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Decision guide on developing livestock enterprises with rural communities in Africa

Part 1: Rabbits, Goats and Poultry

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1 Introduction: Livestock enterprises within the Enabling Rural Innovation (ERI) context

The guidelines provided in this document are not intended to be comprehensive, but rather give field workers and researchers an idea of what to think about before planning to develop new livestock enterprises with communities. The aim is to give the reader enough information to be aware of the possibilities, and to provide warnings to prevent situations of classical mistakes resulting in unnecessary failure of the enterprise. The information is compiled for the African context. There is a reference list at the end that provides practical and comprehensive background information on tropical livestock rearing.

In the ERI process, the selection of enterprises are based on market opportunity assessments, production feasibility and profitability. Technical input is required to facilitate the analysis of production feasibility and ex-ante cost benefits analysis. Knowledge and skills are also required after the initial analysis, especially in livestock enterprises, which tend to be more complex and vulnerable than in crop production systems. In relation to knowledge and skills, one needs to assess whether the farming community has experience, whether there are service providers whom farmers can depend on for advice, and whether farmers or field workers can be trained in absence of required knowledge and skills. Initial necessary capital investments can be high in some livestock enterprises. In the long term factors such as feeding expenses, risk of animal diseases, labour, and marketing infrastructure become important for success and sustainability. The table below gives an overview of requirements and risks for several livestock systems that have been identified by communities in the ERI process. Enterprises with the lowest requirements and risks are semi-intensive rabbit and stall fed goat systems.

Table 1. Type and level of requirements for different smallholder livestock systems in the tropics.

Livestock system	Knowledge and skills required	Starting capital required	Feeding expenses	Daily care and labour	Risk of disease incidence	Marketing infrastructure required
Semi-intensive rabbits	**	*	*	**	**	*
Stall fed goats	*	**	*	*	**	*
Scavenging poultry	*	*	*	*	***	*
Semi-intensive poultry	**	*	**	**	***	**
Intensive poultry	***	***	***	**	***	***
Semi-intensive pigs	*	**	***	**	*	*
Dairy cattle	***	***	**	***	***	***

- * low
- ** medium
- *** high

2 Rabbits

2.1 Advantages of semi-intensive rabbit enterprises

- Doesn't need much land.
- Little starting capital needed, pro-poor.
- Can provide meat in small portions for home consumption
- Rabbits can feed on weeds and kitchen wastes.
- They multiply quickly.

2.2 Risks

- Can multiply faster than farmer can deal with, resulting in overcrowded pens, lack of feed, diseases, and mortality.
- The rabbits need daily care.

2.3 Conditions for smallholder systems

When deciding on rabbit enterprise development, the scale of the enterprise needs to be planned carefully. The biggest investment is in the housing, which can easily become too small when rabbits multiply. Under forage fed semi-intensive conditions, a doe can have three litters per year, each producing 8-10 kids. Each litter will take 8-9 months to reach the body size for sale or consumption. The size of the enterprise and housing required is therefore directly related to the number of breeding does one intends to keep.

2.4 Required inputs

- Building materials for housing
- Daily labour
- Weeds, forages, and tubers or grains
- Water

2.5 Training needs

- Construction of housing
- Feeding practices
- Breeding

2.6 Nutrition

In the semi-intensive system, the bulk of the feeds consist of weeds, grown forages, and kitchen wastes. It is advisable though to supplement breeding does with high concentrate energy and protein feeds during critical times. The critical times, when the doe needs more nutrients, are when she suckles her kids, especially when she has big litters, and after weaning when she needs to regain weight before the next breeding. Concentrates can be home made and can consist of:

- Crushed grains
- Bran of grains
- Oil seed cakes (e.g. from groundnut, cotton seeds, coconut, soya bean)
- Tubers and dried cassava

Do

- Ask about how a rabbit was fed when you buy it and try to carry on feeding it in the same way for the first one or two weeks whilst you change gradually to your system.
- Provide fresh, clean water.
- Provide fresh food, little and often.
- Have proper troughs.
- Remove any food not eaten.
- Feed at the same time each day.

- Feed at least three times per day.
- Feed a variety of foods but change from one food to another gradually.

