# REPORT ON LIVESTOCK MONITORING: BHAVNAGAR

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## Abstract

Goats and cows in Bhavnagar, Gujurat, were monitored during the 1999 dry season to see if the introduction of a water trough affected grazing behaviour. Monitors were recruited from the local community, and monitored livestock during seven, four day monitoring periods from late March to the start of the monsoon rains in mid June. A water trough was introduced near an important dry season grazing area in mid May. Livestock monitoring data indicated that there were large shifts in grazing patterns during the dry season making it difficult to detect changes due to the introduction of the water trough. Nevertheless, the use of Anida Hills as a grazing area for goats increased immediately after the introduction of the trough. The impact of the trough appeared to be that it helped livestock keepers maintain grazing of their animals during a time of feed constraint.

## Introduction

Conroy et al. (2000) describe how in the village of Khumbhan, near Bhavnagar in Gujurat, India, seasonal water scarcity is regarded by livestock keepers as the most important constraint to livestock keeping. The mean annual rainfall in Bhavnagar is about 500 mm, concentrated in the July to September monsoon season. During the hot dry summer season (March to June, inclusive) there is a lack of water at the main communal grazing area. This obliges the livestock keepers to bring their animals back to the village at mid day to water them, before returning to their grazing areas.

As a result, a water trough was constructed next to a well near to the summer season grazing area. As part of the evaluation of the impact of the introduction of the trough, cattle and goats were monitored to study their grazing behaviour and management. The design of the experiment was to monitor livestock before and after the introduction of the trough in the 1999 summer season and make comparisons between these periods.

## Methods

The monitoring methodology was similar to that described for goat monitoring in Udaipur and Bhilwara districts. The village secondary school was contacted with a view to recruiting school leavers as monitors. Eight school leavers were identified for this work, together with two adult monitors who were trained during the time of the visit. The coding system for activities, feed types and locations is given in Tables 1, 2 and 3, respectively.

**Table 1 Activity codes**

| | |
|---|---|
| 1 | Grazing |
| 2 | Walking |
| 3 | Resting |
| 4 | Other |
| 5 | Walking and feeding |
| | |

**Table 2 Feed type codes**

| | |
|---|---|
| 0 | No feed |
| 1 | Lopped tree fodder |
| 2 | Tree fodder not lopped (selected by animal) |
| 3 | Dried leaves (such as "pala") |
| 4 | Concentrate |
| 5 | Other |
| 6 | Grass (grazed) |
| | |

**Table 3 Location codes**

| | |
|---|---|
| 1 | Homestead |
| 2 | In fields |
| 3 | Field borders/roadsides |
| 4 | Anida hills |
| 5 | Anida plains |
| 6 | At new water trough[a] |
| 7 | Walking on road |

Note a In practice this was interpreted by the monitors as meaning watering livestock at any well or trough, not just at the new water trough

Monitoring was conducted over four consecutive days, two days monitoring for both goats randomised over the four days. Monitoring was conducted every two weeks starting on 26 March and ending when the rains started. The dates of monitoring are given in Table 4.

**Table 4 Monitoring periods, Bhavnagar**

| **Monitoring period** | **Dates** |
|---|---|
| 1 | 26 to 29 March 1999 |
| 2 | 9 to 12 April 1999 |
| 3 | 23 to 26 April 1999 |
| 4 | 7 to 10 May 1999 |
| 5 | 21 to 24 May 1999 |
| 6 | 4 to 7 June 1999 |
| 7 | 18 to 21 June 1999 |

The trough came into use in mid May, between periods 4 and 5. The monsoon rains started on 20 June 1999, half way through monitoring period 7 (the monsoon rains normally start on about 15 June, but this is variable in Gujurat).

It was assumed that over this period there would be no major changes to grazing patterns before the start of the rains. Differences in grazing, behaviour and management between the periods before and after the new water trough came into use could then be assumed to be largely due to the introduction of the trough.

**Results**

Average numbers of activity counts for each monitoring period for goats and cows are given in Table 5.

