FASCIOLOSIS 2000- NEPAL

Proceedings of the workshop on

Strategies for Feed Management in Areas Endemic for Fasciolosis

5th March, 2000, Bluestar Hotel, Kathmandu, Nepal

Jointly organised by

Animal Health Division, Tripureswor, Kathmandu, Nepal
Agricultural Research Station- Pakribas, Dhankuta, Nepal
Centre for Tropical Veterinary Medicine, Edinburgh, Scotland, UK
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Editors
Dr. S.N. Mahato
Dr. L.J.S. Harrison
Dr. S.C. Ghimire

Type setting
Mrs. Vishnu Devi Paudyal

Publisher
Animal Health Division, Department of Livestock Services, Ministry of Agriculture, His Majesty's Government, Veterinary Complex, Tripureswor, Kathmandu, Nepal, Post Box No.- 20815, Phone : +977-1-261569, Fax: +977-1-261521, E-mail: ahd@healthnet.org.np

Centre for Tropical Veterinary Medicine, The University of Edinburgh, Easter Bush Roslin, Midlothian, EH25 9RG, Scotland UK
Telephone: +44 (0) 131 650 1000, Fax: +44 (0) 131 445 5099, http://www.vet.ed.ac.uk/ctvm
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Cover Photo: A housewife carrying tree fodder for her animals in the Eastern Hills of Nepal.
Cover Photo by: Mr. D.B. Subba, Agricultural Research Station-Pakhribas
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ABSTRACT

This workshop on strategies for feed management in areas endemic for fasciolosis was an opportunity for a wide range of interested parties (stakeholders) to meet and discuss various issues relevant to fasciolosis control in Nepal. Fasciolosis is recognised as a major constraint to animal production and health in Nepal. The conclusions of the workshop were divided into three areas. Firstly those control messages that could be disseminated immediately to farmers in Nepal, secondly studies and activities that would be suitable for the attention of extension workers and lastly, the identification of areas that require further research. Through the mechanism of this workshop, practical information on fasciolosis control will now be channelled to farmers using the existing dissemination pathways within the Ministry of Agriculture, HM Government of Nepal. It is also worth emphasising that the findings and recommendations of this workshop are also relevant to other areas of South and South East Asia. The agro-ecological zones and the rice production systems are similar to those found in Nepal and favour Fasciola spp. transmission.
Fasciolosis 2000 - Nepal
Strategies for feed management in areas endemic for fasciolosis

PHOTOGRAPH OF THE PARTICIPANTS

IDENTIFICATION OF PARTICIPANTS

1. Dr B Sharma
2. Dr SK Singh
3. Dr L Sherchand
4. Dr NP Shrestha
5. Dr P Sapkota
6. Mr HR Shrestha
7. Dr KR Regmi
8. Dr DR Ratala
9. Dr MN Lohani
10. Dr PP Mainali
11. Mr SK Shaka
12. Mr SB Panday
13. Dr SM Amatya
14. Dr NP Ghimire
15. Dr R Yadav
16. Miss S Mahato
17. Mrs M Rai
18. Mrs Y Basnet
19. Dr IP Thakal
20. Dr B Parajuli
21. Dr R Gupta
22. Miss S Whythe
23. Dr BKP Shaha
24. Dr NB Rajwar
25. Dr JN Rai
26. Dr B Khadka
27. Dr Y Yadav
28. Mr K Rai
29. Mr MN Mahato
30. Dr RP Ghimire
31. Dr R Jha
32. Miss S Mahato
33. Mrs VD Paungyal
34. Dr K Bhattarai
35. Mr JM Thike
36. Dr SN Mahato
37. Dr RM Shrestha
38. Dr A Pradhan
39. Dr RP Thakur
40. Mr R Chhetri
41. Dr P Pathak
42. Mr K Panday
43. Dr Bansi Shrestha
44. Mr HB Rana
45. Dr TP Prasai
46. Dr NPS Karki
47. Dr SC Ghimire
48. Mr RC Khanal
49. Mr Sandeep Mahato
50. Mr KP Bhandari
51. Mr P Mandal
52. Mr AS Ranjit
53. Dr BR Thapa
54. Mr JP Bajracharya
55. Dr SR Neopane
56. Dr BR Joshi
57. Mr S Paudel
58. Mr CR Upadhy
59. Dr DB Subba
60. Dr KC Thakuri
61. Dr B Pahir
62. Dr RA Pearson
63. Mr R P Gupta
64. Mr LP Harrison
65. Dr P Kushwaha
PROGRAMME

Fasciolosis 2000 - Nepal
Strategies for Feed Management in Areas Endemic for Fasciolosis
Workshop, 5th March, 2000
Vishaka Hall, Bluestar Hotel, Kathmandu

9:00 - 12:40 MORNING SESSION

9:00 - 9:30 REGISTRATION TEA/COFFEE

9:30 - 10:30 INAUGURAL SESSION (CHAIRMAN, DR P SAPKOTA)
Welcome Address and objectives of the meeting by Dr KR Regmi, Station Chief ARS-P
Inauguration by Chief Guest, Dr SK Shrestha, Joint Secretary, Ministry of Agriculture
Short address by Mr IB Abington, Director, HARP
Short address by Dr NP Shrestha, Director, Livestock and Fisheries Research, NARC
Short address by Dr LJS Harrison, CTVM
Closing remarks by Dr P Sapkota, Director General, Department of Livestock Services

10:30 - 11:00 Tea/Coffee

11:00 - 12:30 TECHNICAL SESSION (CHAIRMAN, DR NPS KARKI)
Overview of Fasciolosis - an economically important disease of livestock in Nepal (Dr SN Mahato)
Feeding strategies for stallfed buffaloes (Dr SN Mahato)
Response of Fasciola sp. infected sheep to dietary nitrogen (Dr LJS Harrison, CTVM)
Locally derived feed management techniques compared to drug treatment in Fasciola sp. infected:
I. Goats (Dr B Pakhrin)
II. Buffalo (Mr DB Subba)
Model for economic analysis of fasciolosis (Dr RA Pearson, CTVM)
Chairman closes session

12:30 - 1:30 Lunch

1:30 - 4:30 AFTERNOON DISCUSSION SESSION (CHAIRMAN, DR NP SHRESTHA)
Outline of afternoon activities (Dr SN Mahato)
Chairmen and rapporteurs gather each of the discussion groups
Group discussions and preparation of recommendations (50 mins)

2:30 - 3:00 Tea - RAPPORTEURS PREPARE PRESENTATIONS

Presentation 1 - Identification of messages for immediate dissemination and dissemination pathways
Presentation 2 - Further extension and development of findings
Presentation 3 - Priorities for further research (adaptive and/or strategic)

3:50 - 4:30 FINAL DISCUSSIONS WITH NOTES TAKEN BY THE APPOINTED RAPPORTEURS

4:30 VOTE OF THANKS (DR KR REGMI, ARS-P)
CHAIRMAN'S REMARKS AND CLOSE OF MEETING

Thank you
Respected Chairman
The Chief Guest
Director, HARP
Distinguished ladies and gentlemen.

On behalf of the organising committee of the workshop Fasciolosis 2000 Nepal, I would like to welcome you all in this meeting. This workshop is jointly organised by ARSP, AHD, and CTVM.

In 1996 the Agricultural Research Station, Pakhribas and the Centre for Tropical Veterinary Medicine, Edinburgh were successful in obtaining funds from the British Government Department for International Development (DFID) to undertake a collaborative project on 'the interaction of fasciolosis and nutrition in growing ruminants'. The DFID Animal Health and the Livestock Production Programmes jointly funded the project.

The two Institutions have collaborated for over 15 years on various livestock management and health projects, several funded by ODA (now DFID), and have a good record in working together.

The project addressed the disease fasciolosis, which causes serious production losses, particularly in areas which favour survival of the snail intermediate host. Drug treatment is not always immediately available or affordable for small-scale farmers and so alternative means to control the disease are needed. The project has investigated whether food supplementation using locally available feeds could be an option in alleviating the effects of the disease in growing ruminants.

Experiments were carried out by scientists at the ARS-Pakhribas on goats and buffaloes and at the Centre for Tropical Veterinary Medicine in Edinburgh on sheep. The conclusions from these experiments are summarised at the workshop. A student from Edinburgh University studying for his MSc in Tropical Animal Health and Production undertook a small economic analysis of the data from the goat study which is also reported.

I would like to welcome you in this workshop once again and wish you all a successful meeting.

Thank you.
Today we are considering a very important subject. Fasciolosis is a very common and important disease in Nepal. Calculations of the economic losses caused by fasciolosis indicate its tremendous importance, primarily due to the fact that it seriously affects animal productivity and reproductive performance. Fasciolosis is one of the diseases which Nepalese farmers can easily recognise and diagnose. The fact that the disease has local names in Nepal is an indication of the awareness amongst farmers of its importance. Fasciolosis is called 'Namle' and in some places is also known as 'Mate' because infected animals often start licking soil due to nutritional problems and mineral deficiency. This habit is taken as an indicator of infection by farmers and that their animals are suffering from fasciolosis and may die very soon, if not treated. Thus farmers have a very definite concept of the importance of fasciolosis.

Because of the recognised importance of fasciolosis, studies have been carried out on its control at the Agricultural Research Station - Pakhribas (now part of NARC) in collaboration with the University of Edinburgh, Centre for Tropical Veterinary Medicine. The work was financially supported by the Animal Health and Animal Production Programmes of the UK Government, Department for International Development (DFID). I would like to congratulate both the research organisations and the scientists who have been involved in the project. I would also like to thank DFID for its financial support, which allowed the research into this economically important and well-recognised disease to be conducted.

As I understand it, the research project investigated alternative means of controlling fasciolosis through feed management and supplementation in comparison to the more conventional drug treatment strategies. Drugs certainly are a good means of controlling fasciolosis but in rural areas sometimes the appropriate drugs are not available and they may be prohibitively expensive for some farmers. There is also some risk that if the same drugs are used for a very long time that problems with drug resistance may be encountered. It is therefore valuable to look at alternative control methods to ensure that the disease is controlled or its effects reduced in the most cost effective and efficient way.

This workshop aims to disseminate the findings of the scientist to the stakeholders. I think this is a very good way of doing things. There is no point in carrying out research work, spending money and time if the findings are not being taken up by farmers. I can confidently say, that we have carried out useful research into fasciolosis with many organizations. Today, with the participation of the stakeholders, scientist, farmers and funding agencies, we are trying to disseminate the messages that firstly, fasciolosis is very important disease both in terms of economic impact and losses in animal productivity and secondly that there are means available to help control the disease, which can be used by Nepalese farmers.

I would like to thank all the participants for their interest in attending this meeting and wish the workshop every success.
Guests, Colleagues, Ladies and Gentlemen.

Thank you for providing me with this opportunity to say a few words at the inaugural session of this workshop. I plan to take this opportunity to consider three main points:

Firstly how to channel the results of research work to farmers, secondly how to proceed in defining researchable problems and finally to consider the implications of the competitive nature of HARP funding.

As the Hill and Agricultural Research Programme targets the hills, I am not so familiar with Terai Agriculture. Most farming households in hills maintain at least one buffalo and if not, they keep goats. The Agricultural Prospective Plan gives high priority to the development of livestock and livestock products within hill farming systems.

This is an important workshop addressing a very important topic (fasciolosis). I've watched research into fasciolosis progress for the last ten years and seen much of the background research which has been conducted on this disease. The work has been carried out to a very high standard. What I now consider important is exactly what this workshop is beginning to address. That is, how to gather the most relevant research results and disseminate them to farmers in the field. The present project (interaction between fasciolosis and nutrition in growing ruminants) has been very appropriate in that it has looked at sustainable, locally available, alternative means of control of a disease in comparison to its treatment with drugs or other such expensive means of control.

Ought we not look at the methods that farmers themselves can use: I underline the words strategies for field management because I consider that to be important. It is not just an academic exercise, it is something that the farmers themselves can do and hopefully, will be able to adopt.

Missing section:

It is important that when new projects are to be submitted to DFID for consideration for funding that the initiative comes from Nepal. In the HARP it is your ideas which are important, ideas which CTVM, or whatever institutes you are collaborating with, can help you to develop. These institutes can collaborate with you in areas where perhaps the necessary facilities or technologies are not available in Nepal. The first essential is to examine all the problems exhaustively and then set priorities on these problems. At first there may be a huge lists of 20 to 30 problems. We all know these problems exist. Having identified these problems, it is important to priorities them and reduce them down to 2 or 3 main and clear problems. The reason is that if you simply come up with a list of many problems then it is very difficult for others to decide on the most important problems.

So I wish you every success in todays presentation. I am looking forward to hearing the technical presentations and I wish you every success for today's workshop.

Thank you once again for giving me this opportunity to say few words.
SHORT ADDRESS

By

Dr. NP Shrestha

Director of Livestock and Fisheries Research, NARC, Khumaltar.

I express my sincere thanks to the organisers of this workshop on ‘Fasciolosis 2000 - Nepal. Strategies for feed management in areas endemic for fasciolosis’. I am very pleased to note that the workshop is jointly organised by the Agricultural Research Station-Pakhribas (ARS-P), the Animal Health Division (AHD), Tripureswor and the Centre for Tropical Veterinary Medicine (CTVM), Scotland, UK. It is highly encouraging to hear that ARS-P and CTVM have successfully collaborated for the last 15 years on various livestock management and animal health projects. I hope such collaborations between partners such as Nepal Agricultural Research Council (NARC), the Department of Livestock Services (DLS) and International Institutions such as the UK Department for International Development (DFID) and CTVM should continue in addressing their common goals to solve farmers burning problems and needs.

The Agricultural Perspective Plan (APP) and the 9th five year plan have placed a very high priority on increasing the productivity of livestock and poultry, particularly in the milk, meat, animal fibre and egg production sectors. The APP visualizes an increase in the contribution of the livestock sector from 31% to 46% of the National Agricultural Gross Domestic Production in the next twenty years. Animal health problems are reported to cause heavy losses to livestock production. Fasciolosis alone causes heavy milk and meat production losses in Nepal.

A sustainable increase in agricultural production is a justifiable goal for the future. Improvements in the socio-economic status of people in developing countries will undoubtedly be associated with a rise in demand for good quality food stuffs including food of animal origin. The general rise in the world population increases demand for animal products thus placing pressure on natural resources. Increased productivity may be encouraged by the relative efficiency of market led, and sustainable integration of crop and livestock production systems.

Our NARC stations and research divisions located at Pakhribas, Lumle, Tarahara, Khumaltar and Tripureswor need to work further in close collaboration with DLS, and other concerned institutes both national and international. The aim is to identify farmers’ problems and constraints on various livestock management and animal health problems, to develop cost-effective and sustainable technologies. Since the problem of fasciolosis has regional commonalities, the outcomes from these types of collaborative work will be highly fruitful to the farming communities of, not only Nepal, but also to areas of South and South East Asia which have similar agro-ecological zones.

I think that it is high time for crop and animal scientists to work together in developing viable crop-livestock production systems that will be economically sound, culturally acceptable, socially just and environmentally friendly. I wish the workshop a great success and hope that the workshop will come up with solid recommendations of regional and national importance.

Thank you all for your patience and active participation.
Ladies and gentlemen, on my behalf and that of my colleague, Dr Anne Pearson I would like to say how pleased we are to be able to come to Kathmandu and participate in this workshop ‘Fasciolosis 2000 - Nepal Strategies for feed management in areas endemic for fasciolosis’.

Fasciolosis is an important disease in much of the tropics, in particular in areas such as Nepal, where the climate and farming practices favour the survival of the snail intermediate hosts. For this reason, much emphasis has been placed on fasciolosis research at the Centre for Tropical Veterinary Medicine (CTVM) and our collaboration with the Agricultural Research Station - Paknchab is in place for many years. My main interest has been on the study of the disease and its impact on sheep, goats and buffaloes, work which was carried out partly in collaboration with Dr SN Mahato. Another main research interest at CTVM is animal nutrition and productivity and it is in these areas that Dr Pearson specialises. The project we are reporting today has therefore been an interesting opportunity for Dr Pearson and myself to collaborate with our colleagues here in Nepal in an investigation which examined the interaction between the disease (fasciolosis) and the nutrition of growing ruminants.

This workshop is an excellent opportunity to be able to discuss the research finding with the participants and to consider these in conjunction with other means of controlling fasciolosis in Nepal. Since the production systems here in Nepal are similar to those found in other parts of South and South East Asia, the findings should also be of relevance to these other countries. I am hopeful that the workshop will result in a series of recommendations which can be applied on three levels. Firstly, information which can be immediately disseminated to farmers, secondly subjects which will be suitable for further extension studies and finally identification of areas requiring further scientific investigation.

I would like to take this opportunity to thank all our colleagues here in Nepal, the staff at the CTVM and students from John Moores University Liverpool who all contributed to the success of the project. I am looking forward to this opportunity to hear the workshop’s opinions on fasciolosis control in Nepal. Thank you for your attention and I wish the workshop every success.
Fasciolosis 2000 - Nepal

Strategies for feed management in areas endemic for fasciolosis

CHAIRMAN’S REMARKS

By
Dr P Sapkota
Director General, Department of Livestock Services

I would like to offer some remarks on the strategies for feed management in areas endemic for fasciolosis.

Livestock is a major tool for the nation’s prosperity and can significantly impact the agricultural sector. In areas endemic for fasciolosis, strategies for feed management are crucial to prevent the disease and improve livestock productivity.

Within this context, the focus should be on sustainable feed management practices. Participating stakeholders should be encouraged to adopt these strategies to reduce the impact of fasciolosis on livestock health and productivity.

Thank you.
I would like to express my sincere gratitude and thanks to the organizer for providing me the opportunity to chair the inaugural session of the workshop on "Strategies for feed management in areas endemic for fasciolosis".

Livestock is an integral part of Nepalese agriculture and its contribution to both the farming sector and the national economy is well recognized. Given the proper support, this sector has the potential to flourish and increase its contribution to the national economy. This is well recognized in the Agricultural Perspective Plan. Furthermore, development of the livestock sector will be one of the major tools in alleviating poverty of rural farmers in Nepal. However, there are various factors limiting livestock production and productivity in Nepal, and fasciolosis is one of the major constraints.

