ECOLOGICAL HISTORY OF COASTAL SAURASHTRA
AKRSP (I) INTERVENTION

SULBHA KHANNA

Aga Khan Rural Support Programme (India), Ahmedabad
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Dr. (Mrs.) Sulbha Khanna is the Research and Monitoring Coordinator at Aga Khan Rural Support Programme (India) in Ahmedabad, Gujarat.

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ECOLOGICAL HISTORY OF COASTAL SAURASHTRA

INTRODUCTION

The focus on an increase in agricultural productivity, following the Green Revolution, prompted farmers to adopt High Variety Yielding (HYV) seeds for main crops. The introduction of HYV seeds, chemical fertilizers, chemical pesticides, mechanization and monoculture practices created some unforeseen environmental and social problems. Irrigation, in particular, was viewed as one of the most important developments due to its potential for increasing agricultural productivity. However, some of the requirements of HYV seeds include the use of chemical fertilizers together with more water, over and above the amount required by traditional seeds. Therefore, in order to provide water for HYV seeds and certain chemical fertilizers, sources of surface and ground water were overused. The depletion of ground water levels allowed for the ingress of saline water from the sea. This phenomenon affected the integrity of water as well as the soil. In the coastal areas of Saurashtra, the over exploitation of ground water for cultivation has led to the degradation of the land, water sources and vegetation. Not only has the ingress of saline water affected agricultural crops, but it has also limited the access to safe drinking water. Factors which contribute to the growing problem include: the excessive withdrawal of ground water, less natural recharge of the ground source, the sea water ingress in lower aquifers, the ingress of tidal water in upper aquifers and poor land management. The over exploitation and misuse of natural resources has affected the natural sustainability of water sources in the Junagadh area. With proper, responsible management of natural resources perhaps the situation can change.

The Aga Khan Rural Support Programme (India) has been attempting to alleviate this problem through the promotion of its soil and water conservation strategies. AKRSP (I) is a professional development organization working in three underdeveloped districts of Gujarat in the area of natural resources management and human resources development. AKRSP (I)'s mission in these districts is to enable the empowerment of rural communities and groups, particularly the underprivileged and women, to take control over their own lives and manage their environment to create a better and more equitable society. AKRSP (I) has ventured to limit further damage to land and water resources through the introduction of appropriate and mixed cropping patterns, and the efficient use of water on one hand, as well as the construction of check dams and percolation wells, on the other, to conserve water. This paper will examine the environmental and social effects due to the over exploitation of ground water and provide some suggestions to curb the growing problem in this particular district.

HISTORY

The Saurashtra region located in the south-western part of Gujarat is bordered by the Arabian Sea. The area was once well known for its abundant crops of vegetables, fruits and other high value cash crops. The major crops that were grown in this area were groundnut, jowar (sorghum), bajara (pearl millet), wheat, pulses, coconut and various fruits. However, the excessive withdrawal of ground water has led to the rapid deterioration of the soil quality and also increased the salinity of the water due to intrusion from the sea. The introduction of HYV seeds compelled farmers to use chemical fertilizers in order to increase production. The use of these chemical fertilizers, however, required more water. Farmers utilized both ground and surface sources of water for irrigation, while at the same time the sources have not been augmented to the same degree.

Over time, the quantity of water from these sources has diminished and the remaining ground water has since turned saline. Undoubtedly, the poor quality of water has affected the vegetation of the area and as a result had a negative impact on the agricultural incomes of the farmers.

IMPACT OF EXCESSIVE USE OF GROUND WATER

Change in Water Table

The excessive use of water from wells has led to low water tables. Unfortunately, farmers resorted to using even the saline ground water and further depleted the water table. Farmers switched from using conventional techniques of lifting water (mhot) to pumping sets. Under the conventional methods, the extraction rate of water from wells was usually 1000-2000 G.P.H. (gallons per hour). The use of pumps has increased the extraction of water to 5000-10000 G.P.H. As a direct result, water levels in the wells fell and the same number of pumping hours could not be maintained. A study conducted in the Talodra village, in this area, shows that from 1975 to 1995 the number of wells in the village has increased from 25 to 300 and the depth of the water in the wells has increased from 80 ft. to 200 ft. from the ground. The excessive withdrawal of ground water has been unaccompanied by corresponding recharge endeavours.

