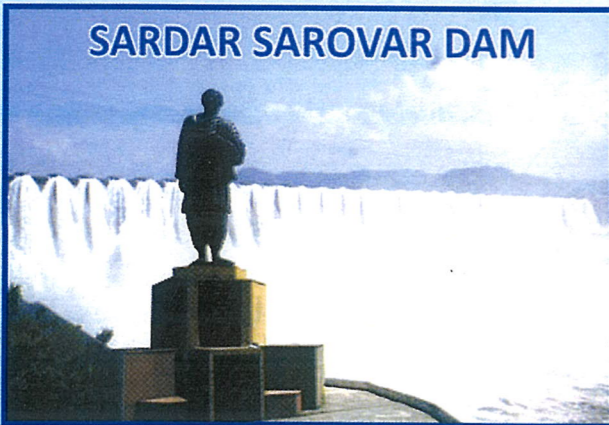


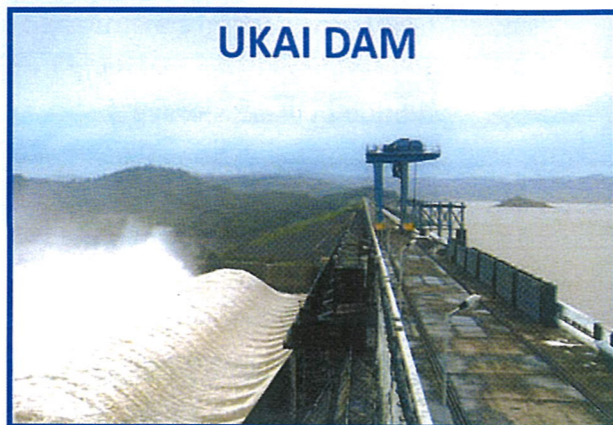
## Main Dams of Gujarat



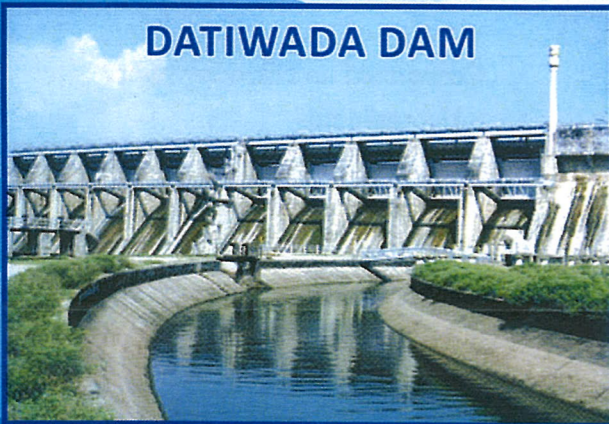
SARDAR SAROVAR DAM



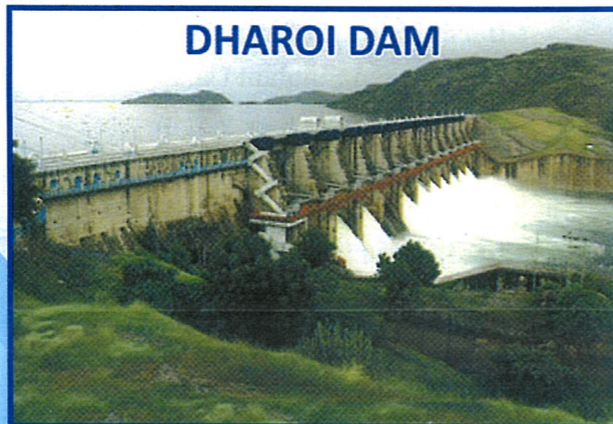
UKAI DAM



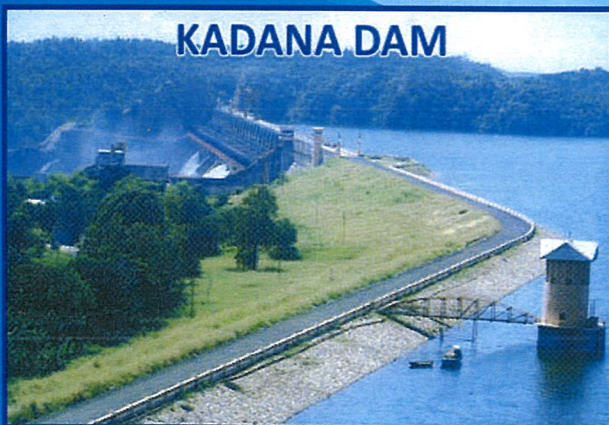
DATIWADA DAM



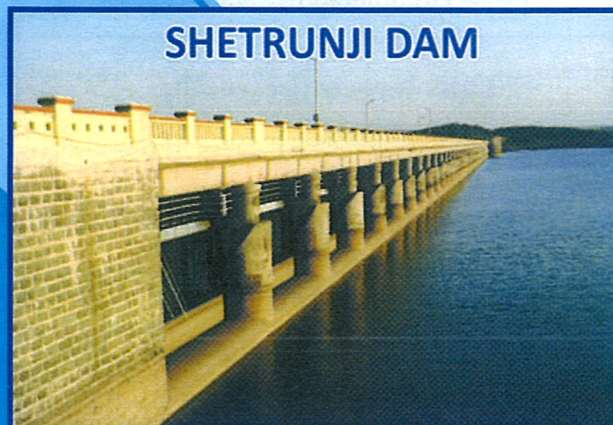
DHAROI DAM



KADANA DAM



SHETRUNJI DAM



## Activities of Water Resources Department



Water Resources Department  
Narmada, Water Resources, Water Supply & Kalpsar  
Department, Government of Gujarat  
[www.guj-nwrws.gujarat.gov.in](http://www.guj-nwrws.gujarat.gov.in)



## WATER RESOURCES OF GUJARAT

Gujarat's water supply varies widely from year to year and area to area. Sometimes floods and water shortage occur in the same year. While the wettest areas are in the South, most of Gujarat's people and farmlands are in the drier Northern and Western portions of the state. State's challenge is how best to conserve, control and deliver enough water to meet needs where and when they occur.

There are very few perennial rivers in the state out of a total of 185 rivers and limited facility of surface irrigation. Perennial rivers are located in 20% area of the state, which accounts for 80 % of surface water of the state.

River Basins		
Gujarat	Saurashtra	Kachchh
17	71	97

The annual rainfall in Western & Northern Gujarat and hilly eastern tribal belt is about 300 to 600 mm. Rainfall is not only scanty, but erratic and unevenly distributed.

Annual Rainfall mm	
Gujarat	800 - 2000
Saurashtra	400 - 800
Kachchh	< 400

As such majority of the area of the state is rain-fed and there is acute shortage of irrigation water in this area. This leads to drought every third year. The drought is such a menace that not only it eats away billions of rupees but along with it because of lack of surface and ground water resources, millions of cattle and shepherds have to migrate from Saurashtra, Kachchh and North Gujarat to the area of South Gujarat in search of water, food and fodder. Further, in order to mitigate scarcity, the State Government has to undertake scarcity relief works at a huge cost.

