1. **DESCRIPTION**

**Summary of the TIP on fasciolosis and its control measures**

**A. Issues addressed by the TIP:**

Farmers & animal owners in some parts of the country have observed that their cattle are in poor condition, have diarrhoea, that their coats are ragged and dull, that they demonstrate low fertility and have long inter-calving intervals, have insufficient strength for draught and in some cases, their animals have died. Examination of livers at the slaughter house reveals that some are damaged and swollen. Cutting bile duct canals is like cutting sand and cirrhosis is seen in the livers. Bile ducts are enlarged, have a bad smell and sticky, dark yellowish coloured fluid within is accompanied by the presence of flat leaf-shaped worms with a length of between 3.5 and 7.5 cm. In general, the price of live cattle infected with Fasciola is less than for uninfected animals.

**B. Goals:**

According to studies conducted by the Department of Animal Health and Production with participation of the Department of Agricultural Extension, the Office of Animal Health and Production, Kandal province, and the Australian Centre for International Agricultural Research (ACIAR), the problems can be resolved. Technology in this TIP on fasciolosis is based on these studies. By using the TIP for fasciolosis spread of the disease will be halted, animals will regain health, fertility will be restored and animals will be sold for a better price.

**C. Methods:**

Education, training and extension programs on fasciolosis such as “school-on-air” have been used for farmers, animal owners and stakeholders. Programs covering epidemiology of the disease and mode of spread, impacts, costs and benefits for control and methods for fasciolosis control and its eradication have been developed and tested. The effective measures for fasciolosis control include biological measures, grazing management and drugs.

**D. Benefits for farmers, animal owners:**

The TIP on fasciolosis will assist farmers & animal owners to understand the impact of fasciolosis in terms of economic losses and the benefits obtained from control. In the regions where prevalence of fasciolosis is higher than 30 percent, cattle are affected thus,

- Weight: 41 kg lighter than non-infected cattle;
- Reproduction: 10 percent lower pregnancy rate than in non-infected females;
- Liver damage: 2.50 kg of damage to the liver;
- Draught: not enough strength for draught; and
- Product quality: lower in infected than in non-infected cattle.

Analysis of the cumulative cost of the three (3) major impacts of fasciolosis is estimated at 109.00 USD/head for castrated cattle and 80.00 USD/head for female. If fasciolosis control measures are implemented, farmers may expect a benefit which will amount to 76.00 USD/head.
Technical Suitability Criteria

Conditions required to exist in order that the TIP on fasciolosis will provide the outcomes expected:

- **Gender:** Women are eligible for involvement in implementation of the TIP on fasciolosis, and have a special role in implementation of biological control. Women collect cattle & buffalo dung and store it in a trench. This dung should be kept for a specific time before using it as fertilizer in the field. In addition, women as money controllers could make a decision to spend money preferentially for treatment of animals against fasciolosis.

- **Climate/water:** Fasciolosis occurs in wet areas where water lies continuously through rainy and dry seasons. Hot and dry weather could minimize the spread of the disease due to the fact that the intermediate host of Fasciola, the mollusc Lymnea, could not spread very far. Most of the molluscs and the Fasciola larvae (metacercariae) may die from desiccation.

- **Geography:** Implementation of the TIP on fasciolosis could be conducted in all parts of Cambodia where fasciolosis is present.

- **Labour requirement:** Men, women and boys aged from 16 year old can be involved in the implementation of the TIP.

- **Farmer/animal owner resources requirement:** Farmers/animal owners require funds to construct dung trench roof and fence. Trench size for dung storage is 7-9 m² for three cattle. Locally available construction materials should be used. In addition, around 50 000 riels is required for treatment of fasciolosis, 50 000 riels being the maximum cost of drugs for treatment of the disease.

- **Number of cattle per family:** The relevance of the TIP does not depend on the number of cattle in the family. The TIP can be implemented whatever the number.

