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Land and Range Resource Management Issues and Food Security in Balochistan

Arid Zone Research Institute
(Pakistan Agricultural Research Council)
Quetta, Pakistan

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Cover: Sheep and goats graze degraded rangeland in Balochistan.

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Introduction

The ability of Pakistan to feed its rapidly expanding population in the 21st century is becoming increasingly doubtful unless major and radical changes in agricultural policy and practices take place. Why are such changes necessary? Quite simply, the rate of yield increase of staple crops such as wheat and rice from the irrigated lands of the Indus Valley has declined and there is little prospect of increasing the amount of land for rain-fed (*barani*) crop production. Demand for animal products is also increasing as the incomes of the people improve, but feed for ruminant animals will have to come from the rangelands, from lands marginal for crop production and from the better use of crop residues. The pressure to use cultivable land for crop production will preclude the growing of fodder crops except on a limited area. Balochistan province has a large land area and a small population, and hence has the potential to contribute more to securing the future food supply of Pakistan.

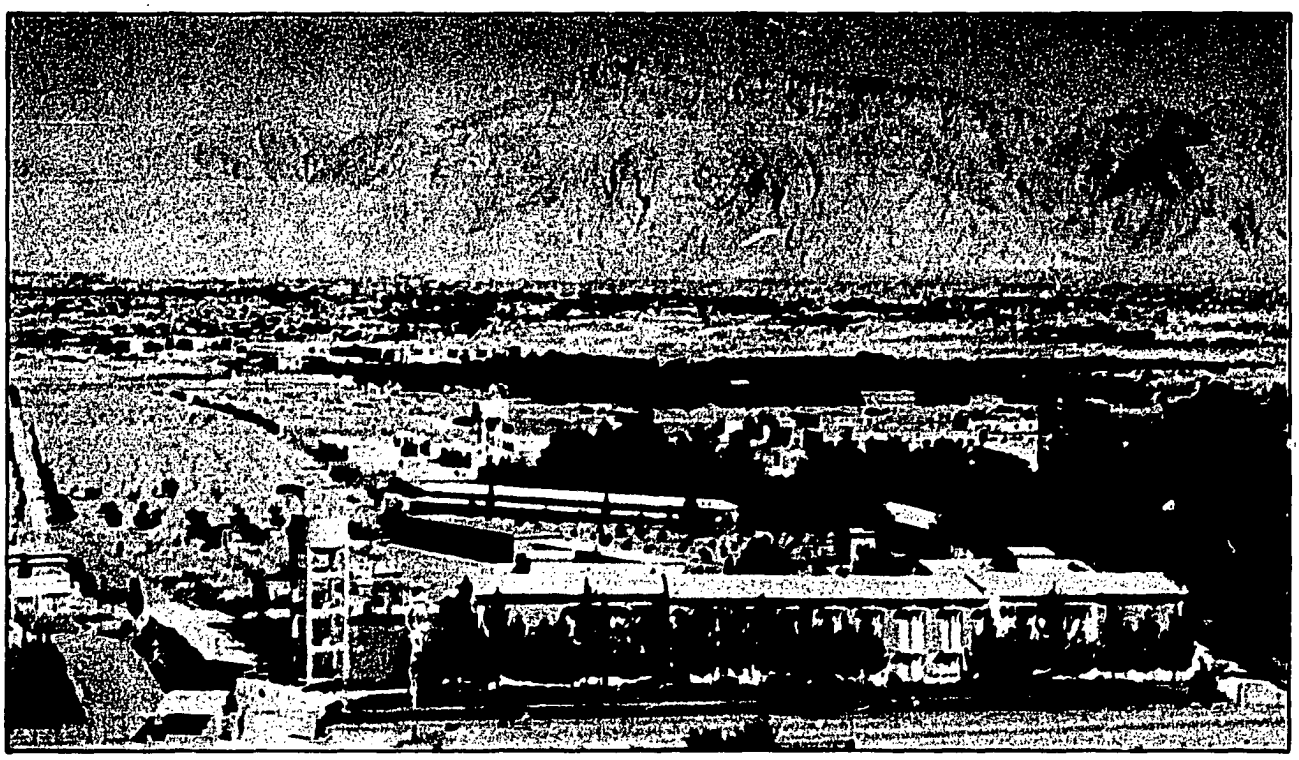
This document outlines, first, the resource degradation issues facing Balochistan and suggests some feasible solutions that should be implemented as a matter of urgency. The second part estimates and, where information is lacking, speculates on the potential of Balochistan province to produce its own wheat under rain-fed conditions and red meat from the rangelands. Information for making more accurate predictions should become increasingly available by the year 2000. It is essential that a strategy for sustainable agricultural development be implemented now, before resource degradation reaches a point of no return. The information presented here is mainly derived from research conducted at the Arid Zone Research Institute (AZRI) in Quetta since 1985†.

Balochistan province has a large land area, a small population, and the potential to contribute more to a secure food supply for Pakistan.

It is essential to implement a strategy for sustainable agricultural development now, before resource degradation reaches a point of no return.

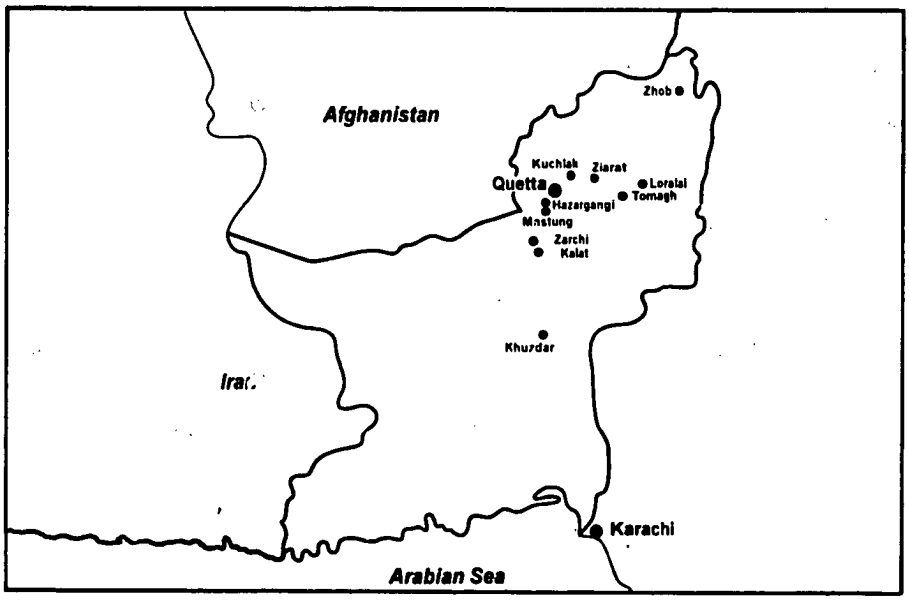
† A full list of the papers providing information for this article can be obtained from AZRI, P.O. Box 63, Quetta, Pakistan.

Arid Zone Research Institute, Quetta, Pakistan.

