Internal parasites are a major health problem in small ruminants. Sheep and goats are more susceptible to internal parasites than other livestock, in view of their grazing behavior and poor immunity. In the past, producers relied heavily on anti-parasitic drugs, called "anthelmintics" to control internal parasites. Unfortunately, parasites have become increasingly resistant to many of the anthelmintics. As a result, producers can no longer rely on anthelmintics alone to control parasites in their flocks. A more integrated approach is warranted to control the parasites of sheep and goats.

Sheep and goats are very susceptible to worms due to their close grazing behavior and slow-to-develop immunity. Goats are more susceptible than sheep when forced to graze (versus browse). All sheep and goats have worms. The parasites that cause the most damage to sheep and goats are stomach worms and coccidia. Stomach worms can cause substantial death loss in sheep and goats, if left unchecked. The barber pole worm (*Haemonchus contortus*) is the stomach worm of primary concern. It is a microscopic, blood-sucking parasite that pierces the lining of the abomasum (the ruminant's "true" stomach) and causes blood and protein loss and anemia, as evidenced by pale mucous membranes (lower eye lid, gums, etc.) and/or "bottle jaw," an accumulation of fluid under the jaw. The barber pole worm is difficult to control because it has a short direct life cycle and a prolific egg producer. Other worms that are common in Namakkal district include *Trichostrongylus colubriformis* and *Oesophagostomum columbianum*. In Kolli hills, *Nematodirrus* is prevalent. These worms also cause digestive upsets and diarrhoea in livestock. Internal parasites of lesser concern in Namakkal district are tapeworms. Tapeworms are generally non-pathogenic, though they can cause weight loss and death in extreme cases. Tapeworms can be controlled by administering praziquantel or niclosamide. In Namakkal district, the prevalence of lungworms and flukes are uncommon.
Worm control starts with good management, with a healthy dose of common sense. Good sanitation will go a long way in controlling parasites, especially coccidia. Feed should not be fed on the ground. Feeders that minimize waste and contamination should be used. Water should always be clean and free from fecal matter. Pens and pastures should not be overstocked. All new arrivals to the farm should be isolated for at least 30 days and dewormed. The use of clean or safe pastures will help to control parasite problems. A clean or safe pasture is one in which sheep or goats have not grazed for 6 to 12 months. A pasture grazed by cattle and/or horses is also considered safe, since sheep/goats and cattle/horses do not share the same parasites. Pastures that have been renovated or rotated with row crops are clean, as are pastures in which a hay or silage crop has been removed.

Rotational grazing generally does not help to control internal parasites unless pasture rest periods are long enough (> 70 days). In fact, management intensive grazing (short duration, high intensity grazing) may exacerbate parasite problems in goats. Goats that browse have fewer parasite problems. Sheep and goats on a higher plane of nutrition and/or with a higher body condition score are better able to withstand parasite challenges. Nutrition in early pregnancy increase fat stores and has been shown to increase the immune response to parasites. Ewes receiving increased protein levels during late gestation are better able to mount an immune response to parasites. Since worms need grass to develop, sheep and goats raised in confinement have fewer parasite (stomach worm) problems and those put in confinement are less likely to get re-infected.

**Anthelmintics**

There are three families of drugs which are used to treat internal parasites in livestock include

1. Benzimidazoles - Fenbendazole, Albendazole, Oxybendazole, Thiabendazole
2. Nicotinics - Levamisole, Pyrantel, Moratel
3. Macrolytic Lactones - Ivermectin, Doramectin, Moxidectin
The Benzimidazoles, also called "white dewormers" are broad spectrum and safe to use. They are effective against roundworms and also tapeworms. Albendazole is effective against adult liver flukes, but should not be used in pregnant or lactating females.

Levamisole (Tramisol®), also called a "clear dewormer" is broad spectrum and effective against arrested larvae. However, it has a narrower margin of safety, especially in the injectable form. Pyrantel and Morantel are effective against adult worms.

