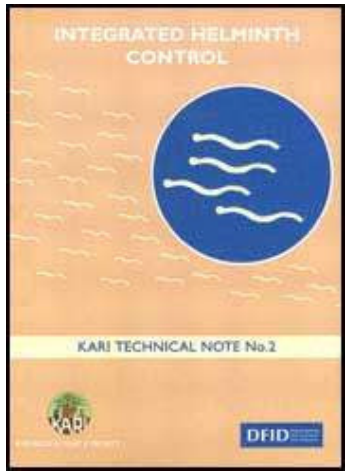

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- Medicated Feed Blocks
- Toxocara Treatment
- Use of narrow spectrum drugs
- Alternate Grazing
- Boma Rotation
- Use of genetic resistance
- Mixed use of broad and narrow spectrum drugs
- Cropping Rotation
- Seasonal Fluke Treatment

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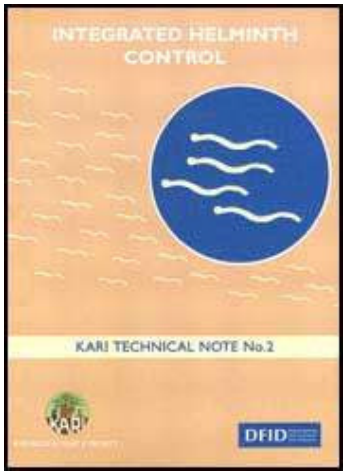

Integrated Helminth Control - KARI technical note no. 2 (DFID - KARI, 1999, 54 p.)

ABOUT THIS MANUAL

This manual has been produced in response to demand from animal health professionals for a simple and clear set of advisory notes to help them in their task of reducing the costs that worm diseases cause to the livestock owned by Kenya's farmers.

It is designed for use by Animal Health Assistants, vets, livestock production staff and others working to advise farmers in disease control, be they in the employment of the Government of Kenya, the NGO sector or working privately.

At present, farmers and advisers tend to rely heavily on the use of drugs to control helminth problems in the flocks and herds under their care. However, the use of drugs should properly be only one weapon in our armoury. By integrating other methods of control, often alongside occasional drug treatment, the costs of control can be reduced and the loss of production caused by the worms alleviated.

However, not all control methods are appropriate to every farm. A good adviser needs to take into account the unique features of each farm that can be used to help in the control effort. In this manual we have tried to list the likely features found on farms in different parts of the country and a menu of the different methods of control that may be appropriate. We leave it to each individual adviser to use his or her knowledge of a particular farm to help the farmer to choose the appropriate methods to incorporate into the farm's worm control programme.

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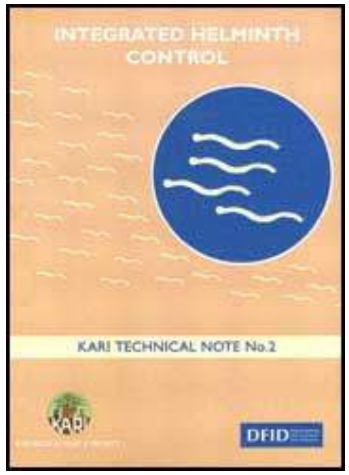


PART ONE - The Helminth Diseases of Kenya

INTRODUCTION

Every animal is infected with worms. How these affect the animal and whether they are important depends on:

1. **the type of worm**
2. **the number of worms present**
3. **the species and breed of animal**
4. **the age of the animal**
5. **the nutritional status of the animal**
6. **the amount of previous exposure the animal has experienced**

THE PARASITES

Helminth parasites can be divided into three main groupings:

1. **Roundworms (Nematodes)**
2. **Tapeworms (Cestodes)**
3. **Flukes (Trematodes)**

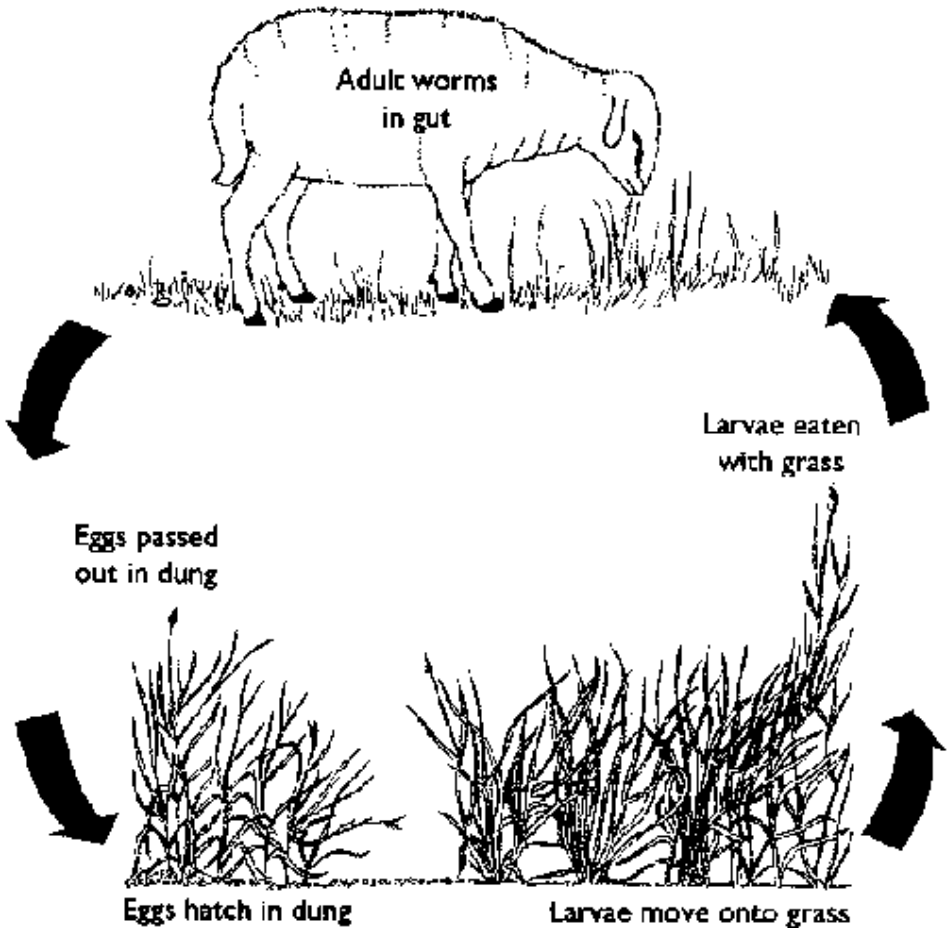
Since the relative importance, the methods of control and the drugs for treatment vary between each of these groups, it is important to draw distinctions between them.

ROUNDWORMS

The most important of these worms live in the gut of the animal, in the stomach, small intestine or large intestine. There are a number of nematode species living in other sites (such as the lungs, eyes etc.) but in Kenya these other types are rarer and seldom of clinical or economic importance. While infection with nematodes may occasionally cause clinical disease or production loss in young cattle, they are rarely important in adult cattle. They are

much more important as causes of losses amongst sheep, goats and camels.

Most of the nematodes of importance lay eggs in the gut which pass out with the animals dung and develop into infectious stages (larvae) in the pasture. Animals become infected during grazing.



ROUND WORM LIFE CYCLE

The larvae on pasture are quite vulnerable to drying and will not survive long In dry, hot conditions. In contrast, in cool damp conditions, the larvae can survive for longer periods and in some areas, grass can still be contaminated with larvae for up to six months after animals

have last been grazing. As a very rough rule, if the grass is green and growing, larvae will be able to develop and survive long enough to infect the animals.

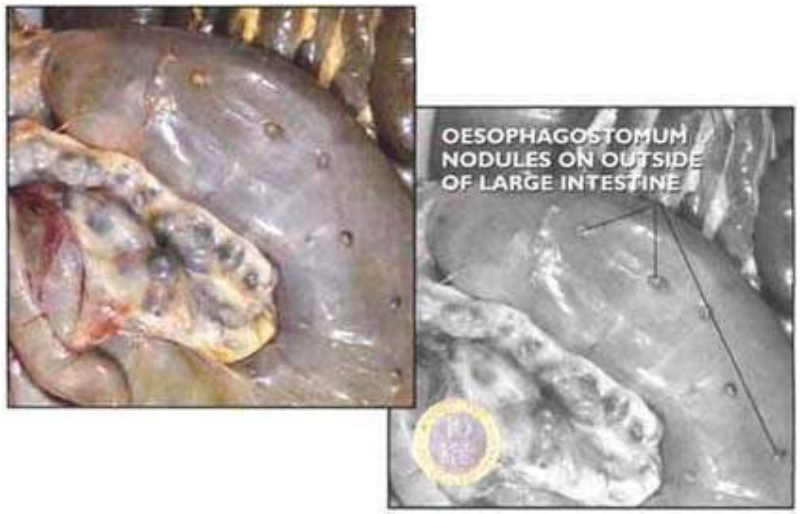
HAEMONCHUS. This worm lives in the stomach of sheep, goats, cattle and camels. It is large enough to be seen at slaughter without a magnifying glass. It sucks the blood of the animal and if present in large numbers, can cause a rapid depletion of the animal's blood reserves. In sheep, goats and camels it can be fatal if present in large numbers or if the animal is poorly fed. It is also a very prolific worm, laying many thousands of eggs, so build up of infection in a flock can be fast. In heavy infections, the animals become dull, thin, have very pale membranes around the eyes and inside the mouth and may develop "bottle jaw" - a pendulous swelling below the lower jaw. In camels this watery swelling is often seen above the eyes and each side of the sternal pad. When pasture is heavily infected, animals may die before showing clinical signs and before the onset of worm egg-laying. Haemonchus does not usually cause the animal to have diarrhoea.