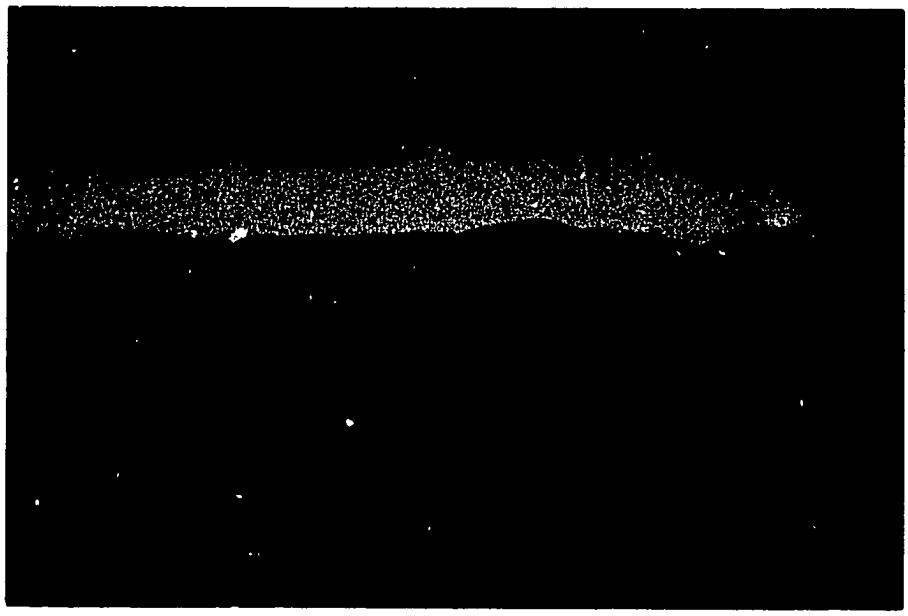


Geography and land categories of Balochistan

Balochistan covers 44% of the surface area of Pakistan. The Indus valley lies to the east of the province and on its western side it has borders with Iran and Afghanistan. Northward from its southern coast on the Arabian Sea, the province becomes increasingly mountainous. Several peaks around Quetta, the provincial capital, exceed 3500 m altitude. Highland Balochistan, which covers most of the northern part of the province with an extension down to Khuzdar, has many flat valley bottoms surrounded by sloping rangelands on gravel fans that merge into mountains. These valley bottoms lie at altitudes between 1000 and 2300 m. Balochistan has no major perennial rivers although the seasonal rivers help to replenish the aquifers.



The main land categories of Balochistan are range, forest and cultivated land. The rangelands, covering some 30 million ha out of the total area of 34.7 million ha, have been broadly classified into areas of 'poor', 'medium' and 'high' potential, producing annually less than 50, 60-190 and 200-250 kg dry matter per hectare, respectively.



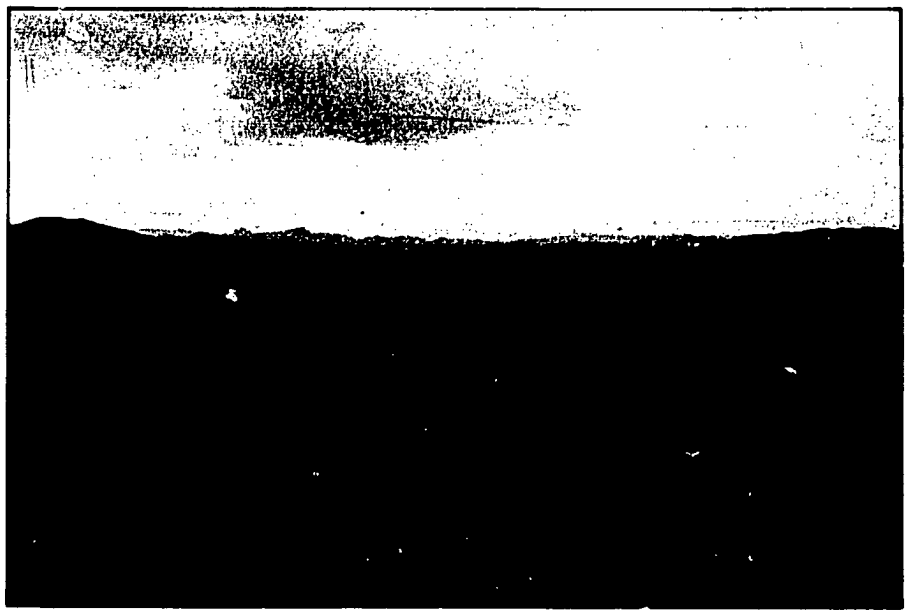
The Dasht Valley, close to Quetta, where AZRI had some of its research on water-harvesting.

The poor rangelands cover about 62% of the province and are generally in the south. The rangelands of medium (25% of the area) and high (13% of the area) potential are mostly in highland Balochistan. An unknown area within these classes is mountains. They are covered by thin soils that support poor grazing, often in areas too far from water to be used by livestock. Remnants of what many authorities consider to have been a more extensive forest cover are found in the remote and protected areas controlled by the Forest Department, such as around Ziarat, where juniper (*Juniperus macropoda*) is the main tree species.

Juniper trees are protected by the Forest Department in Ziarat Valley.

The range vegetation types change from south to north as the rainfall increases. In the south, desert shrubs dominate; in the central area, shrub steppe of *Haloxylon* and *Artemisia* (sagebrush) species; in the north, a perennial grassland is based on species of *Cymbopogon* and *Chrysopogon*. Many of the native annuals have almost disappeared because of heavy grazing pressure.

***Chrysopogon* (left) and *Cymbopogon* (right) are the main perennial grass species in the degraded rangelands in northern Balochistan.**



Sagebrush (*Artemisia*) is the dominant shrub species on heavily eroded rangeland at Zarchi.

The cultivable lands of Balochistan extend to about 1.66 million ha, of which about 0.60 million ha are used for irrigated crop and fruit production, 0.16 million ha for rain-fed crops and the remainder are shown as fallow in government statistics. Much of this fallow appears to be in highland Balochistan.

‡ Farmers in arid areas of West Asia have been using water-harvesting methods for centuries. In Balochistan the main method of crop production using water-harvesting is called *sailaba*, which diverts floodwaters from surrounding mountains and hillsides onto small fields of cultivable land surrounded by earth banks (bunds). *Kushkaba* is the local name for true rain-fed crop production, which is generally found beyond the reach of runoff water. Knowing the area of land under these two systems is vital to any attempt to estimate the potential for expanding water-harvesting in Balochistan.

The climate of Balochistan

The aridity of the central-west Asian region and the altitude of central and northern areas of the province combine to give highland Balochistan a harsh climate. In the high valleys, winter temperatures can fall to −20°C and in the lower valleys, summer temperatures may reach 40°C. Annual rainfall increases from 100 to 150 mm along the Makran coast to 200 mm around Khuzdar in the center. In the north, east of Zhob, rainfall is over 350 mm annually. Most of the rain falls in winter although monsoon rains along the northeastern rim of the province can be significant. Wide variability of rainfall between and within years makes crop production a high-risk activity and also has a marked effect on range forage production‡.