Table 1: **Water Table level Decrease as a Result of the Increase in Number of Wells**

Year	**Number of Wells**	**Water level** (ft.)
1975	25	25-30
1980	60	40-45
1985	120	50-60
1990	180	60-125
1995	300	150-200

Source: Field work, by the author, 1995.

Increase in Salinity in Soil

With the depletion of fresh water, farmers began to use saline ground water for protective irrigation. The use of saline water affects the soil structure and salt balance of the soil. Some of the bacteria and plants essential to the stability of the soil system perished as a result. Salinity has increased mainly through sea water by either subsurface intrusion or vertical percolation. The TDS (total dissolved salts) and chlorine have increased in the ground water over a period of 25 years. The TDS has increased from 500 to 5040 ppm and the chloride from 176 to 2320. Values above 500 ppm are considered unsuitable for irrigation and for drinking.

Increasing Salinity Ingress

The salinisation of water has steadily increased in the coastal areas. Table 2 below as well as Figure 1 and 2 indicates the extent of the ingress in the area.

SAURASHTRA COASTAL AREA, GUJARAT

SALINITY INGRESS (1970-1995)

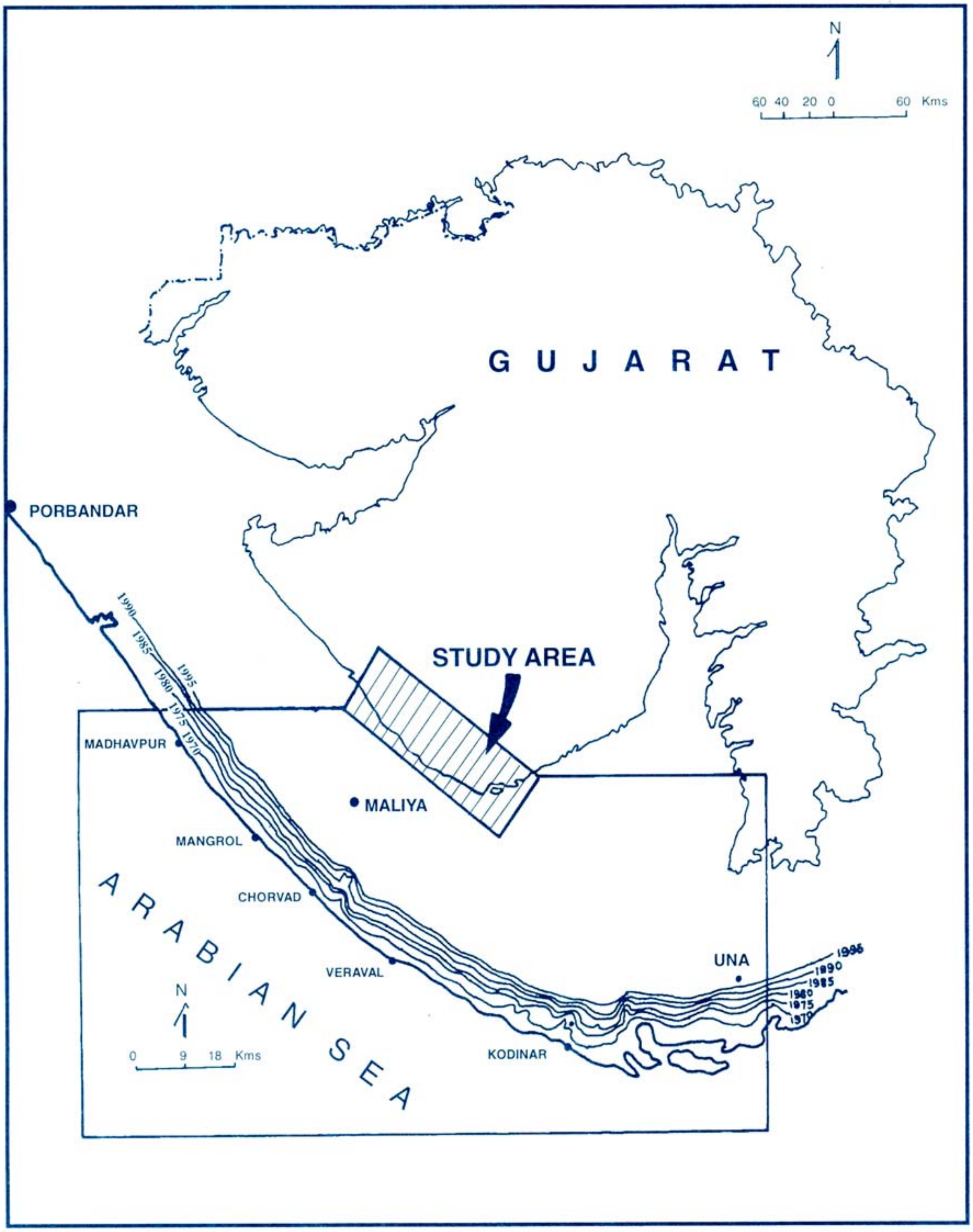

FIGURE 1

Table 2: Progression of Salinity Ingress from 1970-1995 (Refer Figure 1)

Year	Salinity Ingress from Coast
1970	2 km
1975	5 km
1980	7 km
1985	9 km
1990	11 km
1995	15 km

Source: Field work, by the author, 1995 and Report of the High level Committee to Examine the Problems of Salinity Ingress Along Coastal Area of Saurashtra, October 1978, Public Works Department, Government of Gujarat.

Deteriorating Vegetation

The natural vegetation has been affected by the poor quality of soil as well as the decrease in the water table. The area under nagar veli (betel) has decreased by 80-90 per cent. Betel is a high value crop which incidentally also has a high medicinal value. Even coconut trees have started to wither. Twenty years ago, the average weight of a coconut fruit was about 2.5 kg. Now, the weight has decreased to under 1 kg. The land has since become unfavourable for growing sugar cane and ground nut crops. Farmers have to be satisfied with the low yield crops such as jowar and bajara whose yield rates have decreased from 1200 kg/acre to only 300 kg/acre. As a result of this salinisation, there is limited availability of fodder and in turn a decrease in the number of milch animals.