The Macrolytic lactones or "avermectins" (Ivomec®, Dectomax®, Quest®, Cydectin®) are the newest family of drugs. They are broad spectrum and have a wide margin of safety. They are also effective against external (biting) parasites, including nose bots. Moxidectin is a persistent-activity dewormer that is more effective than treatment with Ivermectin at 4 week intervals.

**Anthelmintic use**

Anthelmintics should not be used indiscriminately. Frequent deworming is costly. It accelerates the development of anthelmintic-resistant worms and leads to a false sense of security, which may result in unnecessary production losses and animal deaths. Strategic deworming will help to control parasite burdens in the animals and on pastures. The most important time to deworm a sheep or goat is prior to lambing/kidding (2-4 weeks prior). This will help to prevent the "periparturient rise" in worm eggs that generally occurs around lambing/kidding time. It will also reduce the number of eggs that the ewe/does sheds into her environment that could potentially infect her newborn lambs/kids. Other strategic times to treat with anthelmintics is prior to moving animals to a safe or "cleaner" pasture, at the start of the grazing season when the grass first starts to green up, in the mid-summer when worm larvae numbers are typically the highest, and in the fall after the first frost.

Anthelmintic treatments should be targeted to the most susceptible animals in the herd. This would include lambs/kids, lactating ewes/does, and high producers. Leaving some animals untreated will help to slow anthelmintics resistance. It is important to maximize the effect of a single treatment. Underdosing is a leading cause of anthelmintic resistance.
Animals should not be underdosed. Ideally, animals should be weighed or measured with a tape to determine the proper dosage. When deworming a group of animals, the dose should be set for the heaviest animals in the group, not the average. Anthelmintics should be administered orally, over the tongue of the animal. Research has shown that benzimidazoles are more effective when the animals are fasted 12 to 24 hours before treatment or when two treatments are given 12 hours apart. Goats metabolize anthelmintics differently (it clears their system faster) than sheep and cattle and require higher doses.

**Anthelmintic resistance**

Anthelmintic resistance means, that the drug no longer works because the worms have developed a tolerance or resistance to it. Anthelmintic resistance is determined by a fecal egg count reduction test (FECRT). Animals are weighed and treated with the anthelmintics and fecal egg counts are conducted at the time of treatment and 7 to 14 days after treatment. If the anthelmintic kills 90 percent or more of the worm eggs, it is considered to be effective. If it kills 60 to 90 percent of worm eggs, it is considered to have a moderate level of resistance. Anthelmintics killing less than 60 percent of worm eggs are considered to have severe resistance. Resistance to anthelmintics in the benzimidazoles is considered to be widespread in India including Tamil Nadu and also in Namakkal. Resistance to levamisole is also prevalent although to the extent as benzimidazoles. Ivermectin and Moxidectin are considered to be effective dewormers.

Anthelmintics resistance can be prevented by not introducing animals infected with anthelmintic resistant population of gastrointestinal nematodes. New arrivals should be isolated and dewormed with products from at least two families of drugs. Care should be taken not to underdose animals. Combinations of products may slow down resistance. Anthelmintics should be rotated annually or a product should be used until it is no longer working. Leaving some animals untreated and focusing treatments on susceptible animals will slow down resistance.

**Two tools for integrated parasite management**
There are two tools that producers can use to more effectively control internal parasites: fecal egg counting and FAMACHA®. Fecal egg counts can be used to determine the level of pasture contamination and the need for anthelmintic treatment. FAMACHA® is a system whereby you examine the lower eyelid of the sheep and administer treatment only if signs of anemia are present.

FAMACHA® is a technique developed in South Africa in which a colour eye chart depicting varying degrees of anemia is used to determine the need for anthelmintic treatment. It was developed as a tool for anthelmintics resistance management and integrated parasite management. It only works for *Haemonchus contortus*. It was developed for sheep, but should work with goats with slight modifications. The FAMACHA® technique reduces the number of treatments because only animals showing physical signs of infection are dewormed. It identifies worm susceptible animals for culling and slows anthelmintics resistance, as worms have less exposure to the drugs.