Winters in highland Balochistan can be cold and snowy.

Crop and animal production systems

Wheat is the most important rain-fed crop grown in highland Balochistan, followed by barley and rapeseed. In spite of potentially higher yields of barley, wheat predominates because it provides food security. Also, the local landraces of wheat used in Balochistan yield good quantities of straw and stubble; the latter is grazed by livestock, mostly small ruminants.

Wheat is produced under the *sailaba* system, one of the traditional methods of water-harvesting in Balochistan.

The farming systems integrate crop and livestock to produce foodstuffs for human and animal consumption. The animals can be sold to raise cash whenever it is needed. The income from sheep and goats as a percentage of farm income ranges from 40 to 70% for transhumants to 100% in the case of nomadic pastoralists. Off-farm income is becoming increasingly important as families fail to make a living from the land. It stabilizes the farm income, which is very susceptible to rainfall fluctuations.

Livestock systems vary, depending on the lifestyle of the animal owner and the rangeland property regime. About 30% of the small ruminants are owned by nomadic *powindahs*, 60% by transhumants and only 10% by sedentary livestock producers whose main activity is crop production. About 93% of the farms in highland Balochistan are between 1 and 20 ha. Producers own 30 sheep and 22 goats on average. More than half (60%) of the small ruminants are found in flocks of up to 100 animals; the remainder belong to owners with large flocks and farms.

Cereal stubbles supplement sheep diets in summer.

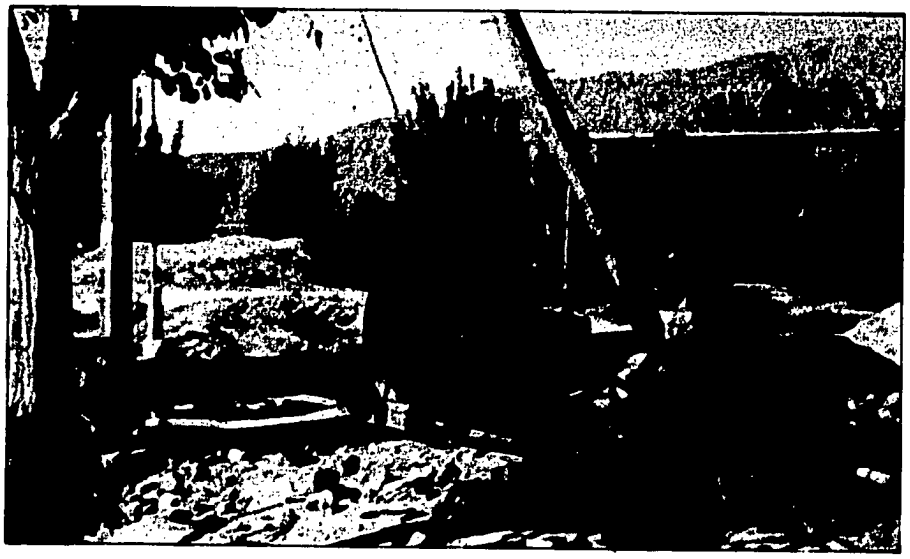
Lambing and kidding take place in winter and spring. Lambing rates vary from 65 to 75% according to weather conditions and feed supply. Because of the predominance of subsistence livestock production systems, productivity per animal is low. The estimated provincial annual off-take is 56 000 tons of meat with a market value of Rs 2840 million (= about US$92 million).

A rapidly expanding human and animal population is the major factor in rangeland degradation.

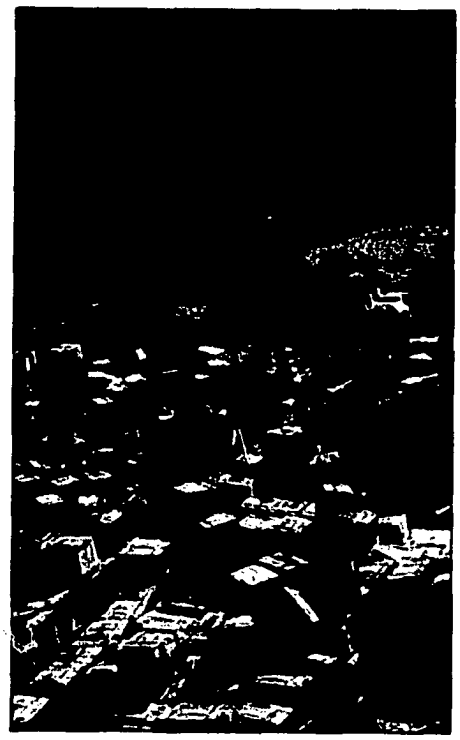
Current resource degradation issues in highland Balochistan

Before addressing the current resource degradation issues facing highland Balochistan, it is important to emphasize that a rapidly expanding human and animal population is the major factor driving this degradation. Indeed, the most recent human population census indicates 4.5 million inhabitants in 1981 and a 7% annual growth rate from 1972 to 1981. A more modest 3.1% annual growth rate since 1982 will result in a population of 6.1 million in 1991 and 8.0 million by the end of the century. The annual population growth rate of small ruminants was 6.5% from 1972 to 1986. This increase was partly due to the animals brought in by Afghani refugees in the early 1980s. An expanding ruminant population is putting the land and range resources of the province under enormous pressure.

Falling water tables. Before the early 1970s most wells in Balochistan were hand-dug, then tube-wells were begun and by 1988/89 there were thought to be more than 10 000. The water is largely used for high-value cash crops such as apples, almonds, apricots and vegetables although some is used for wheat and alfalfa. The water from these tube-wells is often used indiscriminately, as if there were unlimited supplies of water. This misuse is compounded by the flat-rate electricity tariff based on the size of the pumps. In the Quetta Valley the mining of water has reached extremes, with the water table now estimated to be falling at an annual rate of up to 3 m in certain areas whereas between 1900 and 1980 the annual rate of fall was only about 15 cm. A declining water table is one of the main reasons why many of the traditional *karez* have been abandoned. A *karez* is an ancient system of underground tunnels that carry water from the foot of the mountains to cropped areas of the valleys.



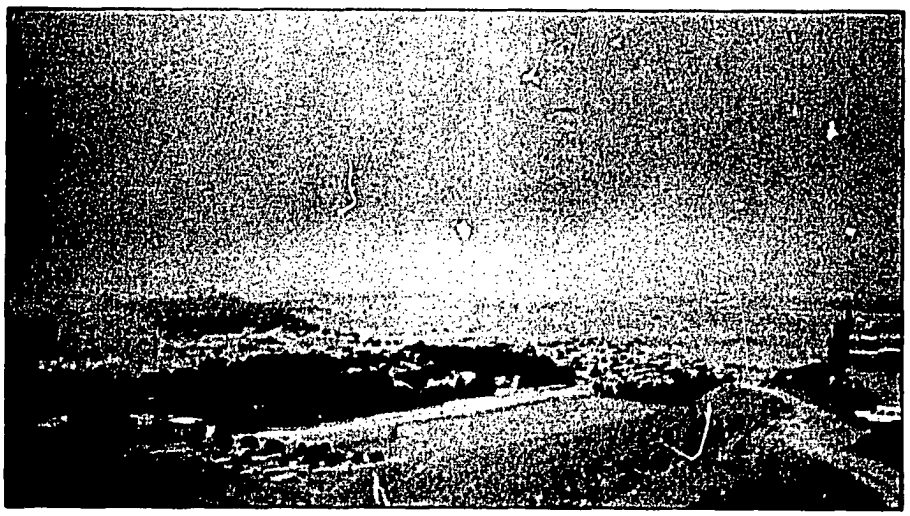
Water from tube-wells is making heavy demands on limited underground reserves.



