1. "The planning and achievement of national pilot projects, capable of allowing the building of a network."
2. "The programs included in these projects should contribute to the improvement of knowledge on the functioning and rational use of the *dehesas* and similar agro-sylvopastoral systems, serving as a baseline for the activities of training, demonstration and information, and acting as the guideline to insure the sustainable development of the rural space considered, warranting the long-term preservation of the environment."
3. "The creation of a Panel that will elaborate an International Cooperation Project for the specification and achievement of the proposed Program."

Literature Cited

Campos, P. 1984. Economía y energía en la dehesa extremeña. MAPA, Madrid.

Comunidad Autónoma de Extremadura 1986. Ley sobre la Dehesa en Extremadura. D.O.E., 40:503-528.

Escudero, A., B. Garcia, J.M. Gómez, and E. Luis. 1985. The nutrient cycling in *Quercus rotundifolia* and *Quercus pyrenaica* ecosystems ("dehesas") of Spain. Oecologia Plantarum, 6:73-86.

Marañón, T. 1985. Diversidad florística y heterogeneidad ambiental en una dehesa de Sierra Morena. Anal. Edaf. Agrobiol., 44:1183-1197.

Marañón, T. 1986. Plant species richness and canopy effect in the savanna-like "dehesa" of S.W. Spain. Ecologia Mediterranea, 12:131-141.

Parsons, J.J. 1962. The acorn-hog economy of the oak woodlands of southwestern Spain. Geographical Review 52:211-235.

Ruiz, M. 1986. Sustainable food and energy production in the Spanish "dehesa". The United Nations University, Paris.

Young, J.A., and C.M. McKell. 1976. Livestock under the Spanish oak trees. Rangeman's Journal 3:172-174.

Rangeland Development in Dera Ghazi Khan, Pakistan

Javed Ahmed and Raja Atta Ullah Khan

Abstract

The first attempt at scientific management of rangelands in Dera Ghazi Khan, Pakistan, was made in 1960. However, the efforts failed to yield good results, and the area, being extremely arid, was declared unsuitable for range improvement (GOWP 1970). The senior author surveyed the area and prepared another range management project for the area in 1982. Range improvement techniques were designed keeping in view the local ecological conditions. The results obtained so far are very encouraging. The story of failure and success of range improvements in D. G. Khan is presented here for the benefit of the readers.

Pakistan (Figure 1) is situated between 24° and 37° N latitudes and 61° and 75° E longitudes. The Dera Ghazi Khan (D. G. Khan) district is situated between 28°-25′ and 31°-21′ N latitudes, and 69°-20′ and 70°-51′ east longitudes. Agricultural crops can only be cultivated with canal irrigation on 17% of the area. The remaining 83% is used for grazing by livestock. The summers are hot with temperatures soaring to 45° C, whereas, the winter temperatures are mild and pleasant.

Rangelands of D. G. Khan consist of piedmont plains and Suleman Hills. Total area of state-owed rangelands is 28,200 hectares, distributed in 13 blocks varying in size from 8,313 hectares to 242 hectares. The areas adjoining state rangelands are private or communal lands. A very small portion of the piedmont plains are cultivated by spreading rain water from the nearby Suleman Hills.

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Average annual rainfall is about 80 mm, most of which is received during the months of July and August. Rain is only effective if it falls in storms of more than 10–15 mm and is followed by similar storms at short intervals. The area is undulating in topography. Ridges consist of deep calcareous sandy loam; slopes are also calcareous; but the soil varies from sandy loam to loam. The slope sub-soil has more moisture than the ridges. The flat areas are made up of heavy clayey soils with little sub-soil moisture (Syal and Hameed 1984). Water penetration is more on the ridges and slopes compared to flat areas. The coarser soil structure of the ridges and slopes prevents upward capillary water movement. Therefore, more subsoil water is retained on ridges and slopes than on the flats.

The area has a long history of indiscriminate and promiscuous grazing. Livestock consists of sheep, goats, cattle, and camels. The area is grazed by animals of both the local people and migratory pastoralists from other parts of the country. It is estimated that the range areas are producing only 10–20% of their potential. There has been no scientific study of the vegetation of the area.