The ground water table is very deep and polluted, quality of which is not suitable for irrigation and drinking purposes. There was depletion of ground water by about 3 to 5 meters every year. Deterioration of quality of ground water leads to diseases like fluorosis.

Considering the extreme situation, the Government had after independence, taken up series of steps to meet with the situation. Attention was focused on creation of storages of water throughout the state.

Storage reservoirs are vital to the exploitation of water resources for sustained development of the state. Several large projects like Ukai, Kadana, Dharoi, Bhadar, Shetrunji, Sardar Sarovar were taken up in the Five-Year Plans along with several other major, medium projects have been constructed.

## FACT SHEET

### WATER CONSERVATION

1. Check dams constructed : 1,66,082
2. Deepening of tanks completed : 26,619
3. Check dams (Large) constructed : 5,543
4. Total additional area receiving irrigation : 6,83,154 Ha.
5. Addition in water storage : 47,961 Mcft

### MICRO IRRIGATION

1. On Government Tubewells : 2273 Tubewells (49,303 Ha.)
2. Canal based pilot project : 165 Ha.

### Participatory Irrigation Management (PIM)

1. Area covered under PIM : 5,55,676 Ha.
2. Water Users' Associations formed : 2618

### Interlinking and inter-basin transfer

1. Sujalam Sufalam Canal : Completed and flowing water
2. 14 Pipelines : • 11 completed  
• 1 at Tender stage  
• 2 at Preliminary stage
3. Kadana High Level Canal : Completed
4. Panam High Level Canal : 90% completed
5. SAUNI Yojna : Under progress (Phase-1 nearly completion)

### Extension Renovation and Modernisation (ERM) of existing canals

ERM Completed in area : 7.43 Lac Ha.

### Salinity Ingress prevention

Area Benefitted : 1,45,491 Ha.

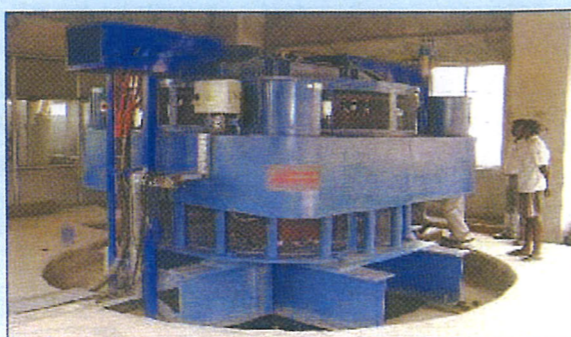
### Protection against erosion in Coastal region

Length covered : 49,166 meters  
People protected : 2,59,700 Lakh.  
Irrigable land protected : 6500 Ha.