Orchard production is a major source of revenue in the Quetta Valley.

A *karez*, an ancient system using tunnels to carry water from the foot of the mountains to cropped areas of the valleys.

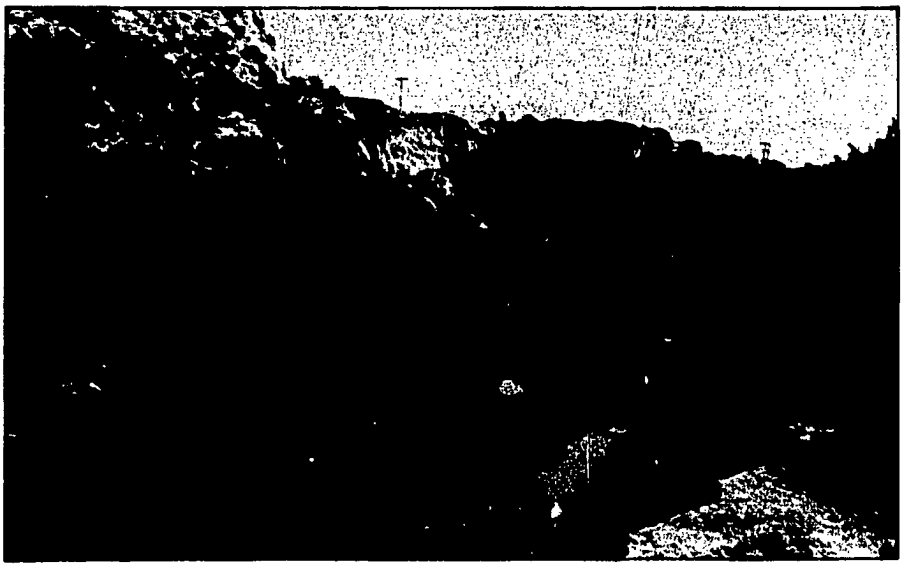
Wind erosion. Wind erosion is an ongoing process although the extent of the problem in highland Balochistan is not well documented. The air is often heavily laden with dust, which originates from the extremely arid western region of the province. Obvious signs of wind erosion can be seen around Mastung where a successful sand dune stabilization program has been going on using tamarisk. The soils often form a crust after the last rains of the season, which protects them from wind erosion until the crust is broken by grazing ruminants or cultivation.



Quetta on a windy day, with a dust-laden sky.

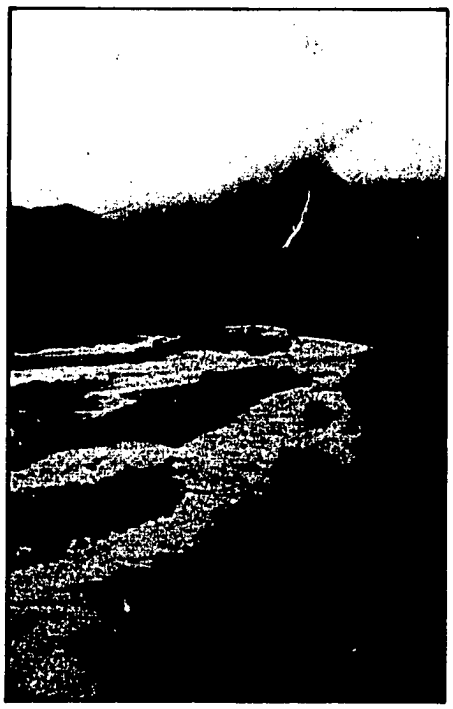
Water erosion. Water erosion has been, and continues to be, a far more significant form of natural resource degradation than wind erosion. The soils in the valley bottoms can be very deep. For example, the depth of the gully (*nullah*) running through Quetta, and the dendritic drainage pattern carved in the soils downstream of Quetta toward Kuchlak, are clear evidence of the massive movement of soils over millennia.

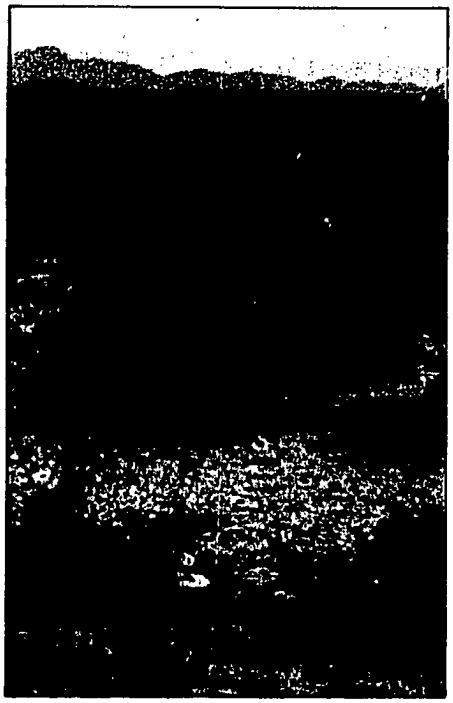
The extensive depth of sediment deposited over millennia is visible in the Quetta *nullah* (valley).



The erosion processes leading to this soil movement appear to have taken place despite, rather than because of, the presence of people and their animals which were at low population densities until quite recently. However, in some areas the erosion must have been fairly recent. For example, at Zarchi, a representative site near Kalat where AZRI has a station, the soil between the native shrubs has probably disappeared within the last 100 years or so, presumably as a result of heavy grazing which removed the annual species. Today only the shrubs remain, perched on mounds of soil held in place by their roots. Few sheep and goat flocks are found in the area because the carrying capacity of this shrub steppe is low and there is a shortage of water for the animals. This shrub range shows little capacity to recover if it is rested.

Flash flood near the Kanak Valley, south of Quetta.



