RANGELAND ASPECTS

The project proposed that, the reservation of sufficient amounts of supplemental feed is essential so that animals can rebuild their strength during drought, the primary objective in supplementary feeding is to minimize the loss of animals. The feed reserve can be improved by increasing hay making, sown fodder, feed manufacturing, and increasing indigenous plant feed preparation. Establishment of cultivated pasture will reduce the livestock dependency on nature and climate. A successful implementation of this measure would greatly reduce not only the expected impact of climate change but also the vulnerability to drought and harsh environment. However, ownership/possession of land often increases investment, as the land would be managed as a capital, in which investments must be made to promote sustainability and prevent land degradation. Therefore, cultivated pasture development would be feasible in the case in which the land tenure is legally certified. On the other hand, the measure is costly because it will require sufficient irrigation, good seeds, and application of fertilizers. Increased vegetation cover of pasture by different varieties of perennials that are tolerant to drought is also a good adaptation option to increase pasture yield and restoration of degraded pasture. The feasibility of this measure depends on seed availability for such varieties of perennial pastures. The willingness of agropastoralists to bear the responsibility is also important. Expansion and rehabilitation of pasture water supply are other promising measures for improved pasture utilization and stock survival, as well as ecosystem conservation and rural development. Research, training, strengthening, and building upon existing capacity might be the most important measure in strengthening the adaptive capacity and enhancing the quality of life, in general. It is also important that more feasible and workable instruments are devised to influence local habits and traditions for the successful implementation of adaptations. This can be reached by educating agropastoralists and increasing their awareness with respect to environmental degradation and climate change. Research and training must be maintained and expanded at the pastoralists' level.

Improvement of the forecasting and warning systems is also essential. Increased disaster forecasting, especially drought would, however, help in preparing to meet potential dangers. An effective early-warning communications strategy should be developed to encourage the farmers to actively respond to climatic changes. Appropriate and effective communication channels including communication networks for the transmission of data from stations to monitoring centers and from monitoring centers to local communities are to be developed.

The Suggested crops do suit the area and the climatic zone of the proposed villages. It has been known for several years that "Guar" was one of the traditional crops in that area. Its importance was accelerated with the establishment of Guar industry in Singa town. Although the industry faced several constraints, but since 2006/2007 it started to replenish and resume its activity. Another crop which suits the area is groundnuts. It can be rotated with sesame and this will give a diversified cropping pattern. This leads to the inclusion of Guar and groundnuts in the area, and accordingly the crop rotation may be amended as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Rotation</th>
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<tbody>
<tr>
<td>First</td>
<td>Sorghum/Guar</td>
</tr>
<tr>
<td>Second</td>
<td>Sesame/G. nuts</td>
</tr>
<tr>
<td>Third</td>
<td>millet/Legume</td>
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</tbody>
</table>

- It is possible to use cow peas as the most suitable edible legume in the area. Cow peas can be grown with sesame in the same hole for better utilization of the soil.
- Since there are some fruit trees suggested in the three villages, how about introducing a supplementary irrigation system during the dry season, which is quite long.
- If the idea of supplementary irrigation is entertained, the winter season may be occupied by growing winter vegetables, at least in demonstration farms or in the home gardens.
- One or two wells may be dug for this purpose (if feasible).
Groundnuts can also be included in the rotation - in this context, only the rainfed varieties are to be used. This will have a dual purpose, as the hay can be stored for animal feeding.

Clitoria has climbing tendrils, if planted in the same hole with sorghum, the tendrils will twine along sorghum stalks, which if grazed as bare stands will add to the nutrition value of the straw. This would be a better method for farmer who prefer to introduce their animals after harvest so as to enrich the soil with animals’ dung.

**CARRYING CAPACITY**

Basic to rangeland management is the concept of carrying capacity: the number of livestock units that can be carried per unit area, in addition to wild herbivores, for the purpose of the production system for which the area is intended, given an acceptable risk factor and provided that no permanent damage is done to the ecosystem.

Carrying capacity is a function of:
1. the productivity of the ecosystem;
2. the purpose of the production system;
3. An acceptable risk factor.