Other recommendations

The use of combined methods for control of fasciolosis is more effective than the selection any single methods. Moreover, prompt implementation of control of fasciolosis by farmers & animal owners who live in the same region or village could reduce the spread of the disease and later, achieve eradication of fasciolosis effectively and sustainably.
2. **TECHNICAL GUIDELINES**

**Fasciolosis of Cattle and Buffaloes and its Control Measures**

Fasciolosis of cattle and buffaloes is caused by a trematode, family-Fasciolidea, genus-Fasciola. In Cambodia, the species *Fasciola gigantica* is found. Prevalence of fasciolosis in cattle and buffaloes is high in some parts of the provinces of Kandal, Prey Veng, Svay Rieng, Kampong Cham and Kampong Thom. Adult Fasciola live in bile ducts and gall bladders and young Fasciola locate in liver tissues. Effects of fasciolosis are seen in reduced weight gain, mortality, low and slow reproduction, liver damage, and lack of physical strength expressed as draught power.

2.1 **Morphology**

*Fasciola gigantica* is leaf shaped, grayish-brown in color, and is 3.5-7.5 cm in length. The shoulder and tail are parallel and are 0.65-1.2 cm in width.

![Fasciola gigantica](image)

2.2 **Life-cycle**

Adult Fasciola lives in the bile ducts and gall bladder of the liver and young fluke lives in the liver tissues. The eggs of Fasciola enter the duodenum with the bile and leave the host in the faeces. The rate of development and the hatching of *F. gigantica* eggs depends on the surrounding environment’s temperature, oxygen levels and humidity. At a temperature of 20-26 °C eggs hatch in about 10-12 days producing the first larval stage, the *miracidium*. At temperatures over 40 °C, eggs will die and in darkness, eggs develop well, though miracidia are not hatched out. A miracidium is about 0.15 mm in length, its head is covered with gland tissues for penetrating into the intermediate host snail and with cilia surrounding it is equipped for movement. In the outside environment, miracidia survive for 2-3 hours. In the event that miracidia do not penetrate into the intermediate host snail *Lymnea spp.,* they die. Following penetration, it casts off its ciliate covering and develops into the sporocysts, then rediae and cercariae. Development from miracidium to cercaria is 4-7 weeks. Cercariae leave the snail and within a few minutes to two hours the cercariae settle on blades of grass, water plants, rice stalks etc. just below water-level. Later, after casting off their tails, they secrete a covering from the cystogenous glands forming cysts at the surface of the water which sink to the bottom. The encysted cercaria is called a metacercaria which is now infective. Cattle and buffaloes became infected by ingesting grass, water plant, rice stalk, rice straw and etc. with metacercaria or swallow them in drinking water. In some cases, infection can occur from mother to the offspring via the placenta.
Following ingestion of the metacecariae into the intestine they become Fasciola larvae which migrate to liver through two routes:

- Larvae of Fasciola may migrate through the abdominal cavity and penetrate the liver capsule. They are later found moving through the liver parenchyma. Within three weeks, Fasciola larvae will reach the bile ducts;
- Excystation of larvae occurs in the duodenum through the bloodstream across the intestinal vein. They then proceed to the bile ducts of the liver. The development of larval Fasciola to adult Fasciola will take for 2.5-4 months. Fasciola may live for 3-5 years in an animal.
The snail intermediate host of Fasciola is called Lymnea. Dr. Suon Sothoeun conducted a research study on the snail intermediate in Cambodia, collecting snail samples and sending them to the Institute of Zoology in the Ukraine for morphological study and taxonomy. Results of the study indicated that the mollusc which is the intermediate host of Fasciola is genus Lymnea, species acuminata. This snail is commonly found in clear, slow flowing water, with a pH range from 5.8-9.0. The snail size is 2.5-3.0 cm. The mollusc Lymnea likes to float on the water surface. At four (4) months the snail starts to lay eggs. Each laying can produce 12-96 eggs which are hatched after two (2) weeks. The hatching percentage is up to 100 percent. During the dry season, Lymnea will bury itself in the mud and survive for some months. Lymnea is common in all kinds of ponds be they natural ponds, man-made ponds or canals, drainage ditches, rice field paddy and in fallow fields.