## REVENUE GENERATION : HYDROPOWER

one of the top priorities of WRD is to generate hydropower in a safe, reliable and efficient manner. WRD's hydropower facilities serve as some of the West's most important electrical resources, with 8 hydropower plants with a capacity of 308 megawatts (MW). WRD's power-plants provide flexible, renewable, and reliable hydropower throughout the state, while also providing the reserve and back start capacity for the state. WRD's power-plants generate over 500 million MWh of hydropower, enough to meet the annual needs of over ONE million households. Further, WRD's facilities help to avoid producing approximately 600 million kilogram of carbon dioxide that would have been produced by fossil fuel power-plants.



The energy produced by WRD's facilities is the energy equivalent of replacing more than about 300 Million kilogram of coal. There is sufficient potential available for generation of hydropower at major dams and canals. In order to tap this potential, hydropower plants have been established at major dams as per details given below:

Sr No	Project	Installed capacity in MW	Annual power generation in MkwH
1	Ukai	300	372.88
2	Kadana	240	272.07

It may be mentioned here that all of these have completed their useful lives, however State's electricity company GUVNL is in the process of refurbishing the same, so that their lives can be extended.

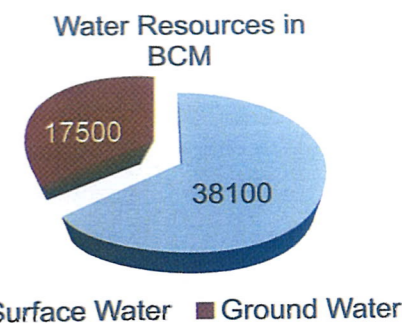
Further, in order to tap further potential, mini hydropower plants have been established on Public Private Partnership basis at 4 major dams. Details are given hereunder:

Sr No	Project	Installed capacity in MW	Annual power generation in MkwH
1	Karjan	3.0	18.15
2	Damanganga	5.6	19.30
3	Wanakbori weir	1.0	7.20
4	Panam	2.0	2.41

## WATER SUPPLIES TO INDUSTRIES

The Department also provides water to several industries. Total annual supplies are of the order of about 500 MCM at a value of Rs . 6700 million.

Extensive network of canals running into 33,000 kilometer length was also laid to distribute water to farmlands along with drainage network of 18,000 kilometer. Almost all the rivers have been harnessed. Besides, more than 1000 minor irrigation tanks, percolation tanks etc were also built to create local storage. Following gives the idea about the area that would be covered and the area that would still be rain-fed:



**Total Geographical Area 196 lac Ha**

**CULTIVABLE AREA 124 lac Ha**

**UNIRRIGATED RAINFED AREA 56.40 lac Ha**

Surface Water Potential 17.88 lac Ha

SSP 17.92 lac Ha

Ground Water 20.00 lac Ha

Minor Irrigation & water conservation Works 11.78 lac Ha

Decade-wise projects constructed and irrigation potential created is given hereunder:

Year of Completion	No of Schemes completed			CCA Ha
	Major	Medium	Total	
Pre-Independence	2	0	2	26,726
1951-1960	3	12	15	1,68,800
1961-1970	3	15	18	1,71,082
1971-1980	3	11	14	3,32,555
1981-1990	2	15	17	4,33,512
1991-2000	4	15	19	2,80,802
2001-2010	1	2	3	88,973
2011-2016	1	3	4	1,86,316
<b>Grand total</b>	<b>19</b>	<b>73</b>	<b>92</b>	<b>16,88,766</b>



## Principal Dams and Reservoirs

	Name	Gross storage million cubic meter	Structure height meter
1	Ukai	7414	80.58
2	Kadana	1249	66.00
3	Dharoi	813	45.87
4	Panam	578	56.36
5	Karjan	545	100.00
6	Damanganga	525	58.60
7	Dantiwada	394	61.00
8	Shetrunji	309	32.02
9	Bhadar	188	29.00
10	Sukhi	177	38.00
11	Watrak	158	43.00
12	Hathmati	146	24.00
13	Sipu	161	39.00
14	Machhu-II	88	25.00
15	Deo	68	26.00
16	Und-I	69	27.00
17	Machhu-I	69	31.00
18	Meshwo	53	14.00

## SALINITY INGRESS PREVENTION

The State has longest sea coast line of 2125 kilometer, which is about one third of total coast line of India. Owing to rapid depletion in ground water, ingress of salinity in coastal area has been a major threat rendering the land infertile. Realizing the danger lying ahead, the Government has taken up measures to arrest further advancement of salinity by taking up series of steps. These are construction of bandharas, check-dams, tidal regulators, recharge reservoirs, recharge tanks, recharge wells, nala plugging, spreading channel and afforestation.

