PART-3

Technical Manuals

N-CLIMP

Training Material 8

Agronomy, October 2015

Phase 2

N-CLIMP

Training Topic: Agronomy

Course Material prepared by Agra ProVision
for JiCA / N-CLIMP

October 2015

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Topic 1: Overview of Commercial crop production in Namibia

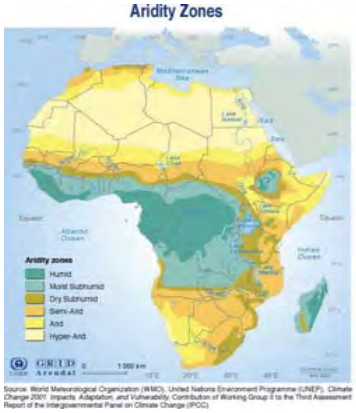
The map of Africa clearly shows that Namibia is the driest country south of the Sahara. This has an influence on the dry-land crop production market in Namibia.

Production of crops is possible on a limited scale and in specific areas. The following crops are commonly used for commercial production:

Millet		Maize	
Sorghum		Sunflower	
Cowpeas		Peanuts	

All crops are dependent on the rain fall in the area. Therefore the profitability depend on mainly Rainfall.

- Crop failure is therefore common



Source: World Meteorological Organization (WMO), United Nations Environment Programme (UNEP), Climate Change 2001: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Controlled crops

The following crops are controlled by the Agronomy Board of Namibia:

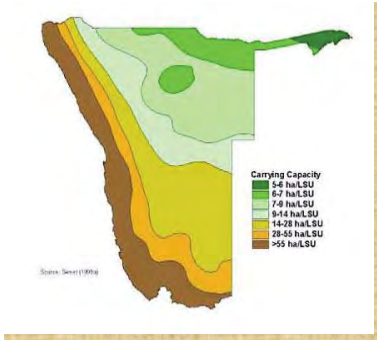
- White maize and products
- Wheat and products
- Mahangu and products

If a farmer produces more than 5 ton he must register with the Agronomy Board.

In 2012 there were 271 commercial crop producers in Namibia and 27 processors (mainly mills).

Maize/dry land

Maize is mainly cultivated in the Maize triangle, Omaheke (Summerdown) and Caprivi.



Maize is planted from December to January and marketed from May to July.

The borders close on 1 May for all imports of controlled products, until the current harvest is milled.

In 2012, 11 000 ha was planted dry land.

The average harvest is between 40 000 to 60 000 ton for Namibia.

Non-Controlled Crops dry land

The following crops are not controlled by the Agronomy Board of Namibia:

- Yellow maize, Sorghum, Groundnuts, Sunflower and cowpeas

Yellow maize and Sorghum and Cowpeas are mainly planted in Namibia as fodder crops. Sunflower is planted only for oil in Namibia on a small scale. Ground nuts are planted up to a 1000 ha per year depending on the price offered.

Quality standards

The quality of crops in Namibia when sold is based on the quality standards of SA. Namib Mills will distribute these standards on request. The millers in Namibia will normally only buy grade 1 and 2 maize and wheat.

Farmers are only allowed to sell the current year's crop production under the marketing scheme for maize and mahangu.

The borders close from:

- 1 May until all available grain from 1 April is sold and partially milled (white maize)
- 1 June until domestic harvest is sold and partially milled (millet).

Crops harvested before 31 May is sold in the open border period.

Only maize harvested from 1 April onwards falls under this agreement.

Prices for grain crops refer to the minimum prices paid by the mill and delivered to the mill.

Marketing of the controlled products must be executed within the parameters of the signed agreement between crop producers, millers and consumers.

Price Principles

Reference price – mill-door price (during the period that the border is closed)

- Five year average of actual spot price (SAFEX) + full official inflation. N$ 2000 /ton +
- GMO premium 8% on SAFEX of reference price
- Transport component official ex Bloemhof min inward diff Randfontein
- Transport component can change if needed
- Staggered price reflecting storage cost
- Reference price only for 14 – 17 June
- 6 weeks before till border open N$ x/week

If SAFEX spot price is higher than reference price

Payment of the crops (within two weeks) is according to the average spot price of the previous two weeks

GMO free a premium of 8% is added to the minimum price

The Transport component (Douglas), i.e. transport from SA to Namibia is included in the calculation of the minimum price.

Both reference price and SAFEX spot price are Mill-door prices.

Levies

The following levies are payable:

- WM producer's levy: 1.4%+15% VAT on the reference price
- Mahangu: 0.9% +15% VAT on the reference price
- Deduction of 6% from grade WM1 to grade WM2.

Crop Producers' Principles

To sell:

1. Sold in the closed border period
2. Has to be sold at least against the reference price
3. In the open border period crops can be imported therefore local producers should sell for not less than actual import parity for GMO-free grain (mill door)
4. Not to stockpile before April
5. To disclose all produce before April

Crop Producers must:

- Deliver at own cost
- With minimum impurities
- Deliver current year's harvest
- Not expect millers to accept feed grade

Minimum Floor price

30% of 5 year average of SAFEX spot price + Transport Upington to Windhoek (transport for Oct. determined first week of November)

70% of 5 year average HRW import parity price from US Rand/US$ Exchange including the transport via Walvisbay to Windhoek. (transport for October is determined during the first week of November)

Price Principles

Reference price – mill-door price (close border)

- Five year average of actual spot price + full official inflation. N$ 2000 /ton +
- GMO premium 8% on SAFEX of reference price
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If SAFEX spot price is higher than reference price

Payment (within two weeks) according to average spot price of previous two weeks

GMO free premium of 8%

Transport component (Douglas)

Both Reference price and SAFEX spot price is Mill-door prices

Levies

WM producers levy: 1.4%+15%vat on reference price

Mahangu: 0.9% +15% vat on the reference price

Deduction of 6% from WM1 to WM2

Producers Principles

To sell:

1. Close border period
   - at least against reference price
2. Open border period
   - Not less than actual import parity for GMO-free grain (mill door)
3. Not to stockpile before April
4. To disclose all produce before April
5. Producer must
   - Deliver at own cost
   - With min impurities
   - Deliver current year's harvest
   - Not expect millers to accept feed grade

It is important to know the potential and limitations of different soil types. Understanding the different soil types will also assist you in knowing how to treat the soil

What is soil?

Soil firstly comprises mother material rocks

- The rocks contain minerals

Soil forms over thousands of years.

Secondly organic material:

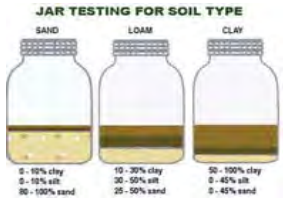
- Plants and animal rests
- Minerals and carbon

Thirdly Micro-organisms:

- Decomposed dead material
- Rhizobium bacteria > N

Types of soil

There are basically 3 main types of soil:



- Sand
- Loam
- Clay

Particle size

- How much air and water is in the soil
- Smaller particles can hold more water and less air
- Different soils have different effects

Clay soil:

- largest moisture retention
- Difficult to work
- Root, tuber unsuited to clay
- Poor aeration

Sandy soil:

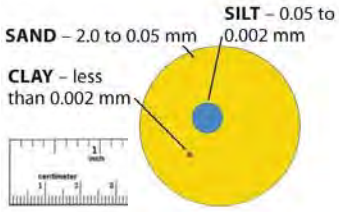
- Poor water retention
- Drain well
- Easy to work
- Application of organic material essential
- Improves root development

Sandy loam:

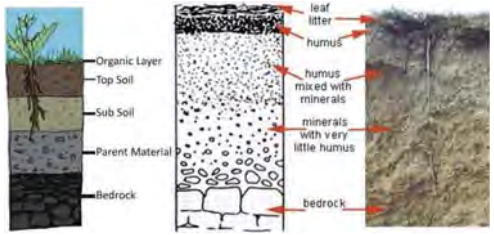
- Combination of above
- Best soil for vegetables

Sand Silt Clay

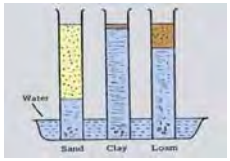
The following graphic depicts the different in sizes amongst the 3 particles:



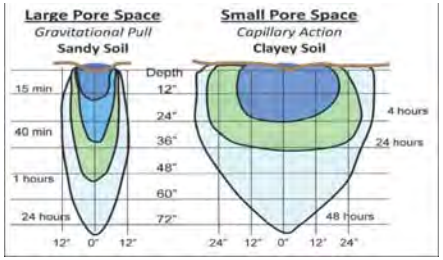
Topsoil and Subsoil



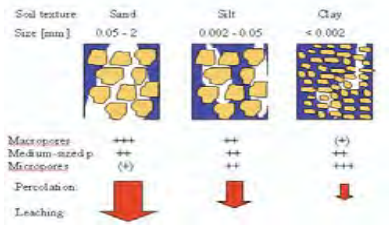
Capillarity of sand and Clay soils



Water infiltration

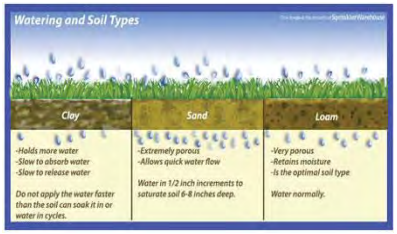


Movement of water through the soil

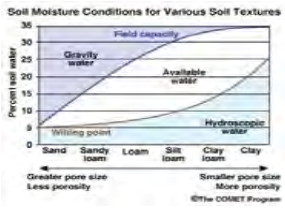


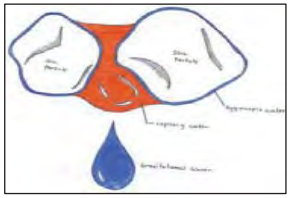
Water moves easily through sandy soils that will lead to leaching of nutrients. In loamy soils less leaching will happen. In Clay soils very little leaching will occur but water logging can be a problem due to poor drainage in clay soils.

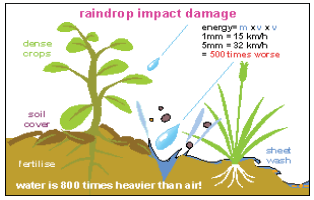
Irrigation and soil types



Soil water







To eliminate the effect of the rain drops on the soil, the soil can be covered with stubble or plant material from the previous crop.

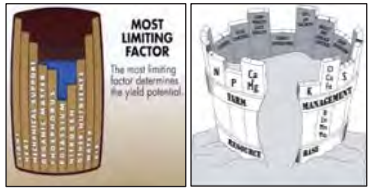
Soil structure

Soil fertility

The following minerals/nutrients are available in the soil for plants:

- N, P, K, S, Zn, Mg, Ca, Cu, B, Mo

Use the weakest element as point of departure to apply inputs – the elements need to be in balance.

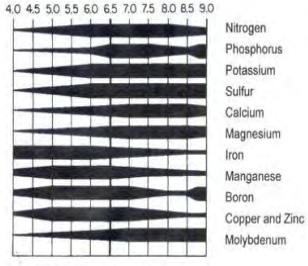


The availability of nutrients is determined by the following:

- pH 5 to 7 suitable for most crops
- Clay content between 15% to 30% clay is ideal will also be able to store the maximum plant available water for dryland conditions.
- **Organic matter**: It is a very limited factor in the Namibian soils due to our climate and therefore soil management must concentrate on increasing the soil organic matter. Organic matter will improve the fertility and water-holding capacity of the soil.
- **Air**: It is important to prevent water logging in the soil and therefore cultivation must aim to prevent compaction of the soil. Organic material will also have a positive effect on the soil aeration. Nitrogen is not available in water-logged conditions.
- **Soil moisture**: water is needed for the soil organisms to convert soil nutrients to be utilised by the plants.
- **Micro-organisms**: It is important to convert soil nutrients in plant available forms.
- **Temperature**: The availability of plant nutrients is determined by the soil temp. Zn will be less available in cold wet conditions.

Soil pH

Influence of pH on Nutrient availability.

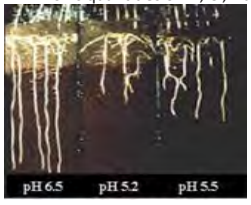


Stunted maize due to low pH

The result is normally an Aluminium toxicity that will prevent root development. This is normally on sandy soils. Can be rectified with liming.

Restrictive factors

- Toxic quantities of Al, Cl, Na, Mo, B



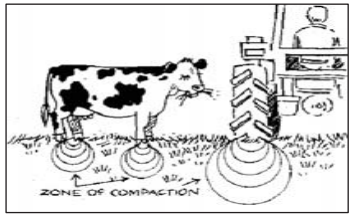
Seedlings exposed to increasing acidity

- Unbalanced elements

A soil sample will assist you in identifying possible problem areas and can be a guide for fertilizer recommendations.

Soil compaction

Animals and Machinery



Ploughing causing a plough pan

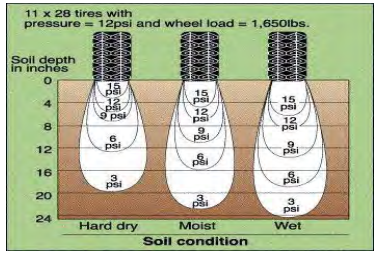
Disk causing a disk pan

Disk and Plough pans

Roots cannot penetrate!

Roots don't penetrate the compact layer!

Compaction in wet versus dry soil



Effect of a compacted layer

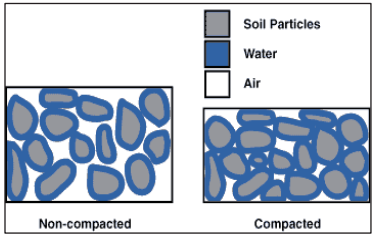
The compact layer will prevent the crop to utilise the full potential of the soil. It is therefore important to make sure compact layers are dealt with in the cultivation of the soil. Dig a profile inspection hole to inspect the soil for compactions and root development.

The profile inspection hole should be at least 1m X 1m x 1 m.

Root deformities

You can identify certain problems in the soil by looking at the roots.

Compaction reduces pore size



Compact soil will reduce the pore size and thus reduce root development and increase water logging in the soil in wet conditions.

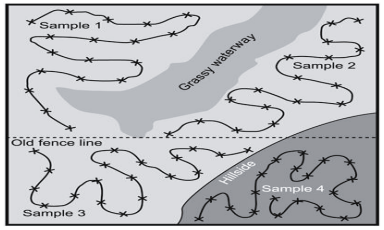
The ripper is used to break compact layer in the soil.

Ripper in action.

Taking soil samples

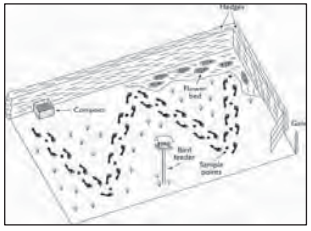
1. Divide the field in homogenous areas
2. Draw a plan of the field
3. Indicate all additional information like grass, stones, waterways, etc.

Sampling soil on a big field



15 to 20 increments per up to 50 ha of homogenic soil and mix the 15 to 20 samples. Take 500g to 1000g as of the mixed soil the sample for the area.

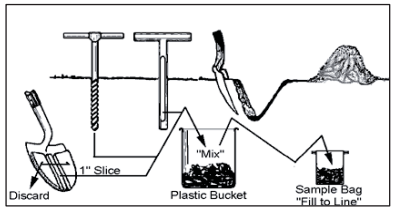
Sampling soil on a small plot



Soil sampling tools

Taking a soil sample

Method of soil sampling



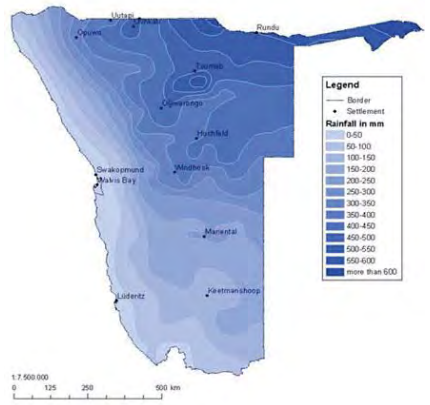
Topsoil sample should be 0 to 30 cm and bottom soil sample 30 to 60 cm.

Mark samples clearly with the necessary info

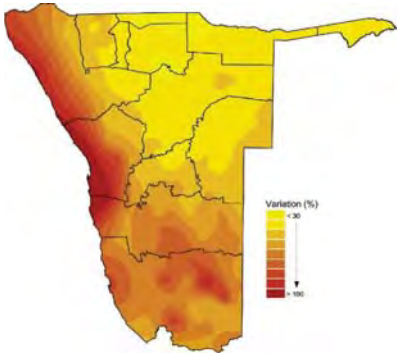
Name :……
Tell: ……
Field name:……
Field no: ……
Topsoil: 0-30cm ……
Bottom soil: 30-60cm ……

Rainfall

The following map shows the average annual rainfall in Namibia:



Rainfall Variation



In arid areas with a big variation in rainfall it is important to manage soil water to achieve maximum water profit in the soil

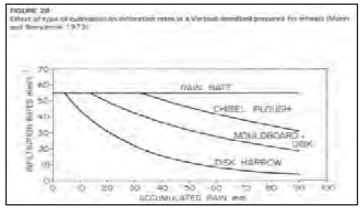
Keeping Run-off a minimum

- Keep the soil surface loose to maximise infiltration

- Keep plant material on the soil

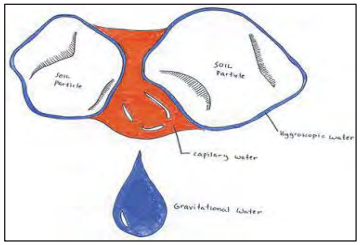
- Maintain soil contours to prevent erosion and Runoff and increase infiltration.

Effect of type of cultivation on infiltration rates and runoff.



- Note that the infiltration on the dick harrow is the lowest
- The infiltration on the chisel plough is the best.
- After 15 mm on ploughed soil run-off will start
- After 33 mm on chisel ploughed soil run-off will start

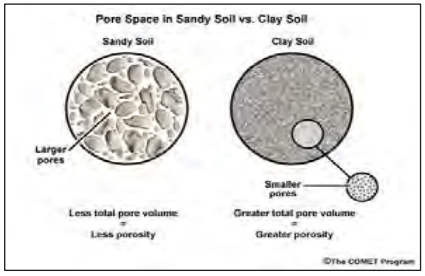
Different types of water in the soil



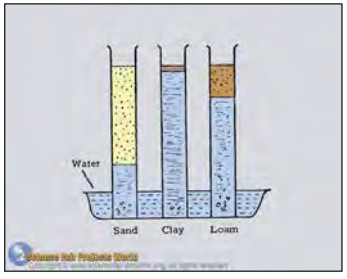
Water logging

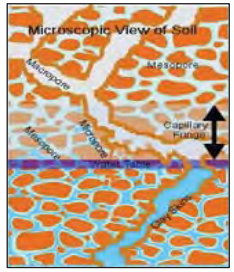
Ideal situation

Pore space in different soils



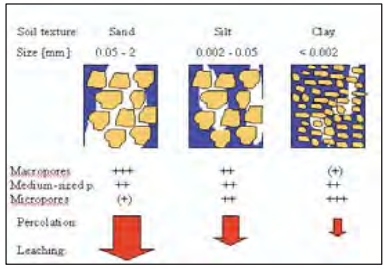
Reaction of Water in the soil





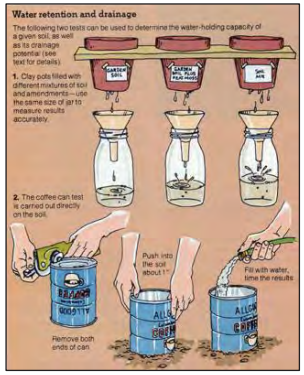
Deep Infiltration

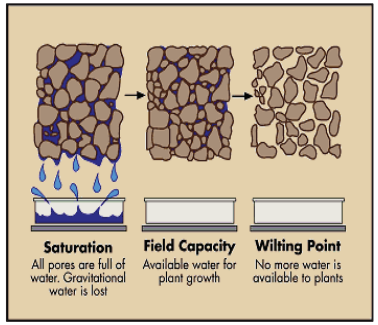
Choice of soil



- Choose a soil with more micro pores (clay/loamy soils) that will hold more water.
- Micro pores (Clay/loamy soils) will reduce leaching of water out of the soil.

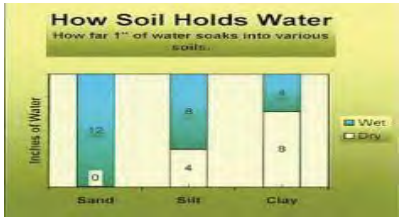
Leaching of water out of the soil





Evapotranspiration

- Clay soils lose more water through evaporation from the soil surface than sandy soils.
- Keep 5 cm on the top soil loose to break capillarity in soil

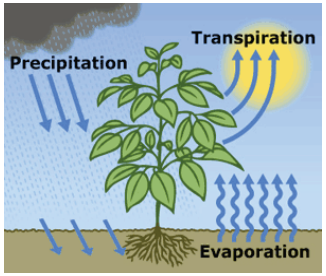


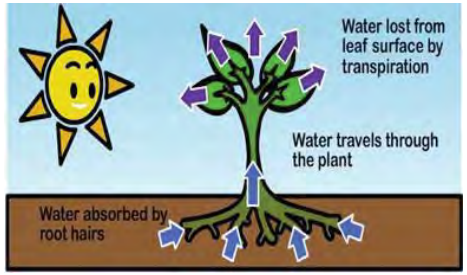
Infiltration depth with 25mm of rain in various soils

Water lost in top 5 cm of soil: Sand > 5 mm
Silt > 6.25 mm
Clay > 12.5 mm

Small rain showers will have more impact on sandy soils

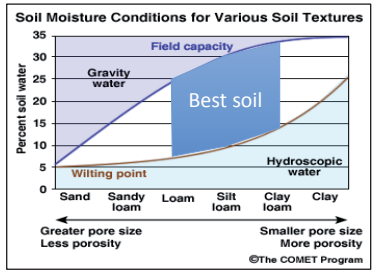
Transpiration





To prevent water lost through transpiration, keep your fields clean from weed. Adapt your plant population according to the available water in the soil

The knowledge of the basic hydrology of soils and the successful management thereof to develop optimum growing conditions for plants will be of utmost importance to realise profitable yields



The purpose of the guidelines is to create optimum conditions for the crops.

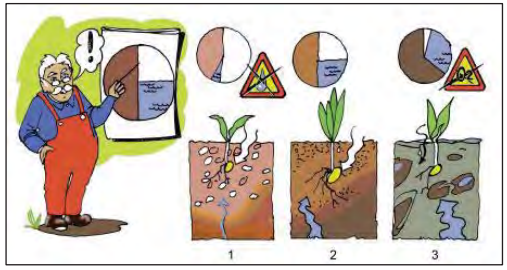
- Improve air, moisture, temp, biology, root penetration
- Prevent soil erosion (water and wind).
- Improve water infiltration.
- Maximum water gathering during season
- Good control of weeds.

Important factors to keep in mind:

- Good establishment of crop
- Economics

Seedbed preparation

To create a seedbed to optimise germination and root development



Result:

- Good seed soil contact means soil has to be firm.
- For uniform planting depth the soil has to be fine and level
- To ensure there is no competition for nutrients and water keep the fields weed free.

Weed control

Shallow tine cultivation: Do this as early as possible when the weeds are still in a very sensitive stage!!!

A clean seedbed and the first 6 weeks after planting are very important successful weed control.

Chemical weed control

Hand weeding

Hand weeding will always be part of a weeding programme.

Soil and Water Conservation

Keep soil surface loose to eliminate soil capping:

- Increase water infiltration
- Prevent evaporation by breaking capillarity
- Important for semi-arid areas

Soil conservation by preventing wind and water erosion

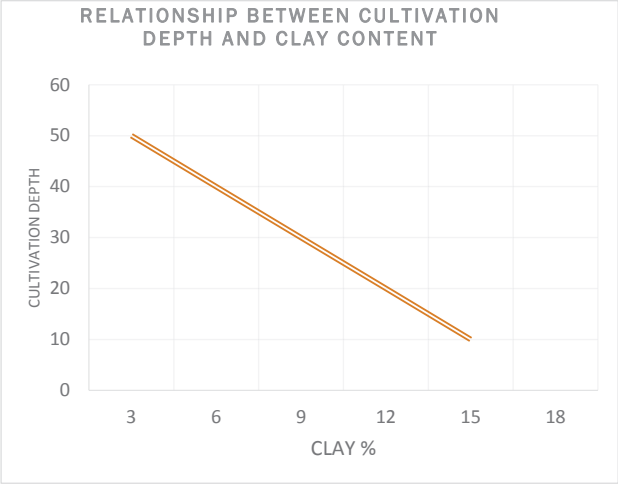
- Keep soil surface ruff.
- This will improve water infiltration
- Prevent wind erosion
- This should not be deeper than 100 mm as it will increase evaporation
- Stubble on the soil will be a more permanent solution
- Maintenance of water structures

Mixing of soils

- Liming and fertilisers

Primary soil cultivations

Before you can sow any seed you need to do a primary soil cultivation, 200 mm to 500 mm deep.



Mould board plough

Working depth:

- 300mm
- Recommended for soils with a bad structure

Benefits:

- Good mixing of soil
- Good aeration
- Water infiltration
- Weeds and plant material buried
- Mixing of fertilizer and lime at cultivation depth

Disadvantages:

- Clay soils sometimes form clots
- Under dry conditions drying of the soil occurs.
- Plant rests are buried > water and wind erosion
- Compaction on ploughing depth to wet soil
- Tractor wheel compaction in deeper soil

Ripper

Working depth:

- 300mm to 1200mm where mixing of soil not needed.
- Sandy soils that are prone to compaction

Benefits:

- Eliminate compactions if cultivation is deep enough and tines spaced not too far apart.
- Leave plant rests on soil increasing infiltration.
- Conserves water clots that are formed not too big.

Disadvantages:

- Need lots of power
- Secondary cultivations needed to control weeds.

Disc plough

Working depth:

- 250 to 300 mm
- Stony and hard soils

Benefits:

- Penetrate better in hard and stony soils
- Clog less with plant material on soil.

Disadvantages:

- Leave a ruff soil surface that need a lot of secondary cultivation.
- Plant rest not buried 100%.

Chisel plough

Working depth:

- 250 mm
- Primary cultivation on good structured soils

Benefits:

- Tractor run on soil surface less compaction
- Only loosen the top soil.
- Plant rest mixed only partly with the soil.

Disadvantages:

- Weed control unsatisfactory
- Plant rests clog in-between tines.
- Cultivation depth normally over estimated.

100 to 150 mm deep

Shallow cultivation with disk implements:

Working depth:

- 100 to 150 mm deep.
- To break clots.
- To kill big weeds.

Advantages:

- Fast and cheap cultivation
- Control young weeds.
- Mix soil good.

Disadvantages:

- Wind and water erosion on sandy soils
- Causes a compaction on working depth
- Don’t illuminate tractor wheel compaction.

Shallow cultivation with tine implements

Working depth:

- 100 to 150 mm deep.
- To control young weeds.
- Loosen of soil surface for moisture conservation.

Advantages:

- Leave a rough soil surface good for water infiltration
- Soil less susceptible to wind erosion.

Disadvantages:

- Only good soil penetration under wet conditions.
- Good rooted weeds not controlled
- Compaction if not designed to break tractor wheel compaction.

Rotovator

Working depth:

- 100 to 150 mm deep.
- Use on strong soils

Advantages:

- Good for mixing of plant material and soil

Disadvantages:

- Powdering of soil.

Blade plough

Working depth:

- 100 mm deep.
- Use on sandy soils

Advantages:

- Leave plant material on soil in upright position
- Good against wind erosion.

Disadvantages

- Not for clay soils

Rodweeder

Working depth:

- 100 mm deep.
- Rod that turn in opposite direction as movement of tractor

Advantages:

- Leave plant material on soil

Disadvantages

- Causes compaction in wet

Cultivation Practises are a combination of cultivations and are determined based on the following:

- Soil type
- Crop
- Rotation
- Slope
- Climate

Sustainability depends on the following:

- Productivity
- Security
- Conservation
- Economically viable

Conventional Ploughing

When: (1) Wind erosion low, (2) Risk of Root diseases is high and (3) A good option in mono culture

- Total incorporation of Stover
- Control germinated weeds effective
- Bring new seeds to the top for germination
- Secondary cultivation necessary

Steps

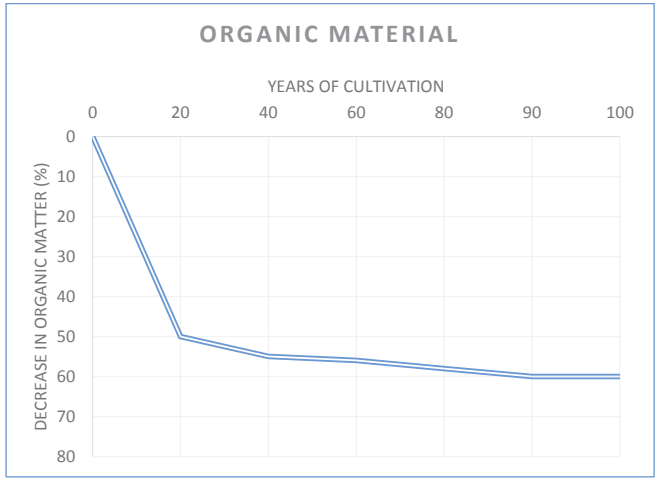
Step 1 Harvesting (May – June)

Step 2 Control weeds until ploughing can start if possible

Step 3 Ploughing water situation in soil will determine

Step 4 Seedbed preparation shallow tine also weed control

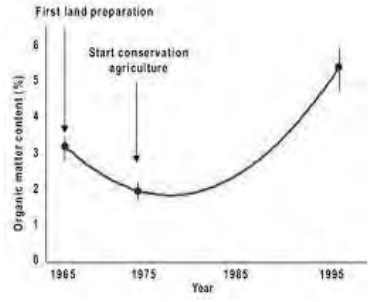
Step 5 Planting

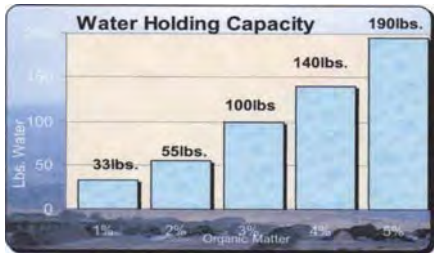


Conservation Tillage

Stubble cultivation:

- The aim is to leave 30% plant material on soil surface.
- Protect soil against erosion
- Increase water infiltration
- Reduce evapotranspiration.
- Implement choice for cultivation to leave material on soil.
- Mainly tine implements.





Frustrations

- Implements clog with plant material.
- Weed control problem
- Lowering of yield

Factors causing the frustrations:

- Lower available N in topsoil.
- Weed problem
- Low plant population because of poor seedbed.
- Low soil temp.
- Higher disease and insect pressure.

Success is normally on sandy soils and soils where water erosion is a problem.

Solving these problems:

- Increase N application for first few years
- Chemical weed control
- Select implements that can't clog.
- Temperature not really a problem in Namibia
- Choose a cultivar that is resistant against diseases and insects
- Insecticides.

Important steps for conservational Tillage

Weed control after harvest

- Chemical
- Mechanical

Deep cultivation to break compactions

- Oct to Dec
- Rip or chisel cultivation
- Timing to ensure min cultivation
- Soil moisture

Sealing of soil with cultivator or harrow

- Roller or harrow behind deep cultivation if necessary.

Weed control normally just before planting

- Seedbed preparation

Plant with a planter that can handle plant material

Minimum till and No till

Minimum till

- No Primary and Secondary cultivation
- Weed control done with Broad spectrum weed killer
- Seedbed preparation take place with or before planting.
- Soil is loosened before the planter with a tine, disk etc.
- This can slow down the plant process not ideal to planting big areas.

No till

- Plant directly without cultivations.
- Weed control remains a problem with minimum and no-till only suitable for some crops
- Promotes soil and water conservation
- Fuel savings of 50 to 70%
- High cost of herbicides eliminate fuel savings
- Only successful on good structured and shallow stony soils.

Deep cultivation

If the soil is compact beneath the cultivation depth roots are prevented from growing down vertically.

Break compactions with deep cultivation of 400 mm to 500 mm.

Soils with more than 10% clay does not have to be ripped every year.

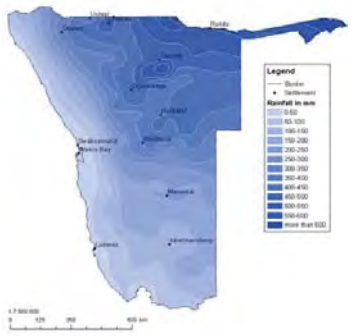
Traffic control

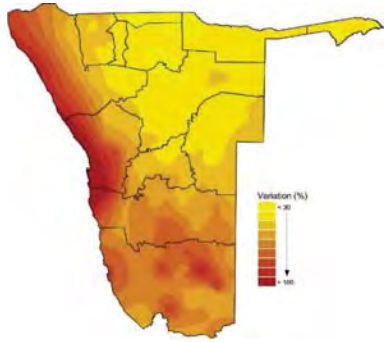
Traffic controlled cultivation means secondary cultivations on the same tracks.

On Sandy soils it results in an increase of at least 10 to 30% in crop yield.

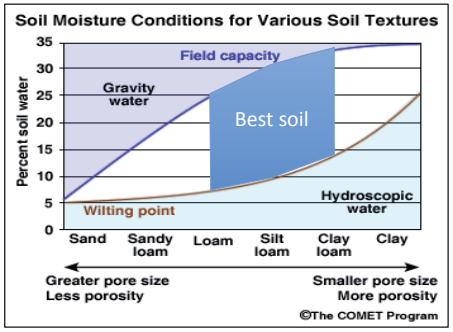
Contour cultivation

The purpose of contour cultivation is to prevent water erosion on slopes of more than 2 to 3 %.





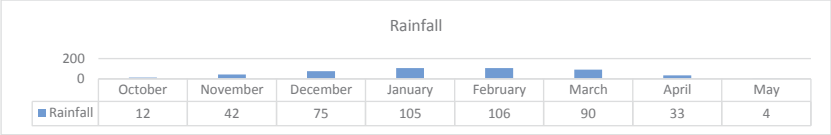
In arid areas with a big variation in rainfall it is important to manage soil water to achieve maximum water profit in the soil

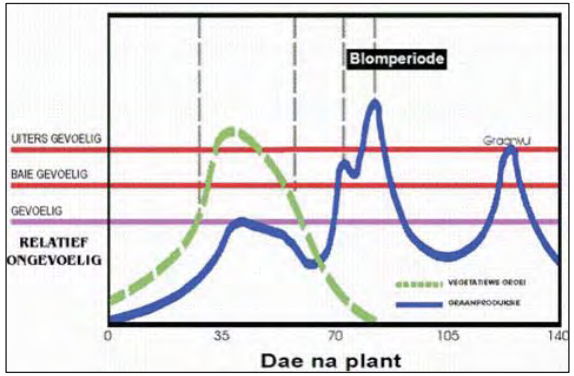


Estimated water retention of soils

Silt + Clay content %	Field water capacity	Wilting point	Plant available water	Hydroscopic water
%	mm/m			
0-5	70	40	30	10
5-10	150	50	100	30
10-15	160	50	110	35
15-20	180	60	120	40
20-25	200	80	120	45
25-30	220	100	120	50
30-40	240	130	110	55
40-50	260	160	100	60
>50	270	200	70	65

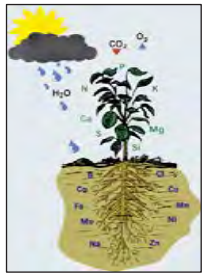
Distribution of rain in Oshikoto/Northern Otjozondjupa region and planting date





To determine planting date it is important to know what the rainfall distribution is.

