Salinity Prevention and Mitigation Initiative

Agriculture and Water Resource Development
In
Salinity Ingress Affected Coastal Areas

1.BACKGROUND

According to UNEP (United Nations Environment Programme) nearly 40 % of the world's population lives near the coastal regions mostly within 60 km from the seacoast and it is predicted that by 2010, 80% of the world's population will live within 100 kilometers of the sea. Those living in the cities face water shortage in terms of household usage while those living in the rural areas face water shortage in terms of drinking water as wells as agricultural reasons. This problem gets further compounded when an area suffers from the problem of Salinity Ingress. This problem is characterized by mixing of the sweet rainfed groundwater and the vertical saline water aquifers. This occurs due to over withdrawal of groundwater and seawater ingress into the substrata. The salinity prevention department of the government first addressed this problem. This problem has been a major hazard for Human And Animal Health, Agriculture, and other allied livelihood activities.

2. GENESIS OF SALINITY

Ambuja Cement Foundation (ACF) is active in the Kodinar and surrounding areas and has been working in the field of participatory Natural Resource Management, Health, Women/Child Development.

The reasons for Salinity Ingress came out from the PRA (Participatory Rural Appraisal exercises) conducted in some of the salinity affected coastal villages. According to the villagers the problem of salinity ingress was first noticed in the late seventies. The major reasons for the salinity problem are as follows:

1. Heavy withdrawal of the ground water to meet the increasing needs of the growing population. This has resulted from a tremendous increase in number of wells, diesel and electrical pumps etc.
2. Cultivation of water intensive agriculture crops like Sugarcane,Wheat,Coconut, Banana, Summer groundnut leading to artificial shortage of groundwater.
3. Inefficient use and wastage of electricity owing to subsidized rates.
4. Over-Irrigation and mismanagement of ground water. Also it has been noticed there is a high water run-off towards the sea due to inadequate water harvesting.

3. SOCIO–ECONOMIC IMPACT OF SALINITY

3.1 Altered Agriculture

Agriculture productivity and soil fertility has reduced considerably due to the increased salt content in the soil. Due to the disruption of primary livelihood of agriculture, the per capita income has also gone down drastically. As shown in the case study of Kadodara the yield has gone down by more than 50 % for most of the crops. Many of the crops like Rice and Black-gram have gone out of priority for the agrarian community. Due to the adverse impact on the ground water levels, farmers have been forced to change their cropping pattern taking two crops instead of the three that they used to take. Crop rotation also became difficult due to the decrease in the number of options. Besides this it has reduced availability of fodder for the animals.

3.2 Decreased Per Capita Income

In a nutshell per capita income of the farmers has gone down drastically. The standard of living has also gone down due to lesser per capita income.

3.3 Drinking Water

There is a saying in Gujarati which goes like this – *"Gaam Ma Pani Na Tanka Awe Ane Beno Na Matha Ma Tanka Awe"* (Whenever the water tanker comes in the village the women-folk get stitches on their head due to conflict with utensils.) Conflicts over drinking water have been seen at all levels right from national, state, regional and even at local village level. The Kodinar coastal region has witnessed severe problems of drinking water owing to Salinity Ingress in the late 80s. While earlier there used to be sweet drinking water in the wells, now most of such wells have saline water. Private wells do have water, but they have not escaped the influence of saline water. The supply of drinking water through taps is at best erratic. This means that the people are left without a reliable drinking water source. People have steadily become dependant upon tanker water supply by Government. This situation has also led to minor skirmishes and conflicts amongst the people.

3.4 Degeneration of Health, Sanitation and General Hygiene

Due to salinity many people are suffering from diseases like Kidney Stone, Rheumatism, etc. Besides, due to the consumption of unhygienic water, incidence of other diseases like Malaria, Jaundice and Viral Fever has been continuously on the rise.

3.5 Availability Of Basic Amenities

The general populace is not able to avail of the basic amenities like Education and Health, since the parents cannot afford these for their children. Drudgery for fetching drinking water from far-off sources has led to increased man-hours being spent by women and children. This has also led to increase in the drop-out rates from the schools.

3.6 Increased Migrations and Social Disharmony

Migration rate has increased from 10 % to 50% (towards diamond cutting, and fishing etc.) Mental stress has increased and many people have started brewing / selling liquor. Small and marginal farmers have sold off up to 50 % of their land. Local traders and Landless people have migrated to urban areas for employment. Salinity has also resulted in splitting of households, where family members have migrated to their farms called *vadi* in search of drinking water.

3.7 Degeneration of Animal Husbandry

Salinity has had an adverse impact on the health of domestic cattle. Milk productivity has decreased over a period of time. Reproductive health has shown degradation. Before incidence of salinity, buffaloes and cows used to give birth to seven to eight calves but now it has reduced to two-three calves only.