2.3 Symptoms
Clinical signs are not distinct and are similar to other diseases. In severe cases, the most characteristic signs are:

- Diarrhoea, characterised by dark brown faeces spotting the rump of the animal. The faeces have an offensive odour;
- Dry, unkempt and dull coat;
- Reduced weight gain, wasted physical condition;
- Oedema of mucous membranes and accompanying pale colour;
- Oedema may be seen in the jaw and chest areas;
- Panting & breathlessness; animal foundering and in some cases, death.

2.4 Pathology
Lymphatic nodes of the liver are swollen, bile ducts are enlarged containing a foul smelling, sticky, dark yellowish coloured fluid in the presence of the fluke, Fasciola. Cutting bile duct canals gives an impression of cutting through sand and cirrhosis is evident in the liver. In cases where few flukes are present, there are few changes in the liver. However, with severe and chronic infection, it is noted that the liver is swollen and haemorrhaging. Autopsy of such livers reveals immature flukes, the small, white, round and leaf-shaped larvae of Fasciola, sized between 0.3 and 1.1 cm. At the same time, adult flukes may be found.

2.5 Diagnosis
Diagnosis is obtained from clinical symptoms, disease epidemiology, faecal examination for Fasciola eggs and from examination of the liver. Diagnosis could be made by serological tests however these serum tests are not available in Cambodia. Liver examination is conducted to detect Fasciola and to record changes in the liver.

a. Sample collection
The hand should be wrapped in a thin, soft plastic bag (preferably lubricated with paraffin) to take about 100g faeces directly from the anus. If a plastic glove is used, after taking the faecal sample from an animal the plastic glove must be washed or rinsed with water to wash away any eggs of Fasciola that might stick to the glove. Cleaning the glove is to prevent contamination of samples and passing of infection from one animal to another. Use of a plastic bag is easy, cheap and comfortable. After taking the faecal sample the plastic bag is
sealed and marked for identification. If faeces cannot be collected from the anus, the upper part of a dung pad could be sampled, again 100g, if it was passed by the animal not more than 24 hours prior to sampling.

B. **Faecal sample preservation**

For faeces preservation for submission to the laboratory, faeces have to be stored at not more than 10 °C in an ice box.

C. **Sending faecal sample**

Faecal samples should be sent to the laboratory as soon as possible. The sample should be accompanied by a form containing the following information:

- Name of the animal owner
- Address (village, commune, district and province)
- Date collection of sample
- Animal species
- Age of animal
- Animal identification.

### 2.6 Control measures and eradication

The three (3) measures provided below could control and eradicate fasciolosis successfully and sustainably. These measures which have been implemented in Cambodia, are drawn from the results of the research study on epidemiology of fasciolosis; on animal husbandry management practices; their appropriateness to the situations of Cambodian farmers and the experiences of farmers. It is true that for the control and eradication of fasciolosis there are other methods which could be used. However, it is contended that they could not be used effectively and sustainably in Cambodia in comparison to these selected methods. The control measures and eradication recommendations are as follows:

- a. Biological control: collection and storage of cattle and buffalo faeces in a trench;
- b. Cattle/buffalo grazing management;
- c. Treatment/control: use of drugs and schedule for drug use.

### A. Biological control

Collection and storage of cattle and buffalo faeces in a trench reduces the spread of fasciolosis. Fasciola eggs leave the infected host or sick animal in the faeces. After storage for two months the Fasciola eggs will have succumbed to high temperatures prevailing in the trench. The trench should be located away from run-off water, above the water table and away from animal access.

**Size of trench**

- Length: 3.50 m
- Width: 2.50 m
- Depth: 1.50 m
Roof and fence for the trench:

The trench requires proper roof and fence to protect dung from rain and sun light which will cause it to lose value as a fertilizer. In addition, the trench should be fenced for human and animal safety and to prevent loss of dung. The roof is made of local materials.

