GOATS HUSBANDRY IN THE AGRO-PASTORAL SYSTEM OF NORTHERN AREAS OF PAKISTAN


ABSTRACT

This paper covers goats productive aspect of bigger multi-sectoral research study conducted during 1999 - 2001. A 2 x 3 factorial design in Genstat program was used to check whether developed infrastructure (transect at 2 level) and agro-ecological zones at 3 levels has significant effect on the performance of goats. Parameters such as changes in body condition score (BCS), abortion, birth weight and growth rate performances were compared in relation to winter stored offered resources in both transects. Higher (33%) feed sufficiency in terms of the Metabolisable Energy (ME) for live weight maintenance in the stored feed in the Karakorum Highway (KKH) transect compared to the Gilgit Ghizer Region (GGR) transect (P < 0.05). Results revealed that an overall one unit increase in feed sufficiency could reduce abortion by 8% in the goat flocks (R² = 0.42). Goats in the GGR transect showed less abortion under severe sub-maintenance levels of Metabolisable Energy (ME) compared to the KKH transect where does lost more foetuses under sub-maintenance feeding but improved when ME supply approached their requirements. Results further revealed that goats BCS significantly influenced birth weight of kids (P<0.001), but the relationship did not differ by transect. However regression analysis worthwhile showed that a unit increase in the dam BCS increased weights at birth in offspring by about 1.08 kg (R² = 0.85). Percent liveweight loss in goats was significantly (25%) greater in the GGR transect than in the KKH transect during 150 days of winter (P < 0.05). Percent weight loss of mature goats was not significantly influenced by cropping zone (P= 0.079), but goats in the single cropping zone (SCZ) tended to lose 7% more weight than goats in the double cropping zone (DCZ). Productive parameters generally did not differ between transect but the significantly (P < 0.05) higher feed sufficiency in the KKH gave animals significant potential to productive and reproductive performance in response to the more abundant feed resource per animal in this transect.

INTRODUCTION

Northern highland region where the Hindu Kush, Karakoram and Himalayan ranges meet is known as the Northern Areas of Pakistan. The Northern Areas of Pakistan covers an area of 7.04 million hectares with a population of around one million (Govt. of Pakistan, 1998). Most of the population are settled in small villages and towns in the valleys and lower foothills, at altitudes of 1,200 to 1,500 m (a.s.l) (Govt. of Pakistan, 1998). Communications are relatively underdeveloped with extensive use of animal power for transport. Where roads are available the jeep is replacing the animal as a means of transport.

Climate of the Northern Areas is extremely cold in winter and relatively hot in summer. Typical temperatures range from -2.4°C in winter to 48.0°C in summer depending elevation and vegetation (Gohar, 1994; Arif, 1995). The area is classified as arid with average annual rainfall of between 100-300 mm (Umran et. al, 1998), apart from a few places in the South, which receive a subdued monsoon with up to 500 mm of rainfall.

Agriculture is the major economic activity involving 90% of the population (Wardeh, 1989) with an emphasis on the subsistence level production for domestic consumption, rather than external, market-oriented production (Sofia, 1989). It is due to limited arable land and water scarcity. The various components of the subsistence farming system are highly interdependent. Interdependence between livestock and crop production is illustrated by the following example: such wheat varieties are chosen in part for their straw yield and quality which will use by animal as their main feed during winter and in return, provide manure, along with the main outputs such as milk, meat and draught power to the households.

Each household keeps greater number of goat heads along with a range of other livestock species such as sheep, cattle and in some cases yaks and donkeys. Despite of the larger herd size per household in the Northern Areas (Govt. of Pakistan, 1998), efficiency of production per animal is considerably low (Feisal, 1991). Among these animals, goats play an important role. It contributes a significant amount of protein in the form of milk and meat to household food resources. Goats also contribute farmyard manure, leather, Mohair and kept as a means of storing capital for farmers and are sold off for cash when needed.

Goats are kept under transhumance system of livestock production. During their winter stay in the villages, the amounts of feed offered to livestock...
have been reported to be inadequate and limited. This perceived feed shortage is thought to result from the short growing season, inefficient farming practices, large numbers of unproductive animals, and poor feeding practices (Feisal, 1991). In order to assess the extent of winter feed shortage in the Northern Areas, there is a need to study prevailing feeding practices and its impact on the productive and reproductive performance of the goats of the Northern Areas.