Non-Availability of Drinking Water

Saline water is not suitable for drinking or cooking. The existi-ng sources of drinking water have become saline and this has led to exploration further afield for other sources of drinking water. The threat is that these sources, over course of time, will also become saline. Women spend a minimum of 3-4 hours a day collecting drinking water. Sometimes drinking water is even sold by water tanks on a camel cart. The cost of 20 litres of water is Rs.5-7 and if an average family requires about 40 litres of water per day, it can cost up to Rs.15!

AKRSP(I) INTERVENTION

Aga Khan Rural Support Programme (India) has been initiating several programmes in order to combat the problem of salinity ingress. The initiatives include:

Chiku Plantation

AKRSP (I) is introducing chiku (Sapota) plantations on a large scale. Farmers have responded favourably to the adoption of this crop due to the fact that chiku is resistant to salinisation. Particularly in Mangrol Area, chiku has become the only economically viable crop due to salinity. Chiku can be planted in a one acre plot consisting of 40 trees at a cost of about Rs.400 per tree. This include the digging of the pit, manuring, grafting, weeding and water for five years. The cost of chiku plantation, on a per acre basis, would be approximately Rs.16,000. The Table below details the output of chiku plantations:

Table 3: Input and Output of Chiku Plantations based of the Span of Production

Year	Input Cost (in Rs.)		Gross Income (in Rs.)		Net Income	Per Acre of Chiku (hi Otis)
	Chiku	Intercropping	Chiku	Intercropping		
I	5000	2600	--	7000	600	--
II	2000	2000	--	6000	2000	--
III	2000	1500	--	5000	1500	--
IV	3000	1000	--	2000	-2000	--
V	4000	--	--	--	-4000	--
VI	*7000	--	12000	--	5000	20
VII	*7800	--	16800	--	9000	28
VIII	*9000	--	24000	--	15000	40
IX	*11000	--	36000	--	25000	60
X	*13000	--	48000	--	35000	80
XI	*15000	--	60000	--	45000	100
XII	*17000	--	72000	--	55000	120

* Denotes cost including plucking chiku. Source: Field Work, by the author, 1996

Intercropping can only be done in the first four years with the first year cultivation on 0.75 acres and the following three years cultivation on 0.5 acres. Expenditure on chiku increases in the fourth and fifth years as trees start to flower and labour charges for plucking increases. Yield of chiku continues to increase every year until the twelfth year when growth becomes static.

