PROBLEMS OF CREATION OF COMMON PROPERTY RESOURCES IN SEMI-ARID AND SALINE AREAS - A CASE STUDY OF KACHCHH DISTRICT IN GUJARAT (INDIA)

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Background

The Kachchh District covers an area of 45.652 km^2 and falls in the arid tracts of western corner of India. The area gets average rainfall of 340 mm spread over an average of 13 days per annum. Evapo-transpiration rate is high. Maximum temperature ranges from 39°-45°C in summer (June) to 4°-6°C in winter (December). Velocity of wind is high, with a mean of 11.21 km/hr. Geologically, Kachchh is a rather young region. Hills are made of sedimentary rocks of Jurassic period lapped by Deccan traps, and sediments of the tertiary period. Hills of moderate heights, pediments, mud-flats, saline-flats and sandy plains constitute dominant land forms. The saline flats (Great and Little Rann of Kachchh) were centuries ago under the sea and have been formed by sediments of the Banas and other rivers.

About half the area of this district is covered by arid and semi-arid deserts. The land use pattern is unique:

- 37.4% area falls under barren and uncultivable wastelands
- 36.4% is cultivable wastelands
- 15.2% represent the gross cultivation area
- 6.3% is the forest area
- 3% is other areas, and
- only 1.5% are permanent pastures.

Salinity is a predominant factor of soils. Total identified saline area is 3652 km^2, including inherent saline area of 2,995 km^2. This is 82% of the total salinity-affected area. There are no perennial rivers. All the rivers and rivulets have water only for a few days after rains. Since water is precious, 85% of surface water is already harnessed through various irrigation schemes, while 55% of the ground water is already tapped. Vegetation consists of:

- Xerophytic tree species like *Acacia, Prosopis, Euphorbia, Zizyphus, Salvadora*, etc.
- Grasses like *Aristida, Cenchrus, Hetropogon, Cymbopogon*, etc.
- Halophytes like *Sueda fruiticosa, Sporobilus, Urochondra*, spp. etc.

There is a good patch of mangrove forest along the sea coast with *Avicennia* and *Rhizophora* spp.

Arid mainland, saline desert, 350 km of coastal line, and the shallow creeks provide a varied habitat to different types of wildlife. Saline deserts are an excellent shelter for the Wild Ass (*Equus hemionus* Khur). During monsoon, this area converts itself into a large lake harbouring Kachchh prawns (*Metapenagus kutchensis*). The small islands in these areas become excellent breeding grounds for migratory birds like Flamingos. It also abounds in a variety of

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reptiles, rodents and mammals, spiny-tailed lizards, and birds like the Great Indian Bustard - Ghuvad and lesser floricans are important fauna. It also has Leopards, Wild Boar, Wolf Jackals, Indian Gazelle and Blue Bulls. The cattle in Kachchh is estimated at 14,20,000 out of which sheep and goats constitute 64% of the population, versus 24% milch cattle. The density of cattle is 31 per km^2. In 1961, the density was 21 per km^2. There has been a decline in the number of milch cattle (as per the observation of last three decades), while there has been a steep rise in goats and sheep.

Human population is rather sparse and is 1.26 million (1991 census). This equates to a density of 21 persons per km^2, versus the average density of 211 persons per km^2 in Gujarat State, and 274 persons per km^2 in India. The literacy rate is 25% against 48% in India (Table 1).

Common Property Utility

Land, water and air are the common property of human society. The land which is not cultivable for agriculture generally falls into the category of government owned wasteland or pasture land. A small percentage of such land, which was having some tree growth, was assigned to legally constituted forests. The vast flats, which have salty encrustation and few species of grasses and shrubs appear to be a wasteland in the true sense. The vast tracts of wasteland can still become an excellent green ground. The carrying capacity of the land as grazing land is rather poor, the reason being low rainfall and inhospitable terrain and soil, which does not permit good quality edible grass for long duration. Drought recurs practically once in three years, when rainfall is scant or almost nil. This makes these areas still risky as

