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Population Growth and the Decline of Common Property Resources in Rajasthan, India

N. S. Jodha

Common property resources—community pastures, forests, waste lands—although rare in Western countries today, are still an important form of natural resource endowment in the rural areas of developing countries. Broadly defined, common property resources are those used by an entire community without any exclusive individual ownership or access rights. In the absence of regulatory institutions, rapid population growth may lead to degenerative patterns of use (e.g., overgrazing) and the gradual depletion of common property resources. Indeed, as popularly conceived, depletion of such resources is a straightforward consequence of rapid population growth.¹ Several recent studies have suggested, however, that the impact of rapid population growth on natural resources is not at all straightforward.² These studies indicate that the effects of rapid population growth are mediated by institutional factors and often overshadowed by pressures arising from changing market conditions.

This paper examines the decline of common property resources in the arid zone of Rajasthan in India and the factors underlying the decline. In Rajasthan, the introduction of land reforms in the 1950s disrupted traditional arrangements that protected and regulated the use of common property resources. Commercialization, population pressure, and large-scale adoption of tractors have played important roles in the resource depletion process; but their impact has been greatly magnified by the circumstances created by various provisions of the land reforms program.

The setting

The arid zone of western Rajasthan, part of the great Indian desert, is spread over 202,000 square kilometers and accounts for 62 percent of the tropical arid area of India. The agriculture of the region is characterized by crop- and livestock-based farming. Studies have repeatedly emphasized the comparative

advantage livestock farming enjoys over crop farming in the region, and the region's comparative advantage over other regions in the matter of livestock farming.³ This comparative advantage is the product of two factors: (1) the agro-climatic and land resource base of the arid region, and (2) formal and informal institutional arrangements governing the usage of the natural resource base.

Low and erratic rainfall, highly erodible and infertile sandy soils, and a variety of hardy grasses and bushes make most of the region more suited to pasture-based livestock raising than to sustained arable farming. Livestock, because they are mobile, are less subject to the adverse impact of localized droughts than crops are. This advantage is lost, however, if a farmer's livestock must depend solely on his own forage and water resources. In other words, the mobility-linked advantage of livestock becomes a reality only when they have easy and unrestricted access to spatially differentiated land resources. It is in response to the need for unrestricted mobility of livestock that common property resources or common access resources emerged as the dominant form of resource ownership and usage by village communities in this region, as in many other parts of the world having similar ecological conditions.⁴ In dry areas of Rajasthan, the village-level common property resources that have effectively supported livestock farming since the feudal period include:

- Community grazing lands, including permanent pastures, uncultivable and cultivable wastelands, and fallow lands contributing to the grazing area of the village
- Village forests and woodlands, including *Orans* (forests protected on religious grounds)
- Private croplands available for public grazing after harvest of crops
- Community threshing and waste-dumping grounds
- Community ponds and animal watering points
- Migration routes and facilities
- Community facilities for stock breeding

Methods and data sources

This paper uses evidence from selected villages of Jaisalmer, Jodhpur, and Nagaur districts in Rajasthan for the early 1950s to the early 1980s. The three districts represent three subzones within the arid region in terms of aridity and density of human and livestock populations. Annual rainfall averages 179mm, 264mm, and 310mm in Jaisalmer, Jodhpur, and Nagaur, respectively. The population density (according to the 1971 census) is 4, 50, and 71 persons per square kilometer in Jaisalmer, Jodhpur, and Nagaur, respectively. The number of cattle, sheep, and goats—the key categories of livestock sustained by common property resources in the area—expressed in terms of animal units is 6 per 100 hectares of area and 164 per 100 persons of rural population in Jaisalmer. The corresponding figures for Jodhpur are 41 and 124, and for Nagaur

they are 70 and 111. Mixed farming based on annual cropping and livestock raising is common to all three districts, although the importance of crop farming increases as one moves from areas of lower to higher rainfall.

Most of the data presented were collected during the period 1963–66 when the author worked for the Central Arid Zone Research Institute (CAZRI). An important objective of the field studies was to examine the existing pattern of land resource use and to compare it with the potential pattern emerging from CAZRI's resource conservation and development technologies.⁵ In 1973 and 1978, the author visited the same villages again and documented changes through quick surveys in Nagaur and Jodhpur districts.⁶ In 1983, during a short visit, data were updated on specific issues. Six villages from which data were collected in all four rounds are the principal focus of this paper.

Considering the total size of the arid zone, findings from six villages can only be suggestive. It should be noted, however, that the broad pattern of change, closely observed and documented in the selected villages, was also evident more widely in the areas to which these villages belong.

Decline of common property resources

From the early 1950s to early 1980s, common property resources in the arid zone declined in area and deteriorated in quality.

Grazing lands

Village forests, permanent pastures, uncultivable and cultivable wastelands, and croplands fallowed for longer periods broadly constitute the total grazing area in the villages. This area is supplemented by cropland that acquires the character of a common property resource in the post-crop season when anyone can graze his animals there. The changing situation of croplands, including current fallows, as a source of grazing will be discussed separately. Table 1

TABLE 1 Changes over time in common grazing areas as a percent of total geographic area in six villages in three districts of western Rajasthan

Grazing area	Percent of total area in study villages									
	Nagaur				Jodhpur				Jaisalmer	
	1953–54	1963–64	1972–73	1977–78	1953–54	1963–64	1972–73	1977–78	1953–54	1963–64
Forests	2	1	0	0	3	2	2	2	0	0
Permanent pastures	6	3	1	1	7	3	3	3	3	1
Uncultivable wastelands	17	13	12	11	13	10	10	9	38	35
Cultivable wastelands	18	10	7	6	15	7	4	3	26	12
Fallow lands (other than current fallows)	15	10	8	6	18	13	10	9	16	13

SOURCE: From patwari records during successive rounds of field work. The data relate to two villages in each district. Data for 1953–54 were culled from village records.

provides relevant information on all other grazing areas. The proportions of common property resources used for grazing in the total land area of the study villages is fast declining. Despite differences in the extent of decline between districts and communities, a few common features are revealed in Table 1.