Plant nutrition



Carbon, Oxygen and Hydrogen is freely available from air and water.

Nitrogen (N) promotes growth, provides the green colour.

- Chlorophyll
- Component of protein

Deficiency, affecting younger leaves:

- Leaves turn yellow
- poor growth

Excess leads to unbalanced growth

- Excessive top growth and poor root development.
- Plants are susceptible to infections and drought

Phosphorous

- Promotes root development
- Resistance to disease
- Plant develop faster less N problems with N surplus
- Don't leach

Signs of Deficiency:

- abnormal dark green purple colour
- weak growth with thin stems in grains
- in maize it restricts cob-forming.

Potassium

- Affects plant vigorous growth
- Manufacturing of sugar and starch

Signs of deficiency

- edges and tips of leafs to go brown
- older leaves affected

Potassium can easily burn the plant

Calcium

- Quality plant strength
- Availability of other nutrients in soil
- Activity of **micro-organisms** in soil

Deficiency > young leaves chloroses

The following trace elements are important:

Boron		Zinc	
Iron		Magnesium	
Molybdenum		Sulphur	
Copper			

Chemical Fertilisers

Chemical fertilisers contain a high % of N, P and K.

- They don't improve the soil texture
- No trace elements are contained
- Micro-organisms

In the case that soils have become irreparably damaged, chemical fertilisers can be most beneficial if used correctly (seek advice).

Fertilisers

Nitrogen:

- Nitrogen leaches out of the soil therefore do not apply all nitrogen at planting.
- 50% to 60% is applied as a top dressing (4 to 6 weeks after planting)
- Fertilizers that contain Nitrogen:
  - Ammonium Sulphate
    LAN (KAN)
    Urea
  - Compounds

Phosphate fertilizers are normally applied during planting and it doesn't leach out

Superphosphate
Compounds

Potassium Fertilizers:

- Compounds usually contain sufficient potassium

Potassium chloride
Compounds

Trace elements:

- Zinc, Boron, Magnesium and other trace elements can be used

Lime and Gypsum:

- Mainly to correct the acidity of the soil

Calibration of planters.

It would not help if we take soil samples and get expert advice to apply fertilizer according recommendations and then plant with a planter that is not accurately calibrated.

Principles:

- The necessity to calibrate the planter regularly is very important
- Calibrate planter at planting speed
- Calibrate planter in the field.

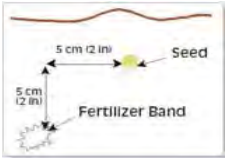
Calibration of the planter fertilizer:

- Measure 100 m distance in the field to be planted.
- Catch the fertilizer over the distance at planting speed.
- Weigh the fertiliser (A) and calculate according to specifications

Application in kg/ha	**100 x .....A.....(kg/100m Row spacing(0.914)**

- Calculate according to formula above or use table below to calculate application rate per ha.

Row spacing	Application rate	
Meter	Calculation	Kg/ha
0.914	109.41 x ...A....	
1.0	100.0 x ...A.....	
1.5	66.67 x ...A...	
2.15	46.73 x ...A...	
2.28	43.86 x ...A...	



Place fertiliser at least 5 cm to the side of the seed and at least 5 cm deeper to prevent seedling damage

- Calibration of the planter seed:
  - Measure 10 m distance in the field to be planted.
  - Count the seed over the distance at planting speed.
  - Calculate according to specifications

Application in seed/ha	**1000 x .....B.....(kg/10m Row spacing (0.914)**

- Calculate according to formula above or use table below to calculate application rate per ha.

Row spacing	Application rate	
Meter	Calculation	Seed/ha
0.914	1094.1 x ...A....	
1.0	1000 x ...A.....	
1.5	666.7 x ...A...	
2.15	467.3 x ...A...	
2.28	438.6 x ...A...	

The success of maize production greatly depends on effective control of weeds.

Weed control the first 6-8 weeks: Compete directly for moisture, nutrients and yield

Weeds after 8 weeks: Competition with crop is smaller, negative effect on soil moisture.

Definition of a weed: Any unwanted plant even a volunteer maize plant

We have a weed problem when:

- We experience yield losses of up to 10% per year
- Weeds are very good competitors for: nutrients, water, light, problems with harvesting and contaminate the harvest

Methods of weed control

Risk management for a weed problem

- Weed control in off season.
- Primary soil cultivation, ploughing and min till
- Seedbed preparation.
- Time of planting.
- Chemical weed control.
- Mechanical weed control.
- Weeding by hand.

Pre emergence herbicide (do not control nutsedges "uintjies" very well).

Important points to remember:

- Read the Instructions
- Take note of follow up periods
- Timing of application "Hormone herbicides not at flowering"

Weed control is difficult and needs an integrated approach of the following:

- Physical methods: hand weeding, machinery and fire
- Cultivation: ploughing in winter, row spacing and crop rotation
- Biological
- Chemical



Methods of chemical weed control

Selectivity of Herbicides:

- Not selective herbicides will affect (kill) any crop or weed: Gramoxone and Roundup

- Selective Herbicides will kill the weeds but not the crop: Atrasien and Silcozine

Contact and Systemic Herbicides

Contact herbicides affect the plant material.

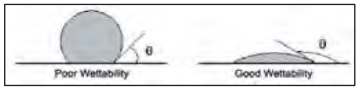
- Good and thorough wetting of weed important.
- Jong weeds very sensitive
- Older weeds more resistant

Systemic herbicides.

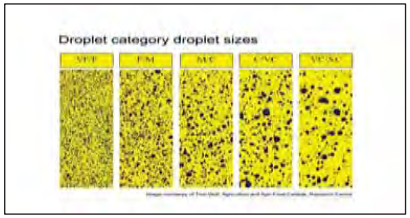
- Chemical trans-located inside the plant will kill the whole plant, even perennial weeds.

Time of application

- Pre emergence (spray before crop emerge after planting): Coleoptile and young developing roots
- Post emergence (After emergence of weed): Herbicide uptake via leafs.



- **Sticker** Prevent chemical to be washed of by rain.
- **Penetrators** Enhance the uptake of active ingredient
- **Suspension** Prevent the chemical and fiscal change in the chemical > can change effectiveness of chemical
- **Buffers** Maintain optimum pH of spray mixture.
- **Drop controller** Drop size. Prevention of evaporation. Prevention of drift



Factors that influence the effectiveness of Herbicides

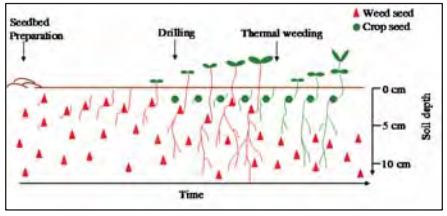
Soil applied herbicides

Seedbed

For effective weed control the seedbed needs to be:

- Fine, even firm
- Even germination
- Even application of herbicide

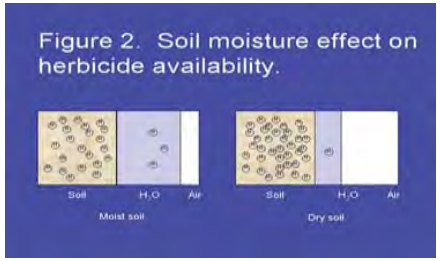
This will improve the effectiveness of the herbicide.



Soil moisture

Soil moisture is important for the effectiveness of the herbicide:

- Rainfall improves moisture
- The rain will enable leaching into soil



Clay content

The clay content has an influence on how much herbicide has to be applied.

Organic matter

The organic matter in the soil has an influence on how much herbicide has to be applied.

pH

The pH of the soil will affect the waiting period.

Timing of application

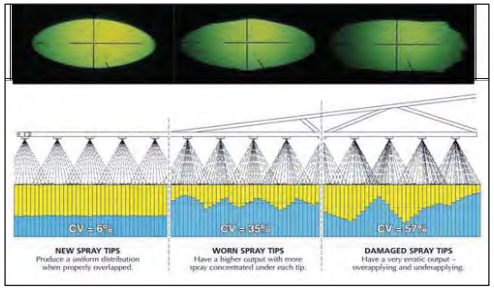
It is very important to apply herbicide in a timely manner to get the best results. Refer to the instructions on the herbicide on when to apply.

Depth of germination

Shallow and deep germinated weeds require different types of herbicide for control.

Application method

This will depend on the type of equipment used for application. The accuracy of the equipment is crucial for calibration purposes. Treat crops with care to prevent unnecessary contamination.



Contact herbicides (applied on the leafs)

Growing stadium of weed is important. Read the instructions on the label of herbicides.

Big Leave area

Active growing weeds

Important points to remember when spraying herbicides

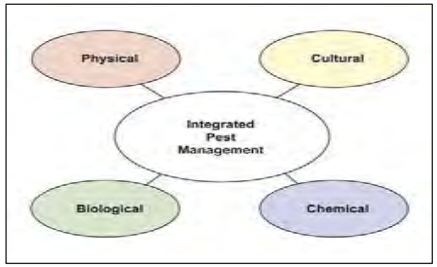
Vigorous growth: When weeds under temperature and drought stress the effect of the herbicide is diminished.

Rain and irrigation: The active ingredient are washed from leaves

Tank mixtures: Wetter increases the effectiveness on waxy leaves. Antagonism between herbicides.

Application method: Equipment; Accuracy (nozzles); Coverage

Consult a technical person and read the instructions!



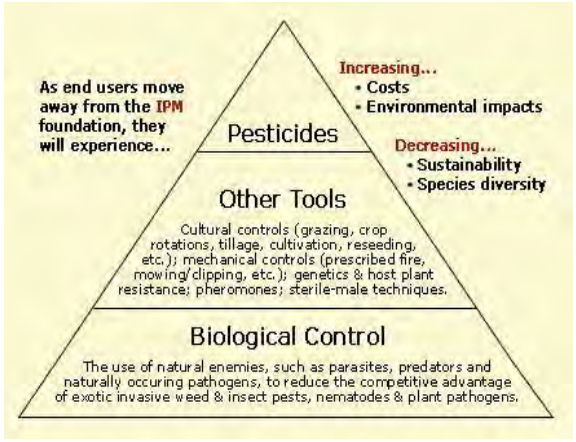
Principles of pest control

Only some of the insects in maize can be classified as pests

Only if the damage result in yield losses and degrading of the product

Increase in value of produce must be more than the cost of the application.

The pest control strategy should consist of means of control that lower the pest population to levels that will have no economic risk > INTERGRATED PEST MANAGEMENT.



Chemical control

Questions to ask before using chemical control:

- Will the pest be economically important?
- Are there other means of control?
- When must it be applied? Growing stadium / Level of infection
- Which chemical to apply for the pest
- How to apply

Cultural control

The purpose of cultural control is to keep pest populations low with the following practices:

- Timely Weed control 35 days before plant > cutworms
- Winter cultivation. Stalk borers
- Get rid of volunteer maize plants
- Cultivar choice
- Planting dates

Biological Control

The purpose of biological control is to use pesticides that are more environmental friendly and not very poisonous to the friendly insects (parasites)

Maize stalk borer (Busseola fusca)

Infestation: First: October > November
Second: January > February Hibernate below ground level
Third: March > April

Control:

- Integrated biological control
- Plant resistance breeding
- Cultural practices
- Chemical control

Parasites can reduce overwintering caterpillars by using the right insecticide.

Infestation potential can be reduced by ploughing.

First infestation is normally low the second one is normally severe and required chemical control

Inspect regularly from 2 – 7 weeks after germination chemical control with 10% infestation

Insecticides can be applied to the soil before planting (recommended)

Sorghum stem borer (Chilo Partellus)

Infestation:

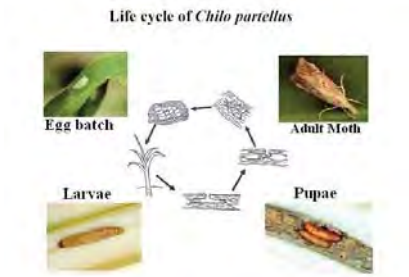
- There are several overlapping generations
- Two peaks of moth activity in October and February
- The second peak go into dormancy in stalks

Very early and very late plantings are most susceptible for attack

Especially sweetcorn plant before October

Plant after October and not later than mid-December.

The strategy is the same as for maize

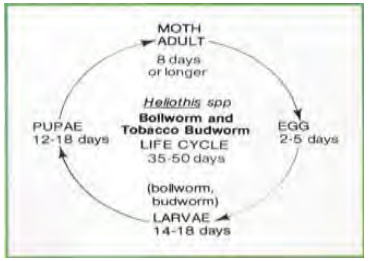


Sorghum borer (Chilo partellus)

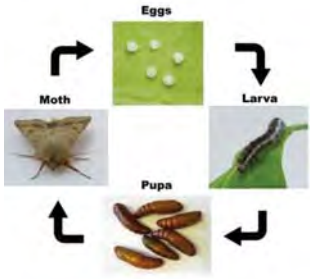
Maize stalk borer

American bollworm

Not a very big problem but can cause degrading of the maize



Cutworm



Friends

Aphoiduis ervi

Insect resistant plants

Short-term: Reduced pest control, lower input cost and protects friendly insects.

Long-term: Resistant plants put the pests under pressure, stabilize economical thresholds, BT maize and Maize streak virus.

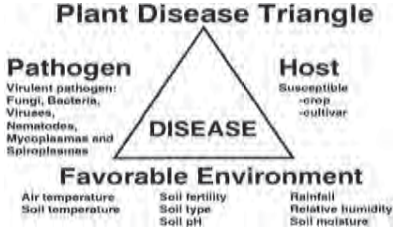
The choice of strategy is unique within a situation and is a consideration of the producer.

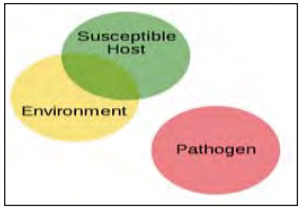
Expert advice is available from Agra.

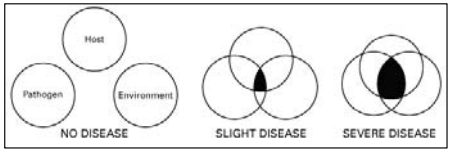
Principles of Disease control

- Diseases cause lower yields, Quality problem, Toxicity for the end user
- Diseases is caused by fungi, bacteria and viruses.
- Attack one or more areas of the plant
- Different diseases need different optimal climatic conditions to develop
- Diplodia stem rot: Good early season rain followed by a dry late season.
- Diplodia cob rot: Dry early season with late season rains.

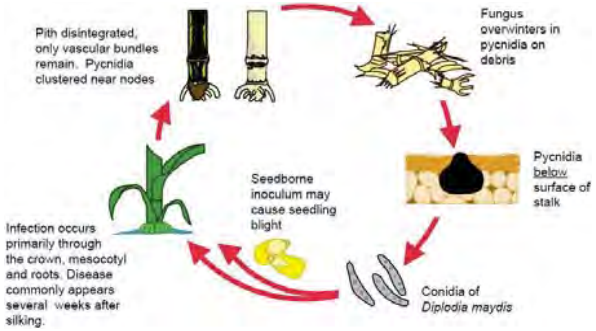
Plant Disease Triangle





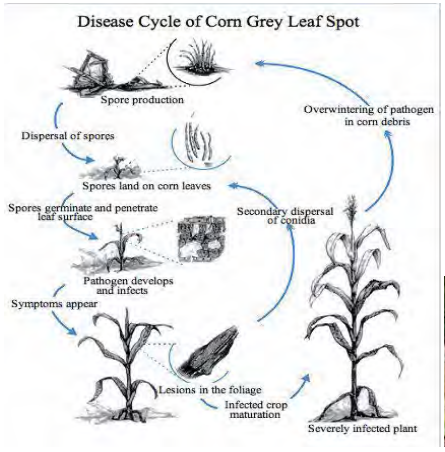


Diplodia cob rot and stem rot (*Stenocarpella maydis*)



Grey Leaf Spot

Heavy dew, frequent showers, high humidity



Northern leave blight

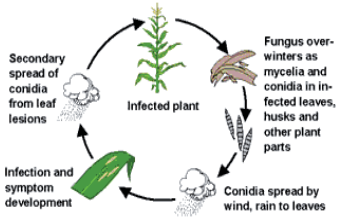
6 to 18 hours to develop at 18 to 26˚C

Lesions appear 1 to two weeks after infection

Heavy dew, frequent showers, high humidity

Northern Leaf Blight Disease Cycle

Exserohilum turcicum (Helminthosporium turcicum)



Disease control strategies

There are four main control strategies to apply.

1. Varieties resistant against a certain disease

   Farmer had to identify diseases in region and make cultivar choice accordingly

2. Chemical control

   Registered fungicide and bactericide

   Determine economic viability

3. Production practices

   Soil cultivation: Some cultivation methods will keep stubble on the soil; Disease build up; Look at the pros and cons of a certain cultivation method.

   Crop rotation: Crops in rotation should not be alternative host. Correct rotation will decrease inoculant and disease.

   Planting dates: Avoid peek inoculation periods of climatic conditions that will favour a disease.

   Control stress: Soil moisture high and low, Heat, Cold; Unbalanced nutrients; Soil acidity, insect and disease damage.

   Minimise stress with: Optimal plant populations, correct feeding, pest and disease control, correct Irrigation.

4. Biological control

The use of biological control agents is limited under extensive conditions.

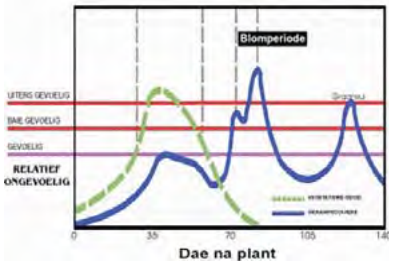
- To get optimal disease control it is important to eliminate one of the three legs of the disease triangle.
- It will be more successful and sustainable to make use of a integrated disease control system.
- Implementing a integrated disease control system will need to call in the expertise of a trained plant pathologist
- Knowledge of crop production and the disease triangle had to be put together to get a successful control strategy.

Planting Date

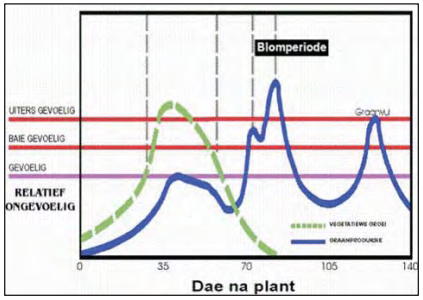
Minimum planting Temp: 10˚C to 15˚C for 5 to 7 days

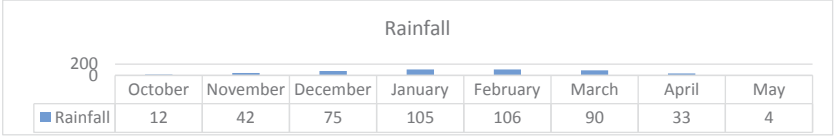
Sensitivity of the maize plant to moisture stress (rain).

Rain:



Distribution of rain in Oshikoto/Northern Otjozondjupa region and planting date





	October	November	December	January	February	March	April	May
Rainfall	12	42	75	105	106	90	33	4

Growing stadium 0: Plant to germination

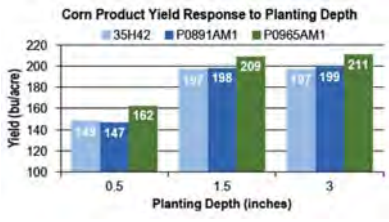
Planting depth determine the time to germinate

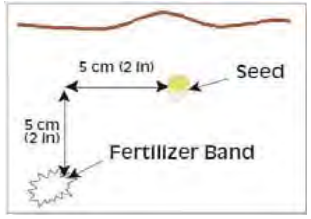
Cultivar choice will also have an effect on the germination.

Fertilizer placement not to close to seed at planting it can causes damage to the seedling.

Look for cutworm. Cutworms normally a problem when was a lot of green weed before planting. Therefore is weeding before plant very important.

Poor germination soil capping. This occurred on soils with a clay content of more or less than 15 % clay when hot sunny weather follows heavy rain after planting.





Growing stadium 1: Four leaves unfold

Problems in this stage are not permanent

Wind damage in sandy soils

Growing point is still under the soil surface, Frost and heal minimum damage

Water logging is a serious problem in the growing stage.

Do not cultivate to near the plant because it can result in root damage.

Growing stadium 2: Eight leaves unfold

Nutrient deficiency will inhibit leaf growth.

Apply top dressing on **moist soil and take care not to** damage the roots

Heal damage will be 10 to 20 % yield lost.

Water logging damage if growing point beneath soil.

Growing stadium 3: Twelve leaves unfold

Stress on this stage will cause small ears and yield.

Growing stadium 4: Sixteen leaves unfold

Warm soil will prevent strut roots to growth. Tassel can be visible insect damage can cause poor pollination. Moisture nutrient stress will cause poor development of the beard. Heal can cause serious yield losses

Growing stadium 5: Tasseling and silting

Planting date choice according to this stage to ensure good growing conditions during this stadium. Wilting of the plant early in morning influence tasselling. High temperature's influence tasselling.

Growing stadium 6 & 7: Green maize

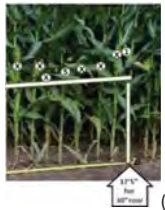
Moisture stress important to fill ears

Point will not develop to mature the rest of the kernels. Water logging and prolonged periods of cloudy weather will cause undeveloped points of cobs

Yield estimation

Count ears on applicable distance in table

Row spacing m	1/1000 ha
0.75	13.3m
0.90	11.1m
1.5	6.67m
2.3	4.35m


(12m for 1m row)

1. Ears/11.1m x 1000 = ears/hectare
2. kernels/row x rows/ear x weight/kernel = weight/ear
3. Weight/ear x ears/ha = yield/ha

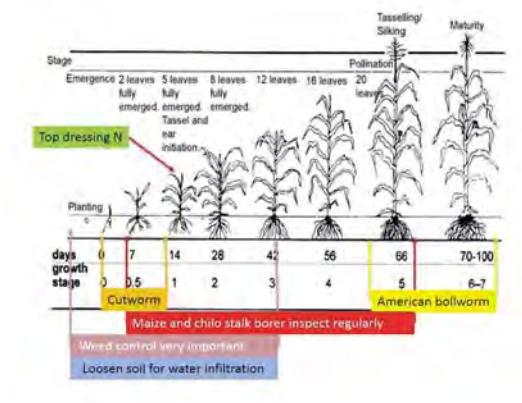
Growing stadium 8: Hardedeeg stadium

The ears start to dent this is the stadium to cut silage.

Growing stadium 9: Biological mature

Keep track of moisture in the grain to start harvesting as early as possible to prevent grain lost. If 12% to 8% moisture is lost, it means that 120 kg equals N$ 360/ha and N$ 72 000/200 ha.

Important Management in growing season



Training Material 9

Horticulture, October 2015

Phase 2

N-CLIMP

Training Topic: Horticulture

Course Material prepared by Agra ProVision
for JiCA / N-CLIMP

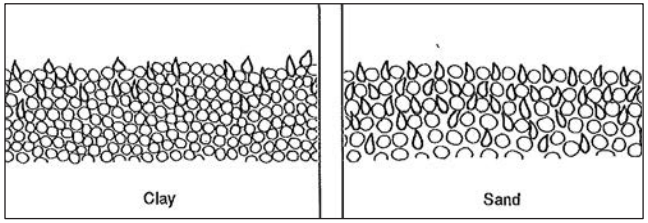
October 2015

Table of Contents

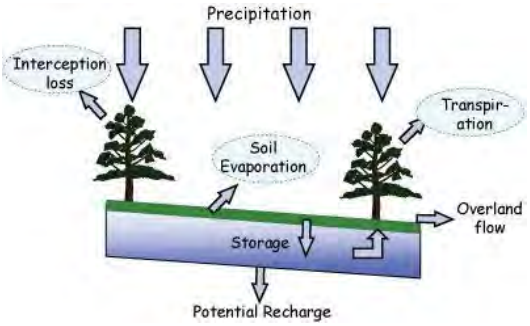
- Watering most importantly affects your harvest. The following questions need to be answered:
  - How much water
  - How frequent
  - When to water

How much water?

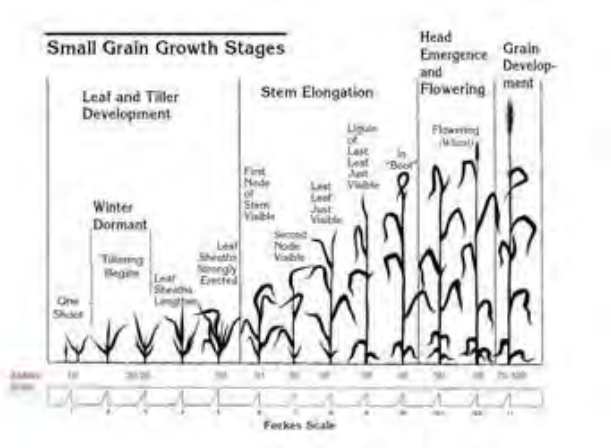
- Clay soil: water longer not just the top layer.
- Sandy soil:
  - drains easily
  - Irrigate for short periods
  - When watered too long, nutrients are washed deeper into the soil
  - Organic material is essential.



- Watering also depends on the climate

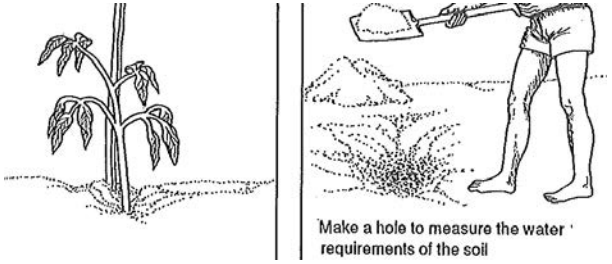


Crop growing stage

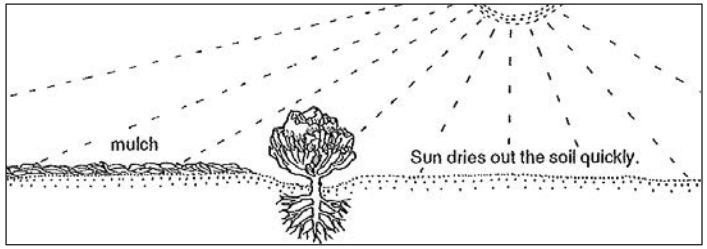


When to water

- Best time is when soil is still moist
- If the plant start wilting not a good method
- Dig the soil and feel.
- Water in the morning.



Mulch



Advantages

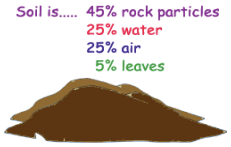
- Prevents evaporation
- Improves soil condition
- Weak weed growth
- Keep soil temp constant
- Creates ideal conditions for root development
- Favourable conditions for micro organisms

Disadvantages

- Insects may use mulch as shelter
- Can hamper germination

Mulching material

It is important to know the potential and limitations of different soil types. Understanding the different soil types will also assist you in knowing how to treat the soil.



What is soil?

Soil firstly comprises mother material rocks

- The rocks contain minerals

Soil forms over thousands of years.

Secondly organic material:

- Plants and animal rests
- Minerals and carbon

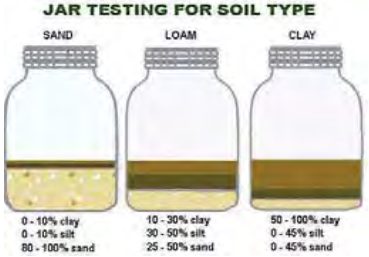
Thirdly Micro-organisms:

- Decomposed dead material
- Rhizobium bacteria > N

Types of soil

There are basically 3 main types of soil:

- Sand
- Loam
- Clay

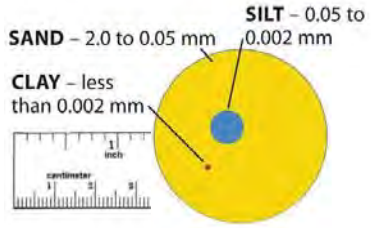


Particle size

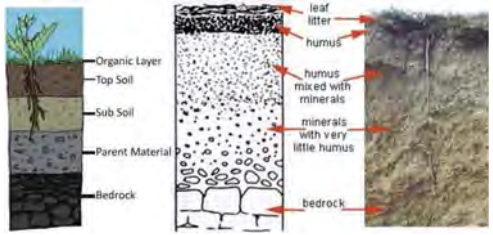
- How much air and water is in the soil
- Smaller particles can hold more water and less air
- Different soils have different effects
- Clay soil:
  - largest moisture retention
  - Difficult to work
  - Root, tuber unsuited to clay
  - Poor aeration
- Sandy soil:
  - Poor water retention
  - Drain well
  - Easy to work
  - Application of organic material essential
  - Improves root development
- Sandy loam
  - Combination of above
  - Best soil for vegetables

Sand Silt Clay

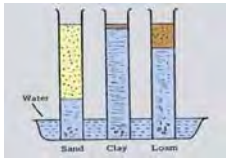
The following graphic depicts the different in sizes amongst the 3 particles:



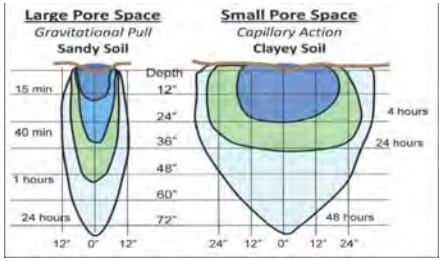
Topsoil and Subsoil



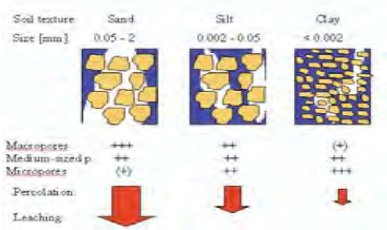
Capillarity of sand and Clay soils



Water infiltration

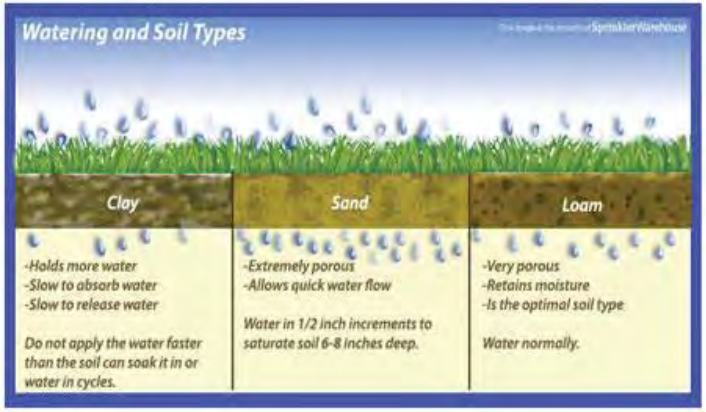


Movement of water through the soil

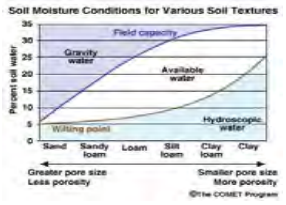


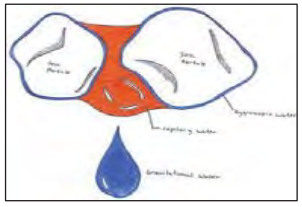
Water moves easily through sandy soils that will lead to leaching of nutrients. In loamy soils less leaching will happen. In Clay soils very little leaching will occur but water logging can be a problem due to poor drainage in clay soils.

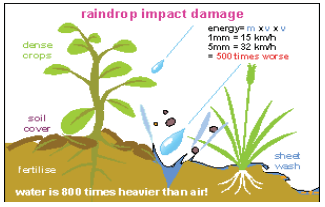
Irrigation and soil types



Soil water







To eliminate the effect of the rain drops on the soil, the soil can be covered with stubble or plant material from the previous crop.

Soil structure

Soil fertility

The following minerals/nutrients are available in the soil for plants:

- N, P, K, S, Zn, Mg, Ca, Cu, B, Mo

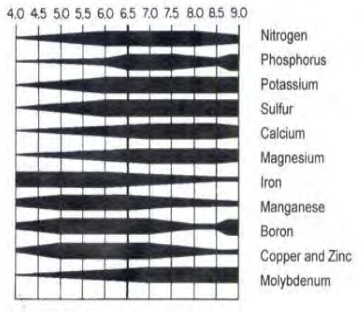
Use the weakest element as point of departure to apply inputs – the elements need to be in balance.

The availability of nutrients is determined by the following:

- pH 5 to 7 suitable for most crops
- Clay content between 15% to 30% clay is ideal will also be able to store the maximum plant available water for dryland conditions.
- **Organic matter**: It is a very limited factor in the Namibian soils due to our climate and therefore soil management must concentrate on increasing the soil organic matter. Organic matter will improve the fertility and water-holding capacity of the soil.
- **Air**: It is important to prevent water logging in the soil and therefore cultivation must aim to prevent compaction of the soil. Organic material will also have a positive effect on the soil aeration. Nitrogen is not available in water-logged conditions.
- **Soil moisture**: water is needed for the soil organisms to convert soil nutrients to be utilised by the plants.
- **Micro-organisms**: It is important to convert soil nutrients in plant available forms.
- **Temperature**: The availability of plant nutrients is determined by the soil temp. Zn will be less available in cold wet conditions.

Soil pH

Influence of pH on Nutrient availability.

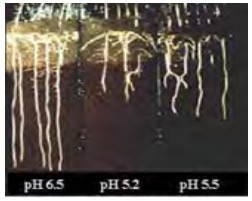


Stunted maize due to low pH

The result is normally an Aluminium toxicity that will prevent root development. This is normally on sandy soils. Can be rectified with liming.

Restrictive factors

- Toxic quantities of Al, Cl, Na, Mo, B



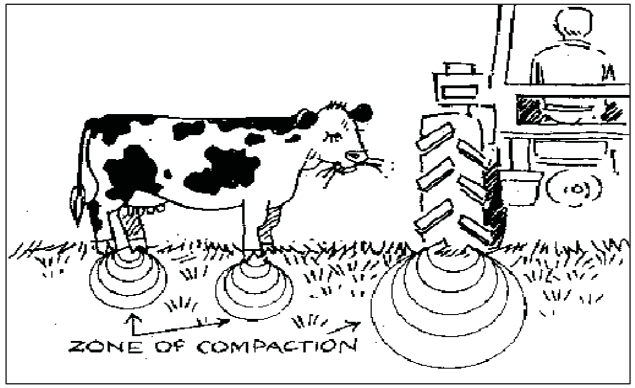

Seedlings exposed to increasing acidity

- Unbalanced elements

A soil sample will assist you in identifying possible problem areas and can be a guide for fertilizer recommendations.