Northern Areas of Pakistan has undergone rapid socio-economic change since 1978, partly as a result of the construction of the Karakoram Highway (KKH) along the Indus River and also due to a community-based development activity initiated by the Aga Khan Rural Support Programme (AKRSP), which bisects the region more developed and underdeveloped areas. Transport infrastructure development has exposed the villages, which are located on KKH to rapid socio-economic development, whereas other parts of the Northern Areas such as the Ghizer area still lack inputs for increasing livestock-based livelihoods. With this in mind the current study was designed to observe the impact of recent rural development on goat productivity and to compare goat reproductive performance constraints in the Karakoram highway transect (KKH transect) (accessible & developed area) and Gilgit Ghizer region transect (GGR Transect) (inaccessible and relatively less developed area).

MATERIALS AND METHODS

1. Statistical Design

A(2 x 3) factorial design with factors consisting of transects at two level i.e. KKH and GGR and agro-ecological zones at three levels: (single cropping zone (SCZ), transitional cropping zone (TCZ) means sometime one and some time two crops per year and double cropping zones (DCZ). One village was selected for each cell of the design and six to seven households were selected for study within each village using a stratified random sampling technique.

2. Data Collection

2.1 Feed Quantification

Measurements were made at each household, roughly every 30 - 40 days for 12 months beginning in Oct 1999 (at the start of winter). All types of stored roughage resources associated with individual households were quantified. Representative samples of different feed types were subjected to chemical analysis to determine dry matter, degradability in nylon bags (Ørskov, et al. 1980) and crude protein by AOAC (1990). Metabolisable energy was estimated from rumen degradability measurements using published relationships (Chowdhury, 1989). These measurements were used to calculate total available dry matter, metabolisable energy and protein at the household level. Repeating measurements roughly every 30 - 40 days until the end of winter assessed depletion of stored feed resources offered to goat during winter. The amount of the different feeds offered to the goats (kg/d) within study households was measured over one full day per week for a period of one year.

2.2 Live weight Measurement

All goats associated with the study households (aprox. 700 heads) were ear-tagged for subsequent identification. To determine seasonal change in live weight, all goats in the selected households were first ear-tagged in October/November, 1999. The individual live weights of all animals in the selected households were recorded for the first time in November 1999 and then once every 30 to 40 days for a period of 12 months. This included measurements once animals had moved from villages to alpine pastures for the summer months. As live weight of all goats is significantly affected by rumen fill; therefore the live weight of each animal in the study households was recorded before feeding early in the morning. A portable, electronic, digital weighing scale (The Tru-Test ® Series 700 Sydney, Australia), powered by a car battery was used for weighing. A weighing crate, which could be dismantled for carriage, was constructed under the author’s guidance by local craftsmen for use during the present study.

2.3 Animal Performance Recording

Live weight and body condition score (BCS) of each tagged goat was recorded early in the morning before feeding. Liveweight was recorded by using a digital weighing scale which was operated by car battery. BCS was recorded by manual palpation of the fats deposited around the vertebral column. Both parameters were recorded once during each 30-40 day measurement cycle.

Live weight change of each animal was expressed in terms of percentage weight change. Winter change in live weight was recorded as (Rahman, A. 2002):

\[
\Delta \text{in } \% W = \frac{W_j - W_i}{W_i} \times 150 \times 100
\]

where change in \%W= Percent change in LW over 150 days

\[W_i = LW \text{ at i-th visit, } W_j = LW \text{ at j-th visit, } T = \text{ interval in days between i-th and j-th visit}\]
This approach was used to calculate weight change over early-winter, late-winter and over the whole winter. A similar procedure was used to calculate weight change over different summer periods. Data on reproductive performance were also collected during each visit to the study villages by interviewing farmers and recording which animals had produced offspring or aborted, and approximate date of births/abortio9ns, since the previous visit. Live weights data was used to estimate herd metabolic live weight \( (\text{kg}^{0.75}) \). Metabolisable energy (ME) requirements for maintenance of live weight were calculated using (AFRC, 1993) guidelines.

### 3. Data Analysis

The influence of transects and agro-ecological zone on stored feed resources and various indicators of animal performance were analysed using residual maximum likelihood (REML) analysis (Patterson & Thompson, 1997; Robinson, 1987). Fixed terms in the REML model were transects, zones and their interaction and any associated factors, which have an impact on the desired parameter, whereas households were entered in the random terms to over come the variation between the households within a village.

The effect of transect and zone on total stored ME and AU per household was investigated using the Generalized Linear Models procedure (GLM) (McCullagh & Nelder, 1989; Schall, 1991) of Genstat, 2000.