**Table 5 Activities of monitored goats and cows by monitoring period**
Data in average counts per day per animal

| **Monitoring period** | **1 Grazing** | **2 Walking** | **3 Resting** | **4 Other** | **5 Walking and feeding** |
|---|---|---|---|---|---|
| **Goats** | | | | | |
| 1 | 38.2 | 26.3 | 31.1 | 16.7 | 29.5 |
| 2 | 36.2 | 26.8 | 32.8 | 15.5 | 35.6 |
| 3 | 42.5 | 25.7 | 37.5 | 20.1 | 22.5 |
| 4 | 34.9 | 24.4 | 38 | 19.2 | 32.6 |
| *5* | *37.5* | *28.5* | *45* | *16.5* | *25.7* |
| *6* | *39.5* | *23.8* | *42.7* | *15.2* | *31.9* |
| ***7*** | ***21.4*** | ***8.5*** | ***15.4*** | ***8.4*** | ***19.2*** |
| **Cows** | | | | | |
| 1 | 48.4 | 33.6 | 34.3 | 13 | 18.3 |
| 2 | 56.8 | 25.8 | 26.3 | 30.2 | 16.3 |
| 3 | 48.2 | 26.7 | 26.3 | 27.9 | 22.8 |
| 4 | 44.3 | 26.8 | 28.1 | 26.3 | 27.3 |
| *5* | *41.8* | *28.3* | *27.8* | *22.7* | *30.8* |
| *6* | *39.9* | *26.1* | *31.3* | *27.9* | *26* |
| ***7*** | ***49.8*** | ***14.4*** | ***35.4*** | ***34.5*** | *7* |
| Sig 1 | * | *** | ns | * | *** |
| Sig 2 | ns | ns | ** | ns | ns |

Sig 1= Statistical significance of parameter*period across goats and cows
Sig 2 = Statistical significance of parameter*with/without trough (monitoring periods 1 to 4/5 and 6 only)
Standard numbers = before trough in use
Italic numbers = after trough in use
Italic bold numbers = start of wet season

Across all seven monitoring periods, there were highly significant ($P<0.001$) differences in Activities 2 and 5, walking, and walking and feeding, respectively. This was due to the sharp reduction in both activities during Period 7, as animals were not taken out to graze when it was raining. The introduction of the trough appeared to

lead to an increase in resting time of goats, which achieved statistical significance ($P<0.01$). Otherwise, the introduction of the trough did not appear to affect livestock activities.

**Table 6 Feed types of monitored goats and cows by monitoring period**
Data in average counts per day per animal

| Monitoring period | 0 no feed | 1 Lopped tree fodder | 2 Grazed tree fodder | 3 Dried leaves | 4 Concentrate | 5 Other | 6 Grass |
|---|---|---|---|---|---|---|---|
| **Goats** | | | | | | | |
| 1 | 67.5 | 0.6 | 46 | 18.5 | 1.2 | 7.5 | 0.8 |
| 2 | 72.8 | 2.6 | 26 | 25.8 | 1.4 | 18 | 0.4 |
| 3 | 81.2 | 21.1 | 12.5 | 22.2 | 1 | 10.5 | 0 |
| 4 | 80.1 | 11.6 | 19.7 | 23.3 | 1.2 | 13.1 | 0.1 |
| *5* | *88.4* | *13.5* | *12.3* | *22.5* | *1.1* | *15.3* | *0* |
| *6* | *80.5* | *14* | *17.7* | *20* | *1.1* | *19.2* | *0* |
| ***7*** | ***75.3*** | ***0.8*** | ***58.3*** | ***2.3*** | ***1.5*** | ***8.8*** | ***0*** |
| **Cows** | | | | | | | |
| 1 | 76.1 | 0.7 | 35.2 | 13 | 2 | 8 | 12.7 |
| 2 | 77.8 | 0.3 | 16.1 | 27.4 | 2 | 15.2 | 16.6 |
| 3 | 77.3 | 0.9 | 5.9 | 23 | 1.9 | 10 | 33.2 |
| 4 | 77.9 | 0.6 | 5.9 | 22 | 2 | 8 | 36.2 |
| *5* | *76* | *1.8* | *5.8* | *16.6* | *3.1* | *1.8* | *46.2* |
| *6* | *81.9* | *1* | *3.4* | *11.5* | *1.7* | *7.4* | *44.5* |
| ***7*** | ***108*** | ***0*** | ***0.5*** | ***1*** | ***1.5*** | ***1.4*** | ***54*** |
| Sig 1 | ** | *** | *** | *** | ns | ** | *** |
| Sig 2 | ** | * | *** | * | ns | ns | *** |