Soil compaction

Animals and Machinery



Ploughing causing a plough pan

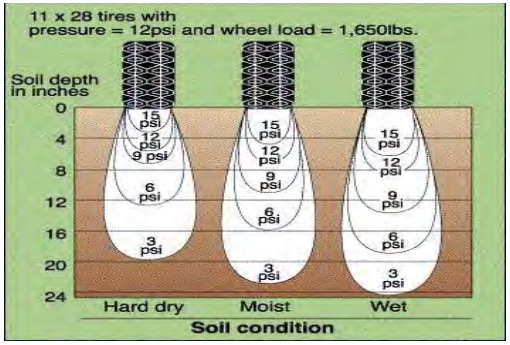
Disk causing a disk pan

Disk and Plough pans

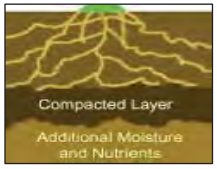
Roots cannot penetrate!

Roots don't penetrate the compact layer!

Compaction in wet versus dry soil



Effect of a compacted layer



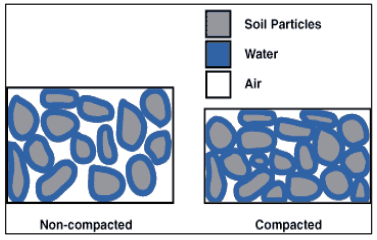
The compact layer will prevent the crop to utilise the full potential of the soil. It is therefore important to make sure compact layers are dealt with in the cultivation of the soil. Dig a profile inspection hole to inspect the soil for compactions and root development.

The profile inspection hole should be at least 1m X 1m x 1 m.

Root deformities

You can identify certain problems in the soil by looking at the roots.

Compaction reduces pore size



Compact soil will reduce the pore size and thus reduce root development and increase water logging in the soil in wet conditions.

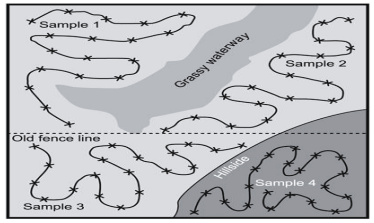
The ripper is used to break compact layer in the soil.

Ripper in action.

Taking soil samples

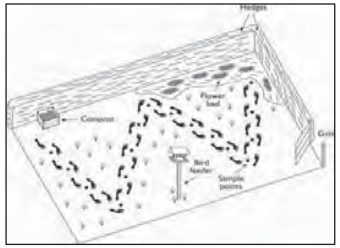
1. Divide the field in homogenous areas
2. Draw a plan of the field
3. Indicate all additional information like grass, stones, waterways, etc.

Sampling soil on a big field



15 to 20 increments per up to 50 ha of homogenic soil and mix the 15 to 20 samples. Take 500g to 1000g as of the mixed soil the sample for the area.

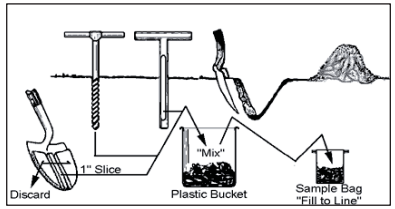
Sampling soil on a small plot



Soil sampling tools

Taking a soil sample

Method of soil sampling



Topsoil sample should be 0 to 30 cm and bottom soil sample 30 to 60 cm.

Mark samples clearly with the necessary info.

Name :……		
Tell: ……		
Field name:……		
Field no: ……		
Topsoil:	0-30cm	……
Bottom soil:	30-60cm	……

Flood irrigation

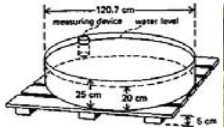
Sprinkler

Centre pivot

Drip irrigation

- **Evaporation** (E_o): water that evaporates in mm from a Class A evaporation pan
- **Crop factor** (F):
  - Value for certain crop
  - in a specified area
  - At various growth stages
  - Plant need for H_2O

- Transpiration ($Et=E_o \times f$)
  - Quantity of water which the plant subtracts from the soil
  - Plus the water that evaporates from the soil in mm



- Effectiveness of irrigation:
  - Difference between quantity of water applied by the irrigation and what enters the soil.
  - Flood irrigation 60%
  - Sprinkler 70%
  - Centre pivot 75%
  - Drip 98%

- Moisture retention ability of the soil:
  - Clay%, Organic matter,
  - Depth of the soil.
  - Restrictive layers in the soil

Soil moisture

Clay %	Field cap. Mm/300mm	Available
< 10%	22	11
10 – 20%	35	17.5
20 – 35%	41	20.5
35 – 55%	56	28

Crop factors

Weeks after planting	Crop factor
0 – 2	0.3
2 – 5	0.45
5 – 8	0.6
8 – 10	0.75
10 – 12	0.8
12 - 14	0.5

Example for drip irrigation

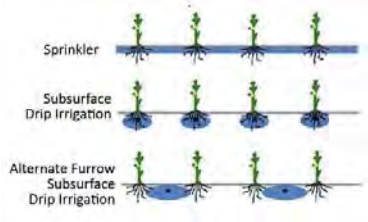
- Soil 450 mm deep 12% clay.
- Evaporation 7 mm
- Crop 7 week after planting
- Moisture in soil available for plant before irrigation 50% of field capacity

35 x 1.5 = 52.5 water in 450mm soil
52.5÷2 = 26.25mm

Moisture usage: = 11 mm x 0.6(7th week) = 6.6mm per day
Length of cycle: = 26.25 ÷6.6 = 4 days
Amount of irrigation: = 26.25 x (100/98) = 26.78 mm
Farmer must irrigate 27 mm every 4 days.

- Drip irrigation - involves dripping water onto the soil at very low rates.
- Water is applied at frequent intervals.
- Pressures typically range from 0.2 to 2 bars.
- Flow rates of 1 l/h to 7 l/h, but most commonly 3.5 l/h.
- costs between N$ 25 000 and N$ 45 000 per hectare

Comparison of water movement with 3 irrigation systems



Advantages

1. High water application efficiency ~ 85%
2. Highly uniform distribution of water
3. Operated at lower pressure => reduce energy costs.
4. Improved fertilizer and pesticide management
5. Less water quality hazards
6. Reduce salinity hazards and minimise soil erosion.
7. Drip irrigation can be used on hilly land.
8. Water efficiency not affected by windy conditions, hot and dry days.
9. Foliage remains dry thus reducing the risk of diseases.
10. Programmable system – Automatisation possible.
11. Provides an ideal moist environment for the roots
12. Drip allow to control where the water is applied less weed.

Disadvantages

1. High initial investment.
2. Timely and consistent maintenance and repairs are a requirement.
3. Filtrations issues
4. Longevity of the system is variable.
5. Application efficiencies of drip systems are primarily dependent on the design of the systems and on their maintenance and management.

Remarks & Recommendation

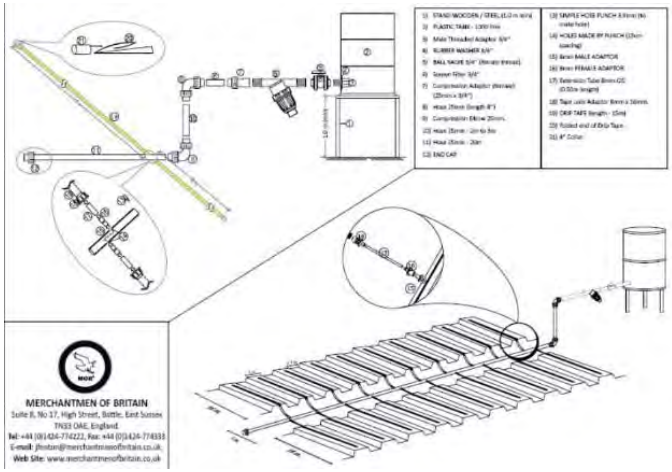
1. Length of lateral lines should not exceed the manufacturer's recommendations for the specific tape used.
2. All delivery lines (mains and sub mains) should be sized to avoid excessive pressure losses and velocities.
3. The maximum size of the zones depends on the flow rate from the well.
4. Zones should be approximately the same size.
5. Drip irrigation systems require filtration.
6. An irrigation system should include an injection port
7. Any irrigation system that will be injecting fertilizers or toxic chemicals is required to be equipped with proper backflow and anti-siphon equipment to prevent the chemicals from contaminating the water source.
8. **Do not mix acid and chlorine in the same container**.
9. Flush the drip line once a month

Maintenance

Acid treatment: Routine maintenance procedure 2 to 3 time a year.

Lateral Flushing: Routine maintenance to flush out debris that accumulates in system
Flush every two to four weeks 30 to 60 seconds.

Chlorination: Will reduce clogging with bacteria and algae.
30 minutes contact time continues or every week



Carbon, Oxygen and Hydrogen are freely available from air and water.

Nitrogen (N) characteristics:

- Promotes growth
- Green colour
- Chlorophyll
- Component of protein
- Signs of deficiency
  - Affects younger leaves
  - Leaves turn yellow
  - poor growth

- Signs of excess
  - Leads to unbalanced growth
  - Excessive top growth and poor root development.
  - susceptible to infections and drought

Phosphorous characteristics:

- Promotes root development
- Resistance to disease
- Plant develop faster less N problems with N surplus
- Don't leach
- Signs of deficiency
  - abnormal dark green
  - purple colour
  - weak growth with thin stems in grains
  - in maize it restricts cob forming.

Characteristic of Potassium:

- Affects plant vigorous
- Manufacturing of sugar and starch
- Signs of deficiency – edges and tips of leafs tend to:
  - go brown
  - older leaves affected

- Can easily burn the plant

Calcium characteristics:

- Quality plant strength
- Availability of other nutrients in soil
- Activity of micro-organisms in soil
- Signs of deficiency
  - young leaves chloroses

The following trace elements are important:

Boron		Zinc	

Iron		Magnesium	
Molybdenum		Sulphur	
Copper			

Chemical Fertilisers

Chemical fertilisers contain a high % of N, P and K.

- They don't improve the soil texture
- No trace elements are contained
- Micro-organisms

In the case that soils have become irreparably damaged, chemical fertilisers can be most beneficial if used correctly (seek advice).

Fertilisers

Nitrogen:

- Nitrogen leaches out of the soil therefore do not apply all nitrogen at planting.
- 50% to 60% is applied as a top dressing (4 to 6 weeks after planting)
- Fertilizers that contain Nitrogen:
  - Ammonium Sulphate
    LAN (KAN)
    Urea
  - Compounds

Phosphate fertilizers are normally applied during planting and it doesn't leach out. They are contained in:

- Superphosphate
- Compounds

Potassium Fertilizers:

- Compounds usually contain sufficient potassium
  Potassium chloride
  Compounds

Trace elements:

- Zinc, Boron, Magnesium and other trace elements can be used

Lime and Gypsum:

- Mainly to correct the acidity of the soil

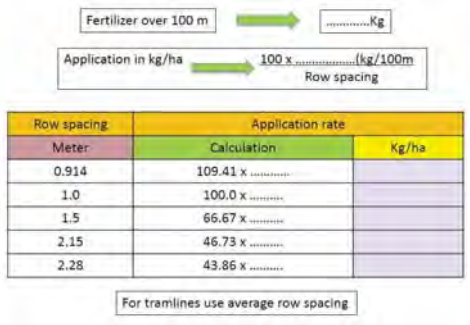
It would not help if we take soil samples and get expert advice to apply fertilizer according to recommendations and then plant with a planter that is not accurately calibrated.

Principles

- The necessity to calibrate the planter regularly is very important
- Calibrate planter at planting speed
- Calibrate planter in the field.

Fertiliser calibration of the planter

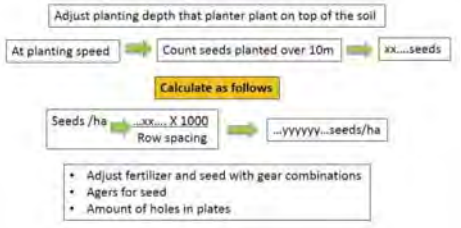
- Measure 100 m distance in the field to be planted.
- Catch the fertilizer over the distance at planting speed.
- Weigh the fertilizer and calculate as follows:



Row spacing	Application rate	
Meter	Calculation	Kg/ha
0.914	109.41 x	
1.0	100.0 x	
1.5	66.67 x	
2.15	46.73 x	
2.28	43.86 x	

For tramlines use average row spacing

Seed calibration



Animal manure is important for maintenance and improvement of the condition and fertility of the soil.

- It provides all the plants nutrients it requires
- It contains N.P.K and most of the trace elements
- It also contains microbes.

Types of manure:

- Chicken manure
- Sheep
- Horse
- Cattle
- Pig

Handling of manure: Manure should be worked into the soil or compost as soon as possible before the rainy season.

Compost

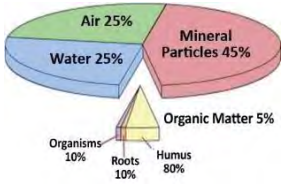
Compost is soil that consists of two parts:

- Non-living : sand and clay
- Living: Humus

Humus consists of millions of micro-organisms living on:

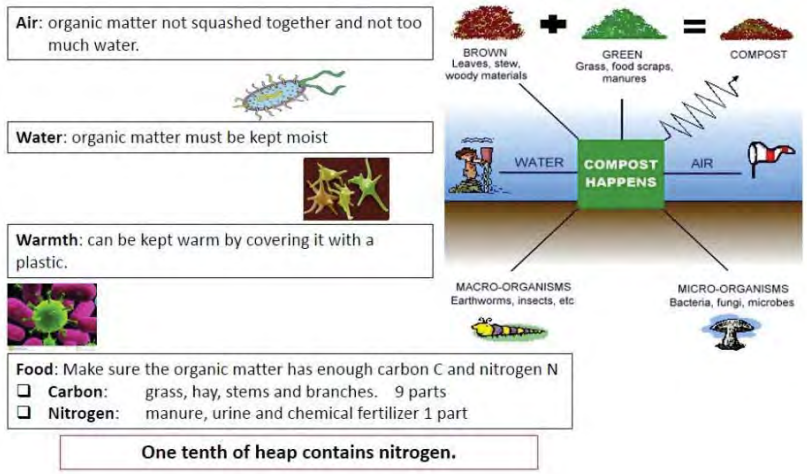
- manure
- Plant matter
- Animal matter

Micro-organisms die when organic matter changes into compost. Dead micro-organisms are good food for plants



Micro-organisms in soil

Micro-organisms function well if the following conditions are met:

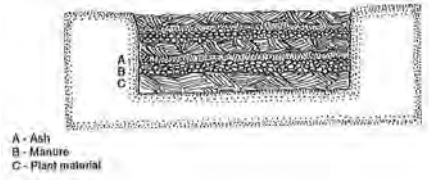


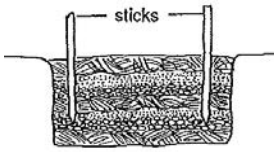
How to make compost

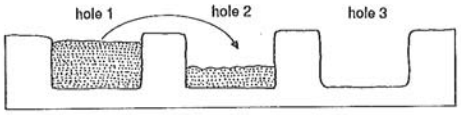
1. Put first layer on ground stems, branches rough material for aeration.
2. 20 cm x 2m x 1.5m high
3. Wet every layer as you go
4. Layer of brown material (grass paper boxes) cut in small pieces if needed 20 cm
5. Layer of green material 20 cm (growing grass leaves waist food not meat milk, etc.)
6. Layer of manure (you can add fertiliser) for nitrogen 5 to 10 cm.
7. Layer of soil for microbes or old compost 5cm
8. Repeat these steps until the heap is about 1.8 m high.
9. Cover with plastic to keep it moist and to keep rain out.



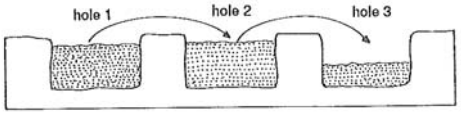
10. Put one or more sticks in the heap that can reach the middle in the heap
11. After 5 days take out the sticks if they are warm the heap works well if dry wet
12. After a six weeks mixing by turn the heap top to bottom
13. Turn it every month for three months then it should be ready for the garden.
14. When turning start a new heap this will ensure you have new compost every three weeks.



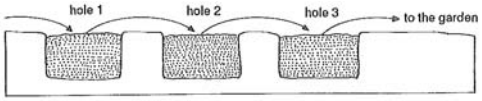




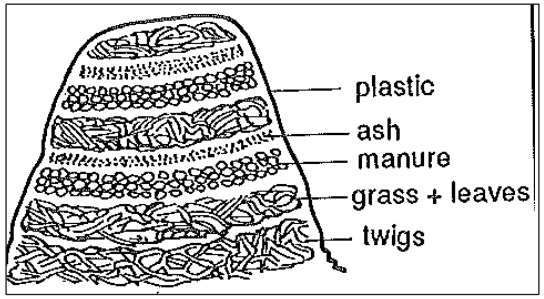
After one month



After two months



After three months



Applying compost: One wheelbarrow for every two m². Evenly work the compost into the soil.

Planting and harvesting winter crops

Crop		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lettuce	Seedlings												
	Plant												
	Harvest												
Cabbage	Seedlings												
	Plant												
	Harvest												
Cauliflower	Seedlings												
	Plant												
	Harvest												
Spinach	Seedlings												
	Plant												
	Harvest												
Spinach beet and Beetroot	Seedlings												
	Plant												
	Harvest												
Carrots	Plant												
	Harvest												
Onions	Plant												
	Harvest												
Garlic	Plant												
	Harvest												
Peas	Plant												
	Harvest												
Broad beans	Plant												
	Harvest												

Planting and harvesting summer crops

Crop		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tomatoes	Seedlings												
	Plant												
	Harvest												
Runner beans	Plant												
	Harvest												
Green Beans	Plant												
	Harvest												
Potatoes	Plant												
	Harvest												
Sweet potatoes	Plant												
	Harvest												
Cucumbers	Seedlings												
	Plant												

Crop		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Harvest												
Pumpkin	Plant												
	Harvest												
Watermelon	Plant												
	Harvest												
Spanspek	Plant												
	Harvest												
Watermelon	Plant												
	Harvest												
Squashes	Plant												
	Harvest												
Brinjals	seedlings												
	Plant												
	Harvest												
Green Peppers	Seedlings												
	Plant												
	Harvest												
Sweet Corn	Plant												
	Harvest												
Asparagus	Sow												

Cabbage family

Lettuce


Cabbage


Cauliflower

Spinach Family

Spinach

Spinach beet

Beetroot 

General vegetables

Carrots 

Onions 

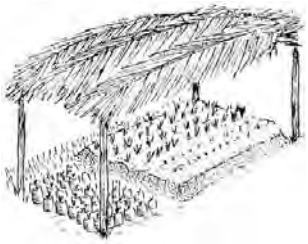
Garlic 

Peas 

Broad beans 

The nursery

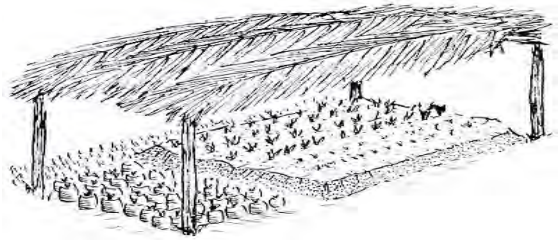
You should have a small shelter made out of poles and shade net as a nursery for your garden to protect seedlings like Cabbage. Lettuce, Tomatoes, etc against sun and hard rain until they are strong enough to withstand weather elements.



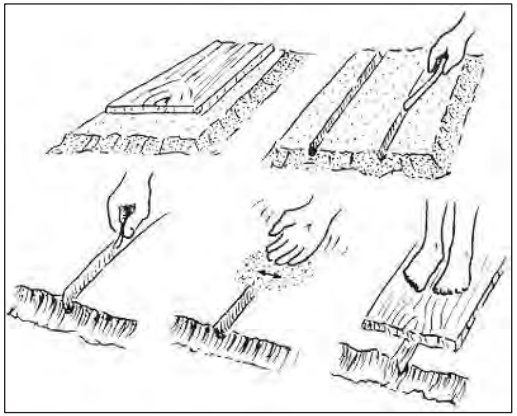
Light shade provided by:

- Branches of palms or other suitable local material can protect seedlings from:
  - too much sun and rain
  - help keep birds and animals away.

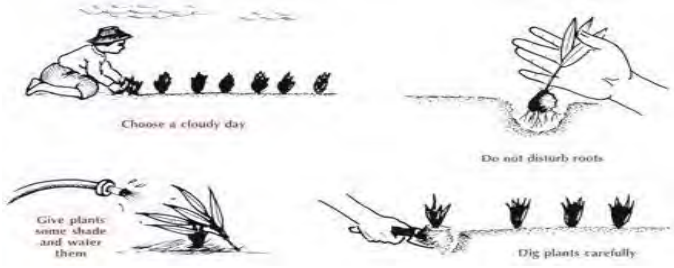
- Pools of stagnant water must be avoided so, when watering seedlings, do not pour the water directly on to them but instead gently sprinkle it using a bunch of grass or disperse it from a perforated container.



Prepare the seedbed for seedlings

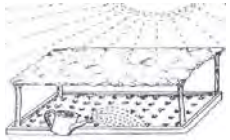
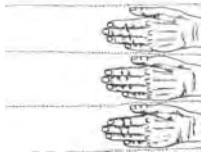


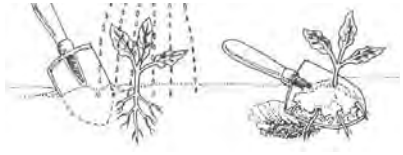
Transplanting



- The roots of a plant should be disturbed as little as possible.
- Plants with bent or distorted roots should be discarded.
- Use a stick to lift up the seedlings, and
- Take as much soil as possible with them during the transplant.
- The planting hole should be deep enough to accommodate the plant's roots. Long tap roots are sometimes cut, but they should not be bent or twisted.
- Pools of stagnant water must be avoided so, when watering seedlings, do not pour the water directly on to them but instead **gently sprinkle it using a bunch of grass or disperse it from a perforated container**.

Planting lettuce

How to sow in the seedbed (nursery)	
	Sow to the depth of your fingernail (1 cm)
	Rows as the hand width of an adult (10 to12 cm)
	After sowing, water thoroughly and regularly. Seed will emerge 5 – 10 days after sowing Seedlings should be watered regularly (2 times /day)
Sow in Bed	
	Sow the seed three hand widths (30cm) apart. Sow to the depth of your fingernail (1 cm) Thin the seeds also three hand widths (30 cm) apart. Disadvantage of sowing directly in the bed is: • Thinning • Unprotected
Transplanting	
	Seedlings are ready to be transplanted • 3 to 4 leaves • 3 weeks after showing



Water before transplanting

Make sure the roots come out **with soil**

Once the seeding is taken out it must be planted immediately

It is better to transplant in the late afternoon

Plant seedlings 3 hand widths between rows (30 cm)

Plant seedlings 3 hand widths in the rows

Water thoroughly after transplanting

Taking care of the lettuce plant

Pay attention to the following:

- Watering
- Protection against pest and diseases
- The use of mulch
- Weeds
- Top- dressing

How to harvest lettuce

After 3 months lettuce is ready to harvest

- Fully grown and firm cut with knife
- When wet from dew or rain don't harvest
- Early in the morning or late afternoon

Planting Cabbage

How to sow in the seedbed (nursery)	
	Sow to the depth of your fingernail (1 cm)
	Rows as the hand width of a adult (10 to12 cm)
	After sowing water thoroughly and regularly. Seeds will emerge 10 days after sowing. Seedlings should be water regularly (2 times /day). When hot provide a shelter to give a light shade for 10 days. Gradually remove the shade
Transplanting	

Seedlings are ready to be transplanted

- 3 to 4 leaves
- 3 weeks after showing

Water before transplanting

Make sure the roots come out **with soil**

Once the seeding is taken out it must be planted immediately

Plant seedlings 5 hand widths between rows (50 cm)

Plant seedlings 4 hand (40cm) widths in the rows

Water thoroughly after transplanting

It is better to transplant in the late afternoon.

Weak seedlings and seedlings with damage growth tips should be thrown out.

Taking care of the cabbage plant

Pay attention to the following:

- Watering
- Protection against pest and diseases
- The use of mulch
- Weeds
- Top- dressing 4 to 6 weeks after transplant

How to harvest cabbage

After 3 to 4 months Cabbage is ready to be harvested.

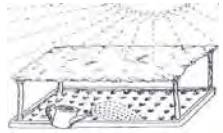
- Fully grown and firm cut with knife
- When wet from dew or rain don't harvest
- Early in the morning or late afternoon
- Store in cool place

Planting Cauliflower

How to sow in the seeded (nursery)

Sow to the depth of your fingernail (1 cm)

Rows as the hand width of a adult (10 to12 cm)



After sowing water thoroughly and regularly.
Seeds will emerge 10 days after sowing.
Seedlings should be water regularly (2 times /day).
When hot, provide a shelter to give a light shade for 10 days.
Gradually remove the shade

Transplanting

Seedlings are ready to be transplanted

- 3 to 4 leaves
- 4 – 5 weeks after showing
- Don't leave too long in seed bed, it will become unproductive

Water before transplanting

Make sure the roots come out **with soil**

Once the seeding is taken out it must be planted immediately

Plant seedlings 5 hand widths between rows (50 cm)

Plant seedlings 4 hand (40cm) widths in the rows

Water thoroughly after transplanting

It is better to transplant in the late afternoon.

Weak seedlings and seedlings with damage growth tips should be thrown out.

Taking care of the cauliflower plant

Pay attention to the following:

- Watering
- Protection against pest and diseases
- The use of mulch
- Weeds
- Top- dressing every 3 to 6 weeks after transplant
- Keep the heads out of the sun light
- Cover head with leaves at 7 – 10 cm diameter.

How to harvest cauliflower

After 3 to 4 months cauliflower is ready to be harvested:

- Correct size , shape and texture fully developed
- Better to harvest to early than to late
- Early in the morning or late afternoon
- Store in cool place

Planting Spinach

How to sow in the seeded (nursery)

Sow to the depth of your fingernail (1 cm)

Rows as the hand width of a adult (10 to12 cm)

After sowing water thoroughly and regularly.
Seeds will emerge 10 days after sowing. Thin out (2cm)
Seedlings should be watered regularly (2 times /day).
When hot, provide a shelter to give a light shade for 10 days.
Gradually remove the shade

Transplanting

Seedlings are ready to be transplanted

- When they are 10cm high
- Don't leave to long in seed bed they will become unproductive

Water before transplanting

Make sure the roots come out **with soil**

Once the seeding is taken out it must be planted immediately

Plant seedlings 3 hand widths between rows (30 cm)

Plant seedlings 2 hand (25cm) widths in the rows

Water thoroughly after transplanting

It is better to transplant in the late afternoon.

Weak seedlings and seedlings with damage growth tips should be thrown out.

Taking care of the spinach plant

Pay attention to the following:

- Sufficient watering
- Protection against pest and diseases
- The use of mulch next to rows in bed
- Remove weeds
- Top- dressing every 3 to 6 weeks during harvesting
- Top dressing for harvest period up to 4 months

How to harvest spinach

After 2 months Spinach is ready to be harvested:

- Outer leaves are cut off above ground level
- Just pick a few leaves at a time
- Leaves can be harvested for 2 to 3 months
- As soon as flower stem appears all leaves should be harvested.
- Early in the morning or late afternoon
- Store in cool place
- Remove plants if flower appears.

Planting Beetroot

Beetroot is a root crop ideal for your garden. Mainly used in salad. Leaves can also be used as Spinach.

When and where to plant:

- Cool weather crop but can be planted throughout the year.
- If the soil is moist it will resist the heat.
- Look at planting table for planting times
- Can be planted in all types of soil but deep loos soils rich in organic matter are the best

How to sow in the seeds

Seeds should be sown directly:

- Make furrows 3 hands apart (30 -35 cm)
- Sew seed 2 fingers apart.
- Plant as deep as the first joint of your finger.

- Thin out the seeds when 3 fingers (4cm)high and again at 4 fingers high
- After the last thinning it should be a hand apart.

Taking care of the beetroot plant

Pay attention to the following:

- Supply sufficient water
- Protect leaves against pests and diseases.
- Remove weeds
- Soil should have sufficient nutrients

How to harvest beetroot

After 8 to 9 weeks beet is ready to be harvest when they are 5 cm in diameter hands

- After pulling out the beetroot, twist the top off.

- If you cut off the leaves, you may damage the root and as a result it will bleed and a loss of colour will appear.

Planting Spinach Beet

Excellent source of nutrients like Spinach. Leaves are the edible portion. It is more resistant to diseases than spinach and easier to grow. It is also tastier and much richer in vitamin B

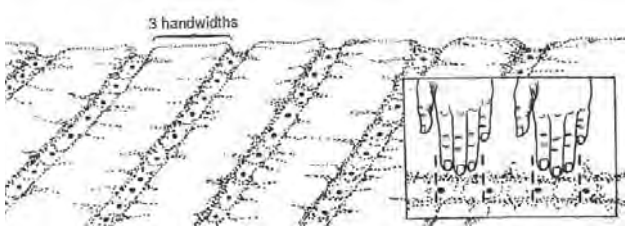
When and where to plant:

- Cool weather crop but can be planted throughout the year.
- If the soil is moist it will resist the heat.
- Look at planting table for planting times

How to sow the seeds

Seeds should be sown directly:

- Make furrows 3 hands apart (30 -35 cm)
- Sew seed 4 fingers apart.
- Cover seed with 1 -2 cm of soil.



Taking care of the spinach beet plant

Pay attention to the following:

- Thin out the seeds when 4 fingers (8cm)high to three hand widths 30cm apart
- Supply sufficient water
- Protect leaves against pests and diseases.
- Remove weeds
- Top- dressing every 3 to 6 weeks during harvesting
- Top dressing for harvest period up to 4 months or more.

How to harvest spinach beet

After 6-8 weeks spinach beet is ready to be harvested when its height is about 2 hands high.

- Outer leaves are cut of above ground level
- Just pick a few leaves at a time
- Leaves ready to be harvest must be picked to keep on harvesting
- Early in the morning or late afternoon
- Store in a cool place

Planting Carrots

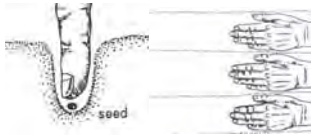
Carrots are among the most important root crops. Rich in vitamin C

When and where to plant:

- Cool weather crop but can be planted throughout the year.
- If the soil is moist it will resist the heat.
- In hot weather they develop a pale colour and strong taste.

- Look at planting table for planting times
- Deep loos sandy soils which have a dressing of manure or compost with the previous crop are ideal.
- No manure or compost just before carrots are planted.

How to sow in the seeds



Seeds should be sown directly:

- Make furrows 3 hands apart (30 cm)
- Plant seed finger nail deep
- Sew seed 2 to 3 fingers apart.
- Water thoroughly after sowing.
- Emerge after 7 to 14 days

Taking care of carrots

Pay attention to the following:

- Carrots prefer cool soil and require a steady supply of moisture throughout the season.
- Reduce water when mature.
- Thin when first two to three leaves have developed. Thin when soil is moist. Earth up water after thinning thin to 3 fingers apart.
- Throughout the season the shoulders of the carrot should be covered with soil to prevent greening.
- Place mulch on soil between plants.
- Protect against pests and diseases.
- Carrots grow slowly initially and should be weeded as soon as possible.
- Top- dressing every 3 to 6.

How to harvest carrots

- After 8-10 weeks carrots are ready to be harvested and will need 3 to 4 weeks to reach full size
- It is better to start harvest early.

Planting Onions

Onions are easy to grow but have a long growing season of 7 to 8 months. Can be eaten alone as well as with other foods. The leaves can also be eaten.

When and where to plant:

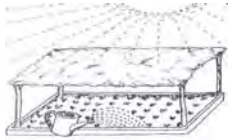
- Onions prefer cool weather the fist part of the season.
- When bulbs are forming and during harvesting they prefer higher temperatures.
- Dry hot temperatures favours insect development
- Moist conditions promotes diseases.
- For planting dates look in the planting table (best March to February).

How to sow in the seeds

For the small farmer sow in seed bed first and then transplant

- Sow to the depth of your fingernail (1 cm)

Rows as the hand width of a adult (10 to12 cm)



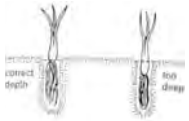
After sowing water thoroughly and regularly
Seed will emerge 10 days after sowing
Seed will emerge 10 days after sowing
Seed will emerge 10 days after sowing.

How to sow in the beds

Advantage to plant direct into the seed bed is: earlier harvest.

- Fingernail deep (1 cm)
- Rows one hand 10 cm apart
- Thin the seeds one hand 8 to 10cm apart.

Transplanting

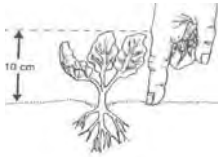


Seedlings are ready to be transplanted

- 7 to 8 weeks after showing

Water before transplanting
Make sure the roots come out **with soil**
Once the seeding is taken out it must be planted immediately.

Plant seedlings 5 hand widths between rows (50 cm)
Plant seedlings 4 hand (40cm) widths in the rows
Water thoroughly after transplanting
It is better to transplant in the late afternoon.



Once the seeding is taken out it must be planted immediately.
Make sure the roots come out **with soil**

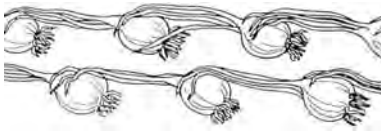
Plant seedlings 5 hand widths between rows (50 cm)
Water thoroughly after transplanting
It is better to transplant in the late afternoon.

Taking care of the onion plant

Pay attention to the following:

- Plant must have sufficient water but don't over water.

- Remove weeds
- Protect against pests and diseases.
- Use a mulch between rows.
- Top- dressing after 4 weeks.



How to harvest onions

After 7 to 8 Months ready to harvest when leaves fall.

- Pull out by leaves
- Leave in sun to dry 3 to 14 days leaves over the bulb.
- Bend the leaves to encourage drying off.
- Plait the leaves together of dried onions and hang in dry cool place

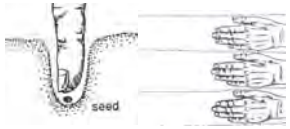
Planting Garlic

Garlic is used to treat conditions such as high blood pressure, chest problems and colds. It is also antiseptic and antibiotic. Can be used to scare off insects.

When and where to plant:

- Garlic prefers cool weather best to plant February to April.
- For planting dates look in the planting table.

How to sow in the seeds



Seeds should be sown directly:

- Make furrows 3 hands apart (30 cm)
- Plant seed finger nail deep
- Sew seed 2 to 3 fingers apart.
- Water thoroughly after sowing.
- Emerge after 7 to 14 days

Taking care of the garlic plant

Pay attention to the following:

- Plant must have sufficient water but don't over water.
- Remove weeds
- Protect against pests and diseases.
- Use a mulch between rows.
- Flower buds must be broken off as soon as they appear to promote the formation of the bulb.
- Top- dressing after 4 weeks.
- Plant in a sunny place.