Kadodara

Village Kadodara has seen a 15 times increase in the number of wells since 1950. At the same time the number of electric pump has trebled since the last twenty years.
Before salinity people used to cultivate crops like rice and black gram, which are out of cultivation practice now. Besides the yield of the same have gone down drastically for the other crops; it has been reduced to half for crops like sugarcane from 87 metric tonne to 38 metric tonne per hectares, groundnut from 15 quintal to 7.5 quintal etc.

4. SOLUTION - THE WAY OUT

Ambuja Cement Foundation has always had a firm belief in the traditional wisdom and knowledge of the farmers and therefore the solution to the problem of salinity was sought from the local people. They came out with their own suggestions during the Participatory Rural Appraisal (PRA) exercises. On the basis of these suggestions ACF undertook the following steps to alleviate the problems related with salinity. The project called Kharash Vistarothhan Pariyojana or "Gujarat Coastal Salinity Prevention and Mitigation Initiative" was started by Ambuja Cement Foundation in collaboration with SRTT (Sir Ratan Tata Trust) in the year 2001-02.

ACF's Three-pronged Approach Prevention and Mitigation

1. **Maximize the recharging of groundwater aquifers through Groundwater Management And Rainwater Harvesting**
2. **Efficient Water Management through Agriculture Development.**
3. **Improvisations to meet the drinking water needs.**

5.GROUNDWATER MANAGEMENT AND HARVESTING

Groundwater is heavily exploited in the programme area for irrigation of water intensive crops such as Sugarcane, Groundnut and Wheat. Consequently, the fresh water table is depleting and there is a tremendous pressure on the existing groundwater resources. Hence ACF has recognized Salinity Ingress as a major issue in Groundwater Management. ACF is gradually moving towards construction of a series of Water Harvesting Structures that cascades on the salinity affected coastal area. This series helps to maximize the impact of prevention of salinity programme. The major thrust under the programme has been on the involvement of local communities in the construction work and empowering them for Operation and Maintenance work of structures. The extension and awareness work carried out by ACF has made the farmers realize the benefits of Water Harvesting. These farmers have been actively involved in various ways, sometimes even engaging their own tractors for transportation of dug out soil from the percolation tanks to their own fields.

Multi-Pronged Interventions In Watershed Development

Interlinking of canals and local water bodies in the coastal belt and linking them with streams and rivers.

Construction of **Water Harvesting Structures** like check dams, percolation tanks etc. in a planned manner.

Deepening of existing percolation tanks and riverbeds.

Renovation of existing tidal regulator and *bandharas* to avoid leakage and run-off to the sea.

Well recharge through rainwater in a scientific manner.

Table 1. Salinity Mitigation And Ground Water Initiatives Done Till Date Through Construction Of Various Water Harvesting Structures

Surface Storage Capacity generated in McFt.	No. Of Wells Benefited	Area Covered In Ha.	Farmers Benefited	Water Table	
				Before	After
299.9	3979	13576.5	3940	8 Avrg.	36 Avrg.

Mutual And Multiple Gains Through Pond Construction:

ACF constructed a big percolation tank in Devli village in the year 2000. Shri Hamirbhai Bhikhabhai Barad of Devli village has a farm situated 300 feet away in south direction of the pond. Due to this tank, water table in the wells has increased to 25 feet. Water was saline in his well before monsoon. The entire tank was filled with water after the first rains and because of this the quality of water has improved considerably. He says that now the water is potable and he can provide support irrigation in his 12-bigha farm for

groundnut, Bajri and sugarcane so that they are saved even in less rainfall year. He also claims that the salty white layer on the soil surface has not occurred this time due to improvement in the quality of water. Because of the pond a total 600-bigha land of 35 farmers in the region have been benefited by support irrigation.

Table 2 : Progress made by ACF under the various Water Harvesting projects

Sr. No.	Activities	1991 -2003	Apr '03 - Mar '04	Cumulative Achievements
	Water Resources Development			
1	Check Dam Construction	26	23	49
2	Check Dam Renovation	17	0	17
3	Well Recharging	689	73	762
4	Percolation Tank	44	5	49
5	Waste Weir Construction	11	4	15
6	Construction of Culvert	3	1	4
7	Link channel (Km)	28	3	31
8	Construction of Nalaplugs	22	0	22
11	Percolation cum recharge well	4	4	8
12	Construction of causeway / check dam	1	2	3

Link Water Channel: An Attempt at Localized Interlinking and Buffering.