Measures taken up so far to prevent salinity ingress include:

- 100 tidal regulators/ bandharas
- 59 recharge reservoirs
- 79 recharge tanks
- 1356 check-dams
- 4487 nala plugging
- 220 kilometer long spreading channel
- 291 kilometer long radial canal and
- Afforestation over 5867 hectares



## PROTECTION AGAINST EROSION IN COASTAL REGION

Coastal erosion has been observed in nine Districts of Gujarat. These are Valsad, Navsari, Surat, Bharuch, Jamnagar, Bhavnagar, Junagadh, Amreli and Porbandar. The erosion is taking place mostly under the action of strong tidal current accompanied by wave action. Heavy damages are found to houses, fertile land and other properties due to coastal erosion. Water Resources Department has identified such locations and has in consultation with Central Water & Power Research Station, Pune worked out various designs, depending upon site condition, to carry out protection works.

In last ten year protection works in 49 km length at an expenditure of of Rs. 249 crore in Valsad, Navsari and Surat Districts of South Gujarat have been completed. About 6500 ha land has been protected and about 2,59,700 people got benefited.





## EXTENSION RENOVATION AND MODERNISATION (ERM) OF EXISTING CANALS

Canal system of projects constructed in the past need complete renovation so as to run the system efficiently benefitting the end users. The system runs into 33,000 kilometers and only 7,359 kilometer length is lined either with sandwich type brick lining or concrete lining. Rest of the length is unlined requiring frequent removal of silt. The canal sections are required to be re-sectioned so as to carry the discharge efficiently.

### Performance Benchmarking:

The Government has taken up comprehensive exercise of benchmarking the performance of the canal system of each of the projects. Reappraisal of irrigation potential has also been taken up in view of modification in cropping pattern as well as land use pattern. It is envisaged to complete the renovation, extension and remodeling of entire canal system of the State over a period of 5 years.

**Water auditing** shall also be carried out simultaneously for each project every year. Following performance indicators are decided to be reviewed:

1. Hectare of land irrigated per unit of water
2. Crop yield per unit of water
3. O & M Cost per unit of water
4. Assessment & recovery of charges per unit of water

### Operation, Maintenance and Repairs

The Department through its own cadres operates, maintains and repairs almost all facilities including dams, barrages, canals and drains. The programme also involves carrying out associated water management activities which are designed to ensure that such facilities are operated and maintained in a manner that protects State's investment. It includes examination of all structures and their repairs/ rectification if required. Minor canals where Water Users Associations have taken over the canals, such activities are performed by them. In respect of all other canals, the Departmental staff carries out all activities under this program.

Water for irrigation is planned to be supplied on rotation basis decided in consultation with agriculture experts and Advisory Committees for respective irrigation schemes.

**A programme for inspection and examination of all canal structures has been launched.**

Engineers have conducted 'walk through' inspection and recorded the deficiencies. A time-bound programme is chalked out and is under implementation for rectification/ refurbishment of such structures.

## DAMS & THEIR SAFETY

Dam safety activities are directly related to Department's priority to ensure reliable and efficient delivery of water and hydro-power. The objectives of Dam Safety Program are:

- (a) to ensure that the Department's facilities do not cause unreasonable risks to people, property or the environment and
- (b) to take appropriate action to reduce and manage risks in an efficient and cost-effective manner.

The Department is responsible for 196 dams that form a significant part of the water resources infrastructure for the state. As these structures age, concern increases about their satisfactory performance.

The Department has therefore launched a massive programme of conducting safety evaluation of all the dams and has taken up necessary corrective steps to ensure the safety of all these dams.

- Necessary guidelines and manuals for conducting safety inspection of earthen, masonry and concrete dams and gates as well as other electrical and mechanical components of the dams have been issued.
- Checklists have also been prescribed and various levels of officers are assigned duties to inspect the dams twice a year- immediately after monsoon and prior to monsoon.
- These officers are imparted training on how to inspect, what to inspect, how to record findings and what follow up action to take subsequent to dam inspection.
- Further, preparation of Emergency Preparedness Plans (EPP) for dams is also taken up.
- Necessary rectification of dams is also taken up.

While all this is done, this still needs to be strengthened by imparting continuous training twice a year to all the officers and by continuous monitoring so as to imbibe a culture of safety inspection and follow up irrespective of the fact that monsoon was very good or very bad.

### Operations during floods

- WRD every year, in the Month of May, prepares Disaster Management Plan (Flood Memorandum) containing:
  - Guidelines for operation during floods
  - Listing of various flood forecasting stations, rain and river gauge stations and focal officers as well as agencies responsible in rescue operation and their phone numbers, effect of floods at different stages etc.



