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Editorial

Livestock in Nepal are enormously important not only for providing animal protein but also as a live machine for maintaining soil fertility and providing employment opportunity. Furthermore, improving livestock production is amongst the few alternatives available to the rural communities to improve their standards of living. This has been realised by national planners, and the livestock sector has been given a due importance in the Agricultural Perspective Plan, a long-term agricultural development policy of the Government. Accordingly, the ninth five-year plan has envisaged several activities to improve the production and productivity of livestock.

The Ninth five year plan aims to improve the production and productivity of livestock and poultry by improving the quality and quantity of available animal feed resources, improving animal health through effective prophylactic and curative veterinary services, and improving productive (genetic) potential of livestock. This is expected to substitute, or at least reduce, the import of livestock and their products, generate self employment for all farmers and more particularly for women, and increase income and hence the living standards of the farming communities. Furthermore, developing market facilities and encouraging private sector to start livestock related enterprises are other priority areas. These development activities and the sector / species of animals to be intervened will, however, be based on the available infrastructure especially the market and road accessibility in an area. Similarly, researches to generate technologies to improve livestock and poultry production and productivity are given due priority. The plan also aims to improve the diagnostic capability of various livestock diseases by strengthening central, regional and districts laboratories, to improve the quality, quantity and range of livestock and poultry vaccines produced within country, and also to expand the veterinary services to more animals / farming households.

It is clear that to achieve all these targets set by the plan, sincere and consistent efforts from all sectors, government and private, research and extension is required in all steps from implementation to monitoring and evaluation. Furthermore, all parties involved need to be aware of the available technologies in time, and be able to apply the successful techniques. It is equally important that time and efforts are not wasted in areas which have already been proved to be unsuccessful or unprofitable. This is where, we believe a journal like the Bulletin of Veterinary Science and Animal Husbandry Nepal could be useful to all the veterinarians, livestock extensionists and livestock farmers not only to learn new development but also to share their knowledge and experience with their colleagues. In the changed context, we have also realised that there is a need to improve the quality of the journal. NVA executive committee in consultation with the general assembly has, therefore, decided to continuously improve the quality of its bulletin. As a result, the Bulletin of Veterinary Science and Animal Husbandry Nepal will be published as the "**NEPALESE VETERINARY JOURNAL**" from its next volume. We are sure to receive cordial help and support from all colleagues working in this field in our endeavour to establish Nepalese Veterinary Journal as a reputed journal.

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CURRENT STATUS OF LIVESTOCK PRODUCTION IN NEPAL

N.P.S. Karki¹

INTRODUCTION

The contribution of agriculture sector on Gross Domestic Production (GDP) is declining from 71.61% in 1975/76 to 40.22% in 1995/96 at current price in a total volume estimated at Rs. 219,896 million (CBS, 1996). This trend will continue as nation becomes more and more industrialised. At present, the share of livestock in agricultural gross domestic product (AGDP) is 31% with a growth potentiality to increase up to 45% (APP, 1995). However, contributions made from supplying farm power, transporting goods, providing manure have not been fully accounted for in real term of monetary value in estimating Livestock GDP (LGDP).

Among different physiographic regions, livestock production derived its 53% from the hills, 9% from the mountains and 38% from the Tarai.

In the agricultural system of Nepal, livestock plays an integral role in addition to animal protein production for human consumption. However, local production of animal protein is far below the market demand. Increasing livestock production to increase the income of the farmers and to meet the market demands is therefore among the priority programmes of the Government. For this reason, the country has recently developed medium to long term policies for development of livestock sector, namely 10 years Dairy Development Plan, 20 years Livestock Master Plan and Agricultural Perspective Plan. However, these policies are not fully implemented, and still shortage of livestock product is envisaged. This paper draws information from analysis of data on production and productivity of livestock between 1985/1986 and 1995/1996, and aims to reflect a current status of livestock production in Nepal. Furthermore, limitations on the available data are pointed out where appropriate so that it could be corrected / adjusted in future.

LIVESTOCK POPULATION

In recent years, both the Central Bureau of Statistics (CBS) and Ministry of Agriculture (MOA) are publishing agricultural data annually. CBS data are based on sample survey whereas MOA estimation is from the data provided by the district offices. These both set of data vary within themselves, and have certain limitations. It has been noticed that the former set fails to recognise the specific production located within district or regions, and the latter one not having a proper mechanism for the estimation.

Specific productions localised in particular area have been seen arising from different cultural practices adopted by various ethnic groups and the climatic conditions resulted from an altitudinal variation. The domestic species of animals associated with such social taboo of ethnicity and topographical variation are sheep, pig and yak. The other production system

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reflected in such situation is poultry, as it is localised in specific area in market accessible regions and not widely adopted in homogenous condition.

Livestock and poultry population of the country with its annual growth within the last decade is presented in Table 1. Overall, there has been an increasing trend in the number of all species of animals, though in the recent years declining trend in sheep and cattle population is noticed. Another striking feature noticed while analysing the population data is that the sheep population in the Mid and Far Western regions have been over estimated in baseline survey itself (please refer to CBS data, and note the unrealistic sheep population of more than 40,000 in some Tarai districts).

HERD COMPOSITION

Herd composition is very much important in estimation of livestock production parameters. However, these are not properly reflected in available population data. Moreover, need of such data in accordance of breed and physiographic region are not taken into account. Available data from sample census of 1991 (CBS, 1993) on herd composition of cattle and buffaloes is presented in Table 2.

Another set of data from MOA (1994) is also available, which are similar to those presented in Table 2. MOA (1994) data distinguishes population of breeding and working bulls, which showed former type only 0.55% in cattle and 1.03% in buffaloes. Working bulls (oxen) identified are 40.82% in cattle and 5.91% in buffaloes in the total population.

As consideration of puberty is not taken into account in female population, these data have little value in estimation of production. Similarly, sheep and goat are distinguished between male and female under and above 6 months of age and the data have very little value in identifying breedable population, and the production.

LIVESTOCK PRODUCTION

Of the many values of livestock production realised, primary one is to provide high quality animal protein required for a healthy human diet. The total volume of different livestock / poultry products with its annual growth is presented in Table 3. These data demonstrate that annual growth in milk production by 2.45% and meat by 2.19% are just at par with the human population growth of 2.1%. However, the growth rate achieved is far below the national target as set out in the eighth five-year plan (Table 4), and is unlikely to reduce the gap between the demand and the supply. Egg production has a growth rate of 4.25% and is improving (Table 3). In general, growth of livestock products seen is continuous and gradual. However, higher growth rate was observed in milk production from 1988 and in egg production from 1990.

Table 1 Livestock Population of Nepal

Category	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	Growth Rate
Cattle	6371,743	6362,930	6343,108	6284,918	6280,852	6254,819	6245,682	6237,231	7128,268	7127,678	7008,420	0.95
Buffalo	2891,440	2917,579	2951,640	3002,803	3012,565	3043,920	3058,341	3072,682	3142,480	3116,241	3302,200	1.33
Milking Cow	673,604	682,903	682,937	688,615	689,374	689,685	695,130	698,931	779,784	786,555	784,940	1.54
Milking Buffalo	690,158	724,796	735,156	744,716	746,563	750,253	751,920	755,996	755,494	761,410	820,920	1.75
Sheep	807,975	836,624	873,159	910,471	892,296	906,493	912,372	911,279	851,271	870,360	859,000	0.61
Goat	5016,298	509,933	5211,043	5302,344	5223,645	5366,946	5405,793	5451,710	5529,617	5597,910	5783,140	1.43
Pig	455,724	476,340	516,059	547,655	574,197	591,602	598,955	604,902	608,480	625,551	676,340	4.02
Fowl	9311,355	9528,333	9784,166	10158,851	13113,008	13558,874	13496,244	13600,807	13736,188	14160,648	14521,100	4.54
Duck	276,818	296,614	334,486	356,684	385,498	391,723	389,542	391,718	400,033	418,550	416,100	4.15
Laying Hen	3103,301	3217,558	3311,491	3421,258	4052,418	4206,459	4187,282	4217,864	4189,537	4363,724	4548,000	3.89
Laying Duck	143,398	154,100	173,883	183,450	199,839	202,411	202,352	204,806	208,017	228,845	218,240	4.28

Source: CBS, 1986-96 and MOA, 1986-94

Table 2 Herd composition of cattle and buffaloes

	Cattle	Buffaloes
Male calves (under 1 year)	7.67	7.49
Female calves (under 1 year)	5.66	10.62
Young bulls (1-3 years)	6.95	4.98
Heifers (1-3 years)	7.26	13.73
Bulls and oxen (3 years above)	43.59	8.82
Cows (3 years above)	36.90	54.07

Source: CBS, 1993

Based on a total human population of 20.5 million in 1995/1996, per capita availability of milk, meat and eggs is 46.8 l, 7.9 kg and 19 in numbers, respectively. Per capita available meat of 7.9 kg is derived from buffaloes (5.11 kg), sheep (0.14 kg), goat (1.56kg), pig (0.56 kg), chicken (0.47 kg) and duck (0.01 kg) (Table 5). Among the various livestock products that are making animal protein availability in 1995/96 from the national production, milk contributed 50.32%, meat 41.33%, fish 5.24% and eggs 3.11% of the total of available animal protein (Table 5). Among different livestock products, cost of per unit animal protein remained lowest in buffalo meat and pig meat, and mutton and egg protein were amongst the costliest one (Table 6). Protein share of different products in the total value of Rs.27,910,281,740 is given with price in Table 6.

REQUIREMENT OF LIVESTOCK PRODUCTS

According to the human growth rate of 2.1% recorded in 1991 population census (CBS, 1992), the present population can be estimated as 2,05,15938 (Table 7). The age group of population depends upon many factors such as mortality, fertility, nuptial pattern etc. and may change in course of time. However, without accounting such changes, the ratio of different age group seen in 1991 census is adopted in working out animal protein requirement of Nepalese people, which is presented in Table 7.

There are many nutritional standards adopted by different countries of which WHO adopts 10% protein energy of the total requirement whereas others work according to body weight and age groups. In this study, protein composition of the livestock product is adopted from "Nutrient Contents in Nepalese Food," (NPS, 1994), Nutritional program section, MOA, and requirement standards adopted is that recommended by the Expert Committee of the ICMR (1988) India.

For the maximum utilisation of intake of protein, 50% of total requirement is recommended to be supplemented from animal protein. This ratio has been gone up to 75% in developed countries but to keep in line with WHO recommendation for developing countries, only 25% of the total requirement is accounted in this calculation.

Table 3 Livestock Products of Nepal

Products	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	Growth rate
Milk (MT)	754856	767577	808081	833891	858768	864831	871234	876594	885360	903636	961560	2.45
Cow milk	219792	220568	232219	243879	255545	256398	259230	260786	288520	293020	296620	3.04
Buff milk	535064	547009	575862	590012	606223	608433	612004	615808	596840	610616	664940	2.19
Meat(Net) MT	130002	132080	137818	141226	145381	147347	148695	149893	153517	159241	161520	2.19
Buffalo	88040	89389	91954	93928	94478	95312	96013	96574	96981	98921	104830	1.76
Mutton	2661	2752	2871	2997	2986	3029	3044	3032	3170	3560	2860	0.76
Goat	26104	26335	28002	28378	28896	29372	29844	30377	32754	24090	32040	2.07
Pig	7467	7727	8702	9399	9911	10242	10407	10447	10581	12270	11800	4.68
Chicken	5542	5674	6072	6295	8861	9138	9119	9195	9747	10115	9700	5.75
Duck	188	203	217	229	249	254	268	268	284	285	290	4.42
Egg (000 No.)	261438	271622	278342	288057	357127	369519	368164	370928	375095	412114	396400	4.25
Hen egg	250656	260021	265451	274433	342147	354296	352983	355539	359583	396349	380400	4.25
Duck	10782	11601	12891	13624	14980	15223	15181	15389	15512	15766	16000	4.02
Wool (kg)	690669	715688	744367	757091	757091	767391	620413	619574	579000	720000	618480	1.09

Source: CBS, 1986-96, and MOA (1986-96)

Table 4 Targeted and actual annual growth achieved for various livestock products during the eighth five-year plan

Items	Annual growth	
	Targeted	Achieved
Milk	3.0	2.14
Meat	3.3	1.85
Fish	12.0	7.00
Egg	5.4	1.41
Wool	1.2	-4.22

Source: National Planning Commission (1997).

Table 5 Animal Protein availability in Nepal

Item	Production Volume	% animal protein content	Per capita availability	Animal Protein available (Kg/day)	% in total animal protein production
1 Milk	961560 MT	4.0	46.87 l	105376	50.32
2 Meat					
Buff	104830 MT	19.4	5.11 Kg	55717	26.61
Sheep	2860 MT	15.9	0.14 Kg	1245	0.59
Goat	32040 MT	21.4	1.57 Kg	18785	8.97
Pig	11800 MT	15.8	0.57 Kg	5107	2.44
Chicken	9700 MT	20.8	0.47 Kg	5527	2.64
Duck	290 MT	21.6	0.01 Kg	121	0.08
3 Fish	21879 MT	18.3	1.00 Kg	10969	5.24
4 Egg	396400000	6 grams/egg	19 Nos.	6516	3.11
Total				209363	

Source:

Production: CBS, 1996

Protein: Nutrition content in Nepalese food, NPS, 1994

Daily requirement of animal protein account 252,937 kg (Table 7) and this in term of availability from available product in 1995/96 is only 209,363 kg (Table 5). The daily animal protein production therefore, falls short by 17.2%.

Based on animal protein requirement and protein composition of Nepalese food, deficiency in term of the products in volume and additional number of animals required to calve for milk production and number of animals required to slaughter for meat production is calculated. Although it seems that the deficiency margin of the livestock product is only 17%, a large additional number of animals are required to meet the demand (Table 8), which is very questionable from availability of animal feed resources. On the other hand, unless growth takes above 4%, deficiency margin will not reduce and then at present level of production, per capita availability is not increasing from home production alone.