Figure

TRICHOSTRONGYLUS. A number of species of worms in this family are found in sheep, goats, cattle and camels. Depending on the species, they live in the stomach or the small intestine. They are normally just too small to be easily visible on the gut surface at slaughter. In heavy

infections, the surface of the small intestine may be reddened. While large worm burdens can cause an enteritis with a distinctive dark-coloured diarrhoea, Trichostrongylus is probably more often important in combination with Haemonchus and other nematodes in a general parasitic gastroenteritis.

OESOPHAGOSTOMUM. This worm lives in the large intestine where it causes formation of nodules. Both the nodules and the worms themselves are large enough to be seen at slaughter, but the occurrence of large numbers of hardened nodules is diagnostic. Apart from the loss of value in matumbo, large infections of Oesophagostomum can be a cause of scouring.



Figure

COOPERIA. This worm is found in the small intestine of all domestic ruminants. In sheep and goats in Kenya it is seldom of economic importance on its own but may contribute to parasitic gastroenteritis. Reports suggest that it may very occasionally be of significance in grazing calves.

BUNOSTOMUM. Infections with Bunostomum are acquired by larvae penetrating through the skin of the legs from contaminated pasture or through the wall of the gut while grazing. This

is a more common infection of cattle than of sheep and goats. It may occasionally reach pathogenic levels. Since the infection is not dependant on pasture intake, even very young calves can become infected. It is more common where boma hygiene is poor.

DICTYOCAULUS VIVIPARUS. This is the cattle lungworm. While it is likely to survive well in the cooler damper parts of Kenya, it is seldom reported as a problem. Heavily infected calves have a distinctive drawn-out dry unproductive cough. Under normal conditions, animals become immune during their first grazing season and cases are unlikely to be seen in older animals. In the differential diagnosis of coughing cattle, other causes are more likely in the Kenya Highlands. Bacterial, viral or mycoplasma pneumonias should be ruled out before a diagnosis of lungworm is made. D.filaria, the large lungworm of sheep and goats, may occasionally be present and be a cause of a clinical pneumonia.

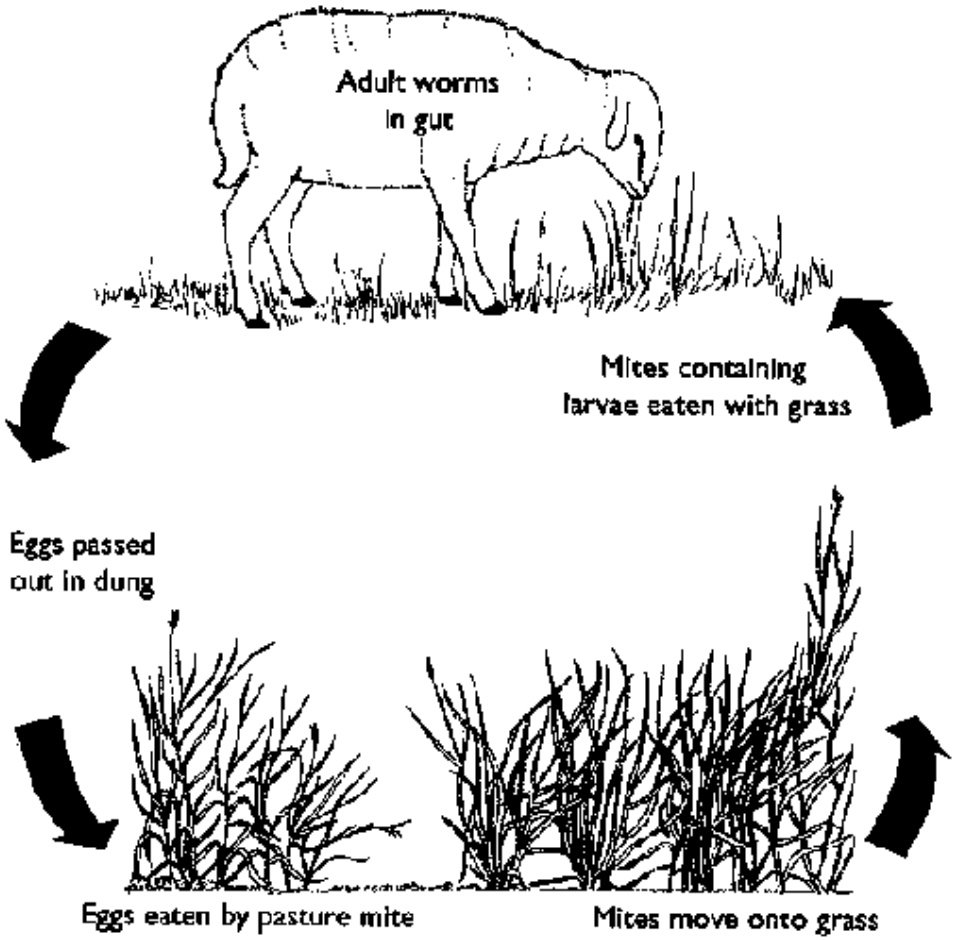
THELAZIA. Species of Thelazia are found in the eyes of cattle in the semi-arid areas of Kenya. The worms are transmitted by flies. Individual cases can be treated with levamisole applied into the eye or by using any of the injectable anthelmintics according to the manufacturers instructions. Where problems are recurrent, use of a persistent insecticide (such as cypermethrin) applied to the head of the animal may help.

TOXOCARA VITULORUM. This is a worm which infects young calves. Calves become infected through the milk from their mothers. Calves can become clinically sick and growth rates can be adversely affected. Larvae are only present in the milk during the first week or so after birth. For unknown reasons, this condition seems to be much more common amongst pastoralist owned cattle.

TAPEWORMS

All tapeworms have an indirect life-cycle. This means that there are two animals involved in the development of the infection. The animal harbouring the adult tapeworm is known as the final host, while that harbouring the juvenile stages is the intermediate host. While for domestic animal species the final host is always a mammal, the intermediate host is

sometimes a mammal and sometimes an arthropod. Control is based on breaking the life-cycle or on drug treatment of the adult infection in the final host.



SHEEP TAPEWORM CYCLE

MONIEZIA. This is the large tapeworm seen in the intestine of calves, sheep, goats and camels. The domestic animal is the final host with species of mites that live on pasture as the intermediate hosts. While these infections are highly visible (due to the tapeworm segments that pass out in the faeces) and quite dramatic (due to the size of the worms found at slaughter), they rarely cause the animal any ill effects. Animal health workers who can find

nothing else to report at post-mortem often ascribe death to the presence of these tapeworms.

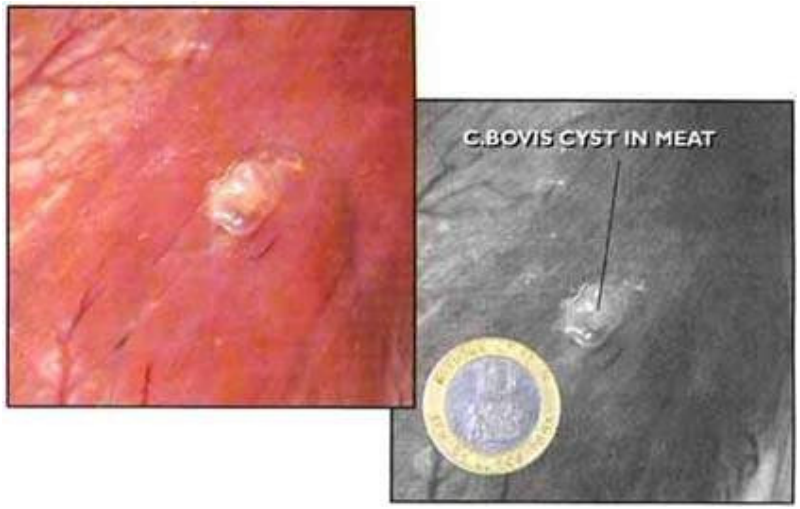
However, in trials where animals have been infected with many thousands of Moniezia, no production loss or clinical signs have been observed. Farmers often treat their animals with anthelmintic whenever they see tapeworm segments in the faeces, these infections are therefore a cause of over-frequent dosing. Also since few of the broad-spectrum anthelmintics are particularly effective against tapeworms, the failure of the treatment to totally eliminate the segments leads to reports of anthelmintic failure, anthelmintic resistance or fake products.

Figure

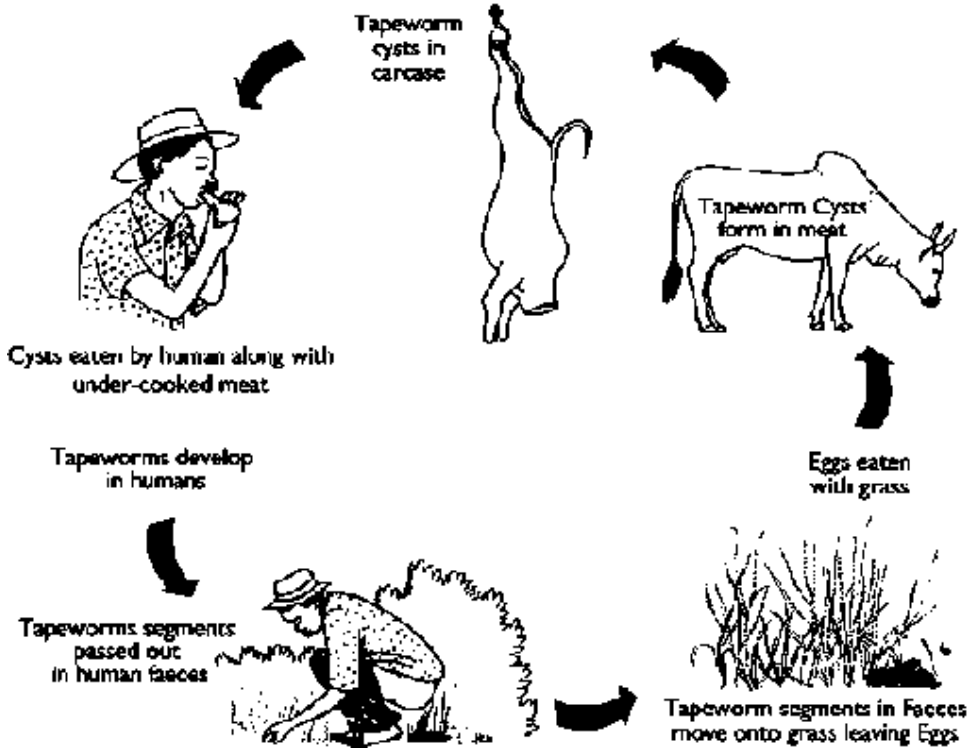
AVITELLINA. In many respects this worm is similar to Moniezia, however, it is smaller, less dramatic and causes the animal no harm.