### RESULTS

Average percentage of goats per household showed a tendency of 28% higher in KKH transect, but was not significantly different between transects \( (P > 0.05) \). However cropping zones produced significant effects on the mean percentage of goats per household \( (P < 0.05) \). Households in the DCZ kept a more than 100% higher of goats than in the SCZ. However transect into cropping zone interaction did not produce significant effects (Table 1).

#### Table I: Influence of transect and zone on mean percentage of goats per household in the study villages of the Northern Areas

<table>
<thead>
<tr>
<th>Species</th>
<th>Transect</th>
<th>SCZ</th>
<th>TCZ</th>
<th>DCZ</th>
<th>Transect Mean</th>
<th>Transect P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goats</td>
<td>GGR</td>
<td>17.4±9.40</td>
<td>38.0±8.36</td>
<td>40.0±13.10</td>
<td>31.0±6.18</td>
<td>0.301</td>
</tr>
<tr>
<td>KKH</td>
<td>28.4±7.69</td>
<td>26.6±11.29</td>
<td>64.2±10.91</td>
<td>39.7±6.90</td>
<td></td>
<td>0.223</td>
</tr>
<tr>
<td>Cropping zone mean</td>
<td>22.5±6.14</td>
<td>32.3±6.92</td>
<td>52.1±8.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropping zone P-value</td>
<td>0.014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GGR= Gligit Ghizar Region, KKH= Karakoram Highway DCZ = Double cropping zone, TCZ = transitional cropping zone SCZ= single cropping zone P-value within the box relates to the interaction between transects and cropping zones. Values presented in the tables are mean±S.E.M.

Number of goats per household in comparison to stored feed resources revealed that their feed sufficiency ratio lower in the GGR transect as compared to KKH transect. Total ME stored in feed resources (inputs) for winter as compared to the total herd requirement for maintenance and maintenance plus production requirement and maintenance plus production requirement plus reproductive requirements of herd show considerable variation between study villages. The energy required for maintenance appeared to be 20% higher than stored ME resources in the both transects. The deficit in the double cropping zone appeared to be especially severe. Larger discrepancies between stored ME and required ME were noted in the GGR transect than in the KKH transect, which further widened when energy costs for milk production and pregnancy were included (Fig. 1).

Increasing feed sufficiency reduced weight loss over winter (Fig. 2). The linear relationship between the feed sufficiency and change in the weight accounted for 68% of the total variation observed. At lower feed sufficiency levels the percent weight loss was higher. Transect effects were not apparent (Fig. 2). The relationship between percent abortions in the goat flock was significantly affected by feed sufficiency \( (P < 0.001) \).

Taking out the effects of feed sufficiency from the model showed that the effects of transect did not influence the occurrence of abortion in goats. Logarithmic regression analysis indicated that on overall basis, a unit increase in feed sufficiency could reduce abortion by 8% in the goat flocks. The relationship accounted for 42% of total variation (Fig. 3).
The relationship between goat body condition score (BCS) and birth weights of kids in the two transect indicated that goat BCS significantly influenced birth weight of kids (P < 0.001), but the relationship did not differ by transect. Regression analysis showed that a one unit increase in the dam BCS increased weights at birth in the offspring by about 1.8 kg. The overall relationship accounted for 85 % of the total variation (Fig. 4).

**DISCUSSION**

The results of the current study provide detailed quantitative information on various aspects of the livestock enterprise in the Northern Areas of Pakistan. It indicates that subsistence and mixed farming enterprise is in a flux. Seasonal measurements of feed use and livestock performance highlight the seasonal dynamics of this transhumance system and emphasise the findings of previous studies which have pointed to a substantial shortage of winter fodder as being an important constraint within the system (Farman and Tetlay, 1991; Dost, 1995).

Inventories of herd composition indicated cattle as being the dominant livestock species within this mixed mountain agriculture system pointing to domestic milk production as being the primary purpose for which livestock are kept (Clemens, unpublished data).