Don't

- Feed on the floor of the hutch
- Feed very wet forages
- Feed spoiled, or dirty, or mouldy food or food that is not fresh
- Give food contaminated with faeces of any kind
- Feed less than three times per day when forages are the main food
- Feed the same food all the time
- Change foods suddenly

(Fielding, 1991)

2.7 Health

Common diseases in rabbits are coccidiosis, mange, snuffles, mastitis, inflammation of the eyes, but there are other diseases as well.

- Coccidiosis. Internal parasite that causes diarrhoea. Dirty and wet environment triggers coccidiosis.
- Mange. External parasite that affects ears and skin.
- Snuffles. Bacterial infection that causes sneezing and runny nose.
- Mastitis. Bacterial infection that affects the milk glands, and can stop milk production soon after kindling.
- Inflammation of the eyes. Bacterial infection, enhanced by dusty foods.

For prevention and treatment see Fielding (1991).

2.8 Breeding

Some numbers related to breeding:

- Age of maturity (first mating) for does: 8-9 months
- Pregnancy: 30-32 days
- Weaning: 6-8 weeks after kindling
- Recovery period before next mating: 4-6 weeks
- Litter size: 8-10
- End of reproductive life: 3-4 years
- Ratio of breeding buck to does: 1 to 10.
- Slaughter live weight of 1.5 kg can be reached at 9 months age.

For mating, the buck should never be brought into the doe's hutch, but the doe should be brought into the buck's hutch. If the buck is brought into the doe's hutch, she will usually fight and injure him. If she refuses using the correct procedure, return her to her hutch and try again after 6 hours. Mounting of the buck triggers luteinising hormone production in the doe, followed by ovulation.

2.9 Housing

Housing can be made of local materials, using poles, small stones, straight sticks, old engine oil, dry grass, chicken wire mesh, bottles, plastic containers (water), cut cans and clay bowls (food). The hutches should be raised above the ground (at least 95 cm) to prevent disturbance by dogs. The location should be quiet, as rabbits are easily stressed.

The doe needs a kindling box in her hutch, where the kids are safe and warm. The doe needs the box to escape from the kids and rest on top of it. The doe's hutch should be larger than the buck's, because of space for the kindling box.

Hutches size (floor space): 90 x 70 cm for does
90 x 70 cm for weaners
70 x 70 for bucks

3 Goats

3.1 Advantages of stall fed goat systems

- Can utilise low quality feeds as basal ration
- Can use a diversity of vegetation to supplement basal feed.
- Relatively little starting capital needed.

3.2 Risks

- Worm infections can severely affect health and productivity when tethered or free grazing.

3.3 Required inputs

- Construction of pen
- Year round supply of forage
- Labour
- Water

3.4 Training needs

- Endo-parasites and other diseases
- Feed rations

3.5 Nutrition

Goats and other ruminants can utilise low quality feeds because of their digestive physiology; they have a large rumen in where fermentation takes place during which micro-organisms turn nitrogenous compounds into high quality proteins. If only low quality roughage is fed, however, goats will stay alive but not be productive. They wouldn't gain weight, and fail to produce milk for their kids. Green, lush forages can provide high amounts of energy and protein to supplement low quality roughage. These extra amounts of energy and protein also enhance the efficiency of the rumen micro-organisms, resulting in higher digestibility of the roughage, and higher productivity.

Low quality roughages:

- Maize-, sorghum-, and millet stover.
- Wheat-, barley-, and rice straw.
- Mature dry grasses.

Energy rich feeds:

- Green grasses (e.g. napier, Rhodes grass, brachiaria)
- Molasses
- Brans
- Tree fodder such as mulberry or ficus

Protein rich feeds:

- Herbaceous legumes (e.g. stylo, lablab, centrosema)
- Leguminous trees (e.g. calliandra, sesbania, leucaena)
- Oil seed cakes (e.g. soya bean meal, cotton seed cake)

One should aim to formulate rations consisting of feeds from each of the three groups above, to optimise use of resources and productivity. If no low quality roughages are available, they can be replaced by grasses.

Sudden complete change of diet can cause diarrhoea or bloat.

