Rain Water Harvesting Activities at Navsari Agricultural University

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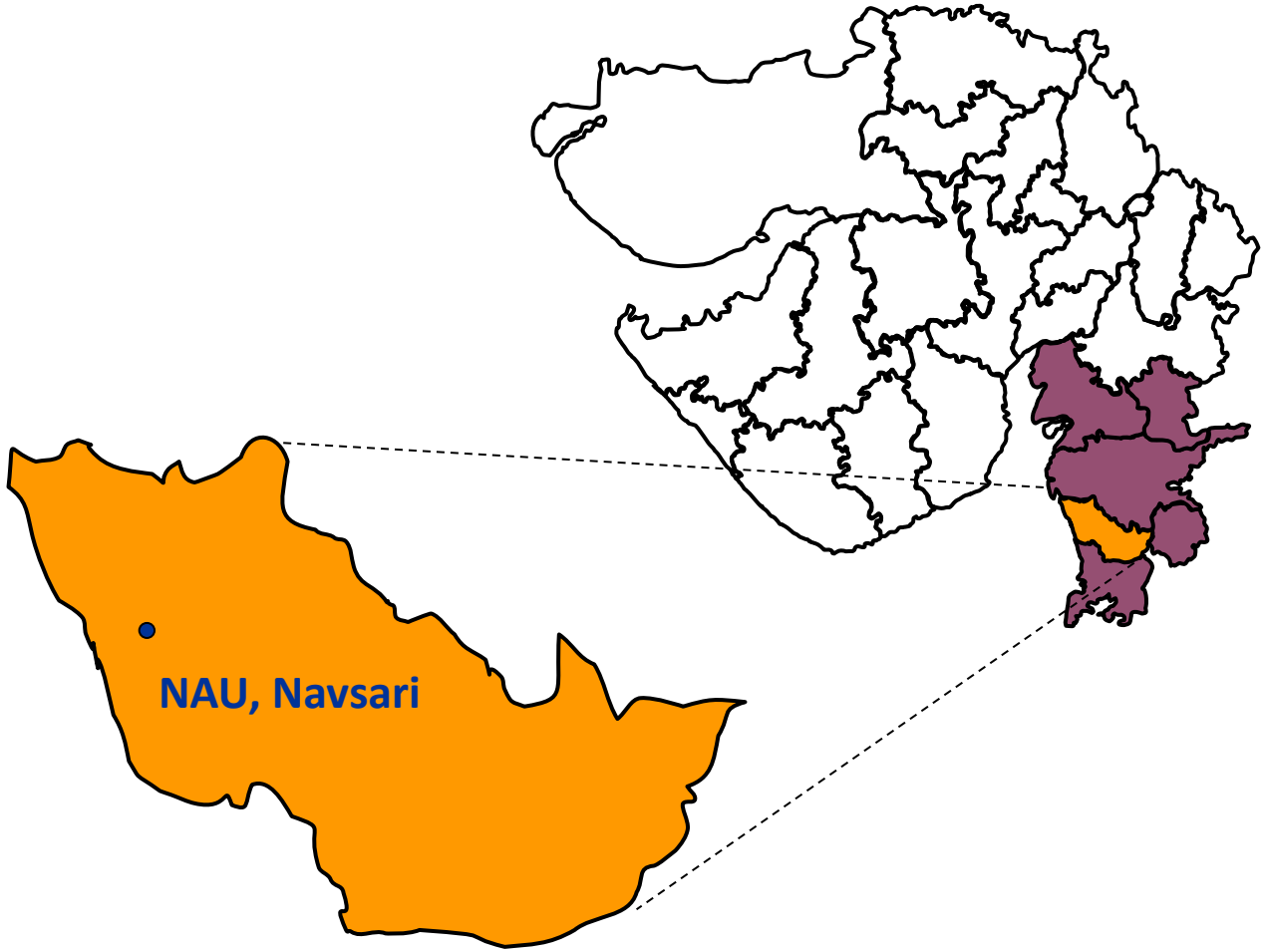
Abstract