Table 6 Value of Livestock Products at the market price in 1995/96

Sr. No.	Item	Total Product	National average price Rs/kg	Total value Rs.	Rs. per kg animal protein	Percent of total value
1.	Milk (MT)	961560	14.89	14317628400	372.25	51.29
2	Meat (MT)					
	Buffalo	104830	49.56	5195374800	255.46	18.61
	Sheep	2860	105.17	300786200	661.43	1.07
	Goat	32040	105.17	3369646800	491.45	12.07
	Pig	11800	55.63	656434000	352.09	2.35
	Chicken	9700	98.83	958651000	475.14	3.43
	Duck	290	98.83	28660700	457.55	0.10
	Total	161520		10509553500		
3	Fish	323040	76.96	1683807840	420.55	6.03
4	Eggs (No.)					
	Chicken	380400000	3.53	1342812000	588.33	5.01
	Duck	16000000	3.53	56480000		
		396400000		1399292000		99.96
	Total			27910281740		

Table 7 Population of different age group and daily protein requirement

S. N.	Age group	% in total population.	Number in age group	Protein requirement gm/day	Total protein requirement Kg./per day	25% animal protein requirement Kg. day
1	0-12 months	3.05	627327	12.63	7923	1980
2	1-3 years	8.53	1749683	22.00	38493	9623
3	4-6 years	9.58	1966429	30.00	58992	14748
4	7-9 years	8.65	1773790	41.00	72725	18181
5	10-12 years male	4.31	884201	54.00	47746	11936
	10-12 years female	3.92	804599	57.00	45862	11465
6	13-15 years male	3.33	683953	70.00	47876	11969
	13-15 years female	3.19	653649	65.00	42487	10621
7	16-18 years male	2.95	606533	78.00	47309	11827
	16-18 years female	3.14	603780	63.00	40358	10139
8	>19 years male	23.43	4806509	60.00	288390	72097
	>19 years female	25.90	5315479	50.00	265773	66443
9	Pregnant women	-	221123	15.00	3316	829
10	Lactating women	-	190674	21.50	4292	1073
	Total		2051593		1011749	252937

Note: (i) Population estimated for 1996 @ 2.1% growth from 1991 census
(ii) Protein requirement based on ICMR, 1988

Table 8 Volume of additional Livestock Products required and number of animals needed to produce it to meet the basic requirement for Nepalese people

Commodity	Production in 1995/96	Requirement in 1995/96	Balance	Yield Unit of animals Kg	Additional animal requirement	Remarks
1 Milk MT	961560	1161410	-199850 (17.21%)	C- 377 B- 809	C- 16358 B- 170823	1. More milk animals needed 2. Ratio of cattle in milk 39.85% 3. Additional numbers required for slaughter
2 Meat MT						
Buff	104830	126633	-21803(7.21)	196.95	110703	
Sheep	2860	3425	-565(16.49)	13.35	42322	
Goat	32040	38697	-6657(17.21)	13.35	498651	
Pig	11800	14257	-2457(18.2)	57.85	42471	
Chicken	9700	11717	-2017(47.21)	1.68	1200595	
Duck	290	341	-51(14.95)	1.68	30357	
3 Fish MT	21879	26437	-4557 (47.2)	-	4556 kg	
4 Egg No.	396400000	478535726	-2135726 (17.16)	83 Nos/hen	989587	

Based on: (a) Volume of products CBS, 1996
(b) Yield Unit CBS, 1996 and LMP, 1993
(c) Volume calculated from protein requirement in Table 7
(d) Figures in parentheses are % short to the requirement

EXTERNAL TRADE OF LIVESTOCK PRODUCTS

It is apparent that Nepal is a net importer of live animals and milk products whereas hide and skin, and ghee are exported (Table 9A, 9B, 10 and 11). Chicken products are imported from India and some volume is exported to Tibet. Besides the woollen carpet, butter, hide and skin are other livestock products that have become major export items in the recent years. Furthermore, their export is seen on increasing trend.

Table 9A Number of livestock and poultry birds imported from India.

Animals (No.)	1995/96	1994/95	1993/94	1992/93
Buffaloes	NA	65353	119733	137962
Cattle	58060	498370	93354	59877
Goat	81993	87603	230159	187041
Pig	6048	8307	12062	13641
Poultry (Baby chicks)	223318	258330	894617	1548288
Eggs '000	NA	10221.8	40259.9	249.3

Source: Department of Customs, 1993-96

Table 9B Livestock and livestock products trade with India (Rs. million)

Year	Live animals			Ghee	Skin and hide	Skim milk
	Import	Export	Balance			
1989/90	319.4	128.9	-190.5	+18.7	+37.9	NA
1990/91	388.9	178.1	-210.8	+27.6	+52.8	NA
1991/92	534.4	158.6	-375.8	+13.2	+53.2	NA
1992/93	560.1	152.9	-407.2	+43.6	+110.2	NA
1993/94	418.4	173.4	-245.0	+46.5	+200.1	NA
1994/95	378.8	187.2	-191.6	+49.6	+159.3	-1451
1995/96	331.6	176.3	-155.3	+35.4	+205.5	-1578

Source: Nepal Rastra Bank, 1990-96
Department of Customs, 1990-96

Note: Negative values indicate net import, and positive values indicate net export, NA not available

Table 10 Livestock trade volume with Tibet (Rs. million)

FY	Wool	Sheep/ Goat	Butter	Chicken	Eggs
1992/93	-416.55	-13.0	+0.21	+1.25	+0.46
1993/94	-320.62	-13.1	+0.52	+0.97	+0.23
1994/95	-218.27	-8.3	+1.69	+1.47	+0.63
1995/96	-485.05	-7.1	+39.64	+2.06	+0.48

Source: Business Promotion Centre Nepal, 1993-96 and Nepal Rastra Bank, 1990-96

Note: Negative values indicate net import, and positive values indicate net export.

Table 11: Trade of Nepal with overseas countries (Rs. million)

Year	Milk power	Wool	Hide and skin	Carpet	Cheese and Butter
1995/96	-20.43	-2333.57	+459.49	+8032.23	-2.16
1994/95	-27.71	-1362.56	+456.48	+7703.75	-7.45
1993/94	-48.89	-1750.47	+217.54	+9518.05	-11.48
1992/93	-43.45	-2657.00	+268.80	+9525.64	-18.73
1991/92	-16.69	-2022.00	+232.40	+7130.92	-3.03

Source: Nepal Overseas Trade Statistics, 1992-96

Note: Negative values indicate net import, and positive values indicate net export.

DRAUGHT POWER

National sample census of agriculture 1991/92 (CBS, 1993) have shown 43.59% of the total cattle and 8.82% of buffaloes are male population above 3 years age and these are potentially working animals. The other source of data (MOA, 1994) showed that there are working oxen

by 40.82% in total cattle population and similar ratio for working buffalo males is 5.90%. These herd composition percentage when applied to present cattle and buffalo population, a working force of 2860,837 oxen and 195,160 buffalo bulls may be available within the country. These figure are higher to an estimate of 2.5 million (Oli, 1984) and it seems that there is more contributions from draught power to the GDP than the estimated Rs. 838 million (Oli, 1989).

In many areas of animal use other than in tilling and thrashing, contributions of animal power are not fully accounted for in estimating their share in GDP. Use of Tractor for tilling land is increasing in Tarai. However, animal power for ploughing is required forever in some areas of Terai and in the hills and mountains. This situation has not been seriously considered in developing future breeding plan for cattle and buffaloes. Export of oxen is increasing, and people of Tarai have been worrying about higher procurement price and decline in availability.

PACK ANIMALS

In the mountains and hills, quite a numbers of horses, mules, yaks, sheep and goats are being used as pack animals, and their value in economical term is not fully known.

National sample census of agriculture 1991/92 (CBS, 1993) have shown a population of 14,311 horses and 5,301 mules as potential pack animals. Other estimates show a population of 9,538 yaks, 13,200 yak crosses, 39,200 ponies, 22,355 mules, 40,400 goats and 40,921 sheep involved in carrying goods (Oli, 1989). Volume of goods transported and economical values is not fully understood in calculating contribution of these animals in LGDP.

TECHNOLOGICAL IMPACT

It is apparent that annual growth of animal products is higher than the growth of animal population (Table 1 and 3), which indicates that there is also some increase in yield of the livestock products per production unit.

Milk production can be increased by increasing the proportion of lactating animals. The growth rate in number of lactating cattle and buffaloes was 1.94% and 1.75%, respectively, as against the growth rate of 0.95% and 1.33% in cattle and buffalo population, respectively, during the last decade (Table 1). Bringing more dry animals in to lactation can easily be achieved when disease control, breed improvement and balance plane of nutrition is introduced. Thus, ignoring the increment in number of lactating animals, annual growth of livestock products above the growth of population is included as a "technological impact" in this study. Annual growth rate from technological impact and this contribution in percentage as seen in various products are presented in Table 12.

More than two thirds of the growth in milk production in cattle is from technological impact, which reflects the fact that there is higher milk yield difference between the native and improved (crossbred / imported) cattle (378 l per lactation against 1090 l per lactation, LMP, 1993).

Table 12: Technological impact on livestock production

Livestock products	Annual growth rate			Percent of Technical Impact in Growth Rate
	In production	In population	From Technological Impact	
Milk				
Cattle	3.04	0.95	2.09	68.75
Buffaloes	2.19	1.33	0.86	39.26
Meat				
Buffaloes	1.76	1.33	0.43	24.43
Sheep	0.76	0.61	0.15	19.73
Goat	2.07	1.43	0.64	30.91
Pig	4.75	4.02	0.66	14.10
Chicken	5.75	4.54	1.21	21.04
Egg				
Chicken	4.25	3.89	0.36	8.47
Duck	4.03	4.28	-	-

Source: Table 1 and 3.

Once the total impact is known it needs to be divided to give the share to different activities such as disease control, breeding and improved nutrition. No such studies are being done in field conditions as yet. The technological impact of 30.9% in goat and 19.7% in sheep (Table 12), for example, might have come mainly from the effect of disease control and improvement in the plane of nutrition, as there is very little breed improvement achieved in these species of animals.

CONCLUDING REMARKS

Analyses of available data indicate that they are not very consistent. For example, cattle population is seen increasing by 14.28 in one fiscal year of 1993/94, as against around 1% in others. Also sheep population seems to be over estimated in Mid of Far Western regions at base line survey itself, and hence there is a need to establish base line survey based on census of total population.

As herd composition is not fully understood, number of lactating animals are not accurately estimated. This has led to estimation of national milk production figure on lower side of production. Similar situation is observed in poultry production where commercial production is not properly integrated in selecting sample sites. Therefore, there is a need of estimating performance parameters based on village / commercial animal population for different species of animals in different topographical condition and under different management practices.

It is clear that the target set in the five-year plans is not being achieved (Table 4). As a result, it will be almost impossible to decrease the deficiency gap of 17% in animal protein production for human diet (Table 5 and 7). Whether the target itself is a difficult one to

achieve or the programmes as set out in the development plans are not properly implemented is not known. However, inadequate data recording system, which can cause improper estimation, has to be blamed in part. In sheep products, both mutton and wool remained in negative growth. Because of declining trend in sheep population (Table 1), the wool and mutton enterprise is not flourishing well. This has also been realised by APP (1995).

In fish production, the growth rate is highly fluctuating which is very difficult to interpret. An annual growth rate of 0.89 in 1993/94, 24.37% in 1994/1995 and 3.45% in 1995/1996 does not show a consistent pattern and it is difficult to figure out the constraints from the available data alone.

Among the export commodities, export of hide, skin and ghee is on increasing trend. However, they have not been included as priority commodity for increased production. There is an urgent need to address this problem and develop marketing channels so that more of these commodities could be exported to earn the very needed foreign currency.

Need of animals for farm power and pack animals is not properly analysed in order to develop breeding plans. Most of the breeding animals, both for milk and draught purposes, are imported from India. There are very scanty literature regarding performances of Tarai breed of animals in situ condition. Most of the studies are mainly from the hills and this may not reflect the true picture of livestock production in the country as a whole. It is important that research scientists and extension workers collaborate for field studies to generate such vital information required for planning at the national level.

It is generally visualised that improved technology is not being adopted by farmers of remote areas where livestock market is not being developed. Therefore, intensive production of milk, meat and poultry is mainly located around the urban cities of which Kathmandu is the biggest one. Milk supply to these metropolitan cities seems almost saturated. To achieve further growth in milk production, new markets for fresh milk need to be developed and factories for production of value added products need to be established. Also, export oriented products are not considered in priorities. Present import substitution policy alone is not allowing to develop livestock products according to the potentiality of the geographical location. While considering export oriented products, at the time when the country is going to be affiliated with the World Trade Organisation, it has become necessary to consider developing disease free status within the country. However, enough efforts and policies towards achieving such a target seems lacking. Only the meat market for import substitution alone seems a big one to allow the growth for some times to come. However, the available fodder resources under the present circumstances may not allow the growth to meet the huge additional number of animals required to meet domestic market demand (Table 8). Thus to increase livestock production from present level, it needs a great effort to increase fodder production and to develop disease free status as required from the World Trade Organisation.

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REDUCING METHANE EMISSIONS BY IMPROVING RUMINANT PRODUCTION IN NEPAL*

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ABSTRACT

Methane is a very important greenhouse gas and a major environmental pollutant. Its contribution to global warming represents about 20% of the greenhouse gases. Among the major sources of anthropogenic methane, ruminants produce around 22% of the total. So livestock ruminants offer a large opportunity for methane reductions. Methane is produced by normal ruminant digestion. The amount of methane produced, however, depends on the quantity and quality of feed, being more with roughages with poor digestibility such as crop residues. Provision of additional nitrogen supplement to ruminants for example through molasses urea multi-nutrient block (MUB) can help ruminal microflora to better breakdown cellulose in roughages into starch and sugars. This could help to increase the digestibility and animal intake of the feed, and reduce methane gas emission. Furthermore, this will also ensure better availability of nutrients to the animals and will help to improve livestock production. MUB is simple, applicable, available and low cost to produce in Nepal at community level, which could also reduce the amount of methane produced per unit of product.

BACKGROUND ON NEPAL

Nepal is landlocked country situated between India to the south and China to the North with a total area of 147,181 sq. km. There are three major physiographic regions found in Nepal, namely the Terai - area of flat riverbed plains and forest which is less than 300 meters in elevation, the hills - which rises up to about 3000 m, and the mountains - consisting of hills above 3000 m and the Himalayas including the world's tallest peak, Mt. Everest. The climate ranges from sub-tropical in the Terai to alpine with long severe winters and cool summers in the mountains (Agricultural Statistics of Nepal 1990; CBS 1996).

