Environmental Change in Drylands

Biogeographical and Geomorphological Perspectives

Edited by
Andrew C. Millington
Department of Geography
University of Leicester, UK

and

Ken Pye
Post Graduate Institute for Sedimentology
University of Reading, UK

JOHN WILEY & SONS
Chichester · New York · Brisbane · Toronto · Singapore

1994

22 Facing Environmental Degradation in the Aravalli Hills, India

C. A. SCOTT
Catholic Relief Services, Tegucigalpa, Honduras

ABSTRACT

Environmental change in the Aravalli Hills of north-western India was investigated by examining the agroecology of the region. Because of their location on the eastern fringe of the Thar Desert, the Aravallis play a crucial role in impeding desertification. Although the climate in the Aravallis, particularly the onset of the monsoon, is variable, there has been no appreciable long-term decline in rainfall. The mix of vegetative species as well as hydrological processes, however, have changed as a result of land use.

The interrelations between resource use and environmental degradation are explored in the context of Dolpura, an *adivasi* (tribal) village in Udaipur District, Rajasthan. In this community, a promising environmental programme based on reforestation and the strengthening of traditional soil and water conservation techniques has been developed by Seva Mandir, a local non-governmental organisation.

INTRODUCTION

The Aravalli Hills (Figure 22.1) separate two very different agroecological zones: the Thar Desert to the west and the sub-humid to humid Gangetic and Malwa plains to the east. The importance of the Aravallis in impeding desertification can perhaps best be appreciated by considering the expanse of arid lands to the west. Southern Pakistan, Iran, the Persian Gulf region, the Arabian Peninsula and north Africa form an extensive dryland area, bisected only by the Indus, Tigris–Euphrates and Nile valleys. With elevations ranging from 300 m to just over 1100 m a.s.l, the Aravallis form not so much a physical, orographic barrier to the spread of the western desert, as an agroecological buffer between these two distinct climatic zones.

While an exhaustive analysis of desertification and environmental change in the region is neither the purpose, nor is within the scope, of this paper, it must be emphasised that the rapid biophysical (and social) transformations under way in the Aravalli Hills have implications for a geographical area beyond the hills themselves. The intent of presenting an agroecological profile of the Aravallis is rather to set the context for a more detailed investigation of specific responses to environmental change in one community in the southern Aravallis.

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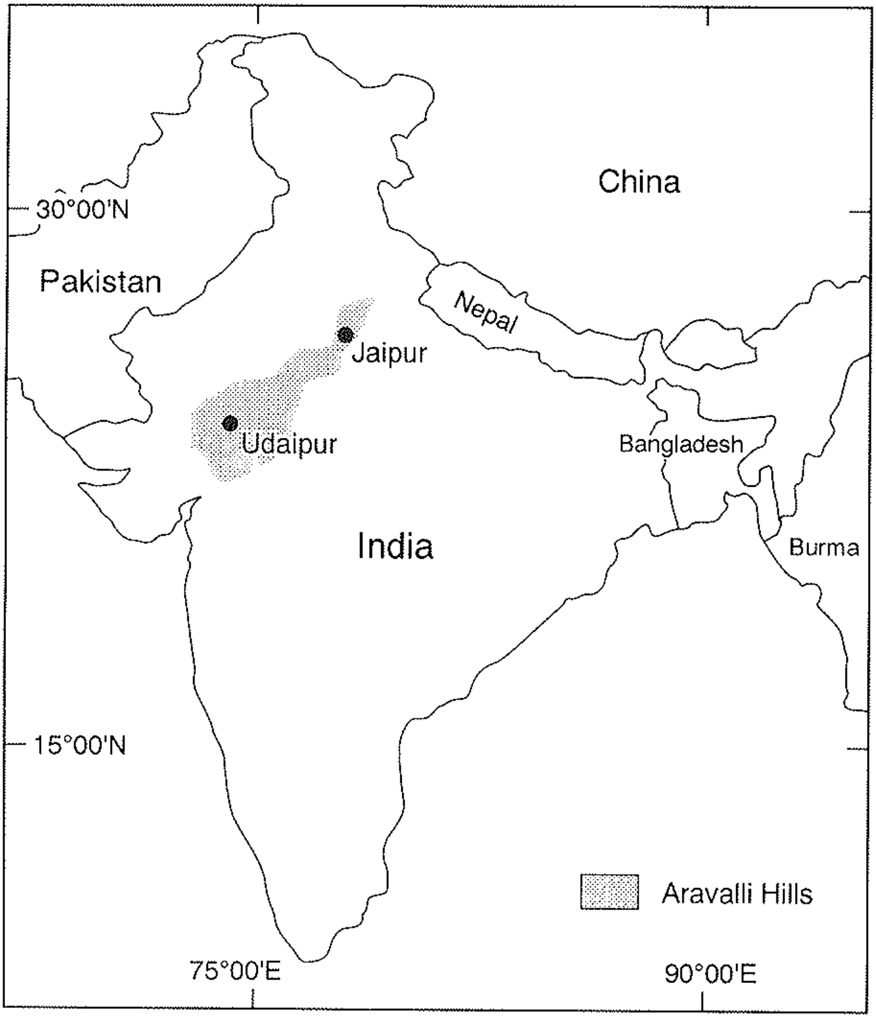