Fasciolosis in a widely distributed endemic disease in Nepal and causes an estimated annual loss of millions of rupees. Control efforts made by the government sector over the years have so far not been very effective in reducing the prevalence of the disease, and hence the economic losses. Subsistence farming systems poverty and illiteracy services for many rural people, are amongst the factors impeding successful disease control.

Within this background, the theme of this workshop on managing the disease by an alternative approach i.e. by feed management seems very appropriate. The recommendations made by the participants representing stakeholders, including national and internationals group and institutions will be highly valuable for future management of the disease in Nepal. I assure you that the Department of Livestock Services will be willing to incorporate into its programme any practical suggestions recommended by this workshop. I wish the workshop a grand success.

Thank you very much
OVERVIEW OF FASCIOLOSIS—AN ECONOMICALLY IMPORTANT DISEASE OF LIVESTOCK IN NEPAL

S. N. Mahato, L. J. S. Harrison1 and J. A. Hammond1

Animal Health Division, Veterinary Complex, Tripureshwar, Kathmandu, Nepal, Telephone: +977-1-261569, Fax: +977-1-261521, E-mail: ahd@ahdpc.healthnet.org.np

ABSTRACT

Fasciolosis is the most common animal disease and one of the important causes of deterio-ration in livestock productivity in Nepal. It is widespread throughout the country affecting all spe-cies of ruminants. Despite increased awareness of the disease and massive increase in the use of anthelmintics, there appears to be no impact on the prevalence of the disease in the last two decades. Failure to control the disease was mainly due to lack of information about its epidemiology in the country. In recent years, however, a substantial amount of information has become available to understand the environment-host-parasite interrelationships. Some control approaches based on these informations have been discussed in this paper.

INTRODUCTION

There are about 6.3 million cattle, 3.0 million buffaloes, 5.4 million goats, 0.9 million sheep, 0.3 million pigs and 11.6 million chickens in Nepal (DFAMS, 1990). Cattle, buffaloes and goats are maintained by the most farm families. The rural household keeps on average 1.6 buffaloes, 3.8 cattle and 2.2. These figures indicate that Nepal has the highest livestock population per household and possibly per unit of cultivated area too. The demand for livestock products, however, is not being met by domestic production. DFAMS (1990) reported that food aid to Nepal in 1988 included 1700 tonnes of skimmed milk powder and 279 tonnes of butter oil. The export of livestock and livestock products (excluding woollen goods) in 1987-88 amounted to Rs.503 million, and the import of livestock and livestock products (excluding wool) amounted to Rs.549 million in the same year.

The failure of such a large population of animals to meet the nation’s requirement is largely due to their poor productivity. Typically the lactation milk yields of cattle and buffaloes are 836 and 455 kg respectively, the growth rates of goats to one year of age is 31 g per day, and the egg production of chickens is 80 eggs per year (Gatenby et al., 1990). There are various factors responsible for limiting livestock productivity, which need to be identified, analysed and resolved. There is no doubt, however, that poor health is one of the important factors that reduce the productivity of animals in Nepal.

Among the diseases of ruminants, fasciolosis is probably the most common disease, and perhaps, one of the important causes of livestock deterioration in Nepal. The disease is widespread throughout the country affecting all species of ruminant livestock; including yaks and yakows of the Himalayas (Joshi and Tewari, 1975). The different local names of this disease, such as namle, mate, lew etc., in different regions, are proof of its continued existence for many years in the animal population of the country. In 1973, Singh et al. (1973) reported an infection rate of 50 to 90 percent in animals in areas below 1800 m and estimate an annual economic loss of Rs.200 million (US$ 20 million) due to this disease alone; (1987; Joshi 37 million therefore, t...
DISEASE OF

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Disease alone. Recent studies have indicated a similar prevalence of the disease (Morel and Mahato, 1987; Joshi, 1988; Oli et al., 1989; Mahato 1993), but a higher estimate of the economic loss i.e. US$ 37 million due to decreased buffalo milk and buffalo meat production only (Mahato, 1995). It appears therefore, that despite increased awareness of the disease and massive increase in the use of anthelmintics, there has been no control on the prevalence of the disease in the last two decades. In this paper, some important features of the epidemiological cycle of *Fasciola* spp. in eastern Nepal is briefly described, and its implications on the control of fasciolosis is discussed.

**CONDITIONS REQUIRED FOR THE ESTABLISHMENT OF FASCIOLA SPP. IN AN AREA**

The life cycle of the parasite involves an alteration of generations and requires a suitable species of *Lymnaea* snail, as an intermediate host. Eggs passed out from the infected animals hatch and the resulting miracidia infect the mollusc host. Following asexual multiplication as sporocysts and rediae, cercariae are released and encyst as metacercariae on herbage. Encysted metacercariae are swallowed by the animal and the young flukes excyst in the gut and migrate through the gut wall and across the peritoneal cavity to penetrate the liver capsule. Then they migrate through the liver parenchyma for some weeks before entering the bile ducts where they mature.

The success of the life cycle depends on the development and hatching of eggs, infection of the snail host by a miracidium, development of larval stages within the vector, cercarial emission from the snail and formation of metacercariae on herbage, and finally establishment within the final host. Completion of such phases of cycle eventually depends on how successfully the parasite can overcome complex interactions continually present in the environment and host.

Thus, before there can be any possibility of the life cycle of *Fasciola* species occurring in any particular area the following conditions must be satisfied. There must be an initial presence of infected final hosts, the intermediate snail host must be present and there must be an opportunity for transmission of the parasite from the final host to the snail habitat and for its return.

**AVAILABLE MEASURES TO CONTROL FASCIOLA**

The methods to control fasciolosis generally include strategic application of anthelmintics to eliminate the parasite from the host at the most convenient time for effective prevention of pasture contamination, reduction of the number of intermediate host snails through drainage and other practices and reduction of the chances of infection by efficient farm and grazing management. In fact control of fasciolosis requires intervention in the labyrinth of relationships between the environment, ruminant hosts, snail hosts, the parasite life cycle, agricultural cycles and animal husbandry procedures. Therefore, good understanding of the environment-host-parasite interrelationships are essential for formulating the control measures suitable for an area.

**APPROACHES TO CONTROL FASCIOLA IN NEPAL**

In general, the interrelationships have not been adequately studied in Nepal, although a substantial amount of information is available for the eastern region as a result of the studies conducted by the Pakhrabas Agricultural Centre (PAC), Dhankuta (Morel and Mahato, 1987/Mahato, 1993). In this region, the density of *Lymnaea* habitats and source of food and grazing site are the major determinants of the prevalence of fasciolosis, these in turn, are influenced by the season and the farming systems. Except in a few instances, there is no reason to suppose that the information available from the eastern Nepal does not apply to the other regions of the country.

From the epidemiological point of view, the pre-monsoon and the monsoon rains, together with rice cultivation practices are important factors that create numerous temporary *Lymnaea* habitats over a
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Widespread area and disperse the infected snails to these habitats. Both these factors prevent grazing of animals near the habitats during the mid and late monsoon thus preventing contamination with Fasciola eggs and also animal infection. However, after the monsoon when rice is harvested, the roadsides and rice-fields that are heavily contaminated with metacercariae are available for grazing. Keeping the animals away from these areas during the pre-monsoon and again after the monsoon until the end of the viable period of the metacercariae would be of great value in the control of fasciolosis. However, this might not be acceptable to farmers, as alternative forage resources are scarce during these periods.

Rice-straw, which is the principal food of large ruminants during the dry season (December-April) is another important source of Fasciola infection, especially in stall-fed animals. In eastern Nepal, where the relative humidity is generally above 60% during the winter, the metacercariae encysted on rice-straw remain infective until March; although, it was found that only the bottom portion of rice-straw contain Fasciola metacercariae (Mahato, 1995). These findings clearly indicate that managing the feeding of rice-straw could prevent fasciolosis in stall-fed animals. Although the most important advantage of this approach is that it does not require any external input, its application will require a considerable extension effort.

Attempting to control snails using molluscicides during the dry season would be of doubtful value due to the large number of permanent habitats, the great biotic potential and aestivating ability of the snails (Mahato et al., 1995) and recurrent labour and equipment costs. Furthermore, chemical molluscicides may be toxic for mammals and their drainage into streams may kill fish and other aquatic fauna including frogs and insects. Planting certain tree spp., the leaves and seeds of which are molluscicidal such as Eucalyptus spp, Sapindus emarginatus, Acacia concinna, Caesalpinia corearia and Embelia officinalis etc. round the edges of habitats has been found as a potential method of vector snail control. It seems unlikely that farmers in the hills would plant trees around springs in their rice-fields because of the adverse effects of shade on rice production. However, tree species with marked molluscicidal properties could be included in the present on going road-sides and canal bank plantation programme run by the Ministry of Forest in the Terai.

It has been observed that when infected with duck fluke larvae, snails are resistant to Fasciola infection. The introduction of large number of ducks into rice fields after harvest is a traditional practice in many south Asian countries. This practice help to reduce the number of snails, as these comprise a large proportion of the food eaten by the ducks and at the same time, contaminate the fields with eggs from the duck flukes. The larvae of these flukes subsequently infect some of the snails, preventing them from being infected with Fasciola larvae. This system could achieve a degree of biological control of fasciolosis in ruminants. Therefore, there is need to study the possibility of introducing ducks in rice growing areas of the country. This may help farmers to prevent losses resulting from fasciolosis and at the same time provide source of additional income from the sale of ducks.

Morel and Mahato (1987) and Mahato (1993) found that the bulk of the infection in snails is derived from fluke eggs deposited on the pasture during March-May and again in October and November. Thus there is a good case for administration of anthelmintics in February and again in late August to control the pasture contamination. However, this approach would only be effective if all stock including goats and sheep are treated with an efficient anthelmintic.

In Nepal, over 90 percent of the population depend largely on farming for their livelihood. Most of the Nepalese farmers are small holders and they keep animals mainly for converting low quality forage and crop by-products to milk and meat for their home consumption and manure and work power required for their subsistence farming. Huge quantity of anthelmintics required for the strategic dosing
of all the ruminant animals (mass drenching) twice a year might not be affordable for the poor Nepalese farmers. It is likely, therefore, that small farmers may not adopt this approach unless there is a huge subsidy on the cost of anthelmintics by the government.

In this situation, alternative means to minimise the effect of the disease are needed for small-scale farmers. Experiments have shown that animals on lower protein diet lost weight more rapidly, developed anaemia and hypoalbuminaemia and died earlier than their better-fed counterparts. Possibly supplementation using locally available feeds could be an option in alleviating the effects of the disease in growing ruminants in Nepal.

CONCLUSIONS

It can be concluded that, because of the great biotic potential of Fasciola spp. and their intermediate host snails, only the continuous and co-ordinated strategic application of the available measures based on the epidemiology can provide economic control of the disease.

REFERENCES


INTRODUCTION

There are about 3.4 million buffaloes in Nepal. Although they contribute the major proportion of the milk and meat produced in the country, their productivity is low. Among the various factors responsible for limiting the productivity, fasciolosis has been known to be the most important one. Based on reduced live weight gain and milk yield resulting from fasciolosis in buffaloes, Mahato (1993) estimated that there is an annual loss of NRs 1685 million or US$ 33.7 million to the national economy. This estimate gives an indication of the enormity of the problem in Nepal when one compares this with the per capita gross domestic product of only US$ 234 in 1997 when the total population was estimated to be 20.8 million (CBS, 1998).

The prevalence of fasciolosis in buffaloes varies between 50 to 90%. About 60% of buffaloes are kept stall-fed and surprisingly the prevalence is higher in the stall-fed than in the out grazed. A detailed study on the epidemiology of fasciolosis in eastern Nepal revealed that rice fields are the main habitats of lymnaeid snails (Mahato, 1993). As rice straw is the principal food of stall-fed buffaloes, this could easily be attributed to the higher prevalence of Fasciola infection.

Several workers (Abu and Shiramizu, 1985; Shiramizu and Abu, 1988) have reported the prolonged survival of Fasciola gigantica metacercariae encysted on the rice-straw. However, this survival appears to depend on temperature, relative humidity and the moisture content of the stored products. Kimura and Shimizu (1978) reported that metacercariae of F. gigantica can survive for up to 4 months on the rice straw kept in barns where the relative humidity is more than 60%. In the hills of western Nepal, Joshi (1986, 1989) found that F. gigantica metacercariae in the rice straw bundles, which were kept in an open place, remained infective at least for two months. These reports suggest that in eastern Nepal, where the relative humidity is generally above 60% during the winter, the metacercariae may remain infective for a considerable period of time. However, no experiment has been conducted to determine the duration of their viability. Therefore, recommendation for a safe period for rice-straw feeding could not be made.

Although encystment may occur on any object, cercariae of F. gigantica, in particular, encyst on fully submerged vegetation or herbage (Mahato, 1993). Dumag, Batalos, Escandor, Castillo and Gajudo (1976) reported that the cercariae of F. gigantica encysted on parts of plants at least about two centimetres below the water and that no metacercariae were found on parts of the plants above the water level. From these reports, a hypothesis can be generated that the top parts of rice-straw are free from the infective metacercariae. Therefore, a series of experiment was conducted with the following objectives:
MATERIALS AND METHODS

Experimental design

Eighteen buffalo calves (9-12 months old), all negative for *Fasciola* spp. infection on faecal examination and the agar gel diffusion test were used in each of the three experiments. The calves were randomly divided into three groups of six animals. Animals in the group A received bottom parts (40 cm length) of rice-straw *ad libitum*, and approximately 7 kg tree fodder and 300 g commercial concentrate feed per head daily. Animals in the group B received similar food except that the bottom parts of rice straw were replaced by top parts while group C which were kept as control were provided only 300 g of commercial concentrate feed and *ad libitum* tree fodder (Table 1). Except for the starting and terminating dates, a similar design was used for the all three experiments (Table 1).

<table>
<thead>
<tr>
<th>Expt</th>
<th>Group</th>
<th>No. of animal</th>
<th>Treatment (feed provided)</th>
<th>Starting date</th>
<th>Terminating date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A₁</td>
<td>6</td>
<td>bottom parts of rice-straw + concentrate feed + tree fodder</td>
<td>15 December</td>
<td>31 January</td>
</tr>
<tr>
<td></td>
<td>B₁</td>
<td>6</td>
<td>top parts of rice-straw + concentrate feed + tree fodder</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C₁</td>
<td>6</td>
<td>concentrate feed + tree fodder only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A₂</td>
<td>6</td>
<td>bottom parts of rice-straw + concentrate feed + tree fodder</td>
<td>27 January</td>
<td>12 March</td>
</tr>
<tr>
<td></td>
<td>B₂</td>
<td>6</td>
<td>top parts of rice-straw + concentrate feed + tree fodder</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C₂</td>
<td>6</td>
<td>concentrate feed + tree fodder only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A₃</td>
<td>6</td>
<td>bottom parts of rice-straw + concentrate feed + tree fodder</td>
<td>10 March</td>
<td>23 April</td>
</tr>
<tr>
<td></td>
<td>B₃</td>
<td>6</td>
<td>top parts of rice-straw + concentrate feed + tree fodder</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C₃</td>
<td>6</td>
<td>concentrate feed + tree fodder only</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rice straw used in the study was obtained from the fields which were known to be the habitats of *fasciola* infected snails. After the harvest and threshing of rice during last week of November, the straw was stored outdoors in stacks as per the local practices. Straw from each field was equally divided for all the stacks and a separate stack was made for each experiment. Moisture content of straw in the stacks was determined at a weekly interval.
Monitoring of the experiment

Faecal, blood and serum samples of the buffalo calves were collected at weekly intervals. The faecal samples were examined for fasciola eggs while the blood sample were examined for eosinophilia using the standard techniques. Within 2 weeks of the termination of experiments, all calves were slaughtered humanely. Autopsy included careful examination of all internal organs for any abnormality, recovery of flukes from the livers and other organs, if any, counting and measuring the recovered flukes.

RESULTS

Haematological data

There was a rise in the mean eosinophil counts from 3rd to 4th week of rice straw feeding and remained raised in the buffalo calves which were fed with the bottom parts of straw in experiment 1 and 2.

Pathological data

The livers of the buffalo calves that were fed with bottom parts of rice straw were relatively enlarged. On the liver surfaces there were perforations of 1 to 3 mm diameter. The cut surfaces showed haemorrhagic fluke tracts and immature flukes in the liver parenchyma. No flukes were seen in the bile ducts or gall bladder.

Parasitological data

No fasciola eggs were detected in the faeces of any animals during the experimental period and flukes were recovered from only those animal, which were fed with bottom parts of rice straw. Number of flukes recovered from the individual animals and their measurements are presented in Table 2. Measurements of the flukes suggested that all these were immature F. gigantica. No flukes were recovered from any of the control animals and those that were fed with top parts of rice straw.

Table 2: Details of the fluke counts and their measurements

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Group</th>
<th>Animal positive (%)</th>
<th>Mean fluke counts*</th>
<th>Average fluke size (mm)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>100.0</td>
<td>18.7 (6-42)</td>
<td>8.3 X 1.9</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>100.0</td>
<td>13.7 (3-28)</td>
<td>7.9 X 1.7</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>50.0</td>
<td>0.5 (0-1)</td>
<td>11.8 X 3.0</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Figures in parentheses indicate ranges
DISCUSSION

Results of these experiments demonstrated that only the bottom portions of rice straw contained metacercariae of *Fasciola* spp. Some of these metacercariae remained viable until March. Therefore, feeding of the bottom portions should be avoided in order to control fasciolosis in stall fed animals. However, the top portions were free from the viable metacercariae, even just 2 weeks after the harvest and therefore these could safely be fed at any time. Although, the timing when bottom portions of rice straw become free from viable metacercariae could not be determined from these experiments, there were some evidences that these could safely be fed from mid April. It can be concluded, therefore, that managing the feeding of rice-straw could prevent fasciolosis in stall-fed animals. The most important advantage of this approach is that it does not require any chemical agent or external input, however, its application in the field will require a considerable extension effort.