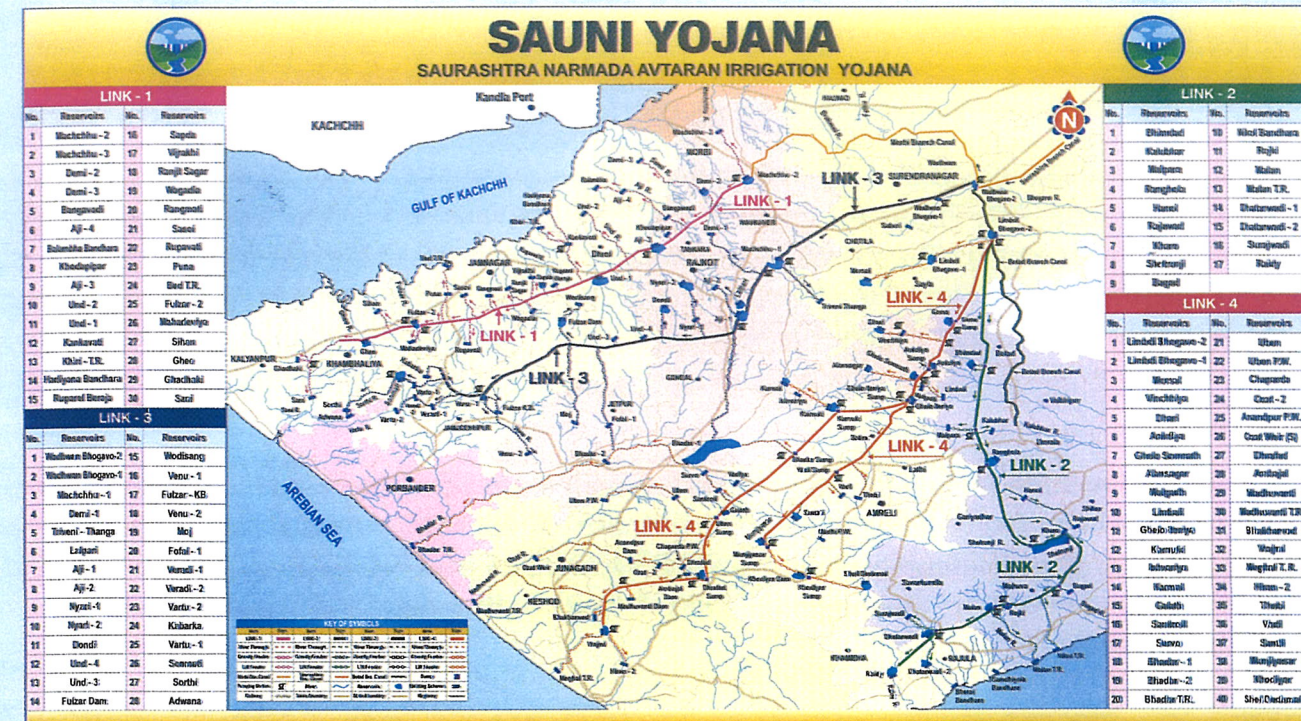
- 12 regional Flood Cells and one Central Flood Cell at Gandhinagar are made operational 24x7 from 15<sup>th</sup> June to 15<sup>th</sup> October for communication.
- The Central Flood Cell at Gandhinagar compiles data of water level, releases from dams, storage position and warnings every day and circulates to all concerned.
- Local Flood Cells and Focal officers keep the district administration and others informed about inflow & outflow, water levels in dams, water releases and their warnings.
- In case of interstate rivers like Damanganga, Tapi, Mahi, Narmada the respective focal officers keep continuously in touch with their counterparts in respective states of MP, Maharashtra and Rajasthan as well as with Central Water Commission so that advance action could be taken.
- WRD has improved its emergency management capability by planning and conducting exercises in conjunction with emergency action plans, continuity of operation plans, occupant emergency plans, the emergency notification system and the emergency operations center.

## INTEGRATED APPROACH

Having harnessed all possible sources, the Government launched massive drive for water conservation. The purpose behind this was to create local storages, which can be done at low cost in a construction season and can be utilized as a supplement to major-medium irrigation scheme. The State adopted an integrated approach for efficient and sustainable water resources development and management, which is inclusive in scope. This includes:

- Water Conservation
- Micro irrigation management
- Participatory Irrigation Management
- Interlinking of rivers and inter-basin transfer of water
- Strengthening of existing canal system
- Salinity ingress prevention

All these assets created by the Government have been put on a GIS based Geo Spatial Database so that development of a watershed can be taken up based on priority determined scientifically.



- Under First Phase (Link-1 to Link-4) 222 Km pipeline work out of total 230 km is already completed and 13 reservoirs receives Narmada Water.
- Second Phase is under progress.





## SAURASHTRA NARMDA IRRIGATION AVTARAN YOJNA (SAUNI)



- This is another interlinking project. Under this project, it is planned to divert surplus waters of river Narmada during monsoon and store the same in 115 irrigation projects located in drought prone areas in Saurashtra region of the State.
- 10,22,589 acres land will receive water for irrigation through 4 link Pipe lines of 1126 Km length.
- 11 districts of drought prone Saurashtra region will get irrigation water. Moreover small towns and villages will also receive drinking water.