CYSTICERCUS BOVIS. This worm is found as small, rice-grain-like cysts in the meat of cattle. Cattle are the intermediate hosts and when these cysts are eaten by man, they develop into an adult tapeworm in the human intestine. The cysts are thought to cause no pathogenic or production losses in the cattle. However, where cattle are sold through a reputable

slaughterhouse, the carcase may be downgraded with subsequent loss of value. Control is by treatment of humans and prevention of contamination of pasture with human faeces.



Figure



HUMAN/CATTLE TAPEWORM LIFE CYCLE

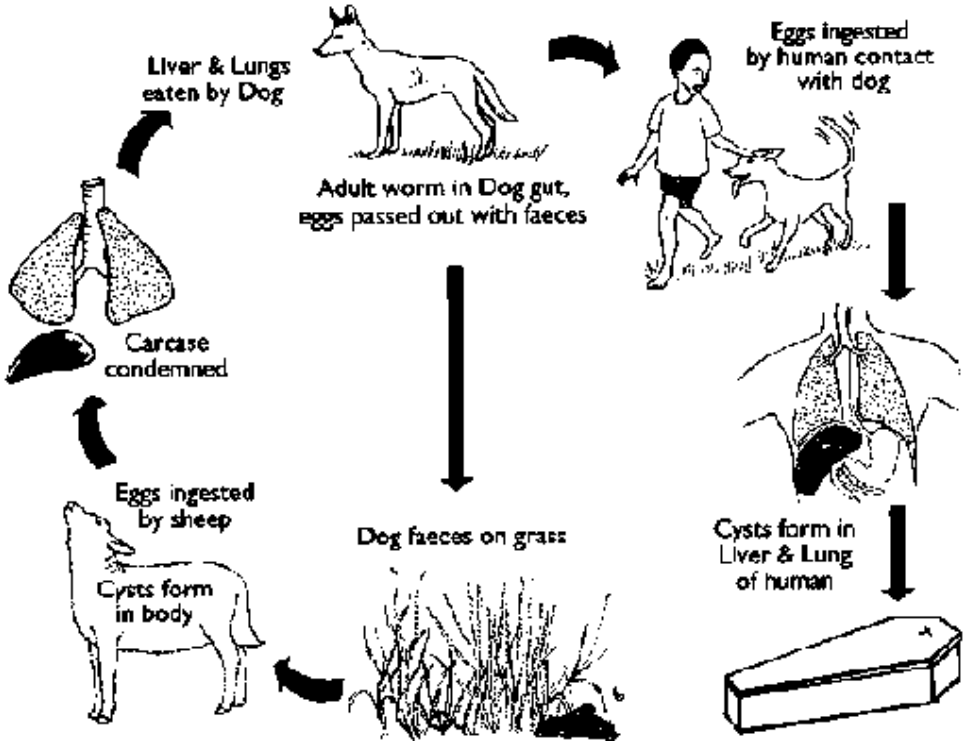
Camels are occasionally infected with Cysticercus bovis, however a similar parasite Cysticercus dromedarii is more common - in this infection, hyenas rather than man are the final host for the adult tapeworm.

CYSTICERCUS TENUICOLLIS. This worm occurs as long, thin-necked, balloon-like fluid-filled cysts in the peritoneal cavity of domestic ruminants. Most commonly these are found attached to the surface of the liver, intestinal mesentery, other abdominal organs or the body wall. These cysts can be confused with hydatid cysts (see below). In this case the domestic ruminant is the intermediate host and the final host is the domestic dog (or perhaps wild canids such as jackals). The dog becomes infected by eating cysts in animal carcasses. The domestic animal becomes infected by eating eggs passed out by the dog. Since the dog may pass out many millions of eggs per day and these can be spread by flies, it is very difficult to control this infection. Treatment of dogs with praziquantel and preventing dogs having

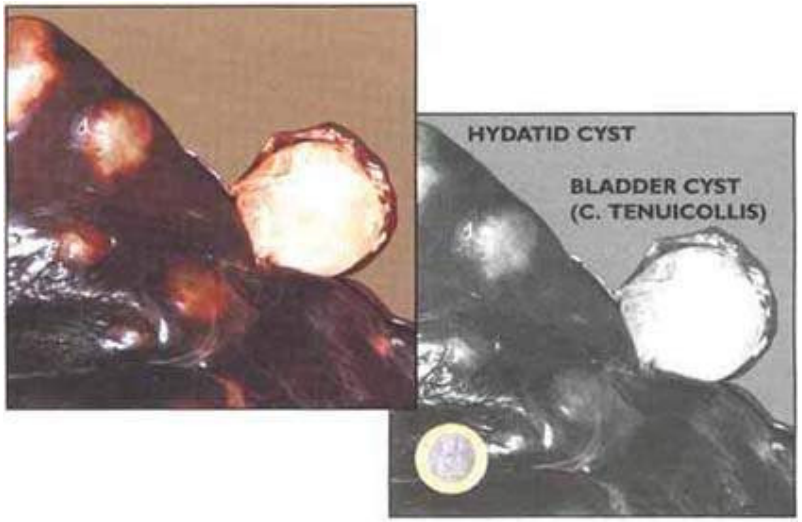
access to carcasses (or raw carcase trimmings) can reduce the incidence.

HYDATID. Hydatid cysts are the intermediate stage of the tapeworm Echinococcus granulosus. The final host is again the domestic dog or wild canids. Like Cysticercus tenuicollis (above) the dog passes out eggs which are infectious to domestic ruminants or camels. The cysts are more rounded than the tenuicollis cysts and are found on or in the liver, the lungs or more rarely in almost any other part of the carcase. While the cysts cause no adverse effects to the animal, they can be a cause of condemnation or downgrading if the animal is sold to a reputable slaughterhouse.

Unlike C.tenuicollis, the eggs passed by the dog are also infectious to man. The resulting infection in man is known as hydatid disease and is very hard to treat. Human cases are best treated with surgical removal of the cyst. However, since the cysts easily rupture these can spread throughout the body and some cases are untreatable and fatal. It is important where hydatid cysts are found in the domestic animals that dogs are kept away from carcasses and that household dogs are regularly treated with praziquantel. In addition, dog-human contact should be restricted and hands washed very carefully after handling dogs. Farm children are particularly vulnerable to infection.



HYDATID LIFE CYCLE

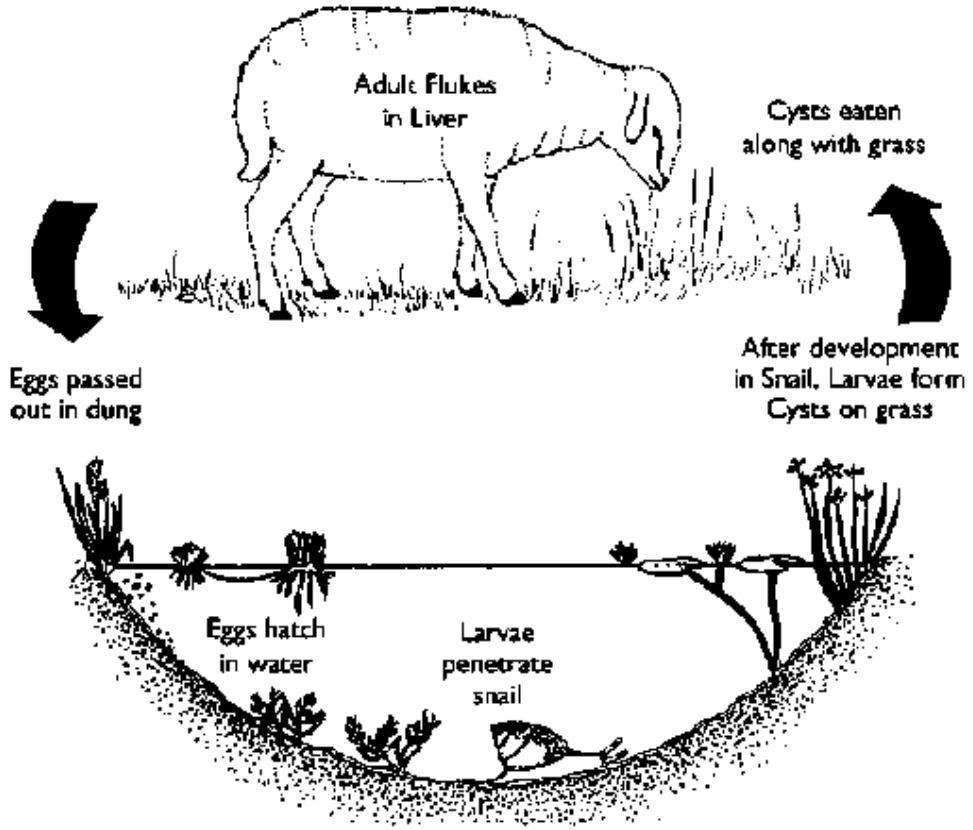


Figure

COENURIASIS. This is a condition where the intermediate stage of another dog tapeworm, Taenia multiceps, forms in the brain of a sheep, goat or camel. The pressure on the brain from the growing cyst causes behavioural changes in the sheep, often resulting in the animal circling and bumping into objects. Sometimes a softening of the skull can be felt over the cyst which is frequently just behind the horn-buds. While surgical removal of the cyst is often successful and has been practiced by shepherds in the past, it is perhaps best if the animal is simply slaughtered.