ACKNOWLEDGEMENTS

This work was carried out at the Pakhrisab Agricultural Centre (PAC), Bhankuta Nepal, which is an ODA (UK) funded Agricultural Research Institute. Staff of the Veterinary Investigation and Analytical Services Section, PAC, particularly K Rai, P B Thapa, J Thapa and Y Basnet are thanked for their technical assistance in this work and Mrs V D Paudyal for word-processing of the paper.

REFERENCES


THE RESPONSE OF FASCIOLA GIGANTICA INFECTED SHEEP TO DIETARY NITROGEN

Leslie JS Harrison and R Anne Pearson

University of Edinburgh, Department of Tropical Animal Health, Centre for Tropical Veterinary Medicine, Easter Bush, Roslin, Midlothian, Scotland, UK, EH25 9RG

SUMMARY

Chronic Fasciola gigantica infections were established in lambs maintained on diets differing in their protein and nitrogen content. The course of the disease and their production parameters were compared with that of similarly maintained uninfected controls. Parasitological, haematological, serological, biochemical and post-mortem data indicated light F. gigantica infections were successfully established in the experimentally infected sheep. Nutritional and production parameters indicated little difference in the growth rates of infected and control sheep maintained on medium (14%) protein diets and that a proportion of the dietary nitrogen (2.4%) could be derived from urea without detrimental effect on production parameters. In contrast infected sheep maintained on either high (>19%) or low (7%) protein diets did not grow as well as their respective controls and the former group displayed a degree of inappetance. It is therefore suggested that a diet containing approximately 14% protein may help alleviate the negative production effects often associated with fasciolosis. This level is close to that generally recommended for ruminant diets but since many ruminants in Nepal are maintained on diets of a lower protein content, feed supplementation to increase the overall protein content of the diet may be a suitable option. Similarly diets with too high a protein content (>19%) should be avoided in areas endemic for fasciolosis.

INTRODUCTION

Fasciolosis is well recognised as a serious constraint to animal production in Nepal, accounting for a losses of 20% and 14% to buffalo and goat producers alone (Mahato, 1993). The extent of the problem, as recognised by farmers, is reflected in the high percentage of the total drug sales (60% Mahato, pers. comm.) that are devoted to drugs for the treatment of fasciolosis. Consequently, a high priority is placed on the control of fasciolosis by the Nepalese Government. There is relatively little quantitative information known about the negative effects of fasciolosis, particularly for F. gigantica (Roberts and Suhardono, 1996) but studies into the epidemiological basis for the control of fasciolosis in Nepal have been conducted (Mahato, Harrison and Hammond, 1997). While strategic and symptomatic drug treatment are an option for control (Shrestha and Joshi, 1997), farmers often cannot afford to treat their animals with expensive drugs, even if they are available locally. A more economic and feasible management strategy may be to supplement the diet of the animals with locally available feeds to improve their nutritional status, as was found to help in the closely related parasite Fasciola hepatica (Berry and Dargie, 1976; Dargie, Berry and Parkhins, 1979). This experiment was designed to test the hypothesis that the amount and source of dietary nitrogen can influence the growth of the infection, inappetance and rate of growth in F. gigantica infected sheep. The effect of sourcing some of the dietary nitrogen from urea was investigated because of the interest in Nepal of using urea molasses blocks as a feed supplement.

Monitorin.

The sheep
parameters:
Diet: The content, not
Intakes: These could be
Parasitology calculated
Haematology could be t
Corpusculi calculated.
MATERIALS AND METHODS:

Experimental design:
A total of 48 Suffolk Cross lambs were split into four diet groups and maintained in individual pens. The sheep were fed ad libitum (Table 1). The composition of the diets and analysis of the diets, which were made up at the Scottish Agricultural College, were as detailed in Tables 2 and 3. The diets were prepared in batches of 2000 Kg. The sheep were also given 150-200g of hay every day to ensure that rumination was maintained. The sheep were infected with Fasciola gigantica (2 metacercariae/Kg at week 15) and examined at post-mortem 24 weeks later.

<table>
<thead>
<tr>
<th>Diet Group (crude protein)</th>
<th>Infected with Fasciola gigantica</th>
<th>Uninfected Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>High protein (20%)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Medium Protein (14%)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Medium Protein plus Urea (14% includes 2.45% urea)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Low Protein (7%)</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2 Composition of the diet batches for the four different dietary groups.

<table>
<thead>
<tr>
<th>Diet Group</th>
<th>Protein/ % content</th>
<th>High</th>
<th>Medium</th>
<th>Medium plus urea</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td></td>
<td>20.6667</td>
<td>19.5000</td>
<td>42.8500</td>
<td>40.8500</td>
</tr>
<tr>
<td>Oatfeed</td>
<td></td>
<td>19.3333</td>
<td>22.5000</td>
<td>17.0000</td>
<td>21.5000</td>
</tr>
<tr>
<td>Citrus pulp</td>
<td></td>
<td>29.9667</td>
<td>29.8750</td>
<td>30.0000</td>
<td>30.0000</td>
</tr>
<tr>
<td>Hi-Pro Soya</td>
<td></td>
<td>20.6667</td>
<td>20.5000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molasses (CMS20)</td>
<td></td>
<td>5.0000</td>
<td>5.0000</td>
<td>5.0000</td>
<td>5.0000</td>
</tr>
<tr>
<td>Salt</td>
<td></td>
<td>0.6800</td>
<td>0.6800</td>
<td>0.5350</td>
<td>0.6800</td>
</tr>
<tr>
<td>Dicalphos</td>
<td></td>
<td>0.4800</td>
<td>0.4900</td>
<td>0.7900</td>
<td>0.7900</td>
</tr>
<tr>
<td>Limestone flour</td>
<td></td>
<td>1.0067</td>
<td>1.2550</td>
<td>0.9950</td>
<td>0.9750</td>
</tr>
<tr>
<td>Scotmin ewe/lamb</td>
<td></td>
<td>0.2000</td>
<td>0.2000</td>
<td>0.2000</td>
<td>0.2000</td>
</tr>
<tr>
<td>Sodium sulphate</td>
<td></td>
<td>*</td>
<td>*</td>
<td>0.1800</td>
<td>*</td>
</tr>
<tr>
<td>Urea</td>
<td></td>
<td>2.000</td>
<td>*</td>
<td>2.4500</td>
<td>*</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Monitoring:
The sheep were monitored regularly throughout the entire experimental period and the following parameters determined:

Diets: The feed batches were monitored regularly during storage to ensure consistency of nitrogen content, neutral detergent fibre, acid detergent fibre and organic matter.

Intakes: The feed intakes/refusals were monitored following every feed so that the total dietary intake could be determined.

Parasitological: Faecal samples were collected every week and the numbers of fluke eggs per gram calculated using standard procedures.

Haematology: Blood samples were collected weekly in order that total red and white blood cell counts could be taken. Differential cell counts were noted. The haemoglobin level in the blood and the packed cell volumes were determined so that, along with the total red blood cell counts, the Mean Corpuscular Volume, Mean Cell Haemoglobin and Mean Cell Haemoglobin Concentration could be calculated.
Strategies for feed management in areas endemic for fasciolosis

Table 3 Feed analysis for the four different dietary groups.

<table>
<thead>
<tr>
<th>Diet Group</th>
<th>Proteins Analysis (Vol 100.0)</th>
<th>Medium</th>
<th>Medium plus urea</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter</td>
<td>872.9733</td>
<td>871.6500</td>
<td>873.2950</td>
<td>871.3885</td>
</tr>
<tr>
<td>Crude Protein</td>
<td>199.4793</td>
<td>140.9375</td>
<td>140.5550</td>
<td>69.4600</td>
</tr>
<tr>
<td>ERDP 5%</td>
<td>145.7237</td>
<td>98.6963</td>
<td>108.6490</td>
<td>51.3461</td>
</tr>
<tr>
<td>ERDP 8%</td>
<td>133.9983</td>
<td>87.0763</td>
<td>105.1365</td>
<td>47.8884</td>
</tr>
<tr>
<td>DUP 5%</td>
<td>28.91</td>
<td>28.7590</td>
<td>9.850</td>
<td>9.9895</td>
</tr>
<tr>
<td>DUP 8%</td>
<td>39.2610</td>
<td>39.0263</td>
<td>12.5833</td>
<td>12.5640</td>
</tr>
<tr>
<td>FIBRE</td>
<td>101.7867</td>
<td>108.6600</td>
<td>96.5110</td>
<td>106.3933</td>
</tr>
<tr>
<td>MADF</td>
<td>161.8767</td>
<td>172.2975</td>
<td>147.7675</td>
<td>162.8703</td>
</tr>
<tr>
<td>NDF</td>
<td>255.1817</td>
<td>272.3363</td>
<td>250.4590</td>
<td>274.8877</td>
</tr>
<tr>
<td>STARCH</td>
<td>125.9127</td>
<td>123.4225</td>
<td>228.0750</td>
<td>222.9345</td>
</tr>
<tr>
<td>SUGAR</td>
<td>102.4233</td>
<td>101.9175</td>
<td>86.9990</td>
<td>86.7197</td>
</tr>
<tr>
<td>STA+SUG</td>
<td>229.0284</td>
<td>226.0413</td>
<td>315.5455</td>
<td>310.1457</td>
</tr>
<tr>
<td>ASH</td>
<td>69.7791</td>
<td>73.2862</td>
<td>64.2909</td>
<td>65.2171</td>
</tr>
<tr>
<td>CALCIUM</td>
<td>9.9972</td>
<td>10.9914</td>
<td>10.0063</td>
<td>9.9892</td>
</tr>
<tr>
<td>PHOSPHORUS</td>
<td>3.5040</td>
<td>3.5173</td>
<td>3.5018</td>
<td>3.4994</td>
</tr>
<tr>
<td>MAGNESIUM</td>
<td>1.2325</td>
<td>1.2169</td>
<td>0.9370</td>
<td>0.9193</td>
</tr>
<tr>
<td>SODIUM</td>
<td>2.9912</td>
<td>3.0640</td>
<td>3.0004</td>
<td>3.0012</td>
</tr>
<tr>
<td>POTASSIUM</td>
<td>10.2588</td>
<td>10.3341</td>
<td>6.1276</td>
<td>6.2893</td>
</tr>
<tr>
<td>SULPHUR</td>
<td>1.7447</td>
<td>1.7545</td>
<td>1.5042</td>
<td>1.1203</td>
</tr>
<tr>
<td>COBALT</td>
<td>0.8701</td>
<td>0.8694</td>
<td>0.8479</td>
<td>0.8473</td>
</tr>
<tr>
<td>COPPER</td>
<td>6.6192</td>
<td>6.6689</td>
<td>4.3369</td>
<td>4.4351</td>
</tr>
<tr>
<td>IODINE</td>
<td>4.8556</td>
<td>4.8554</td>
<td>4.8350</td>
<td>4.8350</td>
</tr>
<tr>
<td>MANGANESE</td>
<td>53.6163</td>
<td>54.0213</td>
<td>47.7705</td>
<td>48.4112</td>
</tr>
<tr>
<td>SELENIUM</td>
<td>0.2503</td>
<td>0.2492</td>
<td>0.1971</td>
<td>0.1963</td>
</tr>
<tr>
<td>ZINC</td>
<td>56.7703</td>
<td>57.0088</td>
<td>51.7410</td>
<td>52.1223</td>
</tr>
<tr>
<td>VIT A (K)</td>
<td>8.0000</td>
<td>8.0000</td>
<td>8.0000</td>
<td>8.0000</td>
</tr>
</tbody>
</table>

Biochemistry: Serum samples were collected weekly so that the serum levels of the enzymes, γ- glutamyl transferase, glucose-6-phosphate dehydrogenase, β-hydroxybutarate and the serum glucose, nitrogen, protein and albumin levels determined, all by standard procedure using kits prepared by Randox Ltd.

Serology: A routine indirect antibody detection ELISA was employed in order to determine the antibody responses of the sheep to F. gigantica infection. Excretory/secretory products collected from adult flukes maintained in culture for 24 hours was used as the antigen, diluted to optimum concentration, as determined by titration. Following addition of the test serum diluted to an appropriate concentration, the presence of anti-parasite antibody was detected by the addition of commercial rabbit anti-sheep (H+L chain) serum/ horseradish peroxidase conjugate, followed by tetramethylbenzidine substrate (Sigma Ltd). The colour reaction was stopped using 0.2M H2SO4 and the optical density of the reaction product measured at 450nm.

Physiological: The sheep were weighed twice weekly so that their weight gain and metabolic weights could be determined.

Post-mortem: At the time of slaughter, the carcass condition was recorded. The dressed out carcass weights were determined and the degree of liver pathology noted. The number of flukes present in the...
livers of the infected animals was calculated by slicing the livers carefully to look for the flukes. Bile was collected and examined to determine whether there were any fluke eggs present.

RESULTS

Feed analysis indicated that the composition remained constant throughout the experimental period. None of the sheep in the control groups gave any indication of being infected with *F. gigantica* by any of the monitoring parameters. All the indications were that the infections established in the exposed animals were mild with small numbers of flukes (in the range 1-11) being recovered from the infected groups, but there was no statistical difference in the number of flukes recovered from each dietary group. This conclusion was confirmed by the haematological and biochemical data. The serological results also indicated infection in the exposed group (Fig 1).

There was no difference in the weight gain following infection in either of the medium protein (14% crude protein groups) whether the protein was derived totally from crude protein (medium protein group) or partly derived from urea (2.45%), medium protein including urea group.

Unfortunately during the course of the experiment two of the sheep in the high protein (20% crude protein) group died. This group also exhibited a degree of inappetance as compared to the corresponding uninfected controls.

|-----|-----------|--------|----------|---------|--------|----------|--------|--------|---------|-----------|----------|---------|--------|----------|--------|-------|-------|-------|--------|--------|-------|--------|-------|-------|--------|-------|-------|-------|-------|-------|

of the enzymes, γ-
the serum glucose,
ng kits prepared by
to determine the
acts collected from
duted to optimum
um diluted to an
by the addition of
ate, followed by
2M H₂SO₄, and
and metabolic weights
dressed out carcass
flukes present in the

Figure 1: The antibody responses as measured by enzyme-linked immunosorbent (ELISA) of *Fasciola gigantica* infected and control sheep maintained on different diets medium protein plus urea (MPU) medium protein (MP) high protein (HP) or low protein (LP). The sheep were infected with metacercariae on week 15.

Regression analysis indicated a significant difference between infected and control sheep in both the high and low protein groups. The infected sheep grew less well than the uninfected controls over the entire post-infection monitoring period, although this was not the case in the pre-infection period. This effect was slightly more pronounced in the high protein infected group (Fig 2).
DISCUSSION

Flukes specifically damage the livers of infected hosts. The liver plays a pivotal role in the physiology of the body, as it is responsible for a large proportion of the body's amino acid metabolism along with other important roles. At the same time, the liver has remarkable functional redundancy and, unlike most other organs in mammals, is able to regenerate functional tissue after physical or chemical injury. Although only a few aspects of liver function have been directly examined in fluke-infected hosts, significant disturbances have been detected, even when only small areas are obviously damaged. Thus even small numbers of flukes have been associated with changes. It seems likely that the availability of amino acids for protein synthesis would be an important factor in determining the extent to which the liver can compensate for the damage caused by the flukes (Behm and Sangster, 1998).

This study indicate an appropriate level of dietary protein for F. gigantica infected sheep would appear to be 14% crude protein and that some of the dietary nitrogen can be derived from urea with minimal negative affect. However, the indications are that deviating too far from this level (>19% and <8% crude protein) has a deleterious effect.

Unfortunately many ruminants in Nepal are thought to be maintained on diets which have less that 14% protein. The suggestion therefore is to investigate the effect of using locally available feed supplementation to determine whether raising the protein content of the diet in ruminants managed...
under Nepalese conditions would help to alleviate the negative production effects of fasciolosis. Such supplementation may form a useful alternative to drug treatment (either strategic or symptomatic), which currently is the main control method available. Unfortunately many Nepalese farmers find this method difficult to apply either because of cost or lack of easy availability of the appropriate drugs. If suitable, such food supplementation may form a useful adjunct to drug treatment regimens or even avoid potential problems with drug treatment such as drug residues in meat and milk and drug resistance.

ACKNOWLEDGEMENTS

This project was conducted at CtVM with inputs from staff the Agricultural Research Station - Pakhirbas, who supplied experimental material and with consultant inputs by Dr SN Mahato of the Central Veterinary Laboratories, Tripureswor, Kathmandu. The work was funded jointly by the Animal Production and Animal Health Programmes of the UK Government, Department for International Development (DFID). However, the opinions expressed are not necessarily that of DFID. The authors acknowledge the technical input of staff of the CtVM, Mrs Denise Bryce, Mr Paul Wright, Mr Bob Archiebald and Mr Harry Urquhart. The contributions made by Mr Richard Ward, Miss Mairi Pierce and Miss Sarah Wythe, undergraduate students of John Moores University, Liverpool are also gratefully acknowledged.

REFERENCES


Berry, CJ and Dargie, JD (1976) The role of host nutrition in the pathogenesis of ovine fasciolosis. Veterinary Parasitology, 2, 317-332


INTRODUCTION:

Fasciolosis is an important constraint to the development of goat production in Nepal and in the tropics. Fasciolosis is a disease of domestic ruminants caused, primarily by infection with the trematodes, *Fasciola gigantica* and *Fasciola hepatica*. It is indisputably a cause of serious production losses to cattle, buffalo, sheep and goat producers particularly in areas where conditions favour the survival of the snail intermediate hosts (Pearson and Harrison, 1995).

In the tropics, the forage base is of medium to low quality, made available to the animals by grazing and cut and carries system. The quality and availability of these resources declines seasonally, coinciding with the onset of the dry season. During the dry season, productivity of the animals declines unless dietary supplements are introduced (Klesse, 1997).

