppings in the cage, you brush them out.

- ✓ Droppings will be fall into a shallow pit under the cages. Sweep away all droppings and take it outside of the pens.
- ✓ Sprinkle lime powder or wood ash under the cages once in a two weeks.
- ✓ When your baby rabbits are big enough and no longer need their nest box, clean the box with soap and water and keep them away for the next time.
- ✓ Clean the cages with soap and water at least twice each year or more often if they become dirty.
- ✓ When all of your young rabbits have been eaten or sold, clean their cages with soap and water before you put in another young rabbits.

2) Health care of your rabbits

Watch your rabbits carefully to see that they are not sick. Rabbit may be sick or getting sick if it:

- does not eat its food,
- loses weight,
- dirties the fur around its tail,
- sits in strange positions or cannot move about easily,
- has rough and dry fur.

If one of your rabbits becomes sick, take it out of its cage, wash the cage with soap and water and, when the cage is dry, put the rabbit back.

If a rabbit becomes very sick, take it out of its cage to keep the sickness from spreading to your other rabbits. This is especially important when there are many rabbits in the same cage.

If a sick rabbit dies, burn it at once to keep the sickness from spreading.

3) Some other points that you should watch for

Sore ears

Sometimes rabbits have sore ears. This may be caused by very small mites under the skin inside the ear. If this happens to any of your rabbits, wash out their ears using a clean cloth and vegetable oil.

Sore or runny eyes

Sometimes rabbits have sore or runny eyes. This may be caused by flies, or they may have scratched their eyes. If this happens to any of your rabbits, wash out their eyes using a clean cloth and clean water.

Sneeze or runny nose

If any of your rabbits sneeze or rub their nose or have a runny nose, they may have a cold. Make sure that they are dry and protected from wind and rain. Make sure that their food is clean and free from dust.

Bleeding feet

If any of your rabbits have sore or bleeding feet, it may be caused by a rough place or a wet, dirty floor in their cage. First, smooth out rough places and clean and dry the cage. Wash their feet in warm, soapy water and rinse and dry them well. Then, rub the bottoms of their feet with vegetable oil.

Long toe claws

Rabbits that live in cage often grow very long toe claws. If their claws become too long, the rabbits may hurt their feet. If you find very long claws, trim the claws carefully. However, avoid the red centre of the claw.

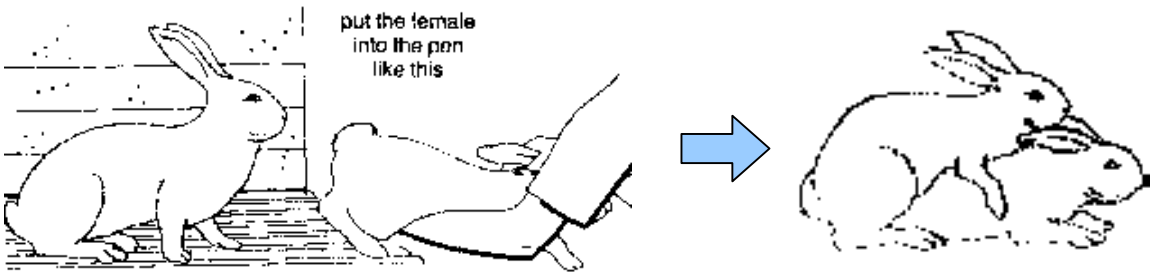
4. Mating, baby care & weaning

(1) Mating

Remember that **female rabbits are ready to be mated when they are 4 to 4.5 months old, and male rabbits when they are 5 to 5.5 months old**.

The best time for mating is early in the morning or in the evening, when it is cool.

When you mate your rabbits, **always put female into male's cage.**



Put female into male cage

Watch to see what happens. Usually they will mate quickly. If male mounts female and in a short time falls off to one side, mating has taken place. As soon as this has happened, put female back in her cage.

If rabbits do not mate after about five minutes, put female back in her cage and try again the next day.

Sometimes female rabbit hide in the corner of cage and male cannot mount her. If this happens, you can help them to mate.

1. Hold the female by her neck with one hand.
2. Then, put the other hand under the female with one finger on each side of her tail, and push gently backwards.
3. This will make the female lift her tail so that the male can mount her.

How to hold a female rabbit to help mating

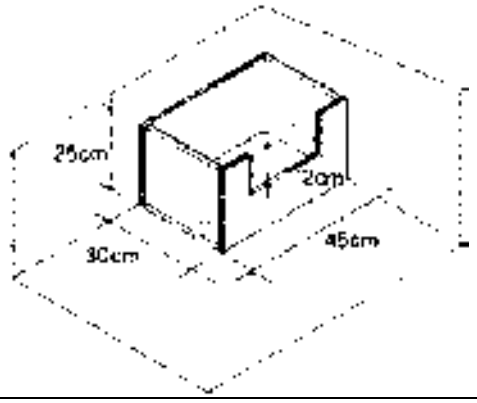
(2) Prepare for baby rabbits

Baby rabbits are usually born about one month after mating. About five or six days before you expect the babies to be born, put a nest box in the female cage.

Nest box:

Make a nest box for each female rabbit using wood plates about 1.5 cm thick.

The nest box is very important because baby rabbits are weak when they are born. Baby rabbits have no fur, they cannot see and they cannot walk. So, they must be well protected.



Cover the bottom of the box with sawdust or wood chips. This will help to keep the box dry after the baby rabbits are born. Put a little dry grass in the box. The female rabbit will then make a nest in the box, using some of her fur mixed with the dry grass.

Soon after the female rabbit has finished the nest, you can expect the baby rabbits to be born.

Important :

Stay away from the cage as much as you can during this time and do not bother the female.

(3) When the baby rabbits are born

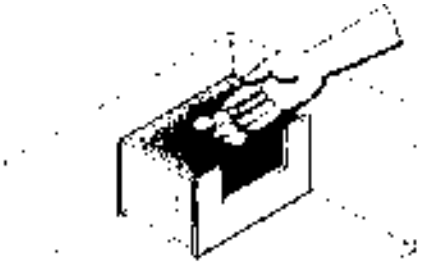
After the baby rabbits are born, look at them carefully to see that they are all well. Look at the babies as soon as they are born. You should see:

- ✓ if they are lying close together or far apart

- ✓ if they are warm and well protected in the nest
- ✓ if they are alive and well
- ✓ how many baby rabbits there are

A female rabbit gives milk to her babies only once a day. **If the babies are not close together, she may not feed them all.** If they are lying far apart carefully move them together.

Wash your hands before touching babies



Carefully move the babies together

All of the baby rabbits should be warm and well covered in their nest. If they are not, put the fur in the nest all around them.

If any of the baby rabbits are dead or deformed, take them away and bury them.

Take away dead or deformed babies

A female rabbit with eight teats can feed only eight babies. If there are too many babies (more than 8) for the female to feed, take some of them away.

Sometimes female rabbits will kill their babies and sometimes they will not feed them. This can happen if a female rabbit does not have enough milk. It can also happen the first time that a female rabbit has babies because she does not know how to take care of them.
If she kills her babies next time too (2 times), replace her with a new female.

if no enough milk, she may kills their babies

A female rabbits with babies need a lot of food. She also needs a lot of water to make milk for the babies. So, be sure that she can get as much food and water as she wants when she is having babies.

Make sure that female rabbit can get as much food and water as she wants

(4) Feeding baby rabbits and weaning

At first, new little rabbits sleep most of the time and move very little. They take milk once a day.
Never disturb mother breath feeding because she may stop milking babies forever.

At about 2 weeks old, their fur will begin to grow and they start to move about.

Baby rabbits are always sleeping

At 2 weeks they start to move

At about 3 weeks old, they come out of the nest box and they begin to eat food in addition to the milk they drink. From this point on, little rabbits will eat more and more food. So, be very sure that there is enough food for all the rabbits to eat.

At 3 weeks they begin to eat

At 6 weeks no longer take milk

By the time they are 6 weeks old, little rabbits will no longer take milk. This weaning time is a very dangerous time for them. They often get sick (diarrhea) and die at this age. Make sure that their pen is always very clean. Make sure that the food and water is always very clean and fresh.
Never move little rabbits of this age. If you move them to a different cage they may get sick or lose weight. **Keep babies with the female until they are 8 weeks old.**

At 8 weeks old, it is safe to move them. Then, you can take them away from the female rabbit and put them in their own pen.

(5) Raising young rabbits

You can put as many as 6 to 8 young rabbits in one cage. However, it is best to keep all of young rabbits from the same female rabbit together in a same cage.
Once they are in their own cage, you can begin to fatten them to eat or to sell. So, give them as much food as they can eat and plenty of fresh water.

Give young rabbits as much as they can eat and drink

After 4 months of age, rabbits begin to eat a lot more food. So, you had better try to eat or sell all of your rabbits by this time.

If you keep rabbits longer than this, the male rabbits may begin to fight. So, it is best to eat or sell the male rabbits first.

Rough estimation of necessary grass volume for raising one (1) baby rabbit is as follows.

up to 120 days (4 month age)	95 – 110 kg
up to 150 days (5 month age)	150 – 170 kg
up to 180 days (6 month age)	200 – 250 kg

Assumptions:
1) Growth rate: 15-20 gram/day, 2) Feed intake: 8% of body weight (DM basis),
3) Water contents of grass: 90%

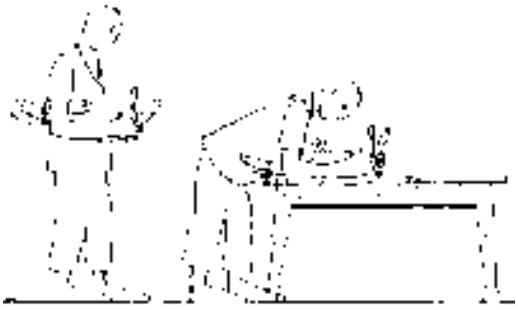
Rough estimation of necessary grass volume for keeping three (3) matured rabbits is as follows.

3.5 kg x 8% x 30 days x 90%/10% =	75.6 kg per month
75.6 kg x 3 rabbits =	about 230 kg per month

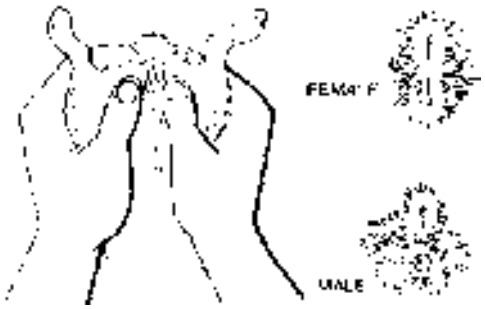
Assumptions:
1) Body weight of matured rabbits = 3.5 kg, 2) Feed intake 8% of body weight (DM basis),
3) Water contents of grass: 90%

(6) How to tell the difference between female and male rabbits

After 8 weeks old, it is not too hard to check the rabbits's sex - female or male.



Hold the rabbit in your arms or put on its back on a table



Look at the second opening

There are two openings just behind the tail. The opening nearest the tail is where the rabbit droppings come out. This opening looks much the same in all rabbits.