Significantly, the decline in area of common property resources was greater during the decade preceding 1963–64 than in the succeeding years. This was the peak period of land reforms in the region. Forests and permanent pastures, which were already small in area, declined the most. The fallow lands declined mainly through a fall in the practice of long-fallow rotation.

The trends in the decline of common property resources are also evident for the arid zone as a whole. Land utilization trends for all 11 districts comprising the arid zone of western Rajasthan are shown in Table 2. The common property resources (grazing areas) in the region have been declining consistently since 1951–52, the first date for which district-level data on land utilization are available. Again, the decline was greatest during 1951–52 to 1961–62—the period of land reforms.

One consequence of the decline in grazing space is the increase in density of animals per unit of common grazing land. In the arid zone as a whole, the density of livestock expressed in terms of animal units increased from 39 animal units per 100 hectares of grazing land in 1951–52 to 105 during 1977–78. This increase was due in part to an increase in livestock population. According to livestock census reports, the number of animals in the arid zone increased by 41 percent between 1951 and 1961 and by 14 percent between 1961 and 1971. The slower growth of livestock during the latter decade is due partly to two severe droughts during this period and partly to declines in grazing area.

Animal watering points

Animal watering points are resources important to the support of pasture-based livestock farming. Ponds and tanks are scattered throughout grazing areas in the villages. They are filled by runoff from their respective catchments, which

TABLE 2 Changes over time in characteristics of common property resources (CPRs) in western Rajasthan, 1951–78

Characteristic	1951–52	1961–62	1971–72	1977–78
Area (million ha)	11.3	9.8	9.2	8.7
Area as a percent of total geographic area	60.5	51.1	47.9	45.1
Percent decline in CPR area over previous period	—	12.4	6.7	4.5
Livestock per 100 ha of CPRs (no. of animal units)	39	86	94	105
Population per sq. km. in the zone ^a	30	39	51	N.A.

NOTE: Common property resources include forests, permanent pastures, uncultivable and cultivable wastelands, and fallow lands other than current fallows.

^a The population density was 18 per sq. km. according to the 1901 census. At the time of the last census before Independence (1941), the population density was 26 per sq. km.

SOURCE: For 1951–52, Deputy Director of Land Revenues (Records), Government of Rajasthan, Ajmer. For all other years, Statistical Abstracts of Rajasthan for different

are also used for grazing. Depending upon their capacity, these ponds supply drinking water requirements of animals and humans. They help in the even distribution of grazing incidence and ensure some degree of rotational grazing. They were dug by the village communities and, at least in the past, were maintained (desilted) through the voluntary or enforced labor of the villagers, as well as by investing part of the revenue collected through periodic auctioning of rights to collect dung and top feeds from around the watering points.⁷

Details of the history, current status, usage, and management of these watering points were collected from two villages⁸ and are presented in Table 3. The number of watering points and the catchment areas of the ponds declined dramatically between 1953-54 and 1972-73.

Watering points were depleted because of reductions in their catchment areas and neglect of their desilting requirements. The decline in the upkeep of the ponds is also indicated in Table 3. Expenditures in terms of labor days on desilting of ponds and their inlets for three-year periods ending 1953-54, 1963-64, and 1972-73 are presented. Whether one looks at the total expenditure or the average expenditure per existing pond, the investment on upkeep of watering points declined substantially over time. More revealing is the change in source of expenditure, which also partly explains the decline in expenditure. Not only did overall expenditures on upkeep of ponds decline, but the people's contribution and common property resource revenue (generated through auctioning of trees, etc.) have disappeared as sources to support the upkeep of common property resources. Government grants or relief has proven to be a poor substitute for these traditional sources of upkeep.

TABLE 3 Changes over time in selected measures of status and upkeep of animal watering ponds in two villages in two districts of western Rajasthan, 1953-73

Item	Nagaur			Jodhpur		
	1953-54	1963-64	1972-73	1953-54	1963-64	1972-73
Number of watering ponds	19	10	8	17	9	9
Area of catchments (ha) ^a						
Total	358	213	181	411	282	275
Average per pond	19	21	23	24	31	30
Range	2-86	4-57	1-58	3-90	5-75	2-60
Modal value	15	35	30	25	40	40
Water retention capacity (range in months)	1-12	3-8	1-8	2-12	4-9	1-9
Desilting expenses (in terms of labor days) during preceding 3 years						
People's contribution ^b	788	0	0	722	0	0
Reinvestment of CPR revenue	450	25	0	675	190	0
Government grant/relief	0	238	120	0	240	300
Average total expenses per pond	65	26	15	82	48	33

^a Represents areas of catchments not occupied by private individuals.

^b People's contribution estimated on the basis of labor days fixed for each household multiplied by number of relevant households in the case of each tank desilted during three years. The amounts of reinvested revenue of common property resources and government grants were converted into labor days using wage rates for the relevant period.

SOURCE: Based on old and current village records.