Food conversion and thus efficient use of animal food resources is additionally compromised by this disease and further exacerbated in many areas, where the ruminants are undoubtedly maintained on a poor plane of nutrition.

Anthelmintics for the treatment of this disease are very costly and also are not readily available at the areas where fasciolosis is the major problem.

With the emergence of a search for sustainable control strategies in the development of domestic ruminant livestock production systems in the tropics, this study aims to see if modifications to animal feed management can ameliorate the production losses caused by fasciolosis.

MATERIALS AND METHODS:

*Experimental goats:*

Fifty male goats aged between 6 and 8 months and free from patent fasciola infection were procured locally from mid and high altitude (above 1100 m) areas in the eastern hills of Nepal. They were castrated with the help of burdizzo castrator.
All goats were treated parentally against ecto and endo parasites with Ivermectin (Ivomec, MSD-AGVET, and UK). They were also immunised against pasteurellosis, lamb dysentery, struck, pulpy kidney, tetanus, braxy, black leg and black disease using Heptavac-P (Hoechst UK Limited). Regular treatment against gastrointestinal nematodes and coccidia infections was also carried out at monthly intervals for the duration of the experiment.

Experiment design:
After pre infection monitoring of one-month period, the goats were divided randomly into five groups (A, B, C, D and E) each group consisting of 10 goats. (Table 1). For identification, colour coded ear tags (colour for the groups and number for individuals) were used.

<table>
<thead>
<tr>
<th>Group</th>
<th>Tag colour</th>
<th>No. of goats</th>
<th>Fasciola infection</th>
<th>Diet</th>
<th>Treatment with Triclabendazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Red</td>
<td>10</td>
<td>Yes</td>
<td>Basal only</td>
<td>Yes</td>
</tr>
<tr>
<td>B</td>
<td>Yellow</td>
<td>10</td>
<td>Yes</td>
<td>Basal only</td>
<td>No</td>
</tr>
<tr>
<td>C</td>
<td>Green</td>
<td>10</td>
<td>Yes</td>
<td>Basal plus good fodder</td>
<td>No</td>
</tr>
<tr>
<td>D</td>
<td>Blue</td>
<td>10</td>
<td>Yes</td>
<td>Basal plus concentrate</td>
<td>No</td>
</tr>
<tr>
<td>E</td>
<td>White</td>
<td>10</td>
<td>Yes</td>
<td>Basal plus urea molasses block</td>
<td>No</td>
</tr>
</tbody>
</table>

The goats belonging to the group A were treated with Triclabendazole against fasciolosis at 20 weeks post infection.

Housing and feeding:
The goats were housed in slatted floor pens with one group of goats in one pen at nights. But during the day, they were tethered to the feeding racks on gravelled ground under a sun shed. All goats received a basal diet i.e. about 5 hours grazing plus cut grasses. However, the goats belonging to group C, group D and group E were supplemented with good fodder (i.e., high nitrogen fodder available during the experimental period) at the rate of 3% of the body weight, commercial concentrate feed at the rate of 1% of the body weight and urea molasses block free access over night respectively. The supplementary feed was offered daily at 7.30 to 8.30 am.

Infection of the animals:
After one-month pre infection monitoring period, all goats were infected during the second week of April 1997 with Fasciola gigantica metacercariae at the rate of 8 metacercariae per kg body weight as described by Mahato (1993). Fasciola gigantica metacercariae used to infect the goats were obtained from naturally infected snail, Lymnaea auricularia race rufescens in the eastern hills of Nepal.

Monitoring of the experiment:
Quantity and quality of feed:
Feed intake (basal and supplement) of the goats were determined daily. Daily dry matter estimation of only supplementary fodder and concentrate was carried out at PAC. While basal feed (pasture grass and cut grass samples) were only dried and stored. The stored dried samples of basal as well as supplementary fodder and concentrate feed were pooled each week and stored for dispatching to Centre for Tropical Veterinary Medicine (CTVM), Edinburgh University for detail nutritional analysis such as Crude protein, Acid detergent fibre (ADF), Neutral detergent fibre (NDF), Gross energy (GE), Ash, Organic matter (OM) etc.
Strategies for feed management in areas endemic for fasciolosis

Measurement of weight gain:
The animals were weighed at weekly intervals at 8.0-8.30 am before feed and water was provided. The weighing was done with the help of Rudweigh electronic balance (Rudweigh Australia Limited).

Sample collection and examination:
Faecal samples were collected directly from the rectum and examined on the same day for helminth eggs. The differential centrifugal flotation technique developed by Sewell and Hammond (1972) were used for the faecal examination.

The blood samples for haematological studies were taken from the jugular vein into vacutainers containing ethylene di-amine tetra acetic acid (EDTA) as an anticoagulant and examined on the same day. The following studies namely, total and differential leucocyte counts, erythrocyte counts, eosinophil counts, packed cell volumes and haemoglobin estimation were carried out at PAC.

The blood samples for biochemical and serology were also obtained from the jugular vein into OX-F and plain vacutainers (Becton, Dickinson & Co. Ltd. UK). The biochemical study was carried out at Central Veterinary Laboratory (CVL) Kathmandu which includes Total serum protein, Serum albumin, Serum globulin, Plasma glucose, Beta hydroxybutyrate, while serological study namely, Serum glutamate dehydrogenase (GLDH) and Serum gamma glutamyl transpeptidase (GGT) was carried out at PAC.

All sampling were carried out at weekly intervals between 8.30 and 9.30 am.

Recovery, counting and measuring the flukes:
The procedure for the recovery, counting and measuring the flukes was used as described by Mahato (1993).

Pathology:
Post-mortem examination was carried out on all animals as soon as possible after they were humanely killed. A careful examination was made of all internal organs for abnormalities, with particular attention to the size, weight, colour and appearance of the livers.

Histopathology:
Samples of liver and other tissues were fixed in 10% buffered formal saline and dispatched to CVL, Kathmandu for Histological study.

Carcass evaluation:
After post-mortem examination, the goat carcasses were processed for dressing out percentage. This includes weight of dressed carcass including shaved skin and edible offal as a percentage of the live weight of the animal.

RESULTS:
The analysis of samples is being done at CTVM, CVL and Central Lab PAC. The results that are present at hand are summarised and presented below.

Growth rate:
The growth rate 60.9 g/d is higher in group D (Concentrate supplement) followed by 52.53 g/d in group C (Good fodder supplement), 46.9 g/d in group E (Urea molasses block), 40.51 g/d in group B (Basal diet only) and 38.89 g/d in group A (Basal diet and treatment) table 2.

The mean body weight at 33 week post infection (wpi) and the mean body weight gained by goats over 33 weeks are also higher in group D followed by group C, group E, group B and group A.
Table 2: Growth rate of the goats

<table>
<thead>
<tr>
<th>Observations</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
<th>Group E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean growth rate (g/d)</td>
<td>38.89</td>
<td>40.51</td>
<td>52.53</td>
<td>60.90</td>
<td>46.90</td>
</tr>
<tr>
<td>Initial mean body weight (kg)</td>
<td>±1.73</td>
<td>±1.69</td>
<td>±1.79</td>
<td>±1.65</td>
<td>±1.43</td>
</tr>
<tr>
<td>Mean body weight at 33 weeks (kg)</td>
<td>±4.60</td>
<td>±2.95</td>
<td>±4.42</td>
<td>±4.52</td>
<td>±3.15</td>
</tr>
<tr>
<td>Mean body weight gained (kg)</td>
<td>9.00</td>
<td>9.29</td>
<td>12.14</td>
<td>14.07</td>
<td>10.84</td>
</tr>
</tbody>
</table>

Dry matter intake:
The total dry matter intake by goats can only be summarised and estimated when detail result of feed (basal and supplementary) and concentrate would be available from CTVM. However, total dry matter intake by goats belonging to group C and group D and total urea molasses block consumed by goats belonging to group E are presented in table 3.

Slaughtering of animals:
The goats were slaughtered at 33 weeks period. Immediately after slaughter a careful post-mortem examination was carried out to observe any pathological changes in the internal organs. But no any major pathological changes except some changes in the liver and gall bladder were observed. Liver flakes recovered from the slaughtered animals are presented in table 4.

Table 4: Liver fluke Recovery

<table>
<thead>
<tr>
<th>Fluke</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
<th>Group E</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Large</td>
<td>40</td>
<td>33</td>
<td>23</td>
<td>53</td>
<td>57</td>
<td>166</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>33</td>
<td>23</td>
<td>55</td>
<td>61</td>
<td>173</td>
</tr>
</tbody>
</table>

The dressing out percentage of individual animal and groups is presented in table 5. Weight of dressed carcass including shaved skin and edible offal (as per local practice) is the live weight of the animal. The edible offals are heart, lungs, kidney, spleen, live including intestines.

Table 5: Dressing out percentage

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
<th>Group E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>62.83</td>
<td>61.10</td>
<td>54.29</td>
<td>67.08</td>
<td>61.33</td>
</tr>
<tr>
<td>SD</td>
<td>±2.74</td>
<td>±6.03</td>
<td>±5.11</td>
<td>±6.07</td>
<td>±4.79</td>
</tr>
</tbody>
</table>
Fasciolosis 2000 - Nepal
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GENERAL OBSERVATION:
In group A, animal number 2 achieved negative growth rate (-1.29 g/d). This animal was exhibiting clinical signs of gid (Coenurus cerebralis) 2 months after the running of experiment. It was losing weight at every weighing up to 20 week post infection (wpi) with Fasciola gigantica metacercariae. However, it started to regain its weight right after drenching with Triclabendazole at 20 wpi. At the time of slaughtering it merely achieved its initial weight. At post-mortem examination fully grown cyst of Ceonurus cerebralis was isolated from the posterior part of the brain.

The goats observed losing daily intake of feeds when there were foggy as well as rainy days. This resulted into losing of body weight in comparison to the last week record.

The goats were also affected by respiratory disease when there were foggy days. The clinical signs include nasal discharge and coughing. The goats having serious problem with this condition found swelling of face, mucopurulent nasal discharge, intermittent coughing and respiratory distress. The sick goats were treated successfully with corticosteroid and antibiotics after conducting sensitivity test.

CONCLUSION
The growth performance of goats belonging to concentrate group was higher followed by Fodder group and Urea molasses block group in comparison to control group and treatment group.

The dressing out percentage of goats belonging to concentrate group was also higher followed by Fodder group, Treatment group, Urea molasses group and Control group.

Liver fluke recovery was higher in the goats belonging to the Concentrate group followed by Urea molasses block group, Control group and Fodder groups. However, the condition of liver was fine, without prominent damage in the supplement groups in comparison to control group.

This suggests that the goats supplemented with extra nutrition on top of their daily diet are capable of tolerating ill effects of flukes than the non-supplement goats.

Least liver fluke recovery from Fodder group suggests that the tree fodder are capable of reducing establishment of flukes in the liver of goat.

Above results indicate that the tree fodder supplement along with basal diet would be the best strategy to ameliorate the losses caused by fasciolosis in goats.

In our context, tree fodder are easily available and affordable by the farmers in comparison to broad spectrum anthelmintic, concentrate feed and urea molasses block, and therefore, this technology would probably be an alternative for combating fasciolosis.

REFERENCES:


1 Animal I
2 Centre fo 44 131 65
gilosis 2000 - Nepal

is endemic for gilosis.

Fasciolosis is now a well recognised parasitic disease of economic importance since it is one of the
major causes of losses of livestock production and productivity in Nepal. The disease is widely spread
at all ecological zones of the country including in the Yakas of the Himalayas (Joshi and Tewari (cited
by Mahato et al. 1997). The prevalence of gilosis in buffaloes in the hills and Terai are 57.9 and
41.3% respectively (Mahato, 1993). The prevalence of the disease depends upon the various feeding
and management practices. Therefore, reduction or the control of the prevalence of this disease could
be either through the improvement in the existing feeding management systems or through drenching
with appropriate anthelmintics. Various anthelmintic drugs are available in the country to control the
disease but they are expensive for a farmer to afford, those available are often found inferior in
gility. Drenching with anthelmintics twice a year is the recommended practice to control gilosis
in Nepal, however the local farmers find it tedious to follow this as a routine procedure or find the
drug unaffordable or drench the animals once a while only when the animals are already ill.

Over the past, various efforts have been made to control the disease from both the private or the
government sectors. However, the overall efforts to control this disease through the use of drug have
largely been a failure. The control measures must be appropriate to the livestock production systems
practised by the local farmers, otherwise the intended beneficiaries simply will not use them.

Therefore, an alternative cost-effective approach to control the production losses due to gilosis
would be through correcting the existing feed management system of the farmers. This approach
which requires no extra investment would be an effective alternative.

1 Animal Health Division, Tripureshwor, Kathmandu, Phone: +977-1-261569, Fax: +977-1-261521
2 Centre for Tropical Veterinary Medicine, Easter Bush, Roslin, Midlothian EH25 9RG, Scotland, Tel:
+44 131 650 6217

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system to counter-act the problem associated with low production due to fasciolosis. In this perspective a study was taken to see whether the improved nutrition including the use of local nutrient resources (e.g. tree fodder) could be an alternative means to control the fasciolosis problem in buffaloes in the hills of east Nepal.

MATERIALS AND METHODS

Grouping of animals and allocation of treatment diets

A total of 40 male buffalo calves, aged between 7 months to 1.5 years having approximately 75 to 100kg live weight were purchased locally from mid and high altitude (above 1100 m) areas of Dhankuta district. The animals were grouped into 5, each group representing 8 animals and the groups were then randomly selected to represent the treatment. The details of the experimental plan is shown in Table 1, as follows:

Table 1: Experimental design

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of</th>
<th>Fasciola</th>
<th>Live wt</th>
<th>Diet</th>
<th>Treatment with</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>8</td>
<td>Yes</td>
<td>104±22</td>
<td>Basal plus Anthelmintics</td>
<td>Yes</td>
</tr>
<tr>
<td>Yellow</td>
<td>8</td>
<td>Yes</td>
<td>103±20</td>
<td>Basal only</td>
<td>No</td>
</tr>
<tr>
<td>Green</td>
<td>8</td>
<td>Yes</td>
<td>104±23</td>
<td>Basal plus Tree fodder</td>
<td>No</td>
</tr>
<tr>
<td>Blue</td>
<td>8</td>
<td>Yes</td>
<td>104±24</td>
<td>Basal plus Concentrate</td>
<td>No</td>
</tr>
<tr>
<td>White</td>
<td>8</td>
<td>Yes</td>
<td>105±20</td>
<td>Basal plus UMB</td>
<td>No</td>
</tr>
</tbody>
</table>

All the animals received basal diet i.e. seasonally available forages that include crop-residues, tree fodder and cut grasses.

As a basal diet, the top portion of the rice straw was provided ad libitum from February until April and the bottom portion of it from May until July whereas Monsoon grasses were supplied during July and September. These diets were supplied with portions of other forages including tree fodder, maize stover and husks and grasses depending upon their availability. The supplementary diets were concentrate feed (i.e. cattle feed from Hetauda cattle feed industry), good fodder (seasonally available tree fodder) and Urea Molasses Block (UMB) (Hetauda cattle feed industry).

The concentrate and the tree fodder were fed at 1% and 3% live wt basis respectively while the UMB was left in the night for ad libitum licking. Prior to the experiment all the animals were treated with Ivermectin, immunised against clostridia infections and dewormed using Albendazole (2.5%). The animals received drinking water at free access and the heat of the sun during winter.

Animal housing

The animals were accommodated in shed constructed with local materials to represent the local barn. The animals were tethered in separate groups in the shed or out side to allow animals to bask under the sun. During the middle of the experimental period, the animals at the extreme east pen were exchanged with the animals at the extreme west pen of the house and so on. The health status of the animals was regularly monitored and the animals were treated as necessary.

Infection of animals with metacercariae

All the experimental animals were infected with fasciola metacercariae at the rate of 2.5-numbers/kg live weight. One group of animals (Red group) was drenched with Fasinex (at double dose rate) against fasciolosis at 20 weeks post infection (WPI).

Prior to the experiment, the animals were allowed to undergo approximately 45 days adaptation period in order to accustom the animals with the diet. During the adaptation period the animals received their respective available f

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Statistical a

Comparison using the post-test

Economic a

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value.

RESULTS

Intake of feed

The average intake of the UMB during the post-test period was 70g/kg live weight.

Live weight:

The average weight of the Green group was 105±20 kg.
Fasciolosis 2000 - Nepal
Strategies for feed management in areas endemic for fasciolosis

In this use of local nutrient fasciolosis problem in approximately 75 to 1100 m) areas of animals and the group

<table>
<thead>
<tr>
<th>Treatment with</th>
<th>UMB</th>
<th>White</th>
<th>Red</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The control group received the “normal feed” available for feeding at that day or season.

Haematology and bio-chemical tests

The eosinophil counts were measured using the method of Dacie and Lewis (1963) using a modified Fuschs Rosenthal Chamber (Weber Scientific International Ltd, Lancing, England). The packed cell volume using Hawksley micro-haemocrit centrifuge and reader (Hawksley and Sons Ltd, Lancing, England). The haemoglobin was measured in the form of cyanmethaemoglobin. The activities of the serum enzymes Glutamate dehydrogenase (GLDH) and γ-glutamyl transpeptidase (GGT) were also measured in-vitro using kits, γ-GT and GLDH activated (Randox Laboratories Limited) at weekly interval.

Faecal examination

Faecal samples were collected weekly, directly from the rectum and examined on the same day for helminth eggs using the differential floatation technique (Sewell and Hammond, 1972).

Live weight gain

The animals were weighed at 8.00AM in the morning every week before feed and water was offered. The animals were weighed using an electronic scale (Electronic weigh bar system – model no 1200 KM3 Basic) until 28 WPI. From 29 WPI, because of the problem with the electronic scale, the animals were weighed out by measurement using the following formula by Yazman (1987):

\[
W = -71.1 + 1.74L + 1.05H
\]

Where:
- \( W \) = wt in kg
- \( L \) = body length from collar-bone to pin bone (cm)
- \( H \) = heart girth (cm)

Statistical analysis

Comparison of the difference between the means of the treatments was analysed by the analysis of variation using MINUAB software computer programme. The difference between or within means, the post-test was carried out using GraphPad Instat software computer programme.