STILESIA. This small tapeworm has its adult stage in the liver of sheep, goats and camels. As far as is known, it causes no pathogenesis but is a cosmetic problem leading to loss of value in the sale of the liver. The intermediate stage is thought to be found in a pasture mite.

FLUKES



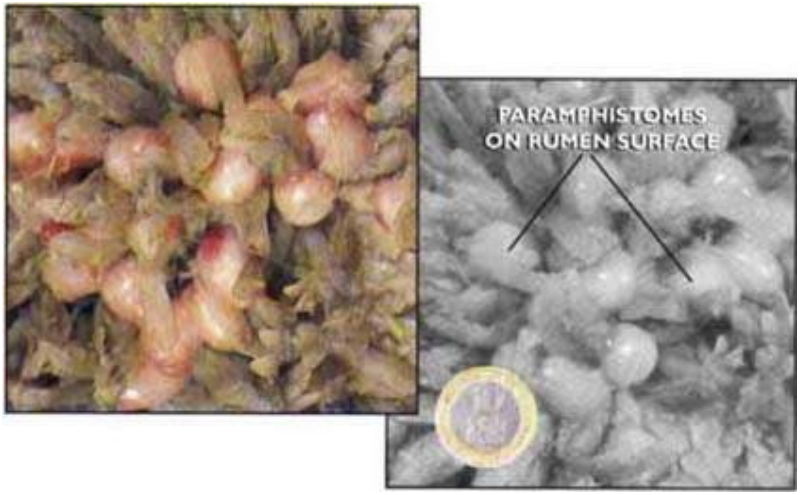
LIVER FLUKE CYCLE

All the flukes of importance to livestock have indirect life-cycles with adults in the domestic animal and intermediate stages in various species of water snails.

FASCIOLA. This worm is the liver fluke, which is found in areas of Kenya where there are marshy areas or slow-moving permanent water courses. The infectious stages passed out by the snail form cysts on the grass which are subsequently eaten by livestock. The young flukes develop and migrate through the animal's liver causing damage. When present in large numbers, over a long time or when nutrition is restricted, the animal can suffer a loss of condition and show signs of "bottle jaw" similar to those described for Haemonchus above. In very heavy infections, death can occur before these signs are apparent. A history of grazing along stream sides, near ponds or on areas that flood during the rains would indicate

that liver fluke control should be included in routine farm management.

PARAMPHISTOMES. These flukes are often found in very large numbers in the rumen of cattle, sheep, goats and camels and are known as stomach flukes. Despite their large numbers, the adult worms are thought to cause little harm to the animal. However a sudden large intake of infectious stages can cause scouring, emaciation and death.



Figure

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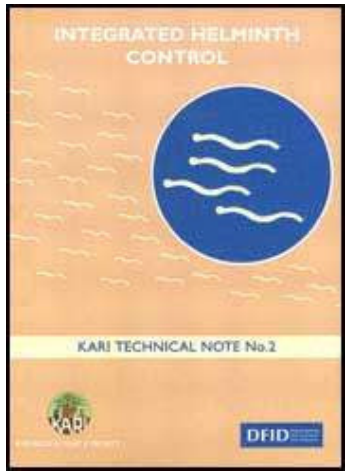
Integrated Helminth Control - KARI technical note no. 2 (DFID - KARI, 1999, 54 p.)
PART TWO - Helminth Control Advice, summarised by area
Western Kenya Sugar Zone
Western Kenya Grain Zone
Western Kenya Tea Zone
Central Kenya High Altitude Zone



- **Semi-arid Zone, Smallholder Farms**
- **Semi-arid Zone, Pastoralist Producers**
- **Semi-arid Zone, Large Scale Ranches**
- **Arid Zone, Pastoralist Producers**
- **Coastal Sub-humid Zone**

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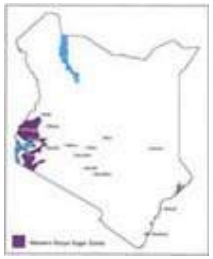
PART TWO - Helminth Control Advice, summarised by area

Western Kenya Sugar Zone



Figure

Typical Problems In This Area

1. Because of the high temperature and humidity, worm eggs develop to the infectious stages very quickly, so problems can build up rapidly.

2. Due to the uneven distribution of rainfall during the year, there are times when grazing is in short supply and animals suffer from nutritional stress.

Features Of The Area That Can Help In Control

1. Anthelmintic resistance is currently rare due to low previous rates of drug use.

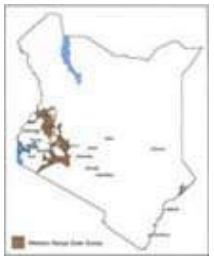
2. Although larvae develop quickly in this humid zone, they do not survive as long on pasture as they might in a cooler area. Where pasture can be left ungrazed for 5-6 weeks, the majority of larvae will have died.

3. Larvae on pasture survive best when the grass is still green. During periods when grass growth has stopped, larvae rapidly begin to die.

Control Methods That May Be Useful

- **Frequent observation of individual animals and treating only clinical cases.**
- **Fresh grass grown after a crop has been harvested will be clean. A rotation of cropping and grazing areas can provide constant availability of clean grass (Cropping Rotation).**
- **Since rates of infection are seasonal, treatments can be targeted at times of year when there are peaks of infection.**
- **Keeping local breeds of animals rather than exotics can lead to higher production at lower treatment costs (Genetic Resistance).**
- **Since periods of poor grazing and nutritional stress are seasonal, treatments can be timed to alleviate chronic infections.**
- **Medicated feed blocks can be made with locally available ingredients and provided to the animals overnight in the boma.**

Western Kenya Grain Zone



Figure

Typical Problems In This Area

1. At certain times of year, because of high temperature and humidity, worm eggs develop to the infectious stages very quickly, so problems can build up rapidly.

2. Because of the relatively cool conditions at this altitude, pasture can remain infective for long periods after it has been last grazed.

3. There are many liver fluke transmission sites.

Features Of The Area That Can Help In Control

1. Farms are often larger than in other areas, so it can be possible for farmers to manage rotational systems.

2. Farms in this area tend to be well developed and have good grazing management.

3. Cattle are often present in numbers which can permit alternate grazing systems to be effective.

Control Methods That May Be Useful

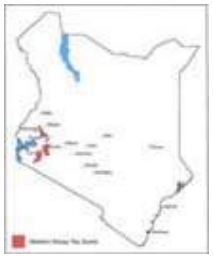
- **Frequent observation of individual animals and treating only clinical cases.**
- **A Dose & Move system where all animals in the flock/herd are treated and moved**

onto clean ground.

- **Fresh grass grown after a crop has been harvested will be clean. A rotation of cropping and grazing areas can provide constant availability of clean grass (Cropping Rotation).**

- **Since rates of infection are seasonal, treatments can be targeted at times of year when there are peaks of infection.**

Western Kenya Tea Zone



Figure

Typical Problems In This Area

1. The weather conditions are suitable for transmission of stomach and intestinal worms throughout the year, so worm numbers can be high.

2. Because of the relatively cool conditions at this altitude, pasture can remain infective for long periods after it has been last grazed.

3. Liver fluke is present in valley bottoms.

4. SEVERE RISK OF ANTHELMINTIC RESISTANCE.

Features Of The Area That Can Help In Control

1. Farms are often larger than in other areas, so it can be possible for farmers to manage rotational systems.

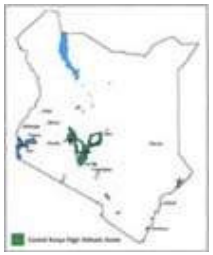
2. Cattle are often present in numbers which can permit alternate grazing systems to be effective.

3. Rapid grass growth can enable cut and carry systems of animal feeding to be effective.

Control Methods That May Be Useful

- **Frequent observation of individual animals and treating only clinical cases.**
- **Adult cattle can graze areas after sheep, goats or calves in an alternate grazing system.**
- **Fresh grass grown after a crop has been harvested will be clean. A rotation of cropping and grazing areas can provide constant availability of clean grass (Cropping Rotation).**
- **Medicated feed blocks can be made with locally available ingredients and provided to the animals overnight in the boma.**
- **Cut and carry systems can prevent animals grazing and contaminating pasture.**
- **GUIDELINES FOR USE OF ANTHELMINTICS SHOULD BE CAREFULLY FOLLOWED TO SLOW THE DEVELOPMENT OF ANTHELMINTIC RESISTANCE.**

Central Kenya High Altitude Zone



Figure

Typical Problems In This Area

1. High grazing pressure means that transmission rates can be high and there are few opportunities to control worms by grazing management.

2. Because of the relatively cool conditions at this altitude, pasture can remain infective for long periods after it has been last grazed.

3. There are many liver fluke transmission sites.

4. Due to the uneven distribution of rainfall during the year, there are times when grazing is in short supply and animals suffer from nutritional stress.

5. The presence of both Haemonchus and liver fluke can lead to a chronic syndrome (which can become worse during periods of poor feeding).

Features Of The Area That Can Help In Control

1. Worm challenge rates vary with the season and periods of peak infection occur during or shortly after the rains.

2. Larvae on pasture survive best when the grass is still green. During periods when grass growth has stopped, larvae rapidly begin to die.