The second opening of female looks quite different from the one of male. This is how you tell them apart.

Push down gently with your thumbs on each side of the openings. You will see that they are red and moist inside. Look carefully at the second opening. Some rabbits have a slit and some rabbits have a circle with a small hole in the centre. **If you see a slit, the rabbit is a female.** If you see a circle, the rabbit is a male.

(7) When should you mate female rabbits again?

Female rabbits can have babies maximum 6 or 7 times each year. However, when you first begin to raise your own rabbits, you should mate your females only 4 or 5 times each year. After you have

been raising rabbits for some time and you see that your female rabbits are strong and healthy, you may be able to mate them more often.

Remember, if you do mate your female rabbits more often, make sure that you feed them enough so that they do not lose weight.

Remember, if you mate all of your female rabbits at about the same time, all of your baby rabbits will be born at about the same time. That way you can easily move them from one female to another if you need to.

(8) When to replace your rabbits for mating

1) Female rabbits

If any of your female rabbits become sick or do not have healthy baby rabbits, do not mate them. Replace them with new full-grown females.

As long as your female rabbits are healthy and have healthy baby rabbits, you can continue to mate them until they are 3 years old.

Change female rabbits after 3 years

2) Male rabbits

Male rabbits can be used for mating until they are about 3 years old, and even longer if they are healthy and the females that they mate continue to have healthy babies.

However, to make sure not to mate a father to a daughter, you should replace your male rabbit about once every year.

Remember:

- ✓ if you exchange male rabbits with another villagers, be very careful that your new male rabbit does not come from the same family as your old male rabbit.
- ✓ choose rabbits that come from big families of five to six babies that weighed at least 1.5 to 2 kg at 3 to 4 months old.
- ✓ new females should have eight teats.

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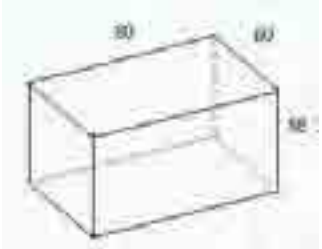
References

- Better Farming Series 36 - Raising Rabbits 1: Learning about Rabbits; Building the Pens; Choosing Rabbits (FAO, 1988)
- Better Farming Series 37 - Raising Rabbits 2: Feeding Rabbits; Raising Baby Rabbits; Further Improvement (FAO, 1988)
- Animal Production and Health Series No. 21: The Rabbit - Husbandry, Health and Production (FAO, 1997)

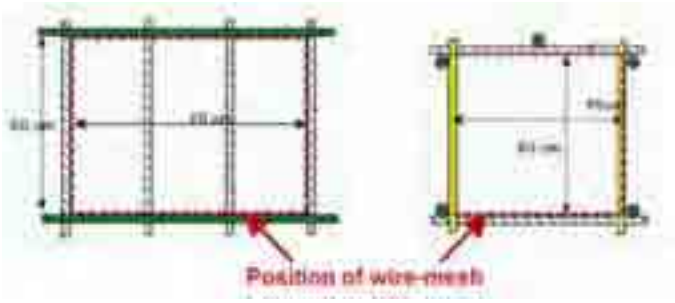
Additional information on Rabbits raising for extension staff

1. Tips on cage making

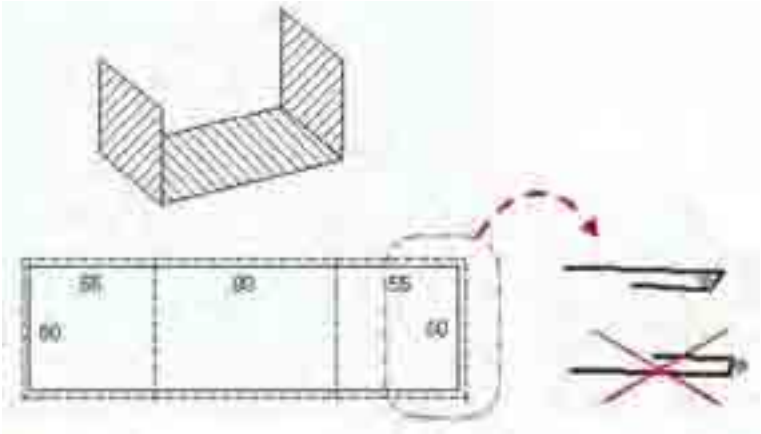


Cage size : (W) 80cm x (D) 60cm x (H) 55cm

Top view Side view



Wire-mesh should be placed inside of the wooded posts. Red-dot lines in the drawing show the position of wire-mesh.



Use 12mm mesh for the bottom and two sides.

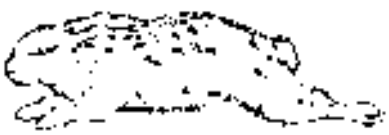
When you cut wire-mesh always add one extra grid all around the cut piece for folding.

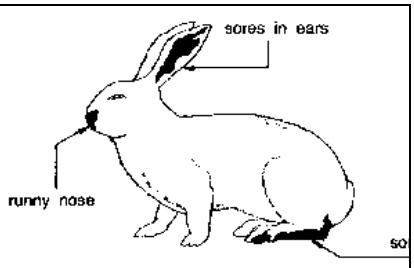
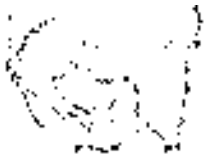
When you fold the edge, a welded-wire should be kept inside the fold.

2. Buying and transporting rabbits

(1) Buying rabbits

Here are some points that you should look for when you choose the rabbits.

Look carefully at each rabbit to see that it is active and moves well. **Never buy a rabbit that moves slowly or looks dull and sleepy.**	

Look to see that each rabbit has bright eyes, a dry nose and clean ears and feet. **Never buy a rabbit with a runny nose, or with sores in its ears or on its feet.**	
Look at its fur. The fur of a healthy rabbit is smooth and clean. **Never buy a rabbit with fur that is rough or dirty or grows in patches.**	
Look at its teeth. The front grinding teeth of a rabbit should be in line. **Never buy a rabbit if the grinding teeth are crooked or out of line.** Teeth that are out of line grow and grow until the rabbit cannot eat.	

- When you buy your rabbits, make sure that your female and your male rabbits are not brothers and sisters.
- The female rabbits that you choose should have eight teats so that they can feed eight babies.
- When you have decided what rabbits to buy, find out what kinds of food they have been eating. This will help you to know what to feed them when you get them at the villages. You may even be able to take some of this food to feed them for the first few days.

(2) Transporting rabbits

Do not give any food to rabbits the night before you move them. It is not good to move a rabbit when its stomach is full. However, if the trip is long they should be given water from time to time.

It is best to move each rabbit in a separate container such as a crate or a basket with a lid that can be closed. However, the containers you use should let in plenty of fresh air during the trip. If the weather is hot, move your rabbits early in the morning.

<u>After reaching the site</u>

When you reach home, put the containers down gently near the pens. Let the rabbits rest and become calm while you prepare their pens.

Now, let your rabbits settle down. Stay away from them as much as you can until they become used to the pen. Do not bring people to see them. Do not let your children play near the rabbit pens. Do not let dogs or cats or other animals near them.

3. Rabbits diarrhea and prevention

Diarrhea is a serious economic threat, primarily in young weaned rabbits (5 to 10 weeks). It is rare before weaning.

Diarrhea is usually the final consequence of some other ailment. The important point to make clear is that the rabbit's reaction to disease, whatever the nature of the attack, takes the form of intestinal disturbance, which nearly always expresses itself as diarrhea.

(1) Causes

Non-specific causes

It has been seen that very different factors can cause outbreaks of diarrhea. Rabbits seem to react negatively to: transport, especially during the post-weaning period; being put in a new hutch or cage; the presence of unusual visitors (people or animals); and sounds not identifiable by the animal and lasting for hours or days.

Food and Feeding

Feeding is unquestionably a prime factor in the occurrence of diarrhea.

Also to be remembered is the fact that the rabbit regulates its intake according to the energy in the feed. Too much energy in the feed can lower the intake too far and vice versa. These are all factors which can favor the onset of intestinal problems. Feed changes are all too often blamed for diarrhea. Even when feed is the obvious cause, more often the problem is the composition of the feed rather than the change itself. On the other hand, when the animals do not always have good feed available, at least the daily timetable of feeding should be respected. There have been many instances of diarrhea "epidemics" in the rabbits pens where changes in timetable were the suspected culprit.

Moldy feed can very quickly cause diarrhea even in healthy rabbits.

Coccidiosis

Coccidia are specific pathogenic agents. Coccidia are protozoa. 11 coccidia species are rabbit parasites. One infests the liver, the other ten the intestine. When inoculated into rabbits pathogenic coccidia cause the same lesions and the same symptoms (diarrhea, loss of weight, death) in all the animals tested.

The main symptoms are: diarrhea, weight loss, low intake of feed and water, contagion and death. Coccidiosis is often extremely difficult to diagnose. It can only be done in the laboratory, by counting coccidia per gram of excrement and examining the viscera. Counts must be made on several animals for several days running to diagnose coccidiosis properly. The specific coccidia species and their pathogenic potential also need to be identified.

Antibiotics do not cure coccidiosis. They may, however, be used in cases of persistent diarrhoea or to prevent secondary bacterial complications.

The most common drugs are nitrofurans and sulpha drugs. Bifuran (50% furazolidane, 50% furoxone) at rates of 200 mg/kg of feed is now used only as a preventive measure.

Non-specific cause and coccidiosis are the basic causes of diarrhea. Good hygiene is the proper way

to prevent the non-specific attacks. Preventive medicine can be added to combat coccidiosis.

(2) Preventive hygiene

Preventing medicine for coccidiosis will not be available in the villages and not be applicable to the villagers. However, it would be wrong to think that you can not grow rabbits without the medicine. Diarrhea can in any cases easily be prevented by elementary sanitary and feeding hygiene.

The farmer’s best ally for healthy rabbits is the animals' own capacity to ward off disease. An organism's defence against outside attacks is basically a global, non-specific response which is fundamentally dependent on good hygiene standards in the rabbits pen. The rules of hygiene are easier to apply and easier to respect in small-scale pens. Daily preventive cleaning will keep the contamination and pollution levels down and make the pen viable and productive for a longer period. Preventive hygiene is a key to the clean, well-managed rabbits raising in which the farmer can more effectively control any disease which might break out.

Feeding

- Grass should be gathered at midday when the dew is gone;
- Grass should not be gathered in areas where there are other animals and chickens;
- Grass should be sun-dried before it is given to rabbits. Drying kills most of worms and their larvae;
- Grass should be distributed on feed racks where animals are unable to soil it with their faeces or urine;
- Daily timetable of feeding should be respected;
- Give fresh and clean water, it should be changed and drinkers cleaned often;
- People are the most dangerous vector of disease. Wash your hands when handling animals and distributing feed and forage.
- There are many toxic plants for rabbits. Feed the grass kinds which are proved as OK.

Environments

- Keep away other animals and kids;
- Keep away strong wind, rain and direct sunshine;
- Keep clean and dry;
- Keep quiet.