Notes as given for Table 5

Very large differences in feed types used were observed between monitoring periods, and between goat and cows. Lopped tree fodder was much more important for goats than for cows. However, even for goats it was little used in Periods 1 and 2, but from mid April to the onset of the rains (Periods 3 to 6) lopped tree fodder was an important component of the goats' diets. Conversely grazed tree fodder was more important for both goats and cows in Period 1 and declined sharply until Period 3, presumably reflecting the increasing shortage of supply of tree fodders for grazing over this period. Goats' access to grazed tree fodder increased markedly at the onset of the rains. Dried leaves were an important component of the diets of goats and cows until the onset of the rains. Grass was a very minor part of the goats' diets, but was of major importance for cows. Increasing consumption of grass by cows after Period 2 may have been due to the general lack of more palatable alternatives; the grass was dry during this period. Grass consumption by cows increased at the onset of the rains, probably due to a lack of alternative feed as the number of counts when cows were not feeding increased sharply. There would have been insufficient time for the new growth of grass stimulated by the rain to become available for grazing.

Significant differences (P<0.05) were observed for lopped tree fodder, grazed tree fodder, dried leaves and grass between the four periods before the use of the trough and the two periods after its introduction. However, these were mainly due to what appeared to be seasonal changes in the period prior to the introduction of the trough.

**Table 7 Locations of monitored goats and cows by monitoring period**
Data in average counts per day per animal

| **Monitoring period** | 1 Homestead | 2 In fields | 3 Borders | 4 Anida hills | 5 Anida plains | 6 Water trough | 7 On road |
|---|---|---|---|---|---|---|---|
| **Goats** | | | | | | | |
| 1 | 6.3 | 90.4 | 20.2 | 0 | 1.6 | 5.3 | 17.7 |
| 2 | 16 | 74.3 | 34.2 | 0 | 0.6 | 3.3 | 18.5 |
| 3 | 13.8 | 60.3 | 50.5 | 4.1 | 2 | 3.1 | 14.5 |
| 4 | 18.8 | 57.5 | 37.7 | 1.2 | 12 | 6 | 16 |
| *5* | *29.8* | *54.3* | *33.6* | *11.4* | *0.9* | *3.8* | *19.4* |
| *6* | *21.1* | *38.6* | *31* | *29.8* | *5.2* | *9.3* | *17.9* |
| ***7*** | ***22.7*** | ***9.3*** | ***19.2*** | ***69.8*** | ***2.2*** | ***7.3*** | ***16.4*** |
| **Cows** | | | | | | | |
| 1 | 37.2 | 69.8 | 7.3 | 1.5 | 0.3 | 4.1 | 27 |
| 2 | 31.7 | 56.8 | 12.2 | 8.6 | 18.6 | 5.8 | 21.7 |
| 3 | 26.5 | 48.8 | 18.5 | 23.3 | 4.8 | 10.4 | 19.8 |
| 4 | 27.6 | 42.7 | 15.5 | 27 | 9.7 | 8.4 | 21.8 |
| *5* | *36.7* | *32.5* | *14.5* | *26.5* | *8.9* | *7.5* | *24.6* |
| *6* | *51.7* | *21.7* | *21.6* | *19.5* | *8.5* | *8.1* | *20.1* |
| ***7*** | ***105.3*** | ***2.1*** | ***3*** | ***14.6*** | ***0.8*** | ***2.4*** | ***12.9*** |
| Sig 1 | *** | *** | *** | *** | ** | ns | *** |
| Sig 2 | *** | *** | ns | *** | ns | ns | ns |

Notes as given for Table 5

The locations used for grazing changed over the period of the study, and there were also differences between goats and cows. Period 7 was quite clearly different from the other periods as the goats stayed mainly in the hill area (Location 4) whereas the cattle stayed mainly in the homestead area (Location 1).

Goats spent more time in the Anida hills (Location 4) immediately after the introduction of the trough (P<0.001). Significant (P<0.001) differences were found between time spent at the homestead and in the fields before and after the introduction of the trough. For both goats and cows, more time was spent at the homestead after trough introduction and less time in fields. Only for counts at Location 6 were no significant differences observed (P>0.05).