Control Methods That May Be Useful

- **Frequent observation of individual animals and treating only clinical cases.**

- **Since rates of infection are seasonal, treatments can be targeted at times of year when there are peaks of infection.**

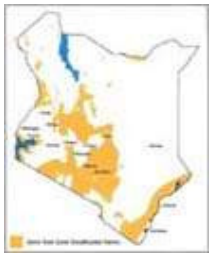
- **Since periods of poor grazing and nutritional stress are seasonal, treatments can be timed to alleviate chronic infections.**

- **Mixed use of broad and narrow spectrum drugs can help control Haemonchus and liver fluke.**

- **Medicated feed blocks can be made with locally available ingredients and provided to the animals overnight in the boma.**

- **Specific treatments to control liver fluke can be applied at times of year when these are most likely to be effective.**

Semi-arid Zone, Smallholder Farms



Figure

Typical Problems In This Area

1. Smaller farms in this zone can seldom manage to support many animals. Feed tends to always be in short supply and animals suffer constant nutritional stress.

2. Worm burdens often build up slowly and coupled with poor feeding lead to a long-

term chronic condition.

3. Trichostrongylus, Haemonchus and Oesophagostomum can all be present and contribute to a generalised parasitic gastroenteritis.

4. During the dry seasons invading larvae may enter a period of delayed development in the animal (Inhibited worms).

Features Of The Area That Can Help In Control

1. Transmission is seasonal and a significant portion of the year is too dry for worm larvae to survive on pasture.

2. When inhibited worms are present, drug treatments can be efficiently targeted at these.

Control Methods That May Be Useful

- **Frequent observation of individual animals and treating only clinical cases.**
- **Since rates of infection are seasonal, treatments can be targeted at times of year when there are peaks of infection.**
- **Since periods of poor grazing and nutritional stress are seasonal, treatments can be timed to alleviate chronic infections.**
- **At certain times of year a large part of the overall worm population is present as inhibited larvae. By correctly applying an effective drug at this time, infection rates can be reduced for the ensuing dry season.**
- **Keeping local breeds of animals rather than exotics can lead to higher production at lower treatment costs (Genetic Resistance).**

Semi-arid Zone, Pastoralist Producers

Figure

Typical Problems In This Area

1. Due to the uneven distribution of rainfall during the year, there are times when grazing is in short supply and animals suffer from nutritional stress.

2. Worm burdens often build up slowly and coupled with poor feeding lead to a chronic condition.

3. Trichostrongylus, Haemonchus and Oesophagostomum can all be present and contribute to a generalised parasitic gastroenteritis.

4. During the dry seasons invading larvae may enter a period of delayed development in the animal (Inhibited worms).

5. Although overall stocking rates may be low, these can be locally high around watering points and bomas.

6. Toxocara may be a problem in young suckling calves.

7. Coenuriasis may be quite common in sheep and goats.

Features Of The Area That Can Help In Control

1. Transmission is seasonal and a significant portion of the year is too dry for worm larvae to survive on pasture.

2. When inhibited worms are present, drug treatments can be efficiently targeted at these.

3. Overall stocking rates are low.

4. There is little need for frequent anthelmintic treatments, so risk of developing anthelmintic resistance is low.

5. Most stock kept are of indigenous, worm-resistant breeds.

Control Methods That May Be Useful

- **Frequent observation of individual animals and treating only clinical cases.**
- **Since rates of infection are seasonal, treatments can be targeted at times of year when there are peaks of infection.**
- **Since periods of poor grazing and nutritional stress are seasonal, treatments can be timed to alleviate chronic infections.**
- **At certain times of year a large part of the overall worm population is present as inhibited larvae. By correctly applying an effective drug at this time, infection rates can be reduced for the ensuing dry season. (treatment against inhibited worms).**
- **Keeping local breeds of animals rather than exotics can lead to higher production at lower treatment costs (Genetic Resistance).**
- **Specific treatments to control Toxocara may need to be carried out where this is a persistent problem.**

Semi-arid Zone, Large Scale Ranches

Figure

Typical Problems In This Area

1. Due to the uneven distribution of rainfall during the year, there are times when grazing is in short supply and animals suffer from nutritional stress.

2. Worm burdens often build up slowly and coupled with poor feeding lead to a chronic condition.

3. Trichostrongylus, Haemonchus and Oesophagostomum can all be present and contribute to a generalised parasitic gastroenteritis.

4. During the dry seasons invading larvae may enter a period of delayed development in the animal (see Inhibited worms).

5. Although overall stocking rates may be low, these can be locally high around watering points and bomas.

6. SEVERE RISK OF DEVELOPING AND DISSEMINATING ANTHELMINTIC RESISTANCE.

Features Of The Area That Can Help In Control

1. Transmission is seasonal and a significant portion of the year is too dry for worm larvae to survive on pasture.

2. When inhibited worms are present, drug treatments can be efficiently targeted at these.

3. Overall stocking rates are low.

4. Presence of infrastructure can permit managed lambing and grazing management.

Control Methods That May Be Useful

- **Frequent observation of individual animals and treating only clinical cases.**
- **Seasonal, treatments can be targeted at:**

  times of peak infection.
  inhibited worms.
  chronic infections.

- **Crossing local breeds of animals rather than keeping pure-bred exotics can lead to sustainable production at lower treatment costs (Genetic Resistance).**
- **A Dose & Move system where all animals in the flock/herd are treated and moved onto clean ground.**
- **Regular movement of bomas can prevent local build up of infection on pasture (Boma Rotation).**
- **Use of narrow spectrum drugs can reduce the reliance on broad spectrum anthelmintics and slow the development of anthelmintic resistance**

Arid Zone, Pastoralist Producers

Figure

Typical Problems In This Area

1. Due to the uneven distribution of rainfall during the year, there are times when grazing is in short supply and animals suffer from nutritional stress.

2. Although overall stocking rates may be low, these can be locally high around watering points and bomas.

3. Coenuriasis and hydatid are common.

4. Worm burdens often build up slowly and coupled with poor feeding lead to a chronic condition.

Features Of The Area That Can Help In Control

1. Transmission is seasonal and a significant portion of the year is too dry for worm larvae to survive on pasture.

2. When inhibited worms are present, drug treatments can be efficiently targeted at these.

3. Overall stocking rates are very low.

4. Larvae do not survive long.

5. Most stock kept are of indigenous, worm-resistant breeds.

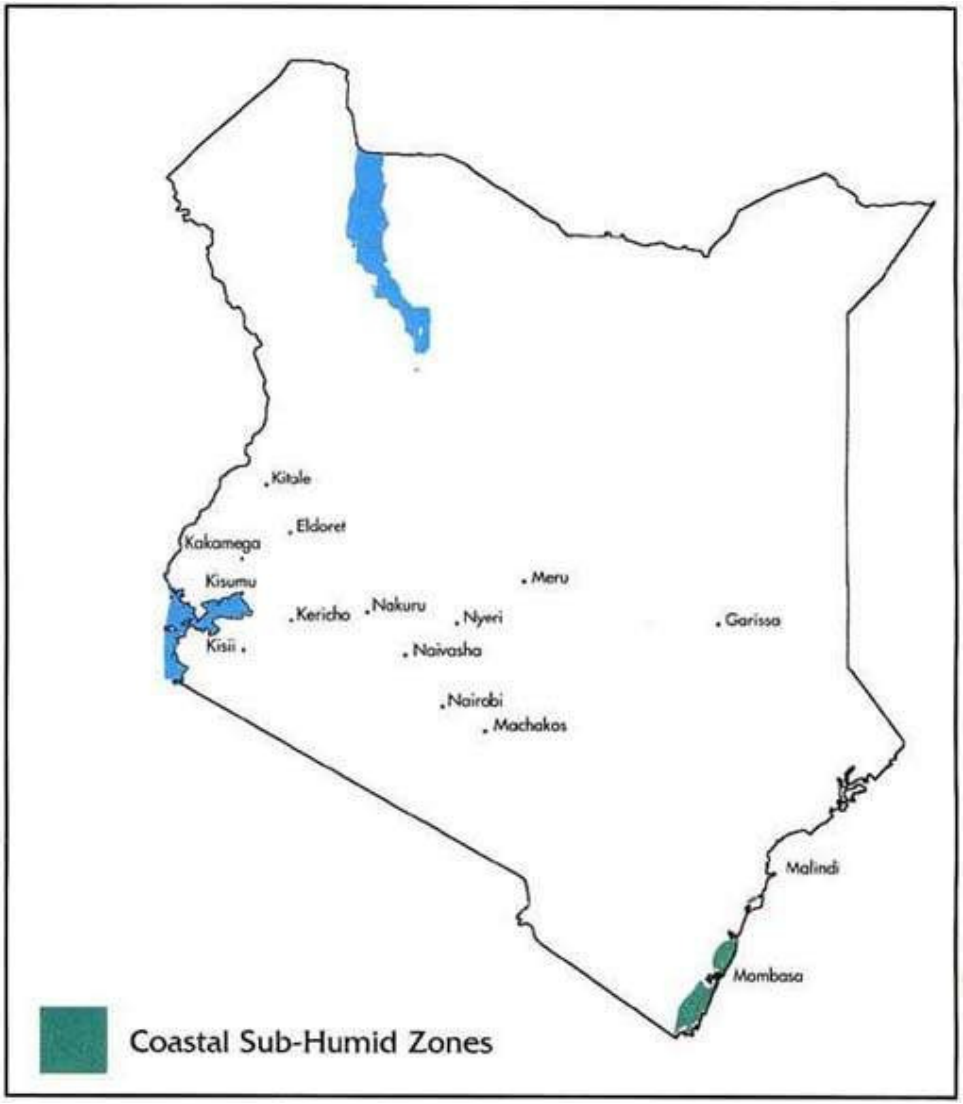
Control Methods That May Be Useful

- **Frequent observation of individual animals and treating only clinical cases.**
- **Seasonal, treatments can be targeted at:**

  times of peak infection.
  inhibited worms.
  chronic infections.