How to harvest garlic

- After 7 to 9 Months ready to harvest as soon as leaves yellow and dry out stop watering.
- After soil dries out lift the garlic using a fork.

- Leave in sun to dry 3 to 14 days leaves over the bulb.
- Hang or place in well-ventilated place for one month.
- After month cut of the leaves and store in a bag in well ventilated place.
- Garlic can last for up to a year under favourable conditions.
- Largest garlic bulbs kept for planting next season.

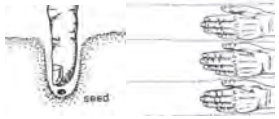
Planting Peas

Very nutritious, easy to grow, but if planted in hot weather diseases can be a problem.

When and where to plant:

- Plant mainly in the winter they prefer cool weather.
- For planting dates look in the planting table.(June to August)
- Prefer well drained soils with high organic matter content.
- Good drainage is essential because the plant is susceptible to parasitic soil fungi

How to sow in the seeds



Seeds should be sown directly:

- Make furrows 3 hands apart (30 cm)
- Plant seed finger nail deep
- Sew seed 2 to 3 fingers apart.
- Water thoroughly after sowing.
- Emerge after 7 to 14 days

How to plant peas

Peas' seed is sown directly in the seed bed.

- Seeds 4 hand apart (40-50 cm) single or double row 7 to 8 hands apart (70 – 80 cm)
- Plant 2 fingers deep (2 -4 cm)
- Don't apply fresh manure before plant this will causes strong top grow to the detriment of flower and fruit formatting.

Taking care of the pea plant

Pay attention to the following:

- Plant must have sufficient water but don't over water seeds and seedlings rot easily.
- Remove weeds immediately.
- Protect against pests and diseases.
- Once the seedlings are big enough earth up the plants will support them.
- Use a mulch between rows.
- Sticks should be placed along the rows to support the plants.
  - Ease of harvest
  - Working between rows
  - Easy spraying
  - Watering not to water leaves.
  - Better quality
  - Increases harvest time.

- Top- dressing after 4 weeks and when flowering.
- Plant in sunny place.

How to harvest peas

- Peas mature in 3 to 3.5 months
- Early harvest must be handled with care plants brittle can break.
- Pick pods holding the plant with one hand and pick with other.
- Pick twice a week

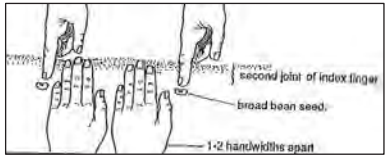
Planting Broad Beans

Very nutritious, protein-rich and easy to grow. You can include broad beans in the winter cropping programme.

When and where to plant:

- Plant mainly in the winter they prefer cool weather and moist growing conditions hot weather pod formation disappointing.
- For planting dates look in the planting table.(April to May)
- They prefer heavy well-cultivated soils.

How to plant broad beans



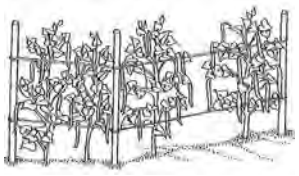
Broad beans grow upright up to 1 m and should be planted in double to triple rows.

- Plant seeds 1.5 to 2 hands apart (15 to 20 cm) Double or Triple row 2 hands apart (20 cm) and 5 hands between set of rows.
- Plant as deep as the second joint of index finger (5 cm)

How to take care of broad bean plants

Pay attention to the following:

- Regular watering essential – flowering and pod formation – narrow planting create a moist micro climate
- Running a single or double string both sides of row.
- Earthing plants for basal support.
- If good number pods form-remove growing point-discourage aphids
- Care for pests and diseases.
- Use mulch
- Weeding



How to harvest broad beans

- Peas mature in 3 to 4 months
- Harvest twice a week
- Removing the pods regularly once mature allows young pods to mature before plant vigour declines

What is crop rotation?

- It is a method whereby different crops are planted in a particular sequence on the same field to give the resources in the soil a chance to recover.
- Same cultivation methods year after year will resulted in **Compaction.**
- **Soil nutrients are depleted** if same crop planted year after year
- Drop in **plant health** and **productivity:** Many **diseases and insects** are plant-specific and planting the same crop year after year result will result in a problem.

To avoid these don't plant the same crop year after year

Advantages

- Lessen need for pest control
- Soil structure is maintained
- Reduce the spread of soil born disease
- Avoid nutrient depletion in the soil.

How crop rotation works

1. Divide your farm in different areas.
2. Identify the crops you want to plant
3. Each year the crops grown in a area change
4. Crop with own requirements, habits, pest and diseases benefit from new soil.

Crop rotation is effective in three to four years. This is the time for soil borne diseases to decline to harmless levels

Traditional method of crop rotation

There are four groups of crops:

- **Legumes**: Beans, peas
- **Root vegetables**: Radish, carrot, potato, onion, garlic, rutabaga, shallots.
- **Leafy Greens**: Spinach, Kale, Cabbage, Cauliflower, Broccoli, Chard
- **Fruit-bearing**: Tomato, corn, cucumber, squash, pumpkin, eggplant.

Traditional methods limitations

Groups don't tell the whole story.

Potatoes and tomatoes look different but belong to the same family.

Plants from the same family should not follow each other.

They attract the same pests and use the same nutrients.

Sophisticated classification system for crop rotation

- Leafy Greens(Brassicas):

- Legumes: Bean family

- Solanaceae: Tomato family

- **Alliums (onion family):** Garlic, Onion, Shallot, Chive, leek.

- **Umbeliferae (Carrot and root):** Carrot, Celery, celeriac, Cilantro, Fennel, parsnip, Parsley, Dill

- **Cucurbits (squash and marrow):** Squash, cucumber, melon, pumpkin.

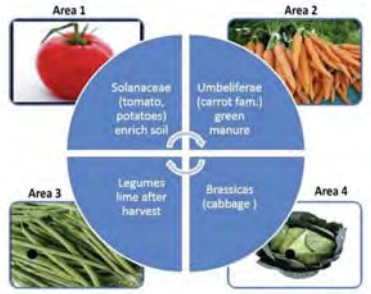
- **Chenopodiaceae (beet Family)**: Beet, Swiss chard, spinach.
  The beet family can follow most other crops.

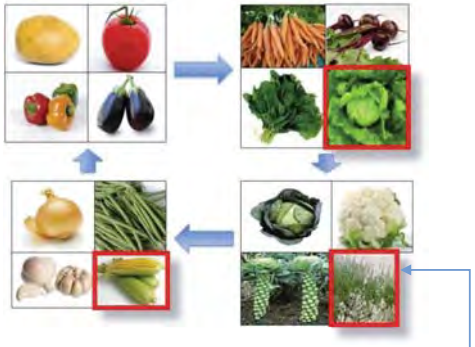
- **Miscellaneous:** all fruit, mint, oregano, rosemary, sage, basil, lettuce, endive, cress, Jerusalem artichoke, corn, asparagus, okra, chicory
  This groups offer greater flexibility it make it easier to design a longer rotation plan.
  Plant plants in the **Miscellaneous group** where ever you have space.

- Brassicas follow legumes
  - Plant cabbage, kale on soils planted by Legumes.
  - Potatoes also but not with brassicas they love different pH levels.

- Very rich soils and roots don't mix:
  - Leave grow in expense of edible parts.
  - Sow after crops like Brassicas.

Four-bed Rotation





Important points on crop rotation

- Rotation promotes organic pest control
- Plant families together
- Don't grow families more than one year on the same soil
- Vegetables from the "different group" can share the same area if required. The same conditions will apply as for the normal crop rotation programme. (Refer to image above, indicated by crops in red block.)
- Perennial and miscellaneous don't need to be rotated in your crop plan.

Sample template for a crop rotation record

Bed	Crop	Planting date	Harvest Date	Next crop

Sample template for crop record

Bed	Crop	Planting date	Remarks	Yield	Problems

Training Material 10

Animal Husbandry, October 2015

Phase 2

N-CLIMP

Training Topic: Animal Husbandry

Course Material prepared by Agra ProVision
for JiCA / N-CLIMP

October 2015

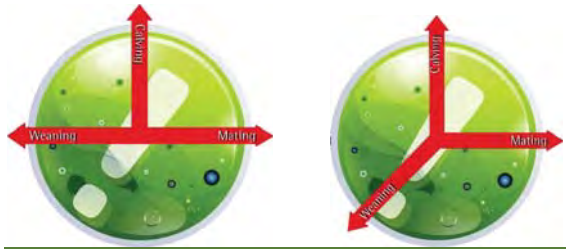
Table of Contents

The Circle Programme – Animal Management

The husbandry cycle on a farm is mainly centred around the calving/lambing season or calving date on a farm. For this you have to decide which system you are using and then use the appropriate chart for that. Of the two cattle systems one is for the season-driven farmer where the animals are grouped into 3 month-periods. The programme combines the different interventions so that a group of animals could be handled together making management easier. The individual cattle programme is for the farmer with a continuous calving season. The husbandry actions then need to follow the young as it is getting older. The sheep calendar could be used for both types of farming.

"Red T" or "Red Y" Arrows

The broad red line represents the main events of the productive cycle on the farm. You can turn the wheel and put the arrow on the event at hand and follow the indicators on the chart to see what is recommended. You will find yourself using the "calving /lambing" arrow the most as it is the starting point of most of the actions.

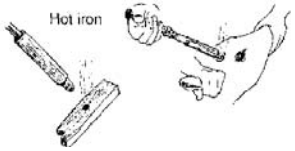


T arrow for Controlled Mating Season and Y arrow for Open Mating Season

Dehorning

- Age 4 – 6 weeks: Dehorning is best done at an early stage with hot iron, gas- or fire-heated tool.

The important thing to remember is that the growth of the horn take place where the hair line starts. This growth line must be destroyed during the burning process to prevent regrowth of the horn. The surest way of doing this is to separate the skin from the burnt horn knob. This is done by swinging the burning iron in a wide circle around the centre knob when finishing off the burning process. This will cut through the remainder of the hot skin giving a clear demarcation line indicating a successful branding.



Dehorning with hot iron

Different tools for dehorning

Castration

1. Cattle
   - **Age 2 – 6 weeks with elastrator elastic rings**. Depending on the race, size (small vs large testes) the decision must be made to do it 2 weeks through to 6 weeks. The measurement is whether both testes can go together at the same time through the opened up elastrator ring.
   - **Age 6 – 7 month at weaning with burdizzo**. As the animal's growth rate are set back with this procedure consideration must be given to do it well in advance of selling them off to give them time to regain lost growth.
   - **Age - Never castrated** – animals that are going to be sold off to feedlots will do better without being castrated. Make sure about that from your marketing agent, well in advance of taking cattle to feedlot.

2. Sheep and Goats
   - **Age 2 – 4 weeks**. Use elastrator rings on the small testes and the burdizzo on the bigger ones (older lambs)

Castration Methods

There are 3 ways to castrate:

- **Elastrator rings:** This method is only applicable for the animals between 2 – 6 weeks.
  - The calf must be restrained on its side by holding it down by two persons.
  - The apparatus which opens up the elastic rubber band is called an elastrator and must be used.

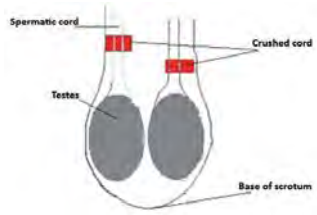
Elastrator

  - Both testes must be able to go through the opened ring simultaneously, otherwise the testes are too big and this method cannot be used.
  - The elastic band is left on until the testes drop off by themselves.

Correct usage of elastrator and rings

- **Burdizzo:** This method is used the most. It is used when the testes become too large for the elastrator rings to be used. The burdizzo method entails the clamping off of the spermatic cord without damaging the skin.
  - The animal can be restrained by using:
    - the immobiliser
    - standing in a crush
    - holding it down especially when they are young.
  - It is important NOT to clip the two cords of the testes together as it will cut off the complete blood supply to the lower part of the testes and the complete sack will fall off leaving a large open wound.
  - Thus do one testes cord at a time and try not to clip them at the exact same height. This is quite logic when one does the bigger bulls.
  - After closing/clipping with the burdizzo, keep it closed on the cord for one minute before opening up.

Pre caution: Although the penis and the testes cords are far apart it is possible to clip them together. Make sure by careful feeling with your hands that there is only one string through the burdizzo's mouth before closing it down.



Using the Burdizzo tool

- **Open method**: This can be done at any age but as the other methods are working better this one is not advised

Branding

Age 6 – 7 month at weaning (as stipulated by FAN Meat regulations). Meatco suggest a small branding iron to prevent unnecessary damage to the skin. This has to be weighed up against the possibility of stock theft where a bigger brand can be burnt over the small one for the "new owner".

Branding Method

Branding is done with a branding iron with the owner's code on it. This is done by heating the branding iron in a fire next to the crush pen or "Manga".
The animal is restrained with:

- Immobilizer
- Pulling up his leg in a crush pen
- Restraining the animal on the ground

The branding iron is heated until red hot in an open fire next to the crush pen.
Even pressure on the skin is made with the hot iron until an impression, half way into the skin, is made.

Branding animals

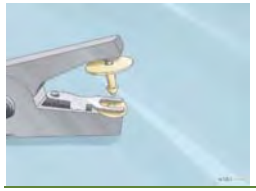
FAN Meat Ear tags

Tagging needs to be done at age 6 – 7 months together with the branding. However, if the calves have been weaned before that age (branding age) they have to be fitted with the FAN Meat tag before they can travel on the national roads.

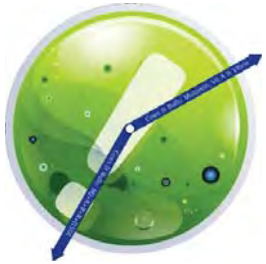
Position the tag correctly in the ear. The recommended position in the ear to apply a plastic tag is approximately **half way between the top and bottom edge** (between the two thickened lines of cartilage) and a **third to half way along the ear measured from the head**. If the tag is applied too close to the edge or towards the tip of the ear, it is at a weaker point and more vulnerable to damage. Metal tags should always be

applied along the top edge and when tagging calves, allow a 5mm free space under the fold to allow for growth.

Positioning of tags and FAN Meat ear tags



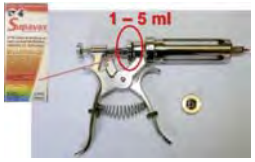
Graphic illustration on how to tag an animal



Vaccinations are applied by injecting animals. It can be done either under the skin (subcutaneous “sc”) or in the muscle (intra muscular or “im”). Most of the time, in fact 99 % of times, it is given subcutaneously. In the current programme it is only Rabicin which needs to be given intra-muscular (im). The important thing is that despite whatever anybody else is saying, you must follow the instructions on the pamphlet which comes with the bottle. It will state whether it must be given **im** or **sc**.

There are two main types of syringes:

- The automatic syringes “revolver type” for small volumes multi dosing.
  - They are mainly used where there are many animals involved who will receive the same dosage. It is very accurate and will save a lot of time.



“Revolver” syringe

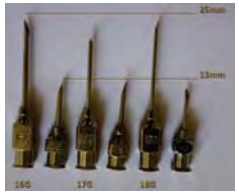
This type of syringe uses a specific type of needle, called “Record needle”. These needles are made completely out of steel and the fitting at the back is smaller than the “other” needles called “Luer lock needles”. The luer lock needles are made up of different colours of plastic at the back indicating the thickness of the needle. Grey is very thick, the same thickness as the 16G record needle where the yellow one is thinner and the same thickness as the 20G needle.

These coloured needles are long needles (25 – 30mm) and are mainly used on the disposable syringes for treating animals with antibiotics intramuscularly (im). They are not handy for subcutaneous injections but could be used for that as well.

A small adapter where the needles could be exchanged to be used on both syringes exists on the market – this might come in very handy. It is however better to buy the correct type of needle for your syringe from the start.

The record needles come in two lengths with various thicknesses.

The numbering imprinted on the wider side indicates the thickness. It will lie between 16G and 23G, the “G” stands for gauge meaning thickness. The higher the number the thinner the needle and vice versa. The length will either be 13 mm or 25 mm. For vaccination we are using the short needles (13mm) for both cattle and sheep. The thinner one, 22G for the sheep and the18G for thicker vaccines and animals with thicker skins, like in cattle.



Record needles

- Disposable syringes comes in different sizes from 3 ml to 50 ml. They are mainly used for treating animals with larger volumes like antibiotics and vitamins **BUT** they are disposable and only to be used once. They are using only the “luer lock” needles, those with the colour fittings.

Disposable syringes and needles

- **Nylon Syringes**: They are for the same purpose as the above disposable syringes but they can be re sterilized and used again. They are mainly using record (steel) needles

Nylon syringes

How to give an injection

1. First fill up the syringe.
2. Attach the needle to the syringe,
3. Fill the syringe with air,
4. Stick the needle into the bottle,
5. Turn it upside down,
6. Push all the air into the medicine bottle,
7. Pull back and suck the syringe full of medicine.

If you are using an automatic syringe, adjust the setting at the back for the necessary amount to be injected. Now you are ready to inject.

Subcutaneous (sc) injection

Grab a skin fold and hold it firmly, push the needle through the first layer of skin, now let go of the skin so that it flattens, inject the needed amount and watch the small swelling appear underneath the skin as the fluid is leaving the syringe.

Subcutaneous injection

Intra-muscular (im) injection

1. Take the needle off the syringe, secure it between your thumb and the side of your bent forefinger,
2. Tap the chosen injection site a few times with the back of your hand holding the needle to make the animal aware that something is going to happen.
3. With the last tap coming on, turn your hand around and firmly hit the needle through the skin into the muscle.
   He/she will not feel the pain compared to pressing it slowly through the skin which is very painful.

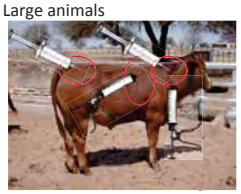
4. Now attach the syringe to the needle and pull back on the plunger as if you want to pull something out of the muscle, this is called “aspirating”.
5. If there are only a few air bubbles penetrating your syringe everything is fine and you can go ahead and press the given amount of medicine into the muscle.
6. If blood is coming into your syringe it means that you are in a small blood vessel, this is the reason why you are aspirating, to find out whether you are clear from any blood vessels.
7. Now you must pull out the needle and hit it back into the muscle close of the first attempt, repeat the aspiration and repeat the follow-up steps as described above

Intra-muscular injection method

Injection sites

- Small animals

- Large animals



Giving medicine by mouth

Some medicine has to be given orally. For example: deworming, emergency medicine, water plus a few others.

- Oral deworming
  - Oral deworming is nowadays given with an automatic dosing or drenching gun. There are two types of dosing guns, one for large and one for small ruminants, a 20 ml gun and a 40 ml gun. The snout or mouth piece differ in length for the two groups and is save for each species. If you are using the correct one it would not hurt the animals throat at the back neither will the dosing fluid escape from the mouth due to a short snout being too small.

Images of different dosing guns

- Bottle dosing
  - Firstly, remember that one cannot give large volumes of medicines (fluid) this way and secondly, care must be taken to give it slowly. The animal must have enough time to swallow. Small ruminants in particular tend to be very difficult to treat this way because they refuse to swallow.

  - In cattle, after restraining the animal, go and stand next to the animal’s head facing in the same direction. Put your closest arm to the animal over its head and grasp its opposite lip firmly with that hand and pull his head up against your body. Its head must be slightly higher than its body. It is important not to lift its head too high, the animal would not be able to swallow so that drenching fluid will run directly into its lungs.
  - Now take the bottle with the dosing fluid, it must be in bottle with a long tapered neck (old grape juice or wine bottle) with your open hand and push it from your side into the side of the animals mouth and push it deeper so that it goes over the tongue’s bolus. Only the hind quarter of the bottle will now stick out of it mouth. Let the first half of the fluid run in, then take the bottle away and wait for the animal to swallow. Repeat the process until finished.
  - In small stock one can hold the animal between your legs with both of you facing in the same direction. Put your one hand’s thumb behind his front teeth and force its mouth open, the other hand you can hold the bottle up to its mouth to dose the animal with small volumes of fluid at a time. Do not hold its tongue, it would not be able to swallow. In small animals it can be easier to use the deworming dose gun to dose the medicine with.

Calves and Lambs - "Light Blue"

The light blue arrows indicate new off-spring: These arrows indicate when to vaccinate and when to deworm the young animals.

Calves must be vaccinated at:

- 6 – 7 Month with:
  - Anthrax
  - Black Quarter
  - Botulism - Use "Supavax"
- 7 -8 Months (one month later) with:
  - Black Quarter
  - Botulism - Use "Duovax"
  - Rabies

The 3 vaccines Anthrax, Black Quarter and Botulism (Sponssiek/Miltsiek/lamsiek) are vaccines which traditionally were administered over long periods of time and are still relevant today. Rabies became more relevant over the last few years and has become a necessity.

- Deworming traditionally is done on 3 months and 6 months. Tape worm and round worms both are necessary at this age.

Knowing that Namibia is a very dry country and worm survival in this climate is limited. The worm egg needs a wet and warm environment to hatch opposed to the ruling Namibian hot and dry conditions. Where calves are separated from the mothers during the night for various reasons the wet kraal provides favourable conditions for the worm eggs to hatch and therefore it is necessary to deworm them on a regular basis. Therefore stick to the routine deworming according to the programme (wheel). Other systems may warrant worm egg count on the calves' faeces too diagnose the presence of the worms to prevent unnecessary expensive deworming.

- Deworming of the older animals should be preceded with a worm egg count for the same reason.

Taking a sample for worm egg counts entails the taking of a small amount of faeces out of the rectum of the animal, roughly 20 ml and put it in a plastic bag that it cannot lose moisture. It must then be kept cool by putting it in a fridge or in a cooler bag until delivering it to a veterinary laboratory or private practitioner the same day. If the sample gets hot the worm eggs will hatch and the sample will test negative which is incorrect.

Lambs must be treated as follows:

- At 2 Weeks:
  - Lambs tail docking with elastrator bands – better done before 7 days. Lambs castration with elastrator bands. Lambs + kids: First Pasteurella
- 1 Month:
  - Lambs castrated with burdizzo. Lambs dock tails with burdizzo
- 1 ½ months:
  - Lambs + kids: Second Pasteurella. Deworm tape worm - *Praziquantal*
- 3 Months:
  - Lambs + Kids. First Pulpy Kidney. Use *Multivax* or *Ultra Shot 7*. First anti-abscess - *Glanvax 3*. Deworm round and tape worm – *Ivermectin, Albendazole*
- 4 Months:
  - Lambs and Kids second Pulpy Kidney – use *Multivax* or *Ultra Shot 7*. Second anti-abscess - *Glanvax 3*
- 5 Months:
  - Lambs + kids. Deworm round, nose and tape worm– *Ivermectin, Albendadzole* (same time as adult sheep)

Bulls, Cows, Rams and Ewes - "Dark Blue"

The dark blue arrows are used for the mature animal: These arrows indicate when to deworm and vaccinate the mature animals.

- Cattle
  - **Cows and bulls**: Inject the cows and bulls one month before the mating season a Vit A injection, Multimin and Vibrin. Vibrin is to counter reproductive diseases and is very important. The other two are vitamins and minerals which will aid in helping to get the cows in calf.
  - Vaccinate the cows and bulls during the middle of the gestation period with Anthrax, Black Quarter, botulism and Rabies. Lumpy Skin Disease can be withheld until there is an outbreak in the cows and bulls. It is a good time to deworm the herd at this time with a broad action dewormer if the worm egg count is positive.

- Sheep/Goats
  - The rams and ewes must be dewormed 2 months before the mating season (after weaning). It is important to deworm them against round worms and nose worms – *Albendazole* and *Closantol*.
  - One month before the mating season is going to start, the ewes and more importantly the does must be vaccinated against Enzootic abortions. This will protect the herd from mass abortions and devastating financial losses.
  - Deworm ewes at the end of the mating season (six to eight weeks after the beginning of the mating season
  - Two months before the lambing season vaccinate the heavy pregnant ewes against pulpy kidney/other clostridias/tetanus/pasteurella/abseses. You can use combinations of Multivax / Ultra Shot 7 / Glanvax 3

Vaccines

- Anthrax:
  - All species
    - Dose: 1 ml sc
    - Calves: 5 – 6 months/ weaning
    - Adults: Once a year

Typical programme:

Vaccinate young animals at wean (5 – 7 months) with OBP Anthrax or Supavax followed thereafter once a year with OBP Anthrax or Supavax.

Compulsory by law to vaccinate

- Botulism
  - Cattle and horses
  - Dosage:
    - Adults - 1ml s/c once a year
    - Young - 1 ml s/c at 6 and 7 months and then yearly thereafter
  - Animals that have not previously been immunised should be given 2 injections with a 4 – 7 weeks interval

Typical programme:

Vaccinate calves at 6 months with OBP Botulism or Supavax. Again at 7 months with OBP Botulism or Duovax. Thereafter once a year with OBP Botulism or Supavax.

- Black Quarter
  - Species: Cattle
  - Dosage:
    - Adults 2 ml s/c once a year
    - Young 2 ml s/c at 6 - 7 month and then yearly thereafter
  - Animals that have not previously been immunised should be given 2 injections with a 4 – 6 weeks interval

- Brucella (Contagious abortion)
  - Cattle only
  - 1) Brucella S19 freeze-dried
    - Heifers only
    - Vaccinate ONLY between 4 – 8 months, not older animals
  - Dosage:
    - 5 ml - subcutaneously
    - (2 dosses in one bottle, mixed water with dry pill)

- Lumpy Skin Disease
  - Cattle only
  - Dose: 2 ml (OBP) subcutaneously (s/c)
    - Adults: Once a year
    - Calves: First dose at 6 months, thereafter once a year
  - Calves from unvaccinated mothers:
    - Vaccinate any time when older than 1 week

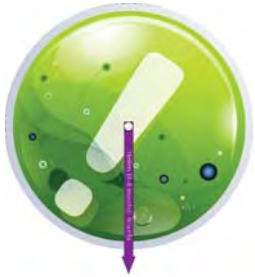
- Rabies
  - Cattle / dogs
  - Dosage: 1 ml sc or im
    - Adults - Once a year
    - Calves - Do not vaccinate younger than 3 months

- Vibrin Fertility disease
  - Bulls:
    - Dose: 2 ml s/c (Double dose twice in positive herds)
    - **Once a year**
    - Best time is 30 days before breeding season
  - Cows and heifers:
    - Dose: 2ml sc
    - **Safe for pregnant animals**
    - Primary vaccination: Between 1 to 7 months before breeding
  - Revaccination:
    - Annual single dose vaccination
    - 1 to 7 months before breeding

- Pulpy kidney /enterotoxaemia
  - Lambs 4 - 6 months
  - Give 2 injections:
    - 1) First the oil-1 ml s/c
    - 2) 4 - 6 weeks later – Alum -1 ml s/c
    - Adults – Give alum 1ml s/c every 12 months

- Brucella Ovis (Bybal ontsteking)
  - Bruselle Rev 1 Vaccine
  - Only male lams 2 – 4 months of age
  - Dose 2ml subcutaneously once

- Glanvac (Abscess)
  - Caseous lymphadenitis
  - Kids and lambs (3 – 4 months), and once again after 1 year



It is very important to vaccinate the heifers against Contagious Abortion (CA), better known as Brucella Abortus or Brucellosis. It causes abortion from 7 month onward during pregnancy. It is very difficult to get the disease removed from your herd once it occurs and it keeps infecting the clean animals. It is also a zoonosis meaning that humans can also get the disease through contact with the afterbirth and by drinking milk of an infected cow.

Only females (heifers) must be vaccinated between the ages of 4 – 8 months. It is compulsory by law.

It is very important, in fact the most important thing to do on the farm is to get your animals pregnant. Firstly you must make sure the male animals are healthy and fertile and secondly you must make sure your cows are pregnant after the season. This will help you to plan your farming practices like fodder flow for the near future.

- Males
  - Your bulls and rams must be tested one month before the breeding season for reproductive diseases and fertility. This will give you enough time to get a replacement male for the season. If you’ve got a continuous season then you must make a specific date to test the males. It is good to test them a month before the green periods where the females come naturally on heat.

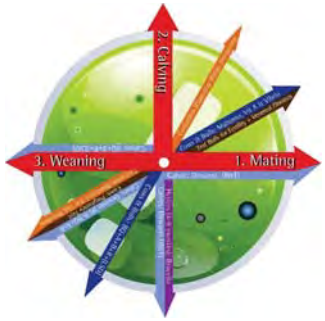
- Female
  - Testing the cows is best done 2 month after the bulls was with them. That means if you are going to group them together the youngest one pregnant must be at least two months pregnant with the latest one 9 months.

In sheep and goat pregnancy testing are done with ultrasound (scanning) from 42 days onwards.

- Sheep
  - Three weeks before the mating season the ewes must get “flush feeding” (100gr/ewe/day every 2nd day) to help them to come on heat earlier in the mating season. Stop flush feeding when the mating season starts.
  - Teaser rams must be introduced to the ewes together with the flush feeding, 3 weeks before the breeding season

1. Year cycle
2. Body Condition
3. Cow cycle
4. Venereal Diseases
5. Other Reproductive diseases
6. Age
7. Record keeping
8. Selection for fertility
9. Test Bulls

1. Year cycle



Calves must be born in the beginning of the rainy season. At that time there is little grass but the calf is only drinking milk.

Two months later the veld has grown into their best production. This is the time when the calf is starting to eat grass together with large quantities of milk. The cow who is producing the milk needs a lot of good quality food for her to be able to go into peak milk production. The good quality food will make her gain weight, this will stimulate her to start to cycle earlier and conceive earlier. So, depending on the rainy season one must decide whether to put the bulls to the cows earlier or later. In the above model the bull was introduced to cows in the beginning of the fourth month of good rain. Depending on which month was the beginning of the rain, December or January, the bull will go in with the cows at the beginning of February or March.

The calves will be weaned at 7 ½ months when there is mainly dry winter grass. To enable them to make good use of the dry veld one has to supplement them with a winter lick so that they can keep on growing.

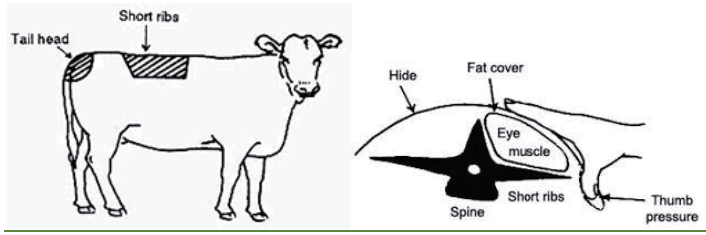
The cow will then calf down again in the beginning of December the following year.

2. Body condition

Body condition is the single most important factor to get females pregnant.

- Her ideal condition must be that of "moderate fat". That is a 3.5 on a scale of 1 – 5.
- A calf at foot will keep her condition down in dry years/season and it is her poor condition that prevents her from getting in calf.

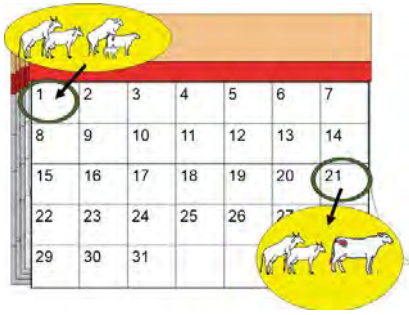
- Green grazing contains the right Vitamins and energy to get the cow in calf. Plan your mating season around that.
- Summer and winter licks contain the trace and macro elements like phosphate (very important) which will help getting them in calf.
- The cheapest way to feed your cow herd is to prevent over stocking right through the year (it does not help to stock less in the winter after you have over-stocked in summer and all the grazing is already gone)
- Try to let your cow calf down in the beginning of the rainy season. Two months later when the veld is at its best there will be enough food to produce a lot of milk for the growing calf, enough food to pick up condition to get pregnant again and enough food for the calf when it starts to eat.



Places where you assess the condition

3. The cow cycle

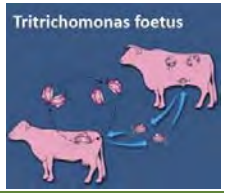
- **The cow cycle** is giving us a good idea about her reproductive health. She will come on heat for the first time roughly 15 days after calving down. This is not always a visible heat and mostly it is an infertile heat. Thereafter she will come on heat every 21 days (18 – 23 days). If the heat cycle is irregular (longer or shorter than 21 days) it is an indication of temporary infertility. This will require your attention as you need to prevent longer inter-calving periods, which in turn might lead to a loss in income.



Heat cycle

4. Venereal diseases

Venereal diseases are diseases that are transmitted from the bull to cows and from the cows to the bulls. This cycle keep on repeating itself and keep the disease in the herd.



Transmitting diseases from bull to cow

- An infested herd will have a low in-calf percentage and the cows will take much longer to conceive. Typically the cows will keep on coming on heat and the bulls will keep on mounting them only to get them in-calf months later. This disease will reduce your profitability dramatically.
- Calving rate in adult cows will be 60% and 40 % in heifers.
- To test for this disease you must test the bulls only. If they are positive the whole herd must be treated and in some instances some of the animals must be slaughtered to get rid of the disease and in other instances the herd must be vaccinated. For this you must contact your local veterinarian to assist you.
- Make bull testing a yearly routine to diagnose this disease early ***AND*** do fertility testing of the bulls at the same time.

5. Other Reproductive diseases

There are a few other diseases that cause abortion in late pregnancy of which Brucellosis or Contagious Abortion (CA) is the most important one. The disease is spreading from one female to the other mainly through direct contact. Contact with the infected afterbirth as well as with genital excretions from infected cows will again infect clean animals which will become livelong carriers and although they would not abort every year, will keep on infecting new animals which will at least abort the first time. There is a compulsory vaccination for this disease which has to be done between the ages of 4 to 8 months.

Abortus

NB! All abortions must be investigated. No abortions are normal and they can have disastrous consequences on the whole herd when left undiagnosed. Contact your nearest veterinarian as soon as possible. No diagnosis can be made on decomposed carcasses.

6. Age

Age by itself is a very important criteria when it comes to reproduction.

- Firstly the heifers should grow according to age. One would expect to cover them between 14 and 24 months depending on the breed. They should then be between 220 – 320 kg in body weight. A rough indicator is to mate the heifer when she reaches 60% of her expected mature weight.
- Older cows are culled when their body conditions deteriorate during the previous lactation compared to that of the herd. Going through their teeth once a year before the mating season will help to select the older cows for culling.

Age indicators

7. Record keeping

"A blunt pencil is better than a sharp brain" If there is one place where this phrase is applicable then it is in cattle breeding. To remember the logic information you have just seen in the kraal will let you down time and time again as other things of life happen around you. To put down the simple things like a cow coming on heat,

mating, calving immediately will not make life easier later on but provide you a basis on which you can do some economic decision

Record sheet: Cow Herd Year: _____

#	cow number	teeth condition	calf number	sex	birth date	wean date
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Example of keeping records of livestock

8. Selection for fertility

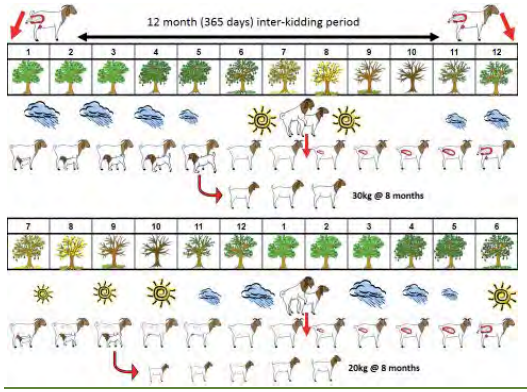
The rules for culling based on fertility are clearly set if a female is not falling pregnant within a set period of time she must be replaced.