3.6 Health

Local goat breeds in the tropics are generally hardy animals. A low plane of nutrition, poor management and lack of sanitation and hygiene, however, can seriously affect their health and performance. Some of the most common diseases that affect goats in Africa are described below (based on Devendra and McLeroy, 1982).

- Peste des petits ruminants (PPR). This is a virus that resembles rinderpest, but is restricted to goats and sheep. Symptoms are high fever, catarrh, nasal secretion, diarrhoea, and lesions in the mouth. Mortality is high. Very contagious. Vaccines do exist.

- Contagious caprine pleuro-pneumonia (CCPP). A micro-organism that spreads through droplets from nasal discharge, for instance when goats are coughing or sneezing. Symptoms are respiratory problems, nasal discharge. Mortality can be very high. Antibiotics can treat the disease. Vaccin exists.
- Coccidiosis. A protozoal disease that occurs in intensive units where adults and kids are housed together. Symptoms are diarrhoea, fever and anorexia. Treatable with sulphur drugs. Sanitary measures are essential for prevention and to stop spread of the disease. Desinfect pens.
- Contagious ectyima. Relatively mild viral disease. Symptoms are sores around the lips. In severe cases prevent goats from eating and kids from suckling. Spreads rapidly between animals. Rarely fatal. Separate infected animals and treat sores with gentian violet. Vaccination is possible, can even be locally made with little means.
- Mastitis. Bacterial infection of the mammary glands. Common in lactating goats. Swollen udder, one or both teats. Reduced milk production. Caused by poor milking hygiene. Treat by proper sanitation, and infusion of anti-mastitis creams in the teats after milking.
- Helminths. Larvae of worms are present in pastures where goats graze, and are consumed by the animals. Larvae develop into mature worms in the gastrointestinal tract, where they compete for food with their host. Haemonchus contortus is particular dangerous worm, which can suck blood and cause death of the host. Young animals are more vulnerable. Goats pass eggs through their faeces and humid conditions stimulate larvae build up in the grass. Prevention through zero-grazing, and treatment with oral anthelmintic drugs. Regular drenching recommended to reduce infection.
- External parasites. Mange mites can be treated with external sprays, powders, or application of old engine oil.

3.7 Breeding

- Does can start breeding at 12 months of age, provided that they have been well fed and are in a good condition. Otherwise, breeding should be postponed. Bucks can start breeding earlier.
- Oestrus cycle about 18-21 days, can vary more. Presence and contact with bucks stimulates oestrus.
- Gestation period varies by breed, ranging from 145 (local) to 153 days Anglo-Nubian.
- Local does can produce kids twice a year or thrice in two years. European breeds are sensitive to seasonality based on day length and normally only breed once a year.
- Litter size ranges from 1-3 kids. The average ranges from 1.1 to 2.4, depending on breed.
- Kidding percentage is:

$$\frac{\text{Number of kids produced per year}}{\text{Number of breeding does}} \times 100 \%$$

- The kidding percentages normally range from 120 – 200 %.
- Average kid mortality is 10 %, doe mortality 5 %.

Ambient temperature, level of nutrition, health, stress, diseases, heat detection, and handling can all affect reproductive performance of goats.

3.8 Housing

Although goats can be kept in extensive grazing systems without any housing, keeping goats in houses has several advantages: protection of crops, prevention of helminths, enabling improved feeding practices, controlled breeding, quarantine, reduced theft and predation. An enclosed pen with a roof is the simplest form. A raised slatted floor promotes hygiene. In case closed walls are constructed, ample openings for ventilation are essential. Local building materials such as bamboo, poles, and off-cuts are cheap and very appropriate. Provide forage in raised slatted troughs, or tied from the roof with a rope.

Required floor space:

- Kid 0.3 m²
- Doe 1.8 m²
- Buck 2.8 m²

4 Poultry

4.1 Advantages

- One can start small, little investment
- Regular supply of eggs for sale or consumption
- Meat supply suitable in portions for home consumption
- Few religious and social taboos on consumption of poultry products.
- Gradual increase in productivity possible, related to investments and care.

4.2 Risks

- If not scavenging, poultry need high quality, expensive concentrate feeds.
- Layer chicks need high feed investments for about 6 months before they start laying eggs.
- Susceptible to highly infectious and highly lethal diseases such as NCD.
- They can damage vegetable gardens.