Coccidiosis is a serious managemental disease in small ruminants below 6 months of age and morbidity in higher age groups. Coccidia damage the host's intestinal epithelial cells, making them more susceptible to bacterial invasion and allowing increased flow of tissue fluid into the intestinal lumen. Watery diarrhoea, which may be bloody in cattle is the major sign of infection and usually occurs about 2 weeks after ingestion of oocysts. It causes severe enteritis and diarrhoea. Coccidia are species-specific, meaning the coccidia species that affect sheep and goats are different from those that affect poultry and rabbits. The disease in sheep and goat is chiefly confined to young animals up to 6 months of age and the infection is of mixed type. In sheep and goats young animals of < 6 months age are the main victims of coccidiosis. *Eimeria ovina, E. ovinoidalis, E. ahsata, E. crandallis, E. intricata* are prevalent in sheep while *E. arlongi, E. intricata, E. parva* and *E. ninakoyakimovae* were reported to occur in goats in Namakkal district. However, good stock management and avoidance of stress can considerably reduce the risk of clinical disease due to coccidiosis. Adequate nutrition, good hygiene practices, reasonable sock density and prevention of other diseases are important. Coccidiostats may be used prophylactically during the anticipated period of risk or to treat clinical cases. Coccidia cause weight loss and ill health in lambs/kids and
diarrhea, which may be streaked with blood or mucous. Affected lambs/kids may become weak and dehydrated and die. Whereas stomach worms are more of a problem with sheep and goats on pasture, coccidia are more of a problem in sheep and goats that are in confinement or under intensive grazing systems. Outbreaks of coccidiosis are caused by poor sanitation, overcrowding (or overstocking), and stress. Consequently, coccidiosis can be controlled by good sanitation, clean water, not feeding on the ground, and not overstocking pens and pastures. Disease outbreaks can be prevented by administering Corid (Amprolium) in the water supply or by including a coccidiostat in the feed or mineral. Lasalocid and Deccox are used as coccidiostats for lambs. Monensin and Deccox are used to prevent coccidiosis in goats. Outbreaks of coccidiosis can be treated with sulfa drugs and Corid. Severely affected lambs and goats will require supportive therapy (e.g. fluids).

Sheep and goats may also get external parasites. The sheep tick is called a "ked" and it can substantially decrease pelt value. Sheep are more commonly infested with fleas. Goats are more likely to get mange mites and lice. Sheep and goats with "snotty" noses may have nose bots, a parasite that gets into the nasal passages. Ticks viz., *Haemaphysalis intermedia*, *Haemaphysalis bispinosa*, *Rhipicephalus haemaphysaloides* and *Hyalomma anatolicum* are encountered in sheep. These ectoparasites, in addition to causing blood loss leading to anaemia also transmit haemoprotozoan diseases. These various "biting" parasites can be controlled by administering an anthelmintic from the Macrolytic Lactone family or Avermectin family (e.g. Ivermectin, Moxidectin).

Haemoprotozoan diseases caused by vector-borne blood protista constitute a disease entity of considerable economic importance in the state. Theileriosis and anaplasmosis are important and are on the increase over the last decade. Theileriosis caused by *Theileria lestoquardi* and transmitted through the bites of *Hyalomma is* considered the most important blood protista in this region with higher incidence in age groups consistent with the general epidemiology of the diseases in tropical areas. Tetracycline has been used with great success in treating *Theileriosis* infected animals. Transmission involves the tick vector and hence elimination of the vector population becomes essential for the control of theileriosis. Anaplasmosis caused by *Anaplasma*
*marginale* is very common in sheep and goats in Namakkaldistrict. Its importance needs a mention since it is usually found either alone or in association with *Theileria*. Control strategies applicable to other haemoprotozoan parasite are also effective against anaplasmosis as well.