Figure 22.1 Location of the Aravalli Hills

BACKGROUND: A REGIONAL AGROECOLOGY

The Aravalli Hills extend over 1000 km in the north-west Indian states of Gujarat, Rajasthan and Haryana, and form the watershed divide between the Ganges and Indus basins. Surface discharge is intermittent in all but the most major rivers. The Luni River is the principal western drainage of the Aravallis, emptying into the Rann of Kutch, an estuary bordering the Arabian Sea. The Mahi and Sabarmati Rivers rise in the southern Aravallis and flow south to the Gulf of Khambat, while the Banas River drains the northern hills and eventually flows into the Ganges. The hills are severely eroded, and extensive quarrying for marble and limestone as well as ore extraction and refining operations have produced mining spoils, which, although limited in geographical extent, contribute to erosion and groundwater contamination.

In Rajasthan the average annual precipitation (P_{ann}) measured at recording stations to the east of the Aravallis is far greater than at stations to the west. For example, the 1009 mm recorded at Chittorgarh exceeds by 2.5 times that at Pali (411 mm), although the two are separated by only 160 km across the central Aravallis. Clearly the Aravalli Hills have an impact on the regional distribution of rainfall (IMD, 1988; Dhabriya, 1988b). Within the Aravallis, annual rainfall is relatively consistent, ranging from 520 mm at Ajmer to 780 mm at Kotra (IMD, 1988). However, intra-annual variability of rainfall at various stations in the region is pronounced (Dhabriya, 1988b) and will be discussed subsequently.

Prevailing climatic conditions in the region result in differences in agroecological capability. To the west where P_{ann} is less than 500 mm, land use is extensive with heavy reliance on livestock, particularly sheep, goats and camels. Here, cropping is restricted to sorghum and pearl millet in the monsoon *kharif* cropping season; unirrigated *kharif* yields are on the order of 200 kg ha^{-1} (Qureshi, 1989). In the *kharif* cropping season, seed is sown after the first monsoon rains in June. Crop growth is largely dependent on intermittent rainfall through October, with the harvest taking place in November. In the *rabi* cropping season, sowing takes place in November or December, with crop growth entirely dependent on residual soil moisture. Depending on the crop, the *rabi* harvest takes place in February or March. In the Aravalli Hills (P_{ann} of 500–800 mm), as further to the east, livestock are primarily buffaloes and cows. The soil moisture regime in the Aravallis allows cropping in two seasons: in *kharif*, maize, gram, dry paddy, sugar cane and fodder are cultivated; and in *rabi*, wheat, mustard, sesame and vegetables (the latter under irrigation).

It is estimated that only 20% of Rajasthan state's western (arid) region is suited to rainfed cropping; however, 30% was being cropped in 1951 and 60% in 1971 (Dhabriya, 1989). Pasture (usually common lands) and long fallows were the land uses most rapidly converted to agriculture. Jodha (1989) further points out that in western Rajasthan, the area of common lands including community forests has diminished significantly through land reform programmes. In other words, the land base on which the rural poor, particularly the landless, depended for subsistence has passed into the hands of those able to secure land allotments.

The intensification of land use brought about in part by human and livestock population growth is a matter of some concern here. For Rajasthan as a whole, the increase in human population in the 1901–81 period was 285% (Dhabriya, 1988a). Livestock population increased in a similar manner. Given the necessary heavy reliance on livestock in arid regions, it is not surprising to note that in 1981 the herd population was nearly double the human population. Livestock are increasingly pastured in forest areas, a process that has contributed to a dramatic change in the mix of vegetative species.

Natural vegetation in the Aravalli Hills may be characterised as sub-tropical, dry deciduous forest with an extensive range dominated by bunch grasses, typically *Heteropogon contortus*. Although somewhat arid for *sal* (*Shorea robusta*), the southern Aravallis borders on regions in Madhya Pradesh state with extensive *sal* forests. The climax forest species in the southern Aravallis are teak (*Tectona grandis*) and bamboo (*Dendrocalmus strictus*). Extensive barren lands are increasingly evident throughout the Aravalli Hills. In place of local species, numerous exotic species have been introduced on a widespread basis, particularly *Eucalyptus* spp. and mesquite (*Prosopis juliflora*). The latter grows as a hardy shrub and has colonised extensive tracts. According to local informants, the prevalence of the cactus-like *thur* (*Euphorbia* spp.) has increased significantly in the last decade.

Much pressure has been placed on the region's forest resources through increased commercial demand for timber, fuelwood and 'minor' forest produce, including leaves for the manufacture of such items as *bidis* (hand-rolled cigarettes) and disposable plates and bowls. The forest department's practice of exploiting resources through private contracting has resulted in the virtual elimination of teak from Aravalli forests.