<b>Total Link</b>	<b>: 4</b>
<b>Total Length</b>	<b>: 1126 KM</b>
<b>Estimated Cost</b>	<b>: 16,638 Crore</b>
<b>District Benefited</b>	<b>: 11 District (Rajkot, Suredranagar, Junagadh, Bhavnagar, Amreli, Botad, Jamnagar, Porbandar, Devbhumi Dwarka, Gir Somnath)</b>
<b>Area Benefited</b>	<b>: 10,22,589 Acre</b>
<b>Reservoirs to be Filled:</b>	<b>115</b>
<b>with Narmada Water</b>	



## WATER CONSERVATION

### Sardar Patel Participatory Water Conservation Scheme (SPPWCS) : The Concept

#### Check Dam :

A checkdam is a simple wall of about 1.5 to 2 meter height constructed across a river / rivulet/ stream. It permits rest of water to spill over if water level in the river rises. It has no moving component or mechanical devices and hence requires no operation or maintenance. It not only recharges the ground water but also offers an opportunity to carry out irrigation by lifting water accumulated behind the wall.

About 1,47,726 checkdam constructed by public participation after year 2001 under SPPWCS.

#### Deepening of ponds

In order to augment the capacity of existing ponds and irrigation tanks, the Government has taken up deepening of them by removal of silt. 26,619 ponds have been deepened after 2001. This enhances the capacity without spending heavily on creation of new capacities.



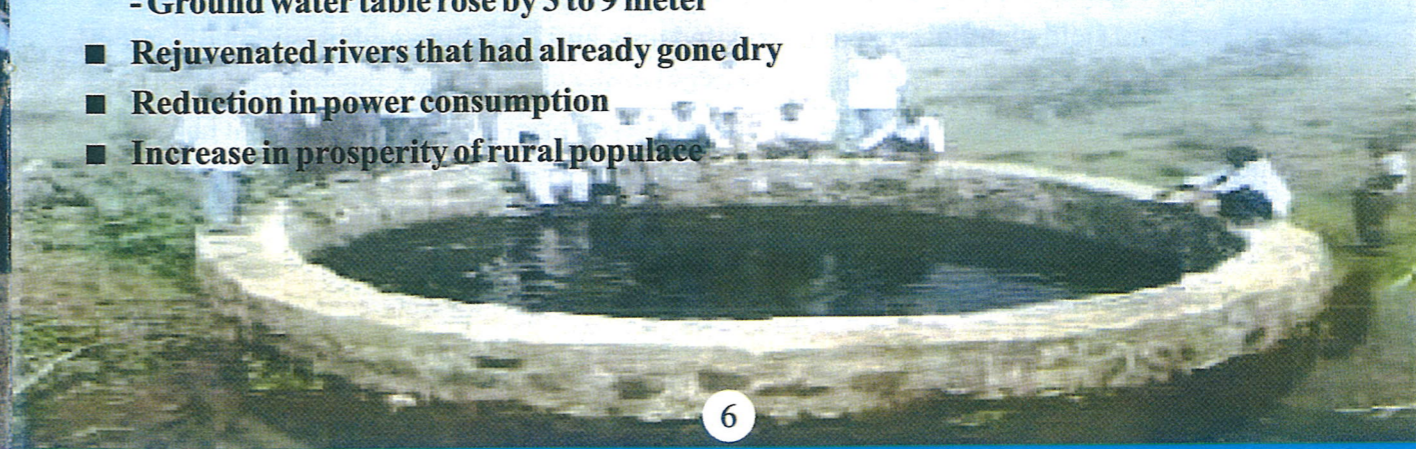
Tank deepened before monsoon



Water filled up due to rains

#### Benefits of water conservation drive

- Secured kharif crop against vagaries of nature like drought, delayed monsoon and early withdrawal of monsoon
- Supported vibrant rabi cropping in years of normal monsoon
- Reduced extraction of ground water for irrigation
- Resulted in optimum utilisation of resources
- Augmented ground water recharge
  - average 7 to 8 wells in surrounding got recharged
  - Ground water table rose by 3 to 9 meter
- Rejuvenated rivers that had already gone dry
- Reduction in power consumption
- Increase in prosperity of rural populace





## MICRO IRRIGATION

The Government has taken up initiative for regulating water use for agriculture by spreading micro irrigation technology. Gujarat Green Revolution Company (GGRC) established in 2005 to expedite promotion of micro irrigation. Instead of providing financial assistance only, GGRC



- motivates and guides the farmers for adoption of micro irrigation
- Helps farmers in selection of crop and deciding layout of micro irrigation system
- Contributes 50% of estimated cost of micro irrigation system or Rs. 60,000 whichever is less as financial assistance
- Assists farmers in securing loan (upto 45 % of estimated cost of the system) from banks to supplement financial assistance
- Ensures third party supervision during installation of the system
- Maintains and ensures trouble free operation for 5 years

WRD has taken up installation of micro irrigation in command area of all its tubewells, so as to prevent further depletion of ground water.