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C-5 Technical Guideline on Duck raising

1. Introduction

Ducks are strong and hardy animal. They are more resistant to some diseases than chickens; it means if all of your chickens die of a disease, your ducks may be able to survive. They can also utilize leaves and grasses more than chickens can do. For these reasons, it is good to keep ducks as well as having chickens.

This manual shows many tips on how to raise ducks by use of a pen. Make the most of this manual and make your farming more successful!

(1) Why you should use a pen ?

Because there are many benefits than you raise ducks without a pen. If you use a pen, you can give better cares easily. Benefits of using pen are:

- ✓ Ducks don't get sick or die so often.
- ✓ Ducks can be protected from cold/hot weather, strong sunlight, wind, predators, etc.
- ✓ Ducks can produce more eggs, more ducklings and more meat, if they are well fed.
- ✓ You don't need to walk around to find eggs.

(2) What you need to do to raise ducks with a pen

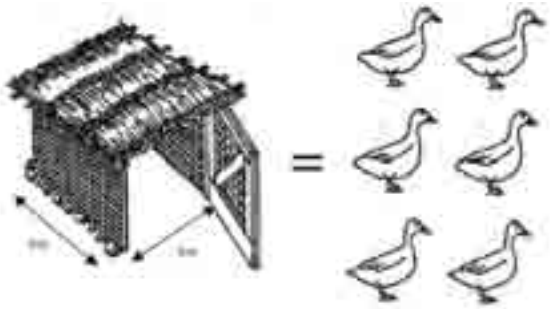
- ✓ To choose a good location to build a pen
- ✓ To build a pen, and make a nest, feeder and drinker
- ✓ To have strong and healthy ducks (You can start with 1 male and 3 females)
- ✓ To feed enough feed and water
- ✓ To plant some forage/grain crops to feed

2. Making a duck pen

Good location to build a pen : Choose a location with the following conditions.

- Have a good drainage
- Have good air ventilation
- Have shadings to moderate the strong sunlight
- There are many green grasses and shrubs (natural feed sources)
- Close to a pond/small stream, if possible

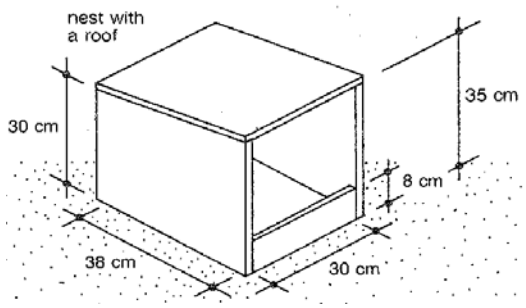
Build a pen where your ducks sleep : Make it with locally available materials such as used wood, bamboo, grass, tree leaves, wire mesh, etc. A pen, where your ducks sleep, should have about 1m x 1m size for 6 adult ducks.



A pen built with local materials

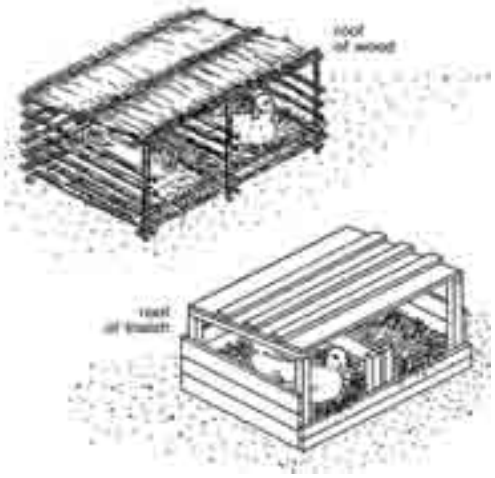
Make a nest for laying & brooding eggs : Make it with local materials such as bamboo, wood, grass etc, and place it in the pen.

- Make 1 nest for 2 female ducks, and make 2 nests for 4 female ducks.
- Put roof over the nest, because ducks like to lay eggs in dark and quite place.
- Put some straws or grasses in the nest to make it warm.



A nest made with wood plates;

for 2 female ducks



for 4 female ducks

Make a feeder and drinker : Make it with bamboo, wood, etc. You can use a plastic bowl or basin, if available.

Put litter : Cover the floor of pen with some leaves, straws, corncobs, saw dust, etc (= litter, put it more than 5cm thick). It avoids your ducks from getting dirty and helps to keep the floor dry.

You should remember that you have to change the litter at least once in a month or when it gets wet and dirty.

Protection from harsh weather : Cover the pen with bamboo mat, grass, plastic sheets etc when there is cold, strong wind or strong sunlight.


3. Feeding your ducks

Let your ducks free to wander about looking for foods by themselves (scavenge) during the daytime, and you give feed before sunset.

DO	DON'T
- Feed always at same time. - When you feed, always call them; this will help your ducks come back to the pen by themselves. - Always give your ducks enough fresh, clean water - After feeding, make the feeder empty (throw away leftover in the feeder). - Leftover meals from your home can be given to the ducks.	- Don't give spoiled (rotten) or moldy food. Otherwise, they can be sick.

Adult ducks eat many things: water plants, grass/leaves, seeds, grains, insects, worms, etc. Try to feed as much varieties as possible.

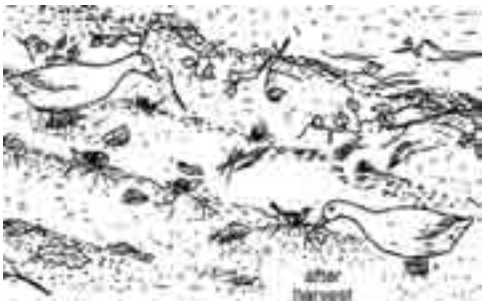

Muscovy duck, fed with broken rice

You can decide the amount of feeds you need to give by the following method.

- If nothing is left in the feeder within 30 minutes after feeding, the amount is not enough. Give more next time.

- If some of the feed is left in the feeder and the ducks start wandering away from the feed, they had enough. You may reduce some next time.

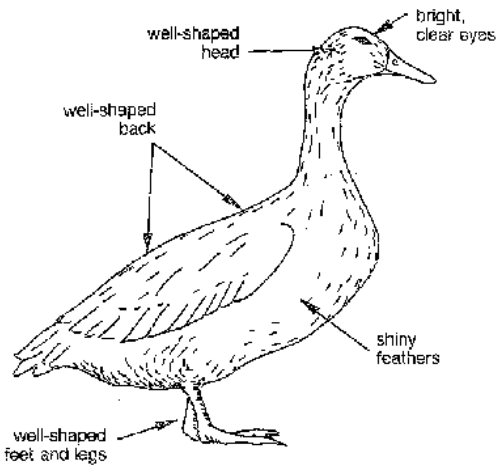
Letting the ducks scavenge in your field after harvest is a good idea. They can eat crop residues, insects and worms that have full of protein. Don't let them scavenge in the field when the crops are still young. They can damage the crop.



4. Managing egg production and brooding

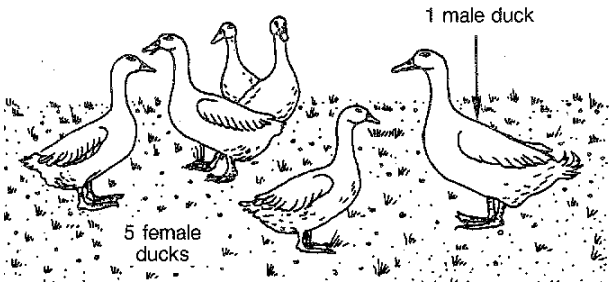
(1) Ducks for egg production

Choose female ducks with the following features. Small, thin or weak ducks are not good for breeding (egg production). You rather sell or eat them than keep them.

✓ Heaviest in the flock ✓ Healthy, strong and active ✓ Bright and clear eyes ✓ Shinny feathers ✓ Well-shaped back, legs, feet and wings	

Notes: Body weight of matured duck is 1.4-1.6kg (female) and 2.3-2.5kg (male)
Muscovy duck at 16 weeks has 2.0-2.5kg (female) and 4.0-4.5kg (male)

One (1) male duck can mate 5 female ducks to have fertile eggs. Don't let them breed within the same family.

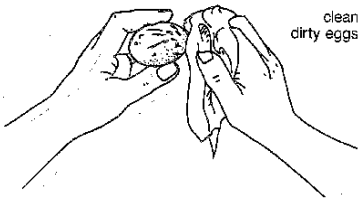


Change the male duck for breeding every 2 years with new and young (but mature) one to make the eggs fertile. You can change it by : 1) buy a new one at the market, 2) buy a new one from another farmer or 3) exchange with another farmer.

(2) Managing eggs production

In general, female ducks start to lay eggs at 8.5 to 9 months old in the village condition. Muscovy duck produces 30-40 eggs per year under extensive system.

Ducks will stop laying egg if they start brooding eggs. Therefore, you have to collect the eggs in the nest every morning after you letting the ducks out of the pen.



After the collection, you do:

- Wipe the eggs gently with wet, soft cloth, if they are dirty.
- Keep the eggs in a box with sand at cool and dark place.

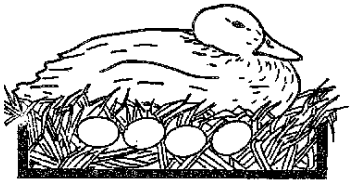
Select 10-12 eggs with middle size from the collection (if you have several female ducks), and put them in the nest to let female duck warm the eggs.

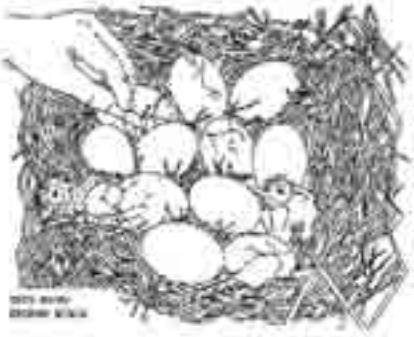
- Don't put very big or small eggs, they will not hatch.
- Don't use the eggs kept more than 7-10 days, they will not hatched.

Note : You should remember that when a Muscovy ducks mate with domestic ducks, the eggs to be laid will not hatch (infertile).

(3) Care of brooding ducks

Make sure that the nest is in quiet place, and there is enough straws or leaves in the nest. Ducks normally lay eggs in early morning. Never disturb the duck while brooding in the nest.





The eggs of ordinary duck hatch after about 28 days. The eggs of Muscovy duck hatch after 35-37 days. Take broken shell away from the nest, after hatching.

5. Care of ducklings and growers

(1) Care of ducklings (after hatching to 4 weeks of age)

Keep the ducklings with the female in a bamboo basket/cage all day until they get 4 weeks old. Don't free the ducklings to wander about looking for foods with other adult ducks. Because:

- Ducklings are easily attacked and eaten by predators,
- Ducklings get easily infected with diseases,
- Ducklings are very weak to the heat and cold,
- 1-2 weeks of ducklings can't find their food by themselves.

You have to :

- give enough feed and clean water.

- clean the place, drinker and feeder everyday

Ducklings need a warm place (28-32°C) especially during the night or cold season. Place a small box with some straw in the pen or basket/cage. Most vulnerable period is 1-3 days after hatching.
Using an electric bulb can be a great help to warm the ducklings, if electricity is available and affordable.