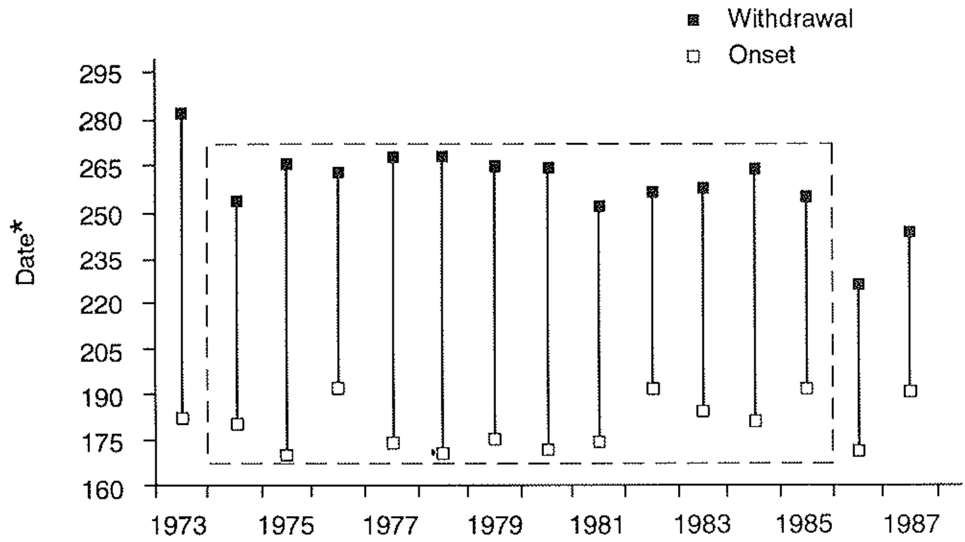
The total forest area in the Aravalli Hills decreased by 42% from 1972 to 1984 (Dhabriya, 1988b). More seriously, according to the same researcher (Dhabriya, 1988a), who has interpreted recent satellite imagery, a series of twelve gaps, or corridors, has formed in the northeastern Aravallis. The gaps are dry valleys, 1–3 km in width, in which vegetative and soil moisture conditions increasingly resemble those in the arid west. There is evidence of 'desert encroachment' on to the sub-humid plains of Rajastan through the twelve corridors; sand dune formation and the increased incidence of dust storms have been detected to the east of the hills (Dhabriya, 1988a). The loss of forest cover and change in the vegetative mix in the Aravallis jeopardises their ability to impede the eastward advance of the desert. The loss of forest canopy on the high ridges may result in differential pre-monsoon heating and increased albedo. Variability in the onset of the monsoon is affected by the non-uniform solar radiation flux that results. It has been suggested that '. . .the effectiveness of the Aravalli Hills as a source of structural control for normal weather and climate can be revived by restoring its ecological status mainly by reforesting its barren peaks, slopes and foothills' (Dhabriya, 1988b).

THE CLIMATE DEBATE

The significance of climatic change in the Aravalli region is the subject of some controversy (for general discussions, see Gupta, 1989, and Meher-Homji, 1989). Dhabriya (1988b) quotes Irrigation Department sources which purport to show that P_{ann} in Jaipur (in north-central Rajasthan on the western fringe of the Aravalli Hills) has decreased 1% and monsoon rainfall 2% over the 1901–85 period. Furthermore, the duration of the monsoon rainy season is said to have decreased from 101 days to 55 days over the 1973–87 period (Figure 22.2). Additional data for the 1961–85 period are presented which indicate that twelve Rajasthan districts receive less than average annual rainfall and fourteen receive less than average monsoon rainfall. While the twelve districts that receive less than average annual rainfall are said to cover two-thirds of the land area of the state, eight are western (arid) districts with a low density of rainfall stations. As Rajasthan has a total of 27 districts, fifteen presumably had an increase (or no change) in average annual rainfall, while thirteen had an increase (or no change) in average monsoon rainfall.

From the data presented in Figure 22.2, it is evident that the 1973 monsoon withdrawal and onset were somewhat later than usual. Additionally, 1986 and 1987 were years of uncommonly short monsoon duration, and 1987 has been unequivocally recognised as a severe drought year in the region. Thus if the data from 1974–85 are assessed (see inset in dotted lines in Figure 22.2), the decline in monsoon duration is not so apparent.

Even within this shorter 12-year data set, however, it seems evident that variability in the onset of the monsoon persists. Thus, the data do not convincingly show that average annual rainfall in Rajasthan is declining. As Meher-Homji (1989) states, there is 'no declining tendency in precipitation of the arid zone of Rajasthan, bereft of forest growth'. While Meher-Homji's analysis does not cover Rajasthan's sub-humid zone (with more vegetative



*Date is indicated in number of days past 1 January: 10 June = 160, 18 October = 290.
Refer to text for comments regarding inset in dotted lines.

Figure 22.2 Onset and withdrawal of the Monsoon, Jaipur, 1973–87

cover), it does assess climatic data from other regions in India with high rates of forest loss. Meher-Homji suggests that forest clearance increases albedo (reflected solar radiation) and alters the atmospheric energy flux. In this manner, forest loss can be linked not to a secular decline in total rainfall, but to variability in its seasonal distribution.

THE COMPLEX HYDROLOGY OF THE ARAVALLI WATERSHEDS

While the data do not indicate a decline in annual rainfall, hydrological processes, particularly soil moisture available for biomass production, are changing in response to land-use practices. The hydrology of the Aravalli Hills' principal western drainage, the Luni River, has been studied extensively in the aftermath of devastating floods in 1979 when 5-day rainfall values exceeded two times P_{ann} (CAZRI, 1982). Stream hydrographs with a very sharply rising discharge, an abrupt peak, a rapid initial decline, followed by a slowly tapering discharge, resulted from rainfall of unprecedented intensity occurring over a 5-day period. However, the ratios of runoff to total rainfall were as important to the nature of the flood event as was rainfall intensity; at numerous gauging stations measuring large drainage areas, runoff ratios exceeded 50%. Agricultural land with no crop cover and barren, sloping pastures were major contributors to the generation of runoff.