Private croplands: seasonal common property resources

Public grazing on private croplands in the post-crop season is an important informal arrangement helping stock raisers. Because of this practice of periodic common access, the cropped area could be described as seasonal common property resources. Depending upon crop and soil moisture conditions in a given season, the available forage consists of crop leftovers, undergrowth, resprouting of harvested crops, and bushes. The net sown area in the arid region as a whole has increased from about 6.6 million hectares in 1956–57 to 8.3 million hectares during 1977–78. Despite an increase of about 25 percent in the seasonal common property resources for grazing, their contribution to total forage supplies for grazing seems to have declined in recent years. The large-scale introduction of tractors during the period under review has meant that soil preparation for the next season is finished soon after the harvest of the previous crop.⁹ This deprives the animals of any post-harvest grazing in the seasonal common property resources. Use of tractors has also led to a decline in the grazing space available from long fallows, cultivable wastes, and the like, because tractors are not subject to the constraint a very short wet period imposes on soil preparation by draft animals—a constraint that in the past restricted cropping to a limited area.

Qualitative degradation of common property resources

Qualitative degradation of common property resources is partly a consequence of their quantitative decline and unregulated use. Degradation of resources is easier to see than to quantify. It is difficult to find any official records covering qualitative aspects of common property resources. Yet such phenomena as conversion of pastures into barren patches near habitations, and substitution of perennial edible species by annual nonedibles have been documented through detailed surveys in the arid zone.¹⁰ According to these surveys, the carrying capacity of such lands has declined far below the present rate of stocking.

Indirect and rough indications of qualitative degradation of common property resources in the study villages were revealed by case histories of a few selected common property resources. Since common property resources constituted important sources of revenue for the *Jagirdar* or *Thikanedar* (landlords in the pre-Independence period), some useful records were available as early as 1945. They indicated the volume of products collected from common property resources and the revenue generated by their auction. Details for four locations, whose area has remained unchanged, are reported in Table 4 to illustrate the decline in the productivity of common property resources due to qualitative deterioration. Availability of timber, top feeds, perennial grasses, and gum declined in all four locations. Felling of mature trees and the growth of stunted and bushy trees, elimination of useful bushes, and a decline in superior perennial grasses were features of the environmental degradation in these areas.

TABLE 4 Decline in productivity of common property resources as illustrated by histories of four forest and grazing plots in a village of Nagaur district, 1945–65

Product	Production							
	Plot 1 (6 ha)		Plot 2 (10 ha)		Plot 3 (12 ha)		Plot 4 (12 ha)	
	1945–47	1963–65	1945–47	1963–65	1945–47	1963–65	1945–47	1963–65
Timber (<i>babul</i> and <i>indok</i> trees)	12	3	11	1	3	0	17	0
Top feed (<i>loong</i> from <i>khejri</i>)	8	4	10	3	21	8	12	3
Top feed (<i>pala</i> from <i>ber</i> bushes)	—	—	7	3	12	4	15	2
Fuel wood (<i>khejri</i> , <i>ker</i> , etc.)	8	2	5	2	18	6	21	4
Cut grass (<i>kared</i> and <i>dhaman</i> perennials)	13	3	18	4	27	9	21	0
Cut grass (<i>bharoot</i> , etc. annuals)	3	5	5	7	10	8	13	9
Dung collection	—	—	—	—	15	0	17	0
Gum (<i>babul</i> and <i>indok</i> trees)	40	0	10	0	—	—	—	—

NOTE: Gum is measured in kilograms. All other products are measured in cartloads. The weight of a cartload ranged from 5 to 10 quintals depending upon the product (e.g., fuel wood versus top feeds) under question. By 1958 due to introduction of rubber-tired bullock carts (*chhakada*) the standard of cartload changed. Compared to earlier wooden-tired bullock carts, the *chhakada* could accommodate 50 percent more product by volume and weight. However, the figures reported in the table are in terms of load carried by wooden-tired bullock carts.

SOURCE: Auction records of ex-Jagirdar and the village Panchayat. In the post-land reforms period, the practice of auctioning has declined mainly because there is not enough material to auction. This in turn is a result of elimination of most of the trees and complete destruction of even roots of perennial grasses.

Causes of the decline of common property resources

The decline of common property resources is a result of multiple forces. It is often not easy to measure the role of specific factors in the process of change. However, a description of the circumstances influencing people's decisions and actions regarding the status and usage of common property resources can shed light on the relative roles of different factors. Three factors that seem to have contributed significantly to the decline of common property resources in the arid zone are: (1) institutional change in the form of land reforms during the early 1950s; (2) population growth; and (3) increased commercialization of the desert economy in general and of common property resources-based activities in particular—aided in part by technological innovation.

Land reforms

The introduction of land reforms during the early 1950s constituted a major institutional intervention in the rural sector of the arid zone. The reforms encouraged the privatization of common property resources for use as crop-lands; drastically reduced the private cost of cultivating submarginal lands (including common property resources); and dismantled the traditional arrangements that protected and regulated the use of common property resources.