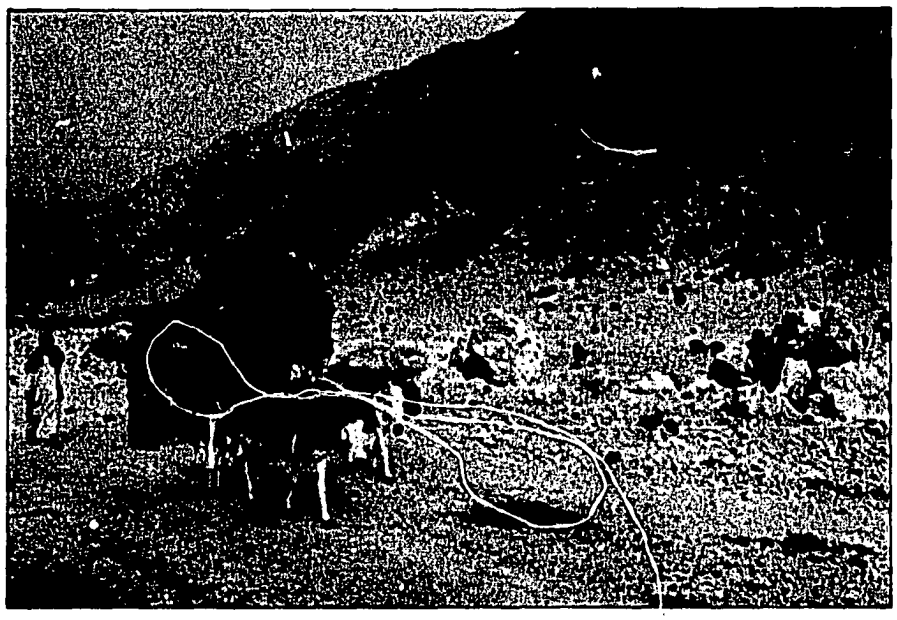


Soil between tufts of *Artemisia* has been eroded away.

Range degradation. The progressive degradation of rangelands in Balochistan is another issue that should concern policymakers. Most of the blame for this degradation is placed on the small ruminants, whose numbers are increasing. For example, the number of sheep and goats is said to have increased from 1.5 million in the mid-1950s to 18 million in 1986. Even if the annual growth rate of small ruminants decreases to 3%, the projection is a population of about 27 million small ruminants by the end of the century! Serious doubt must be cast on these figures. If they are true, however, is there any hope of saving the rangelands of Balochistan?

Blaming small ruminants for the range's degradation is an oversimplification. They are responsible for the disappearance of many of the annual range species over much of the province, but not necessarily for the destruction of the perennial plants. Moreover, the damaging effects of the Afghan animals are mainly confined to the area of the refugee camps. The war in Afghanistan also certainly disrupted some, but not all, of the migratory movements of the *powindahs* across the border with Balochistan and this may have increased the grazing pressure in certain areas. It is unclear to what extent these traditional migrations will be resumed now that the war has ended.

A factor causing range degradation which is often overlooked is the uprooting of native shrubs by people who need fuel for cooking and heating. This activity, which has undoubtedly gone on for centuries, is particularly intense within a 5-km radius of villages, towns and refugee camps. In many areas the last and smallest remaining shrubs are removed by the villagers in their desperate efforts to gather fuel, whereas in the recent past they removed the larger shrubs and before that the trees. This may explain why many people say that within living memory the forests were much more extensive than now, although this is difficult to verify. The increasing use of natural gas in small portable containers should reduce pressure on the range shrubs. The provincial government needs to encourage this development.



People illegally cut the few remaining trees for fuel which is desperately scarce.

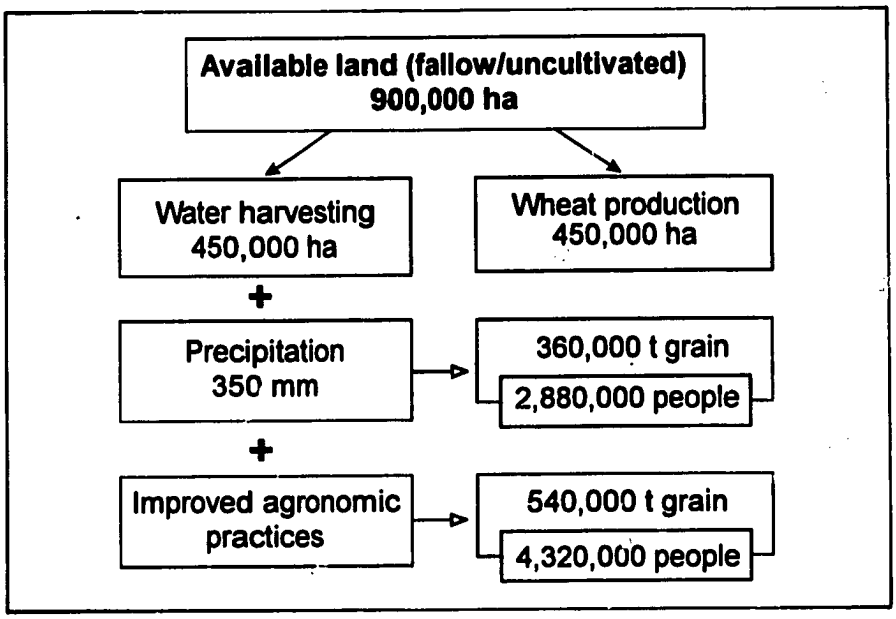
Expansion of the cropped area and greater yield stability would help maintain the vitality of farming communities.

The potential of the cultivable lands

A number of questions can be asked about the production potential of cultivable rain-fed lands of Balochistan. First, what would be the potential output of wheat, the main staple food crop? Second, how many people would this wheat feed and what would be its contribution to the national wheat supply? In other words, could Balochistan produce enough wheat to feed its own people?

Wheat production could be increased in Balochistan if suitable methods of water-harvesting were applied. Without it, the rainfall is too low and erratic to grow wheat‡. If by the year 2000 half of the 900 000 ha of fallow or uncultivated land in Balochistan were used to harvest water for use by crops growing on the other half, that area could produce 360 000 tonnes of wheat at a grain yield of 800 kg/ha. If this amount were added to the 512 000 tonnes of wheat produced on 270 000 ha of irrigated and rain-fed land and there were no improvements in current grain yields, then in the year 2000 about 7 million people could be fed.

Experimental plots of wheat at the Agricultural Research Institute, Sariab (Quetta).



Potential of fallow/uncultivated land for wheat production in Balochistan.

This would make Balochistan 90 or 52% self-sufficient in wheat for annual population growth rates in the range of 3.1 and 6.2%, respectively. (The latter figure contrasts with the figure of nearly 8% during the 1970s.) If this fallow land were not used and the areas and yields of wheat remained at 1990/91 levels, then the self-sufficiency of the province would be between 35 and 53% by the year 2000.

A second scenario favored by the provincial government is to expand the area of irrigated wheat, to make more efficient use of water and to use technologies that increase wheat yields.

The additional wheat needed each year until 2000 for the population increases of 3.1 and 6.2% would be 25 000 and 76 000 tonnes. This is equivalent to an annual expansion of the wheat area by 11 000 to 34 000 ha at constant yields, or an annual increase in wheat yields of 124 to 373 kg/ha from the existing area. These rates of change are well above those in 1986-91.