AKRSP (I) has initiated chiku plantations in the saline areas such as Mangrol where chiku plantations can provide some relief to the farmers. In 1992, a total of 125 chiku graftings were undertaken. Over the last few years, there has been an increase in the adoption and growth in popularity of chiku plantations (see Table 4).

Apart from Chiku plantations, AKRSP (I) has prompted farmers to change their cropping patterns. As well, the introduction of salt resistant and semisalt resistant crops such as sugar beet, date, carrot and various other crops including jowar and bajara which require less water have been promoted by AKRSP (I). Organic manuring is another endeavor that is promoted in order to offset salinisation. The reduction of chemical fertilizers reduces the need for more water.

Table 4: Distribution of Chiku Plants on a Per Year Basis Since 1992

Year	**No. of Chiku Plants distributed by AKRSP (I)**
1992	125
1993	550
1994	1700
1995	3415
1996	5000

Source: AKRSP (I) Record

RANNABHAI AS A ROLE MODEL

Chakhwa village is located 11 km away from the seacoast. Earlier, farmers enjoyed excellent crop production in this area. Over the last few years, increasing salinisation of the water had reduced crop production. Traditionally, the main crop grown in this area was groundnut. There was a need to introduce salinity resistant crops but none of the farmers had the entrepreneurial spirit to take the initiative. However, one farmer came forward. Rannabhai Daki decided to take the risk of changing his cropping pattern by planting chiku (sapota) in his fields in 1988. Groundnut is a highly commercial crop and thus Rannabhai's family members were opposed to the idea of changing to chiku.

Along with chiku, he planted jumrukh (guava) and lemons but they could not survive due to the saline water and lack of rainfall. Although the chiku plants survived, it was difficult for him to sustain his crop because of continuously low rainfall. Irrigating the chiku crop through flow irrigation was almost impossible because enough water was not available.

As a solution, he began to water each of his plants manually. He continued with this process until finally these plants survived even with saline water. In 1991, he only earned small returns from his crop (Rs.1000). In the second year, his income increased to Rs.5000 and in the third year (1993) his income increased more than three fold to Rs.18,000! In 1994 the crop exceeded everybody's expectations by providing Rannabhai with an income of 45,000. In 1995, which was a low rainfall year, Rannabhai was still able to earn Rs.55,000.

In addition, he planted Casuarina trees on the boundary of his field to protect the chiku,plantation, and is also expecting some income from these trees. Many farmers have learned from Rannabhai's example and he has become a role model in adopting chiku crop.

Percolation Wells

AKRSP (I) has been experimenting with the method of open percolation wells since 1990. Open percolation wells are built in stream beds so as to expedite the recharge of ground water tables. The water flow of the stream is distributed by the open percolation well through a round structure which allows water to be permeated directly to the ground, thereby recharging the ground water table. An impact study was conducted regarding check dams and percolation wells in the beds of streams in 1995. The results indicated that these methods helped to decrease the salinisation of water tables. Since 1995, AKRSP (I) has built 6 percolation wells in the following villages: Kankasa, Farangata, Shil, Talodra and Nagichana.

Table 5: Impact of Open Percolation Wells as a Result of Rainfall

Year	Rainfall (in inch)	Rise in Water Table (in feet)	Change in Salinity
1991	45	No change	No change
1992	60	3	Brackish-Saline
1993	37	2	Brackish-Saline
1994	110	10	Brackish-Saline Sweet

Source: Impact study by Vijay Mangukia (see reference)

A BOON FOR WOMEN

In Shil village of Junagadh district, access to drinking water poses a major problem. Women must go through many hardships in order to collect water. Though the water level is 30 feet deep, it is not water which villagers can use to drink, cook with, or give to animals. Therefore, half of the day is spent collecting drinking water.

AKRSP (I) has built two percolation wells in this area. These wells have been built according to the watershed area and as a result, the whole village can benefit from direct well recharge, which makes sweet water available .to the villagers. While the wells were being built, MVM (womens' group) members expressed some concern that these wells would be of no practical use because the entire surrounding area was saline and thus the well water would be saline as well. However, after construction, they were surprised to find that the water in the wells was sweet water. Earlier, women had to depend on private sources of water and they were restricted to certain times of the day.

Finally, women were able to access the water at their own convenience. Even women who had to labour by day, could collect water at night. The increased availability of water has caused awareness among women about the necessity of involving themselves in the development process.