Testing bulls

An infertile bull or a bull carrying a venereal disease is a dead burden to carry and is not something that you want to find out later in the season or after the mating season. The only way to find out about his reproductive health is to test the bull. Do this before the breeding season if you have one otherwise once a year at a set time. If you are believing in killing fire when it is there you must react immediately when cows coming back on heat after being covered, this is already too late but you can at least save the tail end.

Testing a bull involves a veterinarian to visit your farm to perform sheath scraping on the bull for the testing of venereal diseases and he will do tap semen with electro stimulation. The semen is examined under a microscope to see whether the bull is fertile or not.

The sheep/goat year cycle



The above cycle represent a reproduction cycle of the ewe/doe whom is going to be mated only once a year. The lower diagram represents the normal cycle of the ewe where the ewes come naturally on heat with the shortening of the daylight time between February and July. The upper diagram represents a manipulated system where especially goats are forced to come on heat by manipulating their cycle with addition of extra food. Goats and indigenous sheep breeds (Swakara) are not so daylight sensitive as the foreign breeds (Dorpers) and can easily be manipulated. The foreign breeds will most likely stick to their autumn breeding patterns.

The typical autumn breeding season starts at the beginning of April till the middle of May. This is when the mating season happens. Lambing season starts at the beginning of Sept till the middle of October. Weaning from the beginning of January onwards. Wean the lambs when they reach 40% of the ewe's body mass, for a singletons, and 45% combined mass for twins.

Record sheet: Sheep Year: _____

#	ewe number	teeth condition	lamb number	sex	birth date	wean date
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

A sample of a record sheet for sheep

It is very important to keep proper records of the fertility and litter size of each ewe. A poorly fertile ewe usually looks much better than a ewe who raised a lamb each year. If one doesn't keep records one will tend to slaughter your most fertile ewes.

Because ewes are not lactating anymore when the mating season starts there is no reason to start mating the young maiden ewes before the older group of ewes. Attention must be given to the young ewe after weaning so that they will reach 75% of their mature weight at mating time. The importance that young ewes must have the right weight at mating cannot be over emphasized. On good veld they can reach it in 6 months and they can fall into the same year's ewe cycle. In drier climate it can take up to 18 months to reach this weight.

Teaser rams at 3-4% together with stimulating feed for the ewes 3 weeks before the planned breeding season stimulates the ewes to come on heat in a synchronised way, this helps tremendously in shortening your breeding season and get the ewes covered in the beginning of the breeding season. The amount to give is 100gr/ewe/day of a concentrate feed.

Some of the cons of autumn copulation is that:

- Lambs are born in the coldest time of the year, starvation and hypothermia is common
- The ewe gives this time of the year less milk which results in low body weight of the lambs at weaning
- Relative weak lambs are weaned in the hottest part of the year, they will need some protection
- The lambs are growing in the wet rainy season which is also the time with the highest parasite load on the veld. Special precautions must be taken for that.

Cons of spring copulation:

- Lower lambing presentation
- More costly – more flush feeding
- The Swakara pelts are heavier with longer hair
- Plenty moths present (affecting the pelts?)

Some useful criteria in Swakara sheep

Oestrus length	35 – 43 hours
Oestrus cycle length	17 – 18.5 days
Pregnancy length	141 – 159 days (average 148 days)
Time period from lambing and first oestrus	25 days (with bad conception) 42 days (better conception)
Puberty of rams	Jump on 5 months, fertile on 7 months
Age to start using a ram	18 months
Most fertile years of a ram	4 – 6 years
Weight when to cover a young ewe	30 kg
Most productive live time	
(Lambs with heavy birth weights)	3 – 5 years

Cold chain handling of vaccines

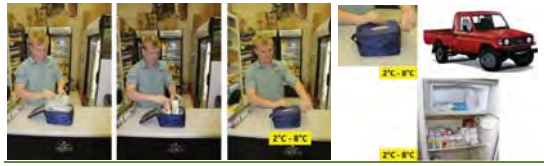
It is of utmost importance to keep your vaccines cold after you have bought it. It comes in a cold chain from the manufacturer to the wholesaler to retail. From retail you must take the responsibility to continue the cold chain until the vaccine is inside the animal.

"Cold chain" means that a specific temperature, in this case between 2 - 8 °C, are maintained right through the transport period, of the object (vaccine), without ONCE moving out of the boundaries of the set criteria.

Things to remember in keeping the cold chain is the following:

- Polystyrene container – you must have one with you when buying vaccines
- Frozen bag inside the above container to keep it cold
- Fridge at home set between 2 – 8 ° C
- Keep the vaccines inside the fridge and not in the inside door of the fridge
- Polystyrene container next to manga to keep it cold and outside of the sun
- Inside of a car is up to 50°, if you place it in the cabby hole it will be worthless
- The average temperature under a bed is 25 °C
- The temperature when the vaccine is buried next to a dam is 15 ° C

Cold chain



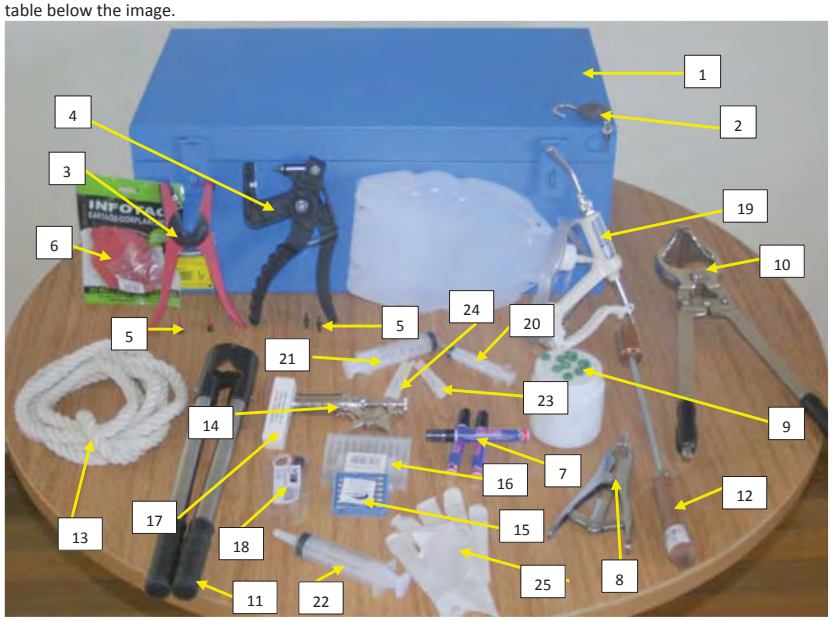
Cold chain

Cold chain

If the temperature of the vaccine exceeds the 2- 8°C parameter "only once" the vaccine loses its value and you are wasting your time and money. You have broken one link in the chain and therefore it is not a chain anymore.

Husbandry Kit

We have included an image of a proposed husbandry kit. All items are numbered and the names appear in the table below the image.



No.	Item	# of Units
1	Lockable container	1
2	Padlock and keys to lock container	1
3	Allflex applicator for FAN Meat tags	1
4	Ear tag applicator: conventional ID small stock (coloured–plastic tags)	1
5	Pins for different types of ear tags	4
6	Packets of ear tags	2
7	Ear tag marker pens	3
8	Elastrator applicator	1
9	Elastrator rings	500
10	Burdizzo emasculator/castrator	1
11	Debudder	1
12	Dehorning bolt	1
13	Rope	1
14	Automatic vaccinator gun (Roux)	2
15	Vaccination needles: 16G ½ inch (packets)	6
16	Vaccination needles: 16G 1 inch (packets)	6
17	Spare glass for vaccinator	2
18	Spare set of washers for vaccinator	6
19	Automatic dosing gun with container	1
20	Disposable syringes: 20 ml	100
21	Disposable syringes: 50ml	100
22	50ml catheter tip (to be used for oral dosing)	10
23	Disposable hypodermic needles: 18G 1½ inch – packet of 100 (pink)	5
24	Disposable hypodermic needles: 20G 1½ inch – packet of 100 (yellow)	5
25	Disposable gloves (latex)	50

Training Material 11

Keeping Village Chicken, November, 2015

Phase 2

N-CLIMP

Keeping Village Chicken

November 2015

N-CLIMP

Table of Contents

Introduction

Need for a manual on small-scale village poultry

There is a growing attention and interest in using poultry as a tool in poverty alleviation in villages throughout the world. However, the existing literature either gives advice on industrial or semi-industrial production systems using exotic (imported) breeds under highly controlled conditions, or very simple field guides giving little useful advice on how to rear poultry at village level. The present manual tries to gather existing knowledge on how to improve village poultry production systems with relatively few inputs. The manual will deal with improved free-range systems consisting of small flocks of 5- 50 local or cross-bred chickens. Smallscale confined poultry rearing, sometimes also called small-scale industrial poultry production will not be dealt with in the present manual. The main reason behind this choice is the fact that many excellent practical handbooks and guidelines dealing with such systems already exists. Please consult Annex A for titles on manuals and books relating to small-scale industrial poultry production, as well as references for relevant training manuals dealing with improved free-range systems. In Annex B, you may find a short introduction to the three major international networks on small-scale village poultry development.

The primary target group of the manual is extension workers in the government and private sector involved with smallholder poultry development at village level. A secondary target group is literate small-scale poultry farmers. It is the intention that extension workers and literate farmers should themselves be able to extract the material they need from the manual and reuse it in their specific contexts.

Need for a participatory approach

When instructing villagers in improving poultry management and production, it is important that the training takes place in a participatory manner. Involvement and learning are enhanced when the participants contribute to the discussion. It is therefore essential that the participants are encouraged to come forward with their own experiences, and that the discussions take their point of departure in records of local practices and problems. Likewise, practical instruction, where the participants prepare equipment out of local materials, mix local feeds etc., highly increases their ability to remember what they have learned. The participatory method and learning-by-doing will create a direct connection between the training and the challenges the farmers encounter when implementing new methods. Please consult the separate Poultry Network manual on Farmer Field Schools for more advice and ideas on how to use the technical advice in practical training at farm level.

Introduction to technical chapters

The manual has been divided into six chapters dealing with 1) Poultry Management, 2) Housing, 3) Feeding, (4) Diseases and Health Management, 5) Profitability and Marketing of products, and 6) Animal and breed selection. Each chapter will present background information and possible solutions to practical problems in the everyday management of small-scale poultry production under village conditions in the tropics.

Chapter 1 Management

Village-based poultry production systems

Nearly all rural and peri-urban families keep a small flock of poultry. These are mostly owned by women and managed by women and children. Profits are usually low and products are used for home consumption, as gifts and for religious purposes. Village-based poultry production systems may be divided into at least three different categories (Table 1.1) i.e., A: traditional free-range, B: improved free-range and C: small-scale confined rearing systems. The aim of this manual is to suggest different interventions which may help the farmer to move from A to B, that is, to improve the traditional free range system into what is often called a "semi-scavenging system" .The small-scale confined systems, also called smallscale industrial poultry production, has been dealt with in several other handbooks and manuals, and will not be dealt with in this manual. Annex A gives references to a number of valuable publications relating to small-scale confined systems.

Table 1.1 Village-based poultry production systems.

A: Traditional free-range (1-10 birds) Low input/low output	B: Improved free-range (5 - 50 birds) Low input/low output	C: Small-scale confined (50 - 200 birds) High input/high output
Majority of rural families	Moderate number of rural families	Few rural families
Owned mostly by women	Owned by women & family	Businessmen
Home consumption	Home consumption and sale on local markets	
Small cash income	Family income	Business income
Social & cultural importance (gifts, religious)	Social importance	Little social importance
	Micro-credit	Credit based on assets
Indigenous breeds	Indigenous/ improved breeds	Hybrids (broilers or layers)
High mortality	Moderate mortality	Low mortality
No feeding (scavenging)	Local feeds (semiscavenging)	Balanced feeds
No vaccination	Newcastle Disease vaccination	Several vaccination schemes
No medication		Full medication
No housing	Little medication/local remedies	Houses with cages or deep litter
Egg production: 30-50 eggs/y/hen	Simple housing	Egg production: 250-300 eggs/y/hen
Long broody periods	Egg production: 50-150 eggs/y/hen	No broodiness
Growth rate = 5-10 g/day	Short broody periods	Growth rate = 50-55 g/day
	Growth rate = 10-20 g/day	

Due to the complexity of the systems, there are many ways of improving poultry production of which the most important are reflected in the titles of the chapters of this manual, i.e. management, housing, feeding, disease and health management, marketing and breed and animal selection.

A. Traditional free-range poultry production

The present situation in many villages is that poultry is left with little or no care. This causes severe fall in productivity. The birds find their feed by scavenging among the houses in the village, and in addition they might get leftovers from the harvest and from the kitchen. As a result, feed is rarely adjusted to the needs of the birds. Young chicks are left scavenging together with adult birds, having to compete for feeds and becoming easy prey for predators and spread of diseases.

Very often birds do not get enough water, or they get dirty water, which may transfer diseases. Birds are seldom put in an enclosure or a shelter to protect them from wind and rain, or to keep them safe from predators and thieves. Nests for hens are rarely provided, causing the birds to lay their eggs on the ground. Furthermore, the system is usually based on hens with an ability to go broody and rear their own chicks. This has many advantages, but the long broody periods reduce egg production. Birds are seldom vaccinated or given medicine against diseases or parasites, as this is not seen as being profitable. Different poultry species are kept together and animals bought in the market or other villages are mixed with the flocks.

Consequently many birds die very young, due to predators, diseases, starvation, adverse weather conditions, and accidents. Often eight out of ten chicks die within the first few months.

Fig. 1.1 Poorly managed poultry farm

Many birds may get ill and grow slowly, producing fewer eggs and less meat. Birds that roam everywhere may easily catch and spread diseases. When one bird has a contagious disease, there

is a greater risk that all birds in the village will get it. If there is a general lack of essential nutrients, resistance against diseases is low.

Village poultry production often encounters problems related to lack of organisation, which implies that local inputs, such as feed, medication, veterinary services, and training, are rarely available locally. Without organisation and knowledge about the potentials of village poultry, the abscense of an enabling environment, the farmers, mostly women, receive very little support and advice from each other or from extension workers. As a consequence village-based small-scale poultry production remains rudimentary in most places.

Poultry behaviour

Normally village poultry form small groups consisting of 5-10 hens with one cock, but flocks may vary from one up to around 30 adults and young growers, depending on the feed resource base and disease level in the area. Up to this number they will still be able to recognise each other, which will help diminishing conflicts among the birds. Each cock or hen in the flock enjoys his or her special status in relation to the others, implying that some have priority over others when choosing places for nesting, for resting, for scavenging, etc. High-ranking animals will have nice feathers and combs, and their posture will show their dominant position. If a lowranking hen comes too close to the territory of a hen of higher rank, the latter will indicate this by stretching her neck and turning her bill towards the intruder. Normally this will suffice for the other to retire. The ranking may change according to age, brooding, and other factors. The system of more or less stable dominance is very practical, since the animals can be free to concentrate on finding food and watch out for enemies.

Poultry have a very constant rhythm day in and day out. In the early morning and late afternoon they scavenge for food. Later in the morning the hens will often lay eggs, and after midday they will rest. When they sleep at night, they prefer to sit high in order not to be easy prey for predators.

Fig 1.2 Dust bathing is important for poultry to keep clean.

To protect against very high or low temperatures and to be fit to escape predators, it is important for birds to have good feathers. They therefore spend much time cleaning and preening their feathers with their beaks. In order to protect themselves against external parasites, they dust bathe several times each day (Fig. 1.2).

B. Improved free-range poultry rearing

A village hen often weighs no more than 1.2 – 1.5 kg at the point of lay. A village cock weighs maybe 1.4 – 2.0 kg at age of maturity. Poultry need a good supply of varied feed and of clean

water. Depending on the time of the year they will be able to find part of their feed by scavenging in the surroundings of the household. But often they will need an extra supply of nutrients in order to gain weight and for hens to lay a good quantity of eggs. Especially the small chicks need good protein-rich feeds such as balanced feeds or from simple supplementary sources such as maggots, snails, termites etc. (see chapter 3 for more advice on feeds and feeding).

Often a free-range hen will lay the first eggs at the age of 22-28 weeks and lay 3-4 clutches of 10-15 eggs a year, depending on season, and in particular availability of feeds. A hen will often find a dark, quiet place for laying eggs and for brooding. She does not want to be disturbed by the others, and she wants to feel safe from predators and passers-by. Unfortunately, many eggs go bad before they are hatched, because of disturbance, lack of nests, and annoying ecto-parasites making the hen leave the nest frequently, with resulting low hatchabililty.

After 21 days of incubation remaining eggs will hatch. Most free-range poultry keepers will let young chicks follow the mother hen immediately after hatching. The result is very high chick mortality during the first weeks of age, mainly due to predation by eagles and snakes, drowning, from road accidents and general chick exhaustion.

Flock management

In general, it only takes a little continuous attention every day to improve your freerange poultry production. But before starting, it is highly advisable to make calculations of whether the enterprise will be profitable or not. For further advice on how to calculate inputs and outputs and to assess the risk, please see chapter 5 on Marketing.

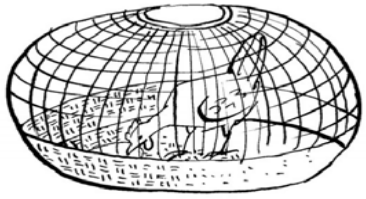


Fig. 1.3 An example of simple housing for up to 5 hens (Night basket)

Fig. 1.4 An example of a simple house for a flock of 10-20 birds in Senegal

A simple night-basket or chicken house or (Fig. 1.3 and 1.4) will diminish the risk of loss because of bad weather, predators and thieves. Inside the house the birds need perches to sit on when they sleep. If you put the nests inside the house as well, it is easy to find the eggs, and the hens will not be disturbed.

For table egg production, you only need hens. However, some farmers keep one cock with the hens to watch for predators and to facilitate the pecking order, thus minimizing conflicts within the flock. To produce fertile, hatchable eggs, you will need one cock for approximately 10-15 hens. When surplus cocks reach a marketable size, they should be sold, slaughtered, or given away as presents, to prevent the cocks from eating the scarce feed resources, as well as fighting and stressing the hens (Fig. 1.5). You may easily recognise young cocks by their tail feathers, their comb, and their general (aggressive) behaviour and appearance in comparison to the hens.

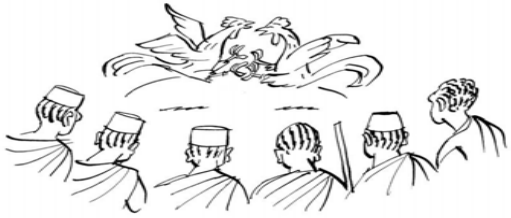


Fig. 1.5 Undesirable cock-fighting may be avoided by selling of young cocks.

Always take into consideration that the size of the flock should match the size of the house, the amount of feed you can afford to buy and the feed resources in the environment (scavenging feed resource base). Additional advice on housing and feeding may be found in chapters 2 and 3.

Do not buy animals at the market from uncontrolled sources, especially not during periods when outbreaks of diseases are common. They may introduce contagious diseases into your flock.

Vaccinate all birds against Newcastle Disease and other prevailing diseases such as Fowl Pox on a regular basis to prevent high mortality. Small chicks should be vaccinated against the common contagious diseases at the age of 2-3 weeks. Revaccination should always be performed according to the instructions (see chapter 4 on disease and health management for further advice).

In case of serious diseases you should slaughter the bird (it can be eaten if cooked well), call the veterinarian, or use drugs if you feel absolutely sure that you know the disease. If you do not kill it the bird at once, it must be separated from the others. Sick birds (or parts from sick birds) should be burned or buried deep enough to avoid that dogs and other animals dig them up and spread the disease. If you have many sick animals, do not introduce new birds, and do not vaccinate.

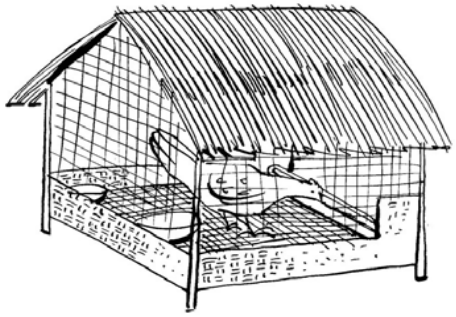


Fig. 1.6 A separate shed may be necessary to isolate ill or newly purchased birds.

Before introducing new birds to your flock, you should keep them isolated for one to two weeks (Fig. 1.6).

Fig. 1.7 Careful observation of the flock on a daily basis is important.

Daily rhythm and careful observation

It is very important to spend some time each day observing every animal carefully (Fig. 1.7). In this way early signs of disease, malnutrition, or other problems may be discovered, and the necessary precautions taken. Knowing each hen will also help you choose eggs from the best hen for hatching, so that the chicks may inherit her qualities.

Eggs for sale or hatching should be collected in the morning and again in the evening. In this way they will not be dirty or crack when the hens sit on them and the hens will not be so tempted to brood as when there are many eggs in the nests. Eggs should be stored in a cool and humid place until sale or brooding.

In order to prevent internal as well as external parasites a good hygiene is a must (Fig. 1.8). So every day the feeders and drinkers should be washed, and the house and the nests must be cleaned for droppings, insects etc. Put fresh straw or hay in the nests weekly. Adding a little ash on top may help prevent parasites (see chapter 2 for nest management).

Fig. 1.8 Every day the house, feeders and drinkers should be cleaned carefully.

At least once a year, and always after serious outbreaks of diseases, the house, perches, and nests should be disinfected by thorough cleaning and lime-washing (fig. 1.9). Alternative ways of disinfection, e.g. smoking, may be used but are less effective. If problems persist in small wooden cages or houses, they should finally be burned, and a new house built, as parasites may hide in even the smallest cracks.

Fig.1.9 Lime-washing the inside of the house for disinfection.

The birds should always have access to a dry place for dust bathing. If they prefer a certain place, you may add a little sulphur or ash against the parasites. You may encounter problems with hens pecking each other, but mostly in flocks with high density, or if you keep local birds inside during the day. Wounds from pecking should be treated immediately to avoid cannibalism in the flock.

Fig. 1.10 Pecking often occur if local birds are kept inside for days.

It is advisable to keep records of your production. This will make it easy for you to see successes and problems at an early stage. See chapter 5 for advice on record keeping.

Feed and water

To produce well and have good resistance against diseases, birds need adequate quantities of good quality feed. See Chapter 3 for more advice on feeding and watering. Supplementary feed and clean water should be given at least early in the morning and again in the evening when the birds are returning to the house for the night. It is important that the feeders and drinkers are kept clean, so that infections do not spread through dirty feed and water.

Fig. 1.11 The drinker and feeder should be carefully cleaned early morning and late evening to avoid spreading of diseases.

Young chickens should be fed separately from the adult birds (Fig. 1.20B) They will often have a special diet, and it is best for them not to have to compete with the adults for food. It is very important for small chicks always to have access to clean water, as they may easily die from dehydration. There is more information on management of young chickens later in this chapter.

Laying hens

Hens start laying eggs at the age of 22-32 weeks, depending on the breed, their health, and development. Often indigenous hens will start much later than imported (exotic) breeds. Hens around 40-50 weeks of age lay the most eggs, and then gradually their egg production decreases slowly. If a mature hen lays very few eggs, you should sell or eat it. In small flocks, it is relatively easy to check whether the hens are laying eggs or not (Fig. 6.4). Laying hens should have easy access to calcium rich food that may be supplemented by calcium-rich sources such as crushed snail or egg shells.

Provide nests in the hen house for laying. This way it is easier to find the eggs, and they can be kept clean. In order to teach the hens to lay in the nests, you may place a couple of eggs or stones looking like eggs in the nests. If you mark the eggs properly, you will know which eggs are new and should be collected. When hens go broody and sit on the eggs, they always stop laying. By collecting eggs several times a day, you may avoid that the hens become broody. If a hen goes broody, and you don't want her to, separate her immediately from the rest. You may for example isolate her in a small cage in a cool place, without access to nest material for a few days (Fig. 1.12).

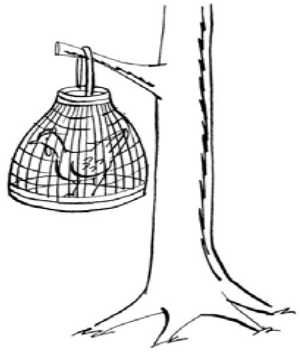


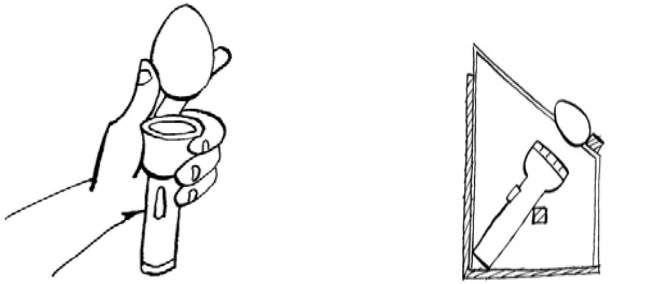
Fig. 1.12 If you do not want a hen to go broody, separate her from the rest.

Do not hatch new chicks if you don't have enough feed for them. If you hatch too many chicks, they may die from starvation or malnutrition, or their resistance to diseases may be reduced.

Natural incubation and hatching

For chickens it takes 21 days for eggs to hatch, for ducks it takes 28 days.

Eggs should be fresh before incubation. The age of eggs should be no more than 10 days, when stored at temperatures below 20° C. If the temperature is higher, the eggs should be no more than 5 days old. To obtain the best incubation result, the eggs selected for incubation should be of average size and normal shape for the breed. Further, the eggs should have a smooth uncracked shell. If there are cracks in the shell, the loss of moisture from the egg can be too high and the embryo may die. There is also a risk of bacteria entering the egg, which may lead to unhealthy or dead embryos. Store the eggs in a cool and humid place until incubation, for example in a box in a hole in the floor of the coolest part of the house. Eggs for sale may also be stored in the same place. During incubation you should always check, which eggs are fertile and which are non-fertile. Fertile eggs very quickly develop blood vessels, which may be seen against a sharp light from a torch (See figures 1.13 and 1.14).



a. b.

Fig. 1.13 Home-made candles using either your hand or a wooden box, and a torch

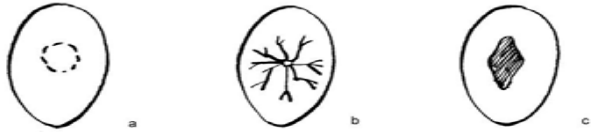


Fig. 1.14 Identification of infertile eggs (a), fertile eggs (b) and eggs with dead embryos (c)

After 7-10 days of incubation the eggs can be candled and the infertile eggs and eggs with dead embryos can be removed from the nest. Figures 1.13a-b shows two simple candlers and figure 1.14 shows how fertile eggs, infertile eggs and eggs with dead embryos are identified at the age of 7 days. When candling, a fertile egg has visible blood vessels and a dark spot that is the embryo. The blood vessels can be more or less developed depending on how strong the embryo is. If the

embryo is dead, it is seen as a ring of blood around the embryo. An infertile egg has an enlarged air cell and the yolk causes and obvious dark area in the egg. It is important that infertile eggs and eggs with dead embryos are removed from the nest as they will decompose and may break and spoil the fresh eggs under incubation.

Fig. 1.15 Bad situation for the brooding hen:

- The hen is disturbed by others.
- She does not have access to feed and water.
- The nest is full of parasites disturbing her.
- The result is few eggs being hatched and a low survivability of the hatched chicks, who easily get ill and die.

Fig. 1.16. A good situation for the brooding hen:

- The hen is left alone with access to feed and water.
- The nest is well-managed with clean hay and antiparasitic remedies.
- She leaves the nest only shortly to drink and feed.
- The result is a high hatchability and healthy and lively chicks with a high survivability.

A broody hen should be separated from the flock to prevent other hens from disturbing her (fig. 1.16). Keep the hen in a separate nest with free access to fresh water and feed within a short distance. Provide the hen with a brooding nest or basket big enough to contain all her eggs. Put fresh hay or straw in the nest and add some ash to prevent parasites. Add more eggs from other nests until she has enough according to her size.

In the dry and hot season, you may spray the breast of the hen with water to increase the humidity around the eggs. The hen will do the work of hatching perfectly if she has the right conditions, for example a clean and suitable nest and quiet surroundings.

If only small quantities of chicks are to be hatched, a free-range hen is a better brooder than an artificial incubator, as she will normally have a higher rate of hatching (80-100%) than an incubator (60-80%).

After hatching and until the chicks are old enough to be on their own, usually around 4 weeks of age, the hen will directly protect the chickens from adverse weather conditions and predators by covering them with her wings. Indirectly, the hen will protect the newly hatched chicks against diseases for the first two weeks; and slowly transfer her natural behaviour to the chicks. Natural behaviour means knowing how to search for food and water; which feed to take and which to avoid, how to avoid predators by hiding or seeking shelter in bushes and trees, how to keep healthy by dust bathing, etc.

Management of small chickens (basket system)

In hot climates, the best and cheapest method to guard the small newly hatched chicks is the so-called "basket system" (Fig. 1.17). Small chickens should be kept with their mother overnight in a so-called night basket, i.e. a round conical cage with a floor, see figure 1.3. A night basket may be made from bamboo or thin pieces of wood. Dry cut straw, rice husk, saw dust or shavings of 8-10 cm depth can be used as litter. In the morning, the chicks should be removed from the night basket and kept in a day basket, which is a bottomless conical cage, see figures 1.17 and 1.18. A dry jute or straw mat should be placed in the cage if the soil is damp or wet. The day basket should be moved to a new clean spot every day to avoid diseases. The night basket is closed in order to prevent predators from entering and in order to keep the hen and chicks warm at night.

Fig. 1.17 A day basket with a jute mat, a feeder and a drinker.

The basket can easily be moved around. The day basket needs to be bigger and more open in order for the chicks to move around without the hen stepping on them and in order to secure good ventilation. There has to be room for a small feeder and drinker. When the weather is hot, the chicks often do not need extra heat, but they should be protected against wind and rain.

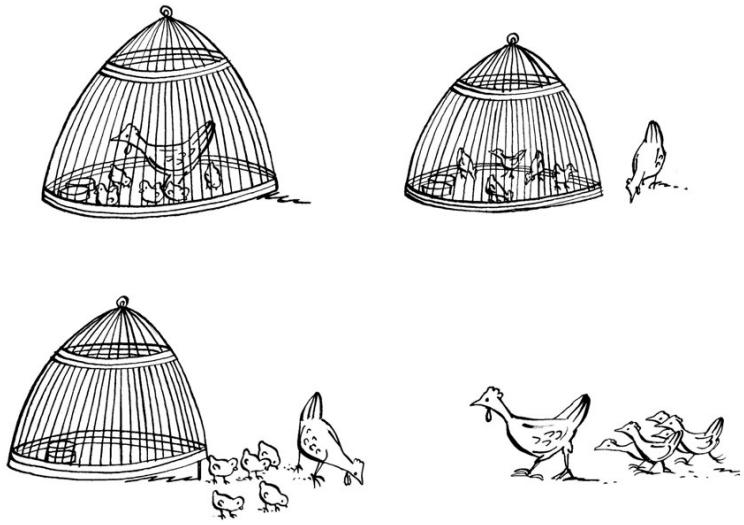


Fig. 1.18 Management of small chickens using the day basket system

The basket system may be used according to the following schedule pictured in fig.

1.18:

A: 0-1 week of age:

Keep the hen with the chicks from 4-7 days to protect them and to adjust the temperature. She will know exactly how to adjust the temperature according to the sound of the chicks. Make sure there is easy access to clean water and high-protein feed for the chicks. Ensure that the basket is kept clean, by removing droppings and spilled feed on a piece of paper or a woven mat placed beneath the basket.

B: 1-3 weeks of age:

Keep the chicks in the cage all the time, but let the hen out for scavenging during the day. She should be able to hear the chicks from where she moves. If she wants to enter the cage, she should be allowed to do so. Make sure there is easy access to clean water and high-protein feed, and ensure that the basket is kept clean at all times. Keep hen and chicks together during the night.

C: 3-6 weeks of age:

Keep hen and chicks together during the night, but gradually let the chicks out for scavenging with their mother during daytime. At first, only for a few hours during the morning, and then gradually a little longer. Make sure that the chicks still have easy access to clean water and high-protein feed under the basket, but that the entrance is too small for older birds to enter. Ensure that the basket and the ground are kept clean at all times.

D: After 6 weeks:

Remove the basket system, and let the chicks scavenge freely together with the mother hen. Give supplementary feeding in the evening for the whole flock, according to their needs (se chapter on feed).

Ten simple rules for better management

1. Provide simple houses or shelters and perches inside houses;
2. Use day baskets during day and night basket during night;
3. Give unlimited access to clean water;
4. Separate young chicks from adults, when they are fed;
5. Control the birds' health daily;
6. Apply vaccines regularly according to the advice of local vaccinators or veterinarians;
7. Isolate a bird when it becomes ill, - call the veterinary assistant or kill the bird;
8. Kill or sell non-productive birds, i.e. cockerels and old hens that have stopped laying;
9. Provide nests, and control nests for eggs two times a day;
10. Check the reproduction status of each hen once a month, and give extra care to hens that are brooding.

Chapter 2 Housing

Why should poultry have houses or shelters?

Housing is essential to protect against predators, thieves, rough weather (rain, sun, very cold winds, dropping night temperatures) and to provide shelter for egg laying and broody hens. A suitable or comfortable poultry house is also important for efficient production and convenience of the poultry farmer. In the following, we will discuss the simple guidelines for size and type of the chicken house, site selection, and lastly the equipment needed for rearing.

Fig. 2.1 Housing should first of all protect against predators and bad weather.

Depending on availability of materials, weather, and tradition you will find different types of poultry houses and shelters in tropical regions. Choice of chicken house should be built upon a rationale involving an estimate of the costs, the durability, and immediate gain of using a house for the poultry.

Fig. 2.2 Three night baskets kept in the stable during night

The simplest and often most cost-effective housing system is the basket system (fig. 2.2. and 1.3). Night baskets (Fig. 1.3) may be placed in a quiet and dry place in the house or in the stables on the farm during night, either on the floor or hanging from the roof. A night basket may hold 5-10 chickens depending on size.