Dairying is important to the economy of the country with its annual milk production of 865,000 MT contributing about 5% to the GDP (CBS, 1996). Of this, it is estimated that 71% is from buffaloes and 29% is from cows. The contribution of dairy products to the GDP significantly under-estimates the importance of livestock in general, because of their multiple uses and the fact that they act as a form of wealth preservation and potential for capital growth (Agricultural Statistics of Nepal, 1990).

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It is estimated that nearly 87% of the milk that is produced in Nepal is consumed at home. The remaining 13% is sold primarily through a well-established informal marketing structure of neighbours and village-level markets. Only about 3% of Nepal's milk enter the formal market, and is sold to private dairies and the Dairy Development Corporation. This represents about 20,000-25,000 MT of milk. Annual import of skim milk powder is estimated to be 5,000-8,000 MT. About 80% of all milk and skim milk imports to Nepal come from the United States (Agricultural Statistics of Nepal 1990; Joshi, 1992, 1993; Joshi et al., 1993).

Livestock are enormously important to the economy of Nepal, considering their roles in rural transportation, land cultivation, and providing manure for fuel and fertiliser. In particular, the 6.3 million cattle, 3 million buffaloes and 6 million small ruminant animals survive on non-arable land and crop residues. Livestock also provide the critical cash reserve and cash income for many small farmers who grow crops essentially for subsistence.

The basic reason for the poor performance of livestock in Nepal is the inadequacy of the quantity and quality of feeds that are available. Efficient utilisation of available feed resources is constrained by a failure to use management practices that increase animal output. In addition, there are many ruminant feed sources that are unused, undeveloped or poorly utilised and these can make a major impact on livestock output. The recommendations here for development encompass the concept of matching ruminant production systems with the available resources, optimisation rather than biological maximisation. The overall plan must avoid the introduction of inappropriate technology, identify and transfer successful innovations and develop new technologies based on research to be carried out in Nepal (Proceedings of the workshop Make Milk Not Methane Gas 1996; Stem et al., 1995).

GREENHOUSE GAS EMISSIONS INTO THE ATMOSPHERE

The world population will increase from its present 4.8 to 5.4 billion people to at least 10 billion in the next 100 years. The demand for food will rise commensurately and that of protein rich foods such as milk, meat and fish will rise even more as the standard of living also increases. Along with this will be a rise in the need for draught power to produce the increased food required. There is a growing environmental crisis which is a direct result of the growth of the world's human population and its increasing use of natural resources and fossil fuels. Atmospheric accumulation of carbon dioxide (largely from fossil fuels), man-made gases (CFCs), nitrous oxide (from soils), methane (from various sources) and small amounts of other gases has led to more of the radiative energy from the sun being trapped in the earth's atmosphere. This situation, if it continues unchecked, will lead to an increase in average world temperatures by 0.5 to 5.0 degrees Celsius during the 21st century (Shrestha, 1996). Various changes may occur if the rise in temperature is not prevented, one of the most serious being a rise in sea level of 0.3 to 0.5 meters by the year 2000.

The Environmental Protection Agency (EPA) of the United States of America has adopted a policy to stimulate development and changes that lead to a decrease in greenhouse gas emissions into the atmosphere. It is recognised that on a global basis it is the responsibility of

all countries to target substantial reductions in emissions of carbon dioxide (CO₂), methane, nitrous oxide and other gases. In particular, CO₂ emissions from fossil fuel use in industrialised countries are being addressed (Leng, 1991; Orlic and Leng, 1992).

Major Greenhouse Gases are as follows:

Carbon dioxide 62%, Methane 20%, Nitrous Oxide 4%, CFCs 12%, HFCs+HCFCs 2%

Global Anthropogenic Methane Sources are as follows:

Coal, Natural Gas, Petroleum 28%, Rice 17%, Ruminants 22%, Manure 7%, Sewage treatment 7%, Landfills 8%, Biomass burning 11%

Strategies that reduce methane gas emissions are also being targeted because methane contributes to about 15-20% of the "greenhouse effect" and only a 20% reduction in methane emissions from human-related sources is needed to stabilise its concentration in the atmosphere. Ruminant livestock are a major source of methane emissions, contributing approximately 20% of the total global emissions. There are a number of strategies that reduce emissions from livestock (Orlic and Leng, 1992).

LIVESTOCK AND THE ENVIRONMENT

Increase in greenhouse gases is largely attributed to increases in emissions from human related activities such as fossil fuel use and agriculture. The concentration of methane in the atmosphere has more than doubled over the past two hundred years and continues to increase steadily. There is a great concern about methane because it is a very potent greenhouse gas, some twenty to forty times more potent than carbon dioxide. About 70% of total methane emissions result from human-related activities. Irrigated rice culture and husbandry of ruminant livestock are the two biggest sources of anthropogenic methane emissions and are both extremely important agricultural activities in south central Asia.

The reduction of methane emissions is a very important part of the strategy for mitigating global warming. It can also achieve other environmental benefits such as reducing smog and reducing atmospheric lifetimes of carbon monoxide and air toxics. Because the primary sink for methane and these other damaging gases is the free hydroxyl radical (OH), and methane's affinity for OH is very high, the more methane in the atmosphere, the less OH is available to remove carbon monoxide and air toxics (Shrestha, 1996).

In countries such as Nepal, strategies for reducing methane emissions can be very attractive. While making a positive contribution to the global environment, the associated socio-economic benefits of increased productivity can make a direct contribution to sustainable development, especially in rural areas. Improving the productivity of large ruminant livestock using available technologies could reduce methane by as much as 60% per unit of product. As production efficiency is increased, fewer animals would be required to satisfy the demand for animal products and overall methane emissions would be reduced (Joshi, 1996; Orlic and Leng, 1992).

It is important to understand that no single country's livestock population could provide a reduction in emissions that would eliminate the threat of global warming. Because

domesticated ruminant animals are so widely distributed around the world, all countries should participate in the effort to improve the efficiency of production of their livestock. The strategies to improve productivity should focus most strongly on resource poor livestock producers who rely on agricultural by-products for animal nutrition and who do not have the ability to significantly increase the size of their landholdings. These people would benefit most from efforts to increase the productivity of their animals through a methane reducing strategy and would realise an increase in their standards of living (Croucher, 1994).

LARGE RUMINANT LIVESTOCK IN NEPAL

Three species of large ruminants are commonly kept in Nepal: cattle, buffalo, and yak. Large ruminants are kept for milk, draught power and manure. Most cattle are located in the Hill and Terai Regions (Livestock Mater Plan, 1993). The local breeds predominate. Crossbred dairy cattle and exotic breeds account for a very small percentage of the total (2%). There is an increasing trend of crossbreeding of buffaloes with the Murrah breed for higher milk production (Study of Nepal Dairy Sector, 1989; Study report on Marketing Status of Milk, 1993).

SMALL RUMINANT LIVESTOCK

Small ruminants are important, particularly for low-income small holders and the "landless". Goats predominate with a population of 5.3 million due to their ability to exploit marginal ecosystems. Sheep number slightly less than 1 million and their wool is processed locally to produce traditional woollen garments.

FEEDMILLS IN NEPAL

The feedmill industry in Nepal is undergoing a period of rapid expansion and change. With promotion of privatisation recently by the HMG, numerous village-level and a few medium scale feed mills have recently opened their doors for business. While many of these claim to produce dairy feed, the amount actually sold is very small and mills survive almost exclusively by providing feed for the poultry production industry, which has recently undergone considerable growth and development.

TECHNICAL NORMS FOR METHANE GAS EMISSIONS FOR LOCAL CATTLE WITH PADDY STRAW BASED DIET

Methane per unit of product is the methodology generally applied on a world-wide basis by organisations working in this area. In the case of dairy animals, the methodology employs a ratio of grams of methane emitted per kilogram of fat corrected milk or FCM, (4% Butterfat) produced for human consumption. For example, a dairy cow annually producing 8,000 kilograms of FCM while emitting 130 kg of methane would have an efficiency rate of 16.25 g of methane per kg of FCM.

For calculation of methane gas emission per unit of product by a dairy cow in Nepal, milk yield of 1000 l per animal per lactation of 270 days was adopted. Similarly, methane gas production per cow in a lactation was assumed to be 40-60 kgs (this depends on breed size

and lactation). It was also assumed that the methane production would be at the lower limit i.e. 40 kg if the animal is principally fed with easily digestible feed resources whereas it would be at the upper limit i.e. 60 kg if the animal is fed with poorly digestible roughages such as rice straw alone (US/EPA and ATI, 1993).

A cow emitting 40 kg of methane to produce 1000 l of milk in a lactation will produce 1 kg of methane per 25 l of the product. In contrast, if methane emission is 60 kg to produce 1000 l of milk, the cow will have an efficiency of 1 kg of methane production per 16.7 l of milk produced. The former produced more milk than the latter for the same amount of methane produced.

A PLAN FOR IMPROVING DAIRY PRODUCTIVITY AND REDUCING METHANE EMISSIONS

The emission of methane by ruminants represents a carbon loss pathway that results in reduced productivity. If the energy that is lost in generating methane could be rechannelled into weight gain or milk production, it would be cost effective to the producer as well as provide a means of reducing methane emissions to the atmosphere. Past studies with ruminant animals have shown that methane production is dependent on the quantity and quality of the diet. Generally, highly digestible feeds yield lower methane emissions when compared with poor quality diets. Thus, with feedlot cattle on high grain diets, about 2% of their energy intake is converted to methane, while as high as 12% of the gross energy intake is lost as methane from cattle on low quality roughage diets. Dietary manipulation may provide a mechanism for reducing methane emissions from domestic livestock (Robertson et al., 1994; Proceedings of the workshop Make Milk Not Methane Gas, 1996; Sollod, 1996; Stem, 1996).

We believe that Nepalese farmers are as rational and price responsive as farmers are anywhere. Once prices are offered which provide sufficient profit over production costs and a ready market for milk, feeding and management practices will change as appropriate. It is possible that farmers will buy highly digestible feed ingredients and adopt technologies that will increase production and at the same time decrease methane emissions into the atmosphere.

Molasses-urea products in Nepal

Molasses-Urea Products (MUPs) are combinations of molasses, urea and frequently other crop by-products. These products provide additional feed supplements and also improve the digestibility of roughages. This could result in faster growth, less time to maturity, better health, greater reproductive efficiency, and greater production in terms of meat, milk, or draught power. Frequently, MUPs are manufactured using basic processes into a block form and are then frequently referred to as Molasses Urea Blocks or MUBs. MUBs are currently produced in Nepal in very limited quantities. However, with easily accessible supplies of molasses locally and just across the border in India, and reliable access to urea, wheat bran and salt, there is a great potential for producing MUBs within the country on a large scale. When fed to animals, MUBs can increase the productive efficiency of Nepalese dairy animals on rice straw and grass-based diets. Careful attention needs to be paid to possible

MUB components, their availability and their price on a local or regional basis where MUBs are to be manufactured.

Use of MUBs can significantly increase the milk production from Nepalese dairy animals. This increase in productive efficiency can provide the farmer with additional cash income without increasing the number of animals kept.

Advantages of Using MUB

Production benefits (Croucher, 1992):

1. A 10-20% increase in milk production - good if lactating cows and buffaloes are crossbred. If used with oilseed cake, milk yield will increase 50%. If ruminal bypass proteins are fed, milk yields will increase 100%.
2. Shorter calving intervals and faster maturation.
3. Easy to add vitamins and minerals to MUB.
4. For new commercial dairy farmers, this is a quick and simple introduction. No fancy balanced rations are necessary.

Environmental benefit:

5. A 50% reduction in methane gas per litre of milk produced.

Socioeconomic benefit:

6. More milk and less methane gas. Better nutrition for Nepalese children
7. Greater profit for farmers and the dairy industry
8. Retardation of global warming

CONCLUSION

All the countries of world are very much concerned about production of greenhouse gases causing depletion of ozone layer, global warming and health hazards. The problem is principally man-made, especially through industrialisation and intensive farming. Methane emission in atmosphere as green house gas has been estimated to be 255 million tonnes per year from all sources, of which 76 million tonnes comes from the livestock. Because of its accumulation in atmosphere at faster rate and its relative effectiveness in terms of global warming potential, reduction in methane emission is targeted to slow down the global warming (Orlic and Leng, 1992; Singh, 1993). Domesticated ruminant animals such as cattle, buffaloes and goats are the second largest anthropogenic source of methane, contributing an estimated 20 to 25 percent of global methane each year. The EPA estimates that changes in feed characteristics through supplementation such as molasses-urea products can reduce livestock methane emissions by 25 to 75 percent per unit of product, cutting global methane emissions from ruminant livestock by approximately 12 percent (Leng, 1991; Robertson et. al. 1994).

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EPIDEMIOLOGICAL BASIS OF THE CONTROL OF FASCIOLOSIS IN NEPAL*

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ABSTRACT

Fasciolosis is the most common animal disease and one of the important causes of deterioration in livestock productivity in Nepal. It is widespread throughout the country affecting all species 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 information 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 goats. 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 455 and 836 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 which reduce the productivity of animals in Nepal.

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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. 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.

PREREQUISITES FOR OCCURRENCE OF *FASCIOLA* SPECIES 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 molluscan 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 FASCIOSIS

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 FASCIOSIS 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 Pakhribas 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 which create numerous temporary *Lymnaea* habitats over a wide 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 road-sides and rice-fields which 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 fasciolosis in stall-fed animals could be prevented by managing the feeding of rice-straw. 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 *Embelica 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 may not be affordable for the poor Nepalese farmers. It is likely, therefore, that this approach may not be adopted by small farmers unless there is a huge subsidy on the cost of anthelmintics by the government.

In this situation, a predictive model which can forecast the incidence of fasciolosis for the impending year may be of great value. Such models have been developed for the fasciolosis caused by *F. hepatica* and used in temperate climates for some time. The use of predictive models allows the risk of a serious outbreak of disease to be assessed quantitatively, so that strategic dosing regimes or other suitable prophylactic actions for the forthcoming year can be selected. The development of predictive model for use in Nepal would be an invaluable asset for control of fasciolosis. The model could then be used to advise farmers on the most appropriate control strategy, which could have a profound impact on fasciolosis and the associated losses in animal production, as well as improving the cost-effectiveness of the control measures undertaken.