## PARTICIPATORY IRRIGATION MANAGEMENT (PIM)

Besides providing irrigation facilities, steps need to be taken to ensure that irrigation water be distributed efficiently and equitably in the command area and that it be used efficiently through Participatory Irrigation Management (PIM). Where irrigation Co-Operatives maintain the canal network and field channels, expand irrigated area and distribute and provide tail enders their fair and just share of water. Rehabilitation of existing canal network through stakeholders' participation to make water available to tail enders is given priority. The Government has taken up initiative to involve beneficiaries and stakeholders in irrigation management by enacting PIM Act in 2007. Under the provisions of this Act, Water Users' Association (WUA) is formed from amongst the beneficiary farmers in command area of an irrigation project. 90% of cost for community mobilisation is borne by the Government. Rehabilitation of canals is completed

## Kakrapar - Gordha Vad Lift Irrigation Scheme

- Irrigation deprived tribal area on the eastern side of Kakrapar Weir will receive irrigation benefit.
- Plan to pump water from river Tapti near Kakrapar weir into Gordha weir on river Ver through 10.96 Km Pipe Line. Second Pipe Line of 21.32 Km to pump water from Gordha Weir to Village Vad of Mangrol Taluka.
- Irrigation benefits to 38,200 acres covering 47 Tribal villages of Surat district.

## Karjan Reservoir Based Lift Irrigation Project

- About 70 Km long Pipe Line is planned to irrigate 7,500 Ha. tribal area of Narmada, Surat and Bhrauch districts.
- 103 Villages will benefited, moreover 40 Ponds, several Check Dams, small rivers and 2 minor irrigation scheme will receive water.

## Ukai-purna High Level Canal

- About 11,600 Ha. tribal area will receive irrigation benefits.
- Head Works and Main Canal is completed and operationalized.

## Chinchai Lift Irrigation Project

- About 5000 Ha. tribal area in 17 villages will receive irrigation benefits.
- First Phase works have been completed and already 10 villages are receiving irrigation benefits in Valsad district.



## Sujalam Sufalam in Tribal Area

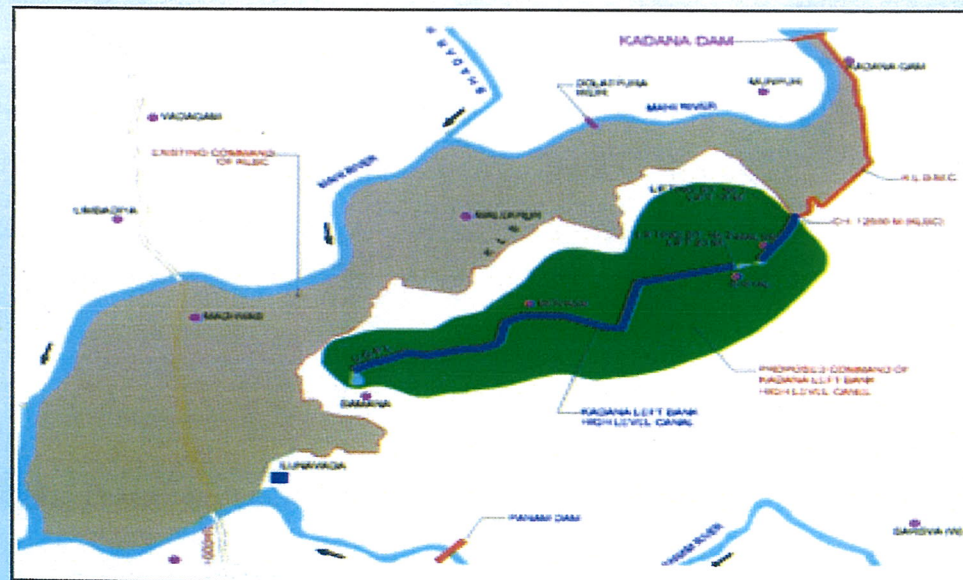
### Panam High Level Canal

has been constructed from Panam reservoir to provide irrigation facility to 18,000 hectares of tribal talukas of Godhra, Lunawada & Shehra. 3.27 kilometer long Irrigation Tunnel has been completed and commissioned in a hilly and challenging terrain.



### Kadana Left Bank High Level Canal

Offtaking from Kadana reservoir has been constructed to provide assured irrigation over 10,700 hectare area of 44 villages of Kadana, Santrampur and Lunavada taluka of tribal area. Distribution network for additional 5000 hectares is also envisaged for the purpose. The other project comprises of large check dams across the rivers Goma and Anas of Panchmahal district in tribal area.



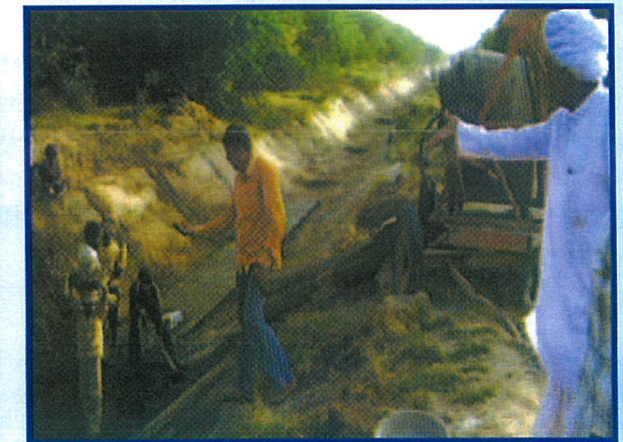
by the Government before handing over to WUAs. The WUA contributes 10% of the rehabilitation cost. Preference is given to WUA to carry out rehabilitation by them. A canal can be handed over to WUA even prior to rehabilitation, if the WUA so demands. Advance payment of the order of 1/3rd of the estimated cost is given to WUA for starting the work.