4.3 Poultry systems for smallholders

In this document, three different poultry systems are referred to: scavenging, semi-intensive, and intensive. Scavenging chickens often serve multiple purposes: production of eggs, meat and savings. They are kept on small scale, with the number of mature birds seldom exceeding 50. Scavenging chickens find their own food in the compound or farm land. They are generally capable of finding enough protein in seeds and insects to meet their requirements. It has been found however that supplying extra energy to these birds can increase their growth rate and egg production. Energy rich feeds such as maize or broken rice grains, or cereal brans are often thrown on the ground or supplied in simple troughs for the birds to feed on. Poultry housing is simple, and only needed at night and to provide a place for laying eggs. In many parts of East Africa though, scavenging chickens need to be locked in during the early growing period of beans, because they feed on the young leaves and flowers. This can form a serious constraint on the system in terms of feed availability. Many households have to sell part of their flock during this season, and market prices generally drop.

The term semi-intensive system is a bit arbitrary indeed. For instance, supplementary feeding of scavengers could be considered a semi-intensive system. There are many additional improvements one can make in the tropics with the aim to increase productivity, without necessarily developing intensive deep litter systems or battery cages. Improvements leading to semi-intensive systems are:

- A fenced off area for chickens to move around.
- Improved housing that can accommodate a larger number of mature birds (50 – 200), and with nest boxes for laying hens.
- Use of improved cock breeds or hybrids to cross-breed with local hens.
- Artificial hatching of eggs
- Controlled rearing of chicks, with or without hen.
- Supply of high quality feeds and clean water.
- Removal and efficient use of manure
- Vaccinations

In intensive systems one is highly specialised in either broiler or layer production. Local breeds are not suitable for this system, as their genetic production potential would be a serious limitation. Hybrids are mostly available in the tropics for these systems, although sometimes pure exotic breeds can be found (Rhode Island Red, Leghorn, Barnevelder). Specialised layer and broiler hybrids and breeds have lost their instinct to hatch eggs, to raise chicks, to scavenge, and are even more susceptible to diseases than local breeds. Hybrid day old chicks are produced by specialised breeders, and often these chicks can be found in the market. Day old chicks need warmth to survive, starting at an ambient temperature of 35° C in the first week, gradually cooling down to 23° C in the fourth week. Broilers and layers in the tropics are often kept on deep litter systems, whereas layers are sometimes kept in cages on top of each other, in the so-called batteries. A range of vaccinations, compound feeds, and hygienic feeders and drinkers are essential in the intensive systems.

4.4 Required inputs

Scavenging:

- Make shift housing
- Water

Semi-intensive:

- Feed supplements
- Improved housing
- Water
- Improved cocks (optional)
- Fenced area (optional)
- Vaccinations (optional)

Intensive

- Hybrids or exotic breeds
- Efficient housing and chick rearing facilities
- Daily labour
- Commercial feeds and feed additives
- Water
- Vaccinations

4.5 Training needs

- Disease prevention strategies
- Vaccination schemes
- Feed rations for home made compound feeds
- Poultry management

4.6 Nutrition

Poultry are monogastrics, they are unable to synthesise essential amino acids and B vitamins, and cannot exist on high fibre diets. Essential nutrients in the diet are:

- Water
- Carbohydrates
- Fats and oils
- Protein (amino acids)
- Vitamins
- Minerals

Commercial poultry are usually fed *ad libitum*; they can eat as much as they like. They normally consume just enough food to satisfy their energy requirements. Diets of laying hens need to consist of 11.5 – 12.5 MJ metabolizable energy per kg food, 16.5 – 17.5 % crude protein, 2.5 – 3.5 % calcium, and 0.6 – 1.0 % phosphorous. Broilers need higher protein levels (19 %), similar energy levels, much lower calcium levels (1 %), and similar phosphorous levels. At the rearing stage, all chicks need higher protein levels (up to 23

% for broiler chicks). Crude protein content is a very poor indication of the quality of the feed; it consists of 11 essential amino acids, and each amino acid needs to be present in sufficient quantity (see McDonald et al, 1981). Likewise, there are at least 5 vitamins that need to be present in much smaller quantities. Commercial feeds are supposed to consist of various plant and animal products, mixed in such a way that all nutrients are present in the right proportions. In many tropical countries though, quality control of poultry feeds is absent or non-functional, resulting in poor quality feeds available for sale. Many medium scale farmers have resorted to mixing their own feeds for that reason. Investing in a feed mill by farmer groups would certainly be an option for intensive poultry enterprise development within the ERI realm.