These two scenarios suggest that Balochistan will become increasingly dependent on the other provinces of Pakistan to cover its wheat needs. The use of fallow land for wheat production using water-harvesting is only likely to find favor with farmers if there is extensive assistance from the provincial government. The second scenario may provide a partial solution in the short term. However, in the long term it will require high levels of water management to replace the present mining of the limited water reserves. Introduction of good water management practices remains the greatest challenge facing the provincial government and farmers.

The standing water after heavy rains may be the only moisture plants receive for many months.

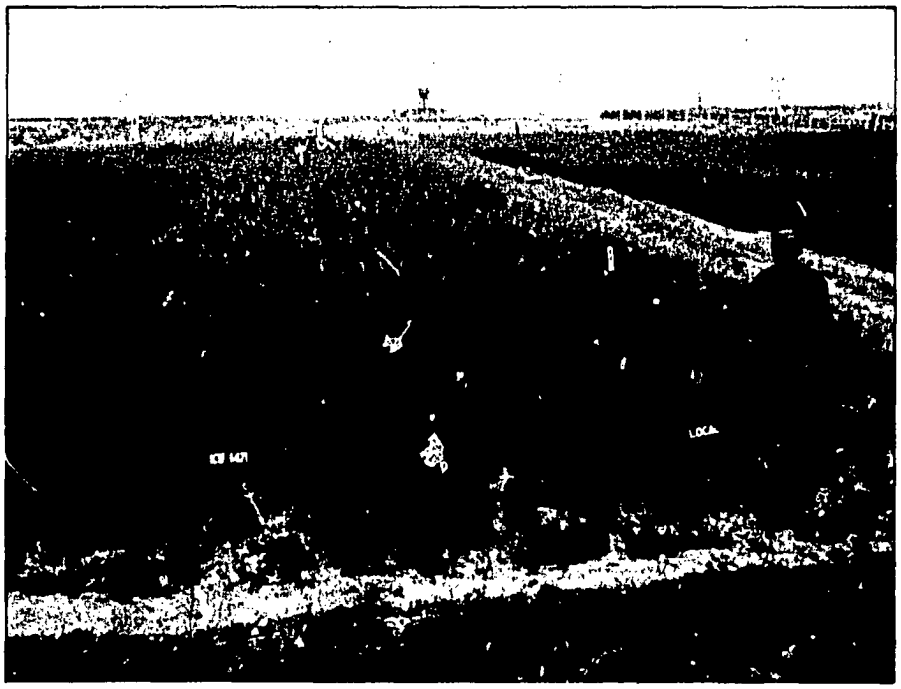
What priority should be given to research to increase rain-fed wheat production in highland Balochistan? One answer lies in maintaining the vitality of the existing farming community, the corollary being a province with an increasing number of derelict villages as even more people move to the towns and cities. Research on water-harvesting at AZRI should continue to receive priority since it has been shown to achieve the same yields as traditional *khushkaba* (rain-fed) practices

Five-Year Plan: 1993/94 to 1997/98

The Government of Balochistan projects that annual wheat production will increase by 10% during the Eighth Five Year Planning period. This is equivalent to 80 000 tonnes of additional production each year and would allow Balochistan to become self-sufficient in wheat by 1996/97.

but farmers' gross margins are increased by 22% and the yearly variability of these margins is decreased by 22%. This would appear to make water-harvesting marginally attractive to farming families practising *khushkaba* agriculture.

One might even speculate that if the *khushkaba* farmers adopted water-harvesting to expand their wheat area by 50% using land currently under fallow or under *khushkaba* crop production, the increased production of wheat grain and straw would be substantial. Such an expansion also would be encouraged by the introduction of wheat varieties resistant to diseases such as yellow rust (*Puccinia striiformis*), already identified at AZRI. Expansion of the cropped area and greater yield stability would certainly help maintain the vitality of these farming communities.



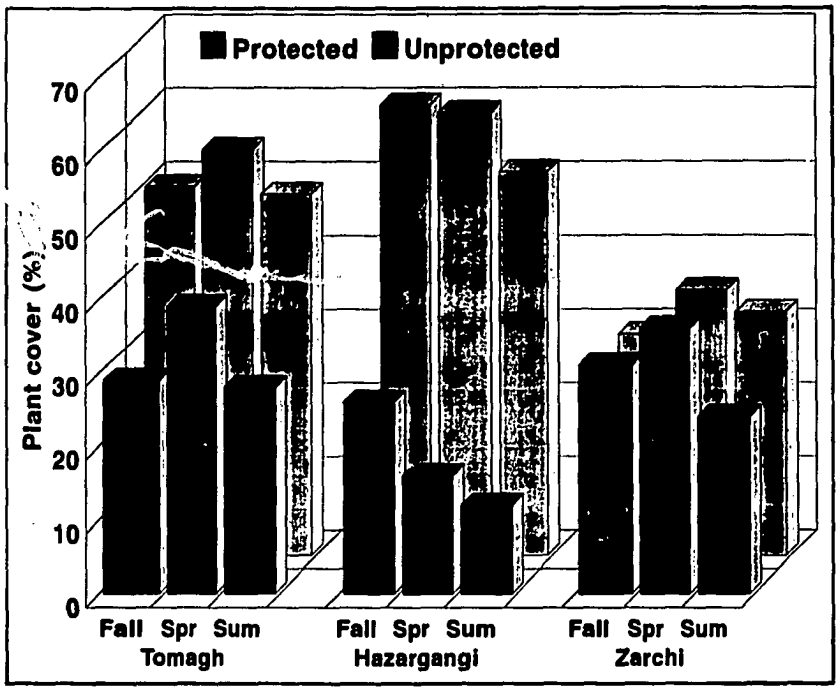
AZRI plots of improved wheat with resistance to yellow rust.

It will be essential for economists and social scientists to address some of the questions that determine whether and under what circumstances the farmers can and will increase the intensity of land use. Indeed, what percentage of their land do they crop? Available statistics suggest only about 150 000 out of 700 000 ha of rain-fed land in highland Balochistan are cropped on average. What are the reasons for this low intensity: low and variable rainfall making crop production highly risky; labor, draught animal and tractor shortages at planting; harvesting and marketing problems? Another question is what changes to the farming system would lead to increased cropping intensity? There are no ready answers to these questions. However, it does appear that water-harvesting, together with disease-resistant wheat or alternative crops such as barley, have the potential to increase crop production and yields. But, it is necessary to know whether or not cultivable land is limited, as well as the soil depth and composition of such land.

The potential of rangelands

A similar set of questions that were asked about the cultivable lands of Balochistan can be asked about the rangelands. First, have sustainable range management practices been identified? Second, if they were applied, what would be the long-term off-take of the small ruminants grazing these rangelands, supplemented with crop residues from the cultivable lands? Third, what would be the contribution of a more productive small ruminant population in Balochistan to the national supply of meat and animal by-products? The following section attempts to answer these questions.

Have sustainable range management practices been identified? Many people claim that these are known; they just have to be implemented. These practices are the ones taught to students of range science: control of grazing access and grazing pressure by deferred and rotational grazing; introduction of exotic species, usually grasses; reseeding, even by air; fertilizer application; fencing. These solutions are often inappropriate in areas where tribal land use is the norm.