If the need for a bigger and separate chicken house arises, you need to carefully consider the site, the materials and not least the costs involved. When choosing the right site, you should consider:

- A shady and dry place on flat ground to keep the floor dry during the rainy season. It may be necessary to dig a drain around the house, or to raise the ground first. Alternatively the house can be elevated from the ground as in figure 2.3.
- A fertile well-drained soil is desired. The area must not get flooded during heavy rains. The chickens can drown. Furthermore it is very detrimental to have wet floors in a chicken house, it leads to many diseases. A sloping hillside provides good drainage and affords some protection also.
- Trees and bushes close to the houses provide shade and are therefore beneficial. Trees serve as a windbreak in the winter and for shade in the summer and protect from flying predators.
- It is also for security reasons important to have the chicken house near the house. You must be able to hear if chickens get disturbed at night by predators, or a thief who wants to steal the birds.
- The orientation of a chicken house has to take into consideration the movement of the sun and the dominating winds, making the house naturally shaded and ventilated at certain times of the day. Select a site on which the poultry house should face South or East in moist localities. Windows placed on the south side of the house will be a good source of light and warmth in winter and a good source of ventilation in summer. In a rectangular house the end walls must face East and West. This will ensure that only the end walls face the hot morning sun or the even hotter sun during the afternoon.

Building the house

- Always use cheap local materials like bamboo, wood, reeds, thatch grass, or clay bricks.
- Remove the bark from the wood you use, as parasites often hide behind the bark.
- Clay houses should have windows. A hole in the top of the house may ensure good ventilation. These measures will also give light, making it easier to work in the house. However, make sure winds will ventilate the house without making chickens or hens cold.
- During the rainy season, rain and wind may cause severe chilling.
- Heat, humidity, and harmful gasses may be considerably reduced through good ventilation of the house or shelter. High temperatures may cause deaths or drop in egg production, low shell quality, and reduced weight gain. A combination of high temperatures and high humidity may kill young chicks.
- Placing perches and nests inside the house will safeguard against most predators. It will also help to keep the legs of the chickens and the eggs clean.
- If the nests are in a quiet place in the house, the hens will feel comfortable and at ease.
- The best protection against diseases and parasites is a good hygiene. It is therefore important that it is easy to clean the house or shelter. It should be tall enough for a grown-up person to work in there. Cleaning will also be easier if the floor in wooden houses is covered with slats.
- Make the nests and perches easy to remove when cleaning.
- Houses or shelters may be sprayed or lime washed after cleaning to disinfect and kill parasite eggs from the walls and cracks. You may put some ashes on the floor and in the nests to discourage parasites.

- Clear the grass and bushes for about 3 meters on all sides of the house to keep snakes and rats away from your chickens.
- In wooden houses, use slatted, raised floors to remove droppings and avoid predators.
- In clay houses, use wired windows to avoid predators.
- Some houses are built on poles, well above the ground to protect the chickens from predators like dogs, rats and snakes, as well as humans.
- Build your poultry house to prevent possible injury to your birds. Remove any sharp edged objects from the house.
- The house has to be so large that there is sufficient room for the birds, and so that the air inside does not become too heavy with humidity and gasses. A round or square house of 1.5-2.0 m² will hold 10-12 adult birds.

Figures 23a and b illustrates a badly and a well constructed chicken house.

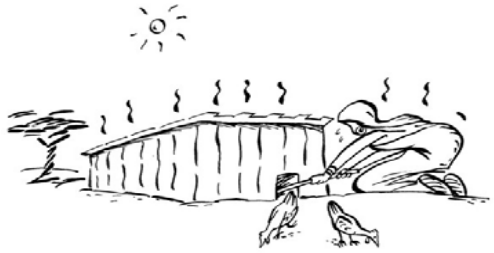


Fig. 2.3a A badly constructed chicken house is placed in the sun with a low flat roof and no windows making it very hot and badly ventilated. It has a small door, which makes it difficult to access and clean.

Fig. 2.3b A well-constructed chicken house is placed in the shade, has a high roof and windows with wire mesh, providing good ventilation. The door is facing north to avoid direct sun. The door is big enough for a person to enter to clean the house frequently.

Theft

Often the entrance to the chicken house is very small and not easily accessible. The reason is that people are worried that their chickens will be stolen. There are however, a lot of problems connected with this method of securing the chickens. It makes cleaning and collection of eggs very difficult and it also causes bad ventilation. The opening to the chicken house must therefore be so big that an adult person easily can enter and work in the house. Other precautions against theft should therefore be taken. The house should be placed near the household in order for the owner to react on any unusual noises during night. Alternatively, a lock may be fitted on the door.

Perches

Perches (fig. 2.4 and 2.5) are important for chickens to rest during night. Diseases and parasites may attack poultry resting on the floor, and perches often reduce the risk of external parasites entering the feathers at night. Each one-meter perch may roost five adult birds. Perches are best made of bamboo or round sticks to accommodate for the size and structure of the birds' feet (fig. 2.5). If the sticks are too big or too small, the birds may fall (fig. 2.4). To prevent attack of external parasites, the perches may be treated with oil or kerosene, where the perch meets the wall.

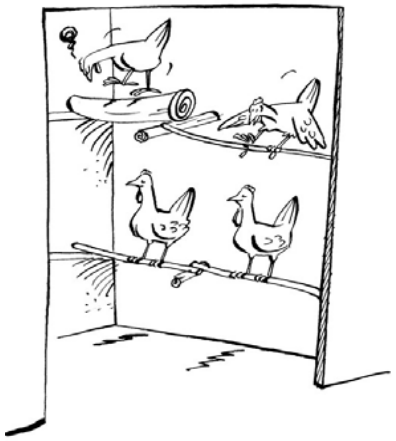


Fig. 2.4 Avoid using either too big or to small sticks as perches

Fig. 2.5 Sticks should match the size of the birds' feet

Nests

In many villages, nests are not provided for the hens and eventually the hens will lay their eggs on the ground, in high grass or in natural shelters, where they may be difficult to find. Some poultry farmers build nests on the ground outside the chicken houses. This should be avoided, as eggs outside houses are more exposed to predators and thieves. Nests should be placed inside the chicken house and preferably above the ground. For laying you may have a battery of nests where more hens can lay at a time (fig. 2.6).

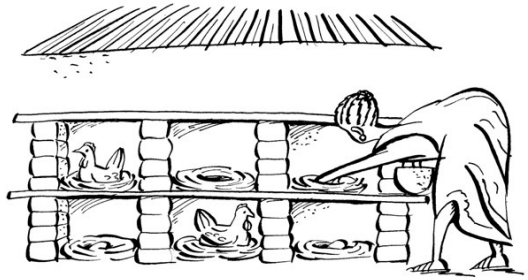


Fig. 2.6 Battery of nests for laying hens

There must be 1 nest for every 5 hens. The nests for brooding on the other hand must be individual, placed in a quiet and dark place, and they must be easily removable (fig. 2.7). Once the hen is broody it can be necessary to remove her to a different place, e.g. the farmer's house, to avoid other hens disturbing her, or even going broody as well.

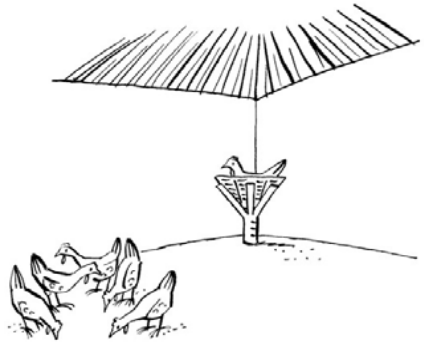


Fig. 2.7 Nests for broody hens should be placed in a quiet place

Simple nests may be clay pots, calabashes or baskets made of local fibres, cardboard, or wooden boxes (fig. 2.8). Nests should be of the right size for the hen to feel comfortable. A nest box will typically measure 30 x 30 x 30 cm. Don't make them too big, as the hen will not feel comfortable.

A calabash or nest basket may measure 40 x 20 x 25 cm (upper diameter x height x lower diameter). A clay pot, more or less the same.

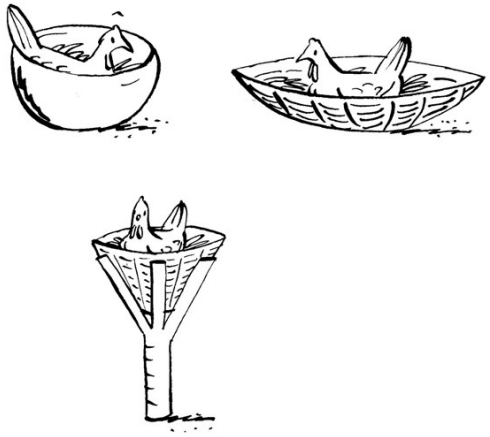


Fig. 2.8 Simple nests for broody hens should be easily transported

A healthy and attractive nest for the broody hen may be prepared by following these three steps (fig. 2.9):

1. Make sure that the pot or basket is clean and dry;
2. Fill sand mixed with ashes up to 1/3 of the depth;
3. Put clean, soft nesting material (hay or straw) on top up to 2/3 of the depth.

Fig. 2.9 Three steps in preparing a nest.

Nesting material should be changed at least once a week. You should assure that the rim is 1/3 of the depth to make the hen feel secure, and if necessary put "dummy eggs" (e.g. boiled or stone eggs) in the nest, to attract a hen. Mixing ashes, tobacco leaves or other anti-parasitic substances with the nesting material will keep out most external parasites. External parasites in nests may

reduce the hatchability of eggs, as the hen will use too much time and energy leaving the nest, cleaning and scratching her body, leaving the eggs cold.

Providing nests also makes it easier to collect eggs. You may avoid dirty and cracked eggs, if the eggs are collected twice a day. Collect eggs at the same time every day, in the morning and the evening. Removing eggs continuously is important if you want to avoid that the hens become broody, as broody hens stop laying eggs.

Shelters for the mother hen and chicks

After hatching, it is important to keep the hen and the chicks close together in a separate cage: the basket (see also Chapter 1, Management of small chickens – basket system). Such a shelter should primarily protect against adult poultry competing for feed, and against predators, and it should provide a stable environment, sheltering from sun, rain, and wind.

Fig. 2.10 Shelter for chicks after hatching. Place the shelter on a mat to protect against the cold.

A shelter of basketwork with a top hole (diameter 20 cm) is useful, as feed and water may be changed without disturbing the birds unnecessarily. It also gives the necessary ventilation.

A woven mat on the floor may provide additional protection during cold periods. The mat should be cleaned daily to remove droppings and leftovers from feeding (fig. 2.10). Droppings may be recycled as manure in a vegetable garden.

Chicken runs

In some regions, chicken runs are very popular, a fenced open air space of 25 m² or more, where poultry may be kept in protection against predators and thieves. Fenced areas are also used for

feeding, watering, observation of the flock, and collection of eggs. 1.5 – 2 meter high walls made of clay or woven mat are constructed as fences (fig. 2.11). A chicken run is relatively costly, but may provide a sort of security to the farmer. It is however crucial that adult birds are left scavenging outside during daytime in order to keep feed costs low.

Fig. 2.11 Chicken runs may be used for feeding, watering and observation of the flock.

Ten simple rules for good housing

1. Use baskets for night shelter and day shelter for small chicks to reduce costs and labour involved;
2. Always use local materials to reduce costs;
3. In wooden houses, use slatted, raised floors to remove droppings and avoid predators;
4. In clay houses, use wire netting for the windows to keep out predators;
5. Place the perches and nests inside the house, and make them removable to facilitate cleaning;
6. Make sure winds will ventilate the house without making chickens or hens cold;
7. Consider heavy rains and hot sun when placing the house or shelter.
8. Provide nests with clean straw, which are easy to access, clean an move.
9. Always house young chicks with their mother away from other adults.
10. Make sure that houses are easy to access and clean.

Chapter 3 Feeding

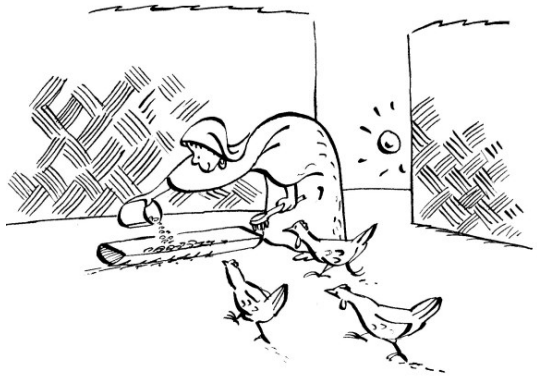


Fig. 3.1 Supplementary feeding and water is essential to increase production

Why give supplementary feed?

Feeding is essential if you want to increase the production of meat and eggs from poultry. Even small flocks will eventually starve during certain periods of the year, if they are fed only leftovers and feed, they find by scavenging. Lack of feed or water will reduce the birds' resistance to diseases and parasites, and subsequently increase flock mortality.

Egg production and the birds' growth are limited by access to feed and their genetic potential. Local birds living in the villages are normally the best converters of feed to eggs under fluctuating environmental conditions, although their production potential is much lower than genetically improved breeds. You may easily increase egg production and growth of local birds by giving supplementary feeds, but also improved breeds may perform well under village conditions, if they are given a steady supply of feeds. However, you should always start by making calculations of the cost-benefit and judge the risks involved (Chapter 5), before choosing the quantity and type of feeding. Advice on feeds and feeding will be different for freerange, improved free-range systems or small-scale confined systems of poultry production, basically due to different economic situations. In the following, we will focus only on improved free-range systems and discuss the importance of feed requirements, feed types, feed mixing, and lastly needs for storing and the equipment needed for feeding and watering.

What to feed?

The composition and availability of feeds will vary, depending on the season, site location and farming systems. In general, poultry, as other animals, need feed containing energy and protein, as well as vitamins and minerals. The need for feed will change, depending on the age and status (chicken, grower, egg layer, broody hen) of the bird. The cheapest – and also often the best – way to supplement the diet of your poultry, is to use local resources. However, many vitamins and nutrients are destroyed if stored too long or under sub-optimal conditions, e.g. high humidity and heat. Knowledge of the quality and source of different feedstuffs is thus important, to reduce the risk of bad feeding.

If your production is based on improved breeds for egg production, different types of commercial diets may be given: usually they are divided into three distinct categories, with decreasing amount of protein, e.g:

A. A starters' diet: high in protein; from hatch up to 4 to 6 weeks of age;

B. A growers' diet: medium in protein; up to 20 weeks; C. A layers' diet: lower in protein; hens from 20 weeks.

If you consider buying commercial feeds, you have to calculate whether it is profitable to do so. If the price of eggs or meat is lower than the price of feed, it does not pay. Avoid giving commercial feeds to local breeds, as it is rarely feasible. Only during the first four to six weeks of age, you may consider giving premixed supplementary feed bought in the market.

Scavenging

In a free-range or improved free-range poultry rearing system, adult hens and cocks should always be given enough time and space for finding feed in the surroundings (scavenging). Small chicks should be kept in confinement for the first 4-6 weeks (see Chapter 1-Management). The best time for scavenging is early morning and late afternoon, as there are most insects and less heat. The best time for giving supplementary feed will be in the morning and in the evening, when the birds come back to the house. Ad libitum water should be provided in shady areas during the day to avoid heat stress.

Types of feeds

Depending on the type of feed, it will contain more or less energy and protein, as well as vitamins and minerals (fig. 3.2).

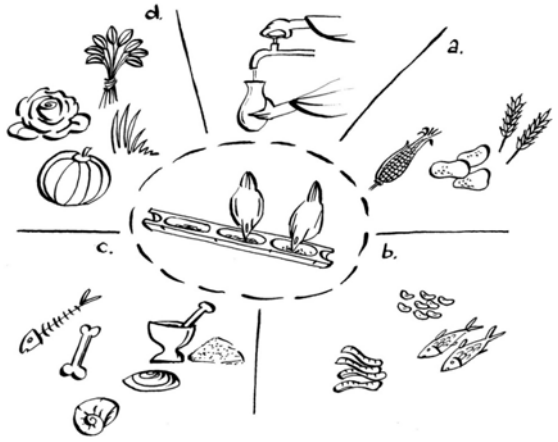


Fig. 3.2 Feed types split into sources of energy (a), protein (b), minerals (c) and vitamins (d). Remember always to give free access to water.

Energy feeds

Normally, at least ¾ of a poultry diet is made of energy feeds. Energy feeds are the most important feeds to maintain body temperature and exercise levels of the birds. Cereals, grain, roots, and tubers are the most important energy feeds. Examples of energy feeds are cereals like maize (corn) and its by-products (bran), sorghum (milo), wheat and its by-products (bran, shorts, screenings), rice and its byproducts (bran, polishing), cassava root meal (farina, tapioca), malanga (taro), yam meal, yucca meal, sweet potato meal, plantain and banana meal. Roots and tubers should be soaked in water for 60 minutes or cooked before drying to remove harmful substances, and the proportion in the diet in general kept below 1/10.

Fat is also a good source of energy, in particular in hot climates, as the heat produced during metabolism is less than from traditional energy feeds, e.g. cereals. Sources of fat are e.g.: tallow, lard, oil cake meals, poultry fat, fish oil, restaurant grease. However, fat should only be given in small amounts, i.e. less than 1/10 of the total diet.

Protein

Protein is needed for growth and keeping up a good health status. Normally no more than 1/5 of a diet is protein-rich feeds, as they are normally very expensive. Protein may come from either animal sources or plants. Examples of protein-rich local feeds are: Maggots, termite eggs, insects, worms, meat scraps, fish scraps, fish meal, meat meal, bone meal, blood meal, feather meal, peas, beans, and oil cakes from e.g. ground nuts, cotton seeds, palm kernels, and coconuts. Harmful substances are present in some protein-rich plants, e.g. beans, and the proportion in the diet should thus be kept low. The level depends on the type of plant, and whether the feed is being prepared before feeding.

Minerals

Minerals are important for bone formation, eggshell formation and a good health status. The most important minerals are calcium and phosphorous. To produce strong shells for their eggs, laying hens need free access to calcium (limestone or crushed shells), and adult birds are usually able to balance their intake according to needs. If you add phosphorous rich feeds, it should be balanced with calcium, since too high levels of one may cause deficiency of the other. Examples of sources for minerals are: bone meal, crushed oyster shells, snail shells, and burned eggshells. Using bone meal or eggshells is a good way of balancing the calcium and phosphorus levels. Eggshells should always be scorched or cooked before re-use in diets to remove any disease germs, see figure 3.3.

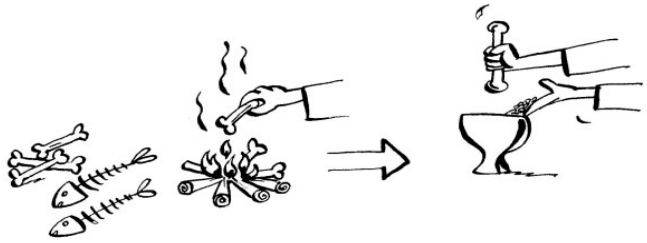


Fig 3.3 Scorching bones or eggs shells to produce calcium-rich bone meal

Vitamins

Scavenging birds get vitamins by eating green grass, vegetables, fresh cow dung and through sunlight. Vitamins A, B2, and D3 are considered very important because many problems arise when birds lack these vitamins. Sunlight and green grass or green fodder normally provide Vitamin A and D, whereas Vitamin B may come from fresh cow dung. Vitamin B may also be added by giving e.g. Riboflavin tablets. Additional vitamins may be given in very small quantities and purchased through drug stores or feed sellers, but this is normally not needed for scavenging poultry. Confined birds always need additional vitamins mixed into their feeds.

Simple feed mixing

It is advisable to make a semi-balanced diet for the small chicks from 0-6 weeks of age. Locally available ingredients should be dried in the shade (the sun may destroy important vitamins) and grounded in a mortar before mixing. Locally available containers such as tomato tins or matchboxes may be used for easy quantification of the different ingredients. Grams or percentages should be transferred into local quantities for field practice. Large ready-mixed quantities should only be stored, if adequate storage capacities are assured (see under "Twelve simple rules" in this chapter). In general you should not store mixed feed more than a few weeks to avoid contamination from mould, bacteria or rodents. Above 6 weeks of age, poultry may be fed in a cafeteria system saving time and energy on mixing feeds. The cafeteria system is described later in this chapter.

Table 3.1 Simple ration for supplementing local chicks age 0-6 weeks (total 930 g)

Ingredient	Quantity
Crushed sorghum/millet grain or maize	1 tin can (1 kg tomato tin)
Wheat bran, sorghum bran or millet bran	1 tin can
Groundnut or sesame oil cake	2 match boxes
Sea shell or bone meal/salt mix	1 match box (1 salt with 13 bone meal)
Fish or blood meal	2 match boxes
Sesbania leaves	2 match boxes

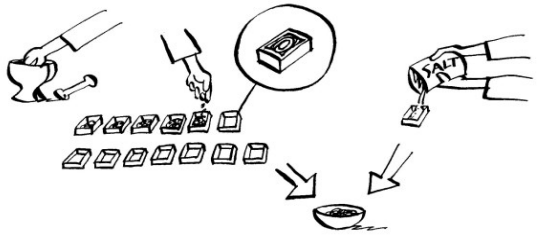


Fig. 3.4 Bone meal (see fig. 3.3.) and salt are mixed in matchboxes in a 13:1 ratio.

Termites or maggots may also be added during the first 6 weeks. Depending on the types of crops grown in particular areas, substitutes for cereals, oil cakes etc. will have to be found. Alternatively a chick starter ration can be used during the first 4-6 weeks of age. In this way you will ensure that the chicks are provided with everything they need during these most vulnerable weeks.

Simple techniques for growing maggots and termites

Maggots and termites are excellent and cheap sources of protein in the improved free-range systems. However, they will only be a supplement to other feeds. Give the maggots or termites to the small chicks, as they have the biggest need for a good protein source.

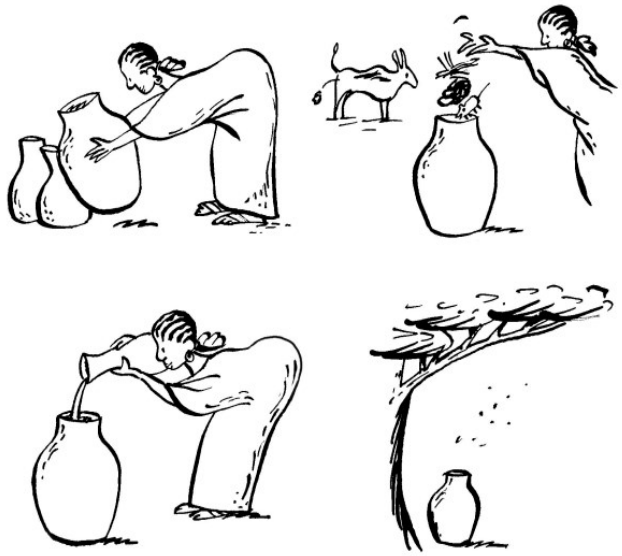


Fig. 3.5 Growing maggots

Maggots may be grown by a simple technique and used to supplement the diet of the young chicks (Fig. 3.5). Blood, offal, and cow manure are mixed in a large open pot. The pot is filled with 1/3 water. Flies will lay their eggs in the mixture, and the maggots will feed on it. Leave the pot open during daytime and closed during the night. After 5-10 days (depending on temperature), when the maggots are ready to pupae, you collect the maggots by gently pouring water into the pot. The maggots will float and you can then wash them, and feed them directly to the birds. Remember to place the pot away from public places, as the smell at times may be offensive.

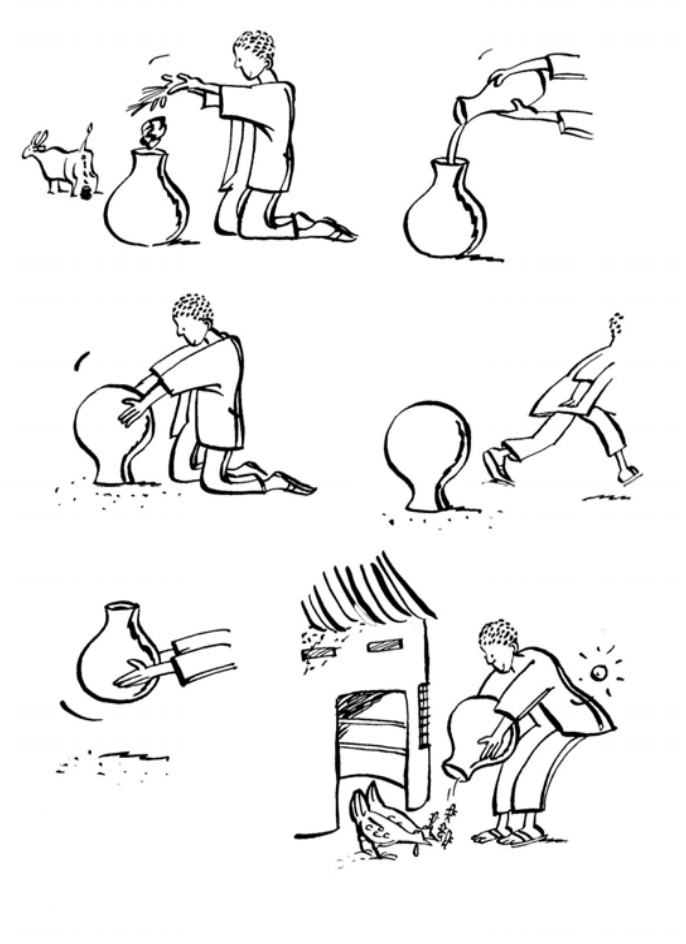


Fig. 3.6 Growing termites

Fig. 3.6 shows a simple method for growing termites to be applied in dry areas. You take a pot with a short neck and a capacity of at least 10 litres. Fill it up with cow dung and straw, and sprinkle it all with a little water. Set the pot upside down with the opening on sandy soil. After one day and one night, the pot will be full of termites and you may empty the living contents in front of the hen house in the morning.

How much to feed?

In the free-range or improved free-range systems, the economic advantage is based on the poultry finding a majority of their feeds scavenging the surroundings. This so-called scavenging feed resource base (SFRB) will change over the seasons and depend on the climate, geography and

farming systems of the areas on which the poultry scavenge for feeds. Depending on the season, the chickens may find nearly all they need in the surroundings (e.g. during harvest) or close to nothing (during lean season).

Table 3.2 Amount of feed given and eaten at different ages of local poultry

Age, weeks	Approximate amount given to each bird per day (g dry weight)	Approximate amount eaten per day per bird (g dry weight)
1 week	10-15 grams dry weight	12-15 grams
2 weeks	15 - 20 grams	15 - 21
3 weeks	21 - 30 grams	21 - 35
4 - 6 weeks	30-40 grams	35-50
8 weeks	30-40 grams	55-60
16 -27 weeks /grower	30-50 grams	65-80
28 weeks /adult	30-50 grams	100 grams

You should limit the quantity you give to local birds to no more than 30% - 50% of their full intake as an adult (see table 3.2. for feed levels and needs). In general this means giving maximum 30-40 g/bird/day from week 4-6 and onwards, gradually reducing the supplementary feeding. At age 0-4 weeks, the small chicks will receive feed according to their needs. As the birds grow, they will gradually get a smaller portion of what they need, until they only get between 1/3 and half of their needs as adults. In practice this means estimating the economic benefit from sale of eggs and live birds, and the costs for medicine, housing, labour and feed, calculating the break-even point, and learning how to reduce costs without reducing benefits (see Chapter 5 for risk assessment and simple estimation procedures).

To assure a stable egg and meat production, it is better to give a little feed on a continuous basis, than to give large quantities during harvest seasons or festivals and no feed during lean seasons. If feeds are too costly, you should consider reducing your flock size, rather than reducing the amount of feed given to each bird.

How to feed?

It is important to use simple local measures to administer your feeds. By using table 3.2, you can calculate how much feed to use. Fig. 3.7. shows the calculation on how is needed per day based on a flock of 1 cock, 4 hens and 15 three week old chicks.

Table 3.3 Simple calculation on how much feed is needed per day

1 cock: 35 g.	=	35
4 hens: 4 x 35 g.	=	140
15 chicks: 15 x 25 g.	=	375
Total:	=	at least 550 grams per day

If you use a container (e.g. a tomato tin or a cup) and measure how much the container holds when full, it is easy to calculate how many containers of feed you need to feed every day. If the container holds 750 g of feed you will need to fill the container only ¾ full. To keep the birds hungry for scavenging, you should give no more than half in the morning, which is then equal to an almost half full container. To avoid competition, you give a little more than half of this to the small chicks under a separate shelter. Then you feed the hens and finally, before the feeder is empty you give the cock. If you give the cock at first, he will eat too much and leave little to the others, and you will gain very little. If the cock is hungry, he will be better at finding feeds in the surroundings. The young chickens will need relatively more protein in their diet than adult birds, so the best solution is to mix two different kinds of rations for young and adult birds, respectively. If you do not want to mix two different rations, you can alternatively give a little extra supplement of a good protein source to the young chickens, e.g. maggots and termites (see table 3.4)

Cafeteria system

Adult birds are able to mix their own feed according to their needs. The best way to feed improved free-range birds above 6 weeks of age is the cafeteria system, whereby the most common types of feeds are given in separate compartments.

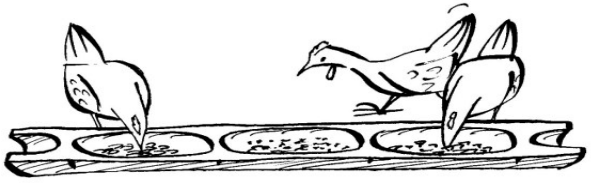


Fig. 3.7 Cafeteria system. A bamboo pole is split and feed divided into three compartments, enabling the poultry to choose from feed ingredients according to their needs.

In the cafeteria system, there should be at least one feeding compartment for

A. Energy rich feeds, e.g. maize, millet, sorghum.

B. Protein rich feeds, e.g. beans, peas, oil cakes, fish, meat, bone meal, maggots, and termites.

C. Mineral rich feeds, e.g. bone meal, crushed oyster shells, snail shells, burned eggshells.

An additional compartment for oil rich feeds may be added, e.g. tallow, oil cake meals, fish oil. By giving adult birds feeds in compartments, you can observe feeding behaviour of your birds and avoid feeding unnecessary amounts and types of feed. For example, during harvest seasons you may find that they feed less on energy feeds in the evenings because there is plenty of cereal in the environment. You may also try out alternative feeds that the birds do not find tasteful. The cafeteria system is a good way of learning about your birds´ behaviour and taste.

Feed mixing

Mixing and formulation of poultry feeds may be based on simple assumptions about the nutritional requirements of the birds and the content of the feedstuffs, or it may be calculated by use of computers and of so-called Least Cost Formulation Programmes (see reference list).

If possible, it often pays to have samples of feed ingredients analysed at a national nutrition laboratory once or twice a year, depending on season and geographical area. National tables on nutritional content of feed ingredients could also be used. Table 3.4 shows the content of energy and protein for some locally used feedstuffs.

Table 3.4 Examples of protein and energy sources. + = low, + + = medium, + + + = high content

Feed ingredient	Protein	Energy
Cassava tuber	+	+++
Sweet potato tuber	+	+++
Millet bran	+	+ +
Rice hulls	+	+
Rice bran	++	++
Sorghum bran	+	++
Maize bran	+	+
Sorghum grain	+ +	+ + +
Sesbania leaves	+ +	+
Cowpeas	+ +	+ + +
Chick pea	+ +	+ + +
Cotton seed oil cake	+ +	+ +
Sesame oil cake	+ + +	+ + +
Groundnut oil cake	+ + +	+ + +
Soya bean meal	+ + +	+ +
Maggots	+ + +	+ +
Fish meal	+ + +	+ +
Meat and bone meal	+ + +	+ +
Blood meal	+ + +	+ + +

It is important to realise that the nutritional requirements of the birds may be met in many ways by offering a large variety of feed ingredients. Final decisions on which feed ingredients to use in which seasons, will depend on the availability, quality, and not least the price. Tables 3.8 and 3.9 give you an example of how to calculate the price of feed based on local feedstuffs.

Table 3.5 Example of composition of 1 kg feed mixture for local chickens at different ages

Ingredients Age	Cereals: millet bran, sorghum bran, rice bran (g)	Oil cake, e.g. ground nut or sesame (g)	Meat, blood, or fish meal (g)	Cassava, tubers (g)	Total (g)
0 – 8 weeks	700	200	100	–	1000
9 – 20 weeks	650	150	50	150	1000
> 20 weeks 600		100	100	200	1000

Table 3.6 Examples of diets for chickens (layers, growers 7–20 weeks and chicks 06 weeks) in Asia, East Africa and West Africa. Contents of 1 kg

Ingredients Age	Rice hulls (g)	Rice bran (g)	Sorghum bran (g)	Sorghum grain (g)	Millet bran (g)	Millet grain (g)	Soya bean meal	Fish meal (g)	Ground nut oil cake	Cassava tuber (g)	Bone meal
Asia Layers	200	600					150	50			Ad lib.
Growers	300	500					100	100			Ad lib
Chicks		300		400			150	150			
East Africa Layers			400	400					200		Ad lib.
Growers			500	300					200		Ad lib
Chicks			100	600					300		
West Africa Layers					300		300			400	Ad lib.
Growers					400		300			300	Ad lib
Chicks							00 100			200	

The diets in table 3.6 are based on a simple feed formulation using the Pearson Square (the Envelope method). As it can be seen from the table, young chicks need a cereal grain. For older birds some of the cereal grain can be substituted with cereal residues as bran or hulls. Which cereal and cereal residue to use will depend on the area, availability and price. All age groups will need to be fed some kind of protein source. Again area, availability and price will determine which one is best to use. There can also be problems in using too high concentrations of some

feedstuffs. Harmful substances in some feeds can cause problems if fed in excessive amounts, or they may contain anti-nutritional components and should not be fed in raw form, see table 3.7.

Table 3.7 Problems related to some feeds

Feedstuff	Problems
Fish meal	Can give a fishy taste to meat and eggs. Can contain excessive amounts of salt.
Cassava tubers	Contains cyanide, which is toxic, and the tubers must be sliced and dried in the sun before fed to chickens.
Oil seed cakes	Can contain excessive amounts of oil and fibre, which lower digestibility of the feed.
Beans and peas	Contain a number of anti-nutritional components and should be dried in the sun or cooked for a short period (chick pea and pigeon pea are exceptions and can be fed raw after crushing)

Table 3.8 Examples of poultry feed prices and quantity measures in Benin (January 2002)

Ingredient	Price USD/kg	kg in a tomato-tin
Maize	0.323	505
Wheat bran	0.129	320
Soya cake	0.517	467
Fish meal	0.536	500
Sea shell/salt mix	0.106	587
Dry Sesbania leaves	Found locally	125

Table 3.9 Simple feed price calculation based on feed prices (table 3.7.) and ingredients and quantities (table 3.1.) for supplementing free-range growers and adults.