With the help of people's participation and initiatives ACF has completed eight link water channel projects in the programme area. The concept is to prevent excess run off through interlinking of Water Harvesting structures. Thus this series helps to maximize ground water recharge in the surrounding areas. In one of the projects called the Goma-Panadar Link Canal project, the farmers connected the link water channel project with five percolation tanks through the support of ACF. Total length of one of the link water channels is 17.5 Kilometers. The coastal rivers Singoda and Somat have also been interlinked with the local *Bandharas* (Tidal Regulator) through water pipelines.

6. IMPACT OF THESE PROGRAMMES

For the purpose of impact assessment a sample of three villages of Kodinar, Damli and Ronaj was selected on the basis of geographical distribution.

6.1. Increase In The Water Tables and Number Of Wells

Generally if a water harvesting structure is built and water percolates into the ground, the neighboring wells are the first ones to get benefit from this recharge. Hence a survey was carried out to find if the number had increased after the building of check dams and percolation tanks. The study of water table increase was carried out using two approaches namely the Before-After approach and the With-Without approach.

- Under the Before-After approach the increase in water table in the beneficiary's wells is carried out through comparison of water table figures across the time, relying upon the farmer's knowledge.
- Under the With-Without approach comparison is done with non-beneficiary's wells.

Moreover, as water levels rise, farmers also start digging new wells to increase water availability. Table three shows evidence of the same.

Table 3: No of wells for irrigation before and after Check Dam

Village	No. Of wells before.	No. Of wells after
Damli	46	76
Kodinar	201	201
Ronaj	314	314

Overall there has been a sizeable increase in the water table from an average of 8 feet previously to present level of 36 feet. Thus there has been seen, an average increase of 26 ft. of water levels in the wells, generally benefiting all the wells in the command areas of the water harvesting structures.

6.2. Increase In The Area Under Irrigation

Due to over exploitation and increase in salinity, water availability as well as quality for irrigation had drastically gone down. As a result of Water Resource Development, there has been sizeable increase in the area under irrigation, indicating greater availability of ground water.

6.3. Increase In Irrigation Intensity

In addition, there has been considerable increase in intensity of irrigations. Some farmers are of the opinion that though increase in area under irrigation is not that high but the intensity of irrigation has significantly increased. This is shown by the increase in the number of pumping hours as well as the number of electric pumps as shown in the table four below.

Table 4. Increase in pumping hours and number of electric pumps used before and after Check Dam

Village	Before construction of water harvesting structure (CD/PT)		After construction of water harvesting structure (CD/PT)	
	No. Of Pumps*	Pump running hours	No. Of Pumps	Pump running hours
Damli	1	3 hours	2	5.5 hrs
Kodinar	1	9 (saline water)	1	12 (fresh water)
Ronaj	1	1 hrs.	1	4 hrs.
*Average per beneficiary				

The number of irrigations has increased by 2 - 3 times, resulting in improved yields. Though the increase in yield is in itself a significant milestone, the saving of crops during drought years is the real achievement. Earlier farmers were able to take only six rounds of irrigations but after the construction of water harvesting structures, water was available in the wells even for the winter crop and farmers have taken up wheat cultivation. Wheat on an average requires 10 waterings, which was made possible through the above-mentioned initiatives. Even during the low rainfall years of 1999-2000, seven rounds of irrigations were being provided which stands testimony to the improved availability of ground water in this region.

Well Recharge Quenches Thirst of five families in drought year.
Babubhai Koladiya of Chhelana had recharged his well through rainwater under Watershed Development Programme's well recharging scheme. The acute drinking water shortage in the village was aggravated during the second consecutive year. Though there was no rainfall in the surrounding area, the upper catchments area of Babubhai's farm experienced 2 inches of rainfall. After the well recharging, Babubhai benefited with 15 feet water in his well, which otherwise remains empty. This water is sufficient to meet the drinking water needs (both human as well as cattle) of five families in the neighborhood. Moreover Babubhai was also able to cultivate Rabi crop.

7. EFFICIENT WATER MANAGEMENT THROUGH AGRICULTURE DEVELOPMENT

1. Promoting **less water-intensive crops** through Agriculture Development Programme.
2. Promotion of **saline resistant and horticultural crops** like Mango and Chikoo, Drumstick, Custard Apples etc. Total 1,00,744 Horticulture saplings have been planted with survival rate of 95%.
3. Encouraging farmers to **adopt modern methods of irrigation like drip-irrigation**, which help increase productivity and reduce water consumption.

Implementing Strategy – The objective of installation of drip Irrigation systems is to create awareness among farmers for efficient use of ground water. ACF has linked up drip irrigation project with Horticulture plantation. During the year ACF has made efforts to motivate farmers through exposure visits and meetings to install drip irrigation systems. While ACF provides 50% of the total cost the remaining 50% is farmers' contribution.