Proper evaluation of use of locally available feed resources will have a positive effect on the profitability of the enterprise. Carbohydrates can be supplied through some unconventional but valuable local feed resources such as: cassava roots, sweet potato tubers, and brans from milling of grains. Likewise, locally available protein sources can be used such as: seeds of legume forage crops, leaves of trees and legumes, fly larvae, and earthworms. Cassava needs to be dried or boiled to eliminate toxic substances. Tree and legumes leaves can be added up to 3% dry matter of the diet without suppressing production. Apart from providing protein, tree fodder provides pigmentation for the egg yolk, some vitamins, and they reduce cannibalism.

4.7 Health

For the intensive systems, there are a few important principles for prevention of diseases:

- Vaccination and prophylaxes¹
- All-in all-out system
- Sanitation
- Isolation

Vaccines often come in individual vials that contain enough material to vaccinate 1,000 birds, such as the New Castle Disease (NCD) vaccine available in Uganda. Before use, the dried vaccine needs to be reconstituted with water, and thereafter it only remains viable for a maximum of one hour. This puts a serious limitation on the practicality of vaccination for scavenging, or semi-intensive poultry. A NCD vial costs about US\$ 6, and its vaccination has to be repeated initially every three months, and later twice a year. Travelling between villages or households, however, often takes a lot of time, reducing the number of small flocks that can be treated with one vial. The smaller the poultry system, therefore, the more expensive the vaccination per bird.

The all-in all-out system means that all chicks arrive at the farm around the same time, raised, and kept for the same length of time, and slaughtered or sold at the same time. Before the next batch of chicks arrives, the sheds and premises are thoroughly cleaned; the floor, walls or cages and utensils disinfected, and kept empty for 2 weeks. Keeping the premises clean from droppings, feathers and carcasses at all times is an important

¹ A medicine that is administered before the occurrence of the disease, but unlike vaccines does not stimulate immunity.

sanitary measure for scavenging, semi- and intensive systems. Isolation can be obtained by fencing the areas where poultry have access, or keeping the birds in houses, and avoiding contact with birds from other farms.

Some major diseases in the tropics are:

- New Castle Disease (NCD). Caused by a virus. Very contagious and spreads from bird to bird by droplets and moisture in the air, contaminated food, carcasses, and even clothing. Mortality rate can be as high as 100 % in young chickens. Other symptoms are paralysis, difficulty in breathing, greenish diarrhoea, and discharge through the beak. There are two types of vaccines, dead and live. The live vaccine should precede the use of a dead vaccine. The vaccinations are repeated several times, depending on the type of vaccine used.
- Gumboro disease. A virus that spreads through direct contact between young birds. Symptoms are diarrhoea and lying down. Prevent spreading by isolation of infected birds. Vaccines are available.
- Fowl pox. Caused by a virus, and very prevalent in scavenging system. Scabs on the comb, wattle and eyelids. Transmitted by insects. Can cause death. Can be vaccinated against.
- Coccidiosis. This disease is caused by protozoa which settle in the intestines or caeca. It causes watery and bloody diarrhoea. It is more prevalent in intensive systems. The disease spreads through droppings. In scavenging and semi-intensive systems, with low levels of coccidiosis, a strategy of building up of immunity is recommended. In intensive systems, prophylaxis are normally fed with the feed, to prevent any infection.
- External parasites. Lice, ticks and mites can cause general illness, slow weight gain, low egg production and skin irritation. Nests should be kept clean and roosts should be painted with nicotine sulphate. Stick-fasts are fleas that stick to the head comb and wattles in their mature stage. Eye sight can be completely obscured by heavy infestations around the eyes. Prepare a mixture of lard and kerosene (3:1) and apply to affected areas on the birds.