Table 1

Cattle Population in Kachchh

	Kachchh (Area 45,652 km^2)				Gujarat (Area 196,024 km^2)			
	1961		1992		1961		1992	
	Nos. ('000)	%	Nos. ('000)	%	Nos. ('000)	%	Nos. ('000)	%
Cattle	460.3	48.9	346.0	24.4	6556.6	48.7	6799	34.6
Buffalo	80.5	8.6	12.9	0.9	2916.6	21.7	5266	26.8
Sheep	180.7	19.2	912.0	64.3	1481.0	11.0	6248	31.8
Goat	200.1	20.3			2223.5	16.5		
*Others	18.6	1.9	198.1	10.4	276.7	2.1	1346	6.9
Total	942.2	100.0	1419	100.0	13540	100.0	19659	100.0
Density/km^2	20.59		31.08		68.63		100.28	

Source : District Census Handbook of Kachchh District - Directorate of Census Operation, Government of Gujarat State. Census 1971, 1981, 1992.

sustainable grazing lands. Thus, although cultivation wasteland is 16,005 km^2, the land which is assigned as grazing land is only 700 km^2.

There are some excellent pasture lands known as Banni Areas. These areas have been the grazers' paradise. There are excellent healthy cattle, known for their milk production and their capacity to bear despite the vagaries of nature. In the drought years, the cattle migrate to the southern part of Gujarat State, which has better rainfall and the forest and pasture lands there afford a migratory shelter to these cattle. In extreme cases, when the cattle is unable to migrate, it survives on whatever fodder is made available through the government and philanthropic efforts. Almost 70-80% of the cattle in Kachchh migrates.

It is a moot question as to what capacity these lands hold for the production of common resources which can be utilized by society. Under normal circumstances, one should shun the idea of doing any effort in such inhospitable sites. Yet, the efforts done so far have given a ray of hope that all is not futile.

Tree Plantation

Due the climatic, edaphic and biotic factors of this region, it is difficult to raise tree crop. In soil having ECe (Electrical Conductivity) of 0.123-0.4 m.mhos/cm, murramy and clayey loam to clayey hard soil with Kankar pan; with average rainfall of 340 mm spread over an average of 13 rainy days; and above all, in areas having frequent salty encrustation, it is virtually impossible to raise any tree crop without the help of at least some support irrigation. It was in 1989 when for the first time, water from a tube well was used to give 5-6 waterings per year. This started a new chapter in growing trees in the saline tract. Initial leaching of salts from the top soil has helped in establishing tree crop. Species used are tolerant to salinity and can withstand drought, i.e., they are xerophytic in nature.

The species used are *Acacia nilotica, Azadirachta indica, Prosopis juliflora, Salvodora oleoides, Salvodora persica, Cordia myxa, Zizyphus mauritiana, Acacia tortilis, Albizia lebbek*, etc. These species have shown excellent survival and good growth. The survival of plantation is almost 80% while growth is about 4-5 m in 3-4 years. The water used is often with ECe more than 4m.mhos/cm with high TDS contents of 3000 ppm. Before planting, gypsum and organic manure is added. Every watering is followed by good soil working which helps in checking the physiological drought. Since the water is saline, and salinity is already present in the soil, it is likely to cause saline encrustation on the rootlets. However, when watering is done, this encrustation gets dissolved, and if it is followed by good soil working, the encrustation is not allowed to form, and such a layer of worked up soil acts as a buffer against evaporation loss from the soil. Through such support irrigation, about 4000 ha of plantation is raised in such wastelands, and a resource is created where no source existed. The estimated biomass production where presently nothing is growing, is likely to be 60-150 tones/ha in a 5 year cycle (Gurumurthy *et al.*, 1984). Besides these are fruit trees, gum-yielding trees and non-edible oil-yielding trees, which have its own economic and social value to the local population.