Exposure visits to other Community Managed Projects have been arranged for this purpose. Farmers of the villages Singsar, Barda, Pipli, Chauhan ni Khan, Gohil ni Khan, Lodhva, Chhara, Rakej, Kanjothar etc. were taken to successful project sites like Mangrol block, where successful horticulture and drip project are being practiced by the farmers under guidance provided by AKRSP (I), IDE (International Development Enterprise) Bhavnagar etc.

4. **Promotion Of Organic Farming Through Workshops.** Workshops have been organized on progressive techniques like Organic Farming in collaboration with the progressive farmers of the Saurashtra region, Agriculture experts of Gujarat Agriculture University Junagadh (Sardar Smriti Kendra), Anand and Surat,

Sajjatha Sangh, Ahmedabad etc. In 2001, ACF, in collaboration with AKRSP (India) and Gujarat Agricultural University (GAU) organized a workshop on "Efficient and Better Water Use".

5. Moreover, ACF also promotes cultivation of vegetable crops in programme areas through Mahila Vikas mandals (women's groups).
6. ACF has also been trying to promote networking in the programme area and has played the role of a facilitator for training, exposure and information dissemination in order to replicate organic farming for larger coverage in the region.
7. Provision of **Animal Husbandry improvement** in the programme area to expand the livelihood options.
8. Construction of **Farm Ponds.**
9. **Soil Testing Laboratory:** Soil analysis in a systematic manner is essential to know soil composition and deficiency of micronutrients if any, in the soil. A soil-testing laboratory has been set-up by ACF in collaboration with R & D Department of Gujarat Ambuja Cement Ltd. Farming community is being encouraged on balanced and efficient use of fertilizers. Link-up with GAU Junagadh & Anand has been established and includes activities like conducting of various soil tests and periodic visits by experts from GAU Junagadh. Soil Health cards will be provided to farmers to provide proper guidance on soil fertility and status.
10. **Women Development Programme:** Although 70% of the agricultural activities are being carried out by women farmers but they are still not aware about advanced agriculture practices. Women self-help groups have been formed in Salinity Ingress affected villages like Muldwarka, Math etc. The women members meet once in a month and save fixed amount regularly. As the earnings from Fishing and Agriculture is not enough the group members have started income-generating projects with the help of ACF. The SHGs have facilitated construction of RRWHS and renovation of saline wells.
11. **Emphasis On Value Addition Activities:** Training for processing and canning is being imparted to womenfolk in collaboration with Horticulture Department, GAU, Junagadh District to create awareness about income generating projects and avenues for adding utility to primary goods like fruits and vegetables. These are being taken up by women Self Help Groups in the salinity affected villages.
12. **Crop Diversification**- A workshop on farming of **Medicinal Plants** was organized jointly by GAU and ACF. Progressive farmers, representatives of pharmaceutical companies, medicinal plant experts participated in workshop. Many farmers have shown keen interest and have started cultivation of medicinal plants.

Table 5 Agriculture Development

A	**Activity**	1991 -	2003 - 2004	Cumulative
1	Demonstration Plots (no.)	2660	138	2798
2	Horticulture Saplings Plantation (no.)	79414	21330	100744
3	Farmers trained	3453	780	4233
4	Kitchen garden plots (no.)	41	1	42

5	Farmers day celebrated	12	0	12
6	Farm Pond Construction	716	1	717
7	Drip Irrigation (Ha.)	81.5	6	87.5
B	**Soil and Water Conservation**			
1	Area treated (Ha.)	9582	2221	11803
2	Gypsum distribution (Mt.)	1197	0	1197
C	**Farm Forestry and Afforestation**			
1	Farm boundary plantation (no. Of trees)	685953	4500	690453
2	Wasteland Plantation (no. Of trees)	207203	0	207203
D	**Women Development Through Training**			
1	Women covered under training	1834	412	2246
2	Children trained	6869	1852	8721
3	Self help groups formed	51	11	60
4	Income Generating Programme	4	17	21
E	**Workshop & Seminars**			
1	Workshop on organic farming	175	99	
	& Agro Products (participants)		55	154
F	**Animal Husbandry Programme**			
1	Health Camps arranged	55	12	67
2	Farmers Benefited	4252	821	5073
3	Cattle Treated	61441	10816	72257
4	Artificial Insemination (Nos.)	0	315	315

8. IMPACT ASSESSMENT OF AGRICULTURAL DEVELOPMENT

8.1 Change In Cropping Pattern

After the initiation of watershed development programme and salinity mitigation, there has been a shift in cropping pattern. Now more fresh water is available for those farmers/beneficiaries who were earlier doing only partial irrigation in their fields. As shown in table below, farmers have started growing cotton in some villages like Damli after the availability of water in their wells increased due to the check dams. Consequently, the income from agriculture too has increased since the check dam was built.