Prior to the introduction of land reforms, the feudal landlord was the sole custodian or "owner" of the village lands.¹¹ All farmers except his kinsmen were the landlord's tenants. They paid him substantial rent in kind (one-

fourth to one-half of farm produce) for the land they cultivated. Although the common property resources belonged to the landlord, villagers had access to them in return for certain charges. While a fixed proportion of land revenue from cultivated land went as payment to the ruler of the state, revenue from the common property resources went to the landlord's own exchequer. (At times, a part of the revenue would be reinvested to increase or sustain income from the land.) Methods of revenue generation from common property resources included a fixed grazing tax per head of animal; the auctioning of produce from common property resources; a number of different levies on the users of the land; and penalties for violation of a variety of regulations imposed on users. The number of different levies and taxes imposed in the princely State of Jodhpur in 1941 varied from 50 to 150, depending on location, of which 64 were considered legitimate by an enquiry committee appointed by the ruler of the state.¹² Many of these related to common property resources. Through levies and penalties on the use of common property resources, the landlord exploited the peasants. However, as a byproduct of this exploitative mechanism emerged a management system that protected, maintained, and regulated use of common property resources. Table 5, based on details from study villages as well as other studies,¹³ lists the practices that were essential parts of the management of common property resources in the past and indicates which are still prevalent.

Following land reforms the Jagirdari system and its variants were abolished. Peasants were made owners of the lands that they formerly cultivated as tenants. The land revenue tax payable annually to the government on these lands was drastically reduced (Table 6). Vast areas of common property resources, mostly submarginal lands unsuited to cultivation, were distributed as croplands to the landless as well as to those who already had land. Within a decade of land reforms, in the arid region as a whole, 3.4 million hectares of common property resources were transferred to private ownership for the purpose of arable farming. This meant an increase of nearly 50 percent in the land put under the plow in the arid zone. It also meant a decline of between 7 and 26 percent in common property resources for grazing.¹⁴

The ownership or custodianship of the remaining common property resources was transferred to the village community, represented by village *Panchayats* (elected councils). The provision of common access continued as in the past, but the old system of management of common property resources disappeared (Table 5). The village Panchayats in practice did not impose grazing taxes and levies on users of common property resources, despite the fact that they were legally empowered to do so. The maintenance and upkeep of common property resources suffered as the Panchayats depended more and more on assistance from the government for this purpose. The main reason for the ineffectiveness of Panchayats, despite their domination by ex-feudal landlords in some cases, is that they were neither as authoritarian as Jagirdars, nor bold enough to take hard decisions (such as imposing taxes) that would displease their voters.

TABLE 5 Management of common property resources in western Rajasthan: whether past practices continue following land reforms

Practice	Practice continues	Practice	Practice continues
Indicators of private cost of use of CPRs		Indicators of revenue earning^c	
Grazing tax (<i>ghas mari</i>)	No	Auction of dung-collection rights from CPRs	No
Fee for grazing in some CPRs on priority basis	No	Auction of top feeds from CPRs	No
Livestock-related levies (<i>laag baag</i>)	No	Auction/sale of wood from CPRs	Yes
Compulsory labor contribution for desilting ponds (<i>begar</i>)	No	Penalties for breaking grazing regulations	No
Penalties for disregarding grazing regulations ^a	No	Cash and kind taxes and levies from users of CPRs	No
Indicators of regulated use of CPRs		Indicators of investment in CPRs	
Evenly scattered watering points	Yes	Periodic desilting of ponds ^d	Yes
Deliberate rotation of grazing around different watering points	No	Payment to watchman (<i>kanwaria</i>)	No
Periodical closure of parts of CPRs (e.g. <i>chaitrakhai</i>)	No	Maintenance expenses of community bulls ^e	No
Periodic restriction on entry of animal category (e.g., sheep/cattle) to parts of CPRs	No	Support to scouts to survey water and fodder situation on migration routes before animals' migration during drought	No
Posting of watchman (<i>kanwaria</i>) with power to enforce regulations	No		
Village <i>phatak</i> (enclosure) to impound animals violating regulations ^b	Yes		

^a Panchayats also have provisions for imposing penalties, but such cases relate to trespassing by persons on migration routes during droughts, or to complaints of damage to one's crops by another's animals, which are brought to officials for impounding.

^b Each Panchayat also maintains a *phatak*, but animals impounded are those that enter somebody's cropped field.

^c Feudal authorities collected substantial revenue from CPRs but reinvested only a small proportion.

^d Periodic desilting of ponds now takes place through government relief expenses during drought years.

^e Some Panchayats have provisions toward maintenance of community bulls.

SOURCE: N. S. Jodha, "Causes and consequences of decline of common property resources in the arid region of Rajasthan," progress report, ICRISAT, Economics Program, Patancheru (A.P.), India.

Overexploitation and depletion of common property resources resulted largely because there was (and remains) no private cost to using these resources. Estimates based on detailed investigations in some villages of Nagaur district¹⁵ indicate that prior to land reforms the animal grazer had to pay Rs41 per household in cash or kind (at 1976–77 prices) plus Rs1.25 grazing tax per animal per year (at 1976–77 prices) (US \$1 = 12.50 Rupees). After the land reforms this cost was reduced to zero (see Table 6).

TABLE 6 Data relating to private costs of land use before and after land reforms: selected villages of western Rajasthan, 1950–65

	Pre-land reforms (1950–51)	Post-land reforms (1964–65)		Pre-land reforms (1950–51)	Post-land reforms (1964–65)
Better cropland (<i>chahi</i>)			Grazing land (<i>gochar</i>)		
Pearl millet yield (kg/ha)	520	520	Grazing tax (Rs/animal)	1.25	0
Times cropped in 5 years ^a	4	5	Other livestock- related levies/ penalties (Rs/household)	23	0
Land rent (Rs/ha) ^b	83	6	Value of contri- bution to protec- tion/maintenance of pasture/tank, etc. (Rs/household)	18	0
Submarginal land (<i>barani</i>)			Animal-product prices, etc. ^c		
Pearl millet yield (kg/ha)	200	200	Wool (Rs/100 kg)	90	480
Times cropped in 5 years ^a	2	3	Ghee (Rs/kg)	5	18
Land rent (Rs/ha) ^b	16	1.50	Milk (Rs/litre)	N.A.	0.60
Pearl millet—average cost of production (Rs/ha)	N.A.	285			

NOTE: Money values calculated at 1976–77 prices.