To convey some idea of the extreme variability of surface runoff in watersheds in the southern Aravallis, it may be noted that flow in the Wagwara Nala in Udaipur District, which was measured by the author, is minimal from September to May (on the order of 2–10 l s^{-1}, or 0.002–0.01 m^3 s^{-1}). Hydrological data for the 95 km^2 catchment area of the

Wagwara Nala, however, indicate that the 25-year maximum discharge may be as high as 400 $m^3 s^{-1}$. A major flood in June 1988 on the Wagwara Nala (not exceeded since 1973 according to local residents) had an estimated discharge of 200 $m^3 s^{-1}$ based on Manning's equation. After three deficient monsoons, the flood of 1988 deposited 30 cm of sediment in a reservoir under construction.

Groundwater potential in the Aravallis is considerable. In the southern hills, shallow aquifers are 5–20 m below the ground surface, allowing relatively simple, low-cost irrigation techniques. Traditional lift technologies include the *rahat* or Persian wheel (Figure 22.3) and *chadas* (skin bags or metal buckets raised by oxen). Diesel, centrifugal pumps can draw down water levels quickly.

The fractured substrate throughout much of the Aravallis is composed of phyllite, schist and quartzite, and is highly permeable (Scott, 1988). The Aravallis' hydrogeology has important implications for surface water resources development. The small reservoir shown in Figure 22.4, for example, has such a fractured bed that the entire impounded volume infiltrates within four to six weeks after the withdrawal of the monsoon.

LAND USE AND DEGRADATION IN DOLPURA VILLAGE, UDAIPUR DISTRICT

The intensification of subsistence resource-use practices in the southern Aravalli Hills has contributed to environmental degradation. With the loss of vegetative cover and the increase in area dedicated to agriculture and grazing, sloping lands are increasingly subject to erosion.