4.8 Housing

Scavenging poultry need housing at night to protect them from predators and to give them a sense of home. Houses come in all sorts of shapes; the most important principle is that they can be cleaned easily. Clean drinking water needs to be provided throughout the day. Raised housing with slatted floors have the advantage that droppings can be easily removed and stored as manure for crops. In some semi-intensive systems, houses are built to accommodate many birds at night. Perches (20 cm per bird) and nest boxes (4 laying birds per nest) are provided.

The deep litter system is appropriate for intensive systems. Litter material can be wood shavings, saw dust, rice husks, or groundnut husks. Per bird, 0.25 m² floor space is needed, 12 cm of feeding space, and 5 cm of drinking space. Two opposite walls need to be of wire mesh, and positioned in such a way that direct sunlight does not enter (east-west longitudinal).

4.9 Chick rearing

Day old chicks are best reared on deep litter, a layer of 6-12 cm. They need a warm environment, starting with 35°C the first week, and gradually dropping to 23°C in the fourth week (see table 2).

Table 2 Temperature requirement of chicks

Age of chicks	Ambient temperature °C
1 day – 1 week	35
1-2 weeks	30
2-3 weeks	26
3-4 weeks	23

Electric heaters, kerosene heaters, or lamps can provide the warmth for the chicks. A round enclosure needs to be constructed to keep the chicks not too far from the heat source. Gradually, the enclosure needs to be expanded (see table 3).

Table 3. Floor space and trough space requirements per 100 chicks.

Age (weeks)	Floor space (m ²)	Trough space (m)
0-4	4	1.5
5-8	9	3.0
9-20	12	6.0

In semi-intensive systems, with small batches of chicks, day old chicks can be reared in insulated wooden boxes without any additional heating source.

5 References

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Appendix 1. Example of cost and benefit calculation of rabbit production, without labour.

3 breeding does										
1 buck shared with neighbours										
Each doe 3 litters per year x 7 weaned per litter										
			Unit	No.	Unit cost	Subtotal	Total	Total	Life	Deprec.
Fixed costs							MK	US\$	yr	MK
Housing²						2,821			5	564
does		hutch	3	70		210				
weaners ³		hutch	37	70		2,590				
buck		hutch	0.3	70		21				
Equipment						120			5	24
Feeding troughs and drinkers ⁴		trough	40	0		0				
Nest boxes (timber)		box	3	40		120				
Animals						660				
Breeding stock			3	220		660			3	
Total fixed costs						3,601				588
Operating costs										
Concentrates						10,920				
mixture of bran, grains and oil seed cake is 2:2:1										
bran		kg	312	10		3,120				
grains		kg	312	15		4,680				
oil seed cake		kg	156	20		3,120				
Roughage						2,170				
fresh or wilted grass/weeds/forages		kg	1,085	1		1,085				
kitchen wastes		kg	270	0		0				
crop residues		kg	1,085	1		1,085				
Health care						0				
antibiotics ⁵		sachet	(check local store)							
Total operating costs						13,090	13,090	119		

² Local materials and purchased nails

³ Weaners spend 7 months in individual hutches

⁴ Locally available materials such as bottles and cans

⁵ Estimate one treatment per year for all animals. In absence of disease not necessary.

FEEDS										
Amount of concentrates		no. animals	days feeding	average grams feed per day (dry matter)	total feed (g)	fresh weight (kg)	fresh or wilted grass/weeds/forage	kitchen wastes	crop residues	
does		3	365	100	109,500	110				
weaners		63	213	50	670,950	671				
						780				
Roughage⁶										
does		3	365	90	98,550	296	118	30	118	
weaners		63	213	60	805,140	2,415	966	242	966	
Profit and loss calculation		No. rabbits sold	Price per rabbit	Income, MK/year	Costs, MK/year	Profit/ loss				
Income calculation		63	330	20,790						
Costs					13,678					
Profit/loss						7,112				

⁶ Total dry matter intake (DMI) of weaners is about 110 g per day. Total DMI of does and suckling kids is about 190 g per day average throughout the year. If less concentrates are fed, intake of roughage increases.