Past, Present, and Future Management

Past

Range management, as a scientific discipline, was introduced in Pakistan in 1954 with the establishment of a pilot research and demonstration project at Maslakh, near Quetta, with USAID assistance. The deteriorating vegetation quickly recovered as a result of fencing and controlled grazing. In turn, rate of lamb mortality among the sheep decreased, and rates of weight gains and wool production increased (Rafi 1965). After this successful experience, similar projects were initiated in different ecological regions of the country. One

Fig. 1. *Map of Pakistan*

such project was established in Rakh Choti Dalana, near D. G. Khan, in the year 1960. The project was aimed at fencing, reseeding, planting of fodder shrubs and trees, water spreading, establishing salting points, and providing better breeds of rams and bulls. The project was closed in 1969 because it was inferred that the project failed to achieve its objectives (GOWP 1970).

One of the major causes for the failure of the range project was that pastoralists were neither involved in the planning stage nor in the implementation of the project. They were unhappy to see large fenced areas where they could not graze their livestock. Fencing of additional blocks each year, without opening reseeded areas to grazing, meant constant reduction in areas where their animals could graze. They felt the project was usurping their privileges rather than helping. When units were opened to grazing, pastoralists wanted to take maximum advantage because they feared that soon those would be closed again. This resulted in overgrazing. Project staff and pastoralists always remained fearful of each other's designs and never developed a harmonious interaction.

Introduction of scientific grazing, if not impossible, is at least difficult among pastoralists whose livestock either roam freely on these lands or who have herded livestock at will for generations. Therefore, all short-term efforts to enforce controlled grazing have failed, which led to the firm belief among administrators and planners that rangelands in Pakistan could be scientifically managed. Another major reason for the failure of the range management project was the attitude of the project staff. The project staff was drawn from the mainstream forestry service. Forest service personnel do not willingly accept range management assignments because of the arduous nature of the job. They have no training or experience in dealing with the public. They are mainly trained to manage government forests on lands where there is little or no public interaction. How can such unwilling people carry out the task of winning cooperation of pastoralists, which requires a missionary zeal?

Present

D. G. Khan is one of the relatively underdeveloped areas of Pakistan. In the early 1980s, the government of Pakistan gave a high priority to development of underdeveloped areas and invited project proposals. The senior author, in 1981, had recently returned from the United States and was working as Deputy Secretary of Planning in the provincial Forestry Department of the Punjab Province. He conducted a reconnaissance survey of the D. G. Khan area and submitted a preliminary proposal for the development of rangelands. The proposal was provisionally approved in principle. However, in view of the past failure, funds were initially allocated for an experimental project. The experiment proved a big success and the project is now fully operational. The salient features of the project and some results are discussed here.

Rangeland development started in the area in April, 1983. The first phase of the project envisaged reseeding, planting of fodder shrubs and trees, and a detailed survey of state-owned rangelands for formulating a comprehensive inte-

The authors (left: Raja Attaullah Khan, and right: Javed Ahmed) evaluating the success of reseeding trials.

grated action plan. The experimental project was inspected by the Governor's Inspection Team in January, 1984. Excerpts from the report of the team are reproduced:

> "The Pilot Project ... is considered successful and the scheme may now be expanded as originally proposed.... Wide publicity should be given to the Pilot Project... and on-site workshops should be arranged at least twice a year so that the locals could be shown the Forest Department's achievements.... T.V., radio, and local magazines should be made use of for the publicity of such schemes."

The Director General of the Agency for Barani (Arid) Areas Development also visited the project in December, 1983. Excerpts from his report are reproduced:

> "The project is presently in the embryonic state but the likelihood of its success, given determined pursuits (as is the case now), are reasonably bright...."

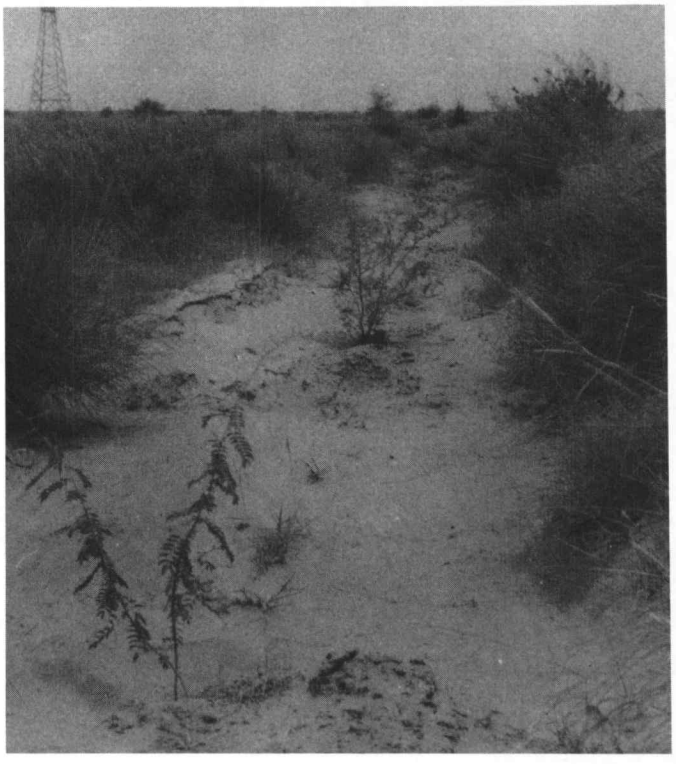
He revisited the project in May, 1984, and recorded the following in his report:

> "Although it did not rain since September last, the grass is surprisingly sustaining itself well... and I feel inspired. My impression is that its take-off will be a little slower and expensive, but once it sets off, the shape of the landscape hitherto barren will change. It is undoubtedly an excellent job in competent hands."

The Inspector General of Forests also visited the project and noted:

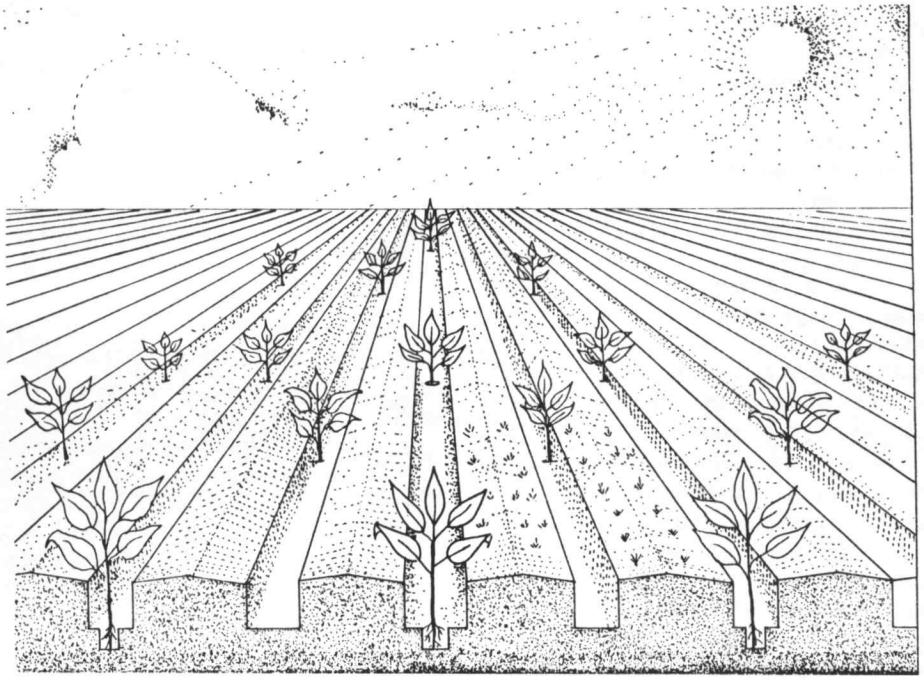
> "It was a wise decision to create Range Management Division in April, 1983.... The start made is most encouraging and the officers concerned are to be complimented for taking pains to start the work thoughtfully and wisely.... The project would be a very fine demonstration area if the work is carried out with the same enthusiasm and interest as is being shown by the team of officers working at present."

The success of rangelands development in an extremely arid area, where a previous project failed, lies in carefully selected prescriptions, keeping in view the local ecological conditions, and avoiding some of the mistakes committed in the project that failed. Reseeding under the previous project



Planting of fodder trees and shrubs under arid conditions.

was carried out by clearing native vegetation over large areas, disc plowing the land, and sowing *Cenchrus ciliaris* seeds. *Cenchrus ciliaris* was selected for reseeding because it was an excellent forage. However, no information was available on its response to grazing. Strong dry winds, prior to the rainy season, resulted in accelerated soil erosion. Loss of top soil and blowing away of some of the seed resulted in



A sketch showing afforestation technique.

poor crop. Once the reseeded areas were opened to grazing, it was observed that plants were very sensitive to grazing under extreme arid conditions. Therefore, the few plants that managed to establish initially, disappeared later under grazing pressure.