Table 6: Crops before and after Check dam

Village	Before Check Dam	After Check Dam
Damli	Sugarcane, wheat groundnut, Lucerne pearl millet,	Sugarcane, wheat groundnut, pearl millet, Lucerne and **cotton**
Kodinar	Sugarcane, groundnut, wheat, pearl millet	Sugarcane, groundnut, wheat, pearl millet
Ronaj	Sugarcane, groundnut, wheat pearl millet,	Sugarcane, groundnut, wheat pearl

		millet, Lucerne

8.2 Crop Diversification

As part of salinity prevention and mitigation programme, ACF strategy has been to successfully wean the farmers away from using water intensive crops in order to prevent further deterioration of salinity ingress problem and further falling of groundwater table. ACF promotes saline resistant horticulture crops like Chikoo (*sapota*) in salinity-affected areas. Mango crops are promoted in non-saline areas to prevent further deterioration since they use less water and give high incomes to farmers. There was also a significant increase in vegetable cultivation due to the availability of water for irrigation. Earlier farmers used to grow vegetables for household consumption only, but now they are also growing for commercial purpose.

8.3 Improved Crop Productivity

Increased availability of water has also had a positive impact on the productivity of crops as shown for the following crops. The data is for the sample villages chosen for the survey namely Damli, Kodinar and Ronaj.

Table 7: Crop Productivity In Kg Per Bigha In The Coastal Villages Before And After Water Harvesting Structures (Whs).

Village	Before WHS		After WHS	
Damli	Sugarcane Groundnut Wheat Pearl millet	20 Mt 420kg 866kg 420kg	Sugarcane Groundnut Wheat Pearl millet Cotton	27Mt 546 kg 1040 kg 610 kg 700 kg
Kodinar	Sugarcane Groundnut Wheat Pearl millet	12 Mt 200 kg 500kg 800kg	Sugarcane Groundnut Wheat Pearl millet	35 Mt 800kg 900kg 1000kg
Ronaj	Sugarcane Groundnut Wheat Pearl millet	15 Mt 400kg 400kg 500kg	Sugarcane Groundnut Wheat Pearl millet	25 Mt 800kg 1000 kg 1000kg

Chikoo Trees Become Savior During Severe Drought

Shri Ranchhodbhai Sankhant, a farmer from village Vadli used to cultivate cash crops without support irrigation. Under ACF's Horticultural development programme, he planted 30 grafts of Chikoo trees. After four years of this grafting he is now able to reap 20 kg of fruit from each tree resulting in a total yield of 500 Kgs from 20 Chikoo plants. He could get a market price of Rs.5/kg thereby getting a total income of Rs.3000. This income will continue to increase, as the trees grow further. Ranchhodbhai has thus noticed that even in drought

situation the Chikoo trees have survived and are giving him returns when other sources of income have dried up. He now has a firm belief in horticulture as one of the most Sustainable And Eco-Friendly practices in agriculture.

8.4 Conservation Of Available Water Resources Through Practices like Drip irrigation.

ACF has put in a lot of effort to encourage farmers to take-up modern farm practices so as to bring about sustainable development. Farmers are consistently being encouraged to take up Drip Irrigation to enable prudent usage of available water. This is amply illustrated through the following case studies.

Drip irrigation prudent water conservation and income generation for the farmers

Shri Bhagwanbhai Chawda is a progressive farmer of village Sandhnidar. Till 1993 he used to cultivate cash crops with rain-fed irrigation. His major crop used to be groundnut. For the summer crop of groundnut he used to provide ten waterings with 5 HP Electric Motor. For a single watering the motor has to run continuously for 24 hrs. The production of groundnut was 20 qt./hectare and the net income was Rs.15000. From Kharrif groundnut yield was 10 qt. / Ha. Net income was Rs. 6000. With the encouragement provided by ACF he has started cultivation of horticultural crops in 1993 –1994. In the year 2002, he installed Drip Irrigation system in his mango orchard. Before Drip Irrigation he used to provide sixty thousand liters/watering for the mango plants using flood irrigation. After installation of Drip Irrigation he now needs to provide just ten thousand liters/watering, which is a fivefold reduction compared to traditional watering system. Similar is the case with Shri Ramjibhai of Valadar village. He says that before drip irrigation he used to run his electric pump for two hours to irrigate forty mango plants. With Drip Irrigation he is able to provide the same watering within half an hour. Besides the other advantage is that there is no longer evidence of any salty layer on the surface of the soil. Ramjibhai no longer has to incur expenditure on weeding and other labor work. Quality of fruits has improved and also there is no need of continuous power supply for irrigation.