Plant cover at three range sites and during three seasons in highland Balochistan.

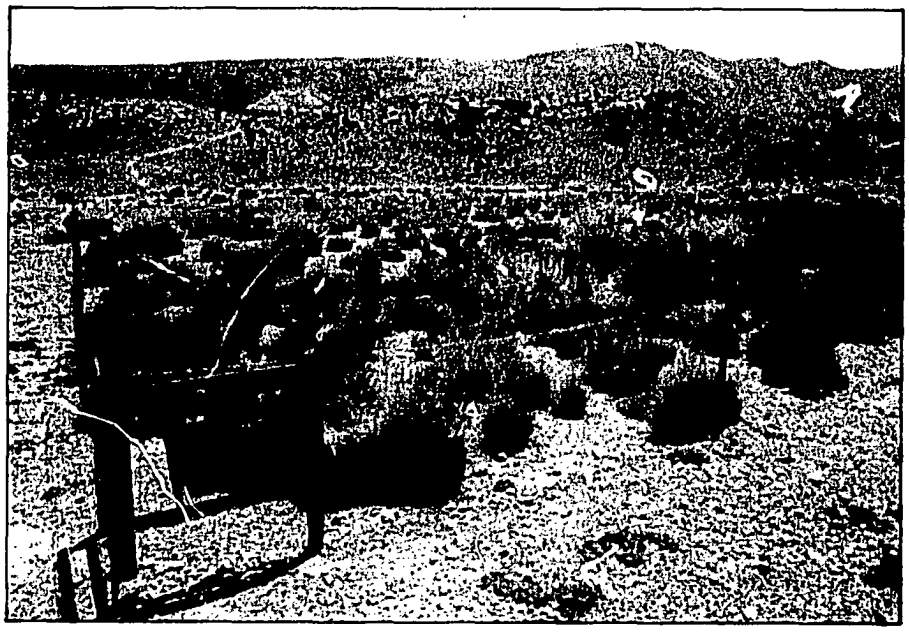
AZRI has looked at several of these classical solutions to range degradation. Deferred grazing, which is a form of temporarily removing grazing pressure, has given results dependent on the type of rangeland. At the Zarchi site, resting the shrub-dominated range resulted in little recovery. Indeed, there was only a small difference in the yield of biomass of the grazed and ungrazed areas. This may have occurred because the grazing pressure was low, which is suggested by the mature size of the plants. It is unlikely that imposing deferred grazing over a long period would have given a different result.

The converse is seen at the Hazargangi location close to Quetta, which is situated across the route of flocks migrating in the spring and autumn.

Here the grazing pressure is very high, especially in spring, and the sagebrush is prostrate but survives well, offering succulent forage to the animals. The lesson here is that certain species, particularly woody perennials, can survive heavy grazing provided they are not uprooted for fuel.

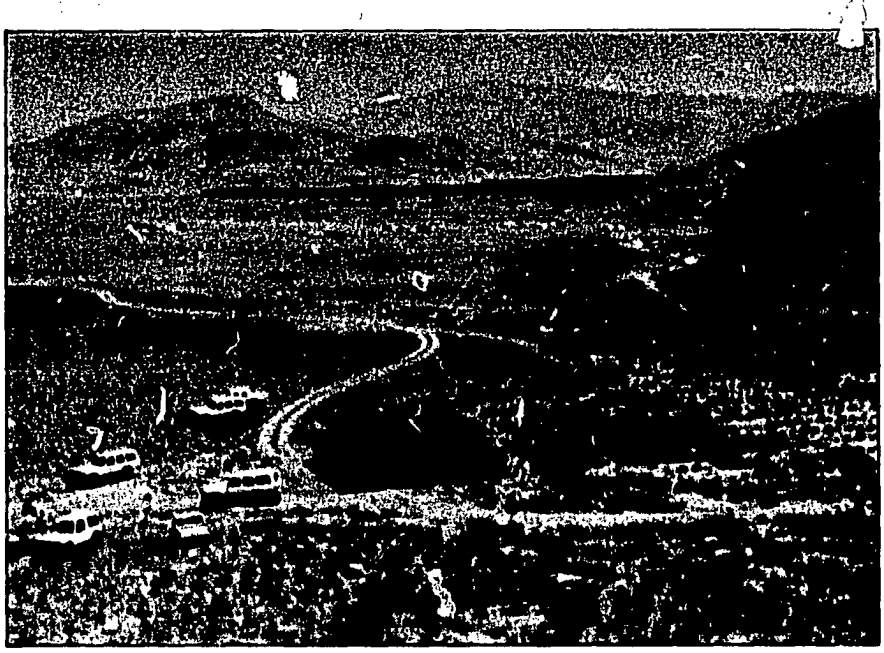
In the Chiltan-Hazargangi National Park the vegetation showed a good ability to recover. The park was fenced about 1980, which provided complete protection; before that it was partly closed to livestock. This partial, followed by complete, protection before the bank of annual seeds was completely exhausted may explain why recovery has been so good. The siting of the park close to a *nullah* also helped the recovery of the vegetation.

At another site called Tomagh, 50 km west of Loralai where AZRI is conducting range research, protection from grazing showed the potential of the perennial grassland to produce biomass. However, the Tomagh results are often misinterpreted as suggesting that grazed areas are producing almost nothing. Indeed, just the opposite is the case since animals are continuously removing small amounts of highly digestible plant material. The yield of digestible nutrients from the grazed area is probably higher than from the protected area. What is needed is a compromise between the two extremes: the range vegetation needs to be rested at appropriate times so that the seed bank of annual species is replenished each year. At other times heavy grazing is less damaging.



Range exclosure showing plant recovery at Tomagh.

Exotic grasses also have been studied by AZRI, such as species of *Agropyron* and *Eragrostis*. However, persistency has been disappointing and even if it were reasonable, it would be too costly to reseed the vast areas of rangeland where the chances of good germination are low and grazing is uncontrolled. Under these circumstances it is difficult to envisage the development of a local grass-seed industry.



Visitors at Miangundi field day, 1993, view well-established saltbush reserve.