Economic analysis

The economic value of the feed supplementation and anthelmintic drenching was calculated by subtracting the purchase price, the total supplement cost and the cost of fasciolocide from the carcass value.

RESULTS

Intake of feed supplements

The average intake of concentrate feed on dry matter basis was 0.80±0.39kg/d and that the average intake of the UMB was found to be 0.93±0.46 kg/d. Although the intake of the Concentrate and the UMB during the initial period was low, a gradual increase in the intake of both diets was recorded over the period as compared to the intake at the initial periods. The average intake of the dry matter of tree fodder was found to be 0.91±0.29kg.

Live weight gain

The average body weight (kg) gained by the Blue group was the highest followed by the White and the Green groups of animals. The Yellow (control) and the Red groups (anthelmintic drenched) were the groups with lowest live weight gains. The percentage of the weight gains at 37 WPI with respect
to the original average live weights were 26%, 31%, 44%, 69% and 43% for the Red, Yellow, Green, Blue and White groups respectively (Table 2). The overall mean live weight (kg±SD) from 0 to 37 weeks post infection is 109±10, 108±11, 121±14, 133±21 and 127±12 for Red, Yellow, Green, Blue and White Groups respectively (Table 2). The one way (repeated measure) analysis of variance indicated that the differences between the group means are extremely significant (p<0.0001). The mean live weight gained by the animals between the Red or Yellow groups and the other groups of animals was significantly different (p < 0.05).

Table 2: Average live weight of Buffaloes

<table>
<thead>
<tr>
<th>Group</th>
<th>Average Initial Body wt (kg)</th>
<th>Average live wt at 37 WPI</th>
<th>Average gain in wt (Kg)</th>
<th>Mean live wt ±STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>104±22</td>
<td>132±33</td>
<td>28</td>
<td>109±10*</td>
</tr>
<tr>
<td>Yellow</td>
<td>103±20</td>
<td>135±32</td>
<td>32</td>
<td>108±11*</td>
</tr>
<tr>
<td>Green</td>
<td>104±23</td>
<td>148±35</td>
<td>44</td>
<td>121±14*</td>
</tr>
<tr>
<td>Blue</td>
<td>104±24</td>
<td>176±47</td>
<td>72</td>
<td>133±21*</td>
</tr>
<tr>
<td>White</td>
<td>105±20</td>
<td>150±36</td>
<td>45</td>
<td>127±12*</td>
</tr>
</tbody>
</table>

*The group means with different subscripts in a column differ significantly from one another.

The growth rate trend based on the calculation of a difference between the weekly weight gain and the initial weight is shown in the Figure 1. The animals in the Red and Yellow groups gradually lost their body weights after they were infected with metacercariae but gained some weights from 26 weeks after infection.

Blood values and serum enzymes

To monitor the fasciola infection, the serum enzymes were measured for the activities of GLDH and GGT. The results showed an increasing trend in the activities of GLDH after the animals were infected with metacercariae until 12 weeks post infection. Thereafter, the activity remained almost stationary until the end of the experiment. The GLDH level in the Red group of animals was found to be least followed by the Green, White and Blue groups of animals. The activity was the highest in the Yellow groups of animals. No general trend in the levels of GGT was observed between the groups of the animals. The blood values were also measured for Eosinophils counts, Hb and PCV levels so as to monitor the intensity of the infection.
In all the animal groups, the general trend of the Eosinophil counts was that the levels raised at 9, 17 and 18 weeks post infection with metacercariae. The level dropped at 20 with a sharp rise in the 30 weeks periods. The difference in the means of the Eosinophil counts among the groups was highly significant (p<0.001). The counts between the Red and Green or Blue groups was also highly significant (p<0.001).

The Haemoglobin (Hb) and Packed cell volume (PCV) levels were found to be comparatively lowest in the Yellow groups and lower in the Red groups as compared to the other treatment groups of animals. The difference in the Hb and PCV among the mean values of the groups was extremely significant (p<0.0001). While making multiple comparisons, the difference between the means of Hb or PCV of the Yellow group was extremely significant (p<0.001) from the means of Hb or PCV of the other treatment groups. Whilst the Hb or PCV means of the other groups were not significantly different (p>0.05). The animals of the Yellow group showed a progressive drop in the mean Hb and PCV levels from 2 to 3 weeks after infection while, the other groups maintained their original levels i.e. the other groups including the Red group (anthelmintic drenched animals) have shown more or less similar pattern in the levels of PCV and Hb. However, it was found that the Hb or PCV levels was comparatively the highest in the Green group followed by the Yellow and Blue groups of animals.

Fasciola eggs were detected in the faeces of the animals in the Yellow groups at 5 weeks after the animals were infected with metacercariae. However, from 12 to 13 weeks post infection only the eggs were detected from all other groups of animals. The egg counts rose sharply from 15 weeks which remained more or less in the same pattern until the end of the experiment except in the Red groups. As no any helminth eggs were recovered from the faeces of the Red group of the anthelmintic drenched animals, this has shown that the anthelmintic treatment was effective to control the animals from fasciola infection. The weekly recovery of the helminth eggs recovered from the Yellow, Green, Blue and White groups of animals are shown in Figure 10.

The one way analysis of variance showed that there are significant differences among the EPG counts among the means of the groups. The multiple comparison between the means revealed that the Red and the Yellow groups are very significant (p<0.01) whereas the other means are insignificant (p>0.05) when compared one another.

At the end of the experiment i.e. 37 weeks post infection the animals were slaughtered using a humane killer. The internal organs were examined for any abnormalities. The examination included size and colour of the liver, size and condition of the gall bladder, condition of the bile and any abnormalities of these organs. The carcasses were examined with particular attention given to the condition of the liver. The number of flukes found in each liver and the duct was noted.

Only one fluke was recovered from one of the animals of the Red group. An average of 45 to 65 numbers of adult flukes was recovered from the ducts of the other groups of animals. The number of flukes recovered was ranging from a minimum of 10 to a maximum of 110. The average percentage of flukes recovered from each of the Yellow, Green, Blue and White groups was 23.9%, 18.16%, 20.16% and 15.11% respectively.

Dressing out percentage and body condition score

The dressing-out percentage given in Table 3 was calculated considering the weight of dressed carcass including edible offal (heart, spleen, liver and guts) calculated as a percentage of the live weight of the animal at slaughter (Table 3). The difference in the dressing out percentage among the group means was found highly significant (p<0.001).

The mean dead weights of the groups of animals were compared (Figure 2). The dressing out percentage was highest in the Blue group followed by the Green group. The difference between the means was insignificant (p > 0.05).
Fig. 2 Average dead weights of buffaloes

![Average dead weights of buffaloes](image)

**Table 3: The dead wt and dressing out percentages**

<table>
<thead>
<tr>
<th>Animal group</th>
<th>Total carcass</th>
<th>Carcass + Offals</th>
<th>Dead wt</th>
<th>Dressing-out (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>37.61±12.83</td>
<td></td>
<td>50.00±12.94</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Offals include liver and guts. The group means with different subscripts in a column differ significantly from one another.

On the slaughter day, the animals were inspected for body condition score. The average body condition score (1 to 5 scale) of the Red, Yellow, Green, Blue and White groups were 1.5, 1, 2, 3 and 2 respectively. The Blue group of animals looked heavier and healthier followed by the White or the Blue groups of animals.

The post-test following ANOVA (F test) for comparison of the means are presented in Table 4.

**Table 4: Post-test following ANOVA (F test) for comparison of the means.**

<table>
<thead>
<tr>
<th>Comparison of groups</th>
<th>Mean difference</th>
<th>Bonferoni p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red group vs. Yellow group</td>
<td>1</td>
<td>NS (p&gt;0.05)</td>
</tr>
<tr>
<td>Red group vs Green group</td>
<td>-11</td>
<td>** (p&lt;0.01)</td>
</tr>
<tr>
<td>Red group vs Blue group</td>
<td>-21</td>
<td>*** (p&lt;0.001)</td>
</tr>
<tr>
<td>Red group vs White group</td>
<td>-16</td>
<td>*** (p&lt;0.001)</td>
</tr>
<tr>
<td>Yellow group vs Green group</td>
<td>-12</td>
<td>** (p&lt;0.01)</td>
</tr>
<tr>
<td>Yellow group vs Blue group</td>
<td>-22</td>
<td>*** (p&lt;0.001)</td>
</tr>
<tr>
<td>Yellow group vs White group</td>
<td>-17</td>
<td>*** (p&lt;0.001)</td>
</tr>
<tr>
<td>Green group vs Blue group</td>
<td>-10</td>
<td>* (p&lt;0.05)</td>
</tr>
<tr>
<td>Green group vs White group</td>
<td>-5</td>
<td>NS (p&gt;0.05)</td>
</tr>
<tr>
<td>Blue group vs White group</td>
<td>5</td>
<td>NS (p&gt;0.05)</td>
</tr>
</tbody>
</table>

Probability is only 5% that any one (or more) of the comparisons would be significant with 'p<0.05' by chance alone.
Economic analysis

Considering the economy of feed supplementation, it appeared that the greatest profit, Rs. 514.00 was achieved from the group C i.e. the animals in the tree fodder supplemented group. The cost of the other feed costs, housing and labour have been made to zero assuming that these are available with a farmer (Table 5).

Table 5: Economic value of feed supplementation and use of fasciolicide

<table>
<thead>
<tr>
<th>Animal Groups</th>
<th>Value</th>
<th>Carcass wt</th>
<th>Guts</th>
<th>Liver</th>
<th>Head</th>
<th>Skin</th>
<th>Carcass value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Red</td>
<td>Yellow</td>
<td>Green</td>
<td>Blue</td>
<td>White</td>
<td></td>
<td></td>
</tr>
<tr>
<td>supplementation</td>
<td>56</td>
<td>2106</td>
<td>2282</td>
<td>2919</td>
<td>3750</td>
<td>2684</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplements</th>
<th>Red</th>
<th>Yellow</th>
<th>Green</th>
<th>Blue</th>
<th>White</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree fodder</td>
<td>0.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urea molasses</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Concentrate feed</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Triclabendazole</td>
<td>0.5</td>
<td>80</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Total supplement costs</td>
<td>80</td>
<td>40</td>
<td>108</td>
<td>2920</td>
<td>3388</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other feeds</th>
<th>Red</th>
<th>Yellow</th>
<th>Green</th>
<th>Blue</th>
<th>White</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree fodder</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Green forages</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rice straw</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maize stover</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maize sheath</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total other feed costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Others</th>
<th>Red</th>
<th>Yellow</th>
<th>Green</th>
<th>Blue</th>
<th>White</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Labour cost</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Purchase price of animal</td>
<td>3200</td>
<td>3200</td>
<td>3200</td>
<td>3200</td>
<td>3200</td>
</tr>
<tr>
<td>NET Profit</td>
<td>-352</td>
<td>-110</td>
<td>514</td>
<td>-1363</td>
<td>-3013</td>
</tr>
</tbody>
</table>

When the cost of tree fodder and the crop-residues were halved assuming that 50% of them are available to a household for feeding to their animals, the benefit was found to be negative for all treatments. The loss was calculated to be 4117, 3875, 3251, 5128 and 6778 for the Red, Yellow, Green, Blue and White groups of animals respectively.

As the animals were bought through a chain of 2 to 3 contractors, the real purchase price should have been different. To confirm this it was understood from a few of the suppliers that the real price was approximately Rs1000 to 1200 less than the price offered by ARSP. Therefore, if we consider the real purchase price then the Red, Yellow and the Green groups will be in profit whereas the Blue and White group will still be in loss.

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DISCUSSIONS

Effect of treatments on live weight gains

As expected, the animals supplied with concentrate diets (Blue group) and the UMB (White group) gained more or less similar weights (p > 0.05). Interestingly, the Green group of animals fed with tree fodder also attained statistically similar (p > 0.05) weight gains to the White group. This has clearly indicated that the tree fodder supplied only at 3% live wt (fresh wt basis) could supply as much of nutrients as UMB could supply. This has clearly shown that the biological requirements of the nutrients by animals are related to the protein types rather than the other nutrients only. The tree fodder considered as the potential nutrient suppliers for ruminants particularly during the dry season in the hills of Nepal, are rich in protein content as well as anti-nutrients such as tannin (Subba, 1999). The supplementary tree fodder that was fed to the animals was composed largely of the Ficus spp trees supplying more than 12% of Crude protein. The protein fractionates available in these species are both the rumen soluble protein and the tannin bound protein. The bound protein could be freed in the lower gut for complete availability to the host ruminants at tissue level. However, the positive role of the phenolic compounds and their association with the improvement in the livestock performances has not yet been fully understood.

There was no effect of the treatment on the weight gains in the animals of the Red group although they were treated against liver flukes. It appears therefore that the animals in the Red and Yellow groups did not receive sufficient amount of nutrients from the supplied basal diets for growth as compared to the other 3 groups of animals. Both the groups of animals were loosing their weights until 21 WPI and regained weights from 21WPI onwards. The negative weight gains between 8 and 17 weeks post infection could be associated with the poor dry matter intake of the supplied feeds by the animals. The animals received rice straw in the form of basal diet until 18 WPI; the top portion of the rice straw was fed until 12 WPI and the bottom portion until 18 WPI. The poor performance could also be related to the animal housing which had been severely effected by the heavy and persistent rainfall of the monsoon. As a result the animals were partially limited to the access of fresh fodder as basal diet and the rice straw has low voluntary feed intake with poor digestible crude protein and dry matter digestibility as a result of the contents of lignin and biogenic silica. On the other hand, apart from the basal diets, the other three groups of animals received additional nutrients through the supplementary feed i.e. tree fodder, Concentrate feed and UMB. It can therefore be argued that the low body weight gains in the Yellow and Red groups of animals was related to the inadequacy in the dietary supply of nutrients. To support this argument, however, there is a need to experiment on the nitrogen balance of these diets.

While comparing the body condition score among the groups, the feed supplemented groups scored higher than either the Yellow (control) or Red (anthelmintic) groups. It is anticipated that the Green, Blue and White groups of animals might have compensated through supplementary feeds for protein losses as a result of fasciolosis. Whilst, the Red or the Yellow groups of animals might have lacked the nutrients particularly nitrogen to counter balance protein losses, hence the poor body conditions in the Yellow or Red groups as compared to the other groups of animals.

The study has shown that the local practice of supply of feed is not enough to improve immunity and compensate protein losses as a result of fasciola infection. Therefore, additional supply of nutrients particularly nitrogen is required to optimise the productivity of animals infected with liver flukes. The animals whether requires rumen degradable nitrogen supply or duodenum available protein supply is an area worth investigating. As the tree fodder (Green group) (which contains both rumen degradable and rumen by pass protein) and the UMB (White group) (contains rumen degradable protein only), the performances of the animals of both the groups are similar. It appears therefore that if animals were

The rectum to a man: buffalo flukes in metacercaria being used a storage tank manager show an excess of fasciolosis Red grove of these intake a: and the livermeat: however meaning the prod

Dressin;

As the a

Econom

Although animals, involved supplement feeding incidenc

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supplied with more tree leaves (i.e., more than 3% live wt.), the performances of the animals could have been further improved.

Fasciola infection and post-mortem examination

The recovery of the flukes was ranged from a minimum of 4% (in the animal no 3 of the White group) to a maximum of 45% (in the animal no 2 of the Blue group). Although the recovery of flukes in buffaloes in another experiment by Mahato (1993) was more or less similar, the low recovery of the flukes in this experiment could be because of either poor viability or the poor infectivity of the metacercariae. Due to some reasons, the metacercariae were stored for a quite longer period before being used to infect the animals. The viability of the metacercariae might have been lost during storage as a result of lack of dissolved oxygen. The other reasons involved could be the nutrition and management practices of the host animals. At this range of the fluke burdens, the animals did not show any signs of fasciolosis. The clinical signs of fasciolosis could be evident at fluke burdens in excess of 144 (Mahato, 1993). However, one of the other 3 animals of the Yellow group that died during the experiment had carried a total of 421 flukes and had shown prominent features of fasciolosis e.g., depraved appetite, bottle neck etc. The other 2 animals from the Yellow and 1 from the Red group which carried less than 32 flukes, did not show any clinical signs of fasciolosis. The death of these animals could have been due to the association of the infection of flukes and the reduced feed intake as a result of weakness through an outbreak of severe dermatitis. One animal each of the Red and the Yellow group, which also suffered from dermatitis, were recovered after treatment with Ivermectin. This study has also shown that anthelmintic drenching to the animals is effective, however, the treatment is not sensible at lower fluke loads. In other words, the anthelmintics become meaningful only when treated to the animals loaded with heavier flukes that have profound effect on the productivity.

Dressing out percentage

The dressing out percentage was highest in the Blue group followed by the Green group (Table 2) as compared to the other treatment groups. It is interesting to note that the mean dressing out percentage was insignificant between Red, Yellow or White groups of animals. As the measurement of body wt alone could underestimate the extent of production losses in ruminants (Mahato, 1993), the measurement of dressing out percentage or carcass yield becomes a necessary step to evaluate the efficiency of feed supplementation. In comparison to the 72% weight attained by Blue groups, the weight lost by the Red, Yellow, Green and White groups was 61%, 56%, 39% and 38% respectively (Table 1). The rationale behind these heavy losses in the Red group of animals is unclear. As earlier mentioned, the only reason of reduced productivity could be attributed to the poor quality of the basal diet. However, further study should be made to confirm and understand the consequences.