Under the provisions of the Act, a WUA is authorized for

- Collecting Government water charges
  - Retention of 50% for O&M permitted, rest goes to the Government
- Deciding water rates higher than the Government charges
- Retaining entire additional amount.
- Increasing women's participation in the WUA

Emphasis is laid on capacity building of the stakeholders by conducting through WALMI, regular training, workshops and exposure visits for farmers as well as Government Officers. Dissemination of knowledge is also done through

- Krishi Mahotsava organised annually in the month of May, covering all the villages before cropping season sets in
- Electronic media, posters, public meetings
- Involvement of experienced farmers in PIM promotion



A calendar for PIM activities is prepared and widely publicized from amongst WUAs. Performance of each of the WUAs shall be judged based on indicators shown in the calendar. It is planned to give incentive to the best performing WUA every year.



## INTERLINKING AND INTER-BASIN TRANSFER

Having exhausted all resources, inter basin transfer of water is the only option left. Interlinking of rivers is a leading step to divert surplus water from surplus to deficit basins.

Some of the interlinking projects taken up are:

### Completed projects

- Harnav - Guhai Link
- Sabarmati - Saraswati Link
- Mukteshwar - Harsoi Link
- 17 enroute rivers on alignment of Narmada Main Canal
- 21 enroute rivers on alignment of Sujalam Sufalam Spreading Canal
- Ukai Purna High Level Canal

### Projects under progress

- Spreading Channels to prevent salinity ingress in coastal region
- Detailed Project Report Prepared by National Water Development Agency Which is under Scrutiny.

### Projects under planning

- Par Tapi Narmada Link
- Damanganga Sabarmati Link
- Water balance study is under progress by NWDA

## Sujalam Sufalam Project

**A leading step to divert surplus water from surplus to deficit basins.**

It is an integrated approach to augment water resources in water deficit and overexploited area of the State. It includes micro & macro level measures like inter basin transfer from surplus to deficit basin and extensive ground water recharge through

- Spreading canals
- Lift irrigation through pipe lines
- High level canals
- Salinity ingress prevention measures
- Check-dams



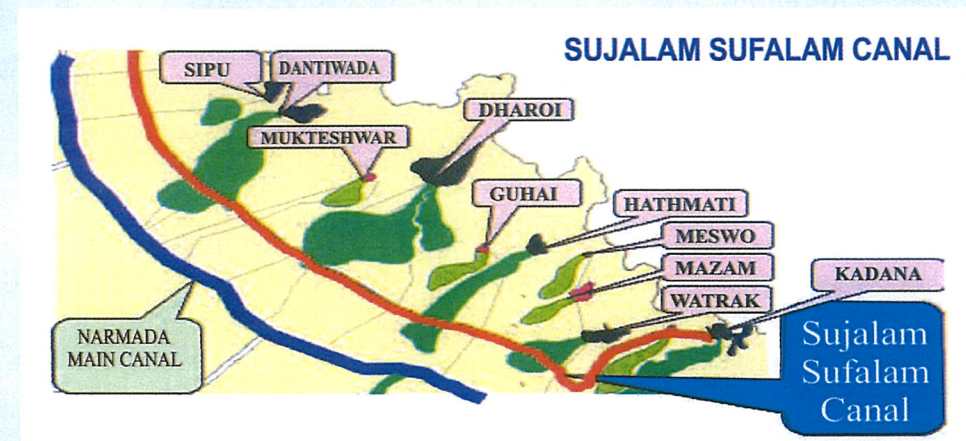
Canal Rehabilitation Work

**Sujalam Sufalam Spreading Canal** is an unlined canal of 332 Kilometer length traversing through seven districts. The canal is having a capacity of carrying 2000 cubic feet per second (cusecs) of water. The canal all along its course has major structures for crossing 21 Rivers, 2 National Highways, 27 State Highways, 07 Railway lines. Besides, there are 600 other structures.

## Sujalam Sufalam Project

**Narmada Base Lift Irrigation Scheme To Utilise Excess Flood Water**

14 lift irrigation pipelines are planned to fill up nine reservoirs and enroute ponds of North Gujarat region to augment irrigation facilities and drinking water supply to villages.



### Benefits Achieved

- Recharging of ground water between 3 to 5 meter
- Envisages irrigation benefit to 70,000 hectare area
- Drinking water supply to 679 villages & 8 towns
- 634 enroute ponds connected