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.

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STRATEGIC DRENCHING AGAINST FASCIOLIASIS IN CATTLE IN THE WESTERN HILLS OF NEPAL

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ABSTRACT

Fascioliasis is the most important parasitic disease of cattle and buffaloes causing heavy economic losses in Nepal. More than 50% prevalence of the disease has been reported in cattle and buffaloes in different parts of the country. Under Nepalese condition, the major risk period of the disease is between September to February. A study was carried out to evaluate the effectiveness of a strategic drenching against fascioliasis in cattle in controlling the disease in the western hills of Nepal. Thirty Fasciola infected cows in each of the four villages (two in mid and tow in low hills) were randomly divided in to two groups. Animals in the treatment group were drenched with 2.5% Albendazole suspension at 12 mg per kg body weight (110-130 ml per cow) once in November and second time in February, and the animals in the other group were left untreated. Faecal samples were collected at monthly intervals, and were examined by standard sedimentation method for the presence of Fasciola eggs. The experimental animals were also scored for their body condition before and three weeks after each drenching. The strategic drenching reduced the overall infection in treated animals. In the mid hills, the strategic drenching was very effective in controlling the infection in cattle for the whole year. However, in the low hills, it was not equally effective in controlling the infection as in the mid hills. The likely reason for this could be the difference in the feeding management influencing the severity and frequency of the infection in the two altitudes. The effect of strategic drenching on the body condition of cattle was significant only in the low hills for February drenching. Farmers response to the strategic drenching, in general, were good with some improvement in body condition and milk production. Study on economic benefits by strategic drenching of cattle in different agro-ecological zones is the further area of research.

INTRODUCTION

Cattle is one of the important livestock species raised for draught power, milk and manure in Nepal. They play a significant role in subsistence agriculture systems in the hills of Nepal. Of various factors, diseases are the major cause for low production and productivity from these animals. Various diseases cause an estimated annual loss of Rs 845 million in the cattle and buffalo industry of the country (Lohani and Rasali, 1995). Fascioliasis, locally known as 'Mate' or 'Namle', alone causes an estimated annual loss of Rs 146 million in these animals

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(Lohani and Rasali, 1995). Eckert and Eichenberger (1970) have reported that the *Fasciola* infected cows produced 10 to 40 % less milk than uninfected cows, and 7.5 to 24 % weight loss in infected calves. The disease prevalence in different parts of the country has been reported to be more than 50 % in cattle and buffaloes (Lowcock, 1982; Joshi, 1986). Previous studies at Lumle Agricultural Research Centre (LARC) has identified the disease prevalence to be mainly affected by the availability of Khetland, paddy cultivation and permanent water sources rather than altitude (Joshi, 1988). Rice straw which is the major feed for livestock during winter months has been reported as the potential source of infection for fascioliasis (Joshi, 1987; Mahato, 1993). Green grasses from near permanent water sources or water lodging areas in monsoon are another potential source of *Fasciola* infection. Therefore, in the Nepalese hills, the major risk period for *Fasciola* infection is during post monsoon and winter months (September to February).

The general recommended practice to control fascioliasis in Nepal is to drench animals twice a year with a fasciolicide. However, farmers drench their animals only when they are clinically ill, and by that time the production had already been adversely affected. Obviously, this could not be the cost-effective way of controlling the disease. Proper timing of drenching based on the local epidemiology of the disease is necessary. A strategic control plan by drenching cattle in November (to control infections from grasses around the sources of water) and February (to control infections from feeding fresh rice straw) was formulated as technological intervention. This experiment, therefore, was undertaken to verify the effectiveness of the strategic drenching against *Fasciola* infection in cattle in the western hills of Nepal.

MATERIALS AND METHODS

The study was conducted from October 1994 to December 1995 in four villages of LARC's research command area (RCA). They are- Pakuwa (Parbat district) and Kundule (Baglung district) in the mid hills, and Bhendabari (Dhital, Kaski district) and Sisuwa (Kaski district) in the low hills. These sites were selected as representative of mid and low hills, and based on the cattle population in the area.

Selection of Animals

Faecal samples of more than sixty lactating or pregnant cows were collected from each site, and were examined for the presence of *Fasciola* eggs by the standard sedimentation technique (MAFF, 1986). Cattle with *Fasciola* eggs in faeces were regarded as infected. Among the *Fasciola* infected cattle, pair matching was done based on parity. From these, fifteen pairs were randomly selected, and were again randomly allocated into two groups, namely, treatment and control groups, each having 15 animals.

Drenching schedule

Albendazole suspension (2.5%) which was reported to be effective against fascioliasis, and without any side effects, and commonly available in Nepalese market was selected as the anthelmintic for drenching. The anthelmintic was administered at the recommended dose rate of 12 mg/kg body weight once during second half of November 1994 and the other during second half of February 1995 to the animals included in the treatment group.

For the animals in control group, a placebo (diluted mineral mixture suspension) was administered during the same time, and were left under farmers management.

Disease Monitoring

Faecal samples were collected at monthly intervals from cattle in both the groups, and transported to the Veterinary Investigation Laboratory, LARC. Standard sedimentation technique (MAFF 1986) was used to examine the faecal samples. Animals with *Fasciola* eggs in faeces were considered as positive for *Fasciola* infection.

Body Condition Scoring

Body condition scoring (1-9 scale) of the experimental animals were done as per the guidelines of Nicholson and Butterworth (1985) four times as scheduled below-

- Just before November (1994) drenching
- Post-November (1994) drenching (mid-December 1994)
- Just before February (1995) drenching
- Post-February (1995) drenching (mid- March 1995)

Feeding Management

A questionnaire survey was conducted at the end of the trial period to record the feeds provided, and their sources for each month of the period of experiment.

Observations and recording

The details related to each cow was recorded including the results of monthly faecal sample examination. Fortnightly milk production of each cows were recorded, but was discontinued because of the high variability among the small number cattle under the experiment. Farmers' feedback and responses for the strategic drenching were recorded in a questionnaire survey at the end of the trial.

Analysis

The prevalence of fascioliasis was determined as percentage of cattle infected out of the total animals sampled for faecal examinations at each site. Data from those cattle which were retained by the participating farmers till the end of the experiment, were analysed. Similarly, cattle under farmer's management group which were treated for fascioliasis by the farmers, were also excluded from the analysis. Repeated measure analysis (Genstat 5 Release 3.1) was carried out to examine the effectiveness of the strategic drenching on fascioliasis and interaction with factors such as time, altitude, location and management systems. For analysis of body condition scores, differences between the condition scores of each animal after and before drenching in November, and February separately were calculated. The differences in body condition scores in two different treatment groups were then compared by using Kolmogorov-smirnov two sample test (Genstat 5 Release 3.1) for significance.

RESULTS

Effectiveness of Strategic Drenching Against Fascioliasis

The summary of the results of repeated measures analysis is shown in Table 1. On repeated measures analysis, the strategic drenching was found highly effective in reducing the *Fasciola* infection among the treated cattle when compared with the untreated ones ($p < 0.005$). Among the various factors examined, only altitude ($P < 0.005$) and time (months) ($P < 0.05$), and interaction between time and altitude ($P < 0.05$) influenced the effectiveness of strategic drenching significantly. Other factors like management system and location were not significant ($P > 0.10$). However, the interaction between the strategic drenching and the time was significant at 90% level of confidence only ($p < 0.10$).

Table 1 Summary of repeated measures analysis of variance of *Fasciola* infection in cattle in the western hills of Nepal.

Source of variation	Degrees of freedom	Adjusted d.f.	S.S.	M.S.	F-value	F-probability
<u>Subject Stratum</u>						
Altitude	1	-	40854.8	40854.8	20.37	<0.005
Location	3	-	7024.7	2341.6	1.17	>0.10
Management System	1	-	321.6	321.6	0.16	>0.10
Treatment groups	1	-	50711.2	50711.2	25.29	<0.005
Management System x Treatment group	1	-	518.4	518.4	0.26	>0.10
Residual	6	-	12031.8	2005.3	3.61	
<u>Subject x Time Stratum</u>						
Time	12	3	86836.2	7236.4	13.02	<0.001
Time x Altitude	12	3	22414.3	1867.9	3.36	<0.05
Time x Location	36	9	17599.8	488.9	0.88	>0.10
Time x Management System	12	3	4284.4	357.0	0.64	>0.10
Time x Treatment group	12	3	38048.6	3170.7	5.71	<0.10
Time x Management System x Treatment group	12	3	2318.5	193.2	0.35	>0.10
Residual	72	18	40005.4	555.6		
Total	181		322969.8			

Note: Degrees of freedom in the subject x time stratum were multiplied by 0.2484 before examining F-values.

The prevalence of *fascioliasis* in cattle in different treatment groups in the mid and low hills are illustrated in Figures 1 and 2, respectively. Among the untreated cattle in the mid hills, the prevalence of *Fasciola* infection naturally decreased to <8% after the month of May, except in August, when the prevalence was 33%. The prevalence increased later to 42% in November. However, in the low hills, the prevalence in untreated animals remained at very high level (>50%) throughout the year, and increased upto 89% in November.

In the mid hills, the strategic drenching significantly reduced the prevalence of *Fasciola* infection in treated cattle for the whole of the year (Figure 1). The infection dropped to 7% and less after the first drenching, and the animals remained free of infection for the rest of the year (except in the month of April when the infection was observed 40%). In contrast, in the animals under farmer's management, the infection remained higher (>58%) until April, and thereafter reduced to very low level for the rest of the months. The infection picked up again (to about 40%) in November in both the treatment and control groups.

In the low hills, under farmer's management, the *Fasciola* infection remained at very high level (>80%) until April, and at moderate level (44-83%) afterwards. In treated animals, the infection was brought down to less than 5% after second (February) drenching. However, the infection increased to >30% after June. The infection increased to >80% in both the groups in November. Differences in the prevalence of *Fascioliasis* between the treated and untreated animals was significant ($P<0.05$) till August, after which it became non-significant. However, the prevalence of the infection among the treated animals in the low hills was generally higher than that recorded among treated animals in the mid hills. Increase in the prevalence from June, and a further increase in September in animals drenched in February (Figure 2) indicates that the source of *Fasciola* infection still existed in the low hills even after February.

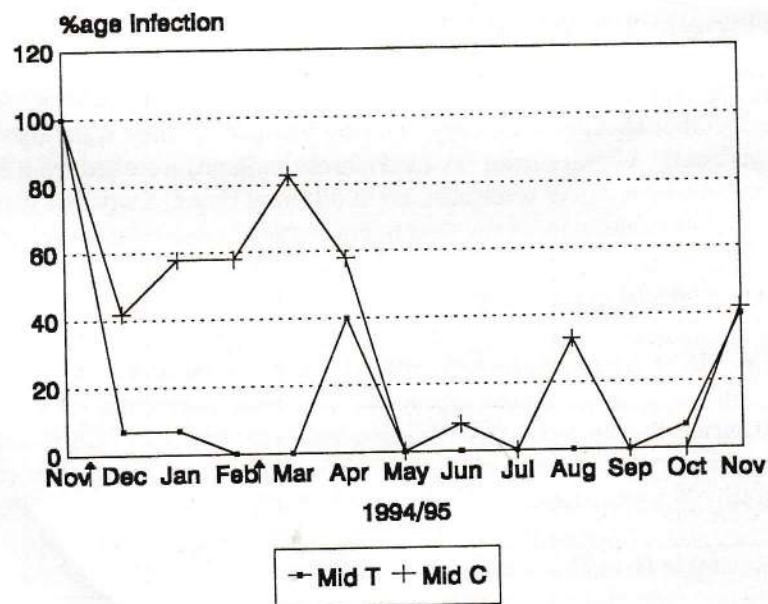


Figure 1 Prevalence of *Fasciola* infection in cattle in the two groups in the mid hills. Arrows(↑) indicate drenching in treatment group. Mid T = Treated, Mid C= untreated

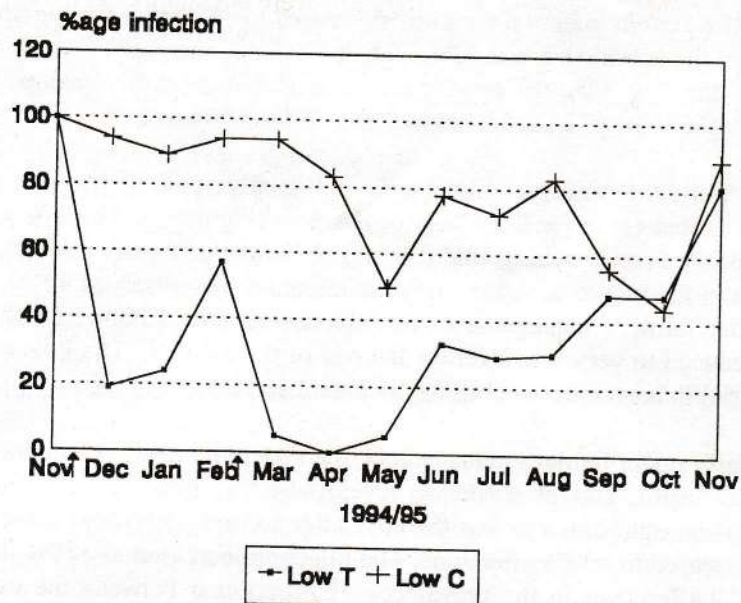


Figure 2 Prevalence of *Fasciola* infection in cattle in the two groups in the low hills. Arrows(↑) indicate drenching in treatment group. Low T = treated, Low C = untreated

Feeding Management of Experimental Animals

Feeding management in the mid hills

In Pakuwa and Kundule, most of the cattle were stallfed. They were fed rice straw from September/October to April/May only. During this period, they were also provided with tree fodder occasionally. Grasses from dry land (forest/bariland) were fed from June to October. In addition, maize/wheat stover were also fed at different times. Only few cattle were allowed to graze dry land/forest throughout the year intermittently.

Feeding management in the low hills

In Sisuwa and Bhendabari, most of the cattle were managed under semi-stallfed system. They were fed with rice straw almost throughout the year depending on its availability in the households. Tree fodders were not available, and were not fed to cattle. Most of the animals were allowed to graze in open communal grazing lands from June to November and in fallow rice field from November to June after the rice harvest.