Feed for ducklings can be broken rice, rice bran, other grains etc. Make them soft with some water or grind them. When the ducklings are at 2 weeks of age, start feeding them little by little with various kinds of feed including grass, leaves etc.

(2) Care of Growers (from 4 weeks of age)

After 4 weeks old, the ducklings (now they are called "Growers") are ready to wander about looking for foods. Let them out of the pen during the daytime with other adult ducks.
Give enough feed and clean, fresh water every time before sunset when they return to the pen. If adult duck bullies the ducklings, give feed and water separately from the adult ducks.

6. Disease prevention

(1) Prevention

Clean the pen, drinker and feeders every day.
Change the litter when it gets dirty and wet or once a month.
Vaccinate your ducks once in a while
Check your ducks every day to find any signs of changes. If your ducks are sick, they would:

- Weak and thin
- Their bill and legs become pale yellow
- Not eat very much
- Crouch all the day in the pen, doesn't join the other flock
- Coughing, sneezing, secretion from nose or eyes
- Stop laying eggs

If you find a sick duck, separate it from other healthy ducks to prevent the transmission. Ask vets for further advice if available.


Separate the sick duck in a shelter

In case an epidemic disease is happening in your area, report the local authorities when you find your ducks are sick.

(2) Common problems and countermeasures

Problems	**Countermeasure**
Eggs with soft shell	Eggs with soft shell or two yolks can be caused by noise. Don't make loud noise around the pen.
Eggs with thin shell, small eggs	Give feed, which is rich in protein, mineral and calcium. Grinded eggshell or toasted and grinded bones are good for calcium supplementation.
Many eggs are not hatched	You may change the male duck. Replace the eggs with fresh ones.
Female duck doesn't produce eggs well or can't take care of ducklings well.	Get rid of it.

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C-6 Technical Guideline on Fish Raising
"How to start small-scale fish farming"

1. Introduction : How do you begin?

Base on our experiences in the Project, commercial purpose fish raising (large-scale, raise only one kind of fish, use factory feed, and it requires high technique and fund) is considered hard to apply in the remote villages in Kon Tum, especially for the villagers who raise fish for the first time.
Therefore, this guideline describe about the small-scale fish raising mainly for self-consumption purpose (raise several kinds of fish in one pond, use local farm products for feeds, and it requires less technique and low fund).

To start the small-scale fish raising, you will need:

- A piece of land where you can make a pond and it has constant supply of water,
- Baby fish to begin,
- Food for your fish,
- Time and labor to make your pond and to care for it regularly, also
- You need to know the basic technique/information written in this guideline.

If there is a successful fish pond near where you live, you must visit it to get information and advice before you start making your pond.

2. Making fish pond

(1) Site selection : Where is good place to make your fish pond?

You need to select a good place to make your pond; otherwise you will fail to raise fish.

Good place	Bad place
A place with near a good supply of water, plenty of water all year round. (You can not depend on rainwater to fill your pond). Water must come from a place that is higher than the pond so that the water will flow into the pond by itself.	A place without adequate supply of water; in volume as well as in quality. Fish do not like "alum" water, therefore pond should not be located in the place where soil contains a lot of "alum".
Soil with enough clay in it - Clay soil holds water very well, also banks of clay will be strong enough.	Soil with too much sand or gravel - Sandy soil can not hold water, bank also can not be so strong. *1
A place with a gentle slope - easier to drain	A place on a steep hill - high risk of broken bank and water leakage. *2
	A place that is so low that it can be flooded during the rainy season.

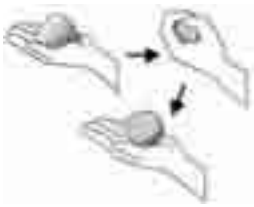
Good place	Bad place
	A place in the middle of small stream (valley floor) - high risk of flash flooding during the rainy season. *3
A sunny place - if it is in the shade, water may not turn green enough.	
A place close to your home so you can take care of the fish easily.	

*1, *2 & *3 : Refer to the countermeasures shown in this guideline.

Testing the soil

Before start digging, you should test the soil to see if it is good for making a pond.

TEST-1

	1. Take a handful of soil from the surface and squeeze it into a ball.	If the soil will not stick together and the ball will fall apart. ➔ No good. Look for another place.
	2. Throw the ball of soil into the air and catch it.	If the ball sticks together well. ➔ It may be good. Proceed the TEST-2 to be sure that soil is good.

TEST-2

	1. Dig a hole as deep as your waist. Early in the morning fill the hole with water. Fill it to the top.
	2. Check it in the evening. You will see water level have lowered. Fill the hole with water again. Fill it to the top. Cover the hole with leafy branches.

3. Next morning if most of the water is still in the hole, the soil will hold enough water to build a fish pond there.

(2) Making pond

You pond should be:

- Size should be over 100 m^2.
- Depth should be at least 0.75 m at the shallow end, and at least 1.0 to 1.2 m at the deepest part.
- Banks should be 40-50 cm higher than the water level.
- It should has a inlet pipe and a overflow pipe. It is ideal if it has a bottom drainage pipe.
- It should has a fence around the pond to prevent cattle and buffalo from stepping on the bank.

Good pond

1) Important points on how to dig a pond

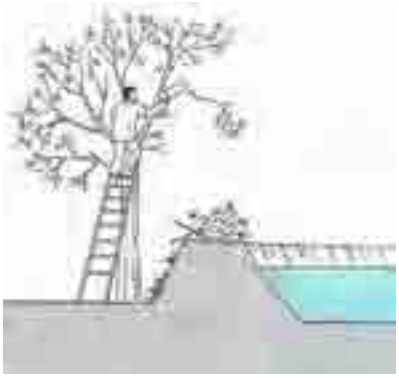
- ✔ To begin with, mark out a shape of pond on the site. A square or rectangular pond is easiest to build, but your pond can have a different shape to fit the size and shape of your land.
- ✔ Remove the topsoil aside (about 20 cm). Later you will put it back on the top and outer sides of the banks to plant grass.
- ✔ Take away as much of roots as you can when you come to them.

- ✔ The banks should have a good slope on the sides and it should be built with soil tightly packed. Whenever the loose soil you put on the banks reaches 25-30cm high, pack it down tightly. You can do this by beating the soil with a heavy plank or a tree trunk.

- Top of the banks should be about 1.5 m wide and should be flat all the way around the pond. If you are building two ponds side by side at the same time, you can make the top of the bank between them 1 m wide instead of 1.5 m.

- Plant grass on the banks. Banks covered with grass last longer.
- Dig a ditch in the bottom of the pond from the centre to the lower end. The ditch should be about 50 cm wide and about 20 cm deep. This ditch will help you drain out all the water when you empty pond.

- Do not plant big trees near your pond. If there are already big trees, cut branches that hang over the pond to give full sunlight to the pond. The water in pond may not turn green enough if it is in the shade. Also, roots of big tree may coming into the pond a few years later. Conifers; such as pine tree; should be kept far enough away from fishpond because falling leaves can spoil the water quality.



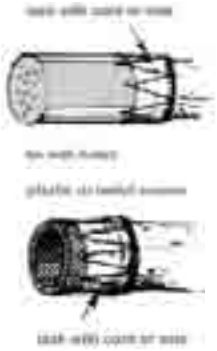
2) Inlet pipe and Overflow pipe

Inlet and overflow can be made from a heavy bamboo or a pipe of plastic or metal. These pipes should be more than 10 cm in diameter, and long enough to reach through the top of the bank from one

side to the other. You will need a pipe about 3 m long to reach through the top of the bank.
Both of inlet and overflow pipe should have a screen. For a inlet pipe, it can keep out wild fish (wild fish may eat your fish) and trash coming into your pond. For a overflow pipe, it can prevent your fish go away.

Inlet pipe

Overflow (outlet) pipe

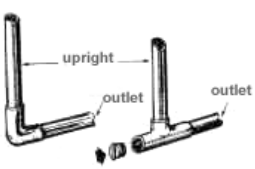


End covers

3) Outlet / drainage system

If the topography allows, it is recommended to install an outlet pipe at the bottom; at the lowest part of your pond; to let water out. So that you can empty your pond without destroying the bank.

Simple bottom drainage



Bottom drainage with standing pipe

4) Countermeasures if you make a pond at unfavorable place

a. If you make a pond on sandy soil, you have to reinforce the banks with timbers and sand bags.

b. If you make a pond on a steep slope, water can keep leaking from the side. In this case, you have to plaster the mixture of cow-dung and clay soil inside of the pond and do compaction. If you can afford a large plastic sheet, you install it inside of the pond.

c. If you make a pond in the middle of stream, you have to make a divert channel to protect your pond from swollen stream when heavily rain.

3. Preparing water (fertilizing the water)

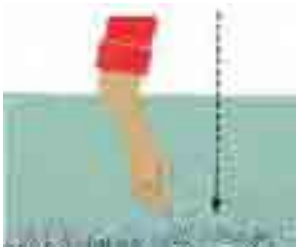
After finishing the earth work, you need to treat the soil in the bottom of pond, fill water, and fertilizing the water.

Step 1: Apply lime powder evenly to the bottom of the pond to sanitize (7-10 kg of lime powder for 100 m^2).

Step 2: After 3 days of applying lime powder, apply 20-30 kg of cow-dung and 50 kg of green leave for 100 m^2. The green leaves are bundled and put them at the corner of pond.

Step 3: Fill the pond with water. Do not forget to put a screen to keep out wild fish and trash coming into your pond.

Step 4: The water begins to turn green in 2 to 3 days. This means that natural food is growing in your pond. It will take about a week to become green enough, and then take out the bundles of green leaves (at this time branches only). To know the water is green enough or not, put your arm in the water up to your elbow. If you are just able to see the ends of your fingers, the water is green enough.



How to check the water is green enough or not

Good greenish water color

4. Kinds and number of fish

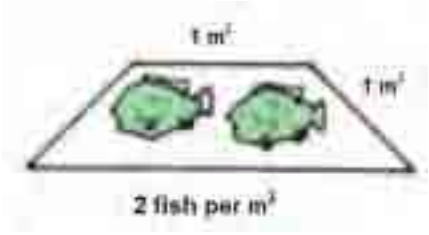
Those three kinds of fish are commonly raised in small-scale pond.

Grass carp *(Ctenopharyngodon idellus)* Cá châm Treng (called "Tram" in Kon Tum)  Grass carp live in the middle layer in the pond, eat mainly green plants such as: vegetable, duckweed, cassava leave, banana leave, young banana truck, sweet potato leave, etc. It also eats maize powder and rice bran. It can reach 0.8-1.5 kg in 10-12 months.	
Common Carp *(Cyprinus carpio carpio)* Cá Chép 	Carp live at the bottom of the pond; eat worms and insects. It also eats boiled (cooked) grain such as: maize and rice. Carp can reach 0.3-0.5 kg in 12 months.