Duration of dung storage

Dung is stored in the trench for two months before using it as a fertilizer. During this period, Fasciola eggs in the faeces will die at temperatures of around 60 °C in the dung mass.

B. CATTLE & BUFFALO GRASSING MANAGEMENT AND FEEDING

Grazing management

- Dry season rice area: cattle and buffalo may become infected in the dry season rice field by ingestion of metacercariae with water, grasses, water plants or rice stalks in drainage ditches or in rice fields. Infection occurs from January to April. Infection can be circumvented by grazing animals away from these areas in the January to April period.
- Orchards: cattle and buffalo may similarly be infected in orchards by ingestion of metacercariae in water and from grasses, water plants, man-made ponds or drainage ditches. Infection occurs from September to December. For the prevention of infection, cattle & buffalo should graze in other places during this period.
- Household area: cattle & buffalo could be infected in the household area again by ingestion of metacercariae with water, grasses, water plants, man-made ponds or drainage ditches. Infection occurs from September to April. For the prevention of the infection, cattle & buffalo should graze in other places during this period.

Watering

Underground water from wells or water from a river should be used for cattle or buffalo to avoid the possible fasciolosis infection.
Feeding

Feeding cattle & buffalo should be avoided from places where infection is likely and as described above under *grazing management*. Grass should be cut about 5 cm above water level because metacercariae encyst on these plants close to the water surface.

c. Treatment/control: use of drugs and schedule for drug use

The drugs listed below are for the treatment and control of fasciolosis in cattle and buffalo to reduce prevalence, mortality and morbidity rates, improve animal health, improve strength and enhance reproductivity.

1. Triclabendazole/Fasinex. Australian.
3. Albendazole/Farmbazan. French.
Schedule for drug use

These four drugs are highly effective for the treatment and control of cattle and buffalo fasciolosis. While they are effective, the timing their use is equally as important as their efficacy. The best time for treatment for control of fasciolosis is when it is assessed that animals might be free from infection as the occurrence of fasciolosis is seasonal. Thus the recommended schedule for drug use is as follows:

- Triclabendazole/Fasinox: use once/year in May;
- Genesis Ultra Pour On: use once/year in May;
- Albendazole/Farmbazan: use twice/year:
  - First time: May
  - Second time: July
- Dovenix-25%; Nitroxinile: use twice/year:
  - First time: May
  - Second time: July

2.7 Economic benefits

2.7.1 Impact

Fasciolosis has considerable impact on national economy as young animals can die, suffer reduced weight gain, become physically weak and have reduced reproductive rate, have low productivity and low quality of product demonstrated by reduction of protein, fatty acids and mineral content in meat and liver. In addition, there is discharge from the liver due to liver damage.

In places where the prevalence of fasciolosis is higher than 30 percent, specific effects of the disease are:

- Reduced weight gain: female cow-21.3 kg/head and male-41.0 kg/head
- Reproduction: 10 percent lower pregnancy rate than in non-infected females
- Liver damage: 2.5 kg of damaged organ in each liver
- Weakness: insufficient strength for draught. The strength is reduced by about 40 percent
- Quality of product: reduced nutritional value in meat and liver and the water content of these products is high
- Some animal die
- Sale price of live infected animals is low

2.7.2 Costs and benefits for control

Research work on fasciolosis in Cambodia has been conducted by an expert and specialists from the Department of Animal Health and Production and has involved staff of the Department of Agricultural Extension, officers of the Offices of Animal Health and Production of Kampong Cham and Kandal together with staff of the Saang District Agricultural Office. The fasciolosis study measures the costs and benefits of the control program. Based on this pioneering work the technology implementation procedure (TIP) on fasciolosis could be used as a model for the fasciolosis control program in other places where it is a threat. Below are the costs and benefits of the fasciolosis control program.
Technology Implementation Procedure
Fasciolosis of Cattle and Buffaloes and Its Control Measures

a. Costs of control by farmers

- Trench with roof for dung storage-60 000 riels (20 000-60 000 riels). The trench could be used at least for two years. In this case the cost is 30 000 riels (a range of 10 000-30 000 riels).
- Drug/control-20 000 riels (a range of 10 000-20 000 riels)/head/year.
- Total costs: 50 000 riels (a range of 20 000 riels-35 000 riels)/year/head