Economic analysis

As the anthelmintic drugs or the UMB or the Concentrate feeds did not justify the cost (Table 3), the alternative methods of managing the disease to employ will be the use of tree fodder as every house hold maintains tree fodder sufficient for their animals at least for the dry winter season. Also, the Blue group of animals performed better than either the Green or White groups of animals, promotion of the Concentrate or UMB feeding is not cost effective. Considering the cost involved and the accessibility of the Concentrate or UMB, the tree fodder could be genuine supplementary feed resource for nutrients for ruminants particularly the buffaloes. Along with the feeding of tree leaves, prevention of animals grazing fasciola infected forages will further lower the incidence rate of fasciolosis thereby increasing the productivity of the animals.
CONCLUSION
The results showed that the supplementation of concentrate feed daily at the rate of 1% per kg body weight is the best among other treatments in terms of the production yield i.e. live weight gain and carcass weight. However, considering the cost effectiveness and technology adoption risks, feeding of tree leaves at 3% live weight would be most appropriate for consideration. The efficiency of feed conversion can further be improved, if the animals are prevented from eating fasciola infected forages.

Future areas of research
It has been understood that the use of tree fodder as a supplement is an effective approach to minimise production losses in livestock caused by fasciolosis. The positive response could be associated with Tannin or the compensation of protein of the trees to the losses due to fasciola infection. It is necessary to study on the use of tannin rich tree fodder and examine their fasciola inactivating properties. Also, screening of local herbal materials recognised by local farmers having molluscicidal properties need to be fully investigated to effectively use to control this important disease.

The study has also shown that the quality of the local feed supply was not enough to a level sufficient to the production of an animal. Nutrients balance trials of the local feeds would therefore be worthwhile to confirm this argument.

ACKNOWLEDGEMENTS
Thanks are due to the laboratory staff of the ARS-Pakhris both past and present, particularly to Mr LB Rai, Mrs M Rai and Mrs Y Basnet for their excellent technical support. Thanks are also due to Mr C B Nepal and the hard working team of labourers for efficient record keeping, feeding and taking care of the experimental animals. The financial support of the DFID, UK is gratefully acknowledged.

REFERENCES
A FINANCIAL ASSESSMENT OF STRATEGIES TO MANAGE FASCIOLOSIS IN GOATS IN EASTERN NEPAL

R. Anne Pearson and Peter Holloway
University of Edinburgh, Department of Tropical Animal Health, Centre for Tropical Veterinary Medicine, Easter Bush, Roslin, Midlothian, Scotland, UK, EH25 9RG.

INTRODUCTION

The purpose of this study was to construct simple financial models using data available from the experiment investigating locally derived feed management techniques compared to drug treatment in Fasciola gigantica infected goats (see paper by Dr B Pakhrin). The economic value of different management techniques in the control of fasciolosis was examined. The economics of dietary supplements were compared with the economics of drug control to help identify the most cost-effective techniques to manage fasciolosis in goats in Eastern Nepal. The models can be used as an aid to decision making in determining cost-effective and appropriate control measures for fasciolosis.

METHODS

The information collected from the previously described, goat experiment on intake of supplements, and the comparative effects of the nutritional treatments and drug treatment, on live weight gain, were used along with current information (1998) on supplement, product and meat prices to construct simple financial models. The following figures were used in the financial analyses. The cost of the drug used in the analysis was 32.5 NRs per 900 mg tablet of triclabendazole. A dose of triclabendazole of 1.2 mg/kg was used to drug treat the goats when they weighed approximately 22 kg. Tree fodder was costed at 5 NRs/kg fresh weight. Each goat in the fodder-supplemented group was estimated to have consumed a total 95 kg of tree fodder as supplement during the period of study. Concentrate was priced at 11.3 NRs/kg with goats in the concentrate treatment group having consumed a total of 41 kg during the study. Consumption of urea molasses block by each goat was estimated at 29 kg and a blocks were costed at 13 NRs/kg. Performance and intake data was taken from the five goats in each group, which at examination post-mortem had been shown to have a positive fluke count.

ASSUMPTIONS

In creating the spreadsheet models certain assumptions were made:

- No cost was included for routine husbandry or the basal diet. Also no account was taken of the cost of additional drugs, vaccinations, cost of buildings or infrastructure. The reasons for this were that such values were considered to be constant or similar for each group and so would make little overall difference when comparisons of profitability were made. Furthermore, for most subsistence farmers the majority of these inputs will not carry any significant monetary cost.

RESULTS

Spreadsheet 1
This spreadsheet represents the scenario when the actual costs of the drugs and food supplements used during the course of the experiment are used in the financial model. From this spreadsheet it can be seen that the greatest profit, 387 NRs, occurred in the group treated with triclabendazole at 20 weeks post infection. The second most profitable management method was feeding supplementary concentrates with a net profit of 334 NRs. Following this the most profitable form of management was the control group where the goats received no supplement or molluscicide. The use of the urea molasses block was barely profitable at all and the tree fodder group actually made a loss.
### Spreadsheet 1: Incorporating the Actual Cost of Supplements and Fasciolocide Used in Goat Experiment

<table>
<thead>
<tr>
<th></th>
<th>Basal</th>
<th>+</th>
<th>+ Fodder</th>
<th>+ Conc'n</th>
<th>+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase price (NRs)</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>Mean initial weight (kg)</td>
<td>11.48</td>
<td>11.82</td>
<td>11.64</td>
<td>11.94</td>
<td>11.90</td>
</tr>
<tr>
<td>Mean live weight gain (g/d)</td>
<td>37.96</td>
<td>46.18</td>
<td>40.30</td>
<td>63.20</td>
<td>41.86</td>
</tr>
<tr>
<td>Total weight gain (kg)</td>
<td>8.77</td>
<td>10.67</td>
<td>9.31</td>
<td>14.60</td>
<td>9.67</td>
</tr>
<tr>
<td>Body weight at 33wks</td>
<td>20.25</td>
<td>22.49</td>
<td>20.95</td>
<td>26.54</td>
<td>21.57</td>
</tr>
<tr>
<td>Killing out percentage</td>
<td>61.10</td>
<td>62.80</td>
<td>64.30</td>
<td>62.80</td>
<td>61.30</td>
</tr>
<tr>
<td>Meat value (NRs/kg)</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Carcass value (NRs)</td>
<td>1,485</td>
<td>1,695</td>
<td>1,616</td>
<td>2,000</td>
<td>1,587</td>
</tr>
<tr>
<td>Supplement cost (NRs/kg)</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>11.3</td>
<td>13</td>
</tr>
<tr>
<td>Total supplement intake</td>
<td>0</td>
<td>0</td>
<td>95.7</td>
<td>41.2</td>
<td>29.2</td>
</tr>
<tr>
<td>Total supplement cost</td>
<td>0</td>
<td>0</td>
<td>479</td>
<td>466</td>
<td>380</td>
</tr>
<tr>
<td>Fasciolocide cost (NRs/mg)</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0</td>
</tr>
<tr>
<td>Fasciolocide dose (mg)</td>
<td>0</td>
<td>268.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fasciolocide x. cost (NRs)</td>
<td>0</td>
<td>107.52</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net profit (NRs)</td>
<td>285</td>
<td>387</td>
<td>-62</td>
<td>334</td>
<td>7</td>
</tr>
</tbody>
</table>

### Spreadsheet 2

In this model the cost of tree fodder has been reduced to zero. This assumes that most farmers are able to collect their own tree fodder without charge from communal or private sources. If the cost of tree fodder is reduced to zero then the tree fodder supplement, becomes the most profitable group (416 NRs), followed by the drug treated group (387 NRs), then the concentrate group (334 NRs). This suggests that tree fodder can be an extremely effective form of supplement in fasciolosis control if it can be provided at very low cost and no labour charges are incurred in collection.

### Spreadsheet 2: The Cost of the Tree Fodder Supplement is Reduced to Zero While all Other Supplement Costs Remain Unchanged

<table>
<thead>
<tr>
<th></th>
<th>Basal</th>
<th>+</th>
<th>+ Fodder</th>
<th>+ Conc'n</th>
<th>+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase price (NRs)</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>Mean initial weight (kg)</td>
<td>11.48</td>
<td>11.82</td>
<td>11.64</td>
<td>11.94</td>
<td>11.90</td>
</tr>
<tr>
<td>Mean live weight gain (g/d)</td>
<td>37.96</td>
<td>46.18</td>
<td>40.30</td>
<td>63.20</td>
<td>41.86</td>
</tr>
<tr>
<td>Total weight gain (kg)</td>
<td>8.77</td>
<td>10.67</td>
<td>9.31</td>
<td>14.60</td>
<td>9.67</td>
</tr>
<tr>
<td>Body weight at 33wks</td>
<td>20.25</td>
<td>22.49</td>
<td>20.95</td>
<td>26.54</td>
<td>21.57</td>
</tr>
<tr>
<td>Killing out percentage</td>
<td>61.10</td>
<td>62.80</td>
<td>64.30</td>
<td>62.80</td>
<td>61.30</td>
</tr>
<tr>
<td>Meat value (NRs/kg)</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Carcass value (NRs)</td>
<td>1,485</td>
<td>1,695</td>
<td>1,616</td>
<td>2,000</td>
<td>1,587</td>
</tr>
<tr>
<td>Supplement cost (NRs/kg)</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>11.3</td>
<td>13</td>
</tr>
<tr>
<td>Total supplement intake</td>
<td>0</td>
<td>0</td>
<td>95.7</td>
<td>41.2</td>
<td>29.2</td>
</tr>
<tr>
<td>Total supplement cost</td>
<td>0</td>
<td>0</td>
<td>479</td>
<td>466</td>
<td>380</td>
</tr>
<tr>
<td>Fasciolocide cost (NRs/mg)</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0</td>
</tr>
<tr>
<td>Fasciolocide dose (mg)</td>
<td>0</td>
<td>268.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fasciolocide x. cost (NRs)</td>
<td>0</td>
<td>107.52</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net profit (NRs)</td>
<td>285</td>
<td>387</td>
<td>-62</td>
<td>334</td>
<td>7</td>
</tr>
</tbody>
</table>
Here the price of the fasciolocide has been increased by 100%, from 0.4 NRs/mg to 0.8 NRs/mg. In this situation there is no financial benefit in treating with fasciolocide because the additional liveweight gain achieved is outweighed by the cost of the drug. The net profit from the control group, 285 NRs, is approximately the same as that from the triclabendazole treated group, 280 NRs. Thus the use of triclabendazole is only of economic advantage when its cost is not too high, in this situation less than 0.8 NRs/mg.

**Spreadsheet 3: The Cost of the Fasciolocide is Doubled While all Other Costs Remain Unchanged from the Actual Goat Experiment**

<table>
<thead>
<tr>
<th>Purchase price (NRs)</th>
<th>Basal</th>
<th>+ 1,200</th>
<th>+ Fodder</th>
<th>+ Conc’n</th>
<th>+ UMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean initial weight (kg)</td>
<td>11.48</td>
<td>11.82</td>
<td>11.64</td>
<td>11.94</td>
<td>11.90</td>
</tr>
<tr>
<td>Mean live weight gain (g/d)</td>
<td>37.96</td>
<td>46.18</td>
<td>40.30</td>
<td>63.20</td>
<td>41.86</td>
</tr>
<tr>
<td>Total weight gain (kg)</td>
<td>8.77</td>
<td>10.67</td>
<td>9.31</td>
<td>14.60</td>
<td>9.67</td>
</tr>
<tr>
<td>Body weight at 33wks</td>
<td>20.25</td>
<td>22.49</td>
<td>20.93</td>
<td>26.54</td>
<td>21.37</td>
</tr>
<tr>
<td>Killing out percentage</td>
<td>61.10</td>
<td>62.80</td>
<td>64.30</td>
<td>62.80</td>
<td>61.30</td>
</tr>
<tr>
<td>Meat value (NRs/kg)</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Carcass value (NRs)</td>
<td>1,485</td>
<td>1,695</td>
<td>1,616</td>
<td>2,000</td>
<td>1,587</td>
</tr>
<tr>
<td>Supplement cost (NRs/kg)</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>11.3</td>
<td>13</td>
</tr>
<tr>
<td>Total supplement intake</td>
<td>0</td>
<td>0</td>
<td>95.7</td>
<td>41.2</td>
<td>29.2</td>
</tr>
<tr>
<td>Total supplement cost</td>
<td>0</td>
<td>0</td>
<td>479</td>
<td>466</td>
<td>380</td>
</tr>
<tr>
<td>Fasciolocide cost (NRs/mg)</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Fasciolicide dose (mg)</td>
<td>0</td>
<td>268.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fasciolocide x. cost (NRs)</td>
<td>0</td>
<td>215.84</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net profit (NRs)</td>
<td>285</td>
<td>280</td>
<td>280</td>
<td>334</td>
<td>7</td>
</tr>
</tbody>
</table>

In this spreadsheet the cost of the concentrate has been halved. This assumes that the farmer is able to provide a comparable concentrate diet of his own making at a reduced cost. Since the majority of farmers feed their own selection of concentrates this is a reasonable assumption. If this is the case the financial gain from such a system is good. The profit from the concentrate fed group, becomes 565 NRs, almost 50 percent greater than the profit from the drug treated group, 387 NRs, where the goats are treated with fasciolocide. This serves to emphasise the importance of feeding supplementary concentrates when they are available as low cost 'by products.'
Spreadsheet 4: The Cost of the Concentrate Supplement is Halved While all Other Costs Remain Unchanged from the Actual Goat Experiment

<table>
<thead>
<tr>
<th>Purchase price (NRs)</th>
<th>Basal</th>
<th>+</th>
<th>+ Fodder</th>
<th>+ Conc'n</th>
<th>+ UMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>Mean initial weight (kg)</td>
<td>11.48</td>
<td>11.82</td>
<td>11.64</td>
<td>11.94</td>
<td>11.90</td>
</tr>
<tr>
<td>Mean live weight gain (g/d)</td>
<td>37.96</td>
<td>46.18</td>
<td>40.30</td>
<td>63.20</td>
<td>41.86</td>
</tr>
<tr>
<td>Total weight gain (kg)</td>
<td>8.77</td>
<td>10.67</td>
<td>9.31</td>
<td>14.60</td>
<td>9.67</td>
</tr>
<tr>
<td>Body weight at 33wks</td>
<td>20.25</td>
<td>22.49</td>
<td>20.95</td>
<td>26.54</td>
<td>21.57</td>
</tr>
<tr>
<td>Killing out percentage</td>
<td>61.10</td>
<td>62.80</td>
<td>64.30</td>
<td>62.80</td>
<td>61.30</td>
</tr>
<tr>
<td>Meat value (NRs/kg)</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Carcass value (NRs)</td>
<td>1,485</td>
<td>1,695</td>
<td>1,616</td>
<td>2,000</td>
<td>1,587</td>
</tr>
<tr>
<td>Supplement cost (NRs/kg)</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5.7</td>
<td>13</td>
</tr>
<tr>
<td>Total supplement intake</td>
<td>0</td>
<td>0</td>
<td>95.7</td>
<td>41.2</td>
<td>29.2</td>
</tr>
<tr>
<td>Total supplement cost</td>
<td>0</td>
<td>0</td>
<td>479</td>
<td>235</td>
<td>380</td>
</tr>
<tr>
<td>Fasciolocide cost (NRs/mg)</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Fasciolocide dose (mg)</td>
<td>0</td>
<td>268.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fasciolocide x. cost (NRs)</td>
<td>0</td>
<td>107.82</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net profit (NRs)</td>
<td>285</td>
<td>387</td>
<td>-62</td>
<td>565</td>
<td>7</td>
</tr>
</tbody>
</table>

Spreadsheet 5: The Cost of the Fasciolocide is Halved While all Other Costs Remain Unchanged from the Actual Goat Experiment

<table>
<thead>
<tr>
<th>Purchase price (NRs)</th>
<th>Basal</th>
<th>+</th>
<th>+ Fodder</th>
<th>+ Conc'n</th>
<th>+ UMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>Mean initial weight (kg)</td>
<td>11.48</td>
<td>11.82</td>
<td>11.64</td>
<td>11.94</td>
<td>11.90</td>
</tr>
<tr>
<td>Mean live weight gain (g/d)</td>
<td>37.96</td>
<td>46.18</td>
<td>40.30</td>
<td>63.20</td>
<td>41.86</td>
</tr>
<tr>
<td>Total weight gain (kg)</td>
<td>8.77</td>
<td>10.67</td>
<td>9.31</td>
<td>14.60</td>
<td>9.67</td>
</tr>
<tr>
<td>Body weight at 33wks</td>
<td>20.25</td>
<td>22.49</td>
<td>20.95</td>
<td>26.54</td>
<td>21.57</td>
</tr>
<tr>
<td>Killing out percentage</td>
<td>61.10</td>
<td>62.80</td>
<td>64.30</td>
<td>62.80</td>
<td>61.30</td>
</tr>
<tr>
<td>Meat value (NRs/kg)</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Carcass value (NRs)</td>
<td>1,485</td>
<td>1,695</td>
<td>1,616</td>
<td>2,000</td>
<td>1,587</td>
</tr>
<tr>
<td>Supplement cost (NRs/kg)</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5.7</td>
<td>13</td>
</tr>
<tr>
<td>Total supplement intake</td>
<td>0</td>
<td>0</td>
<td>95.7</td>
<td>41.2</td>
<td>29.2</td>
</tr>
<tr>
<td>Total supplement cost</td>
<td>0</td>
<td>0</td>
<td>479</td>
<td>235</td>
<td>380</td>
</tr>
<tr>
<td>Fasciolocide cost (NRs/mg)</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Fasciolocide dose (mg)</td>
<td>0</td>
<td>268.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fasciolocide x. cost (NRs)</td>
<td>0</td>
<td>107.82</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net profit (NRs)</td>
<td>285</td>
<td>387</td>
<td>-62</td>
<td>565</td>
<td>7</td>
</tr>
</tbody>
</table>

CONCLUSIONS

These spreadsheets are cost-effective ways to demonstrate the efficacy of the drug to farmers. They also enter into the equation of availability and cost. Farmers may prefer to buy these products directly from local suppliers or collect their own feed mixtures. Because prices are high, decision making is economically affected. These spreadsheets may also be used to determine the most cost-effective method of production. In addition, they provide a means of comparing the cost of different treatments. The net profit from both groups under these circumstances would be 387 NRs. Such a scheme could again be made possible through foreign aid perhaps administered through government projects in certain poorer regions. However, in view of the poor performance of the

ACKNOWLEDGMENT

This study was funded by the Government of Nepal.