- **Keeping local breeds of animals rather than exotics can lead to higher production at lower treatment costs (Genetic Resistance).**

Coastal Sub-humid Zone



Figure

Typical Problems In This Area

1. The weather conditions are suitable for transmission of stomach and intestinal worms throughout the year, so worm numbers can be high.

2. Because of the high temperature and humidity, worm eggs develop to the infectious stages very quickly, so problems can build up rapidly.

3. There are high rates of Haemonchus, Trichostrongylus and Oesophagostomum.

4. Sites for transmission of liver fluke are common.

5. Both clinical and chronic worm infections are made worse by the presence of trypanosomiasis. Care is needed in deciding a cause for anaemia.

6. Mixed infections of fluke, roundworms and trypanosomes can occur.

7. SEVERE RISK OF ANTHELMINTIC RESISTANCE.

Features Of The Area That Can Help In Control

1. Due to the high temperatures, larvae do not survive very long on pasture.

2. If ground is kept completely free of animals for a period of four weeks it will be clean.

3. The presence of palm trees can help in providing evenly spaced tethering points for use in a rotational grazing system

Control Methods That May Be Useful

- **Frequent observation of individual animals and treating only clinical cases.**
- **Rapid Rotation around a series of paddocks or tethering points.**
- **A Dose & Move system where all animals in the flock/herd are treated and moved onto clean ground.**

- **Medicated feed blocks can be made with locally available ingredients and provided to the animals overnight in the boma.**

- **Keeping local breeds of animals rather than exotics can lead to higher production at lower treatment costs (Genetic Resistance).**

- **GUIDELINES FOR USE OF ANTHELMINTICS SHOULD BE CAREFULLY FOLLOWED TO SLOW THE DEVELOPMENT OF ANTHELMINTIC RESISTANCE.**

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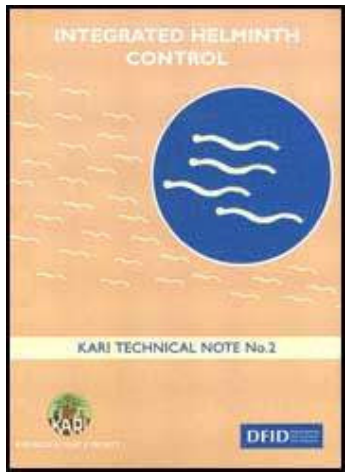

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PART THREE - Guidelines For Anthelmintic Use

GUIDELINES FOR ANTHELMINTIC USE

- **To minimise the risk of anthelmintic resistance, the frequency of drug use should be reduced as much as possible. As a rough guide, no more than four doses of**

anthelmintic should be given to any stock in one year.

- **Use drugs from different chemical groups in successive years**

- **The drug market in Kenya contains a number of fake and substandard products. Use only products made by a reputable manufacturer. Report any suspected drug efficacy problems to the local Veterinary Investigation Laboratory.**

- **Dose animals on the basis of the heaviest animal in the group. Farmers have a tendency to underestimate animal weights and hence often under dose the animals.**

- **Most anthelmintics given orally are more effective if given on an empty stomach. Animals are best dosed early in the morning before they are released for grazing. Animals that are not normally kept in a boma over night should have their feed restricted prior to treatment.**

- **Oral dosing should aim to place the drug into the animal's throat rather than into the mouth. This ensures proper uptake into the rumen.**

- **Dosing equipment should be accurate and properly maintained.**

- **Anthelmintics should not be combined with other drugs or diluted.**

- **Bottles of anthelmintic should be properly mixed prior to use. Repeated slow inversion of the bottle is better than vigorous shaking.**

- **Care should be taken in introducing animals to the flock/herd. They may be bringing resistant worms with them. Only buy animals from farms who practice a minimal dosing regime. Try to get a history of anthelmintic use. On arrival treat the animals with ivermectin (if possible) or with one dose of levamisole and one dose of benzimidazole. If possible keep the new animals separate from the herd/flock for 48 hours after treatment and discard and burn any manure produced during that time.**

Sheep And Goat Wormer Guide

Group 1: Benzimidazole Drugs.

Chemical	Product Name	Round worms	Tape worms	Flukes	Nasal Bots	Dose Rate
Albendazole	Tramazole	YES	YES	AT 7.5 MG/K		5 mg/kg
	Valbazen 10%	YES	YES	AT 7.5 MG/K		5 mg/kg
	Valbazen 2.5%	YES	YES	AT 7.5 MG/K		5 mg/kg
	Vermiprazole	YES	YES	AT 7.5 MG/K		5 mg/kg
	Vermitan	YES	YES	AT 7.5 MG/K		5 mg/kg
	Wormita	YES	YES	AT 7.5 MG/K		5 mg/kg
Fenbendazole	Curazole	YES	YES			5 mg/kg
	Panacur 10%	YES	YES			5 mg/kg
	Panacur 2.5%	YES	YES			5 mg/kg
	Zerofen 10%	YES	YES			5 mg/kg
	Zerofen 2.5%	YES	YES			5 mg/kg
Oxfendazole	Systamex	YES	YES			5 mg/kg

Group 2: Levamisole Drugs.

Chemical	Product Name	Round worms	Tape worms	Flukes	Nasal Bots	Dose Rate
Levamisole plus Rafoxanide	Flukazole	YES		YES	YES	7.5 mg/kg
Levamisole	Levacide	YES				7.5 mg/kg
Levamisole	Levacide injection	YES				7.5 mg/kg
Levamisole plus	Levafas	YES		YES		7.5 mg/kg

Levamisole plus Oxyclozanide	Levafas	YES		YES		7.5 mg/kg
Levamisole plus Oxyclozanide	Levafas Diamond	YES		YES		7.5 mg/kg
Levamisole plus Rafoxanide	Multidose	YES		YES	YES	7.5 mg/kg
Levamisole	Nilverm	YES				7.5 mg/kg
Levamisole plus Oxyclozanide	Nilzan Plus	YES		YES		7.5 mg/kg
Levamisole plus Oxyclozanide	Vermofas	YES		YES		7.5 mg/kg
Levamisole	Wormicid	YES				7.5 mg/kg
Levamisole plus Bithionol	Wormicid Plus	YES		YES		7.5 mg/kg

Group 3: Macrocyclic Lactone Drugs.

Chemical	Product Name	Round worms	Tape worms	Flukes	Nasal Bots	Dose Rate
Ivermectin	Ivomec	YES			YES	0.2 mg/kg
Ivermectin	Oramec	YES			YES	0.2 mg/kg
Ivermectin plus Clorsulon	Ivomec Super	YES		YES	YES	0.2 mg/kg
Moxidectin	Cydectin	YES			YES	0.2 mg/kg
Doramectin	Dectomax	YES			YES	0.2 mg/kg

Group 4: Other Drugs.

Chemical	Product Name	Round worms	Tape worms	Flukes	Nasal Bots	Dose Rate
Nitroxynil	Trodax	Haemonchus only		YES	AT 20 mg/kg	10 mg/kg

Rafoxanide	Ranox	Haemonchus only		YES	YES	7.5 mg/kg
Oxyclozanide	Zanil			YES		

Cattle Wormer Guide

Group 1: Benzimidazole Drugs.

Chemical	Product Name	Round worms	Tape worms	Flukes	Nasal Bots	Dose Rate
Albendazole	Tramazole	YES	YES	AT 10 mg/kg		7.5 mg/kg
	Valbazen 10%	YES	YES	AT 10 mg/kg		7.5 mg/kg
	Vermiprazole	YES	YES	AT 10 mg/kg		7.5 mg/kg
	Vermitan	YES	YES	AT 10 mg/kg		7.5 mg/kg
	Wormita	YES	YES	AT 10 mg/kg		7.5 mg/kg
Fenbendazole	Curazole	YES	YES			7.5 mg/kg
	Panacur 10%	YES	YES			7.5 mg/kg
	Zerofen 10%	YES	YES			7.5 mg/kg
Oxfendazole	Systamex	YES	YES			7.5 mg/kg

Group 2: Levamisole Drugs.

Chemical	Product Name	Round worms	Tape worms	Flukes	Nasal Bots	Dose Rate
Levamisole plus Rafoxanide	Flukazole	YES		YES	YES	7.5 mg/kg
Levamisole	Levacide	YES				7.5 mg/kg
Levamisole	Levacide Injection	YES				7.5 mg/kg
Levamisole plus	Levafas	YES		YES		7.5 mg/kg

Levamisole plus Oxyclozanide	Levafas	YES		YES		7.5 mg/kg
Levamisole plus Oxyclozanide	Levafas Diamond	YES		YES		7.5 mg/kg
Levamisole plus Rafoxanide	Multidose	YES		YES	YES	7.5 mg/kg
Levamisole	Nilverm	YES				7.5 mg/kg
Levamisole plus Oxyclozanide	Nilzan Plus	YES		YES		7.5 mg/kg
Levamisole plus Oxyclozanide	Vermofas	YES		YES		7.5 mg/kg
Levamisole	Wormicid	YES				7.5 mg/kg
Levamisole plus Bithionol	Wormicid Plus	YES		YES		7.5 mg/kg

Group 3: Macrocyclic Lactone Drugs.

Chemical	Product Name	Round worms	Tape worms	Flukes	Nasal Bots	Dose Rate
Ivermectin	Ivomec	YES			YES	0.2 mg/kg
Ivermectin	Oramec	YES			YES	0.2 mg/kg
Ivermectin plus Clorsulon	Ivomec Super	YES		YES	YES	0.2 mg/kg
Moxidectin	Cydectin	YES			YES	0.2 mg/kg
Doramectin	Dectomax	YES			YES	0.2 mg/kg

Group 4: Other Drugs.