- The productivity of the ecosystem depends on the primary production of the area, which is determined by rainfall, soil fertility, the condition of the range and management.
- The number of animals that can be carried on an area depends on the feed requirements of the animals. Therefore, the carrying capacity is smaller for dairy cattle than for beef production, which in turn is smaller than for animal survival.
- The acceptable risk factor is the risk the manager is prepared to accept if not achieving the set production goals. The magnitude of the risk depends on the reliability of the production system (rainfall), on the level of utilisation of the primary production, on the reserves of the system, the financial ability of the landholder and the pressure on the system by the human population.

**STOCKING RATE**

Stocking rate is the number of livestock units per ha and it determines the amount of feed that will be utilised. The higher the stocking rate, the more of the feed will be consumed, but also fouled and trampled, whilst the ability of the animals to select the most palatable and nutritious parts of the vegetation decreases. Increasing stocking rate will therefore lead to reduced production per animal. With more animals per ha, the production per ha will first increase, till a maximum has been reached and subsequently decrease to a point of no gain and eventually weight loss will occur. Conversely, with decreasing stocking rate, production per animal will increase to a maximum that is determined by the genetic potential of the animal and the quality of the feed. The nearer the stocking rate is to the point where maximum utilisation of the feed and thus maximum production per ha take place, the greater is the risk of losses due to extreme conditions, such as drought. In the relationship between animal production and stocking rate, three phases can be distinguished:

- (i) maximum production per animal; changes in stocking rate have no effect on production per animal, whilst production per ha increases linearly with increasing stocking rate;
- (ii) declining production per animal (Y) with increasing stocking rate (X); \( Y = a - bX \), where a is the theoretical maximum production per ha, and b is the amount of production per animal that changes with a change in stocking rate of 1. The greater b, the more production per animal will change with a change in stocking rate. The constant b will increase as the resilience of the rangeland decreases and deterioration begins to develop, until the following phase has been reached;
- (iii) overgrazed deteriorated range. The relationship between stocking rate and production per animal becomes steeper (b increases). The botanical composition deteriorates, with perennial grasses being replaced by unpalatable species and annuals.

The stocking rate should be determined by the carrying capacity, but the optimum stocking rate can be based on ecological or economic considerations. The ecological optimum is highly variable and depends on rainfall, the forage reserve, the animal production system and...
the proper use factor. Proper use is the degree of grazing which ensures the fullest possible use of forage while maintaining growth, vigour and reproduction of the herbage, taking into account the conservation of the soil and other land uses. From this a proper use factor can be derived, which is the percentage of vegetation growth that can be grazed without lasting damage.

The economically optimum stocking rate is based on profit maximisation, in which short term and long term goals can be distinguished. Short term profit maximisation can be aimed at when there are good market opportunities and only when the rangeland has sufficient resilience to withstand heavier grazing. However, in the long term it would be better to aim for sustainability of production and to accept lower short term profits.

**CONSERVATIVE USE**

On a global scale rangelands are used for ranching or in nomadic and transhumance systems. Land tenure is either private or state ownership with long term leases, with the potential to allow producers to exercise a conservative use, i.e. grazing to carrying capacity with due regard for the long term sustainable production potential. According to Friedel et al. (1990) there are two extreme approaches to management being applied in arid rangelands under conditions of uncertain markets. The first approach is a highly conservative stocking policy aimed at drought resistance (long term survival), relying on low animal numbers and relatively high production per animal. This approach gives an assured take off of better quality meat for markets in good as well as bad years, with a steady basic income. The opposite approach is to get the most out of good years by high stocking densities after good rainfall with high utilisation of the herbage and rapid destocking at the start of drier seasons. The first approach contains low risk and lower incomes in good years and the second approach requires higher management skill, is extremely risky, both financially and ecologically and can only be practiced successfully on resilient landscapes (fertile soil, flat land). Failure to destock in time, for example as a result of low prices, will lead to degradation of susceptible landscapes, unless there is reserve pasture on hand.

Conservative management is hindered by variable markets and prices for animal products from rangelands, as well as by banking and taxation policies.

**Sound ecological management should contain the following features**

1) a conservative upper limit for stocking rate;
2) small flocks or herds per watering point;
3) subdivision into “small” paddocks according to pasture type and stock distribution;
4) recognition of the importance of key seasonal events for vegetation recovery coupled with
5) pasture resting to allow for recovery of perennial species;
6) burning for shrub control;
7) conservation or re-establishment of “fertile islands”.

There is evidence that sound ecological management in the long run also gives higher economic returns.