REFERENCES

Gatenby, R.M., Technic
Srihakam, S. at Veterinary

45
Strategies for feed management in areas endemic for fasciolosis

These spreadsheets are examples of the simple financial models, which can be produced to help identify the most cost-effective way of controlling fasciolosis within a location or on a farm. Issues such as availability and efficacy of the drugs for treatment and the range and availability of feed supplements that the farmers have access to also enter into the scenario. The choice of drug made by a farmer will usually have more to do with availability and cost than efficacy. Feeds available as supplements will also change during the season. Few farmers may purchase commercial concentrates for goats, but may buy some by-product concentrates such as brewers residue and mustard seed cake (Gatenby et al., 1990). The majority of concentrates fed, such as maize flour, rice bran and vegetable waste are likely to come from farmers’ own. Likewise farmers are more likely to collect their own fodder rather than purchase it at present, although shortages of tree fodder in some areas may mean that this becomes a tradable commodity in the future.

Because prices do not remain stable, and resources vary, so options change for farmers. Hence it is important in decision making to make use of financial models when planning and determining which strategies are currently economically attractive to farmers. The above simple models illustrate what can be done.

ACKNOWLEDGEMENTS

This study was funded jointly by the Livestock Production and Animal Health Programmes of the UK Government Department for International Development.

REFERENCES


46
Fasciolosis 2000 - Nepal
Strategies for feed management in areas endemic for fasciolosis

REPORTS ON THE AFTERNOON DISCUSSION SESSIONS

Chaired by
Dr. N.P. Shrestha
Director, Livestock and Fisheries Research, Nepal Agricultural Research Council
Khumaltar, Lalitpur, Nepal

Delegates split into three discussion groups to consider

- Messages for immediate dissemination to Nepalese Farmers and dissemination pathways
- Further extension and development of findings
- Priorities for further research (adaptive and/or strategic)

Following detailed discussion, the rapporteurs prepared summaries of the group conclusions and recommendations, which are presented below.

DISCUSSION GROUP NO. 1

Topics for discussion: Messages for immediate dissemination to Nepalese Farmers and dissemination pathways

Co-ordinator: Mr. Shyam Paudel

Group members: Mr. A.S. Ranjit, Dr. B. Parajuli, Dr. P.S. Kushwaha, Dr. R.M. Shrestha, Dr. N.P. Chimire, Dr. N.B. Rajwar and others

Recommendations:

1. Drug treatment messages

- Strategic drug treatment for fasciolosis (usually February and August) - listen to announcements on radio, TV, newspapers or messages from extension workers for the time to treat animals
- Treat clinical cases of fasciolosis as and when they arise
- Do NOT use Triclabendazole (Fasinex) for the treatment of buffalo fasciolosis use Oxyclozanide, Rafoxanide or Albendazole. Use Triclabendazole (Fasinex) for the treatment of cattle, sheep and goat fasciolosis.
- Do NOT use carbontetrachloride for the treatment of fasciolosis as it is toxic

2. Feed management messages

- The bottom parts of rice straw are a potential source of fluke infection especially just after harvest. To reduce the risk feed only the top half of the rice straw. Either send the bottom halves of the rice straw to the paper mill or store it and use as feed from the 1st of April onwards.
- Aim to feed a diet which contains up to 14% protein. To help achieve this level of protein feed supplement the basic diet with either tree fodders or feed concentrate or urea/molasses blocks as available.

- Tree fodder farm and it rec
3. Make use of
- Radio, television
- Information listeners
- Listen to exten
4. Adoption an
- It is important whether the n and if not why
- Such inform appropriate c

Topics for discu
Co-ordinator:
Group member:

Recommendatio
1. Drug Treat

- The value of trials/demonstrations to be extend variation in epidemiology
- Routine evaluation co-ordination
- Financial evaluation outputs

2. Feed Mana

Rice Straw

- Verify optimum conditions in
Strategies for feed management in areas endemic for fasciolosis

- Tree fodder has added advantages as a supplement: it is nutritious, can be grown and harvested on farm and it reduces the severity of fasciolosis.

3. Make use of the available sources of information
- Radio, television, newspapers
- Information literature video and audio tape, posters, pamphlets, booklets and brochures.
- Listen to extension workers messages and information given at farmers group meetings

4. Adoption and uptake of ideas
- It is important for extension workers to hear farmers responses to suggested control measures, whether the measures are practical, whether the farmers carry out the suggested control measures and if not why they don't.
- Such information can be relayed to decision-makers to help them develop the best and most appropriate control plans.

DISCUSSION GROUP NO. 2

Topics for discussion: Further extension and development of findings

Co-ordinator: Dr. D.R. Ratala

Group members: Dr. L. Sherchand, Dr. B.K.P. Shah, Mr. S.K. Shrestha, Mr. J. Bajracharya Dr. S.C. Ghimire, Dr. K. Blatturai, Dr. K. Chand Thakuri, Dr. S.M. Amatya, Dr. R.P. Ghimire and others

Recommendations:

1. Drug Treatment
- The value of strategic drug treatment for fasciolosis has been verified in a series of farmers field trials/demonstration projects conducted in the Eastern and Western Regions of Nepal. This needs to be extended to the Far West, Mid West and Central Regions. Apart from an east to west variation in the duration of the Monsoon (which is known from meteorological data) the epidemiology of fasciolosis is similar between regions. However, because of the differences in the Monsoon, there may be slight differences in the optimum dates for strategic drug treatment for fasciolosis. This should be investigated.
- Routine evaluation of efficacy of locally available anthelmintics against fasciolosis. This work will be co-ordinated by the central / regional laboratories but carried out on selected farms in collaboration with the farmers and district staff.
- Financial evaluation of the all strategic control programme based on opportunity cost of the inputs and outputs

2. Feed Management
- Oxyclosanide, cattle, sheep and goats after harvest.
- Rice straw halves of the is.
- 1 of protein feed classes blocks as
In some areas there is a shortage of rice straw fodder to feed animals. An investigation should be conducted to determine whether, instead of cutting the rice straw in half, if it can be cut further down the stalk. This would ensure that there was enough rice straw to feed the animals until it was safe to feed the stored bottom parts of the straw.

Studies should be conducted to obtain feed-back on rice straw use and the acceptability of handling and storing the straw in the suggested manner.

**Feed Management (Diet)**

- Studies should be carried out to determine the protein content of the diets fed to ruminants in the various area of Nepal to determine if the diets vary from the generally recommended level of 14% crude protein.
- The reasons for the non-uptake of the urea treatment of rice straw should be examined.
- An investigation should be conducted to determine whether ensiling rice straw (with or without urea) kills metacercariae.
- On-farm trials should be conducted on the practicality of feeding tree fodder in the country as a whole.
- Economic verification should be conducted on different feeding regimes, e.g. fodder, rice straw, concentrate etc. in relation to fasciolosis control.
- Financial evaluation of feed management based on cost of the inputs and outputs.

**3. Making use of and developing messages for dissemination - Extension methods**

- Develop dissemination messages to increase awareness regarding the control of fasciolosis, incorporating feed management techniques.
- Develop audio-visual, poster, pamphlets, booklets, agricultural diaries etc. media for the use of extension workers.
- Conduct mass awareness campaigns through organised extension outlets, farmers groups, institutions and other agents.

**4. Other suggestions:**

- Research is required on the treatment of rice straw with chemicals and herbs to reduce the viability or kill metacercariae and thus reduce the infectivity of the bottom parts of rice straw.
- Due to the method of spring-fed irrigation, some fields remain water logged after harvest. These fields are a better habitat for the intermediate snail hosts of Fasciola gigantica and represent a greater risk than fields that are dry after harvest. The management of rice straw from the water-logged fields should be investigated as should methods to avoid water logging.
- Food laws prohibit use of urea in concentrates, but not in medicine or for treatment of roughages. If the research results support the conclusion that urea treatment is effective, the act should be amended appropriately.

**Topics for discussion**

**Co-ordinator:**

**Group members:**

1. General comments
   - Institutional research stations
   - A regulatory on anthelmintics would be considered
   - Available data on times of year
   - Updated research problems, e.g. the fact that fasciolosis is used for treatment of fasciolosis

2. Drugs
   - Screening of such work on herbs in the field were found effective

3. Feed Management
   - Complete data on performance
   - The role of balance will have an effect on negative effects
   - Studies have on energy metabolism

4. Integrated Management
   - Integrated management
   - Effect of fasciolosis
   - Effect of integrated feeding
GROUP NO. 3

Topics for discussion: Priorities for further research (adaptive and/or strategic)

Co-ordinator: Dr. A. Pradhan

Group members: Dr. S.K. Singh, Dr. P. Pathak, Dr. K.R. Regmi, Dr. B.R. Thapa, Mr. S.B. Panday, Dr. J.N. Rai, Dr. Ranjana Gupta, Mr. J.P. Thikey, Dr. B.R. Joshi, Mr. Raju Chhetri, Dr. Banshi Sharma, Mr. Kishor Panday and others

1. General comments and suggestions

Institutional strengthening is required to improve the research capabilities of animal health research stations/institutions in Nepal. A regulatory veterinary authority is required in order to conduct quality control and efficacy trials on anthelmintics supplied within the country. This would be organised centrally but the testing would be conducted on selected farms. Available data on tree fodders, their tannin content, nutritional value and toxicity levels, at various times of the year, should be collated and presented in an easily available form. This data can then be updated on a regular basis.

Research proposals have to be prioritised in order of importance. While assessment of field problems, economic analysis of the disease etc. are important aspects of research, it is a proven fact that fasciolosis is widely prevalent in Nepal. Almost 60% of veterinary drugs sold in Nepal are used to control this disease. Farmers realise its importance. Efforts should not therefore be wasted just to "reinvent the wheel". Instead available resources should be directed to adaptive research such as verifying and promoting promising control strategies.

2. Drugs

Screening of local herbs having flukicidal/molluscicidal properties should continue. However, such work may be considered of low priority since it was noted that a large proportion of local herbs in the Eastern hills were screened for their flukicidal/molluscicidal properties, but none were found effective.

3. Feed Management techniques

- Complete database on various aspects of fodder trees in relation to nutrient content, such as performance, anthelmintic properties, nutrient and balance trials of local tree fodders
- The role of tannins as flukicide should be investigated, especially since as pointed out elsewhere a balance will have to be struck between the beneficial effects of tannins in killing flukes and the negative effects tannins have as nutrient inhibitors.
- Studies have concentrated on protein balance in the diet but the interaction between fasciolosis and energy metabolism also required investigation.

4. Integrated Approaches

- Integrated approach on fluke control using anthelmintic, biological methods and feeding management
- Effect of fasciolosis in ruminants under different feeding regime and field management
- Effect of interaction of fasciolosis and nutrition on draught power of animals

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APPENDIX 1

LIST AND ADDRESSES OF PARTICIPANTS

MINISTRY OF AGRICULTURE
Dr M N Shrestha
Secretary to the Ministry of Agriculture
His Majesty's Government of Nepal
Singhdharbar, Kathmandu, NEPAL.
Phone: +977-1-225108

Dr S K Shrestha
Joint Secretary, Planning Division
Ministry of Agriculture
His Majesty's Government of Nepal
Singhdharbar, Kathmandu
Phone: +977-1-226465

Dr Lila Pathak
Joint Secretary, Woman Development Division,
Ministry of Agriculture
His Majesty's Government of Nepal
Singhdharbar, Kathmandu
Phone: +977-1-223441

CENTRE FOR TROPICAL VETERINARY MEDICINE (CTVM)
Dr LJS Harrison
Parasitologist
CTVM
Easter Bush, Roslin, Midlothian
Scotland, EH25 9RG
Tel: +44 131 650 6217, Fax: +44 131 445 5099
Email: leslie.harrison@ed.ac.uk

Dr R A Pearson
Livestock Production
CTVM
Easter Bush, Roslin,
Midlothian, Scotland, EH25 9RG
Tel: +44 131 650 6217, Fax: +44 131 445 5099
Email: anna.pearson@ed.ac.uk

NEPAL AGRICULTURAL RESEARCH COUNCIL (NARC)
Mr D Joshy
Executive Director,
NARC, Khumaltar, Lalitpur
Tel: 525708

Dr N P Shrestha
Director, Livestock and Fisheries Research
NARC, Khumaltar, Lalitpur
Tel:524040

Mr H R Shrestha
Chief, Bovine Research Division
NARC, Khumaltar, Lalitpur
Tel: 521423

Dr S P Neopane
Chief, Animal Breeding Division
NARC, Khumaltar, Lalitpur, Phone: 532922

Mr S M Pradhan
Chief, Fodder & Pasture Division,
NARC, Khumaltar, Lalitpur, Phone: 523038

Mr R C Khanal
Chief, Animal Nutrition Division
NARC, Khumaltar, Lalitpur, Phone: 523039

Dr Adarsha Pradhan
Chief, Animal Health Research Division
NARC, Tripureswor, Tel: 261732/250716

AGRICULTURAL RESEARCH STATION,
PARKHIRIBAS (ARS-P)

Dr K R Regmi
Station Chief
ARS-P, Dhanakuta
Fax: 026 20345, Tel: 026 20365/381
email: arsp@ccsl.com.np

Dr R P Thakur
Scientist-3
ARS-P, Dhanakuta

Mr D B Subba
Animal Nutritionist
ARS-P, Dhanakuta

Mr Kisan Rai
Chief Technician
ARS-P, Dhanakuta
Present address : Panchratna Groups of Hatcheries
and Food Industries, Narayangarh, Chitwan,

Mrs Minu Rai
Lab technician
ARS-P, Dhanakuta

Mrs Yasoda Basnet
Lab technician, ARS-P, Dhanakuta

AGRICULTURAL RESEARCH STATION,
LUMLE (ARS-L)

Dr R P Sah
Station Chief
ARS-L, Kaski
Tel: 061 29456, Fax: 061 22653
email: dirarl@mos.com.np

Dr R R Joshi
Scientist 3
ARS-L, Kaski

Dr R S Rana
Animal Nutritionist
ARS-L, Kaski

REGIONAL AG STATIONS (RA)

Mr S B Panday
Regional Director
RARS, Nepalgunj
Tel: 081-20052

Mr Chita Ranja
Regional Director
RARS, Tarhara, 6
Tel: 025 80461, 1

Mr Pulaskit Man
Buffalo Research
RARS, Tarhara, 6

SHEEP AND GOAT (SG)
Mr C R Upreti
Sheep and Goat F Department
Bandipur, Tanahu, Tel: 065 20137

DEPARTMENT

Dr Pralalit Sai
Director General
Department of Livestock
Harihar Bhawan, 1
Phone: +977-1-5,
E-mail: dg@dls.

Dr. N P S Karki
Deputy Director
Department of Livestock
Harihar Bhawan, 1 Phone: +977-1-5

Mr. SK Shakya
Deputy Director
Department of Livestock
Harihar Bhawan, 1 Phone: +977-1-5

Mr. Dalaram Pr
Project Manager
Third Livestock 1
Harihar Bhawan, 1 Phone: +977-1-5

Dr Prabhakar P
Co-director
SVSLDC Project
Harihar Bhawan, 1

Dr. N B Rajwar
SVSLDC Project
Harihar Bhawan, 1
Strategies for feed management in areas endemic for fasciolosis

Dr R S Rana
Animal Nutritionist
ARS-L, Kaski

REGIONAL AGRICULTURAL RESEARCH STATIONS (RARS)

Mr S B Panday
Regional Director
RARS, Nepalgunj, Banke
Tel: 081-20052

Mr Chita Ranjan Yadav
Regional Director,
RARS, Tarhar, Sunsari
Tel: 025 80461, Fax: 025 81018

Mr Pukait Mandal
Buffalo Research Programme
RARS, Tarhar, Sunsari

SHEEP AND GOAT FARM, BANDIPUR

Mr C R Upreti
Sheep and Goat Farm,
Bandipur, Tanahu,
Tel: 065 20137, Fax: 065 80035

DEPARTMENT OF LIVESTOCK SERVICES

Dr Prashalad Sapkota
Director General
Department of Livestock Services
Harihar Bhawan, Lalitpur
Phone: +977-1-522056, Fax: +977-1-522058
E-mail: dgs@ds.wink.com.np

Dr. N P S Karki
Deputy Director General
Department of Livestock Services
Harihar Bhawan, Lalitpur
Phone: +977-1-521610

Mr. S K Shyam
Deputy Director General
Department of Livestock Services
Harihar Bhawan, Lalitpur
Phone: +977-1-521610

Mr. Dalaran Pradhan
Project Manager
Third Livestock Development Project
Harihar Bhawan, Lalitpur
Phone: +977-1-531007, Fax: +977-1-531006

H STATION, Hepals of Hatcheries

Mr. Prabshak Pathak
Co-director
SVSLDC Project
Harihar Bhawan, Lalitpur
Phone: +977-1-542914, Fax: +977-1-542915

Dr N B Rajwar
SVSLDC Project
Harihar Bhawan, Lalitpur

LIVESTOCK SERVICES TRAINING DIVISION

Dr B M Shrestha
Chief, Training Division
Harihar Bhawan, Lalitpur
Phone: +977-1-522059

Mr Shyam Poudel
Livestock Officer
Training Division, Harihar Bhawan, Lalitpur

Mr Kul Prasad Bhandari
Cameraman
Training Division, Harihar Bhawan, Lalitpur

ANIMAL PRODUCTION DIVISION

Dr B K P Shah
Chief Livestock Officer
Animal Production Division
Harihar Bhawan, Lalitpur
Phone: +977-1-522031

Mr Lila B Karki
Marketing Specialist
Animal Production Division, Harihar Bhawan,

Dr L. Sherchand
Chief, Animal Breeding & A I Section
Khumaltar, Phone: 526234

Mr J Bajracharya
Chief, Pasture and Animal Nutrition Section
Harihar Bhawan, Lalitpur
Phone: +977-1-527020