**Discussion**

The monitors had been confused by location code 6 “at new water trough” and had interpreted it as meaning at the new trough or being watered anywhere else. Thus it is not possible to simply extract a measure of trough use. Livestock keepers indicated that about 85% of the livestock went to the water trough for the mid-day watering

during Periods 5 and 6. It was also said that the trough had attracted some non-traditional users of the watering facility.

An underlying assumption of the monitoring exercise was that any major changes in grazing behaviour between the periods before and after the introduction of the trough could be assumed to be due to the trough itself. In the event, there were clear trends during Periods 1 to 4 before the trough was introduced. The grazing area in Anida Hills became increasingly important for both goats and cows over this period, apparently because there was greater access to lopped tree fodder and grass (albeit dry) in this area. This trend was believed to be a response to declining feed availability from alternative sources. Therefore livestock monitoring was unable to distinguish between seasonal changes which coincided with the introduction of the trough and direct impacts of its introduction.

The changes in the use of Anida Hills appeared to have little impact on the overall pattern of activities, probably indicating that the strategy of using Anida Hills for grazing at the end of the dry season was reasonably successful. Monitoring of milk production (BAIF, unpublished data) over this period indicated that production was maintained during what goat keepers perceived to be a period of feed scarcity. By helping livestock keepers to use Anida Hills as fully as possible the water trough contributes to this strategy, but given the large changes in grazing patterns over this period it was not possible to identify changes arising specifically due to the introduction of the trough. The largest change coinciding with trough introduction was the increased use of Anida Hills for goat grazing. This change was anticipated when the trough intervention was identified and was consistent with the trough enabling goat keepers to maximise the use of this grazing area, but this may have been due to a coincidental seasonal shift in grazing rather than a direct response to the trough.

Discussions with livestock monitors and livestock keepers were held to clarify the interpretation of the monitoring data obtained. Before the water trough came into use, the goats were watered at the village first, on their way out to graze. At mid day they were watered at wells, including the one which supplied the water trough. There were a total of six such wells in use by the goats, different wells/grazing areas being used on different days. Cattle were similarly managed, but were more usually watered at the well supplying the water trough as this was more convenient for the Anida hills and plains, the favourite area for grazing cattle.

After the trough came into use there was a coincidental shift in where the animals were watered. This was said, in large part, to have been due to the limited availability of water at the five other wells normally used. These wells adjoin agricultural land which is prepared for crop planting at the end of the summer season. Farmers do not want livestock interfering with their preparations, so do not allow animals to be watered at the wells at that time of year.

When the rains started on 20 June changes had been observed in the monitoring data. Initially the monitors said that the rain made no difference to grazing behaviour, but when the results from the initial analysis of the monitoring data were presented to them, the monitors recalled that the cattle did not graze well. It was said that the cattle did not appear to like to graze moist feed. Most were kept in the homestead and

stall fed. The coming of the rain did not appear to directly affect the goats' grazing behaviour very much. This is when new leaves sprout on *Ziziphus mauritiana*, *Ziziphus nummularia*, and *Acacia* sp., the major tree fodders available in the Anida area. Hence, there was an increase in the availability of grazed tree fodder reflected in the increased consumption of this feed type by goats in Period 7.

There was little evidence of a major change in grazing activity as a result of the introduction of the water trough. The major impact may have been more to enable the livestock to maintain their grazing patterns at a time when lack of water would otherwise restrict grazing, rather than stimulate an increase in grazing per se.

## Conclusions

Livestock keepers appeared to be able to maintain the supply of grazed feed by using the Anida Hills and Plains areas towards the end of the dry season, when alternative sources of grazing become scarce. Livestock monitoring data indicated that there were large shifts in grazing patterns during the dry season making it difficult to detect changes due to the introduction of the water trough. The impact of the trough appeared to be that it helped livestock keepers maintain grazing during a time of feed constraint.

## References

Conroy, C., Bausar, G., Jape, A. and Rangnekar, D. V. (2000) The related effects of water scarcity and feed scarcity: a case study from Bhavnagar District, Gujurat. Paper presented at the Seventh International Conference on Goats, held in France, 15 - 21 May 2000.