Table 8: Comparative Statement On Water Consumption In For Drip Irrigation Vs. Traditional Irrigation

Sr .No	Name of beneficiary Farmer	Village	Area Ha.	Crops	Water consumption In Ltrs / Irrigation.	
					Before Drip system	After Drip System
1	Devsi Vijanand Kachhot	Vadnagar	1.0	Mango	1 Lakh	10,000
2	Naranbhai Bhagwanbhai	Vadnagar	0.5	Mango	69000	5000
3	Budubhai Rambhai Gohil	Arithiya	0.7	Mango	70000	7000

4	Rambhai Masribhai Gohil	Arithiya	0.6	Mango	50000	5000
5	Babubhai Naranbhai Patat	Vadnagar	1.0	Mango	1 Lakh	15000
6	Kalabhai Devsibhai Vadher	Lodhva	0.3	Chikoo/ Mango	15000	2000

8.5 Collaboration with the Government and NGOs.

Since ACF has been a key agency in the mitigation of salinity in this region therefore it was appointed as member in the state level steering committee to mitigate salinity. AKRSP (I) has started a Quarterly Newsletter on Coastal Salinity programme for which ACF has been nominated in the editorial committee. It also carried articles by ACF at periodic intervals.

8.6 Knowledge Sharing and Networking

Through workshops with other experts and NGOs like AKRSP(I), VRTI(Kutchh), Sajjatha Sangh (A Network Of NGOs), IWMI Anand, GAU (Gujarat Agricultural University) Junagadh mutual knowledge sharing has been enabled. For example major outcome of one of the workshop was that farmers and scientists came to a conclusion that there is no need of chemical fertilizers in the Groundnut crop.

9. COMPARISON BETWEEN CASH CROPS & HORTICULTURE CROPS.

(A Cost-Benefit Analysis)

In order to achieve judicious usage of available land resources and to reap maximum benefit/income from the inputs farmers have been encouraged to do the Cost-Benefit Analysis themselves. For the above purpose, ACF has conducted training camps for the farmers and have been shown model farms where it has been proven that horticultural crops are far less water intensive and give better return per acre of cultivation.

Table 8: Comparison of cost and net income earned for different Crops per acre

Particulars	Sugarcane	Ground-nut	Wheat	Bajri	Vegetables	Horticulture crops, Mango/ Chikoo
No. Of watering	35	9	8	8	30	20
Quantity of water cubic	31500	2700	2400	2400	9000	6000

meter						
Duration of Crop (Months)	12	4	4	3	4	0
Cost of Details (Rs.)						
Ploughing cost	990	517	704	579	800	700
Cost of seeds	4350	1447	608	367	300	0
Cost of sowing	900	292	267	176	1400	0
Chemical fertilizers	1140	502	597	794	850	100
Organic Manure	1235	850	500	0	2886	0
Pesticides / Insecticide	500	347	0	0	1000	600
Water Charges	2700	0	989	0	1260	630
Weeding Exp.	825	500	0	367	600	1500
Harvesting Exp.	0	1117	613	926	3060	0
Transport Exp.	0	304	358	292	2150	0
Total	12640	5876	4636	3501	14306	3530
Production (Kgs.)	48 t	735	1595	1850	5100	12000
Market Price (Rs. / Kg.)	750 t	15	7	6.75	8.5	3.75
Total Income (Rs. / Acre.)	36000	11025	11165	12487	43350	45000
Net Profit (Rs./ Acre)	**23360**	**5149**	**6529**	**8986**	**29044**	**41470**

10. INITIATIVES TO OVERCOME DRINKING WATER PROBLEM.

Following are some of the activities undertaken to mitigate the drinking water problems for people living in the salinity ingress affected areas.

1. **Construction of Roof Rainwater Harvesting Structures.** Each RRWHS is sufficient to provide a family of 10 with sufficient water for drinking and cooking purposes throughout the year. This programme has been successful in providing fresh, safe and pure drinking water to the coastal populace. While earlier ACF used to motivate the beneficiaries, now the trend has changed and beneficiaries are themselves coming forward to take benefit from the programme. Gradually the subsidy from ACF/SRTT is being reduced while the farmer's contribution is increasing.
   Implementation strategy - For the implementation of the same, technical and financial support is being provided to the beneficiaries. Once the pit digging work is completed, a representative from ACF visits and certifies the measurements of the pit, after which the beneficiary gets the first installment (i.e. Rs. 2000). After the completion of construction of the RRWHS and its physical verification by ACF staff, second installment of the required cement is released to the beneficiary. Finally after the fitting of pipes, hand pumps etc. is completed, last installment is given to the beneficiary. This way it is ensured that the funds are utilized properly.