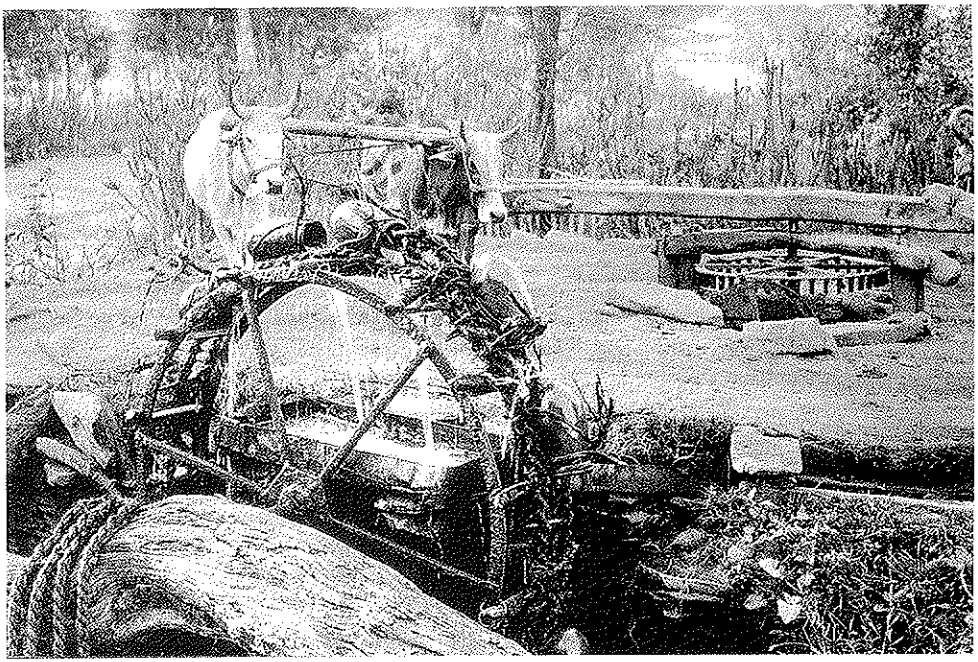


Figure 22.3 A *rahat* or Persian wheel in operation

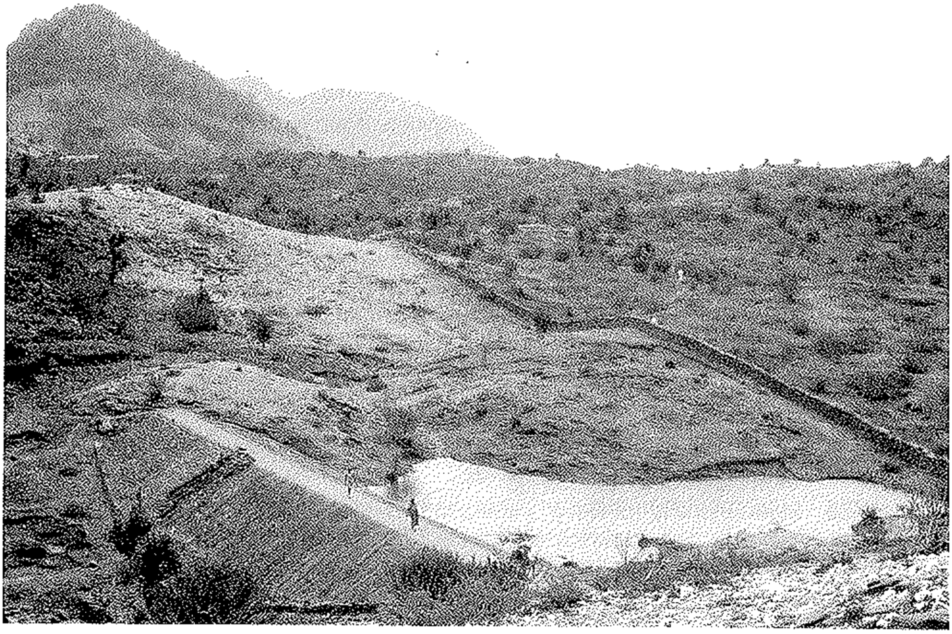


Figure 22.4 A reservoir catching runoff from a small watershed in the Aravalli Hills

Changing surface and sub-surface hydrological processes (increased runoff and decreased infiltration) result in soil moisture conditions adverse to traditional cropping strategies. Residents have adopted more risk averse behaviour, including crop diversification, increased reliance on livestock and rural–urban migration. To investigate the interrelations among resource use and environmental change in the Aravallis in more specific terms, land-use and climatic data available for Udaipur District, Rajasthan, are analysed, while observations on local practices in Dolpura village are presented.

For the period 1931–1980, the P_{ann} in Udaipur District was 638 mm (Sharma, 1987), while annual potential evapotranspiration at 1373 mm exceeds rainfall by a factor of 2.2. As seen in Figure 22.5, an intense seasonal drought occurs in April and May. The seasonal distribution of rainfall and potential evapotranspiration is critical for rainfed agriculture as only 28% of the district's cultivable land is irrigated (Seva Mandir, 1989). As the onset of the monsoon is variable, farmers in Dolpura do not sow all of their *kharif* crops at once, but rather stagger sowing to ensure that only part will be lost if the rains fail. All available fertile land is cropped, a practice that accelerates sheet erosion. The remaining land is used as pasture, with the prevalence of free grazing in the pre-monsoon season leading to soil compaction and subsequent increase in runoff as well as rill and gully erosion.

In 1981, 51% of Udaipur District's area (9740 km^2) was comprised of wasteland (1981 Census of India figures, quoted in Seva Mandir, 1989). Given that much wasteland is privately owned, government reforestation programmes have had little appreciable effect on limiting the expansion of wastelands or on converting them to productive uses, e.g. fodder production. Because resource use on government lands is not regulated, there is little conservation of resources on the part of local residents.

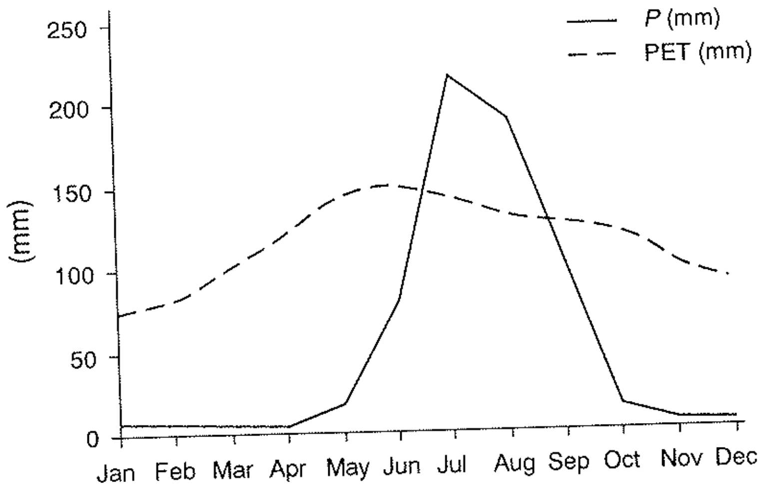


Figure 22.5 Mean monthly rainfall (*P*) and potential evapotranspiration (PET), Udaipur

At the 1981 population of 2 357 000, Udaipur District's population density averaged 123 persons km^{-2}, with a density on cropped land of 7 persons ha^{-1} (1981 Census figures, quoted in Seva Mandir, 1989). Udaipur heads the Rajasthan districts in absolute numbers of *adivasi* (tribal) inhabitants. The southern portions of the district, particularly Kherwara and Jhadol *tehsils* (administrative units), are predominantly *adivasi*. In Kherwara Tehsil (where Dolpura is located), over 85% of the population is made up of different *adivasi* groups, including Bhils, Garasias, Meenas and Saharias.

Bhils constitute the entire population of Dolpura village. Comprised predominantly of the Damor clan, Dolpura is steeped in *adivasi* tradition. Vagadi dialect (a variation of Bhili intermixed with Gujarati) is spoken, although schooling and local media (primarily radio) are in Hindi, the official language of Rajasthan. Given its proximity, Gujarat state exerts a powerful cultural and economic influence on the local area. Because Bhils must marry outside the clans of both parents, the women of Dolpura are from distant villages.