Effect of Strategic Drenching on Body Condition

In the low hills, the difference in body condition scores after and before February drenching were significantly different ($P=0.04$) in the two groups indicating a significant effect of drenching on body condition during that time.

However, there were no significant difference in body condition between the groups for November drenching. Similarly, the differences were not significant in the two groups for both drenching in the mid hills. Overall, the differences between condition scores of cattle after and before drenching in November and February (separately) were not significant for the two groups ($P=0.38$ and $P=0.20$, respectively) (Table 2).

Table 2 The effect of strategic drenching on body condition.

	Kolmogorov Smirnov Two Sample Test		Probability (P)
	Maximum Differences	Chi-square (2df)	
Overall The effect of November (1994) drenching against fascioliasis in body condition scores.	0.1222	1.941	0.38
The effect of February (1995) drenching against fascioliasis in body condition scores.	0.2222	3.232	0.20
Mid hills The effect of November (1994) drenching against fascioliasis in body condition scores.	0.1167	0.3630	0.83
The effect of February (1995) drenching against fascioliasis in body condition scores.	0.08333	0.1852	0.91
Low hills The effect of November (1994) drenching against fascioliasis in body condition scores.	0.2222	1.915	0.38
The effect of February (1995) drenching against fascioliasis in body condition scores.	0.4127	6.603	0.04

Farmers Feedback on Strategic Drenching

Feedback was collected only from farmers whose cattle were drenched against fascioliasis. All these farmers responded favourably. There were no side effects of the anthelmintic, it was easy to administer (animals accepted it easily when given mixed with concentrate), and subjectively, some improvement in milk production and body condition were observed by the farmers. All farmers reported increased appetite in their animals.

Though all farmers showed willingness to follow the strategic drenching, only few actually adopted in the following year (data not presented).

DISCUSSION

In general, the strategic drenching was effective in reducing the prevalence of fascioliasis in cattle. In the mid hills, *Fasciola* infection in cattle was significantly reduced for the period of November to March/April, and treated cattle remained almost free of infection thereafter for the whole year (Figure 1). However, in the low hills, the infection was seen throughout the year which could possibly be due to the feeding of rice straw, and allowing them to graze throughout the year. Therefore, though the infection was brought down for up to August by the drenching, infection might have been continuously picked up by the animals from the rice straw and by grazing, and the drenching was not able to control the infection in the low hills. The strategic drenching, though controlled the possible infection during post monsoon and winter months, was not adequate in controlling infection during other periods (Figure 2). The pattern on prevalence of fascioliasis in the low hills suggests that there is need of one or two additional drenchings, perhaps in between June and August for the year round control.

Fasciola completes its life cycle through an intermediate host, snails of genus *Lymnaea*. These snails are aquatic. As a result, life cycle of the parasite outside the ruminant host can be completed only around the permanent water sources or in a rainy seasons around water lodging places including irrigated paddy fields. *Fasciola* metacercariae contaminated grasses and rice straws (Joshi, 1987) are the major sources of *Fasciola* infection in animals in Nepal. This restricts the infection of the animals to a limited period (post-monsoon and winter months) in most of the areas. On analysis of feeding management of the experimental animals in the two altitudes, a distinct difference was observed. In the mid hills, animals were mostly stallfed, and rice straw was fed to animals from September/ October to April/ May. Grasses from dry land/ forest were fed to cattle. In addition, tree fodder, maize/ wheat stover were also available in some months. Grasses from wetland (*Simkhet*) and near permanent water sources were generally not available. Therefore, in the mid hills, the major source of *Fasciola* infection seems to be mainly the rice straw which is fed from September/ October to April/May. In contrast, in the low hills, cattle were fed rice straw, and were allowed to graze in the open field (near streams/riverside) and fallow rice field throughout the year. Tree fodder and other roughages were not available to these animals. Therefore, unlike in the mid hills, the potential for *Fasciola* infection to cattle in the low hills was almost throughout the year. This might be the reason for the difference observed in the effectiveness of strategic drenching against *Fasciolasis* in cattle in the mid and the low hills.

The effect of strategic drenching on body condition of cattle was found significant only for the February drenching in the low hills, and not for November drenching. In the mid hills, no effect on body condition was observed for both the drenchings. The reason for this lack of effect on body condition might be due to the fact that the effect of drenching on body condition was masked by that of nutrition. In the low hills in February, animals in untreated group had been affected by both nutritional stress (low plane of nutrition) and by heavy *Fasciola* infection. In contrast, in the treated group, though the animals were affected with nutritional stress, many of them were free or have lower burden of infection during the period. This might have resulted in better body condition than that of untreated animals. In

contrast, in the mid hills, the nutritional status of the animals were better than that of low hills (availability of tree fodder), and the infection was comparatively low even in untreated group of cattle. Better nutrition could have been able to overcome the stress of parasitism, and hence the lack of differences between the groups.

In general farmer's response to the strategic drenching was good. No side effects were reported, and the anthelmintic was easy to administer. Farmers generally reported improvement in body condition, better appetite, and in some cases increase in milk production. Though all the farmers were willing to adopt the practice of strategic drenching to control *Fasciolasis* in their cattle, only few understood its importance and potential benefits. There is a need for more extension education to the farmers on the importance of strategic drenching. It is also necessary to have quantitative analysis of economic benefits of the strategic drenching to these animals. Considering a similar susceptibility of buffaloes to the disease (Joshi, 1988), and similar agroclimatic conditions of the area, similar drenching schedules with slight modifications to adjust their feeding management could probably be adopted to control the diseases in buffaloes.

CONCLUSION

In general, the strategic drenching was effective in controlling the *Fasciola* infection in cattle in the western hills. The technology was very effective in controlling fascioliasis in cattle for the whole of the year in the mid hills where *Fasciola* infection is limited to post-monsoon and winter months. In contrast, it was not equally effective in controlling the disease in cattle in the low hills where new *Fasciola* infection is possible throughout the year. The pattern of prevalence of infection in the low hills suggest that there is need of one or two more drenchings after February to keep the infection at low level throughout the year, and this needs further verification. It should be taken into consideration that the risk period may vary within an altitude depending on the feeding management and feed sources. There is need of extension education to the farmers on the importance and potential benefits of the strategic drenching. Analysis of economic benefits of the strategic drenching in different agro-ecological zones is the further area of research.

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FOOTROT TRANSMISSION IN MIGRATORY FLOCKS OF WESTERN NEPAL DURING DESCENDING MIGRATION THROUGH THE FOREST

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ABSTRACT

Two migratory flocks (GP2 and GG2) of Ghanpokhara village of Lamjung District where footrot was endemic were observed for footrot lesions during various stages of migration in the year 1993. These flocks left the village free of infection in April. When inspected at alpine pastures in August, none of the sheep were affected with footrot whilst the prevalence in goats in GP2 and GG2 was 5.4% and 10.4%, respectively. In November, sheep and goats of both flocks were affected with a prevalence of 14.7% and 16.5%, respectively in sheep and goats of GP2, and 9.7% and 5.1%, respectively, in sheep and goats of GG2. These observations provided the direct evidence on transmission of footrot during descending migration through the forest (October - November). Previous studies (Ghimire and Egerton, 1996) have identified that the period of ascending migration through the forest (May - June) also to be favourable for footrot transmission. Therefore, both the periods of ascending and descending migration to and from the alpine pastures are the risk periods for footrot transmission in these flocks. Any prophylactic measure instituted to control footrot in these flocks should, therefore, aim to protect animals for the whole period of six months (May to November) spent on migration.

INTRODUCTION

Footrot is a contagious disease of the feet of sheep and goats which causes lameness (Beveridge, 1941). It is a mixed bacterial infection of which *Dichelobacter nodosus* (Dewhirst *et al.*, 1990) is the essential transmitting agent. Though, *D. nodosus* can survive for a prolonged period in an infected foot, it cannot penetrate the healthy skin of a sheep's feet (Beveridge, 1941; Egerton *et al.*, 1969). Various environmental factors, which induce devitalisation and superficial bacterial invasion of interdigital skin, facilitate the invasion by *D. nodosus*. Under field conditions, maceration of the feet by prolonged wetness, invasion by other bacteria and environmental temperatures constantly above 10°C are important for the natural transmission of the disease (Graham and Egerton, 1968). As a result, transmission of footrot is seasonal.

Virulent footrot was introduced into Nepal in the nineteen sixties with imported rams, and became endemic in migratory flocks of Kaski, Lamjung and Manang Districts (Karki, 1983). As conventional techniques were not completely successful in eradicating the disease from these flocks, the possibility of managing the disease by specific vaccination was

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explored (Egerton *et al.*, 1996). Vaccination has to be properly timed to make it more effective (Egerton, 1986). Studies were therefore, undertaken to identify the disease transmission period in these flocks (Ghimire and Egerton, 1996). These studies identified the period between May and July to be the most favourable season for transmission of footrot in these flocks. However, those studies (Ghimire and Egerton, 1996) could not conclude on the transmissibility of the disease during descending migration through the forest (September to November). As the majority of the animals under observation was affected by July/August, there would have been only a few susceptible animals left in the population which could indicate the true transmissibility of footrot during descent. It was of interest to know whether animals protected in the period of April to August, became susceptible to major outbreaks during the homeward migration. During the course of another study described in detail elsewhere (Ghimire, 1997), two flocks which were essentially free from footrot for the period of April to August, succumbed to a major outbreak of footrot between September and November. These findings which indicate the occurrence of footrot transmission during the descending migration through the forest are presented in this paper.

MATERIALS AND METHODS

Animals and observations

Disease situation in two flocks (GP2 and GG2) of Ghanpokhara village during migration in 1993 is presented in this paper. These flocks were inspected four times at monthly intervals from January to April 1993. All animals in these flocks were individually identified by ear tagging. During this period, affected animals were treated and non-responders were culled, and only apparently disease free animals were allowed to go on migration. They were then inspected at the Alpine pastures in August, and in November after their arrival at the village level. At every inspection, affected animals were scored for footrot lesions (Egerton and Roberts, 1971).

Clinical history of the two flocks

GP2

In January 1993, this flock had 104 sheep and 152 goats, of which 2 sheep and 3 goats were affected with footrot. Affected animals were treated with antibiotics and vaccination, and all these five animals were recovered by March. In all four inspections made between January and April, no new cases of footrot were detected. In March, excluding the previously affected and recovered animals, and lambs and kids below one month of age, there were 109 sheep and 152 goats, which were vaccinated with a monovalent E vaccine. They received a booster dose of the same vaccine at the April inspection before leaving the villages for the Alpine pastures. The five affected animals which recovered after the first treatment also received a booster dose of monovalent E vaccine in April, and migrated together with the rest of the flock.

GG2

In GG2, there were 340 sheep and 206 goats in January, of which only one sheep was affected with footrot. The affected animal was treated as described above, and had recovered in February. No other cases of footrot were detected in the flock during this season. In March, there were 360 sheep and 222 goats in this flock, of which 184 sheep and 110 goats were vaccinated with a commercial multivalent footrot vaccine (Vaxal NoRot, Arthur Websters Ltd., Castle Hill, NSW, Australia), whilst the remaining 176 sheep and 112 goats were left unvaccinated. All animals were inspected again in April, and were apparently free of footrot. Animals vaccinated in March received a booster dose at this inspection. As in the other flock, a few young lambs and kids below 1 month of age were left unvaccinated.

RESULTS

Footrot prevalence during migration

Sheep

When these flocks were inspected at alpine pastures in the first week of August, sheep and goats of GG2 were found pastured separately. Sheep and goats in this flock migrated together till mid July, after which they were separated; sheep were taken to pastures located at a higher altitude (approximately 4,000 m asl) whilst goats grazed at a slightly lower altitude (approx. 3,700 m asl) pastures. They were again mixed together after the August inspection, and remained together thereafter. Sheep and goats of GP2 were together, and at the same pastures as sheep of GG2. It is important to note that though these two flocks grazed the same slope of the mountain and were at the same pasture during the August inspection, they utilised different pastures for most of the time during this migration.

During August, there was no evidence of footrot among the 408 sheep from the two flocks. Three sheep which were affected in January and recovered after treatment remained free of footrot. However, whether some of these sheep were infected without apparent clinical signs or were still under incubation could not be ruled out. It was not, however, possible to inspect all animals at this or later inspections due mainly to animal losses inherent to the system.

At the November inspection, it was obvious that footrot had transmitted to the sheep in these flocks (Table 1). As goats in these flocks were affected in August (see below), it is most likely that goats were the source of infection for these sheep. The shepherd responsible indicated that severe lameness in sheep of GP2 was noticed for the first time in October. In November, about 15% of the sheep in GP2, and 9.5% in GG2 were affected with footrot (Table 1). The prevalence of footrot between the two flocks was not different ($P>0.05$). However, an obvious difference between the two flocks was the severity of the infection; in GP2, 13 of the 14 affected sheep had underrunning lesions in contrast to 8 of 28 sheep in GG2 ($P<0.001$).

Table 1. Prevalence of footrot among sheep from two flocks of Ghanpokhara during various phases of migration in 1993

Flock	Vaccine group	Proportion of sheep affected		
		March/April	August	November
GP2	Monovalent E x 2	0 / 109	0 / 97	14 / 95 ^a
GG2	Polyvalent x 2	0 / 184	0 / 166	13 / 165 ^a
GG2	Nil	0 / 176	0 / 145	15 / 138 ^a

Note: Values within a column with different superscript were significantly different ($P < 0.05$)

Goats

At the August inspection, and in contrast to sheep, there was evidence of footrot infection in the goat component of these flocks (Table 2). About 5% of goats of GP2, which were vaccinated with monovalent E vaccine, had footrot lesions. The figure for GG2 was about 10.4%, being 7% among goats vaccinated with multivalent footrot vaccine and 14% for unvaccinated goats. When the prevalence of footrot among different groups was compared, a significant difference ($P < 0.05$) was observed only between goats of GP2 and non vaccinated animals of GG2 (5% vs 14% respectively). However, there was no difference between two groups of the same flock, as well as between two flocks as a whole. Of the three goats affected in January but recovered after treatment, one had footrot in August.

All animals that went on migration were apparently free from footrot in April, and the likely source of infection is the breakdown of subclinical infection in a few animals. The disease would have been transmitted from these relapsed cases to other healthy animals.