2. Building **Percolation and Recharging Wells** to bring about increase in the ground water table.

3. **Supply of water through tankers** to salinity affected areas.
4. **Renovation of Saline Wells** through various improvisations like sealing their bottom with cement.
   Implementation strategy - Under the sealing of wells project, in order to keep saline water at bay following steps were carried out:

   - De-watering of existing wells,
   - Sealing of the bottom of wells with two feet of cement and concrete.
   - *Bela* stone masonry work with plaster is carried out from the bottom up to the surface of the wells.
   - Eight galvanized pipes (Length two feet, Diameter one-inch) are installed horizontally on the walls of the wells.
   - Thus after sealing of the bottom, the vertically saline ground water aquifers were closed, and water close to the surface remains sweet.

5. Water supply through other schemes like overhead tanks, deepening of wells etc.
6. Training on Water Quality and Hygiene Awareness. Village level training programme had been organized on drinking water in seven villages by ACF staff with support of experts of AKRSP (I) and GAU Junagadh.
7. Quality monitoring and testing by conducting water quality parameters tests before and after renovation of wells. Quality of water stored in RRWHS is also being tested on a regular basis.

Table 9: Drinking Water Initiatives

Sr no.	Drinking Water Programme	1991 -2003	2003 - 2004	Cumulative
1	RRWHS constructed	437	346	783
2	Renovation of Saline wells through well sealing	20	3	23
3	Drinking water wells	11	2	12
4	Supply of drinking water (No. Of Villages)	55	10	65
5	Various other water supply schemes including construction of overhead tanks, deepening of wells etc. (No. Of villages)		10	

11. IMPACT OF THE DRINKING WATER PROGRAMME

Table 10: Period of availability and relative time spent by beneficiaries and non-beneficiaries for collection of drinking water.

Type	Period of availability of drinking water	Time spent in collection of drinking water
Beneficiaries	Full year	Negligible
Non-beneficiaries	Five months	4 hours/day

11.1 Meeting Distress Needs

During the drought period immediate need of the hour was to fulfill the drinking water needs of the people. ACF tried its best by supplying drinking water through water tankers.

11.2 Water Lasts For Much Longer Duration (Beyond Winter)

While earlier on the drinking water used to last only till November, now it is available in the wells even during the summers. The above analysis clearly proves that the beneficiaries of the RRWHS have an edge over the non-beneficiaries, who have to toil during a major part of the year. Hence, it becomes imperative to reach out to these people who are in dire need of help and support.

Returns Of Roof Rain Water Harvesting Systems- A Reduction In Dependency on external sources.

Shantaben Nakum lives in Kanjotar village situated on the coastal region. This village has been consistently facing problems of salinity ingress. Saline groundwater is found at a depth of 25-30 feet. Shantaben constructed an RRWHS with the help of ACF. During the latter part of the year, she wrote a letter to ACF explaining how she got to benefit from the RRWHS. Through the water supply scheme, they used to get water once in ten days. The drinking water used to be supplied through water tankers and even after waiting in Queue for long hours; the water requirement was not fulfilled.

Cost-Benefit Analysis of drinking water as estimated by Shantaben is as follows:

There are total five members in her family. The total daily needs for water for various households and drinking purpose is 80 liters. Apart from this they also make use of saline water for other domestic purposes. During severe drought months of April to June they have to spend up to Rs.1200 on an average for purchase of water. Shantaben spent around Rs.3230 last year during the winter and summer on purchase of water. “After construction of RRWHS, I have benefited not just financially but got a permanent solution to my water needs” says Shantaben. The cost of RRWHS came to around Rs.11,000, out which Rs. 8000 was contributed by ACF while the rest of Rs.3000 she herself contributed. Some of the benefits of RRWHS as enumerated by Shantaben are as follows:

Saving of time and drudgery, effective storage of safe and pure water, improvement in health due to reduction in the incidence of water borne diseases and reduced dependency on ground water. Shantaben says that the RRWHS has proved to be a boon especially during social occasions. Now she no longer has to incur costs of purchasing plastic barrels. Coupled with the monetary benefits is higher status in the village since they have turned into water suppliers from water consumers.

Substituting milk with water.

Water scarcity has always been an acute problem in Nana/Mota Sakaria village of Jafrabad block in Amreli District. In the absence of wells or bore wells, the people of the village were dependent on rainfall to fulfill their water requirements. The *sarpanch* (village headman) Sri Nankubhai wistfully remembers the time when they had to mix milk with flour to make the dough and women had to trudge 4 to 5 kms each day to fetch drinking water. But this does not hold true any longer. ACF sensitized the villagers about the capability of Roof Rainwater Harvesting structures to fulfill drinking water needs. Motivated by this extension support, 22 households in the village undertook construction of RRWHS. Nankubhai was able to collect 25,000 litre of water in the underground tank last year, which was sufficient to fulfill the drinking and cooking needs for his household of 10 members through out the year.