Ingredient	Local containers	Quantity (g)	Price (USD)
Wheat bran	50 tomato tins	50 x 320 g	= 16 kg x 0.323 = 2.07
Soya cake	2 tomato tins	2 x 467 g	0.934 kg x 0.517 = 0.48
Fish meal	2 tomato tins	2 x 500 g	1 kg x 0.536 = 0.54
Sea shell/salt mix	1 tomato tin	587 g	0.587 kg x 0.106 = 0.06
Sesbania leaves	2 tomato tins	2 x 125 g	0
Total	1 bag	18,8 kg	3.15 USD
Price/kg			0.168

Feeders and drinkers

Feeders and drinkers are the same, whether being used in free-range, improved free-range systems or small-scale confined systems. Feeders and drinkers should always be kept clean to prevent spread of diseases (see also Chapter 1 on Management). They should be big enough for all birds of the same age to feed at the same time. One metre trough or a 35 cm (diameter) tube feeder is big enough for 20 adult birds to eat and for 40 to drink. Feeders and drinkers may easily be produced out of local materials. An empty tin can placed upside down on a plate forms an excellent drinker. By keeping the tin can upside down, you avoid dirt contaminating the water (fig. 3.8). You start by making two small holes near the rim diagonal to each other. Pour clean water in the can. Put a flat plate with a small rim on top and turn the can and plate upside down, while pressing them against each other. Gently place the drinker on the ground. The rim of the plate should be low enough for small birds to drink, but also high enough for adult birds to dip their wattles to keep them cool during hot weather. Usually several waterers in different sizes should be applied. It is important that the feeders are constructed in such a way that feed waste is avoided. Also feed waste can be decreased if feeders are not filled to the top. It is better to fill feeders just half full and then check them regularly for refills.

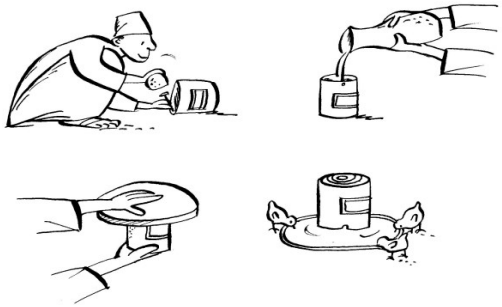


Fig. 3.8 Simple drinker made of an old tin can and a plate

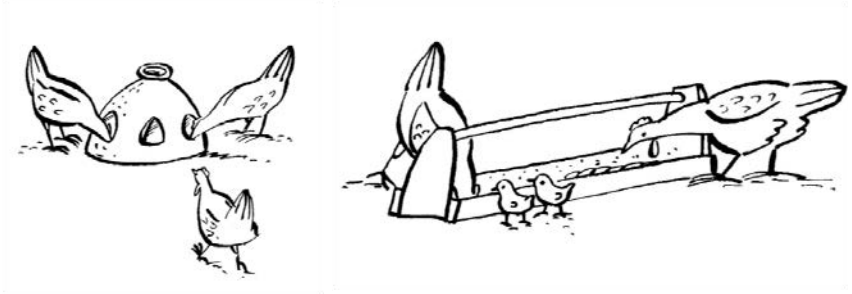


Fig. 3.9 Feeders and drinkers may also be made locally of wood, clay, or metal.

Fig. 3.10 Commercial drinker/feeder in plastic or metal

Commercial feeders and drinkers may also be bought at the market, either in metal or plastic. They are often expensive and normally not any better than locally produced feeders or drinkers.

Twelve simple rules for feed management

Before buying, mixing, and storing feeds, it is important to understand some underlying principles of good feed management.

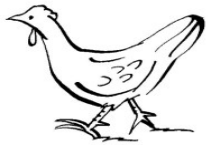
It is crucial to:

1. Use local feed ingredients for local birds;
2. Know the quality or feed value, and changing prices of each feed ingredient;
3. Buy missing feed ingredients, such as vitamins or protein sources locally;
4. Change the feed formulation depending on availability, quality or feed value, and changing prices;
5. Reduce the flock size in free-range systems during lean seasons and if the feed becomes too costly;
6. If you change feed and feeding level, always do it slow and gradual;
7. Mix feed ingredients uniformly in relatively small quantities to avoid too long storage time;
8. Use locally available materials such as tomato tins or matchboxes for quantifying the different ingredients to be mixed. Grams or percentages do not work in practice;
9. Store mixed feed or feed ingredients separately upon a platform approx. 30 cm above the floor;
10. Stop the entry of rats, pigeons, or other type of birds into the feed store room;
11. Make sufficient ventilation of air so that the feed ingredients are not wet due to humidity;
12. Be careful that feed ingredients, which are mouldy, discoloured or from which pests have eaten, are not used.

Chapter 4 Diseases and Health Management

Healthy and unhealthy birds

It is very important for the farmer to learn how to detect an unhealthy or sick bird, so he can initiate the right action In fig. 4.1 you will find the main characteristics of healthy and unhealthy birds. Healthy birds may be able to fight against the diseases themselves whereas unhealthy birds will have difficulties in fighting diseases. It is important to isolate unhealthy or sick birds from the healthy flock in order to ensure a minimum of loss.



Healthy birds	Unhealthy/Sick birds
- Alert and on guard	- Tired and lifeless
- bright eyes and comb	- dull eyes and comb
- walk, run, stand, and scratch continuously	- sit or lie down
- eat and drink normally	- eat and drink less
- lay eggs normally	- lay less or stop laying eggs
- smooth and neat feathers	- ruffled and loose feathers
- soft compact droppings	- wet droppings with blood or worms, diarrhoea
- breathe quietly	- cough, sneeze and breathe noisily

Fig. 4.1 Characteristics of healthy and unhealthy birds

If you find an unhealthy or sick bird, isolate the animal and call for the veterinarian or health assistant for disease identification and further advice. If the bird dies, burn it or bury it. You should remove dead birds, so that the germs are not left on the ground to be passed on to the other birds.

Ten simple rules for disease prevention:

1. Give access to the right feed and clean water, in particular for small chicks;
2. Build shelters against wind and rain;
3. Clean houses regularly and apply lime wash on the floor and the walls;
4. If necessary, provide dry litter regularly;
5. Do not put too many birds together;
6. Different species of poultry, for example hens, turkeys, pigeons, ducks and guinea fowls should be kept separate;
7. Separate chicks from adult birds except from the mother hen;

8. Vaccinate chicks against the most important diseases and revaccinate if necessary;
9. Isolate and treat sick birds – if medication is not available then kill the sick birds;
10. Burn or bury killed birds.

Prevention of diseases

Diseases are everywhere and will attack birds at all ages, but careful management will prevent many diseases. Figure 4.13 shows a poultry house, which is clean and nicely kept outside and inside. A woman is vaccinating a bird with eye-drop method. One sick hen is isolated in a small shelter away from the others. Birds are well fed and characteristically healthy. Figure 4.2 shows a poultry house with food and droppings lying around, with sick and dead birds among each other, dirty water in the pot and dirty feed in the feeder. Birds are characteristically sick and the farm generally badly managed.

Feeding

Supplementary feeding, in particular for small chicks, is one of the most important means of preventing diseases. Feeds should always be stored in a dry and clean place, as they may easily get contaminated and spread diseases.

Clean Water

Clean water from a well, not a pond, is important to avoid the spread of waterborne diseases, such as Fowl Cholera and Avian Influenza (AI). If a highly contagious strain of AI is present in the environment strict care should be taken to avoid water potentially contaminated by wild birds.

Hygiene

Dry and clean housing is essential for diseases not to spread or develop. Once in a while after cleaning, houses and shelters should be disinfected with lime wash (see Chapter 1 for detailed advice on proper management). It is best to slaughter hens that are too thin and do not grow or produce eggs any more, as they do not resist diseases well and can pass diseases to poultry in good health.

Fig. 4.2 Bad management = diseases

Space

Too many birds together may wound or even kill each other, as the stronger ones peck the weaker (see fig. 1.10). You should never keep local breeds in confinement without free access to outdoor areas. If you use outdoor runs, you should provide at least 5 square meters per adult animal. When space is limited, diseases are passed more easily from one bird to another. Other species of birds may carry diseases without showing any signs of being ill. For example, ducks, guinea fowls, and turkeys can pass on diseases to hens, or vice versa. The best way to avoid spreading diseases from one species to another is to keep them separate in different cages, baskets or houses. Always keep domesticated birds as far away from wild birds as possible.

Table 4.1 Disease types and possible treatments

Disease type	Possibilities for control or cure
Virus	Viral diseases cannot be cured, but may be prevented or controlled if the animals are vaccinated before the disease occurs in the flock. If the disease is present in the flock, vaccinations might increase the severity of the disease, ultimately killing the birds.
Bacterial	Many bacterial diseases can be treated with the use of antibiotics. It is important to diagnose the disease in order to choose the right antibiotic.
Parasites	Most parasites can be treated with traditional and conventional medicine (anthelmintics).
Fungus	Fungal diseases might be treated with antibiotics.
Nutritional diseases/disorders	Nutritional diseases or disorders are caused by a wrong feed composition. Depending on the disease it can be prevented by mixing the right feed with minerals and vitamins, or giving access to a diversity of feedstuffs from the surroundings, e.g. green grass and fresh cow dung.

Important diseases

Diseases are often characterised according to their biology, such as Virus, Bacteria, Parasites, Fungi, and their causes, e.g. nutritional disorders (table 4.1). However, in the following the most important diseases in poultry are divided into three categories according to their severity and importance in village-based small-scale production systems. Distinct features such as their characteristics during outbreaks (symptoms), and possible treatments (prevention or control) as well as the time of occurrence, will be presented. The importance of a disease is judged by mortality rates and effect on production, and will vary greatly from area to area and from season to season. High importance (▼▼▼) signifies a common disease with high mortality (more than 30% of the flock), highly contagious and difficult treatment. Medium importance (▼▼) common, medium mortality (10-30%) of the flock and/or difficult treatment. Less importance (▼) signifies not common, lower mortality and/or easy treatment.

Combination of diseases

Some less important diseases may interact with other diseases to create a more severe effect on the birds. This is the case for e.g. E.coli infections, nutritional deficiencies and internal parasites. Such diseases rarely kill the individual bird, but have a remarkable effect on the immune system of the birds, thus creating the basis for easy infection by other diseases.

▼▼▼Newcastle Disease (fig. 4.3)

The disease is very common during dry seasons, and is often seen in young chicks, but also in adults. High flock mortality, often between 30% and 80% of the birds die, when the disease hits. The chickens lose appetite and have poor digestion. They might show heavy breathing, greenish droppings, and sometimes bloody diarrhoea. They may show nervous symptoms, paralysis and die suddenly, and the symptoms may occur all at the same time. The disease is a virus, so there is no treatment, but it may be prevented through vaccination of all birds including chicks from two weeks of age.

▼▼▼ Avian Influenza (AI)

The disease is found naturally in ducks and other waterfowl, and may spread as a highly contagious and potentially dangerous form to chickens. High flock mortality, blue and swollen comb and wattles. Infects through contaminated feed and drinking water from ponds. The disease is a virus, so there is no treatment. Best prevention is strict hygiene and slaughter of sick birds. AI can presently NOT be prevented through vaccination of birds. Culling and burning of all birds in the flock and strict cleaning of chicken houses must be considered after a disease outbreak. Always call a veterinarian, if you suspect an AI outbreak. Do not eat infected birds.

▼▼▼ Fowl pox (fig. 4.4)

Is often seen in young chicks, but also in adults, and shows as pocks (small lumps) on wattles, comb and face. High body temperature, tiredness followed by sudden death. The disease is common during dry seasons, but may be found all year around. The disease is a virus, so there is no treatment. Vaccine is available and highly effective.

▼Marek´s disease (fig. 4.5)

Seen only in birds older than 16 weeks. Initially the birds may show paralysis of one or both wings. Or one or both legs might be paralysed. The disease is a virus, so there is no treatment, but commercial vaccines are available.

Fig. 4.3 Newcastle disease in advanced stage

Fig. 4.4 Fowl pox

Fig. 4.5 Marek´s Disease

▼ E. coli infection

Common among newly hatched chicks, causing infection in the stomach region. Symptoms in older birds: Respiratory distress or infection in the egg organ with stop of egg production. The best prevention is improved hygiene of eggs for hatching and of the nests. Treatment of sick chicks might be possible with antibiotics.

▼▼▼Fowl cholera (pasteurellosis)

May occur any time in all ages. Symptoms are severe diarrhoea, respiratory symptoms, loss of appetite, blue combs and wattles. May occur as a chronic disease or hit as sudden death. Infection through contaminated feed and drinking water. There is no treatment. Best prevention is strict hygiene and vaccination. Kill and burn affected birds. Vaccine is usually available.

▼▼ Pullorum disease (Baciillary white diarrhoea)

Usually in young chicks. Chicks walk with difficulty, show big bellies and drag their wings. Faeces is liquid and turns white. There is no treatment. Prevention is strict hygiene. If illness occurs, isolate or kill and burn the birds. Disease is transmitted to chicks from the eggs of infected hens, which may not show signs of being ill.

▼▼ Fowl typhoid

Usually seen in older birds. Symptoms: high body temperature, tiredness, blue comb, sudden death. No treatment. Prevention through strict hygiene and culling of ill hens. Do not buy chicks from unknown sources, and do not use eggs for hatching from hens that have been ill.

▼▼Gumboro (fig 4.6) (Infectious Bursal Disease, IBD)

Only seen in chicks younger than 6 weeks, and normally only in large flocks kept in confinement. Not common in small-scale village based systems. Common symptom: Diarrhoea. The disease is a virus, so there is no treatment. Vaccine is available.

▼▼ Infectious coryza

Symptoms: Runny nose, swellings under the eyes, closed eyes, drop in egg production. Treatment by adding antibiotics in drinking water.

▼▼ Chronic respiratory disease (Fig. 4.7) (Mycoplasmosis)

Symptoms: Runny or blocked nose, swollen face, closed eyes, drop in egg production, rare deaths. Treatment by adding antibiotics in drinking water.

▼▼▼Coccidiosis (internal parasites)

The disease may occur at any time at all ages, but can be prevented by regular and careful cleaning of troughs and poultry houses. Symptoms: Sick, tired, head down, ruffled feathers, bloody diarrhoea. Death in young chicks. If the chicks survive, they will remain thin and be late in laying. Treatment: Anticoccidiostatics in drinking water or feed. Prevention: Not too many birds together. Avoid different age groups of birds in the same house, as the disease may spread from adults to young chicks.

Fig. 4.6 Gumboro

Fig. 4.7 Chronic respiratory disease

Fig. 4.8 Diarrhoea may be caused by several diseases, but the looks and colour will differ.

▼▼Roundworms and tapeworms (internal parasites) (fig. 4.8 and 4.9)

Internal parasites are very common in all ages in the village based production systems. These parasites will cause poor health, weight loss, drop in egg production, and bloody diarrhoea. The best treatment is adding anthelmintics in the drinking water once or twice a year, at best two weeks before vaccination against ND (See above). Careful hygiene may prevent heavy infection.

Fig. 4.9 Internal parasites as found in the faeces

▼▼External parasites (fig. 4.10)

Attacks all ages any time, but occurs more frequently in humid chicken houses with bad hygiene. Adult birds are clearly disturbed and spend a lot of time pecking and polishing feathers. Young chicks may die from anaemia. If not treated, mites, lice, fleas, ticks will cause weight loss and possibly loss of feathers due to the parasites sucking blood and to skin irritation. Lice can be seen around eyes and nose. Fleas can be seen on the belly. Treatment: Spray or dust with pesticides, ashes, and oil. Ashes and sulphur powder may be used where the hens do dust bathing. Nests may be protected by putting a few tobacco leaves mixed with ashes in the nests.

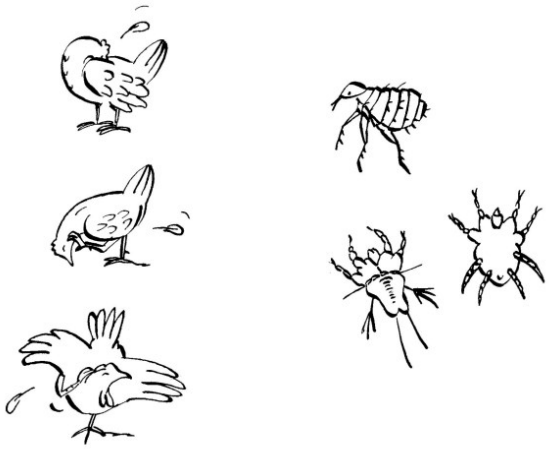


Fig. 4.10 External parasites (behaviour and parasites)

▼ Scaly legs (fig 4.11)

Scaly leg is caused by an external parasite irritating the skin on the birds' legs. Symptoms: Legs clearly have scales and wounds and may become crippled in their appearance. Treatment: Dip the legs daily in kerosene, oil or in an insecticide until the scales disappear.

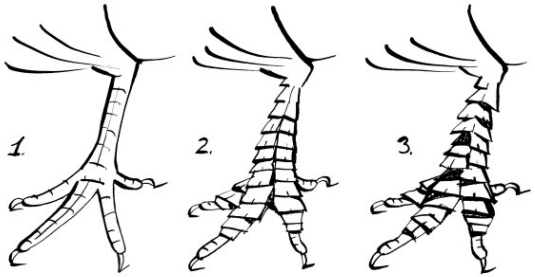


Fig. 4.11 Scaly legs in three stages

▼Nutritional diseases (fig. 4.12)

Symptoms: Bone deformation and feather loss. The birds walk with difficulty; they limp. Legs are deformed. Some deficiencies may cause feather loss. Treatment, if detected in time: Supplementary vitamins and calcium, fresh grass, and cow dung. Nutritional diseases may be avoided when the birds have access to normal vegetation and are therefore rare in scavenging chickens.

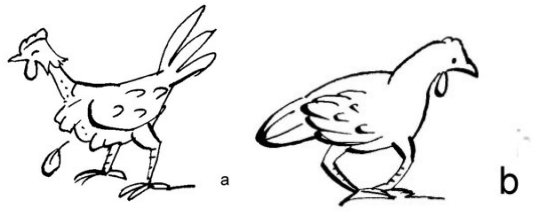


Fig. 4.12 Nutritional diseases. Feather loss (a) and leg deformation (b)

▼▼Mycotoxicosis (fungal poisoning)

Symptoms: Weakness, pale combs. Treatment: Supplementary vitamins. Prevention: Proper storage of feed to prevent growth of the fungi producing mycotoxins, the cause of the disease.

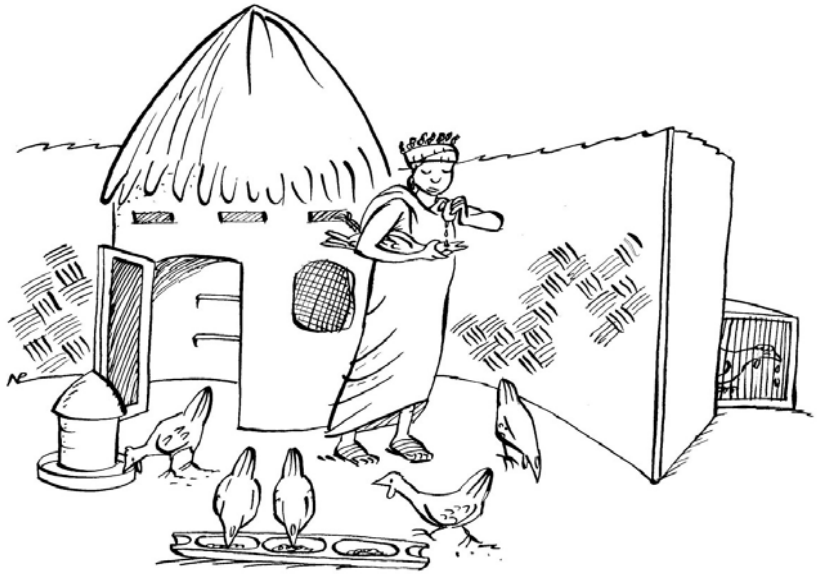


Fig. 4.13 Good management = healthy birds

Medication and vaccination

Medication

Some diseases may be cured by drugs. Parasitic diseases, such as lice or worms may be cured by use of anti-parasitic drugs or by applying simple methods such as baths in oil. Some bacterial diseases causing diarrhoea, may be cured with antibiotics. For viral diseases there is no treatment. But the viral diseases may often be prevented by vaccination.

Vaccination

All poultry should be vaccinated against the most common viral disease(s) in the area. Vaccination schemes at village level should cover Newcastle Disease and Fowl Pox. Vaccination against Avian Influenza should be avoided, unless recommended by veterinarian authorities. Other viral diseases such as Gumboro and Marek's disease may be covered by vaccination, but they are often less important at village level. A bacterial disease such as Fowl cholera may also be prevented by vaccination. Poultry should be vaccinated when they are very young, and before they have begun to lay eggs. Most young birds that have not been vaccinated do not resist diseases, and often die. Vaccines should only be given to healthy birds. If you vaccinate a sick bird you may kill the bird, see fig. 4.14. Anthelmintics against internal parasites should be given two weeks before vaccination, to improve the effect of the vaccine.

Fig. 4.14 Never vaccinate a sick bird

Vaccination methods

There are four fundamental ways of vaccinating birds:

1. Eye drops
2. Injections
3. Skin piercing.
4. Orally (in feed or water)

For scavenging poultry, you should avoid mixing vaccines with drinking water or feed, as it is difficult to give the right dose. Research have shown that protection against e.g. Newcastle Disease is highly variable if vaccine is given through water or feed. Giving the right dose is essential for the vaccine to work properly. A too high dose of a live vaccine may kill a young chick, whereas a too low dose will not give adequate protection. Thus, it is important to consult a veterinarian or auxiliary veterinarians (barefoot vets, village vaccinators) for further advice before carrying out a vaccination.

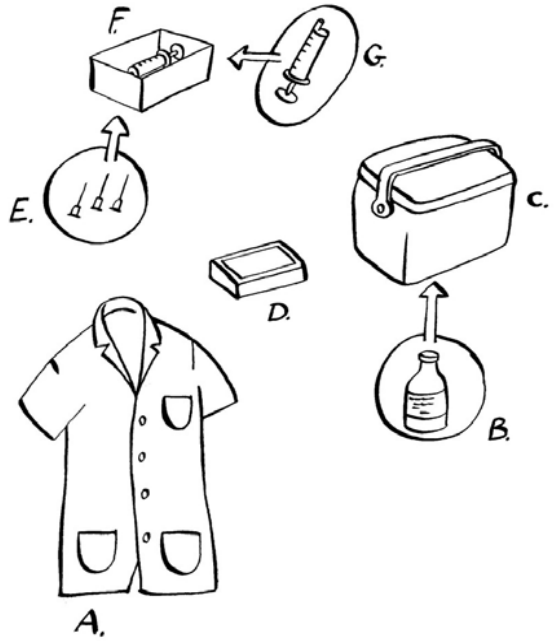


Fig. 4.15 Important vaccination tools

Tools for application normally include a clean apron (green or other dark colour if possible) (Fig. 4.15A), vaccine vial (B) stored in a cool box (C), soap to clean hands (D), clean needles (E), clean syringe (G) and a clean box for needles and syringe (F). Needles and syringe should be boiled in water for 5 minutes and cooled before reuse (Fig. 4.16).

Fig. 4.16 Boiling water to clean needles and syringe before vaccination

It is important to treat the clean syringe and needle carefully. Do no touch the end of the needle after cleaning. Put the needle gently on the syringe holding the needle with the sharp end upwards (Fig.4.17A). Put the vaccine vial upside-down and press the needle gently through the plastic seal of the vial cap. Pull the syringe handle gently down, while sucking the vaccine out of the vial until the syringe is full (Fig. 4.17B). Press the syringe handle back until you reach the right volume

(Fig.4.17C). Make sure that there are not air bubbles trapped in the syringe or the needle. Air bubbles will give the wrong dose to the chickens. Normally a full 1 ml syringe will match 10 doses, one for each of ten adult birds (Fig. 4.18). This however depends on the weight of the bird and the type of vaccine, and the application method.

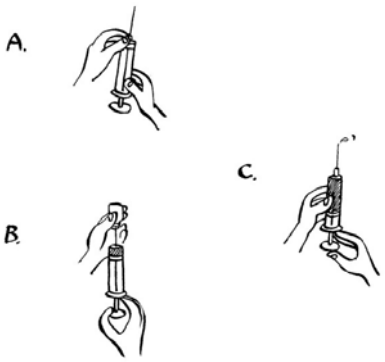


Fig. 4.17 It is important to handle the syringe and needle correctly

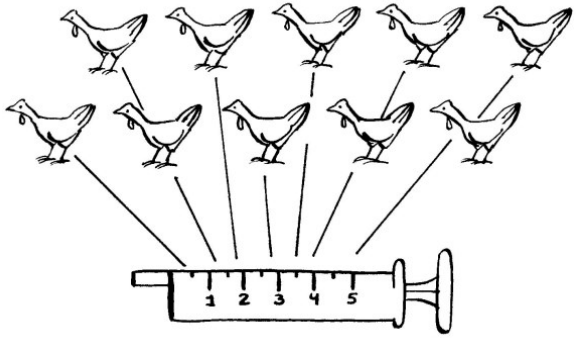


Fig. 4.18 One full 1 ml syringe is usually enough for ten adult birds

A B C

Fig. 4.19 The most common methods for vaccinating adult poultry are eye drops (A), injections in the breast or thigh muscles (B) or by piercing the skin of the wing (C).

The most common methods for young chicks are eye drops and skin piercing (fig. 4.19, A and C). When the birds grow older, injections are given in the breast or thigh muscles (Fig. 4.19, B). Depending on the vaccine type, eye drops may also be used for adult birds. Please consult the reference list in Appendix A for technical literature on how to vaccinate against Newcastle Disease and other diseases. Vaccines should be given either early morning, before letting the birds out of the chicken house or when the local birds are easy to catch resting in the trees. When vaccinating adult poultry for the first time, you should preferably be two persons, one holding the bird, the other one vaccinating (Fig. 4.20).

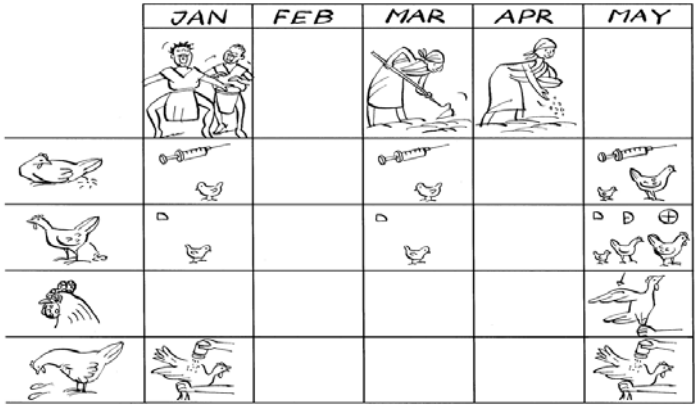
Fig. 4.20 Two persons vaccinating adult poultry by injection in the breast muscle

General precautions for vaccination with live vaccines

1. All vaccines should be stored in a refrigerator before use.
2. Some vaccines are so-called heat stable, which means that the vaccine will tolerate high temperatures. However, heat stable vaccines should also be stored in a cold place to keep them viable. You should always keep vaccines out of direct sunlight.
3. When using vaccines in the field, you should as far as possible transport them in a cool box with ice.
4. The syringe, needle and other equipment to be used for vaccination should not be cleaned by any chemical disinfectants, as these may destroy the vaccine. They should instead be disinfected in boiling water (Fig. 4.16) and be used after cooling.
5. The vaccines must be mixed or diluted in cold distilled water, and care must be taken to ensure that the vaccines do not come in contact with direct sunlight.
6. It is best to vaccinate birds during the cool hours of the day, either in the morning or evening.
7. Some mixed vaccines should be used within 30 minutes. Otherwise they will be useless and should be thrown away.
8. Always consult a veterinarian or an auxiliary veterinarian before conducting a vaccination campaign.

Disease prevention calendar

It is important to prevent and treat diseases according to the occurrence of diseases. Vaccination campaigns against Newcastle Disease (ND) or Fowl Pox should be implemented before the onset of the disease, as the vaccine otherwise may kill already sick birds. To plan vaccination and medication, it is advisable to use a so-called "disease prevention calendar", where veterinarians, farmers and extension workers together identify the periods, where diseases should be prevented or treated. The last table in chapter 4 shows "disease prevention calendar" indicating how birds at different ages are vaccinated against ND (a) and Fowl Pox (d) and treated against internal parasites (worms) (b) and external parasites (d) following the annual cropping cycle and festivals.



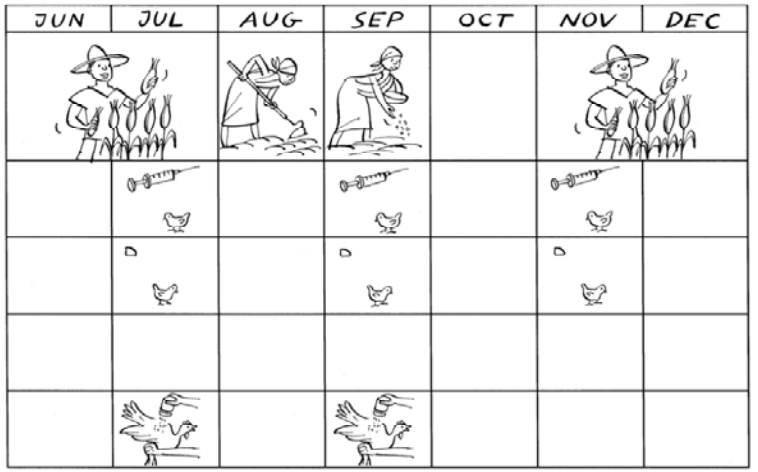


Fig. 4.21 Disease prevention calendar

Chapter 5 Profitability and marketing of products

Introduction

Before starting any production, it is important to know the market situation, the investment costs, running costs, and expected revenue for the different products.

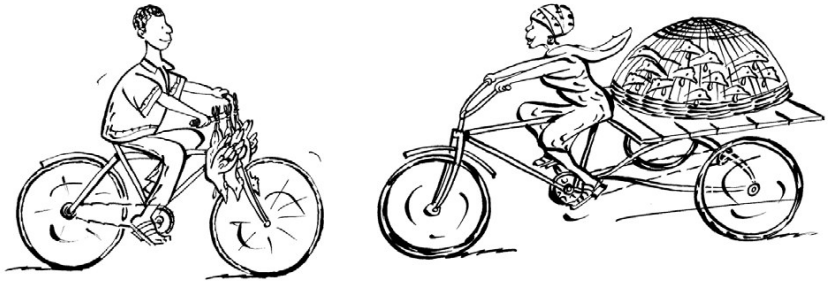


Fig. 5.1 Marketing your products is essential

It is advisable to know the local situation very well through detailed market studies and cost and benefit analysis, before deciding on the type of production to introduce. At village level, it will often be advisable to start with a production based on local breeds, local feeds, and local demands, before entering into a more sophisticated production system with improved breeds and a need for a more stable market outlet. In general the economic outcome as well as the need for investments and the risk involved in the production, will be very different for improved free-range systems (relatively low risk) and small-scale confined systems (higher risk).

Commercialisation

At traditional village markets, mainly live birds and sometimes fertile eggs are for sale. Imported non-fertile table eggs are more often found in peri-urban areas or along traffic corridors, where confined production systems can be managed.

At local markets cocks and hens are sold at highly variable prices depending on factors such as demand (high during festivals), size and weight, plumage and colour (often a higher price for white-feathered birds). Cocks are usually higher priced at the market than hens. In most regions, local birds are also higher priced than imported improved breeds, although they are often smaller. Also local eggs are often higher priced than imported eggs, despite their smaller size. Taste and texture of meat and eggs are major reasons for the higher price of local products.

Fig. 5.2 A-B Birds for sale

Birds for sale

Cockerels should be sold as soon as they fetch a good price, as one cock to 10-15 hens is sufficient to produce fertile eggs. In some cases, you may also want to sell a cock, if it is not doing a good job in mating. At the age of 6 months and a weight of approximately 1 kg, cocks are usually big enough to be sold at the market. Birds should always be sold alive in the markets, but no live birds should be returned from the market, as this is a major cause of transfer of diseases. Old hens, which are no longer laying (See fig. 1.13), should also be sold. When you want to catch the birds, you catch them in the house in the late evening during sleep, or attract them with feed, or by using a long stick or a piece of metal wire, bent at the end.

Eggs for sale

Eggs should be collected and marketed while fresh, in particular if not cooled.

Collect eggs from the nesting boxes at least once, but rather two times a day, and store them in a dark and cool place. Eggs should normally not be cleaned, but kept clean in the nests. If they are dirty, clean the eggs with a clean, dry sponge or cloth, and sell the eggs immediately.

Cleaning eggs with water may disturb the natural protection of the shell and introduce infections to the egg.

Fig. 5.3 Eggs for sale

Pack eggs in boxes, egg trays, or other suitable package, e.g. banana leaves. Sell eggs in the market two to three times a week, so you get a good name for selling fresh eggs. If profitable, grade your eggs according to size. Always keep records of your production and sale, as explained below.

Fig. 5.4 Keep records of your production and sale

Keeping records

To manage a poultry production, you have to keep detailed records on a daily or weekly basis. Table 5.1-5.2 and fig. 5.5 -5.6 give two examples of how to keep records. The first may be used for literate, the second for illiterate people. It is very important to spend some time each day observing your flock carefully. In this way early signs of disease, malnutrition, or other problems may be discovered, and the necessary precautions taken (see chapter 1 for advice on management).

Table 5.1 Record keeping for small-scale chicken production. Animals

Production Record Name of farmer:		Week/Day: Family:	
Record	Number	Price	Comments
1. Hens			Health status, in lay?
2. Cocks			Health status,
3. Growers			Health status, age, weight
4. Chickens			Health status, age, weight
5. Dead birds			Cause of death
6. Eggs laid			
7. Fertile eggs incubated			
8. Chickens hatched			
9. Cocks sold			Where and to whom?
10. Hens sold			
11. Growers sold			
12. Chicks sold			
13. Eggs sold			To whom?
14. Eggs/Poultry consumed			
15. Poultry given as gifts			
16. Hens and Cocks vaccinated			What treatment/vaccine and how?
17. Growers/cockerels vaccinated			
18. Chickens vaccinated			
19. Birds given medicine			

Table 5.2. Record keeping for small-scale chicken production.