^a Frequency of cropping due to the practice of periodic fallowing of land. This also indicates the number of times when rent (25 percent of crop produce) was paid during pre-land reforms period.

^b Land revenue during the pre-land reforms period was charged in the form of 25 percent of the grain yield of the plot whenever it was cropped. The annual rent has been calculated by multiplying the money value (at 1976–77 prices) of crop share by number of years when land is cropped and dividing by five. Land reforms fixed the land revenue on a permanent basis at a much lower rate, as indicated in the table.

^c Prices as obtained in the villages.

SOURCE: Jodha, cited in note 15. Details relate to a cluster of three villages in Nagaur district. Data were collected from village records and interviews during field work in 1963–66 (see Jodha, cited in note 5).

Population growth

Increased population pressure is widely considered an important contributor to shrinkage and depletion of common property resources. The relative resource scarcity created by increased population density is thought to induce privatization of resources for reasons of efficiency and internalization of gains from resource use.¹⁶ In the case of the arid zone of Rajasthan, however, the role of population in the decline of common property resources does not appear to be dominant. Although no long-term records are available to measure the relationship, scattered and circumstantial evidence supports this view.

In the arid zone as a whole, population grew from 3.6 million in 1901 to 10.2 million in 1972, a growth of 183 percent. This is a greater increase than that registered for Rajasthan State, 150 percent, or for India as a whole, 132 percent, during the same period.¹⁷ However, there are no data on land

utilization prior to 1951 against which to assess the consequences of this growth.

Privatization of common property resources in the arid zone has invariably meant conversion of common property resources land into cropland. Hence, the impact of population growth can be judged in terms of increase in the area of cropland as well as the decline in the extent of common property resources. The population of the arid zone increased by 29.8 percent from 1951 to 1961 and by 27.9 percent from 1961 to 1971. Croplands increased by 50 percent and 7 percent respectively during the same periods. The area of common property resources (on a larger base), as calculated from Table 2, declined by around 16 percent and 7 percent respectively. Crude as they are, the above figures do not indicate a correspondence between population trends and land use trends.

Historical evidence Indirect and circumstantial evidence suggests that traditional management systems prevented rapid population growth from exerting a corresponding pressure on the land during the feudal (pre-land reform) period. As reported and documented by Rai,¹⁸ one of the major problems of peasants in the princely State of Jodhpur (covering five out of eleven arid districts) was that despite substantial increases in the peasant population (as high as 50 percent in some villages mentioned by Rai) during 1910–40, the Jagirdars did not allow additions to cropland from common property resources. Instead, they raised the levies from one-fourth to one-half of the produce on the already-established and overcrowded croplands, and proposed to charge the same (increased) revenue rate for the submarginal (common property resources) lands, if and when any peasant agreed to accept such lands for cropping.

Examination of records relating to land revenue collected by Jagirdars in our study villages also reveals an insignificant extent of conversion of fallow land into cropland. The area of cropland (including net sown area, current and long fallow) increased by only 1–3 percent during 1935–51. The population of the same villages increased by 43–45 percent during this period.

In the face of exploitation by the Jagirdars, the peasants could satisfy their increased demand for cropland only through reduction in the extent of long fallow. (Boserup describes such intensification of land use in response to population density at the global level in prehistoric times.)¹⁹ However, as indicated in Table 1, long fallow represents only a small fraction of total common property.

The terms and conditions governing the use of cropland during the feudal period were not conducive to the conversion of submarginal grazing lands into cropland. Most of the lands of the arid zone are submarginal in physical terms and not suited to cultivation. During the feudal period they were submarginal on economic grounds as well. Since the Jagirdar took one-fourth to one-half of the farm produce as rent, the tenant's share was not enough to compensate for the cost and effort of raising crops on poor land. Furthermore, the Jagirdar

imposed more levies on crop producers than on animal raisers. Hence, despite increased population pressure, there was not enough incentive for tenants to extend crop farming by exploiting common property resources.

Besides the harsh terms and conditions imposed by Jagirdars on tenants, the traditional occupational structure contributed to lower pressure on cropland despite increases in population. The traditional caste occupations—services and crafts under the *Jajmani* system and, outside it, exclusive engagement in livestock raising, petty trading, and so on—kept a substantial proportion of village populations away from the croplands.

Demographic factors in the post-land reforms phase The introduction of land reforms, combined with other post-Independence changes, unleashed the forces of population growth. The land reforms of the early 1950s not only liberally distributed submarginal lands (common property resources) to the people, they also changed the economics of land use. Land was granted to people for nominal annual rents payable to the government. In Nagaur district, rent payable as crop share to the Jagirdar was Rs16 per hectare (at 1976–77 prices); following land reforms, fixed rent on submarginal lands was Rs 1.50 per hectare (see Table 6). The low fixed rent reflected the low crop productivity of these lands as compared with fertile lands in well-endowed areas. The reduced cost of submarginal lands, accompanied by the government's liberal approach to their distribution (partly to project a democratic image in areas formerly ruled by feudal lords), induced people to acquire private lands at the cost of common property resources.