Table 2. Prevalence of footrot among goats from two flocks of Ghanpokhara during various phases of migration in 1993

Flock	Vaccine group	Proportion of goats affected			No. of new cases in November
		March/April	August	November	
GP2	Monovalent E x 2	0 / 152	7 / 129 ^a	20 / 121 ^a	17
GG2	Polyvalent x 2	0 / 110	6 / 89 ^{ab}	2 / 76 ^b	1
GG2	None	0 / 112	12 / 84 ^b	6 / 80 ^{ab}	4

Note: Values within a column with different superscript were significantly different ($P < 0.05$)

By November, the majority of the goats affected in August had recovered, but at the same time there were new cases detected (Table 2). In GP2, the prevalence of footrot among goats increased from 5% in August to more than 16% in November. In contrast, it decreased from 10% to 5% in GG2, though there was evidence of disease transmission not only amongst sheep but also among goats of this flock (Table 1 and 2). The incidence of footrot between August and November, and the prevalence in November was significantly higher among goats of GP2 than GG2 ($P < 0.001$). The increase in prevalence of footrot amongst goats in GP2 is probably due to transmission of footrot during descending migration, September–November, though the possibility that these animals were under incubation or were infected without apparent clinical signs at August inspection could not be ruled out.

Bacteriological investigation

These flocks had had a very low level of footrot infection in 1992, and bacteriological culture taken from a few animals, selected on the basis of their history of lameness, was unsuccessful for isolation of *D. nodosus*. Isolates of virulent serogroup E, and later on benign serogroup B and C, had been cultured from other flocks of this village (Ghimire *et al.*, 1996). During 1993, virulent serogroup B isolates were isolated from another village flock whose source of infection was identified to be one of the Ghanpokhara flocks (GP4). At the November 1993 inspection, samples were taken from affected animals, but due to temporary failure of the culture facilities at the LARC laboratory, *D. nodosus* involved in this outbreak could not be isolated and characterised. As animals of GP2 were vaccinated with monovalent E vaccine, the disease in this flock at least, was suspected to have been caused by serogroup B isolates. However, this could not be confirmed.

DISCUSSION

For transmission of footrot, susceptible sheep and goats need to be exposed to a source of *D. nodosus* under suitable environmental conditions. Under field conditions prolonged wetness of the feet and ambient temperatures constantly above 10°C are essential to predispose animals to footrot (Graham and Egerton, 1968). Previous studies (Ghimire and Egerton, 1996) had identified that in Nepal, the period of upward migration through the forest (May–July) provides ideal conditions for footrot transmission. Alpine pastures grazed between late July and mid September are not conducive because they are too cold to facilitate footrot transmission. However, if animals graze at lower altitudes (around 3,700 m asl) during this time of the year, footrot transmission can occur (Ghimire and Egerton, 1996). Furthermore, results presented in this paper provided evidence that the period of descending migration (September / October) through the forest can also facilitate footrot transmission if the animal population is susceptible. The whole period of six to seven months spent on migration to and from the alpine pastures, therefore represents the risk period of footrot transmission in these flocks.

During the previous studies (Ghimire and Egerton, 1996), some animals with subclinical infections relapsed early in the migration and apparently provided the source of infection for the rest of the flock. As a result, the majority of the animals were affected before July / August. Whilst in 1993, though some goats did relapse before August, the disease transmitted only to a low proportion of goats. It is likely that this year, for some unknown

reasons, subclinical infections relapsed late in migration, possibly just before the flocks entered alpine pastures. As goats in GP2 were taken to high altitude pastures together with sheep, the cold climate in these pastures did not favour transmission to either sheep or goats. Similarly, sheep in GG2 were separated before any transmission could have occurred. However, the healthy goats in GG2, which were pastured at lower altitudes, acquired footrot before the August inspection. Disease transmission among goats pastured at similar altitudes had been previously recorded (Ghimire and Egerton, 1996). The route and speed of ascending migration is more or less similar for a flock in any year, though minor variations can occur. It is therefore, difficult to ascertain why subclinical carriers did not relapse early in migration and transmitted the disease to rest of the population in this year.

Alternatively, it is possible that sheep and goats detected with footrot for the first time in November were also infected before entering the alpine pastures but were not diagnosed clinically. This is possible if infected animals were still incubating (incubation period of approximately 10-12 days), or if the development of clinical lesions was suppressed due to the cold climate in these pastures. The comparatively warmer climate in the forests during the descending migration facilitated the development of clinical lesions in these animals. However, as none of the sheep in either flock had any clinical lesions in August, it is less likely that all sheep and goats affected with footrot for the first time in November were already infected before the August inspection. This argument is substantiated by the fact that often a higher proportion of sheep is affected with virulent footrot (Ghimire *et al.*, 1992; Ghimire and Egerton, 1996), and with more severe lesions (Ghimire and Egerton, 1996) than the goats. Furthermore, when exposed simultaneously to a source of infection under natural conditions, sheep are likely to exhibit clinical signs of footrot earlier than the goats (Ghimire, 1997).

Results presented in this paper did not indicate the presence of subclinical infections among sheep. There were, however, subclinical infections in some goats. This difference in subclinical infection rate between sheep and goats might have been by chance, as sheep are also known to have subclinical infections (Egerton and Raadsma, 1993). Alternatively, this might be a true indication of higher rate of subclinical infection in goats, despite the fact that they suffer from a less severe form of clinical disease when compared with sheep (Ghimire and Egerton, 1996).

The infection recorded in GP2 in November 1993 was certainly virulent, with the majority of animals having underrun lesions. However, this could not be substantiated by *in-vitro* tests. Sheep and goats of this flock were vaccinated with monovalent E vaccine before they went on migration. Though the immunity in response to commercial multivalent vaccine is short lived, monovalent vaccines provide a much longer, at least six months, protective immunity (O'Meara *et al.*, 1993; Raadsma *et al.*, 1995; Ghimire, 1997). In addition, considerable protection was achieved in other similarly vaccinated sheep (Ghimire, 1997). Therefore, it is unlikely that the disease in this flock was caused by isolates of serogroup E. As only one other virulent serogroup (B) of *D. nodosus* had been identified in Nepal, and because this was also isolated from some other flocks of the same village, the disease in this flock was probably caused by a virulent serogroup B isolate. Unfortunately, this was not proved because of the temporary failure of the culture facility during that time. As all infected animals were treated with parenteral antibiotics in November and all of them recovered,

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AN ATTEMPT TO SYNCHRONISE OESTRUS IN ON-STATION AND ON-FARM LOCAL COWS IN THE WESTERN MID HILLS

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ABSTRACT

A trial was conducted to test the use of technique of oestrus synchronisation in local cows of on-station group (n=10) kept under stall feeding, and on-farm group (n=9) kept under semi-stall feeding managements in the mid hills of western Nepal. The cows of both the groups were given 5ml each of Prosolvin (Intervet) containing Luprostiol 7.5 mg/ml, a Prostaglandin F₂ alpha analogue intra-muscularly two times at 11 days apart during the summer of 1996. At 72 hours of the second Prosolvin injection all the cows were inseminated with frozen semen of Jersey bulls. As a result of the fact that the cows of on-station group received better feeds and fodder than those of the on-farm group, body condition scores (1-9 scale) were 6.1 ± 0.5 in the former group and 3.7 ± 0.3 in the latter, and their girth measured body weights averaged 245.6 ± 10.8 kg and 168.1 ± 7.6 kg respectively. Both these parameters were significantly different ($P < 0.05$) between the groups. The median values of duration taken for oestrus expression following first and second instances of Prosolvin injection were not significantly different between the two groups. However, oestrus signs such as vaginal discharge, bellowing, frequent urination and vulva being moist and pink particularly following the second injection were significantly higher ($P < 0.05$) in on-station group. The very low pregnancy rate of 20% in on-station group and 33.3% in on-farm group needs further investigation as to ascertain its cause before the technology could be recommended for use in mass insemination of cows under the western mid hill conditions.

INTRODUCTION

Artificial insemination (AI) has been one of the powerful tools used in crossbreeding local cows in Nepal with exotic high yielding breeds. However, due to lack of use of technologies for manipulation of their reproduction, AI has been carried out only in a limited scale in some accessible pocket areas.

Synchronisation of oestrus is one of the advances in animal reproduction which is being widely used both in the advanced and developing countries, providing the potential advantages of reducing the problem of heat detection and permitting mass insemination on a predetermined schedule. This, in turn, could improve their reproductive efficiency by way of reducing calving intervals and making preplanned calving possible in desirable seasons. This also gives non-oestrus but regularly cycling animals (silent heat cases, which may be mistaken for infertility ones), an opportunity to conceive (Sankhi and Capitan, 1993).

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As the synchronisation technique could be potentially utilised for improving the reproductive efficiency of the local cows by way of timely insemination through mass A.I. in them, a trial was conducted to test the technique in local cows in the mid hill situation of western Nepal under the on-farm management in which it has been a difficult technology to be adopted widely as compared to on-station management in which the technology is supposedly working well based on the experience of other countries.

MATERIALS AND METHODS

Experimental Animals

Twenty sexually matured and normally cycling local hill cows with active ovaries of various physiological stages were selected for the trial following their gynaecological examination. Ten of these cows were kept under completely stall-fed condition in a cattle shed at Lumle Agricultural Research Centre (LARC) as the on-station group, whilst ten others were raised by a farmer in the adjoining village in Dhikurpokhari VDC as the on-farm group and were maintained under semi-stall fed condition. However, one cow in the latter group had uterine abnormality and was dropped from the trial. The cows in on-station group were fed with green forage (tree fodder and grasses) and rice straw *ad-lib* and restricted quantity (1-2 kg) of commercial concentrate feed, whilst those in on-farm group were allowed to graze in the forest during the day time and sheltered in a *Goth* (temporary shed) during the night and were given some supplemental forages and feeds, but were not subjected to any researcher's intervention in their management. The animals were kept under these conditions for about 2 months before the trial was actually conducted. The feed stuffs and their approximate quantities given to the experimental animals were monitored daily during the trial period in order to assess their feeding status.

Experimental Activities

The cows of both the groups were given 5 ml each of Prosolvin (Intervet) containing Luprostiol 7.5 mg/ml, a Prostaglandin F₂ alpha analogue (which can regress a functional corpus luteum) as an intramuscular injection at Day-0 (beginning of the trial) and at Day-11 of the trial. The body condition scores and girth measured body weights were recorded for all the cows both in the beginning and the end of the trial. The signs of oestrus were monitored in all animals from the beginning of the first injection of Prosolvin to 18th day of the trial. After 72 hours of the second injection of Prosolvin, all the cows were inseminated with Jersey bull frozen semen stocked at LARC from a donation of Jersey Society, UK. The final confirmatory diagnosis of pregnancy was conducted through rectal palpation after 3 months of insemination of cows, although regular checking up was performed following 45 days of insemination.

RESULTS

Feeding management of experimental cows

The experimental cows in on-station group were fed largely on tree fodder and crop residues (rice straw), whilst those in on-farm group were largely dependent on grazing on forest pasture and tree fodder given at their shelter supplementally. The average daily quantities of feed stuffs given and average duration of grazing allowed to the experimental cows as monitored during the three week trial period are presented in Table 1.

Table 1 Average daily quantity of feed stuffs given and average duration of grazing allowed to the experimental cows as monitored during three week trial period

Management system	n	Tree fodder kg	Green Grasses/ Shrubs Kg	Crop residues kg	Concentrate feed, Kg	Common salt, g	Duration of grazing hours
1. On-station	10	5.25	2.5	5.33	1.0	25.0	0.0
2. On-farm	9	6.25	0.0	0.50	0.0	0.56	7.44

Note: n = number of experimental animals

Body conditions of experimental cows

The means and standard errors of girth-measured body weights and Nicholson and Butterworth (1985)'s body condition scores (1-9 scale) of the experimental cows across management system are presented in Table 2. The results showed that the body weights and body condition scores were both significantly higher ($P=0.000$) in on-station group than in on-farm group, whilst the effect of their parity was not significant in both these measurements.

Table 2 Means and standard errors of girth-measured body weights and body condition scores of experimental cows across management system and parity

Factors	n	Body condition Score (1-9 scale)	Girth-measured body weight, kg
Management system		($P=0.000$)	($P=0.000$)
1. On-station	10	6.1 ± 0.5	245.6 ± 10.8
2. On-farm	9	3.7 ± 0.3	168.1 ± 7.6

Note: n = number of experimental animals

Expression of oestrus signs and pregnancy rate

The median values of duration taken by the experimental cows for expressing standing oestrus signs following the first and second injection of prostaglandins F_2 alpha analogue (Prosolvin,

Intervet) are presented in Table 3. The duration taken to exhibit oestrus signs was not significantly different between the two experimental groups or across the parity of the animals. The median value for the duration taken by the 10 on-station and six on-farm cows was 80.00 and 90.00 hours respectively.

Table 3 Median value of duration taken for expression of standing oestrus following first (Oes1) and second (Oes2) injections of Prosolvin in the experimental cows

Factors	Oes 1 hours	Level of significance based on the Wilcoxon (Gehan) Statistic	Oes 2 hours	Level of significance based on the Wilcoxon (Gehan) Statistic
Management: 1. On-station 2. On-farm	145.0 (6) 220.0 (8)	(P=0.0926)	80.0 (10) 90.0 (6)	(P=0.5876)

Note: The number in the parenthesis indicates the number of animals expressing standing oestrus.

The frequencies of occurrence of different oestrus signs in two groups of experimental animals following first and second injections of Prosolvin are given in Figure 1. Generally the oestrus signs such as vaginal discharge, bellowing, frequent urination and vulva being moist and pink were more evident in on-station animals than in on-farm animals. The vaginal discharge was most striking oestrus sign in both the instances of Prosolvin administration in on-station (OS) group, whilst, this sign was not even observed in on-farm (OF) group. The χ^2 -test revealed that the frequency of oestrus expression was significantly higher ($P < 0.05$) in on-station group than in the on-farm group in the second instance of Prosolvin injection, whilst no significant difference was observed in the first instance of the injection.

Table 4 presents the frequency percentage of experimental cows expressing standing oestrus and positive pregnancy across the two management groups showing significantly higher frequency of oestrus animals in on-station group than in on-farm group but no significant difference in positive pregnancy.