Reseeding under the current project is done in 30m-wide strips of land alternating with 30m-wide strips of undisturbed native vegetation laid across the prevalent wind direction to act as a wind breaker. The area to be reseeded was disc-plowed to invert the soil, followed by a harrowing which pulverizes the soil and, hence, increases the water infiltration. *Lasiorus hirsutus*, a good forage grass, is drought resistant and tolerates heavy grazing. Therefore, a mixed crop of *Lasiorus hirsutus* and *Cenchrus ciliaris* would be a good long-term strategy to spread the risk. If *Cenchrus ciliaris* decreases under adverse climatic or biotic conditions, at least *Lasiorus hirsutus* would be able to hold the ground. Grass seeds (*Lasiorus hirsutus* 70%: *Cenchrus ciliaris* 30%) are sown broadcast and covered with a thin layer of soil by dragging brushwood immediately prior to the rainy season.

Torrential summer rainfalls result in local run-off. This run-off from outside the reseeded areas is channeled to reseeded areas. In addition, the strips of native vegetation also act as small watersheds. Run-off water from the strips of native vegetation makes additional water available for the establishment of reseeded grass. These water-harvesting techniques redistribute the water from meager precipitation and have proved very valuable in ensuring success of reseeding operations. A preliminary sampling was done in the summer of 1986 to compare forage production from native range to the reseeded areas. The average grass biomass in native vegetation was 216 kg/ha. The reseeded areas, which were not irrigated by run-off water, produced 2,072 kg/ha air-dry forage. Reseeded areas, irrigated by water spreading, produced over 4,480 kg/ha of air-dry grass forage. Well-established grass plants on the clay flats, however, completely died by the onset of summer rains in the second year. This can be attributed to poor water infiltration in the clay flats, heavy evaporation losses from upward capillary movement of water, and strong water-holding capacity of clay soils.

Fodder trees are a valuable source of protein and vitamin supplement for animals in winter when the feed consists mainly of dried grasses. Trees also provide much needed shade during hot summer months. Therefore, growing of fodder trees and shrubs was also attempted in the area. Saplings of xerophytic species such as *Prosopis spicigera, Zizyphus jujuba, Tecoma undulata,* and *Tamarix articulata* were raised in nurseries and transplanted in the field. These species form part of the potential climax vegetation of the area. Although the success of afforestation was only 10–25%, the results are not discouraging for an extremely arid area.

The afforestation technique consisted of trenches (0.5m × 0.5m) with pits (0.25m in diameter and .30m deep) dug 2m apart in the trenches. The distance between trenches was 2m. The excavated dirt was stocked between the trenches such that it sloped towards the trenches on either side. Transplanting of saplings was synchronized with monsoon rains. Grass seed was also sown broadcast in the strips between the trenches. Rain water from the strip collects in the trenches and the pits and is stored in the soil profile below the pits. The initial sapling establishment was 80–90%. Maximum mortality occurred in the second year in the dry period preceding the rains.

Apprehensive of herders getting out of control and the consequences of overgrazing, the project leader (junior author) decided not to allow grazing in the reseeded areas. Instead, he encouraged people to manually harvest the grass and stall-feed the animals. Nominal fees are charged on the basis of a head load or donkey load of grass. Production of grass from reseeded areas was much more than local herders could harvest. Therefore, it was decided to introduce the grass in a nearby city market. For this purpose, harvested grass was transported to the city and distributed free of cost to forage/fodder vendors.

Future

The concept of range management is new in many developing countries, and has been imported, long with expatriate experts, as part of projects funded by developed countries. However, expatriate experts usually have little or no knowledge of the local socio-economic conditions and ecology. Expatriate-led projects generally have emphasized fencing, reseeding and introduction of exotic plants, and improvement of livestock breeds. These projects are easy to implement and have highly visible demonstration value. It is a good short-term investment, although, on a long-term basis, the models of range management from more advanced countries have not worked under local conditions. The frustration has increased with passage of time, and many experts are now of the opinion that range management cannot be successful in developing countries (personal communications).

In view of the importance of rangelands in the national economy, modest rangelands development projects have been in operation in Pakistan in spite of the failure of the initial projects. However, the emphasis has always been on fencing, reseeding, and water development. Reseeded areas look no different from those not seeded in 2–3 years because of the improper choice of species and uncontrolled grazing. Large areas have now been reseeded many times over.

There is no reason for large-scale expensive rangeland development if the real benefits are not going to be exploited or, after a couple of years, the reseeded areas become worse than even native vegetation under uncontrolled heavy grazing. The first and foremost prerequisite is that administrators and planners must change their notion that proper management of grazing lands is not possible in Pakistan. They must realize that pastoralists and their livestock are an integral part of the natural ecosystems in the area. However, rapid agricultural development in the recent past led to shrinking of pastoral lands which resulted in overgrazing. Continuous reduction of pastoral areas is the single most important cause of continuous deterioration of grazing grounds.