**Fig. 1** Comparison of stored ME resource with mean herd requirement at maintenance and maintenance plus milk and pregnancy requirement during winter 2000 in the study villages

Ba = Bargo (DCZ-GGR), Ga = Gahkuch (TCZ-GGR), Da = Darkot (SCZ-KKH), Bu = Bunji (DCZ-KKH) Mi = Minapin (TCZ-KKH), Mo = Morkhun (SCZ-KKH) and ME = Metabolisable energy

**Fig. 2** Influence of feed sufficiency for maintenance on percent live weight changes over winter in the study households of the Northern Areas during 2001-02

\[ y = 9.0912x - 4.167 \]

\[ R^2 = 0.68 \text{ Transect P 0.254} \]

\[ \text{Feed sufficiency P <0.001} \]
Fig. 3 Influence of feed sufficiency on the occurrence of abortion in goats during the study period 2001-02

Fig. 4 Effects of dam body condition score at parturition on the birth weight of kids in the two transects during 2001-02

Socio-cultural norms may also play an important role in determining species composition of herds as found in similar communities in Chitral, North-West Pakistan (Parkers, 1987). The keeping of a mixed species herd is also typical of smallholder, subsistence production since it provides multiple products for domestic consumption. Mixed livestock holdings also lend efficiency to the utilization of available roughage resources, which are utilized differently by different livestock species. Finally mixed livestock holdings help to spread risk of species-specific disease (Dahl and Hjort, 1976; Ørskov et al., 1999; Ørskov, 2000). Metabolisable energy requirements at different levels for all herd animals of the study households were calculated using MAFF tables (MAFF 1980; AFRC, 1993) These ME allowances considerably vary if compared with values described by Kehr (1982); Pathak and Jakhmola (1986). For example a 200 kg cow’s ME requirement for maintenance is 24.82 MJ/day according to British ARC tables, 15.38 MJ/day using Utah Agric. Expr. Station USA values and 9.38 MJ/day applying Indian Vet. Research institute, Izatnagar values. UK AFRC energy requirement
values are best probably for temperate livestock breeds, but are less suitable for livestock breeds of the Northern Areas. However, these allowance tables were used to calculate the requirement at different levels since AFRC allowances were easily accessible, understandable, systematic and rigorous, which allowed reliable comparison of different transects and zones according to a reliable benchmark.

Feed sufficiency values may be associated with a better transport infrastructure in KKH transect, but also itinerant contractors could make frequent visits to purchase animals (Rahman, A., 2002), allowing households to minimise their flock according to available resources. On the other hand, in the case of the GGR transect, feed sufficiency values showed that feed resources appeared to be remarkably low except TCZ. A feed deficit was also reported by a number of authors who worked in the Northern Areas, although their approach was generally crude (Debord, 1989; Feisal, 1991, Langendijik, 1991 and Wardhe, 1989). In other similar environments similar feed deficit have been reported. (Singh and Naik, 1991; Tripatite and Sah, 2001). Reported that in the Central Himalayas a feed shortage of 35% exists and (Trapp, 1999) stated that in Nepal the feed gap is 30%. Devendra, (1983) and Pathak and Jakhmola, 1986 reported that hilly villages of India have a feed deficit of around 40%.

Reproductive performance was generally lower in the GGR transect than in the KKH transect. Again, the most likely cause of this is the relatively lower levels of stored feed resources in this transect although animal husbandry skills may also have had an influence. The high numbers of animals per household in the GGR transect would have had the dual effect of reducing feed resources per animal and reducing the attention that farmers were able to pay to reproductive management.

Goats in the both transect showed abortion rates at the severe sub-maintenance levels of feeding. Results indicate that abortion incidence becomes significant as feed sufficiency for maintenance fall below 70%. The relatively weak relationship between feed sufficiency and abortion may reflect the high initial variation in body condition score of the individual animals at the start of winter. Abortion in household above the 70% feed sufficiency level may not have been due to nutritional condition but may be due to diseases such as brucellosis (Radostitis et. al., 2000) as found in some of the study households (Pers. Observation).

Offspring birth weight in goats was strongly and positively influenced by the dams’ body condition with goats in good condition producing heavier kids. The results agree with the classic findings of Gunn and Donev (1973) and (1975) who conducted several studies in Blackface sheep in Scotland and found that dam body condition affected birth weight of the offspring. Because of the importance of birth weight on early survival, it is postulated that higher lifetime production in the livestock species of the Northern Areas could be achieved by ensuring that animals were in better condition at the time of parturition.

CONCLUSION
This study has demonstrated the importance of winter nutrition on performance of goat production during the food scarcity. Furthermore, by recording livestock parameters in transects differing in their degree of development, has allowed the impact of developmental changes on the livestock enterprise. The efficiency of various livestock productive and reproductive parameters were higher in the KKH transect than in the GGR transect reflecting the relatively advanced stage of development found along the KKH.

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