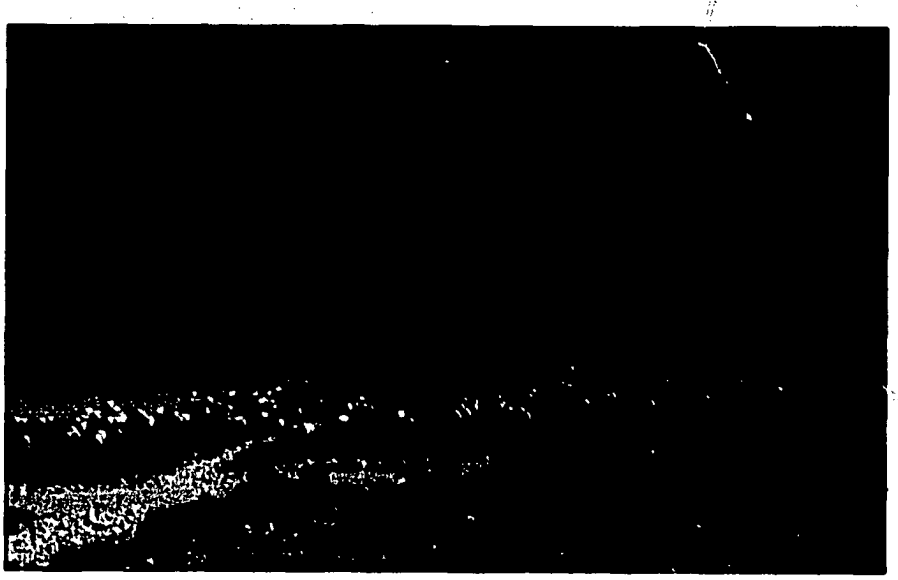
AZRI therefore is giving increasing attention to revegetating heavily degraded range areas with native shrubs such as sagebrush and a species native to the arid areas of the western USA, fourwing saltbush (*Atriplex canescens*). The 6-month-old seedlings of this perennial forage shrub can be planted out in winter and grazed 18 months later.

Fourwing saltbush has shown high resistance to the aridity of the summers and to the winter temperatures (down to −20°C) that occur in Balochistan. The shrub is less suitable for rangeland revegetation because control of grazing in these areas is so difficult. Thus, more attention is currently being given to the forage-reserves concept on land owned by farmers. This has the advantage of being under the control of farmers. The grazing period is from June until October and the protein-rich leaves are a useful supplement to cereal stubbles, which become available in June. Plants that have been rested until autumn can be grazed in early winter when feed is in shortest supply. Current research at AZRI aims to define grazing management and optimal plant spacing.

Even introducing saltbush on modest areas of marginal crop land will require massive assistance from the provincial governments. Planting a mere 1000 ha each year would require 2.5 million seedlings. Many thousands of hectares would have to be sown each year to make an impact on the feed supply of Balochistan.

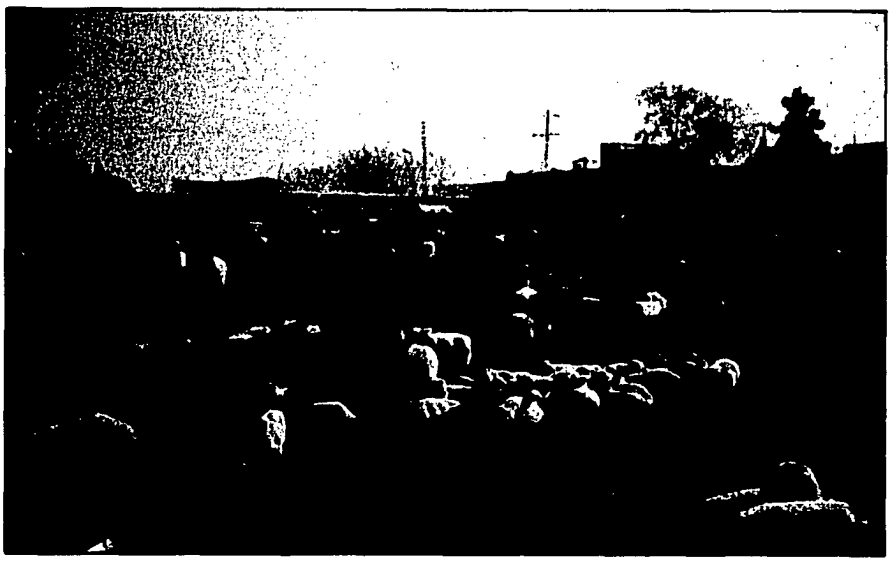
Can animal off-take be improved? The key to improved animal off-take is undoubtedly better nutrition which itself depends on better rangeland productivity. This will be very difficult to achieve in practice. Other factors such as inferior genetic potential and poor health also limit animal productivity. However, it is not clear whether the animals are really genetically inferior under the harsh conditions they face. Moreover, some of the diseases, particularly internal parasites, would be less debilitating if the animals were well nourished. A better marketing system would enhance off-take by encouraging livestock owners to sell younger, better quality animals, thus reducing pressure on the ranges.

The key to improved animal off-take is better nutrition, which depends on better rangeland productivity.



Small ruminant flock grazing sparse ranges in Balochistan.

Achieving a modest increase in off-take poses a considerable challenge: livestock owners will have to use more concentrate feeds such as barley grain and wheat straw if the range forage production does not increase. Wheat straw is already being used but consumption of concentrates is low, mainly because the feeds are expensive. If they were available at more attractive prices, the danger arises that farmers would choose to increase flock size rather than sell animals with higher weights. This could even be a step toward the 'steppe feedlots' situation that has arisen in Syria and elsewhere in the Middle East (Near East) during the last 20 years. The larger flocks would only increase the pressure on the already heavily degraded rangelands. This possible scenario deserves research.



Livestock market, Quetta.

What would be the contribution of increased off-take at the provincial and national level? One estimate indicates that Balochistan produces about 56 000 tonnes of meat from 11.2 million sheep and 7.2 million goats, representing about 3.9% of the total red meat production in Pakistan. If the liveweight of each animal at

slaughter increased from 27 to 30 kg, an additional 6200 tonnes of sheep and goat meat would be produced, marginally increasing Balochistan's contribution to the national meat supply. Alternatively, better nutrition before mating could increase lambing rate from 60 to 70% and result in another 5600 tonnes of meat. Without economic studies it is not possible to predict whether livestock producers would increase or decrease their production in response to changes in meat prices. Nevertheless, these figures indicate that Balochistan may be far from self-sufficient in red meat; this is evident from the imports of small ruminants from Iran and Afghanistan and cattle from Sindh and Punjab.

Conclusions

A general overview rather than an in-depth analysis of some of the current resource degradation processes occurring in Balochistan is presented here. It only looks 10 years into the future; the present information base is too inadequate to make projections beyond that point.

- This document has probably raised more questions that it has answered. If so, it has achieved another part of its aim: to highlight some of the knowledge gaps that need to be filled so that better estimates can be made of the potential contribution of crops and small ruminants to feeding the people of the province.

- Filling these knowledge gaps will require urgent research, more of a socioeconomic than of a technological nature. Indeed, solutions to technological problems are generally known but need to be tested with the full involvement of farmers.

- Research on socioeconomic issues that determine adoption of these solutions should be expanded. Otherwise, the gap between what can be, and what actually is being, achieved will widen. Such research would also allow priority setting based on equity criteria.

- Other socioeconomic issues should be addressed, such as tribal rangeland ownership and grazing traditions, the potential to expand crop production, and the relative areas of *sailaba* and *khushkaba* land.

- Balochistan is facing serious resource degradation problems that are largely due to a rapidly increasing human and animal population. Solutions to these problems are known but there must be a will to implement them. Only massive support from the provincial government to the farming and pastoral community will allow this to happen.

- Without this support it is likely that Balochistan will become increasingly dependent on staple foods and meat from other parts of the country, which is struggling to supply its rapidly expanding population.