DISCUSSION

The total average daily quantities of feed stuffs were higher in on-station cows than in on-farm cows, although for some quantities of feed stuffs on-farm cows could have been compensated through grazing. These differences in feeding and higher body condition score and girth-measured body weight in on-station group as compared to the on-farm group were the notable differences between two experimental groups in the trial.

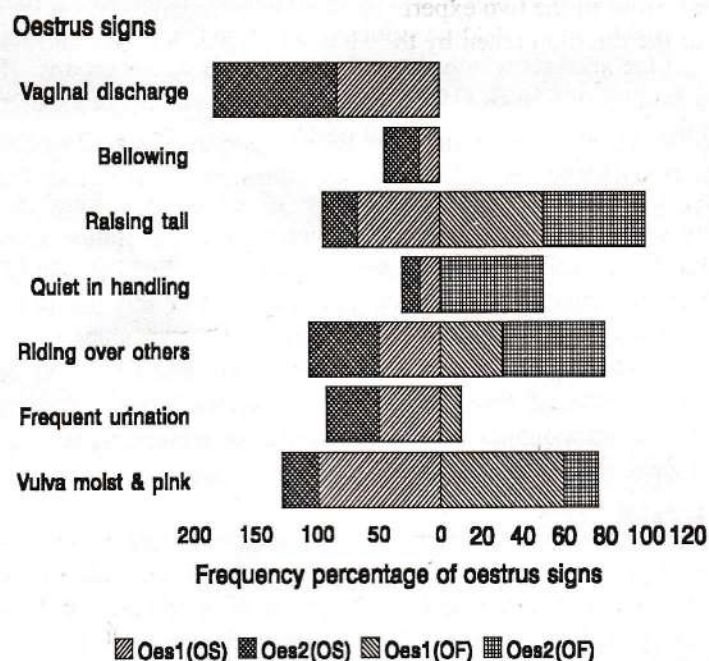


Figure 1 Occurrence of different oestrus signs in on-station (OS) and on-farm (OF) groups following first (Oes1) and second injection (Oes2) injections of prosolvin

Table 4 Frequency percentage of experimental cows expressing oestrus following first infection (Oes 1) and second injection (Oes 2) of Prosolvin and final pregnancy (Preg) across the management system

Management system group	n	Frequency of oestrus animals (Oes 1) after 1st injection, %	Frequency of oestrus animals (Oes 2) after 2nd injection, %	Pregnancy percentage (Preg)
On-station	10	60.0 (6)	100.0 (10)	20.0 (2)
On-farm	9	88.9 (8)	66.7 (6)	33.3 (3)
Overall	19	73.7 (14)	84.2 (16)	26.3 (5)
Level of significance in χ^2 -test		(P=0.153)	(P=0.046)	(P=0.509)

Note: n = number of animals in the group. The number in the parenthesis indicates the number of animals expressing standing oestrus

Despite these differences in feeding status and body conditions between the two groups, there was no significant differences in the median values of duration taken for expression of standing oestrus among those of the animals which showed oestrus in both the groups. This result was comparable with the finding of Clinch (1993) that no distinct pattern of relationship emerged with the change in body condition and displays of oestrus.

However, there was significantly higher frequency of cows exhibiting standing oestrus particularly following second instance of Prosolvin injection in on-station group than in on-farm group indicating that greater success in synchronisation technique could be achieved in the on-station animals with better body condition and capacity probably due to better metabolic and physiological condition than in on-farm group in which oestrus signs may not have been expressed fully. The oestrus responses of 100% in on-station and 66.7% in on-farm groups following the second injection of Prosolvin were satisfactory when compared to those of 62.6% and 60.6% after the intravaginal and the intramuscular treatments respectively reported in Ethiopian highland Zebu cattle (Heinonen et al., 1996).

Very low conception rate as expressed in terms of final pregnancy rate in both the experimental groups could not be explained by the trial results, as the conception rate in oestrus synchronised cows could be expected to be as high as 80% (Sankhi and Capitan, 1993). However, the very low conception rate i.e. 20% in on-station group and 33.3% in on-farm group could be attributed to insemination faults probably involving human errors. On the other hand, it could be a considerable phenomenon that the standard recommended time of insemination at 72 hours of second Prosolvin injection might not be suitable to the local cows as the median time of oestrus in both the experimental groups was beyond 80 hours. These need to be further investigated and corrected in order to make the synchronisation technique a feasible technological tool for mass artificial insemination aiming at improving the reproductive efficiency of the cows under the hill conditions of Nepal.

CONCLUSION

The frequency of expression of synchronised oestrus was significantly favourable in on-station group of experimental cows as compared to on-farm group probably due to better body condition with higher physiological activity in the former. However, the very low pregnancy rate in both the groups suspectedly due to some faults in artificial insemination involving human errors rather than the oestrus synchronisation itself and also the time of insemination for local cows need to be further investigated and corrected before the technology could be recommended for use in mass insemination of cows under our conditions.

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ACUTE FASCIOLIASIS IN SHEEP: A CASE REPORT

M.S. Karki¹

INTRODUCTION

Fascioliasis is the most common parasitic disease affecting all of the domestic as well as wild ruminants in Nepal. Two species namely *Fasciola hepatica* and *Fasciola gigantica* are known to be endemic and responsible for threatening livestock industry in Nepal. The disease causes heavy losses every year by reducing production and productivity of affected animals. Infection with liver flukes could be aggravated when it is complicated by *Clostridium novyi* infection, especially during migration of flukes through the liver parenchyma. Cattle have been reported to be occasionally affected by *Clostridium novyi* type D with rare instances among sheep and pigs (Mahato et al., 1994). This present communication describes a case report of acute fascioliasis probably complicated with *Cl. novyi* infection in sheep.

HISTORY

A thirteen months old dead ram was brought to the District Livestock Services Office, Kaski for post mortem examination. The owner reported that out of a total of 43 Sheep, 18 sheep aged between 5 months to 3 years died within a period of 45 days. The signs noticed by the owner were loss of appetite, dryness of the muzzle, distention of lower abdomen, high fever (108° F), ocular discharge and colic. The owner also reported haematuria, bulging of eyeball and frothy nasal discharge. All affected animals died within three days after the onset of clinical manifestations.

There was a history of medication of the sick animals with long acting oxytetracycline (Terramycin LA, Pfizer India Ltd) at the rate of 5 ml deep intramuscular injection once. The flock had been drenched with Albendazole and Yakrifit (a herbal liver corrective) one month before.

POSTMORTEM FINDINGS

On postmortem examination, the visible mucous membranes were pale. The liver was enlarged and congested with areas of petechial and diffuse haemorrhages. There were numerous haemorrhagic streaks on the liver surface probably due to the protrusion of migratory flukes. Flukes of varying size were recovered from cut surfaces of the liver. The gall bladder was filled with blood clot and contained three mature flukes. The urinary bladder and intestine contained a moderate amount of blood clot. There were areas of ulceration on mucous surface of the intestine. Blood stained fluid was present in the abdominal cavity. Thoracic cavity had blood stained fluid along with areas of sub-epicardial haemorrhages. The kidneys were slightly enlarged and congested. Bacteriological, hematological and serological examination could not be carried out.

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DISCUSSION

Out of 18 sheep died, only one was brought for postmortem examination. The clinical symptoms reported by the owner were similar in all affected sheep that died within the period of past 45 days. The pathological changes observed in the liver parenchyma of post-mortemed sheep, which were the prominent features and likely to be due to the migration of immature flukes, were similar to those described by Wiedosari et al. (1991) in Javanese thin tailed sheep experimentally infected with *F. gigantica*. This indicates that the affected sheep died most likely due to *Fasciola* infection.

Mahato et al. (1994) described *Cl. novyi* to be a major cause for bacillary haemoglobinuria in cattle in the field outbreaks in Nepal. This condition is observed when the liver parenchyma is damaged by migrating liver flukes amongst others. The pathological lesions described in a calf suffering from bacillary haemoglobinuria (Mahato et al., 1994) were similar to those observed in the necropsied sheep. It is, therefore, suggestive that the condition in this outbreak was likely to be complicated by *Cl. Novyi* infection. Though, sheep experimentally infected with *Fasciola* are reported to have subnormal temperatures (Mahato, 1993), a marked rise in body temperature was observed in this outbreak. This might have been due to toxemia from the toxins produced by *Cl. novyi*, and massive destruction of liver parenchyma.

In the western hills of Nepal, Kage, Baruwal and Bhyanglung breeds of sheep are raised at different altitudes. Though fascioliasis is common in this area, outbreak of this kind had not been previously recorded. A detailed systematic study on susceptibility of the breeds of animals, epidemiological pattern of disease outbreak and efficacy of the drugs against the parasites particularly against *Fasciola* species is necessary in order to reduce the losses to the small holder farmer due to this disease in this region.

ACKNOWLEDGMENT

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OCCURRENCE OF BLOOD PARASITES IN BANKE DISTRICT: A CLINICAL STUDY

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ABSTRACT

Blood smears from twenty animals (nine cattle, eight buffaloes, one horse and two dogs) presented to the District Veterinary Hospital, Banke, and suspected clinically for haemoprotozoan diseases were screened for blood protista. Of them, blood parasites were detected in thin blood smears of five animals comprising of one cattle, three buffaloes and one dog. Babesia, Anaplasma and Trypanosoma were detected in buffaloes, whereas only Anaplasma in a cattle and Babesia in a dog were detected. These findings confirmed the occurrence of three major blood protozoans in the western Terai of Nepal.

INTRODUCTION

Several blood protista are known to be endemic in domestic animals in tropical countries with hot humid environment which favours occurrence of ticks and various biting flies (Soulsby, 1968). Of them, babesiosis, theileriosis, anaplasmosis and trypanosomiasis are common in Indian sub-continent including Nepal (Soulsby, 1968; Gautam and Ghimire, 1988; Acharya and Pradhan, 1996; Shakya et al., 1996). Babesiosis is a blood parasitic disease that can commonly affect various domesticated livestock species. Anaplasmosis, a rickettsial disease, also has similar host range. Occurrence of both these diseases has been previously confirmed in the eastern Terai of Nepal. In addition, theileriosis is also endemic among crossbred cattle in the eastern Terai (Acharya and Pradhan, 1996). Though, a country-wide distribution (especially in the Terai), both on clinical and on epidemiological backgrounds, of these diseases is suspected in Nepal, confirmatory diagnosis from other parts is lacking.

Trypanosomiasis is another blood protozoan disease endemic in Indian sub-continent (Soulsby, 1968). Clinical disease is generally observed in equines and dogs whilst cattle and buffaloes are considered to be relatively resistant and generally suffer from sub-clinical infection. Trypanosomiasis has previously been diagnosed in dogs in Kathmandu (Gautam and Ghimire, 1988) and in mules in Salyan district (Shakya et al., 1996). Though an outbreak of trypanosomiasis in Banke district was suspected in 1993/94 (K. Karki, unpublished observations), it has not been confirmed by laboratory investigation. This short communication reports the confirmed diagnosis of babesiosis, anaplasmosis and trypanosomiasis in the western Terai district of Banke.

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MATERIALS AND METHODS

Sick animals presented to the district veterinary hospital, Banke, Nepalganj during the summer months of mid June to mid August, 1998 were the subject of this study. Animals with a history of anorexia, dyspepsia and emaciation, and with clinical symptoms of high fever (104-105° F), lacrimation, mild enlargement of superficial lymph nodes were suspected for infection with blood protista. Thin blood smears were prepared from these animals for laboratory investigation. Three blood smears from each suspected animal were prepared, Giemsa stained and examined under high power magnification. Diagnosis of the blood parasites in the smears was based on the description of Soulsby (1968). Animals were considered negative if no blood parasites were detected in all three smears.

RESULTS AND DISCUSSION

During the study period of two months, a total of 20 animals including cattle, buffaloes, equines and dogs were suspected clinically for blood parasitic infection. Examination of Giemsa stained thin blood smears from these animals revealed the presence of various blood protista in blood smears from five animals (Table 1). Of the eight buffaloes screened, three were positive, one each suffering from babesiosis, anaplasmosis and trypanosomiasis. Similarly, one cattle was positive for *Anaplasma*. The location of the parasite in the infected red blood cells of cattle and buffalo suggested it likely to be *Anaplasma marginale*. However, no other investigation were done to confirm it. *Babesia* were also detected in blood smear from one dog. These findings confirmed the occurrence of three blood protista in the western Terai of Nepal. Only one horse examined was negative for any blood parasite. However, previous confirmation on occurrence of trypanosomiasis in Salyan district (Sakya et al., 1996), suggests that equines in this region are also likely to be affected with this parasite.

Table 1 Detection of blood protista in thin blood smears of various domesticated livestock in district veterinary hospital, Banke during mid June to mid August, 1998

S.No.	Species	No. examined	No. positive	Laboratory Findings – Species identified		
				<i>Babesia</i>	<i>Anaplasma</i>	<i>Trypanosoma</i>
1	Cattle	9	1	-	1	-
2	Buffalo	8	3	1	1	1
3	Equine	1	-	-	-	-
4	Dog	2	1	1	-	-
Total		20	5	2	2	1

Babesia and *Anaplasma* are transmitted through various tick vectors such as *Rhipicephalus*, *Boophilus*, *Dermacentor*, *Ornithodoros* etc. *Trypanosoma* parasites are transmitted by biting flies such as *Tabanus* and *Stomoxys* (and tse-tse fly in African continent). All these flies and ticks are active during hot humid months of monsoon, which might have been the cause for common occurrence of these diseases in summer than in the winter months.

All these animals diagnosed with blood protista infection were treated with recommended medicines. Though all of them recovered after treatment, the number was too small to compare the effectiveness of the treatment provided.

As the present study together with those previously reported from various parts of Nepal (Acharya and Pradhan, 1996; Shakya et al., 1996) suggest the endemic nature of these diseases at least in Terai of Nepal, there is a need to investigate the problem more seriously so as to identify the prevalence, identify risk factors, and formulate control programmes accordingly.

ACKNOWLEDGMENT

We would like to extend our sincere thanks to technical staff of the district veterinary hospital, Banke for technical assistance, and to Drs D.R. Ratala, K. Acharya and N.B. Singh for their help in confirmatory identification of various parasites. We are highly indebted to Dr S.C. Ghimire for his invaluable suggestions in preparation of this manuscript.