Chemical	Product Name	Round worms	Tape worms	Flukes	Nasal Bots	Dose Rate
Nitroxynil	Trodax	Haemonchus only		YES	AT 20 mg/kg	10 mg/kg

Rafoxanide	Ranox	Haemonchus only		YES	YES	7.5 mg/kg
Oxyclozanide	Zanil			YES		

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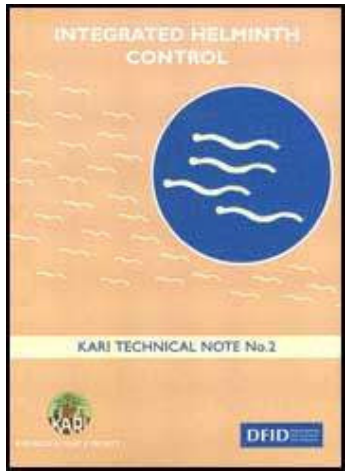

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- **PART FOUR - The Strategies**
  - **Treating only clinical cases**
  - **Anaemia Diagnosis**
  - **Seasonal Anthelmintic Use**
  - **Rapid Rotation**
  - **Dose & Move**
  - **Medicated Feed Blocks**
  - **Toxocara Treatment**
  - **Use of narrow spectrum drugs**
  - **Alternate Grazing**
  - **Boma Rotation**
  - **Use of genetic resistance**
  - **Mixed use of broad and narrow spectrum drugs**
  - **Cropping Rotation**
  - **Seasonal Fluke Treatment**

Integrated Helminth Control - KARI technical note no. 2 (DFID - KARI, 1999, 54 p.)

PART FOUR - The Strategies

Treating only clinical cases

Dose only the animals in the flock/herd that appear to be clinically affected. These animals will be acting as a source of infection for the rest of the group. Follow the guidelines for anthelmintic use. Early diagnosis of clinical signs and good farmer awareness are required for successful use of this strategy.

This strategy is based on two principles:

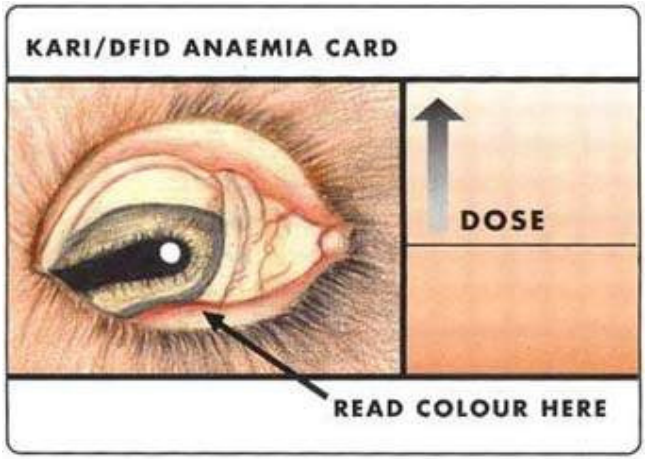
1 In some farms, subclinical production losses are unavoidable and/or not significant to the farmers income perception. In these cases, the cost of routine drug treatment may outweigh the benefits that the farmer will achieve from their use. It is therefore better for the farmer to invest in treating only the animals which will benefit most from treatment. (It may also be found that particular animals are requiring treatment more often, in which case it may be more economical to slaughter these individuals).

2 Where long periods of the year offer good conditions for larval development, treating the whole flock/herd whenever a few clinical cases appear will lead to the rapid development of anthelmintic resistance. Treating only the clinical cases reduces the proportion of the worm population that is exposed to drug selection pressure, slows the development of resistance and ensures that effective drugs are available for the future.

Clinical treatment against fluke may be effective in chronic conditions, however acute fluke can be caused by infection with large numbers of young flukes. Most of the readily available flukicides on the market will not be effective against immature flukes and may not have the desired effect when used on acute cases. Triclabendazole should be used in such circumstances.

Anaemia Diagnosis

Diagnosis of fluke and Haemonchus infection in sheep and goats is aided by proper identification of signs of anaemia. Observing the eye as described in the diagram, and comparing the colour with the eye card will help identify the animals in a flock that will benefit from treatment.



Figure

KARI/DFID ANAEMIA CARD

For more information refer to the KARI/DFID Manual of Integrated Helminth Control.

This card is designed to help in the diagnosis of liver fluke and haemonchosis in sheep. In certain areas other diseases may cause anaemia.

1. Open the eyelid by pushing gently down on the upper eyelid with one thumb while the other thumb gently pulls the lower eyelid downwards.

2. Look closely at the colour inside the lower eyelid and compare it with the colours on the chart.

3. If the colour is similar to any of those above the black line, the animal should be treated with a suitable anthelmintic.

Produced by the KARI/DFID NARP II Project, c/o KARI, Box 57811, Nairobi, Kenya.

Seasonal Anthelmintic Use

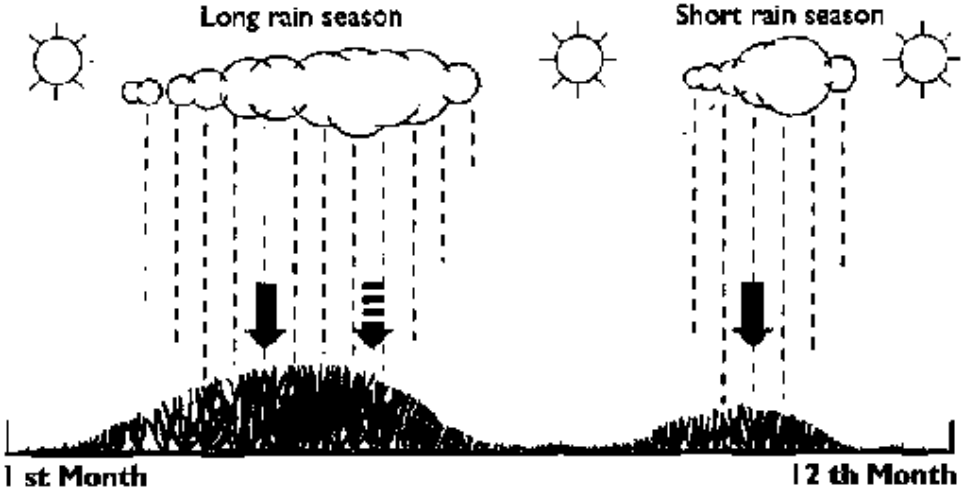
Since levels of worm infection are related to the climate and seasons, it is possible to treat animals at particular times of the year or in response to weather patterns. Three main strategies are possible:

1 Treatment at times of peak infection

The purpose here is to treat all animals in the flock/herd at the time of year when it can be predicted that infection levels will be at their highest or just before this when animals are under their greatest challenge. Greatest challenge is usually a few weeks after the onset of the rains.

While there are drawbacks to such a strategy in areas or seasons where there is prolonged rain, this scheme might be particularly suitable in more arid regions where rains are brief and larvae on pasture do not survive long after the rains stop.

Such a treatment may prevent the onset of clinical signs but may not prevent production losses or the build up of pasture infection levels for later seasons.

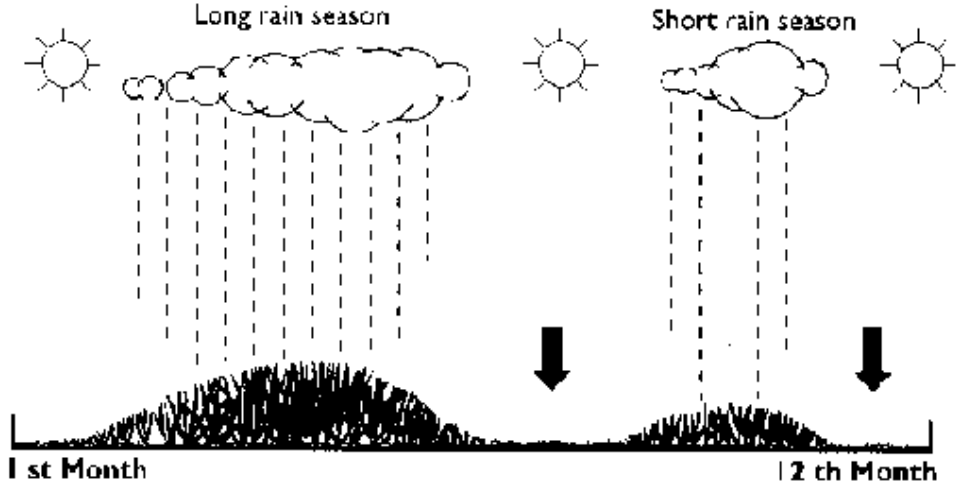


TREATMENT AT TIMES OF PEAK INFECTIONS

In practice, peak infection levels will commonly occur about 4-6 weeks after the onset of the rains and hence treatments at about 3-4 weeks into the rains may prove effective. If the rains prove to be prolonged or where grazing is a shared resource, a second treatment may be required 4-6 weeks later. The use of rafoxanide or closantel at this time in areas where combined fluke and Haemonchus infections are common may prove beneficial.

2 Treatment to alleviate chronic Infections

Infection with low numbers of Haemonchus at times of poor nutrition can lead to a chronic syndrome which can be difficult to diagnose. Animals respond well to an improvement in nutrition and/or treatment with an anthelmintic.