Aspects of Bhil social organisation, particularly with respect to land use and ownership, are unique. The settlement pattern in Bhil communities is dispersed. Each household maintains a separate homestead, usually atop a hillock, surrounded by numerous plots of cultivated and pasture land. The equitability of landholding is particularly exceptional. While a nearby caste Hindu village, Kalyanpur, is characterised by skewed land concentration with pervasive tenancy, Dolpura has no landlessness. Each household maintains more than one separate parcel of land. In the traditional Bhil practice of land inheritance, every individual plot must be subdivided among a father's sons. For example, a household with five plots and five sons will divide each plot by five instead of giving each son one plot. Although this practice leads to fragmentation of holdings which are difficult to till, it is equitable in its distribution of risk, as each of the five plots possesses a different production potential.

Agriculture, livestock, minor forest produce use and migration are the principal survival strategies in Dolpura. Each has an effect on environmental change. Agriculture in Dolpura is largely subsistence-oriented. Due to the seasonality of male migration, women are the primary agricultural labourers in Dolpura. Labour mobilisation is most difficult during early monsoon land preparation, which coincides with the lean season of food shortage. What dung is not burned as fuel is used to fertilise fields. The use of nitrogen fertiliser is restricted to high-yielding varieties cultivated on irrigated land. Farmers rightly do not use fertiliser on rainfed land as they feel that such fertiliser 'burns' their crops in the absence of water to 'cool' the roots. Nutrient depletion of local soils is severe. Dolpura is not on a paved road, and is distant from markets; nonetheless, there is interest in growing onions, garlic and turmeric for market. However, irrigated landholdings are small (averaging less than 1 *bigha*, or 0.2 ha, per household). Rainfed farming is practised on both levelled land and sloping parcels better suited to other uses. Considerable erosion is generated by unsustainable farming and grazing on sloping lands.

Livestock consist primarily of goats, cows and buffaloes. Intensive pasture management is not prevalent, and bears significant potential for improvement, particularly fodder development. Common pasture (*charnot*), pooled private holdings (*chak*) and land owned by the forest department (though not necessarily forested) are the principal lands on which livestock are grazed. A number of local tree species which coppice well, particularly *neem* (*Azadirachta indica*) and *dhak* (*Anogeissus* spp.), are used as fodder sources in the pre-monsoon season. Because herders from Rajasthan's western districts move through Dolpura twice annually with their goats and sheep which graze unrestricted on all unfenced vegetation, local residents are compelled to graze their livestock in a similar manner or to lose it all.

In 1984, Udaipur District, centred in the southern Aravallis, accounted for 39% (or 2415 km^2) of Rajasthan's forest area. Prior to the nationalization of forests in 1947, forest cover in the Aravallis surrounding Udaipur was thick and supported a large wildlife population (Jagat S. Mehta, President of Seva Mandir, personal communication). In more recent times, forest cover and biodiversity have declined by all accounts. Historically, forests provided *adivasis* with a wide range of resources, including food, medicinal herbs, timber, fuel, fodder and fibre. With the nationalisation of forests and the post-independence emphasis on the institution of private contracting for resource extraction, local forest management practices have been neglected. At present, the decline in biodiversity resulting from deteriorating forest conditions has meant that *adivasis* are increasingly dependent on agriculture. Due to the virtual total lack of fuelwood in Dolpura, women are compelled to dry and burn *thur* (*Euphorbia* spp.), despite the harsh smoke it creates. According to local informants, this species was previously only used as a live fence.

With regard to rural–urban migration, it should be emphasised that men seasonally leave Dolpura in search of wage labour, usually in Gujarat. For four months during the intense pre-monsoon 1988 drought, few men in the age range of 16–45 remained in Dolpura. Men try to return for the planting season, unless they secure permanent, remunerative employment. In effect, migration mitigates pressure on resources in two ways: (i) migrants do not consume local resources while they are away and (ii) cash remittances allow for the purchase of some resources (notably kerosene and timber).

RESPONDING TO ENVIRONMENTAL DEGRADATION

While the subsistence resource-use practices in Dolpura contribute to declining forest cover and to soil loss, they can also serve as an effective means to rehabilitate resources. This section describes such local responses to changing environmental conditions in the Aravalli Hills.

In 1982, an Udaipur-based non-governmental organisation (NGO) (Seva Mandir) began working on watershed resource management in rural areas of the district. The primary vehicle was an adult literacy movement organised by Seva Mandir. Funding for community forestry, soil and water conservation, lift irrigation and the construction of a community centre in Dolpura was raised through domestic (Action for Food Production, or AFPRO) and international (Swiss Development Cooperation, SDC) sources and through community-wide *shramdan* (voluntary labour). While the programme objectives were straightforward, i.e. to enhance natural resource capability and local management, particularly of underused upslope land, the dynamics of implementation have been intricate. Programme outcomes have been mixed.

A reservoir was constructed on the Wagwara Nala which runs through the village. This served not only as the source for a lift irrigation scheme but also raised water levels in numerous wells scattered throughout the village. The village provided 25% of the labour costs of reservoir construction through *shramdan* and has a viable community organisation which directs soil and water conservation and reforestation activities.

Based on local practices for runoff control and soil moisture enhancement called *medbundi*, Seva Mandir promoted conservation measures that were initially implemented on individuals' agricultural holdings. As a support for agriculture, *medbundi* detains runoff and organic matter in the field. Ponded water increases the soil moisture necessary for seed germination. The water requirements of different crops are met through elaborate detention and drainage processes during the early monsoon (Scott, 1988). Paddy cultivation is possible in certain fields with good bunding and moisture retention (Figure 22.6).