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NAVEL – ILL: A CASE STUDY AT THE VETERINARY HOSPITAL, BIRGANJ, PARSA

P.S. Kushwaha¹

ABSTRACT

Navel ill was commonly reported at the Veterinary Hospital, Birganj, Parsa. To understand the extent of the problem, case register of the Hospital between 15th August and 15th November, 1996 was analysed. Naval-ill was diagnosed as the predominant (60%) problem among non-parasitic clinical cases of buffalo calves in this district hospital. None of these clients practised recommended hygienic measures like shed disinfection and antiseptic dressing of the navel cord during calving. It is suggested that such problems could significantly be reduced if preventive measures were adopted. The available knowledge and technology, therefore, needs to be properly extended to the farmers.

INTRODUCTION

Umbilicus is the uniting structure of the foetus to dam during pregnancy. It gets detached at the time of parturition and is very prone to infections in an unhygienic environment. The infection may spread to the umbilicus and its associated structures leading to different pathological conditions. Infection of external aspect of umbilicus results into omphalitis and that of umbilical veins into omphalophlebitis. Similarly, infection of umbilical artery and urachus results into omphaloarteritis and urachitis, respectively. Rarely, the infection may extend up to the urinary bladder to cause cystitis. All these above mentioned pathological conditions are clinically recognised by a common name - Navel- ill.

The aetiology is the mixed bacterial flora from the environment, including *E. coli*, *Proteus spp.*, *Staphylococcus spp.* and *Corynebacterium pyogenes*, amongst others.

Occasionally, bacteraemia and localisation of infection may occur in joints, eyes, meninges, endocardium, and endoarteritis of feet, ears and tail may occur.

CLINICAL REPORT

Veterinary Hospital, Birganj represents the district veterinary hospital of Parsa district in the Central Development Region of Nepal. It experiences a typical sub-tropical climate of Terai region. In this district, both cattle and buffaloes are raised by the farmers as milk producing animals. However, buffalo population dominates the cattle (MOA, 1994). It was realised that cases of navel-ill in buffalo calves were commonly presented to the hospital during the monsoon months, which is also the peak calving period for buffaloes. To investigate the extent of the problem, the case register of the hospital for a period of three month, between

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15th August and 15th November, 1996, was analysed and presented in this communication. The summary of clinical cases of buffaloes during the study period is presented in Table 1.

During the monsoon months, young calves represented a significant proportion (40%) of clinical cases among buffaloes presented at Veterinary Hospital, Birganj. Of those, majority (86%) were suffering from parasitic infestation, mainly ascariasis (data not presented). Next to parasitic cases was the problem of naval-ill (60% of non-parasitic cases, see Table 1).

Table 1 Summary of clinical cases of buffaloes registered between 15th August and 15th November 1996, at Veterinary Hospital, Birganj

Description	Number
Total cases of Buffaloes treated	367
Total cases of Buffalo calves treated	150 (100%)
Calves treated for parasitic diseases	130 (86%)
Calves treated for non-parasitic infections	20 (14%)
Calves treated for navel – ill	12 (60% of non-parasitic infections)

The cases of naval-ill presented to the hospital were generally chronic in nature. Calves were brought to the hospital only when the naval was inflamed, enlarged and purulent. Affected calves were anorexic, depressed and unthrifty. Majority of the farmers had treated the calves themselves by applying some local tree leaves paste over the naval before presenting to the hospital.

All cases were treated on general principle of treatment of an abscess i.e. allowing the abscess to mature then draining the pus and daily dressing of the wound in a routine manner for a few days. Wound healing and fly repellent ointments were applied locally. All calves were given oral antibacterial (Trimethoprim plus sulpha) for 3-5 days. All cases got cured. Two calves took longer to cure due to negligence of farmers for daily dressing. None of the cases had complication of spreading infection to umbilical artery, vein or the urachus.

DISCUSSION

Clinical report shows that majority of the calves actually presented to hospital for treatment in the monsoon season were affected with navel- ill. About 60% non-parasitic cases of calves actually presented to the hospital were suffering from the problem of navel- ill. The season selected for the analysis of cases matched with the parturition season for buffaloes. So, during peak calving season, the cases of navel- ill were second in occurrence in buffalo calves after the problem of worm infestation.

One interesting feature noticed while analysing the case record was the fact that not a single case of naval-ill was recorded in calves (cattle) during the same period (data not presented), even though quite a number of cattle also calve on that season. Whether the calves are more resistant to this problem or they are kept under more hygienic environment is not known, which needs further investigation.

History indicates that farmers neither disinfected the shed during calving nor applied antiseptics to the naval cord soon after the birth of calf. This problem could have been significantly reduced if such hygienic measures were followed during the time of parturition. This indicates that there is an urgent need to extend the available knowledge and technology to the farmers and educate them for the same.

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KARYOTYPE OF INDIGENOUS KHARI GOATS IN THE WESTERN HILLS OF NEPAL

D.P. Rasali¹, H.D. Joshi¹, R.S. Rana¹, N. Amatya¹ and R.K. Patel²

ABSTRACT

Lymphocytes were cultured from the blood samples of one male and one female jet black colour Khari goats and one male and female white Khari goats kept at Agricultural Research Station, Lumle, using RPMI-1640 media supplemented with foetal calf serum, antibiotics and a mitogen. The cultures were harvested at 72 hours of incubation. Prepared slides were then screened under microscope. Results showed that all the goats had normal Karyotype with 60 diploid chromosomes resembling Indian domestic goats.

INTRODUCTION

Khari is an important breed of indigenous goats raised under sedentary management in the hills of Nepal. The breed is distributed all over the hills from north of Terai to south of the high mountains. Their population is 56.2% of the total goat population in the country (Kharel, 1997). Due to their external body characteristics, they are said to be close to Indian Black Bengal goats. However, no cytogenetic study on the breed has been reported to date in order to describe their karyotype. This paper presents a short communication to document the karyotype of the Khari goats raised in the western hills.

MATERIALS AND METHODS

A small herd of indigenous Khari goats comprising various colour types has been maintained at Agriculture Research Station (ARS), Lumle (formerly the Lumle Agricultural Research Centre) for over 10 years. They were founded from the Khari goats randomly collected from various districts of the western hills. Four Khari goats comprising one male and one female adult jet black coloured goats and one each of the male and female white colour goats were randomly sampled from the herd for studying their Karyotype.

About 5 ml of blood sample was collected from each animal in heparinised vacutainer tubes (Becton Dickinson, UK). The lymphocyte cultures were set up from each sample immediately after blood collection. Following the procedure described by Douge *et al.* (1989) and Patel *et al.* (1995), the samples (0.5 ml whole blood in each) were cultured in RPMI-1640 media, supplemented with antibiotics, lectin (Sigma, USA) - a poke weed mitogen and 10% foetal calf serum. The lymphocyte cultures were then incubated at 37°C for 72 hours during which time the samples were gently shaken once in a day. Ethidium bromide (10mg/ml) was added to the culture 3 hours prior to their harvest in order to increase the frequency of metaphase of the

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lymphocytes. Colchicine (2mg/ml) was added to the culture one hour prior to harvesting in order to break the spindle fibres and thereby arrest the cell division at metaphase stage of the lymphocytes. The cells were separated by centrifugation at 1000rpm for 10 minutes. The sediment of cells was treated with a hypotonic solution (0.56% KCl) and kept in a water bath at 37°C for about 30 minutes. This was followed by treatment with a cold fixative (3:1 methanol and glacial acetic acid). The cells were washed with the fixative for about 2-3 times, separating them by centrifugation every time till the pellet became clear. The slides were prepared by dropping a few drops of cell aliquot on them. The slides were stained with Giemsa. Photography was taken on the metaphase fields under 100x microscope objective from each of the samples for karyotype analysis.

RESULTS AND DISCUSSION

It was evident that the karyotype of both the male goats irrespective of their colour type was normal with (2n=60) diploid chromosomes comprising 29 pairs of acrocentric autosomes and a large acrocentric X-chromosome and a very small metacentric Y-chromosome (Figure 1), whilst that of both the female goats irrespective of their colour type was normal (2n=60) diploid chromosomes comprising 29 pair of acrocentric autosomes and a pair of large acrocentric X-chromosomes (Figure 2). These findings showed that the karyotype of Khari goats was quite similar to that of Indian domestic goats as reported by Umrikar *et al.* (1997).

CONCLUSION

The karyotype of Khari goats in the western hills resembled with that of Indian domestic goats. Further study in large number of breeding goats to detect the possible chromosomal aberrations among them is recommended.

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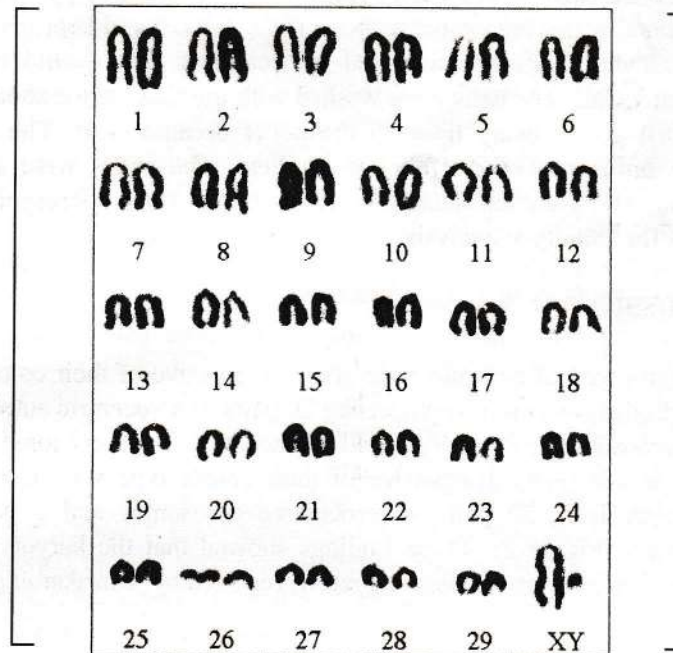


Figure 1 Metaphase field showing the karyotype of a male Khari goat

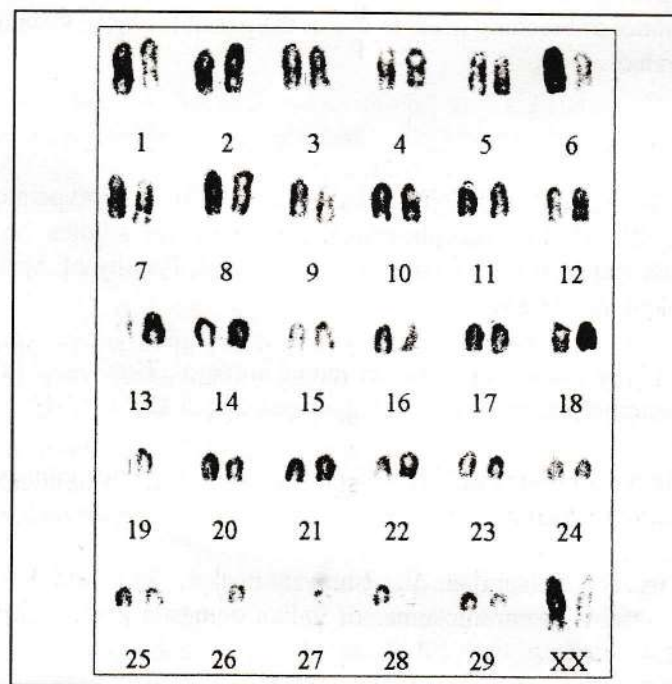


Figure 2 Metaphase field showing karyotype of a female Khari goat

INSTRUCTIONS TO CONTRIBUTORS – NEPALESE VETERINARY JOURNAL (Continuation Of Bulletin Of Veterinary Science And Animal Husbandry, Nepal)

SCOPE OF THE JOURNAL

Nepalese Veterinary Journal is the official organ of Nepal Veterinary Association and is published annually. It is the continuation of Bulletin of Veterinary Science and Animal Husbandry Nepal. The first issue of the journal will therefore be published as volume 26. It publishes research articles, review articles, results of investigation and observations, personal experience of practical procedures, case reports, news and letters related to veterinary science (including zoonoses) and animal husbandry which may lead to improve health, productivity and welfare of domestic animals and wildlife, and better utilisation of animal resources for ultimate improvements in public health and economy of people, and to improve knowledge, understanding and skills among veterinary professionals in the country. All contributions are judged by the criteria of originality and scientific content. However, the opinions expressed in the articles are those of the authors and do not necessarily represent those of the publisher or the Editorial Board. Articles based on the work carried out in Nepal are preferred, however relevant papers from outside are also accepted. The Editorial Board reserves the right to accept, reject or ask the author(s) for modification of a paper submitted for publication. Rejected manuscripts will not be returned to the author(s). The articles are accepted on the understanding that they have not been published or submitted for publication elsewhere, and that the accepted articles will not be published elsewhere in whole or in part without the Chief Editor's permission. In special conditions, the message of an already published article may be communicated, however prior consultation with the NVA editors is essential.

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Two copies of manuscript typed in double spacing with generous margins and numbered all pages in sequence beginning with the title page should be submitted. Neatly and clearly hand written articles can also be accepted. Submission of a 3½" computer floppy disk with the text in Word 6.0 or Word 97 or another common readable computer language is highly appreciated. Articles must be concise with a clear objective and systematically presented. Unnecessary duplication of data in text, tables and figures should be avoided. The first page should contain the title (which should be short but informative), name of the author(s), a short title (not more than 40 letters to be used as running heads), affiliations (institution where the work has been carried out), and full postal and electronic (if applicable) address for communication. In case of multiple authors, corresponding author must be identified.

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Results and discussion section could be combined together, if it helps to present the findings more logically.

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- Rasali, D.P., Gurung, D.B. and Yadav, E.R. (1997). Performance of monsoon calver buffaloes across genotypic and non-genotypic factors under farmers' management in western hill districts of Nepal. *Veterinary Review*, **12**: 17-20.
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8. Illustrations should be of the high quality preferably camera ready glossy bromide photographs.

For **short communications**, all or some of the sections described for research articles could be combined together. **Review articles** can be formatted in different sections as per the need for logical presentation of information.