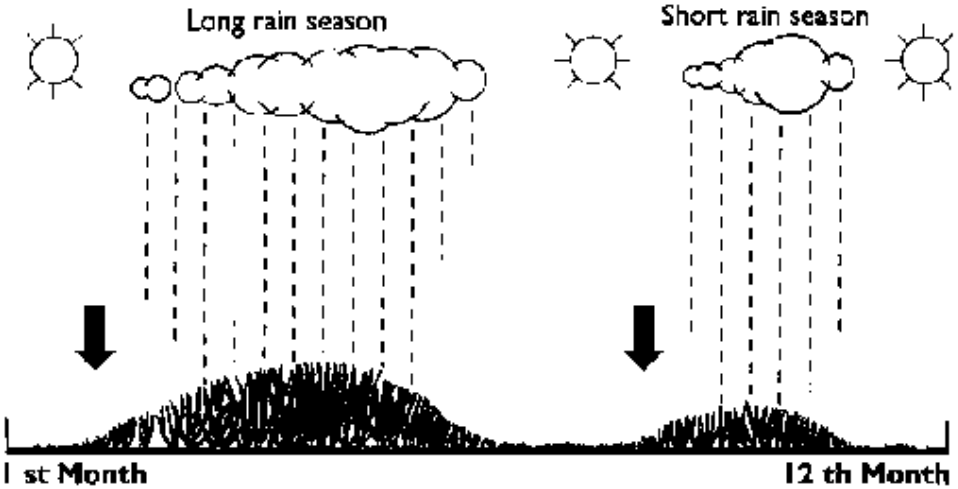


TREATMENT TO ALLEVIATE CHRONIC INFECTIONS

Usually such a treatment is likely to be most beneficial during the long dry season or in periods of drought. The earlier in the dry season that treatments are provided the less that body condition will have deteriorated and the greater the animal's chance of surviving through to the next rains. Treatment should not be before the pasture has started to brown off or else the animals may become reinfected after treatment.

3 Treatment against inhibited worms

Haemonchus larvae can enter a period of arrested development within the host in order to delay adulthood and egg laying until conditions are more suitable for transmission. There are two likely stimuli for this delay in development: the onset of host immunity and exposure of the infective larvae to increasingly arid conditions on pasture. In the first case, larvae will not develop further until there is a relaxation in immunity such as may occur during periods of nutritional stress, intercurrent infection or in late pregnancy. In the latter case, the stimuli for the larvae to recommence development are unknown but it is thought that this may occur randomly through the dry season, ensuring that the host always has a low but egg-producing worm burden.



TREATMENT AGAINST INHIBITED WORMS

The purpose of treating animals to eliminate the burden of inhibited larvae that they are carrying is to prevent them recontaminating pasture when conditions become more suitable for larval development. Thus female sheep or goats, treated in mid pregnancy may have a lower egg count through lambing and contribute less to infecting their offspring. Also by treating animals in the arid lands in the middle of the dry season, there should be fewer worms to contaminate grazing during the rains.

Rapid Rotation

In areas of high temperature and humidity, helminth eggs hatch very quickly and can develop into infective larvae in a short period, however they also expend their energy reserves quickly and cannot survive as long on pasture as they might in cooler or drier areas. This feature can be exploited by moving animals round a number of grazing areas ensuring that they have left an area before the eggs have developed into infective larvae and that the animals do not return to that area until all the larvae have died.

In practice it is best for animals to be moved every three and a half days, say Monday morning and Thursday lunch-time. They are rotated round eight to ten areas before they

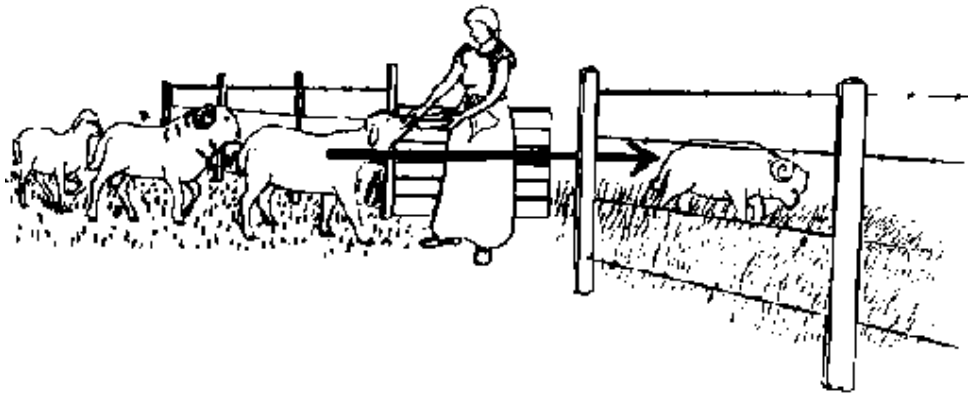
return to the original area.

It is very important that the rotation discipline is maintained since the whole system relies on animals not returning to any area before the month is finished. Also animals must move as planned or they will begin to be infected if they spend any longer on the initial area.

This system lends itself to places where the grazing area is controlled by one livestock owner and is particularly suitable for use in tethered grazing systems. It is unlikely to prove practical in communal grazing systems.

Dose & Move

The principle of this system is to always move "clean" animals onto "clean" ground;



DOSE AND MOVE PROCEDURE

Animals are treated with an effective anthelmintic and moved onto grazing that has not been used by livestock for a suitable period. (The length of time that the area should have been free of stock will vary from area to area, perhaps six weeks at the coast to six months in the Highland areas).

Medicated Feed Blocks

Medicated feed blocks are high energy feed and mineral supplement blocks incorporating an anthelmintic. Animals can have access to these blocks at night in the boma and effectively worm themselves. The continued ingestion of low levels of anthelmintic can help to overcome anthelmintic resistance and the additional mineral, protein and energy supplement can be very beneficial to animals during times of nutritional stress. Problems may be encountered with particular animals that do not take to the blocks, but in most cases animals will learn very quickly by watching others. Blocks are not currently commercially available in Kenya, however the technology required to make them and the ingredients are all readily available:

2 volumes molasses
1 volume urea (fertiliser grade)
1 volume cement
½ volume common salt
½ volume mineral premix
2 volumes maize germ (or other suitable bulking product)
1 × 100 kg cow dose of a benzimidazole anthelmintic per kg of ingredients
1 volume water

The technique is essentially that of making concrete blocks. Thoroughly mix half the water with the urea until the urea granules dissolve. Mix in the anthelmintic then the cement and most of the remaining water. Add the molasses, the salt and mineral premix and the remaining water. Finally add the maize germ or other bulking agent. It is important that the ingredients are mixed well before the addition of each additional ingredient. After all the ingredients are well mixed, pour the mix into moulds (buckets, basins, pots or wooden frames). Stand the moulds in the sun for 3-4 hours then turn the blocks out of the moulds and allow them to dry for a further week before use.

Blocks should be placed in the boma protected from rainfall.

Caution: If animals (especially sheep) consume too much of the block at once they can suffer from urea poisoning. It is important that blocks are introduced gradually and that the consistency is not too

soft otherwise an animal may eat too much. Since ingredient quality can vary greatly the above recipe can only act as a rough guideline.

Toxocara Treatment

Where toxocarosis is a problem in young calves, calves should be treated with piperazine at 6 weeks of age.

Use of narrow spectrum drugs

When haemonchosis is present or a chronic condition of haemonchosis and fasciolosis, animals can be treated with a salicylanilide drug such as rafoxanide or closantel. These drugs have the added benefit of treating the animals for nasal bots.

Use of a narrow spectrum drug rather than a combined fluke and worm drench helps reduce the usage of the broad spectrum wormers and slow the onset of anthelmintic resistance.

Alternate Grazing

By using a "leader and follower" system, the cleanest pasture can be retained for the more susceptible animals and the more contaminated pasture can be grazed by the most resistant stock. These latter animals may also help clean the pasture of infectious larvae.

The "leaders" in the system are normally the younger animals and the followers the older animals. The system can also utilise differences in breed or species susceptibility, with small ruminants grazing ahead of cattle or more resistant genotypes such as red maasai sheep grazing behind more susceptible types.

Boma Rotation

Bomas often become sources of infection with high numbers of infectious larvae in the surrounding herbage and in the pasture immediately adjacent to the boma. The frequent

movement of bomas can reduce the rate of reinfection from such areas. Normally bomas should not return to the original position within one year. The more often bomas can be moved the better. Such a practice can also lead to a reduction in cases of pneumonias. While the use of more mobile (and hence less robust) bomas may lead to an increase in the numbers of animals lost to predators, the benefits in terms of animal health can often overcome any such losses.

Use of genetic resistance

It has been shown that some breeds of animal are less susceptible to worms than others. Thus indigenous fat-tailed sheep are often more resistant than exotic types. Where losses to helminths are difficult (or expensive) to control, the use of these animals can minimise the need for other control strategies. Using indigenous fat-tailed rams for crossing into an existing flock can produce not only an improved resistance to worms but also introduce the benefits of hybrid vigour and increased hardiness to other conditions.

Mixed use of broad and narrow spectrum drugs

In order to minimise dependence on the broad spectrum wormers, the use of salicylanilide products at particular times of year can eliminate fluke and Haemonchus burdens and (in the case of closantel) provide a period of protection against reinfection. At other times of year a normal broad spectrum drug should be used to prevent a build up of other worm species such as Oesophagostomum.

In practice, salicylanilides are perhaps best used at the start of the rains with a broad spectrum drug used at other times.

Rafoxanide (Ranide or Ranox) and Closantel (Flukiver) can be difficult to obtain in Kenya but can be more frequently found in combination (rafoxanide with levamisole as Flukazole or Multidose).

Cropping Rotation

The rotation of cropping areas and grazing areas can be used to prevent pasture larval burdens becoming excessive.

Seasonal Fluke Treatment

The purpose of seasonal treatments against fluke is twofold: firstly to remove burdens of flukes in the livestock and secondly to reduce the contamination rate amongst snails.

Treatments should therefore be at times of peak infection and during periods when snails are not active (during droughts or floods).

FAO guidelines suggest that for the Kenya Highlands, treatments should be in February, June and October.

Seasonal treatment is unlikely to be successful in preventing infection unless both the grazing and the watercourse are under the farmer's control or if all the farmers sharing these resources act together.

NOTES

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KARI/DFID NARP II Project
c/o KARI, Box 57811, Nairobi, Kenya

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