Changes in the occupational structure of villages also increased dependence on, and therefore demand for, cropland. The *Jajmani* system governing patron–client relationships had tied many rural households to their traditional caste occupation (services and crafts). This system was disrupted following the introduction of the land reforms, and no substitution emerged for the Jagirdar's authority to oversee and enforce norms of intergroup relations.²⁰ Perpetuation of dependence on traditional caste occupations now appeared less economically attractive than farming land available for a very nominal charge. Subsidies, credit, and other forms of assistance available mainly to land owners under various development programs were further incentives to land ownership. This induced traditionally noncultivating households to acquire cropland.²¹

A little-publicized social reform movement among low-caste craftsmen (*chamars, regars, bhambis*) was another important development beginning in 1949. Entire communities gave up caste occupations (leatherwork, weaving, etc.)—jobs that, according to the caste leaders of Untouchables, were responsible for their lower social status. Throughout northwestern Rajasthan, crop farming was adopted in place of crafts.

During the feudal period, an important category of absentee landlords consisted of land owners from the Rajput caste who worked in the military forces of princely states. With the merger of princely states in the Indian Union during 1950–52, most of these army units were disbanded. These people

returned home to find their lands already transferred to their tenants. The rehabilitation of these and other absentee landlords who lost their lands during the reforms again led to distribution of lands once held as common property resources.

As these examples illustrate, demographic factors have exerted increased pressure on common property resources largely through the opportunities for cultivation created by various provisions of the land reforms program. Unfortunately, the categories used by census reports are too broad to be able to quantify occupational and other shifts in a way that would fully demonstrate the changes brought about by land reforms.

Commercialization of community property resources—based activities

Because of the harsh desert conditions and the absence of even a minimum transportation network, most villages in the arid zone, until recently, were physically isolated from wider markets. Whole village economies were subsistence-oriented. Due to improved infrastructure and transportation facilities, the villages are now better linked with the market centers. Barter has been replaced by a largely monetized economy; visiting caravans of traders have been replaced by regular marketing arrangements. Consequently, the subsistence requirements of producers and local demand are no longer important determinants of demand for several products of the arid lands, particularly animal products. Marketability and value of products have increased substantially, especially in the case of wool, mutton, milk, milk products, and so on. Prices of such products, net of inflation, increased by roughly 350–550 percent during the 15 years ending 1964–65 (see Table 6). The resulting adoption of sheep and goat raising (an occupation traditionally followed by low-caste poor groups) by high-caste rich farmers in different areas in recent years has added to the pressure on common property resources.²²

Profitability rather than concern for upkeep of common property resources has become the guiding force behind the choice of enterprises and usage pattern of common property resources.²³ Privatization of common property resources, through legal processes or illegal seizure, and overexploitation by increasing the number of animals on common property resources have been the major consequences.

Technological innovation The introduction of irrigation, fertilizers, and improved seed varieties has affected a few parts of the arid zone. The most important technological change influencing the status of common property resources, however, was the widespread introduction of tractors. The introduction was initially supported by government subsidies to farmers and subsequently gained momentum due to its commercial profitability. For the region as a whole, the number of tractors almost tripled, from 2,251 in 1961 to 6,652 in 1971,²⁴ and it has increased further since then. In our study of the arid zone,

in a cluster of six villages the number of tractors increased from 10 in 1964–65 to 59 in 1973–74, and the proportion of net cropped area to total land area increased from 44 percent to 81 percent during the same period.

Besides the poor soils, a major constraint to successful cropping on arid lands is the shortness of the wet period required for sowing. Using draft animals (i.e., bullocks and camels), it was difficult to sow large areas in the time available. The introduction of tractors eases this constraint enormously. Even small farmers rent tractors. This has induced businessmen to acquire tractors for hire.²⁵ These practices reduce the extent of short and long fallows and promote conversion of submarginal common property resources into cropland.

Consequences of decline in common property resources

The decline in common property resources has several implications. Among the most significant are the long-term implications of increased intensity of use of submarginal lands, the distributive implications of privatization of common property resources, and the impact on livestock farming.

Long-term implications

Increased intensity of use of submarginal lands (i.e., through crop farming instead of animal grazing) is not a consequence of privatization of common property resources per se, but rather of the usage practices that accompany privatization. In the case of the arid zone of Rajasthan (unlike the situation in Europe following privatization of common property resources), privatization has invariably meant putting the land under plow. This practice strains the limited use-capability of the land. The expected (and in some cases already visible) consequences are soil erosion and decline in overall crop yields. An analysis of area and production data from the early 1950s to the early 1970s for the region as a whole reveals that the successive additions to the area devoted to rainfed crops have led to corresponding declines in yields per hectare.²⁶ The decline in the productivity of remaining (overused) common property resources was illustrated in Table 4.

Distributive implications

Distributing common property resources to the poor deprives them of collective gains, while improving the position of individuals who receive the land. We do not have enough data to assess the net gain or loss to the poor following the privatization of common property resources. But limited evidence suggests that privatization has helped well-endowed land owners more than the poor. As shown in Table 7, in the study villages farm households owning more than 10 hectares of land prior to privatization acquired 59 and 62 percent of total privatized lands in the villages of Nagaur and Jodhpur districts, respectively. On average they added more land to their existing holdings than did poor

households. Furthermore, virtually all the common property resources with more fertile soils (e.g., forest, tankbeds, etc.) were acquired by large farmers. Most of the poor received their land following official action on their formal application. Large farmers' principal mechanisms for obtaining common property resource lands were either fabricating proof of title to certain pieces of land or gaining legal recognition of *de facto* (illegal) occupancy.