Materials and feed

Name:			Day:
Record	Numbers	Price	Comments
Materials			
a. Baskets			
b. Shelters			
c. Chicken houses			
d. Nests			
e. Feeders			
f. Drinkers			
g. Other materials			Type, quantity
Feed			Type, quantity
h. Feed stuffs			
i. Formulated feeds			
j. Vitamins, minerals			
k. Medicine			

Fig. 5.5 Record keeping for small-scale chicken production. Animals

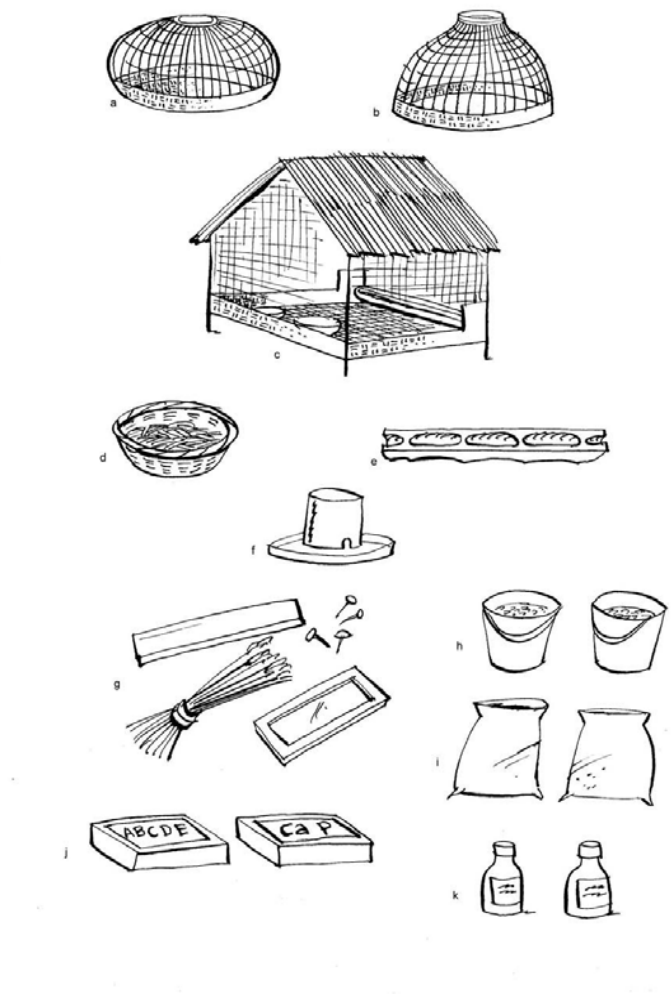


Fig.5.6 Record keeping for small-scale chicken production. Materials and feed

Records should be kept on chickens and hens, noting their approximate age or time of hatching. As you know that hens should start laying eggs at 22-32 weeks of age, you should monitor the age of first lay and the production over time. If egg production is delayed or drops suddenly, you should check conditions in the house, access to feed, water etc. If egg production drops gradually, it may be time to change the older hens. If your costs for feed exceed the income from selling cocks and/or eggs, you may also consider selling birds, or reducing the amount of feed given.

All expenditures for feed or feed ingredients should be registered carefully, noting quantities, price and date of purchase. If you buy feed from feed sellers, note the name of the seller and the time of purchase. Feeds of bad quality should as far as possible be tracked to the seller or producer of feeds. The price and date of purchase of vaccines and medicine should also be carefully noted. Supplementary feed consumed on a daily or weekly basis should be noted for each flock or poultry house separately. Sudden changes in feed intake may be the first indicators of bad health. Income from sale of eggs, cockerels or chickens should be carefully noted. Gifts and home consumption of eggs and birds by your family and friends should also be noted.

Economic analysis and simple risk assessment

Before you start a poultry production, you should calculate if it is economically feasible to do so, thereby making the right decisions about the production type and the type interventions you may start with.

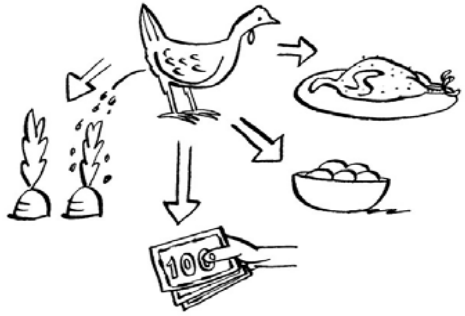


Fig. 5.7 The revenue from poultry may be in terms of meat, eggs, money or manure.

The revenue or income are all the money you earn in relation to your poultry, that is:

- Income from sale of live birds, e.g. growers, cockerels or spent hens;
- Income from sale of eggs;
- Value of eggs or poultry eaten or given away.

To this you may add the value of standing stock, e.g. the flock you have built up, that you will not sell, but which is the foundation of your future income. Poultry manure also represents a value when given to your plants. It provides many nutrients to the plants, and you may reduce cost for buying fertilizer (fig. 5.7)

The costs involved are all the expenses in relation to your poultry, which are for buying:

- Materials for constricting baskets, shelters or poultry houses;
- Growers, hens or cocks;
- Fertile eggs for incubation;
- Day old chicks;
- Supplementary feed, vitamins or minerals;
- Vaccines and medicine; • Labour and technical advice.

If you feed with crops that could otherwise be sold, this also represents a value and should be included in the calculation. If you borrow money, the repayment and interest on loans is also an expense that has to be included among the inputs. In village poultry, where the outputs are usually low, the inputs should also be kept low. This means that expenses for buildings and other equipment should be kept at a minimum. Small basket or shelters (Fig. 1.3. and 2.2) may be built of local materials without high costs.

Cost-benefit calculation

In order to calculate the profit in your enterprise, you should estimate costs and revenues on an annual basis. Tables 5.3 -5.4 show examples of the information you need to make a simple cost-benefit analysis.

Table 5.3 Example of small-scale free-range system, 52 weeks plan (Benin, 2000)

Flock size	Numbers
Local hens laying and brooding	3
Local hens laying eggs, not broody	2
Cocks	1
Surviving chickens/hen/batch*	8
Growers. Weeks 4-24	24
Total Flock size	30
Feed consumption: 1 Kg /bird/4 week =35 g/bird/day	Kg
Adults feed: 1 kg x 6 birds x 52/4 weeks	78
Chicken/growers feed: 1 kg x 24 birds x 46 /4 weeks	276
Egg Production:	Numbers
Local broody hens. 72 eggs/bird/year	216
Local hens not going broody. 104 eggs/bird/year	208
Eggs for hatching. 3 hens x 12 eggs x two batches /year	-72
Home consumption, 1.5 egg/week	-82
Saleable birds: 3 batches x 8 growers	Numbers
Cockerels. 22 weeks of age	24
Pullets for sale. 24 weeks of age	24

*(12 eggs laid=10 eggs hatched=8 chicks surviving after 6 months)

Table 5.4 Cost-benefit analysis based on example in table 5.3.(*540 Fcfa = 1 USD)

Cost-benefit Analysis	Text	Cost/Unit	Cash flow
Costs		Fcfa*	Fcfa
5 hens and 1 cock 5 x 1500 + 1 x 2000 -9500 Baskets, 3 night + 3 day baskets 6 baskets 1000 -6000 Low cost home made feed 354 Kg 100 -35400			
Vaccine (ND)+medicine (Coc+anti-worm) 60 Doses/year		50	-3000
Miscellaneous -5000 Cash out-flow -58900			
Income (Benefit)			
Sale of Eggs 424 - 154 = 270 30 8100 Sale of cockerels, 22 weeks 24 1500 36000 Sale of pullets, 24 weeks 24 1200 28800			
Total cash in flow 75000 Net cash flow 14000			

In the example referred to in table 5.3 and 5.4, the flock size is initially 5 hens and 1 cock, all local breeds. A production may also start with less, i.e. only 1 hen laying eggs, fertilised by a local cock in the village. Figures will then have to be adjusted accordingly. With 1 cock and 5 hens, of which no more than 3 hens at one time are allowed to go broody, the flock size may grow to a maximum of 24 growers and 6 adults, which is manageable for a small-scale farmer. Very important for this system is that the scavenging feed resource in the village will be less depleted, if the flock size is kept below 6-10 adults and 20-30 growers and chicks.

Supplementary feeding should always be kept at a reasonable low level to reduce costs. However, chicks at age 0-4 weeks should be given what they need (See chapter 3 on advice for feeding). On average each bird will be given 1 kg feed every 4 weeks. This corresponds to 1000 g/28 days = approximately 35 grams per bird per day. 2 batches of 24 growers will need feed two times 22-24 weeks, i.e. 44-48 weeks, on average 46 weeks. The total annual need for feed in a flock of 6 adults and 24 chicks and growers is calculated in Fig. 5.8.

Table 5.5 Supplementary feed needed for a flock of 30 birds in one year.

1 cock:	1 x 1 kg/ 4 weeks x 52 weeks	=	13 kg
5 hens:	5 x 1 kg/ 4 weeks x 52 weeks	=	65 kg
24 chicks/growers:	24 x 1 kg/ 4 weeks x 46 weeks	=	276 kg
Total:		=	354 kg

It is assumed that by improved management and feeding, the egg production of the non-broody hens will increase to 104 eggs/hen/year, i.e. 2 eggs per week on average. Broody hens will also on average lay 2 eggs per week, however excluding 2 x 3 weeks hatching + 2 x 5 weeks brooding, i.e. 2 x 8 weeks = 16 weeks non-laying period per year. Annually each hen will then lay: 52 - 16 weeks = 36 weeks x 2 eggs = 72 eggs/hen/year. For three hens going broody only twice a year, the total egg production will be 3 x 72 = 216 eggs/year.

A production of 24 cockerels and 24 pullets per year (table 5.3.) is based on the following assumptions: A well-managed broody hen will sit on 12 eggs and hatch on average 10 chicks. Using the basket system and the improved management will reduce the overall mortality on the chicks to a maximum of 1 chick out of ten during the first 4 weeks (equal to 10%) and 1 grower out of nine in the remaining 20 weeks. At the age of 22-24 weeks, when the growers are to be

sold, on average 8 growers per batch will be alive. Using three broody hens, a total of 3 x 8 growers = 24 birds may be sold twice a year. Out of these, the half will be cockerels and the other half pullets.

A well-managed production plan means selling birds at the time of highest price, and buying feeds, new hens or inputs (e.g. baskets, feeders and drinkers) at the time of the lowest price. For many farmers this means keeping the birds in the flock until the time of festivals (e.g. Eid festival, Christmas, Easter or national holidays), where they may get a price often two or three times the normal price. However, it is important to stress that keeping birds in the flock means more feed and a higher risk in terms of losing birds caused by predators, diseases or theft. In general birds should be sold no later than at the age of maturity, e.g. 22-32 weeks of age.

In the example from Benin in table 5.3 and 5.4, the cost of feeding one bird was 100 Fcfa every 4 weeks, as one kg feed costing 100 Fcfa would be spent during 4 weeks. In this case, if you want to keep a bird 4 weeks longer in the flock, you should be sure to gain more than 100 Fcfa on the market price. Otherwise, it would be better to sell 4 weeks earlier at a lower price, and thus be able to restock with new growers.

Thus, by knowing the market and environmental conditions and by doing simple economic calculations, you will be able to plan when you should sell your birds, when you should let your hens go broody, and when you should keep your birds in the flock.

Risk assessment

A risk assessment is a judgment that most farmers do every day in their normal lives. They judge, whether they should buy some seeds, sell a chicken, call a veterinarian for a sick animal etc. or whether it would be better to wait until conditions are more favourable. In particular, when starting a new enterprise, the risk assessment becomes crucial. When improving your free-range poultry production, it is important to judge whether your choice of intervention (e.g. feed, vaccination, housing, chick shelter) has an effect and which risks may be involved.

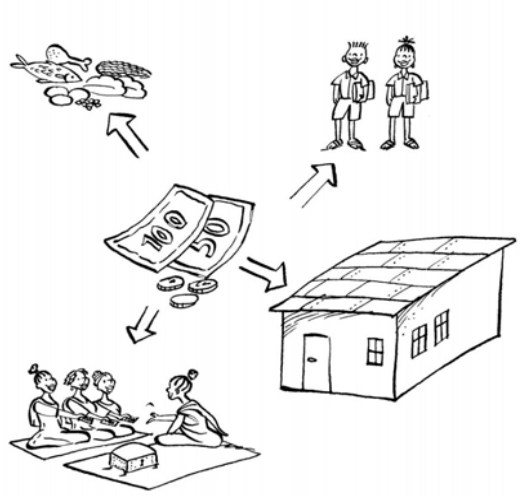


Fig. 5.8. Income is often spent on a variety of items, such as food, children, housing and savings

Ten simple rules for marketing and financial analysis

1. Analyse the market situation, demand for products, investment costs, running costs, and expected revenue for different types of poultry production before starting.
2. Make a thorough calculation of expected costs and revenues for different production systems.
3. Always keep records of your production and sale.
4. Keep your flock size below 30 birds to assure a feed resource in the environment.
5. Estimate the production of eggs and birds over the year
6. Plan beforehand when and how you want to sell your birds 7. Never introduce birds from the market directly to your flock.
7. Sell birds, if feed costs are too high or there are high risk of diseases or dwindling market prices
8. Remember that costs involve investments, running costs, labour, losses, and maybe loan repayment and interest on loans.
9. Judge the risks involved in each type of production system before starting.

Chapter 6 Animal selection and breeds

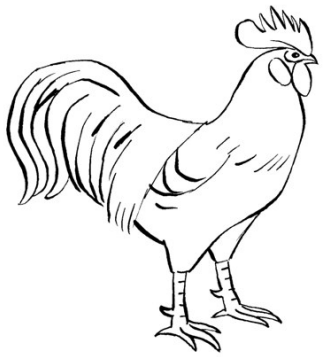


Fig. 6.1 A healthy and strong cock

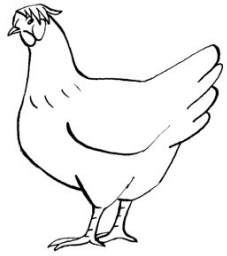


Fig. 6.2 A healthy egg-layer

Introduction

Selection of healthy and sound-looking animals in the villages or markets is important, if you want to assure a healthy flock and a high productivity.

You should therefore know how to judge the quality of different breeds in different ages and sex, based primarily on their looks, sound and behaviour. Judging a dayold chick, a full-grown cock or a laying hen, naturally demands different skills. The features to look for become even more complicated, when dealing with different breeds with distinct looks, behaviour and purpose, i.e. egg laying or meat producing. In the following, we will introduce simple guidelines on how to select a sound animal at different ages, and introduce what to consider in terms of breed selection.

Animal Selection

It is important to look for different features in chicks, growers, hens and cocks. Select or buy your new animals early in the day, as stress from lack of water, feed and rest, will make most animals look rather sick and drowsy.

Fig. 6.3 A soft belly and a clean, dry navel are important features of a healthy, newly hatched chick

A healthy, newly hatched chick should have the following features (Fig. 6.3):

- Well-developed body length and depth
- Shiny, dry, thick and coloured down feathers
- Soft belly
- Clean, dry navel hollow
- Thick shanks with spaced and straight toes
- Big clear eyes
- Lively behaviour

A healthy and good grower should have the following features:

- should appear healthy and lively
- feathering shiny and normal (may depend on the breed)
- large size for the age
- eyes clear and shiny
- clean and dry beak and nostrils
- clean feathers around the vent
- straight legs and toes

A healthy and good egg-layer should have the following features (Fig. 6.2)

- should appear healthy and lively
- feathering normal for the breed
- A red comb (more coloured when in lay)
- eyes clear and shiny
- clean and dry beak and nostrils
- clean feathers around the vent
- straight legs and toes, with no signs of scaly legs
- Legs less coloured in lay
- The breast bone should not be too sharp
- A big broad bottom (laying status can be checked, see fig. 6.4)

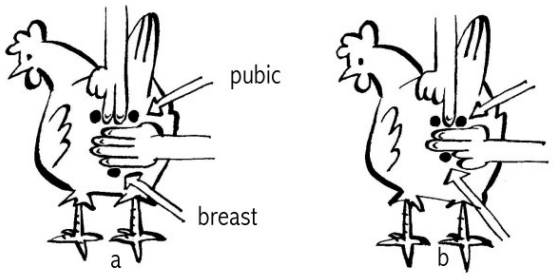


Fig. 6.4 Hen in lay (a) and outside lay (b)

In small flocks, it is relatively easy to check whether the hens are laying or not (Fig. 6.4). Check with your hand. The distance between the pubic bones (top) will be equivalent to two fingers, when the hen is in lay. Only one finger may pass between the pubic bones, when the hen is outside lay.

A healthy and good cock should have the following features (Fig. 6.1):

- alert and protective nature
- shiny and normal feathering for the breed
- clear and shiny eyes
- clean and dry beak and nostrils
- clean feathers around the vent
- straight legs and toes with no signs of scaly legs
- large size relative to the hens

It may be an advantage to keep records on the growth and productivity of each bird in order to select birds according to features such as egg production, growth (meat production) and broody behaviour. Keeping records may help you select the best layers or the best mother to protect the chicks. See chapter 5 for example on record keeping.

If new birds are bought on the market it is important to isolate the new birds in separate baskets for the first two weeks. This will enable you to discover possible diseases or disorders in the new birds. If they show signs of any kind of illness you should return them to the seller or slaughter them.

Breed selection

When you have succeeded in improving your productivity and survival of you local free-range poultry through improved management, housing, feeding, chick protection etc, you may want to further increase productivity by introducing better breeds.

A breed is a group of poultry with a characteristic body form and feather contours. These unique characteristics are inherited from one generation to the next. Also features such as the comb, colour of ear lobes and shank colours and length are usually determined by breed. In every breed,

different varieties can occur usually determined by plumage colour. Thus a white and a black hen may just be different varieties of the same breed. Figures 6.5 – 6.7. shows three different breeds commonly found in tropical regions, i.e. Frizzled Feathers, Naked-Neck and the Dwarf. Naked-Neck genes are found in almost every village, and are believed to be a natural adaptation to avoid heat stress. Frizzled feathers may look ill at a first glance, but is also common in most village based systems. In some countries, Frizzled Feathers are higher priced in the markets than normally feathered poultry. Dwarf poultry show standard colours and plumage, but tend to be 2/3 of the normal size for poultry, mostly because of the short shanks.

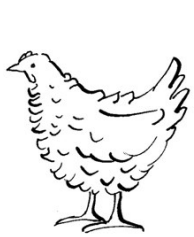


Figure 6.5. Frizzled Feathers

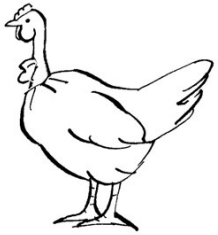


Fig. 6.6. Naked-Neck

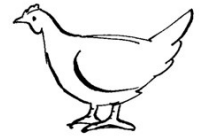
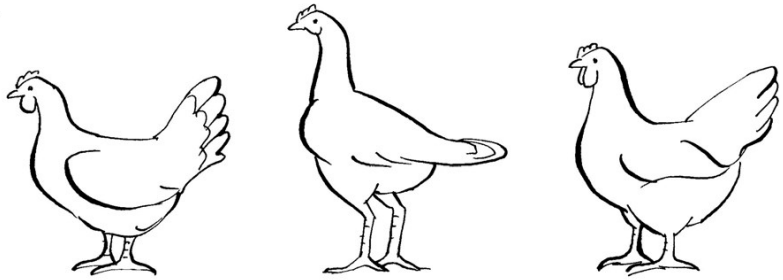


Fig. 6.7.Dwarf breed

Chickens and ducks in industrialised systems are usually kept for two distinct purposes, that is either egg or meat production. A high productivity in either egg or meat production is a result of specialised breeding programme. The so-called dual-purpose breeds is also a result of breeding programmes, and may produce more eggs as well as more meat than traditional birds. It is important to select birds, which are suited for the kind of production you have in mind, and which are suited for the conditions under which they are kept, e.g. free-range or confinement.

The features of birds specialised in egg production, meat production or both (dual-purpose) are shown in figures 6.8abc. Laying hens are "boat-shaped" with a long straight back and a big bottom. Meat producers (broilers) are long-legged, in a more upright position and wings in high position on the body. Dual-purpose breeds is a form in between the layers and broilers. Local breeds often have the form of a dual-purpose breed, although much less heavy in body form and size.



a b c

Figures 6.8a, b and c Typical breeds producing eggs (a), meat (b) and both (c)

The commercial sector has developed highly specialised hybrids (crosses of several breeds) of which layers can produce 300 eggs per year and broilers can reach 2 kg in 6 weeks. To obtain this high production, the hybrids have very specific requirements to management, feeding and disease management and production costs are high. They are therefore not normally suited in free-range and improved free-range systems.

Cross-breeding

To increase production from local chickens, crossbreeding with other breeds can be practised. It is however, important to consult professional breeders or breeding companies, who may recommend suitable and available breeds to increase egg production, growth or both. It is important to be aware that the offspring will obtain different qualities depending on whether the cock or the hen of the new breed is used. This is because some qualities are sex-linked and thus it is important to consult a breeder.

In Bangladesh, the female of an Egyptian breed, Fayoumi, and the male of an American breed, Rhode Island Red (RIR), were crossed to produce a crossbreed layer suitable for a semi-scavenging life under village conditions. The result was a laying capacity of up to 160 eggs/hen/year and a growth rate under semi-scavenging conditions of 10 g/day. Furthermore, the brown-golden feathers were highly praised by the farmers, who named the breed "Sonali" (meaning "Golden" in Bangla). The cross of male Fayoumi and the female RIR did not give the same satisfactory results.

It is also important to stress that if a cross-breed is introduced at village level, it is crucial that management, feeding and health protection schemes are improved.

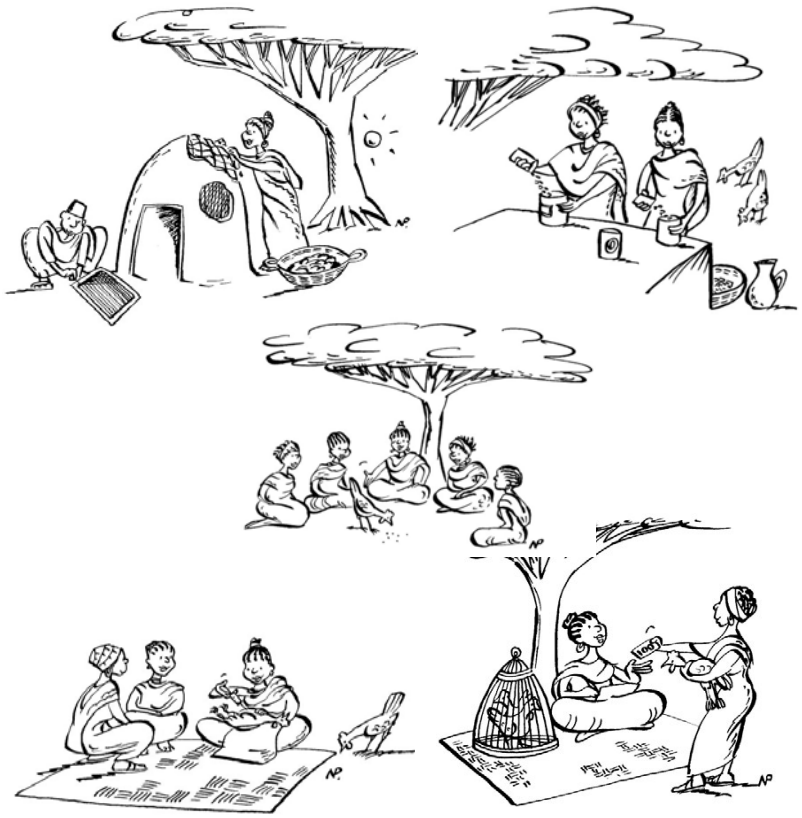
Cockerel exchange programs

In many countries, a common attempt to increase production from local chickens has been to establish so-called cockerel exchange schemes. The idea was to improve the productivity of local birds by mating them with improved cocks. For several reasons these schemes usually failed to work. First of all the introduced breeds could not adapt to the hot climate, low feeding and

management and thus many of them died. Furthermore, the improved cocks were not as lively and active under village conditions as the local cocks and thus lost in the mating competition for the hens. When reproduction succeeded, the first generation of these cocks often showed a slight increase in production, but as no strict breeding schemes were maintained, the effect was gone after a few generations. Another set of important potential disadvantages were loss of broodiness, reduced scavenging capacity and reduced survival. Diseases such as Newcastle Disease and Leucosis were introduced to new areas and the result was high mortality among local birds. For all these reasons it is very important that selection of breeding birds take place in the existing environment. Simple cockerel exchange programmes are as such not recommended.

Simple rules for animal and breed selection

1. You should practice judging the external features of cocks, hens, growers and chicks, knowing what signifies a good animal.
2. Always choose birds with a lively behaviour.
3. Always check whether the hens are in lay (Fig. 6.4).
4. A potentially good layer has a long straight back a broad bottom.
5. Always check the belly and navel spot of newly hatched chicks (Fig. 6.3).
6. Keep new birds isolated for a few weeks before introducing them into the flock.
7. The results of crossbreeding should always be monitored carefully.
8. Uncontrolled release of exotic cocks into the environment should be avoided.



Front pictures from Bangladesh, Burkina Faso and Benin by Jens Christian Riise.

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Training Material 12

Goat Production, October, 2016

Phase 3

N-CLIMP

LS-11

Goat Production

N-CLIMP

Sheep and Goats Husbandry Programme

GOAT: Schedule of management

	Month	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
	SEASON												
	BROWSING												
SHEEP GOAT	Reproduction			Optimal lambing/kidding				Weaning lambs/kids		Ram care	Mating ewes		
		Ewes mated in Jul./Aug. give birth			4 months suckling period with good browse				3 months rest before breeding			Pregnant for 5 months	
	Husbandry				Castrate and eartag		Vaccinate lambs/kids		Vaccinate entire herd				
	Disease control								Venereal disease control				
	Parasite	Internal and external parasite control, especially if goats and sheep are kraaled at night											
	Supplement	Energy supplement for pregnant ewes								Flush feed the ewes to enhance pregnancy rate			
		MPE supplememtation			Mineral Supplementation for improved performance						MPE supplement		

Tools for treatment and husbandry

The goat farmer should have access to:

- Cooler box
- Goat book
- Animal Health Book
- Burdizzo
- Ear tag applicator

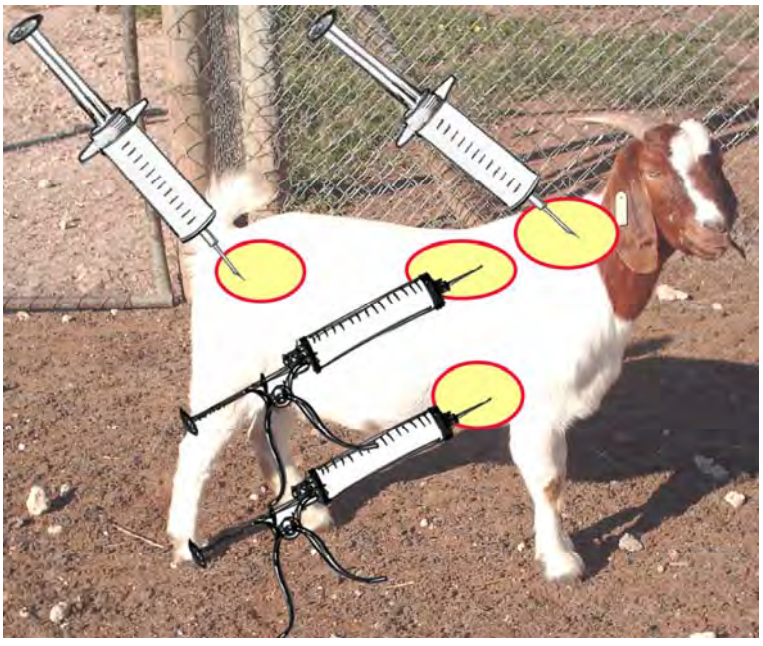
Hoof trimmers
Tattoo applicator, ink and alphabet
Knapsack sprayer

- Scale or weight belt
- Mask y Gloves
- Blades y Digital thermometer
- Antiseptic handwash
- Gauze swabs.

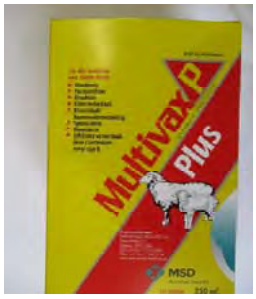
Medicines, Vaccines and Syringes

- Disposable syringes (5cc, 10cc)
- Large syringe for drenching/dosing (60cc)
- Non disposable syringe
- Needles (20 gauge or 22 gauge but preferably 5/8 or 1 inch length)
- Antibiotic eye powder
- Antibiotic powder (such as Terramycin powder)
- Broad spectrum dewormer for wireworms, tapeworms and flukes, (e.e Prodose Orange and Eradiworm)
- Dip – a conventional one to be mixed with water (such as Tactic)
-Wound spray with fly repellen
- Coopers Wound oil
- Tick grease
- Long acting antibiotic (such as Terramycin LA)
- Short acting antibiotic (such as oxytetracycline 120)
- Sulphur based antibiotic (such as Disulphox) for treating coccidiosis
- Injectable solution for mange, lice (such as Ivermectin)
- Iodine spray
- Iodine drops (for newborn kids)
- Copper Sulphate (for foot baths)
- Vitamins (such as Multivite).

Parts for injection



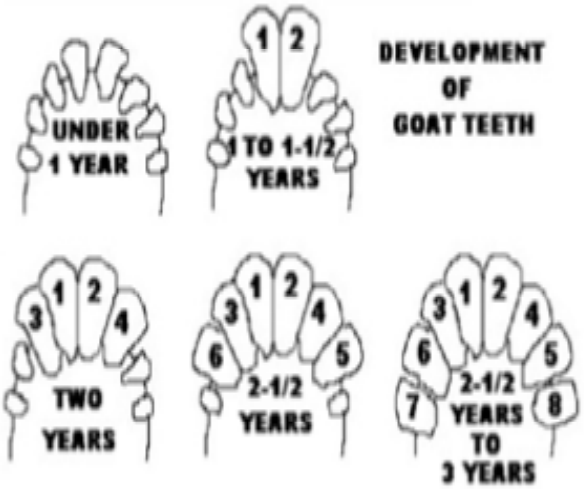
Preventive Programme



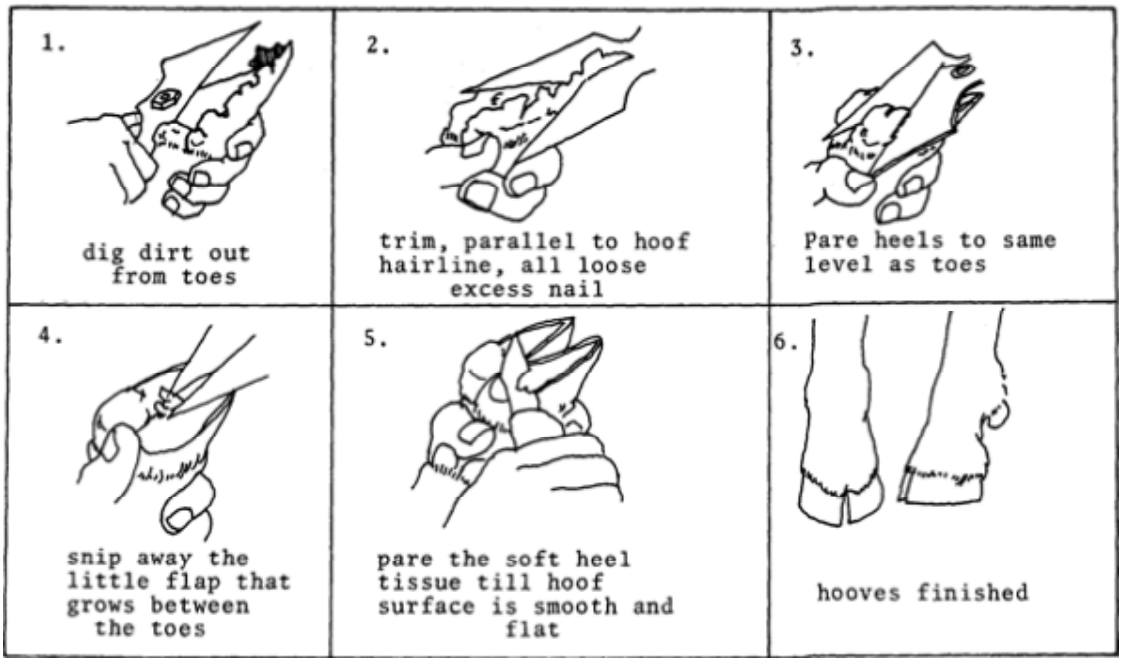
Multivax Plus → (Pasteurellosis + Pulpy kidney + Tetanus + Blackquarter)

Dectomax →
(External and internal parasites)
Change of season → (Parasite control)

Teeth and years



Hoof Trimming

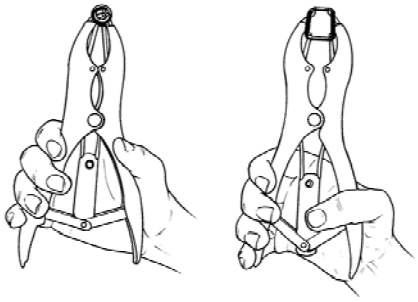


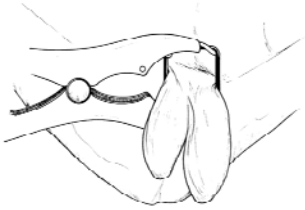
Hoof Trimming

Castration

By Burdizzo

By Elastrator with rubber ring





Parasite control

Deworm before the rains and just after

Tick control by spraying or dipping

Nutritious foods

Acacia pods

Bean residue

Green pasture

Lucerne

Why to prepare foods for goats ?

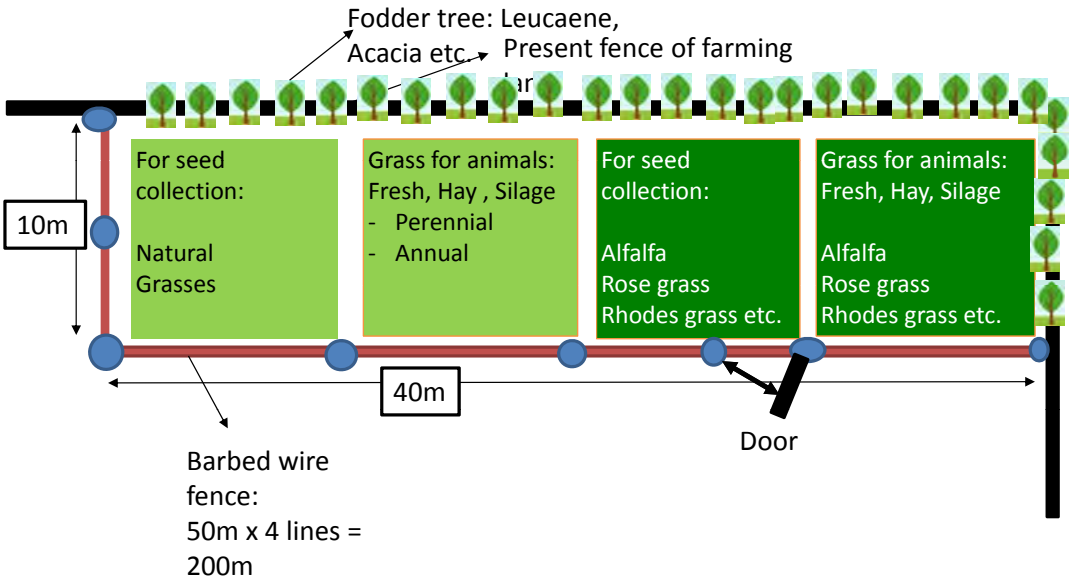
1. You need fodder during dry season for your goats

2. You can prepare fodders by yourself

3. You can sell your fodder as cash crops to others

4. You can practice to produce fodder easily

Fodder production



Land preparation

Hay preparation

1. Cutting

3. Store

2. Drying

Hay making

Keep green colour
Keep in shadow
Dry rapidly

Hay table

Seed collection

Top of fodder grass