Roof Rain Water Harvesting

To further solve the problem of drinking water, AKRSP (I) has tried to provide sweet water at houses themselves, through the construction of Roof Rain Water Harvesting Structures (RRWHS). Rain water is collected in these structures through pipes on the edge of the roof which channel the water into an under ground tank. This can then be utilized through out the year. People are trained in the maintenance of the structures and in keeping the water clean. Till now AKRSP has constructed 50 RRWHS. According to the users of these structures, the water is drinkable throughout the year.

Direct Well Recharge

Direct well recharge is a microlevel activity to reduce salinity, which can be taken up by an individual farmer. AKRSP (I) tried to encourage farmers to take up this activity on their farms by providing some assistance in terms of digging pipes and channels for diverting rain water into open wells. In 1995, 323 wells and in 1996, 350 wells were recharged by AKRSP (I) in the area. On average, this activity costs about Rs.2500 per well. Some farmers have diverted water over a distance of about 1.5 kms at a cost of Rs.10,000 for recharging their wells. Many farmers expressed that the additional sweet water thus stored in wells has helped to support fodder cultivation.

VALUABLE TIME AND MONEY IS SAVED

The salinisation of the drinking water had been increasing over a period of time in Rahij village. In order to percolate sweet water in the ground, a river well was constructed in Rahij village in 1996, before the monsoon season. Due to the direct well recharge through rainwater, the water table of the well increased. Besides percolation of sweet water throughout the underwater aquifer, the well also served the purpose of directly providing drinking water to the villagers, and women no longer have to walk for kilometers to fetch water.

Check Dams

Check dams are constructed across streams to prevent rainwater from flowing away. Water which is collected through the check dams, then percolates to aquifers which helps to reduce salinisation. AKRSP (I) has constructed eight check dams in the area, which have increased the duration of the availability of water from four months in the rainy season, to eight months. Villagers have become convinced of the positive outcome of check dams. In many of the villages where AKRSP (I) has not constructed check dams, villagers are coming forward with cash contribution, requesting AKRSP (I) to construct similar check dams in their villages.

Role Of Government

The government has recently tried to promote the use of indigenous crops and methods of cultivation that do not degrade the integrity of the soil and water. The government has also made the growth of certain salt resistant crops compulsory. However, the government needs to introduce policies wherein high water consuming crops such a sugarcane or groundnut are discouraged or banned. Suggestions for achieving this are as follows:

- Use of chemical fertilizers can be reduced through government policies by reducing subsidy and supply.

- The extraction of ground water can be controlled through government intervention. Government can make policies which restrict the digging of new wells. Also such areas should be declared black zones and in those areas dug wells and borewells should be banned.

The introduction of modern technology may give short term economic benefits but it can cause longterm socio-economic and environmental damage. In the above case, the degradation of the land has gone to such an extent that often it does not even produce at all. Ironically, the process of agricultural modernization was introduced in order to improve the quality of life for all people. However, it has inadvertently deprived them of even the most basic needs such as drinking water, nutritious food and shelter. Still many traditional technologies exist which may be modified with current scientific knowledge, and used to increase production in a sustainable way.

CONCLUSION

Salinisation of ground water sources can cause severe environmental problems and economic loss. There is a need, therefore, for collective action both at the macro as well as the micro level. A concerted effort must be made by farmers as well as the government to address the problem of the degradation of soil and water resources. The role of the government is instrumental in enforcing policies which emphasize soil and water conservation. Through a joint effort with the government, farmers should be encouraged to adopt salt resistant crops and also reduce their production of more water consuming crops. People need to use sweet water economically and reduce the wastage of water. Efforts should be made to increase the recharging of ground water, and avoid wastage of water. A conscientious partnership between communities and organizations can bring back environmental and economic prosperity to this region.

References :

1. Gujarat State Gazetteers: Junagadh Districts, revised edition, Directorate of Government Printing and Publications, Gujarat, Ahmedabad, 1970.
2. Khanna Sulbha: Planning for Sustainable Agricultural Development, Discovery Publishing House, New Delhi, 1995.
3. Mangukia Vijay: Comparative Study of AKRSP built check dams and percolation wells in Mangrol area 1995 (Unpublished).
4. Report of the High level Committee to Examine the Problems of Salinity Ingress Along Coastal Areas of Saurashtra, Public Works Department, Government of Gujarat 1978.