Tilapia *(Oreochromis niloticus niloticus)* Cá Rô phi vằn    Male Female	Tilapia lives in the middle layer and bottom part of the pond. It eats various kinds of foods; mainly eat organic mud and manure. It also eats green grass such as duckweed, maize powder and rice bran and boiled grains. It can reach 0.3-0.5 kg in 12 months. It can not survive in low temperature; therefore the pond water should be always kept at least 1 m in depth during the cold season.

Recommended kinds of fish:

The purpose of fish farming was mainly for self-consumption in the Project. Therefore, the number of fingerlings for start-up was limited at 250 per household (250 fingerlings if the pond is over $100m^2$). In general, in case of tilapia, you can stock 2 baby fish for each $1m^2$ of pond.



Fish kinds and ratio for the place where has no cold season:

	Grass carp	Carp	Tilapia	Total
Basic ratio		50%	50%	100%
$100m^2$ (or for 1 family)		125	125	250

Fish kinds and ratio for the place where has a cold season; such as PoE & Hieu commune:

	Grass carp	Carp	Tilapia	Total
Basic ratio	10%	10%	80%	100%
$100m^2$ (or for 1 family)	25	25	200	250

Fingerlings : Use a strong baby fish, 8 to 10 cm long.

Grass carp

Common carp

Tilapia

5. Daily management

(1) Feeding

You fertilize the pond water by adding cow dung and green leaves so that there will be natural food for your fish to eat. In addition, you must feed other kinds of food to make your fish grow more quickly. You can feed your fish with :

- Termites
- Tender leaves and waste of banana and cassava
- Grain mill sweepings
- Rice bran, broken rice
- Local wine wastes
- Slaughterhouse wastes
- Animal wastes
- Spoiled fruit and vegetables
- Left-over food
- Chopped grass

Rules for feeding:

- Feed at least once a day. If you feed more often, your fish will grow better.
- Feed early in the morning and/or late in the afternoon, when it is cool.
- Try to feed at the same time every day.
- Make a rectangle-frame with bamboo which can float on the surface of the water. This frame keeps feed inside of it.

- Regularly check for left-over food and adjust food ration accordingly.

(2) Daily checking

Check your fish is healthy or not every day.

- Fish swim strongly in mid-water → OK
- Fish eat actively when you feed them → OK
- If fish don't eat well, and especially if they stay at the water surface gasping for air.
  - quickly add some new water to the pond
  - stop fertilizing the water for a week
  - stop feeding for a few days until your fish look healthy again
- If you find any dead fish floating in your pond, take them out right away. Change some of the water in your pond to put more oxygen into the water.
- When seeing fish died or fish looks infected with diseases, it is necessary to ask technical person immediately.

Check your pond every day when you feed the fish. Make sure that :

- Pond remains full of water.
- Water is not leaking through the banks. If you find leaks repair them right away with good soil.
- Screens on the pipes are in place so that your fish cannot get away.

(3) Fertilizing water

Put 10-15 kg of cow dung per 100 m^2 of fish pond in each week. In addition, if the water color is not good (greenish), put grass leave in the pond.

(4) Maintenance of your pond

Do regularly:

- Do not let waterweed covers more than one quarter of the surface. If there are too many weeds, clean your pond.
- Cut the grass on the banks of pond regularly.
- Get rid of birds, frogs, turtles, rats and snakes. Stick branches in the pond to get rid of birds.

- Maintain the fence around the pond. Do not let large animals such as cattle and buffalo on the banks of your pond. They are too heavy and may break the banks down.

(5) Providing air into the water

If the weather is too hot, if you feed your fish too much or if you use too much cow dung, there may be too little oxygen in the water for your fish to breathe.

If you see your fish coming to the surface gasping for air, give them less food and do not put cow dung for several weeks. Change some of the water for several days to put more oxygen into the water.

After several days if your fish are still not well, if they are not eating well, are gasping for air or are not swimming strongly, ask your extension agent or your fish culture station for help.

(6) Others

- Place some floating weeds such as Eichhornia at one corner of the pond during the breeding season. Common carp will deposit eggs on the roots of the floating plants.
- Avoid polluting the fish pond. Villagers living around the water system should avoid polluting it. Pollution leads to fish deaths. If a pollution source is identified, try to stop or at least limit it.

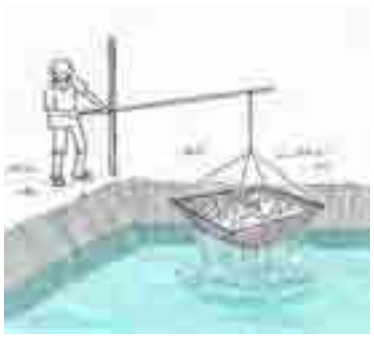
6. Harvesting

Do not take any fish out of your pond during the first 5 months. After 5 months you may catch a few big fish each week to eat.

Choose your method of harvest according to how much water is available and how many fish you want to take out. .

[Method-1] No draining or drain part of the water; Use a net:

Cast net



Lift net

Seine net

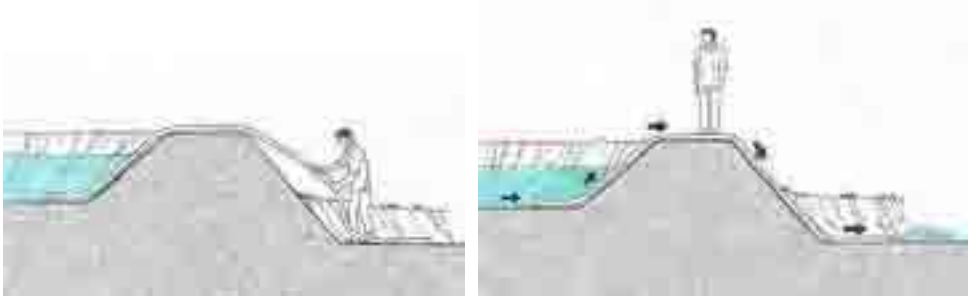
You need several people to harvest with a seine net. Use a seine net of 3-3.5 cm mesh to allow small fish to escape through the net.

[Method-2] Drain all the water; Catch all the fish and clean the bottom of pond:

This method must be the easiest way to catch fish, and you can clean the bottom of you pond. Apply this method when most of the fish are big enough. Use baskets or hand-nets and some watertight containers ready to store live fish. Be careful to gather all of the fish in small pools on the bottom.

<u>How to drain all the water:</u>

If you don't have a bottom drainage pipe in your pond, you need to break a part of the bank. But if you have a flexible tube larger than 3 cm in diameter, you can drain the water out by siphoning. It may take several days to empty, but you will not need to break and repair the bank.

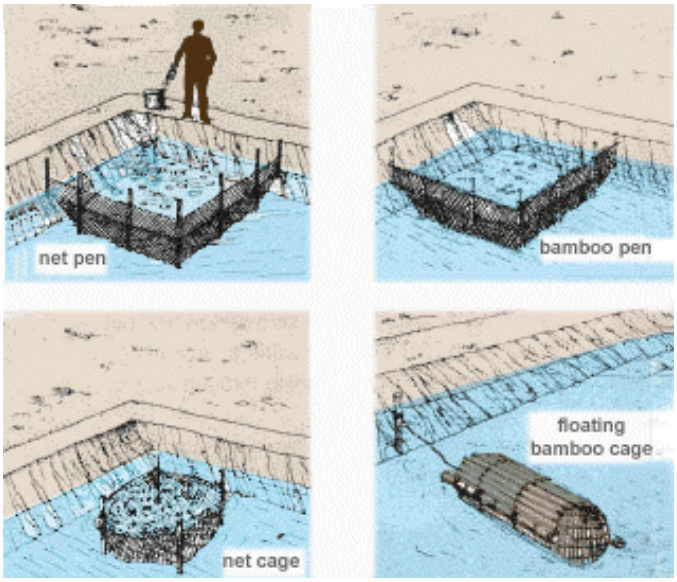


Make a center ditch (50 cm wide, 20 cm deep) in advance. This ditch will help you drain out all the water.

What to do with baby fish if you drain all the water:

You need to keep the baby fish alive to use them again.

[Case-1] If you have another pond that is full of water, you can keep the baby fish in a pen or fish cage made with split bamboo and/or net in the corner of other pond.

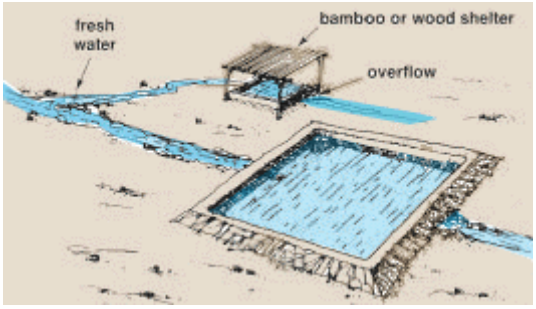


Firmly bury (cover) the lower end of the net in the earth.

* You may ask another villagers who have a pond to keep your baby fish tentatively.

[Case-2] If you do not have another pond, you can keep the baby fish alive in a small pond, but only in short period.

The small pond can be a simple hole in the ground about 3 x 3 m and about 40 cm deep. You have to make it in the shade under a tree or put a simple shelter over it. Bring fresh water with a small ditch or a hosepipe; make it gentle water flow. Feed them a little food each day with termites or finely ground rice bran or maize flour.



Note that you can keep baby fish alive in a small pond for only short period (about 5 -10 days only).

7. Starting again

To re-start again after harvesting all fish by emptying your pond, you must do:

- Cut the grasses on the banks.
- Clear out most of the plants in the water.
- Remove unwanted fish, crabs and any other water-life. Use a fine-mesh net to catch them.
- Repair any broken parts of the bank and inlet/outlet pipes.
- Dredge the mud if it is too much.
- If you had fish diseases, drain all water completely and dry the bottom of the pond, and apply lime powder evenly to the bottom of the pond to sanitize (7-10 kg of lime powder for 100 m2 of the bottom).
- Do fertilize the water as you did it the first time.

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References

- Fish culture in undrainable ponds, A manual for extension, FAO Fisheries Technical Paper 325, FAO
- Handbook on small-scale freshwater fish farming, FAO Training Series No.24, FAO
- JICA Project on the Villager Support for Sustainable Forest Management in Central Highland, The trainers' handouts for fish raising training (making pond, care and management) (English translation) May 2008.

D. Technical Guidelines on Other Activities

D-1 Technical Guideline on Compost making

1. Introduction

Composting means piling up vegetation (grass, farm wastes, tree leave/branches, etc.) in layers to make them decompose quickly. Any vegetation that falls to the ground and decomposes aerobically turns into compost. Thus, composting is an imitation and acceleration of the natural process of decay.

Composting is done to produce an organic fertilizer that is balanced in plant nutrients and improves soil fertility. It also improves the moisture retention and soil aeration.

Compost can be used in all soils with low fertility. It is especially good in areas that have low rainfall, where artificial fertilizers cannot be used effectively because of lack of moisture. It is also useful in sandy soils which have poor water-holding capacity. Compost improves the structure and drainage of all soils.