The second requirement is to have a group of land managers who can communicate with pastoralists and work with them. Pastoralists are rational people, and once they see the advantages of a practice, there is no reason why they would not cooperate with the land managers. Initially, they may have to be given some incentives, but these may be withdrawn gradually.

Efforts should be made not to replicate grazing models from developed countries. Each pastoral situation is unique,

and only development of appropriate local technology can solve the problems.

Because of setbacks which range management has received in pastoral situations, many donor agencies are now reluctant to invest in range management projects in developing countries. Grazing lands are there, and animals have grazed on these lands and would continue to do so whether range management programs succeed or fail. There is a need to develop a rangeland anthropology and sociology course in the range schools for those interested in international work and for the international students. Programs fail simply because prescriptions are made without a proper diagnostic analysis of the problem.

Most people think of range management the way they read about it in text books or have seen it in the developed countries. Therefore, there appears to be a need for an appropriate term which portrays the grazing situations in developing countries. This will lay a foundation for research and development in a new direction: pastoralism, nomadism, transhumance, or mixed farming systems. It is suggested that development and management of rangelands in developing countries be called Pastoral Systems Management.

Literature Cited

GOWP. 1970. Report of the working group on range management. Government of West Pakistan Planning and Development Department (Project Wing), Lahore, Pakistan. 42 p.

Rafi, M.M. 1965. Maslakh range project, Quetta, West Pakistan (a review of its first ten years). Pak. J. Forest. 15:319-338.

Syal, M.N., and A. Hameed. 1984. Soil potential assessment in relation to plant production in forest areas of D. G. Khan Forest Division. Soil Survey of Pakistan.

Viewpoint: Comments on the Proposed Use of Native Insects for Biological Control of Snakeweeds

J.P. Cuda

As a scientist currently involved in research on the biological control of weeds on rangelands. I would like to comment on the conclusions and recommendations of an article published in the April 1987 issue of *Rangelands* entitled "The Potential of Two Insects for Controlling Broom Snakeweed" (Gonzales 1987). Although I agree with the author that biological control would be an appropriate method for controlling broom snakeweed, *Gutierrezia sarothrae* (Pursh) Britt. & Rusby, I question the feasibility of the augmentation approach recommended by the author and also his assessment of one of the insects purported to be an important natural enemy of broom snakeweed.

I would also like to point out that a project on the biological control of snakeweed is already in progress at Temple, Texas. The program was developed in 1975 by Dr. C. Jack DeLoach, who is affiliated with the USDA, Agricultural Research Service (ARS). Dr. DeLoach is one of a small group of federal and university scientists working full- or part-time on biological control of weeds at several locations across the United States.

For the purpose of this discussion, biological control of weeds is defined as the use of insects, plant pathogens, or other organisms to control weeds (Huffaker 1959). It must be emphasized that "control" is not synonymous with "eradication"; the weed species controlled biologically is simply reduced to a level such that it is no longer considered economically important. Also, because this method of control is species specific, its effects are not detrimental to non-target species or to the environment.

The use of biological control on rangelands has been examined in detail by DeLoach (1978, 1981) and DeLoach et al. (1986). The two approaches of biological control that are currently available are (A) introduction of foreign organisms not already present (classical biological control), and (B) augmentation of the effectiveness of organisms already present in an area. The key issue here concerns the selection of the biological control method that is *appropriate* for use in a low-value per acre agricultural system such as rangelands where snakeweeds (perennials) and broomweeds (annuals) are important weeds. DeLoach (1981) states that "biological control is ideally suited to control rangeland weeds and brush of which the major pests are perennials growing in a relatively undisturbed habitat and in areas where the low economic return per unit area makes chemical and mechanical controls relatively expensive." He further states that the introduction of foreign control agents is more suitable than augmentation for use on rangelands because of its lower cost. DeLoach et al. (1986) recently compared the relative cost of biological control by augmentation and introduction. They clearly showed that the augmentation approach would be too expensive in a rangeland system because the cost for an augmentation program is proportional to the area treated. In this regard, the total cost and cost per acre is basically similar to control with herbicides. In contrast, the total cost of biological control by the introduction method is independent of the area treated and the cost per acre actually decreases over time as the introduced agents reproduce and

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