Local ingenuity has devised a range of conservation techniques with significant innovation induced by the diversity of site conditions. For example, where soil depth is poor and stone is abundant, dry stone masonry retaining walls are constructed. Moisture retentive soil with high clay content is wetted and compacted against the upslope surface. Alternately, where soil depth is good, fields are usually bunded with wetted and compacted soil. If structural support is required, the earthen bund may be built with a dry stone masonry core wall (Scott, 1988). As soon as possible, bunch grasses are transplanted in an effort to reinforce the bund. Given that fallowed fields are opened to grazing, the establishment of effective vegetative reinforcement is found to be difficult. For this reason, farmers prefer structural techniques over vegetative conservation measures.

In order to assess Seva Mandir's district-wide programme supporting *medbundi* initiatives, a total of 1580 farmers were surveyed (Seva Mandir, 1987). Among the principal techniques, the highest preference (49%) was found to be for field bunds, both stone and earthen. Boundary walls around private pasture and forest plots were second at 30%. A good indication that conservation work actually benefited farmers and was performed not merely to receive the cash incentive is provided by the fact that 60% of households constructed more than twice the maximum payable volume of conservation structures stipulated by the programme. Considerably less interest was expressed in conventional soil conservation techniques; gully plugging and terracing were implemented by 8 and 4% of households respectively. The latter techniques are costly and have less direct impact on agricultural yields (Scott, 1987), but have been used successfully to enhance soil moisture for fodder production and reforestation on village commons (Figure 22.7).

Efforts at reforestation, particularly of upland areas, was undertaken in earnest by Seva Mandir in 1986. Because initial technical input came from the forest department, the species selected at the outset were primarily rapid-growing exotics, including *Eucalyptus* spp. In