Advantages

- ✓ Large amounts of vegetation, such as crop remains, garden weeds, household wastes, hedge cuttings, garbage, etc, are put to use.
- ✓ When properly made, compost becomes immediately available as plant food without the need to be first broken down by soil microorganisms.
- ✓ Compost does not cause excessive weed growth, as is the case with ordinary farm manure.
- ✓ Good crops can be obtained without the need for extra chemical inputs.
- ✓ All farmers, regardless of their financial abilities, can make and use compost.

Disadvantages

- ✓ Compost requires a lot of labor to prepare and spread it over the farm.
- ✓ The nutrient composition of the compost varies a great deal. It depends on the materials used and the preparation methods.
- ✓ Not enough vegetation to make compost may be available in drier areas.

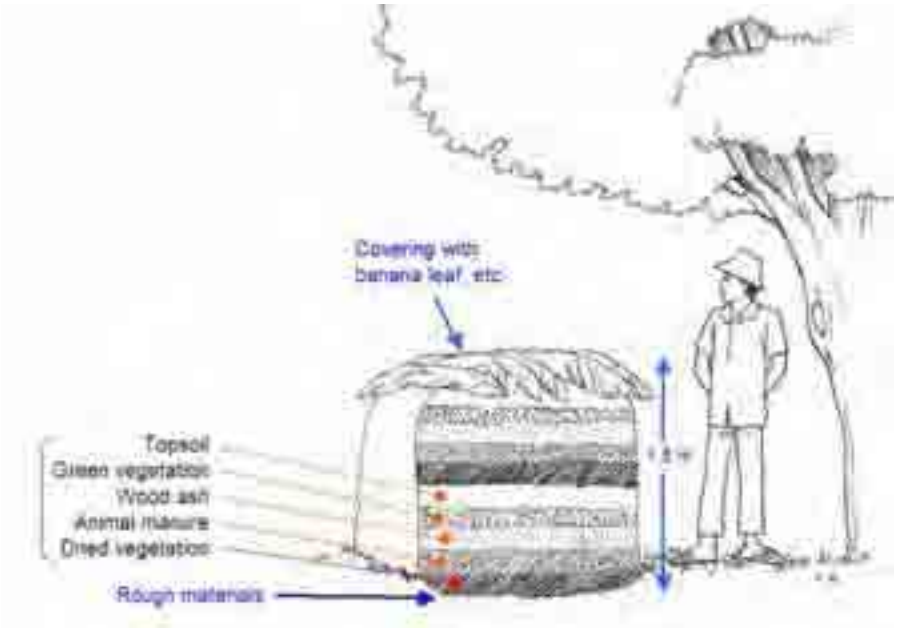
Items to be prepared

- ・ Various types of vegetative materials
- ・ Animal manure
- ・ Wood ash or lime
- ・ Water
- ・ Watering can, hoe, machete, wheelbarrow

2. Pile method

This method is making a pile above the ground, and it is suitable for areas with higher rainfall. For low-rainfall areas, pit method (described later in this section) may be used.

1. Select a location close to where you want to use the compost. The place should be sheltered from the wind, rain, sun and runoff. A compost pile must not get either very dry or very wet.
2. Measure a rectangle 120 cm wide and 150 cm or more long (the length depends on how much composting material you have). Do not make the rectangle wider than 120 cm, as you must be able to work on the compost without stepping on it.
3. Dig a shallow pit about 30 cm deep. Put the soil on one side (you will need it later).
4. Begin building a compost pile by putting a bottom layer of rough materials such as maize stalks and hedge cuttings in the pit. This layer should be about 30 cm thick. Chop up any materials which are too long to improve the air circulation in the pile. Sprinkle some water on this layer.
5. Add a second layer of dried vegetation, hedge cuttings or grass. This layer should be about 15 cm thick. Sprinkle water on this layer, too. You should sprinkle water on each layer as you add it. The pile should be moist throughout.
6. Put on a third layer of animal manure. The manure contains micro-organisms which are vital for decomposition.
7. Sprinkle some wood ash on this layer. The ashes contain valuable mineral including potassium, phosphorus, calcium and magnesium. The ashes also neutralize the acids produced during decomposition, especially by the animal manure.
8. The next layer should be of green vegetation about 15-20 cm thick.
9. Sprinkle on a little topsoil or old compost. The topsoil contains bacteria which are useful in the decomposition process.



10. Add more layers in turn, starting with dried vegetative materials, then animal manure or biogas slurry, followed by wood ash, green vegetation and topsoil. Remember to sprinkle water on every layer. Build the pile up to 1.5 m high. A well-made pile has almost vertical sides and a flat top.
11. To complete the pile, cover it all over with a layer of topsoil about 10 cm thick. This layer prevents plant nutrients from escaping from the compost pile. Lastly, cover the whole with dry vegetation such as banana leaves to reduce moisture loss through evaporation.
12. Take a long, sharp, pointed stick and drive it in at an angle so that it passes through the pile from

top to bottom. This stick will act as your "thermometer". After three days, decomposition will have started in the pile, and the stick will be warm when you pull it out.

13. Pull the "thermometer" out from time to time to check the progress of the pile. You can also tell from the thermometer how dry or wet the pile is: it should be moist but not wet.
14. Sprinkle water on the pile occasionally (about every 3 days, depending on the weather). If it has been raining, you may not need to water the pile.

Turn the pile after 2 weeks

15. After 2-3 weeks, turn the pile over. Do not add any fresh materials except water. You must turn the pile if the "thermometer" is cold when you pull it out, or if it has a white substance on it, as this shows that decomposition has stopped. Turning the pile is important because it mixes the different layers, making the decomposition faster and more complete.
16. The compost can be ready after 4 to 8 weeks. Check the temperature of the pile to make sure. If the stick feels warm when you pull it out, the pile is still decomposing and the compost is not ready. Finished compost should have a fresh, earthy smell and contain no grass, leaves, or animal manure.
17. You can store compost by covering it with a layer of banana leaves or polythene.

DOs	**DON'Ts**
- Choose a sheltered site for the compost pile. - Chop up long stems and big leaves. - Sprinkle some water on every layer, and ensure that the compost is moist all the time. - Turn the pile every 3 weeks. - Protect the finished compost from sun, wind and rain.	- Don't use materials that might contaminate the soil. - Don't step on the pile. - Don't use waxy leaves (such as eucalyptus leaves). - Don't over-water the compost pile. - Don't compact the layers. - Don't use materials that do not decompose.

3. Pit method

The pit method conserves moisture, so it is useful in areas with low rainfall and a long dry season. Do not use this method in wet areas, as the compost may become waterlogged.

1. Dig a pit 1.2 m wide and 0.6 m deep, and as long as you need for the amount of materials you have.
2. Build a pile in the pit, using the same method as in the pile method (see above).
3. Add water if necessary.
4. Push long poles into the pile to allow air to get into the layers beneath.
5. Turn the pile every 2 weeks.

You can produce a regular supply of compost by digging three pits side by side. Every 2 weeks, turn the compost from one pit into the next one, and start a new compost pile with fresh vegetation in the empty pit.

4. Using compost

In general, well-decomposed compost can be applied at the rate of 20 t/ha: enough to barely cover the ground with a layer 1 cm thick.

5. How to check the maturity of the compost

In case the compost has not yet well matured (organic materials are not well decomposed), such compost may harm the growth of crops. This is because of the intermediary metabolite/gas in immature compost can damage the roots and inhibit the germination. To avoid this situation, “maturity of the compost” needs to be checked.
There are many methods for checking the maturity. This paper shows the two methods which are simple and applicable by the villagers.

(1) Testing with earthworm
Earthworms do no like the phenols and ammonia gas containing in the immature compost. This method is to check the maturity by using the earthworms.
i) Tools
Container (glass cup), Black cloth/rag for shielding light, some Earthworms (size about 5cm long)
ii) Procedures
- Adjust the moisture contents of the compost to 60-70% (When you squeeze the compost, no water dribble and a lot of compost stick to open hand). Put the compost up to 1/3 of the container.
- Put some earthworms in the container, and observe the response/reaction of the earthworms.
- Cover the container with black cloth and keep it in the house. Ideal temperature is 20-25℃. Observe the earthworm after 1 day.

iii) Evaluation criteria

Immature	Earthworms try to escape (do not move into the compost) when you put them in the container, and die after 1 day
Half mature / not yet fully matured	Earthworks are looked uncomfortable when you put them in the container, and change color and/or become weak/vigorless after 1 day.
Fully matured	Earthworms move into the compost when you put them in the container, and are in vigorous after 1 day.

Note : Adjust the moisture contents properly. If the compost is too wet, earthworm will try to escape when you put them in such too wet compost.

(2) Scoring method

Score the compost by using following table. Total the score to evaluate the compost: less 30 = immature, 31-80 = half mature/not yet fully matured, over 81 = fully matured.

Check items	**Evaluation criteria & Score** * figures in ( ) show the score.
Color	yellow – yellow/brown (2), brown (5), dark brown – black (10)
Shape/appearance	still have original shape (2), fairly decomposed (5), almost no original shape is recognized (10)
Smell	strong smell of dung and urine（2）, slightly smell of dung and urine (5), smell o f compost (no smell of dung and urine) (10)
Moisture contents	When you squeeze (grasp strong) the compost with your hand : water dribble through fingers = over 70% (2), no water dribble and a lot of compost stick to open hand = around 60% (5), not so much compost stick to open hand = around 50% (10)
Highest temperature during composting	below 50°C (2), 50 - 60°C (10), 60 - 70°C (15), over 70°C (20)
Period of composting	・Only animal dung…. less 20 days (2), 20 - 60 days (10), over 60 days (20) ・Animal dung + soft materials such as grass, remains of crop…. less 20 days (2), 20 - 90 days (10), over 90 days (20) ・Animal dung + hard (woody) materials…. less 20 days (2), 20 - 180 days (10), over 180 days (20)
Times of turning around	less than 2 times (2), 3 – 6 times (5), more than 7 times (10)
Forced air-blowing	not applied (0), applied (10)

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References

- Sustainable Agriculture Extension Manual, International Institute of Rural Reconstruction (IIRR) http://www.iirr.org/book.htm
- 良い堆肥生産のポイント 藤原俊六郎、神奈川県環境農政部農業振興課 http://jlia.lin.go.jp/

Additional information on Compost making for extension staff

1. Effects of the compost

Well-matured compost has effects to improve the soil fertility in many aspects, thus we can expect higher yield, better quality and stable production.

Effects on improving the soil fertility

		Chemical fertilizer	Compost
Chemical property	Providing nutrients	○	○
	Improving nutrient-holding capacity	×	○
	Improving pH	×	△
Physical property	Improving water-holding capacity	×	○
	Improving permeability	×	○
	Easy tilling/plowing	×	○
Biological property	Increasing useful microorganism	×	○
	Decomposing organic matter	×	○
	Restraining diseases	×	△

○ : Close relationship △ : Some relation × : Almost no relation

2. Three important factors in compost making

Aerobic microorganism decomposes the organic matters. Therefore, it is very important to prepare a good working environment for aerobic microorganism. There are three important factors: 1) C/N ratio, 2) Water contents and 3) Air permeability.