The trees have brought down the

Table 2

Soil Analysis Report of some sample areas before and after Plantations

Name of village	Sample Depth (cm)	pH	Salinity % (M. mhos/cm)	Organic C (%)	Available P	pH	Salinity (M. mhos/cm)	Organic C (%)	Available P
Shikarpur	30	8.10	2.50	0.35	35	8.0	0.20	0.10	17
	60	8.20	2.40	0.38	33	7.9	0.25	0.28	19
	90	8.1	3.25	0.36	30	8.1	0.21	0.10	19
Lakodia	30	8.5	0.25	0.30	33	8.2	0.22	0.13	19
	60	8.3	0.37	0.38	30	8.1	0.20	0.15	22
	90	8.2	0.45	0.34	39	8.1	0.22	0.14	26
Vandhiya	30	8.2	0.60	0.45	26	7.9	0.30	0.13	24
	60	8.3	0.45	0.50	24	7.8	0.20	0.12	17
	90	7.5	2.60	0.32	22	7.9	0.18	0.13	19
Bhachau	30	8.0	1.50	0.30	39	8.0	0.22	0.14	22
	60	8.1	1.61	0.32	33	8.1	0.20	0.15	17
	90	7.5	1.70	0.38	30	8.0	0.21	0.14	39

Source : Soil Analysis Reports by Forest Department, Gujarat State, India.
C - Carbon; P - Phosphorus

salinity of soil. This can be seen from the successive soil analysis of some plots every year over a period of years (5 years). The data is compiled and given in Table 2. It is a fact that due to depletion of salinity, better grasses have colonized the area and this has attracted wildlife like Chinkara (Black Buck - Deer family), and the almost near-extinct bird, the Great Indian Bustard. These birds have reappeared on the scene and have not only started coming to the plantation areas, but have also laid eggs. Number of migratory and local birds are also seen around. Thus, the eco-system appears to have truly accepted the effort done to change wasteland's treeless ecology to tree-clad ecology. Trees also help water to infiltrate in the soil. It acts as vertical drains to reduce salinity. The comparison of successive soil analysis reports over a period of time indicate this (Table 2).

Water Resources

Rainfall on an average is 340 mm, which is not only meagre, but is erratic with very high coefficient of variation. There are about 90 seasonal rivers which are ephemeral in character. As per estimate, the surface water potential is of 390 million m^3 (MCM) against which, through 20 medium irrigation projects, it has developed a designed gross storage capacity of 330 MCM (which is 84% of gross storage potential). However, average filling of these dams is only 37% of designed capacity. Similarly, irrigation is only 16.2% of the total CCA. Likewise, in case of 162 minor irrigation schemes, average filling is 50% and utilization is only 25% of CCA. Similarly, with a view to conserve water, 175 percolation dams are constructed. Whenever there is good rainfall and some water is

stored, farmers utilize this through lift irrigation.

Ground Water Potential

There are about 30,000 dug wells and 176 tube wells. Total ground water recharge is 517 MCM/year. Utilizable is 440 MCM/year. Gross draft per year is 346 MCM. Net draft per year on the basis of 70% utilization is 242 MCM. Thus, the balance is 195 MCM/year. As such, 55% of ground water development is done of the total annual recharge capacity. However, utilization and over exploitation of ground water is there in some parts, while it is under-utilized in other parts. In four talukas (administrative units of districts), there is over-exploitation, and depletion is 1-2 m per annum. This has reversed ground water gradient, resulting in saline water ingress in coastal areas. Thus, 45% of wells in these areas have saline water with TDS more than 2,000 PPM.

Recharging of Ground Water

As against estimated infiltration and recharging of total precipitation, it is estimated that only 8% goes to recharge the ground water. This is the major cause of worry. Innovative measures of recharging of ground water has been successfully tried and is being implemented by a voluntary organization - the Vivekanand Research Training Institute at Mandvi (Kachchh). The organization has taken up recharging of water as its major activity. The technique envisaged is to utilize the stream and rivulet water by storing in mini check-dams at some intervals along the stream, and dig tube- or bore-holes in the bed of such a check-dam. This directly helps the water to aquafer rather quickly than allowing it to percolate in normal course. By now, 58 check-dams, 48 percolation dams, 2 sub-surface dams and 39 recharge tube wells have been successfully done by this organization, creating an annual recharge capacity of 1.44 MCM. During flood years, its capacity would be 3 MCM.