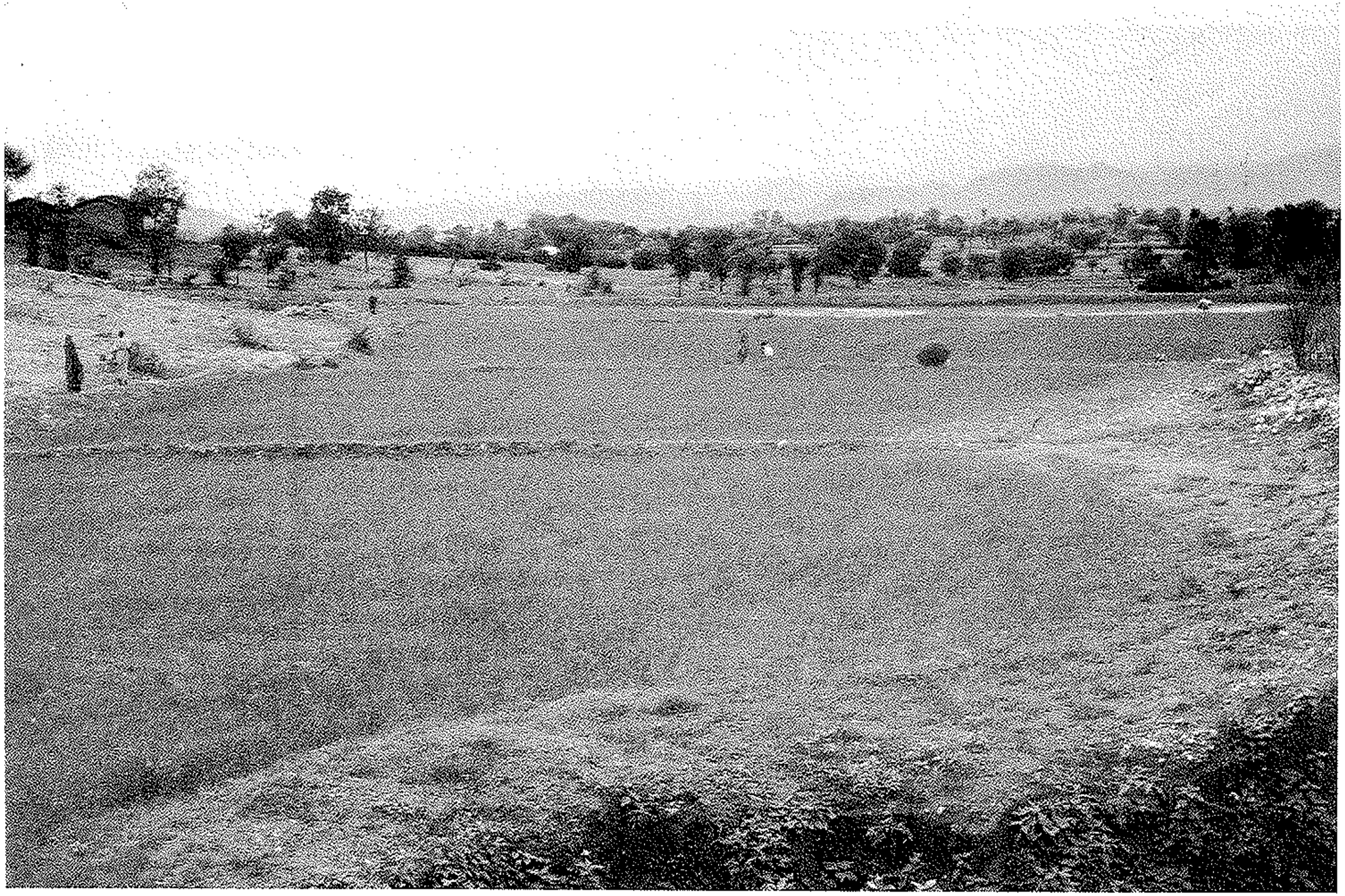


Figure 22.6 Paddy cultivation through *medbundi*

Figure 22.7 Infiltration of impounded runoff behind a gully plug

the first year, one million saplings were planted (Seva Mandir, 1989). Sapling mortality rates at the nursery and once planted were high. Subsequently, popular local species including *neem* (*Azadirachta indica*), *bans* (*Dendrocalmus strictus*) and *vilayati babul* (*Acacia nilotica*) were introduced. Additionally, shallow trenches to harvest runoff from 3 m × 10 m microcatchments were dug upslope from the sapling to provide moisture to the root zone. In 1987, over two million saplings were planted and as many trenches were dug, while in 1988, 2.2 million saplings were planted. Survival rates once planted ranged considerably (from 0 to 80%) depending in part on local conditions and management intensity. Following the disastrous drought period of 1987–8, reforestation efforts were scaled back. In 1989, just 356000 saplings were planted.

According to participants, the greatest benefit of reforestation activities has been the increased availability of fuel and fodder (Seva Mandir, 1989). In addition to meeting local resource needs, the programme has met with some success in re-establishing canopy cover on the Aravallis' ridges, although the survival of saplings in low-lying regions is clearly better than further upslope. Any farmer or conservationist knows, however, that land treatment, like water, proceeds downslope. Whatever transpires uphill will eventually manifest itself further down. Watershed treatment begins at the ridge, protecting meager soil resources. The effective establishment of saplings at the ridge level (Figure 22.8) must be supported by large pits (0.5 m × 0.5 m × 0.5 m) to allow moisture collection in the root zone. In this manner, techniques in moisture conservation aid in the reforestation of ridgelines which are critical in the conservation of watershed resources.

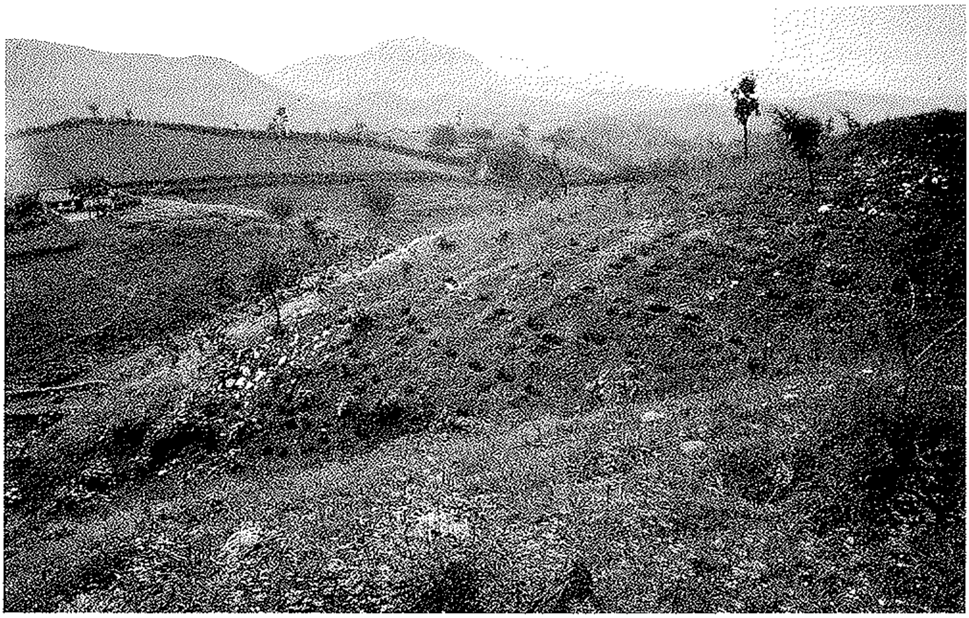


Figure 22.8 Reforestation of hilltops and ridges

CONCLUSIONS

Because the Aravalli Hills form the eastern limit to the Thar Desert, environmental degradation in the hills bears significance for the sub-humid and humid areas to the east. While the onset of the monsoon in the region is variable, average annual precipitation has not declined. Rather, changes in the mix of vegetative species and hydrological processes result from changing land-use practices. According to local informants, commercial forestry and mining have caused a significant loss in forest cover and groundwater contamination. Subsistence resource-use practices have exacerbated environmental degradation. The result of both types of resource-use practices has been an increase in arid-zone vegetation, indicating desertification in the Aravallis. With the loss of vegetative cover in Dolpura, an *adivasi* village in Udaipur District in Rajasthan, traditional agricultural and grazing practices on sloping lands have accelerated erosion. However, traditional soil and water conservation techniques in this community offer significant potential to respond to changing environmental conditions. These have been complemented by reforestation activities introduced by Seva Mandir. The programme is an effective means of meeting subsistence resource needs while protecting the agroecology of the Aravalli Hills.

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