Microbes use N (nitrogen) to decompose C (carbon compounds, cellulose). Therefore, a ratio of C and N (so called C/N ratio) in the raw materials is very important. An ideal C/N ratio is in a range of 25 to 40, i.e. amount of C is 25-40 times of the amount of N. Animal dung have low C/N ratio and vegetative materials have high C/N ratio. You have to adjust the C/N ratio by mixing some materials when you make compost.

An ideal water contents is 50 to 60%. Fresh animal dung (cow dung, pig dung) contains a lot of water (70-80% of water contents). Therefore such fresh dung should be dried to reduce water level to 50-60% before using it. You may lower the water contents by adding/mixing some dried materials such as rice straw and fallen tree leaves. But you must be required to collect a large amount of such materials.

Water contents and C/N ratio of row materials

	Water contents	C	N	C/N ratio	Decomposing
	%	%	%		
Hen down	20	27.9	3.5	8.4	Easy
Cow dung	50	34.9	2.2	16.7	Easy
Pig dung	36	35.0	3.7	9.9	Easy
Rice straw	10	38.0	0.49	77	Difficult
Rice husk	10	34.0	0.36	96	Difficult
Fallen tree leaves	15	48.0	0.90	53	Easy - Difficult
Saw dust	10	46.0	0.20	230	Very difficult

Air permeability is indicated with a weight-volume ratio. Ideal air permeability is about 0.5 (5kg of material has volume of 10 liters). You can measure the air permeability with a plastic bucket and weighing scale.

3. How to adjust the C/N ratio and water contents

Before mixing raw materials, you have to calculate (estimate) the amount of each material to be mixed. Followings show examples of the calculation. The figures shown in the above table are used in the calculation.

Case-1: You have 100 kg of rice straw

How many kgs of urea fertilizer is needed to adjust the C/N ratio at 30 ? :

100 kg of rice straw contains;

C : 100 kg x (100-10)/100 x 38% = 34.2 kg (Weight of material x dry matter ratio* x C ratio)

** The water content of rice straw is 10%, it means that the balance (90%) is dry matter. Therefore, dry matter ratio is (100-10)/100.*

N : 100 kg x (100-10)/100 x 0.49% = 0.44 kg

To make the C/N ratio at 30, necessary N amount is: 34.2/30-0.44 kg = 1.14-0.44 = 0.7 kg

Urea contains 46% of Nitrogen; therefore necessary urea amount is 1.5kg (= 0.7 kg/46%)

How many liter of water is needed to adjust the water contents at 50% ? :

100 kg of rice straw contains 10 kg of water (100 kg x 10%); therefore weight of dry matter is 90 kg. To make 90kg dry matter at 50% water contents, 90 liters (kg) of water is necessary (Y / (90 + Y) = 0.5, Y=90). This rice straw originally contains 10 liters of water, therefore 80 liters of water (= 90-10) is necessary to make it at 50% water contents.

Case-2 : You have 100 kg of cow dung

How many kgs of fallen tree leaves is needed to make the C/N ratio at 25 ? :

100 kg of cow dung contains:

C : 100 kg x (100-50)/100 x 34.9% = 17.5 kg (Weight of material x dry matter ratio x C ratio)

N : 100 kg x (100-50)/100 x 2.2% = 1.1 kg

Assume that you have added Z kg of fallen tree leaves to make C/N ratio at 25. Z kg of fallen tree leaves contains:

C : Z kg x (100-15)/100 x 48.0% = 0.408 Z kg

N : Z kg x (100-15)/100 x 0.9% = 0.00765 Z kg

Then the following equation is made: (17.5 + 0.408 Z) / (1.1 + 0.00765 Z) = 25. Answer (Z= amount of fallen tree leaves you need) is approx. 46 kg.

How many liter of water is needed to adjust the water contents at 50% ? :

100 kg of cow dung contains 50 kg of water and 50kg of dry matter.

46 kg of fallen tree leaves contains 6.9 kg of water and 39.1 kg of dry matter.

To make total of 89.1 kg dry matter at 50% water contents, 89.1 liters (kg) of water is necessary (Y / (89.1 + Y) = 0.5, Y=89.1). This cow dung and fallen tree leaves originally contains total of 56.9 liters of water, therefore 32.2 liters of water (= 89.1-56.9) is necessary to make it at 50% water contents.

4. Fertilizer value of animal manure and compost

Fertilizer value in animal manure (%, dry matter base, total value)

Type of manure:		Dry matter	C	N	P	K	Ca	Mg
Cattle	feces	19.9	34.6	2.19	1.78	1.76	1.70	0.83
	urine	0.7		27.1		88.80	1.43	1.43
Pig	feces	30.6	41.3	3.61	5.54	1.49	4.11	1.56
	urine	2.0		32.5				
Hen for egg production	feces	36.3	34.7	6.18	5.19	3.10	10.90	1.44

Note: Above figures are examples in Japan. Values can be altered by ways of husbandry.

Fertilizer value of various compost (%, dry matter base, total value)

Compost made with:	C	N	P	K	Ca	Mg
cattle dung + rice husk	37.4	2.1	2.2	3.5	1.7	1.2
cattle dung + sawdust	39.7	2.3	2.6	4.4	1.3	1.2
pig dung + rice husk	38.1	3.2	5.5	3.2	2.9	1.9
pig dung only	36.8	4.1	9.0	4.5	4.8	2.7
hen down only	27.3	3.6	8.8	5.2	10.4	2.4

Note : Above figures are examples: analytical values of commercial products in Japan. Values can be altered by ways of making, original materials, etc.

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D-2 Technical Guideline on Rice husk charcoal making

1. Introduction : What is rice husk charcoal?

Currently rice husk is abandoned at rice mill in the villages. You can change this unused material into a good soil conditioner with simple tool.

Rice husk charcoal shall be used in the upland fields and home garden. By mixing the charcoal into soil, you can expect following good effects.

- It neutralizes the acid soil since it is alkaline (pH 8-10) like lime and ash.
- It improves the physical condition of soil; make soil softer, i.e. more air in soil, better water permeability, and better water retention.
- It increases the good microorganisms in soil (such as mycorrhizal fungi), and then crops absorb more nutrients (especially phosphate) in soil.
- As the result of above effects, crops growth better and increase the yield. *

You can use rice husk charcoal for mulching in vegetable garden to keep moisture and to control weed. Rice husk charcoal is much better than grass to mulch the seeding bed, since it is no need to remove after germination. Some people say that it prevents some kinds of pests such as slug, rats, etc. In the Project, rice husk charcoal was used to improve physical condition (aeration) of potting soil for acacia nursery.

2. How to make rice husk charcoal

Items to be prepared

- Rice husk,
- Chimney for making rice husk charcoal,
- Some wood/branch for lighting a fire,
- Water to extinguish a fire, and
- Hoe or shovel

* Amount of rice husk charcoal to use in the field varies by soil type, crops, etc. In general, recommended amount is maximum 1 to 2 ton per sao (1000m^2). If you spread 1 ton of rice husk charcoal evenly over 1000m2, thickness is about 4cm.

Procedures

1. Make a small fire and put a chimney over the fire.

2. Pile rice husk over/around the chimney.

3. When carbonization starts, white smoke comes out.

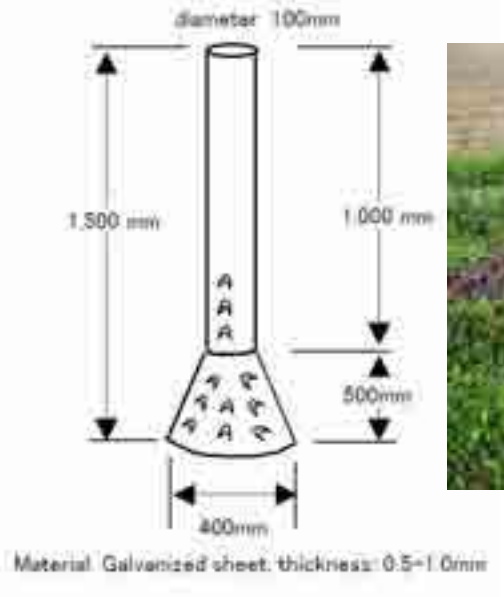
4. Mix husk sometimes to have uniform carbonization.

5. Ready to extinguish the fire.

6. Be sure to extinguish the fire perfectly with water. Otherwise all charcoal will burn up and become ash.

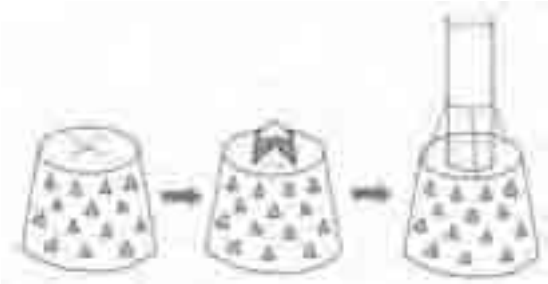
You can store rice husk charcoal in a plastic bag after drying it.

3. How to make a chimney



The easiest way of making a chimney is to use a bucket made with zinc plate (see right photo).

1. Make holes on the bucket with chisel and hammer.
2. Make a pipe (chimney) by rolling a thin steel sheet (zinc plate, 1m x 40-50cm, 0.5 to 1mm thick). Bind a pipe with steel wire.
3. Make an opening on the bottom of bucket with chisel. Be sure that size of opening fit to the pipe you made.
4. Then fix the pipe on the bucket with steel wire. (Above photo shows a square-shaped pipe fixed with screws)



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D-3 Technical Guideline on Planting elephant grass for fodder

1. Introduction

"Elephant grass" is an improved fodder grass that produces a lot of high-protein forage, and it is commonly used in a cut-and-carry system. * It is also known as " Napier grass". Its scientific name is *Pennisetum purpureum*.

Elephant grass is best suited to high rainfall areas, but it is drought-tolerant and can also grow well in drier areas. It does not grow well in waterlogged areas. It can be grown along with fodder trees along field boundaries or along contour lines or terrace risers to help control erosion. It can be intercropped with crops such as legumes and fodder trees, or as a pure stand.

Advantages

- ✓ Elephant grass is propagated easily.
- ✓ It grows very fast.
- ✓ It has deep roots, so is fairly drought-resistant.
- ✓ It has a soft stem that is easy to cut.
- ✓ The tender, young leaves and stems are very palatable for livestock.

Disadvantages

- ✓ Elephant grass is an aggressive plant that spreads through rhizomes under the ground. If it is not controlled, it can invade crop fields and become a weed.
- ✓ The older stems and leaves are less palatable for livestock.

* If you want high quality feed, cut young grass. If you want high yield, let the grass grow longer.

2. How to plant elephant grass

Items to be prepared

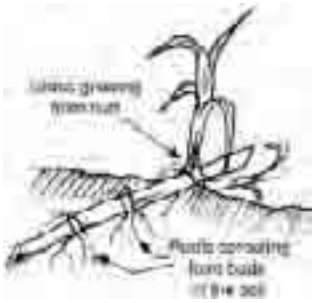
- Planting materials
- Hoe, rope, tape-measure or measuring stick with marks at 60 cm and 90 cm
- Manure or compost

Procedure

Elephant grass can be planted using three different methods: by “cuttings”, "splits" or “whole stems”.