Costs and benefits for fasciolosis control (animal/year)

<table>
<thead>
<tr>
<th>Effect</th>
<th>Gain per cow/Y</th>
<th>Minimum cost</th>
<th>Maximum cost</th>
<th>Average cost</th>
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</thead>
<tbody>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>21.3 Kg/head</td>
<td>170 400 riels</td>
<td>213 000 riels</td>
<td>191 700 riels</td>
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<tr>
<td>Pregnancy</td>
<td>10%</td>
<td>60 000 riels</td>
<td>80 000 riels</td>
<td>70 000 riels</td>
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<tr>
<td>Liver for sale</td>
<td>2.5 Kg</td>
<td>15 000 riels</td>
<td>25 000 riels</td>
<td>20 000 riels</td>
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<tr>
<td><strong>Total</strong></td>
<td>245 400 riels</td>
<td>318 000 riels</td>
<td>281 700 riels</td>
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<tr>
<td><strong>Male</strong></td>
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<td></td>
</tr>
<tr>
<td>Weight</td>
<td>41.0 Kg/head</td>
<td>328 000 riels</td>
<td>410 000 riels</td>
<td>369 000 riels</td>
</tr>
<tr>
<td>Liver for sale</td>
<td>2.5 Kg</td>
<td>15 000 riels</td>
<td>25 000 riels</td>
<td>20 000 riels</td>
</tr>
<tr>
<td>Strength</td>
<td>40%</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td><strong>Total</strong></td>
<td>343 000 riels</td>
<td>435 000 riels</td>
<td>389 000 riels</td>
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<tr>
<td><strong>Control costs</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Dung shelter</td>
<td>10 000 riels</td>
<td>30 000 riels</td>
<td>20 000 riels</td>
<td></td>
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<tr>
<td>Drug</td>
<td>10 000 riels</td>
<td>20 000 riels</td>
<td>15 000 riels</td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
<td>20 000 riels</td>
<td>50 000 riels</td>
<td>35 000 riels</td>
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<tr>
<td><strong>Benefits</strong></td>
<td></td>
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<tr>
<td>Female</td>
<td>225 400 riels</td>
<td>268 000 riels</td>
<td>246 700 riels</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>323 000 riels</td>
<td>385 000 riels</td>
<td>354 000 riels</td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>274 200 riels</td>
<td>326 500 riels</td>
<td>300 350 riels</td>
<td></td>
</tr>
</tbody>
</table>

Note: Average price of calf sold after two years divided by number of years of investment.
- Male of two years old: 1 200 000 riels; one year old: 600 000 riels
- Female of two years old: 1 600 000 riels; one year old:800 000 riels
- Price of live cow per Kg: 8 000 riels-10 000 riels; average: 9 000 riels
- Liver per Kg: 6 000 riels-10 000 riels; average: 8 000 riels
- Liver damage per animal: 2.5 Kg/liver

b. Benefits

**Female**

- Average benefits: 246 700 riels/head/year (225 400-268 000 riels)
Male

- Average benefits: 354 000 riels/head/year (323 000-385 000 riels)

Average benefits from fasciolosis control

- Average benefits: 300 350 riels/head/year (274 200 riels-326 500 riels)

2.7.3 Environmental effects

Technology introduced for the implementation in this program “fasciolosis in cattle and buffalo and its control measures”, especially the introduction of the biological control measure improves hygiene at household level. The health of the farm family is protected by placing a control on a source of possible infection. An added benefit is that farmers will have manure in greater quantity and it will be of better quality. Farm incomes are accordingly raised and living standards positively impacted.