11.3 Capacity Building

Deepening of existing dry wells by ACF has resulted in improvement in the capacity of these wells. In order to make this project cost effective, ACF encourages people's participation both in terms of cash as well labor contribution *(Shramdaan)*. For instance, , each family in Gohil Ni Khan village contributed Rs. 50/- as voluntary contribution to renovate the well for community benefit.

11.4 Increased Groundwater Recharge Through Percolation

Percolation and Drinking water wells are serving the twin purposes of ground water recharge as well as meeting the drinking water needs. Percolation wells have benefited those lower income group people who are not even in the position to afford an RRWHS. One percolation well serves the domestic drinking and cooking needs for over one hundred households. The impact of sealed wells on water quality is shown in Table 12.

11.5 Improvement In The Quality Of Water

Quality of water has drastically improved in the renovated wells as shown in Tables 11 and 12. ACF conducted parameters tests on water quality before and after renovation of wells. Quality of water stored in RRWHS is also being tested on regular basis. Water quality analysis of a renovated well in Muldwarka village is shown below:

Table 11: Improved Water Quality In Renovated Wells In Village Muldwarka – A Before –After Comparison.

Sr No	Quality parameter	Before Monsoon (8/6/2001)	After first Rainfall 23/6/2001	Standard Value
1	PH	7.5	8.0	6.5 – 7.5
2	Total Hardness (as Calcium Carbonate)	2200	240	300
3	Chlorides	2650	225	250
4	TDS (Total dissolved Solids)	5000	600	500

All results are in mg/Ltrs. except pH

Table 12. Water Quality Of Renovated Wells-A With-Without Comparison.				
Sr. No.	Description	Existing nearby * well (saline)	Renovated well	Standard Value
1	pH value	7.50	8.00	6.5 – 7.5
2	Total hardness	4880	480	300
3	Chloride	1524	750	250
4	TDS	7900	1600	500
* Without renovation				

11.7 Saving Of Time And Energy:

The time and energy, earlier devoted for fetching water is being saved and hence has reduced dependency on other external agencies. A feeling of cohesiveness in the community has come up as a result of sharing stored RRWHS water with the neighboring families. This has been one of the ways of developing people's participation and sense of ownership for the projects.

12.CONCLUSION

With ACF's continuous efforts at spreading awareness and initiatives like construction of water harvesting structures, farmers have come to realize that erratic rainfall is not an issue. The real issue is that of efficient use and management of existing resources. ACF has been trying to do the same in its programme area with peoples' participation.
Currently a major portion of the groundwater is being used for Agri-related purposes, (79 % of the total).
Overall ground water level has risen because of construction of a series of water harvesting structures. This has addressed the twin problems of Salinity Ingress and Groundwater depletion to some extent in the programme area. The excess water runoff has been captured by water harvesting structures. Rainfed farming is able to get support waterings and farmers have been enabled to save the Kharif crops even during less rainfall years. In areas with average rainfall, Rabi crops are being grown. ACF's strategy to promote Horticulture crops and Drip Irrigation devices, has succeeded in promoting awareness among the people, as is evident from the growing demand for more and more horticulture crops. Thus ACF has come a long way since the time when farmers had to be individually approached about growing less water intensive crops e.g. Chikoo in salinity affected area and Mango in non-saline areas. Mindset of an average farmer has slowly undergone change and these farmers have increasingly adopted less water intensive cash crops coupled with efficient irrigation practices. Both the area under irrigation and productivity of crops have gone up as a result of water harvesting leading to increase in per capita income in the programme area.
In the aftermath of the green revolution there was a general feeling of confusion amongst farmers and they adopted all kinds of crops regardless of the suitability to the local soil condition and ground water availability in the region. This has led to widespread depletion of

groundwater. Today increasingly the need is being felt for continuous efforts for motivating the farmers to adopt a suitable cropping pattern. Therefore on a policy level it is essential that farmers are directed towards cultivation of less water intensive crops. Coercion will not help, as is suggested by some critics who want to impose a limit on groundwater usage. Groundwater harvesting coupled with judicious crop selection are the only long-term solutions. Though, some efforts in this direction have been made in isolation, but more are needed to sensitize the farmers towards prudent groundwater usage.

In the villages where drinking water programme has been implemented, earlier on availability and quality of drinking water was a major problem. Both these issues have been addressed after implementation of programmes. Availability of drinking water has substantially increased especially during the summers and drudgery of women has come down significantly. Due to interventions such as sealing of wells, well deepening, percolation cum drinking water wells, RRWHS and other water supply schemes, the drinking water problems of families have been ameliorated to a large extent in these villages.

Till now these activities have been on a small scale and scaling up of such initiatives in a larger geographical context would help in replicating the success.

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