(1) Plant cuttings

1. At the beginning of the rains, collect the planting materials. With a sharp knife, cut the bottom part of young elephant grass stems into pieces. Each piece should have at least three nodes (knobs on the stem).
2. Stretch out a rope across the plot to make sure you have a straight line. Using the hoe and measuring stick, plant the pieces of stem at 60 cm intervals along the line. Plant them angled into the ground at about 30 degrees, so two of the nodes are buried in the soil and one is above the ground.
3. Plant more rows with a spacing of about 90 cm between the rows.



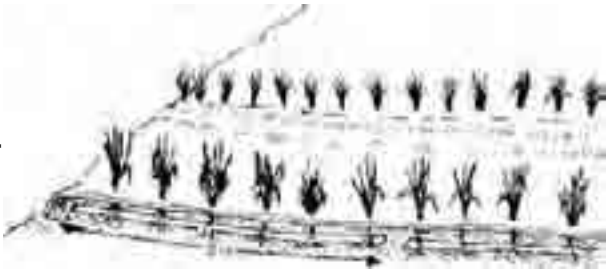
(2) Plant splits

If you planting splits, you do not have to wait a long time for the grass to grow before you can multiply it. Seedlings from the slips become established more quickly than those grown from cuttings.

1. Cut elephant grass stems at ground level to remove all the green material.
2. Dig up the clump of roots and shoots growing under the ground.
3. Separate each seedling from the clump. Each seedling must have both roots and a shoot.
4. Trim the roots to about 5 cm long.
5. Plant the seedlings in small holes or a furrow.
6. Cover the roots with soil, but leave the shoots open to the air.

(3) Plant whole stems

Planting whole stems is useful during the heavy rains, and in hilly areas where you need the grass to sprout quickly to cover the ground. Plant them along the contour to control erosion.



1. Cut whole young stems of elephant grass, about 2 m long.
2. Put the stems end-to-end in a furrow, and cover them with soil.

3. Maintenance and harvesting

1. Water immediately after planting, if no rain.
2. Weed the plot regularly.
3. If any of the cuttings die, fill in the gaps with new ones.
4. Harvest the grass when it is 90 to120 cm high. Harvest the grass following a pattern. Begin at one end of the row, cut enough grass to feed your animals for 1 day. The next day, cut the next grass along in the row. Carry on until you reach the end of the row. In this way, you will always be able to cut fodder for your livestock.

5. Apply liquid manure by digging trenches in between the rows of grass. Pour liquid manure into the trenches.
6. If the livestock do not eat all the grass, use the remainder as mulch or compost.

DO	**DON'T**
- Cut the grass 15-25 cm above the ground. Cutting at ground level may damage the plant too much. - Fill in any gaps in the rows with fresh cuttings.	- Don't use very older stems as planting materials, as they will not germinate well. - Don't intercrop with cereals, as the grass will compete with the crop for nutrients and light. - Don't allow animals to graze on the elephant grass, as they damage or kill the plants. - Don't allow the grass to grow too high (more than 120 cm), as they become very stemmy and livestock will not eat it.

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References

- Sustainable Agriculture Extension Manual, International Institute of Rural Reconstruction (IIRR) http://www.iirr.org/book.htm
- Developing forage technologies with smallholder farmers: how to grow, manage and use forages (ACIAR Monograph), ACIAR and CIAT
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D-4 Technical Guideline on Urea treatment of rice straw for improving the nutrition value

1. Introduction

Rice straw is widely used in feeding cattle. Rice straw provides some carbohydrate (energy) but it has low nitrogen (protein) and minerals.
Urea treatment is a technique to increase the nutrition value by adding more nitrogen. Treatment is simple and it is widely practiced in Asia and Africa. This manual shows the method of treating. Make use of this manual and make your farming more successful!

2. How to treat rice straw with urea

Items to be prepared

- Rice straw
- Urea
- Salt
- Clean water
- Large plastic bags which can contain water (no holes); size should be similar to the plastic woven bags
- Plastic woven bags which are commonly used to keep harvested crops (To put the plastic bag inside of it)
- Plastic sheet
- Weighing scale (To measure weight of rice straw, urea, salt and water)
- Bucket (To measure water volume, To resolve urea/salt)
- Watering can
- Knife to chop rice straw

Amount of raw materials to be prepared

Items	Mixing ratio (weight base)	Amount of raw materials		
		If you treat 10 kg of rice straw:	If you treat 50 kg of rice straw:	If you treat 100 kg of rice straw:
Rice straw	100%	10 kg	50 kg	100 kg
Urea	4%	0.4 kg (400 g)	2 kg	4 kg
Salt	0.5%	50g	250g	0.5 kg (500g)
Clean water	100%	10 liters	50 liters	100 liters
(Plastic bag)		1	5	10
(Plastic woven bag)		1	5	10

* You need 10 sets of bags to treat 100 kg of dried rice straw.

Procedures

1. First, collect rice straw and prepare all other items and working place.
2. Measure the weight of the collected rice straw. Chop the necessary amount of rice straw into small pieces (5 to 10cm long), and pile it up on the plastic sheet.
   * If rice straw is dried, you tie the straw in bundles to measure the weight before chopping. Or you may put a bamboo basket on the scale to measure the chopped straw.


3. Measure the necessary amount of urea, salt and water. Then, resolve urea and salt with the necessary amount of clean water.
4. Spray the solution (water + urea + salt) over the chopped rice straw with water can. Mix the straw well to make it wet evenly.

5. Put a large plastic bags into a plastic woven bags.
6. Put the rice straw (now it is wet with the solution) into plastic bags, then depress by your hands to make it compact. Remove air as much as possible; then seal the bags with string. You have to tie the bags firmly to make it airtight.


7. Carry the bags to under the shade for keeping. After one week, treatment will be completed and you can feed it to your cattle.

(Left) Not yet

(Right) OK

Good treatment is:

- ✓ colour has changed to brown or dark brown (dark yellow is not enough),
- ✓ strong but good ammonia smell,
- ✓ straw has become easy to twist and fold,
- ✓ no mould.

<u>Important factors you should know for the successful treatment</u>

i) Amount of urea and amount of water:

Mixing ratio and the amount of raw materials shown in the above table are the ratio/amount for the **"dried rice straw"**. It is not recommended but if you use wet rice straw, you have to reduce the ratio of water to 60-70% and urea to 3%. If you treatment in the dry season, you must no need to reduce water and urea.

ii) Temperature and period of treatment:

Ideal temperature is over 25-30 degree centigrade and, in this temperature, the treatment surly be completed after one week.

The activity of urease (microorganism) is either severely reduced or even cancelled out for temperatures below 5 to 10 degree centigrade. PoE and Hieu have possibility to have such low temperature in the nighttime of cool months, therefore it is better to practice the treatment during the warm months.

iii) Way of sealing:

If you want to treat a large volume of rice straw at once or if you cannot find the large plastic bags, you use two plastic sheets instead of the plastic bags.

Lay one sheet on the ground, and use another sheet to cover and wrap the wet rice straw. It is better to use a larger sheet for covering/wrapping. Make an overlap of these two sheets at least 70cm to attain the good sealing. Remove air as much as possible. Hold and weigh down the overlap all around.

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Additional information on Urea treatment of rice straw for extension staff

* *This paper provides the basic theoretical information about urea treatment.*

Rice straw can provide some carbohydrate but is very deficient in other nutrients. Also, because of the high lignin content, digestibility is poor. Urea treatment is a technique to increase the nutritional value of straw (enriching straw in nitrogen). It can be easily mastered by farmers and widely use in the countries in Asia and Africa.

1. Key factors for success urea treatment

Treatment consists of spraying a solution of urea onto the mass of dry straw and covering with materials available locally so as to form an airtight seal.
In the presence of water and the enzyme (urease), and if the ambient temperature is sufficiently warm, the urea hydrolyses into gaseous ammonia and carbonic gas through reaction with the enzyme. Generated ammonia gradually spreads and treats the mass of straw.

For a successful treatment, most of urea must first be hydrolysed into ammonia, and then this must diffuse correctly so fixing itself to the straw and modifying it chemically. These two processes take place simultaneously within the straw. Therefore, favorable conditions for two processes are to be ensured.

Practical conditions affecting successful treatment include the presence of urease, the application rate of urea, moisture content, ambient temperature and the treatment period, the degree of hermetic sealing achieved during the treatment and finally, the quality of straw to be treated. These factors are interdependent and it is difficult to dissociate one from the other.

Presence of urease

Hydrolysis of urea can only take place if urease (enzyme) is present. Urease is produced by ureolytic bacteria. These bacteria are present in the soil and also, in urine and faeces from both humans and animals. Therefore, urease is rarely lacking in rural areas.

Application rate of urea

It is now well established that optimum application rates lie between 4 and 6 kg of urea per 100 kg of straw matter.

In conclusion and in practice, the majority of the studies and field observations lead to a recommended urea application rate of 5 kg per 100 kg of dry straw.

Efforts have been made to reduce urea application rates to 2 or 3 % by mixing it with lime, $Ca(OH)^2$. A trial in Vietnam (BUI VAN CHINH et al., 1994) concerned rice straw treated with 2.5 kg of urea, 0.5 kg of lime and 0.5 kg of salt, yielding interesting results for crossbred cattle.

Moisture content (amount of water to add)

Hydrolysis of urea can only occur if water is present. The amount of water to be added to the straw is thus a determining factor for a success of the treatment.

The final moisture content should never be greater than 50 %. Ideally, it should lie in the range of 30 to 50 %.

As a practical conclusion one should aim for adding 50 liters of water to every 100 kg of forage (during the dry season). This general rule has been well proven in many situations. There is no problem if the amount of water added varies within the range of 40 to 80 liters.

Amount of water (liters) to add to 100 kg of straw to obtain a final moisture content of 30 to 50 % according to the straw DM content

Water to add (1/100 kg of straw)	Initial DM content of the straw (%)	Final Moisture Content (%)
23	85	30
30	90	
38	95	
75	85	50
85	90	
95	95	
50	90	39

Ambient temperature and the treatment duration

The ideal ambient temperature for ureolysis is between 30 and 40°C. For temperatures above 25 or 30°C ureolysis is accomplished after a few days or even less if moisture content is not a limiting factor. At lower ambient temperatures activity of the ureolytic bacteria is slowed down as is the ureolysis.

In practice: ambient temperature in tropical countries is high and is not a limiting factor for treatment with urea, except in the particular case at high altitude.

Degree of hermetic sealing

Degree of hermetic sealing is important from the point of view of avoiding losses of urea solution and also to ensure an anaerobic environment (serving as a guarantee against the development of mould).

In effect, the ammonia which is lighter than air, diffuses throughout the forage and has a tendency to escape if the straw is not sufficiently compacted and the straw heap not sufficiently air tight.

Quality of straw

It is difficult to distinguish between good and poor quality straw. It is generally recommended to treat only forages which are “dead” (shriveled and no longer green) and which are not damp so as to avoid possible mistakes of applying either too much water or urea.

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References

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