Impact on livestock farming

Since livestock farming is the key activity sustained by common property resources, the impact of the decline of these resources would be expected to be greatest on this enterprise. In view of a number of other developments, however—such as improved marketing facilities for animal products, changes in the relative profitability of different livestock enterprises, and institutional change facilitating or obstructing the migration of different categories of animals—it is not easy to isolate the impact of the decline in common property resources on livestock farming.

Table 8 compares several aspects of livestock farming in 1963–65 and 1977–78. The average size of livestock holding expressed in terms of animal units has declined. This is true in the case of both small and large farmers. The ratio of unproductive animals (young stock, dry cattle, etc.) to productive animals has declined. The extent of stall feeding has increased, while the dependence on common property resources for grazing has declined. These

TABLE 7 Distribution of land acquired through privatization of CPRs in two villages in two districts of western Rajasthan

Size of land holding prior to new land distribution (ha)	Average size of land holding per household before and after new land acquisition					
	Nagaur			Jodhpur		
	Before (ha)	After (ha)	Percent of new land acquired ^a	Before (ha)	After (ha)	Percent of new land acquired ^a
None	0	2.8	13 (—)	0	3.1	11 (—)
Up to 5	3.9	5.4	10 (1)	3.6	5.5	13 (—)
5–10	7.8	11.5	12 (—)	8.2	10.2	9 (2)
10–15	12.6	19.6	25 (27)	13.1	20.9	23 (32)
Above 15	25.5	35.1	34 (63)	20.5	30.4	39 (58)

NOTE: Data were collected during the first phase of field work (1963–64). They relate to one village each in Nagaur and Jodhpur districts. Total number of households and area involved in the Nagaur village are 281 and 74 (ha), respectively; the corresponding figures for the Jodhpur village are 307 and 77 (ha), respectively. The table excludes a few cases in which land went to people from neighboring villages; hence the percentages do not sum to 100.

^a Figures in parentheses indicate the percent share of each group in superior type of CPRs privatized, including forest lands and areas near watering points, etc., that have good soils. They are not submarginal lands.

changes are more pronounced in the case of large farmers. Such changes could be attributable to both the decline of common property resources and the increased commercial importance of livestock farming. Discarding of unproductive animals and greater emphasis on stall feeding help improve efficiency and profitability of livestock production.

Of the remaining two indicators of change shown in the table, the increased proportion of buffalo is surely a result of improved mechanisms for milk marketing. Buffalo milk fetches a higher price than other milk in these villages because of its higher fat content. The increased proportions of sheep and goats in livestock holdings are a response to a decline in common property resources and to higher wool and mutton prices. Cattle find it difficult to graze in the poorer quality common property resources, but sheep and goats can manage. Similarly, it is easy for sheep owners to migrate: they are welcome in the canal areas of Punjab and Haryana for sheep penning. Cattle owners do not have this opportunity.

Conclusion

The process of change described in this paper suggests that well-intentioned public programs like land reform can deprive a region of its comparative advantage in a key economic activity (in this case, livestock farming). Privatization raises the cost of livestock raising and, hence, erodes the region's comparative advantage. The adjustments to the decline in common property

BLE 8 Changes over time in livestock farming in two villages in two tracts of western Rajasthan, 1963–78

Item	Nagaur				Jodhpur			
	1963–65		1977–78		1963–65		1977–78	
	Small farmers ^a	Large farmers ^b	Small farmers	Large farmers	Small farmers	Large farmers	Small farmers	Large farmers
Average size of livestock holding (animal units)	15	13	13	9	16	14	15	9
Share of sheep/goats in animal units (percent)	38	6	42	22	40	9	46	31
Proportion of buffalo in milch stock (percent)	5	23	13	46	6	27	15	51
Unproductive animals per productive animal (no.)	7	4	6	2	5	3	5	1
Cattle regularly stallfed (except in monsoon) (percent)	6	25	11	49	5	23	18	57
Proportion of animal grazing days depending on CPRs (percent)	81	59	76	31	85	62	76	29

NOTE: Data relate to one village in each district. Details of the first four items relate to the whole village, while the last two items relate to sample households. The details of only two farming groups are presented to indicate the contrast or comparison.

^a Those owning up to 5 hectares of land.

^b Those owning 10 or more hectares of land.

resources in Rajasthan suggest the directions that will characterize the future of livestock farming in the region. The continuing shrinkage and degradation of common property resources is likely to force further reductions in the size of livestock holdings and changes in their composition. This has already happened to some extent, as indicated by the decline in the number of cattle and unproductive animals and the increased emphasis on sheep and buffalo raising. Another likely consequence is increased dependence on stall-feeding of cattle and a greater incidence of seasonal outmigration of sheep. However, the lasting consequence of all these changes could be the erosion of comparative advantage that the arid zone enjoys in livestock farming.

Another conclusion from this study relates to the future of common property resources in general. Considering their several advantages—such as promoting the economic activity best suited to the natural resource base of a region, sustaining the rural poor, and ensuring the use of arid lands according to their capabilities—there is a strong case for protecting and developing common property resources. A government strategy along the following lines might reverse the trends illustrated in this paper: a strict ban on further curtailment of common property resources through privatization; regulated use of common property resources, achieved by introducing some element of private cost for the users; and designation of common property resources as a source of revenue for the Panchayats, to induce them to conserve and systematically manage them as productive resources.