This recharging has brought back water in many dug up wells which had disappeared since long. It has also created potential of irrigating 2,185 ha in 17 villages. This is only a beginning and holds great potential for development. It has not only given better quality of drinking and irrigation water, but has also improved the yield of agriculture and brought prosperity to the population living there.

Trees play a very important role in recharging of aquafer. Average rate of infiltration in wooded areas as observed at Dehra Dun (Ghosh *et al., 1979*), is 5.87 cm/hr in the first hour, 3.78 cm/hr in the second hour, 3.83 cm/hr in the third hour. In barren wastelands, the rate of infiltration would be much less as the run off would be more. The tree plantation should be done maximum in these areas. Whatever species can come up, should be adopted. It would not only reduce salinity, help in recharging of aquafers, but also give much needed biomass.

Development of Wind Energy

Average velocity of wind is more than 11 km/hr. However, in coastal belt, number of areas are identified by Gujarat Energy Development Agency, where the average velocity is more than 18 km/hr - which is suitable for establishing eco-friendly wind energy farms. Two wind farms of 0.695 MW and 1.6 MW are already established and the energy is supplied to Electricity Grid System of the State. As per estimate of potential, entire coastal line of Gujarat State including

Kachchh is 5,000 MW. Kachchh has also substantial potential which can be harnessed.

Conclusion

The development of common property resource of land, water and wind can be made a reality in this inhospitable, saline, arid land for the benefit of the human population. The efforts suggested above are all eco-friendly and would help to utilize the resources in a better manner.

SUMMARY

Saline and arid lands are considered to be unproductive or low productive area and coupled with inhospitable climate, the common property resources of land, water and wind are threatened for neglect by the human society. The development of such area is a necessity, particularly in developing countries, which also have the problems of excess population. Utilizing these resources for creating utilizable common property/resources is a need which cannot be overlooked. A case study of Kachchh district in the western part of India is presented with a view to show that efforts are done in this direction of land utilization, and utilization of ground-water, wind energy, etc. The efforts are only a beginning and much remains to be done. The paper in short, focuses on the problems of creation of resources for such a society.

अर्धशुष्क एवं लवण क्षेत्रों में पंचायती संसाधन बनाने की समस्याएँ - भारत के कच्छ ज़िले का एक विशिष्ट अध्ययन

एम०बी० मेहता

सारांश

लवण और अर्धशुष्क भूमियाँ अनुत्पादक या निम्नोत्पादक क्षेत्र समझी जाती हैं और यदि उनके साथ अहितकारी जलवायु जुड़ जाए तो भूमि जल और हवा के सार्वजनिक संसाधन मानव समाज की उपेक्षा के और अधिक संकट में फंस जाते हैं। ऐसे क्षेत्रों का विकास विशेषकर विकासमान देशों में एक अनिवार्यता है जो अधिक जनसंख्या की समस्याएँ भी झेल रहे हैं। उपयोगी सार्वजनिक सम्पत्तियाँ/संसाधन बनाने के लिए इन संसाधनों को उपयोग में लाना ऐसी जरूरत है जिसकी अषेक्षा नहीं की जा सकती। भारत में पश्चिमी भाग के कच्छ जिले का एक विशिष्ट अध्ययन यहाँ यह दिखाने के लिए प्रस्तुत किया जा रहा है कि भूमि उपयोग तथा भूमि जल वायुऊर्जा आदि को उपयोग करने की दिशा में काम किया जा रहा है। ये प्रयत्न मात्र एक आरम्भ है और अभी बहुत कुछ किया जाना बाकी है। अभिपत्र छोटा है और यह ऐसे समाज में संसाधन तैयार करने की समस्याओं पर ध्यान केन्द्रित करता है।

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