Dr B Sharma
Livestock Officer,
Sheep and Goat Section, Harihar Bhawan

Mr J M Thike
Livestock Officer,
Milk Production Section
Harihar Bhawan, Lalitpur
Phone: +977-1-522031

NEPAL VETERINARY COUNCIL

Dr D D Joshi
Chairman,
Nepal Veterinary Council
Tripureshwor, Kathmandu
Phone: +977-1-252348

ANIMAL HEALTH DIVISION

Dr Shubh N Mahato
Chief Veterinary Officer
Animal Health Division, Tripureshwor, Kathmandu
Phone: +977-1-261509, Fax: +977-1-261521
E-mail: ahv@healthnet.org.np
Fasciolosis 2000 - Nepal

Strategies for feed management in areas endemic for fasciolosis

Dr. Karuna Bhattarai
Veterinary Officer
Livestock Services Directorate, Central Region,

Dr. M S Karki
Regional Director, Livestock Services Directorate, Western Region Pokhara, Phone: +977-61-20454

Dr D R Ratala
Regional Director, Livestock Services Directorate Mid-Western Region, Shurkhet, Phone: 083-20937

Dr K B Bhattarai
Regional Director, Far-Western Region, Dipayal, Phone: +977-94-40146

REGIONAL VETERINARY LABORATORIES

Dr K C Thakuri
Chief, Regional Veterinary Laboratory Western Region, Pokhara, Phone: 061-20419

Dr Pitamber Kushwaha
Chief, Regional Veterinary Laboratory Mid-Western Region, Surkhet, Phone: 083-20937

DISTRICT LIVESTOCK SERVICE OFFICES

Dr T P Prasad
Chief, District Livestock Services Office Tehrathum, Phone: 026-20283

Dr Yogendra Yadav
Chief, District Livestock Services Office Ilam, Phone: 027-20043

Dr T P Subba
Chief, District Livestock Services Office Kabre, Phone: 011-61266

Dr P R Bhattarai
Chief, District Livestock Services Office Nuwakot, Phone: 010-60012

Mr. R P Ghimire
Chief, District Livestock Services Office Baglung, Phone: 068-20121

DEPARTMENT OF AGRICULTURE

Mr. B. Bimoli
Chief, Agriculture Communication Division Harihar Bhawan, Lalitpur, Phone: +977-1-522248, Fax: +977-1-522258

Mr Prakash Sharma
Radio Broadcaster, Agriculture Communication Division, Harihar Bhawan, Lalitpur

DEPARTMENT OF FORESTRY

Dr. S.M. Amatya
Department of Forestry Research and Survey Babarmahal, Kathmandu

Dr. S. B. Singh
Hills Leasoleid Forestry and Forage Development Project, Babarmahal, Kathmandu

UNIVERSITIES

Dr Ranjana Gupta
Reader, Department, University, Kirtipur.

Dr I P Dhakal
Chief, Veterinary Institute of Agriculture Rampur, Fax: 056

Dr H B Rana
Parasitologist Institute of Agriculture

Mr Kishor Pand
Student, Dept. of Miss Sarah Wijesinghe
Student, School of Biological Sciences, John Moores University, Lynn Street, Liverpool, Miss Sanju Mahal
Student, Buddha University

NGOs/INGOs

Dr Balram Thapa
CARE International Pulchowk, Lalitpur.

Dr Mahendra
Country Director Heifer Project International

Mr M N Maha
Executive Director Himalayan Conservation Project

Mr. Raja Chhetri
Nepal Agee-feo

DFID/HARP

Mr Sam Bickerton
Natural Resource International Lalitpur, Phu
STRY

Search and Survey

DFID/HARP

Mr Sam Bickersteth
Natural Resources Advisor, Department for International Development-Nepal, Ekantkuna, Lalitpur, Phone: 542980, 542981

ICULTURE

Mr M N Mahato
Executive Director
Himalayan Community Development Forum, Dhaubadi, Nawalparasi, Phone: 078-39300/40145

Mr R P Gupta
Plan International
Hetauda, Makawanpur, Phone: 20642

Mr Sandip Mahato
Plan International
Padam Pokhari, Makawanpur, Phone: 20642

Mr. Raju Olhetri
Nepal Agro-forestry Foundation, Baneswor, Kathmandu

NGOs/INGOs

Mr Bidur Pukhrin
Technical Officer
Heifer Project International, Satdobato, Lalitpur
Phone: +977-1-532554, Fax: +977-1-542873
E-mail: hpinbp@mos.com.np

Mr Kishor Panday
Student, Dept. of Zoology, Tribhuvan University

Mr Puma Prasad Nepal
Dairy Co-operative, Itahari, Sunsari

Mrs Nanda Maya Neupane
Women's Buffalo Farmers Group, Dairy Cooperative, Itahari, Sunsari

Mrs Pratima Nepal
Women's Buffalo Farmers Group, Dairy Cooperative, Itahari, Sunsari

Mr P. G. Rood
Research Advisor, HARP
c/o HARP Office, Pulchowk,

MEDIA

Mr Nav Raj Pokharel
Editor, Nepal Television, Singhdarbar
Phone: 228447

Cameraman
Nepal Television, Singhdarbar

Mr Biplavmanl Acharya
Radio Nepal, Singhdarbar, Phone: 223910

Mr Surendra Pokharel
National News Agency
Singhdarbar Plaza, Phone: 262636

WORKSHOP ADMINISTRATION

Mrs Vishnu Devi Poudyal
Baneswor, Kathmandu, Phone: 491529

Miss Srijana Mahato
Tripureswor, Kathmandu, Phone: 261210

Mr Gohind Ghimire
Tripureswor, Kathmandu

Mr Dambar Prasad Timilsina
Tripureswor, Kathmandu

Mr J B Ablington
Director
Hill Agriculture Research Programme
Pulchowk, Lalitpur, Phone: 545180, Fax: 521425

Mr P. G. Rood
Research Advisor, HARP
c/o HARP Office, Pulchowk,
APPENDIX 2

DISSEMINATION OF INFORMATION AND UPTAKE PATHWAYS CURRENTLY OPERATING IN THE ANIMAL HEALTH SECTOR OF NEPAL.

SN Mahato and SC Ghimire
Animal Health Division, Veterinary Complex, Tripureswor, Kathmandu

1. The pathways for dissemination
The media currently used for dissemination is defined in section 3, while this section outlines the pathways through which information is channelled and how the decisions on what information is to be delivered are made in Nepal.

Decisions are made on suitable information for dissemination by the Animal Health and Animal Production Divisions of the Department of Livestock Services. Each of these Divisions is divided into several specialist sections for example the Central Veterinary Laboratory and Animal Disease Control Section would be responsible for fasciolosis control. Staff in these sections access information from scientific meetings, workshops, institute reports and scientific publications in order to make recommendations as to what information should be disseminated. Alternately requests are made, through DLSO, by field technicians and village level animal health workers, who encounter problems, for help from section staff. The information gathered to solve these problems might be considered suitable for dissemination on a wider basis. There are several different pathways through which dissemination is accomplished:

- The dissemination messages are incorporated by the Livestock Services training Division into in-service training or refresher courses for field technicians and village animal health workers who are in day to day contact with farmers and farmers groups.

- The Animal Health Division and other central and regional institution within DLS organise regular workshops, seminars and conferences on various topics such as animal health, investigation of epidemics and disease control, laboratorv diagnostics etc. New findings on e.g. disease management and disease control technologies are discussed and documented in the meeting proceedings. The meeting and circulation of the meeting proceedings help disseminate the technology to field staff and technicians.

- Preparation of information by the Animal Health Division, the Livestock Services Training Division or concerned technical sections. The information is prepared in various media formats and is distributed to field workers, farmers, farmers groups and village level animal health workers via the District Livestock Service Offices (DLSO). Television and radio broadcasts are aired through Radio Nepal and Nepal Television.

- Important messages and technology packages are incorporated into the District Animal Health Extension Programmes by the following approaches:

  **Demonstration programmes**: The field staff selects sites and implements a particular programme, such as strategic drug treatment on farm. The services are provided free of charge to the farmers and the results monitored in comparison with control farms in order to demonstrate the value of the programme to the farmers. The participating farms are selected following discussion with local farmers groups. In some cases the farmers groups decide to pay the cost price of the drug into the group account for future bulk purchases etc.
Currently, the endemic for fasciolosis is divided into section outlines the divisions in animal disease control. Information from the Health and Animal Health and Animal Disease Control sections will be considered in order to make requests are made, encounter problems, might be considered ways through which the division into information from field workers and this is reported verbally. If the problems continue then the District Officers will report this verbally at the four monthly Regional Level Review meetings. This system has the effect that problems are recorded while successful uptake of new ideas may not receive the deserved recognition. It is, therefore, suggested that the reporting should be improved to formally record uptake or adoption of novel strategies and that funds should be sought to carry out projects which will allow the rates of uptake and the consequent impact to be quantified.

2. The current pathways to monitor uptake

Progress reports are prepared on a monthly basis by Livestock Service Centre / Sub-centre staff and are presented at the district meetings. This information is used as a basis for the District monthly report. As with other meetings such as workshops, seminars and conferences (see section 1) the level of adoption of novel ideas and practices is not recorded formally but a subjective impression is taken by the field workers and this is reported verbally. If the problems continue then the District Officers will report this verbally at the four monthly Regional Level Review meetings. This system has the effect that problems are recorded while successful uptake of new ideas may not receive the deserved recognition. It is, therefore, suggested that the reporting should be improved to formally record uptake or adoption of novel strategies and that funds should be sought to carry out projects which will allow the rates of uptake and the consequent impact to be quantified.

3. The media employed in dissemination

Within the agricultural sector, there are several mechanisms employed in order to rapidly disseminate information to farmers and extension workers alike. National television and radio are accessed in order to broadcast immediate news items, while current event radio and television programmes are employed to convey information in greater detail. Although some information is delivered through conventional reporting methods such as newspapers and magazines, much of it for broadcast is channelled through two special units that produce dissemination material. These are the Livestock Services Training Division and the Agricultural Communication Division (ACD) of HMG/Ministry of Agriculture. The units have, at their command, well appointed radio and television/video production studios, which can rapidly produce material for broadcast or on audio or videotape. The ACD has a complete printing unit which prints information in booklet, pamphlet, brochures or poster formats, which can if desired be mainly pictorial in nature. The unit also produces a quarterly bulletin, diaries and calendars. The media produced by the units is distributed as appropriate to extension workers, farmers groups, farmers and schools etc. It is the role of extension workers to interact with farmers and farmers groups in order to ensure that the desired information is imparted to farmers and farmers groups. Finally it should be pointed out that although there is an awareness of the potential of the Internet and CD-ROMs as dissemination mechanisms, these are not as yet in wide use in Nepal. These mechanisms will undoubtedly be of much value in the future and their use should be encouraged. To date only limited numbers of people have access to this technology, but undoubtedly its use will increase in the near future and funds are actively being sought by the epidemiology unit of the AHD to do this.

'CAMPS' (Targeting specific areas): DLSOs each have an annual work plan which is based on the needs of their service areas and prepared in consultation with local farmers groups. As part of this programme the above two parties will either target specific problems or attempt to increase general awareness of animal health issues. The plans will be advertised when a certain village is targeted. At the 'camps' specific disease problems will be treated and through this, general awareness of animal disease problems and the services available to help control them will be increased.

Schools Teaching Programmes: In some areas of Nepal adult literacy is low and there is some resistance to novel ideas amongst these farming communities. In these areas schools are targeted by DLSOs with the animal health messages so that the children can convey these new approaches to their parents. This takes advantage of the fact that the young people are very receptive to new ideas and generally will be motivated to improve farm productivity and farm income.

Special Veterinary Field Services Teams: As new technologies become available or new problems arise specialist teams of veterinarians are assembled so that they can run short training courses in the field. For example, in giving information on feeding rice straw or strategic drug treatment for fasciolosis or in diagnosis of disease.

Strategies for feed management in areas endemic for fasciolosis

DLSOs organise regular discussions with local health workers who investigate the cause of disease problems and the services available to help control them. As part of this particular programme, feedback is obtained from the farmers and the discussions with local health workers. Discussion with local health workers is usually accompanied by a visit to one or more villages to check on the progress being made. If necessary, further training and assistance is provided. This information is then used to prepare a report. As with other meetings such as workshops, seminars and conferences (see section 1) the level of adoption of novel ideas and practices is recorded formally but a subjective impression is taken by the field workers and this is reported verbally. This system has the effect that problems are recorded while successful uptake of new ideas may not receive the deserved recognition. It is, therefore, suggested that the reporting should be improved to formally record uptake or adoption of novel strategies and that funds should be sought to carry out projects which will allow the rates of uptake and the consequent impact to be quantified.

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APPENDIX 3

DISSEMINATION OF INFORMATION - TV, RADIO, NEWS PAPER OFF-CUTS AND PRESS RELEASE

Reports of the meeting were aired on Nepalese National television and radio on the six pm and 10pm news on the 5th of March 2000. Two current event radio programmes, Ghatana Vichar and Pariwesh devoted 10-15 minute slots on the 5th and 6th March 2000 respectively to the problems of fasciolosis and its control in Nepal. Further radio programmes for farmers which were based on the participants interviews (Dr NP Ghimire and Dr DR Ratala) were aired on 2nd, 9th and 16th March 2000. A copy of the press release and photocopies of the newspaper off-cuts are presented below and in the next page respectively. The media coverage was presented in both Nepali and English.

PRESS RELEASE

An International Workshop was held on March 5th 2000 at the Blue Star Hotel, Tripureshwor. The Workshop "Strategies for Feed Management in Areas Endemic for Fasciolosis" was jointly organised by the Agricultural Research Station - Pakhribas (ARSP), Ministry of Agriculture, Department of Livestock Services, Animal Health Division (AHD) and the Centre for Tropical Veterinary Medicine, University of Edinburgh (CTVM), Scotland UK.

The purpose of the workshop was to discuss appropriate ways of controlling fasciolosis, which is a serious and important disease of domestic animals in Nepal. Drug treatment is not always immediately available or affordable for small-scale farmers and so alternative means to control the disease are needed.

In 1996 the Agricultural Research Station, Pakhribas (ARS-P) and the Centre for Tropical Veterinary Medicine (CTVM), Edinburgh were successful in obtaining funds from the British Government Department for International Development (DFID) to undertake a collaborative project on 'the interaction of fasciolosis and nutrition in growing ruminants'. The DFID Animal Health and the Livestock Production Programmes jointly funded the project. ARS-P and CTVM have collaborated for over 15 years on various livestock management and health projects and have a good record in working together.

The project has investigated whether food supplementation using locally available feeds could be an option in alleviating the effects of the disease in growing ruminants.

The main findings were:

Extra feed supplementation can be a viable alternative to drug treatment in alleviating the effects of fasciolosis in growing ruminants, provided it is of medium protein content (about 14% crude protein), so that supplementation with many of the tree fodders would be suitable. High protein supplements (over 19% crude protein - such as oil seed cakes, fodder legumes or dairy cow concentrates) and low protein supplements (about 7% crude protein) were not suitable alternatives to drug treatment.

In the mid-hills supplementation of the normal feed of buffaloes and goats with 3% tree fodder was the most economic strategy to use in alleviating the effects of the disease.

Earlier work at the then Pakhribas Agricultural Centre (now ARS-P) has shown that, when feeding rice straw to buffaloes in the hills, only the straw tops (over 40 cm from the base) should be fed until April. After April it is safe to feed the bottom of the rice straw stalks. This is because the parasite is rarely found on straw tops and the parasites on the bottom part of the straw die after storage.

At the workshop, the project findings and how best they, and other information about fasciolosis control can be advertised in Nepal to help farmers keep their animals healthy and productive were discussed. Seventy five people with an interest in the subject attended the workshop including farmers, extensionists, media specialists, NARC scientists, DLS officers, International scientists involved in livestock research and development, representatives from NGOs.
Fasciolosis claims 70% of buffaloes in mid-hill region

Kathmandu, Mar. 5 (RSS): Fasciolosis or liver-fluke claims some 70 per cent of buffaloes in the mid-hill region of Nepal causing a loss of some Rs. 1.685 million every year.

According to a survey of 1997, 90 per cent of buffaloes in the mid-hill region contracted the disease causing a loss of some Rs 1.685 million, while a study carried out in the past recorded a loss of some Rs 1.3 million. As compared to other animals, buffaloes are more likely to contract the disease.

Despite public awareness about the disease and investments of some Rs 10 per cent of the budget for eradication of livestock diseases, there is no decline in the cases of fasciolosis.

The disease spreads from the grazing ground and hay before and after harvesting crops. Stagnation, weight loss, reduction in milk-producing capacity, etc. are the symptoms of the disease.

A workshop jointly conducted for the past four years by the Agriculture Research Station, Palpa, and the Centre for Tropical Veterinary Medicine (CTVM), with the assistance of the Department of International Development (DFID) of the United Kingdom shows that extra feed supplements can be a viable alternative to drug treatment in alleviating the effects of fasciolosis in growing ruminants, provided it is in medium and less production systems up to 14 per cent.

High-protein supplements such as oil seeds cakes and fodder legumes were found to be suitable alternative to drug treatment.

Chair of veterinary officer of the Livestock Services Department, Animal Health Division, Shambhu Narayan Malho, CTVM experts, and Dr. B. Pari and D. B. Subba at the AI expressed their views.

International workshop on "strategies for feed management in areas endemic for fasciolosis" jointly organized by the ARS-P and CTVM of Scotland today.

Mr. Secretary of the Ministry of Agriculture Dr. K. Sharma, inaugurating the workshop, said it is necessary to combat fasciolosis which farmers can also identify.

Director General of the Department of Livestock Services Dr. Prakash Sapkota, from the chair, noted that livestock farming contributes 30 per cent to the gross agricultural production.

Various other speakers including PhDs Dr. K. R. Regmi and NARC executive director Dr. D. Pari presented their views at the function.

Some 15 persons had taken part in the day-long workshop.