Notes

1 See Garrett Hardin, "The tragedy of the commons," *Science* 162, no. 859 (1968).

2 For differing opinions on resource depletion in developing countries, see C. F. Runge, "Common property externalities: Isolation, assurance, and resource depletion in a traditional grazing context," *American Journal of Agricultural Economics* 63, no. 4 (1983); S. Sanford, *Management of Pastoral Development in the Third World* (London: ODI—John Wiley and Sons, 1983); and R. Repetto and T. Holmes, "The role of population in resource depletion in developing countries," *Population and Development Review* 9, no. 4 (1984).

3 Studies comparing livestock farming to crop farming in Rajasthan are found in *Agriculture and Livestock in Rajasthan* (New Delhi: National Council of Applied Economic Research, 1965); and in N. S. Jodha and V. S. Vyas, *Conditions of Stability and Growth in Arid Agriculture* (Gujarat, India: Agro-Eco-

nom Research Centre, Sardar Patel University, Vallabh Vidyanagar).

4 For further discussion of resource ownership by village communities, see A. E. Nyerges, "Pastoralists, flocks and vegetation: Process of co-adaptation," in *Desertification and Development: Dryland Ecology in Social Perspective*, ed. B. Spooner and H. S. Mann (London: Academic Press, 1982); and W. Weissleder (ed.), *The Nomadic Alternative* (Chicago: Beresford Book Service, 1978).

5 See N. S. Jodha, "Capital formation in arid agriculture: A study of resource conservation and reclamation measures applied to arid agriculture," Ph.D. thesis, University of Jodhpur (1967).

6 Field visits during 1973 were in connection with the preparatory work of the World Bank's project proposal for drought-prone areas. The 1977–78 round of field work was conducted on behalf of the International Crops Research Institute for the Semi-Arid Tropics

(ICRISAT). The main objective was to examine the extent and type of farmers' group action in watershed-based pasture development promoted under the Drought-Prone Area Program (DPAP) and in milk marketing co-operatives promoted under the Operation Flood Project.

7 For further description of animal watering points, see *Socio-Economic Survey of Live-stock Breeders in Anupgarh-Pugal Region of Western Rajasthan* (Jodhpur: CAZRI, 1965); see also Jodha, cited in note 5.

8 The purpose of the study was to compare the watering points with *Tanka* (underground water storage tanks) tried by CAZRI in its rangeland development and management experiments at 52 locations in different arid districts. Findings are described in M. C. Prajapati, N. S. Vangani, and L. D. Ahuja, "In the dry range lands of western Rajasthan 'Tanka' can be the answer," *Indian Farming* 22, no. 11 (1973); and in L. D. Ahuja and H. S. Mann, "Rangeland development and management in western Rajasthan," *Annals of Arid Zone* 14, no. 1 (1975).

9 Tractorization is discussed in N. S. Jodha, "A case of the process of tractorisation," *Economic and Political Weekly (Quarterly Review of Agriculture)* 9, no. 52 (1974).

10 These studies, conducted by CAZRI, are discussed in M. Prakash and L. D. Ahuja, "Studies in different range condition grasslands in western Rajasthan," *Annals of Arid Zone* 2, nos. 1, 2 (1964); and in K. A. Shankararayan, "Impact of overgrazing of the grasslands," *Annals of Arid Zone* 16, no. 3 (1977).

11 Minor variations existed from place to place, especially in *Khalsa* villages—those directly under the administration of rulers of princely states.

12 For further discussion of regulations imposed on users of common property resources, see H. Singh, "Caste and Kisan movement in Marwar: Some questions to the conventional sociology of kin and caste," *Journal of Peasant Studies* 7, no. 1 (1979).

13 See R. Rai, *Akal Kasha Niwarak* (in Hindi) report on famine-scarcity eradica-

14 Agriculture in the arid zone is discussed in N. S. Jodha, "Scarcity oriented pattern of arid agriculture," *Indian Journal of Agricultural Economics* 21, no. 4 (1966).

15 These investigations are analyzed in N. S. Jodha, "The operating mechanism of desertification and choice of interventions," in *Arid Zone Research and Development*, ed. H. S. Mann (Jodhpur: Scientific Publishers, 1980).

16 See Y. Hayami and M. Kikuchi, *Asian Village Economy at the Crossroads: An Economic Approach to Institutional Change* (Baltimore: The Johns Hopkins University Press, 1981).

17 See S. P. Malhotra, *Socio-Economic Structure of Population in Arid Rajasthan* (Jodhpur: CAZRI, 1977).

18 See Rai, cited in note 13.

19 Ester Boserup, *The Conditions of Agriculture Growth: The Economics of Agrarian Change Under Population Pressure* (Chicago: Aldine, 1966).

20 See A. B. Bose and N. S. Jodha, "The Jajmani system in a desert village," *Man in India* 45, no. 2 (1965).

21 See Jodha, cited in note 15.

22 Goat and sheep raising is discussed in K. A. Ram, Mruthyunjaya, G.V.S.R. Krishna, and D. Goyal, "Growth of goats and sheep in Rajasthan desert: Analysis and implications," *Agricultural Situation in India* 38, no. 10 (1984).

23 See N. S. Jodha, "Market forces and erosion of common property resources," paper presented at the International Workshop on Agricultural Markets in Semi-Arid Tropics, ICRISAT Center, Patancheru (A.P.), India, 24–28 October 1983; see also Jodha, cited in note 15.

24 Tractorization is discussed in H. S. Mann and J. C. Kalla, "Asset-liability imbalances in agricultural sector of the Indian arid zone," ICAR, *Desertification and Its Control*, presented at the UN Conference on Desertification, Nairobi, Kenya, 1977.

25 See Jodha, cited in note 9.

26 See N. S. Jodha, "The role of administration in desertification: Land tenure as a