- Navsari Agricultural University which caters to the needs of farmers of seven districts of South Gujarat is among the leading Agricultural Universities of the country.
- The University not only trains aspiring students and farmers but is involved in basic and adaptable research for the region.
- To improve Water Use Efficiency, comprehensive watershed management and water conservation techniques are adopted in a scientific manner in the University farms spread across South Gujarat.
- Rain water harvesting and water management adopted comprised of land use planning, crop selection, irrigation method, irrigation scheduling, mulching, green house technology, water conservation, rain water harvesting, waste water recycling, organic farming, afforestation, conjunctive use, alternate farming practices, zero tillage and conservation agriculture.
- Expertise for recommending location specific technologies for rain water management from few square feet to hundreds of hectares are available at the University.

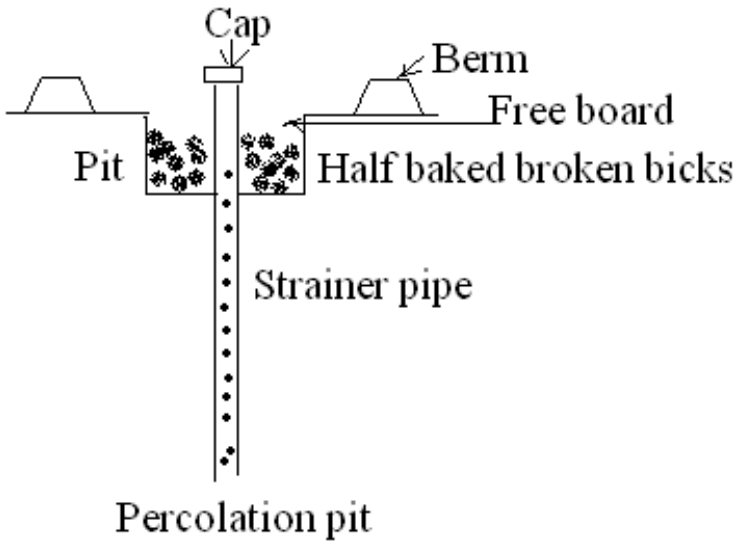

NAU, Navsari

General Features of Navsari Campus

- Latitude : 20° 57’ North
- Longitude : 72°54’East
- Altitude : 9 m AMSL
- Annual Rainfall : 798 to 1655 mm in 31 to 71 rainy days
- Agro Climatic Zone :XIII
- Topography : Flat
- Soil : Clay in texture with 40 % clay content
- Major Crops : Paddy, Sugarcane, Mango, Sapota, Coconut, Pulses, Banana,

  Papaya, Brinjal, tomato, Chillies, Tuber crops, Several types of flowers, Teak, Bamboo, Melia, Ailanthus, Ficus species, Mangium, Casuarina, Eucalyptus, Grasses, Medicinal plants

Percolation pit for clay soils of South Gujarat



Features of pit recommended for clay soils of south Gujarat coast

- Location of pit should be at the lowest point of the field
- Pit dimensions - 4 m x 3 m x 2 m
- Inserting two casing pipe (strainer) of -200 mm dia. at the center of pit till 12 m BGL
- Strainer pipe to be capped at the top
- Filling the pit till 1 m depth by half baked broken bricks
- Free board of 1 m

Precaution

- Only good quality runoff water should be allowed to be drained vertically
- Strainer pipe should be capped at the top end to prevent any accident, rodents, and muck to enter the ground water

Percolation pit for clay soils of South Gujarat

- **To harvest rain water and to maintain their water quality, farmers of coastal area of south Gujarat are recommended to construct a percolation pit near their bore well, in the available natural depression / monsoon drain. The size of pit could be 4.0 m long x 3.0 m wide x 2.0 m deep, along with 200 mm PVC strainer pipes up till 12 m depth inserted before digging the pit. It could help in marginally improving the water quality or prevent further deterioration in water quality. The pipe should be compulsorily capped at the top and should be about 0.6 m above ground to avoid direct entry of runoff or any rodent in the well.**

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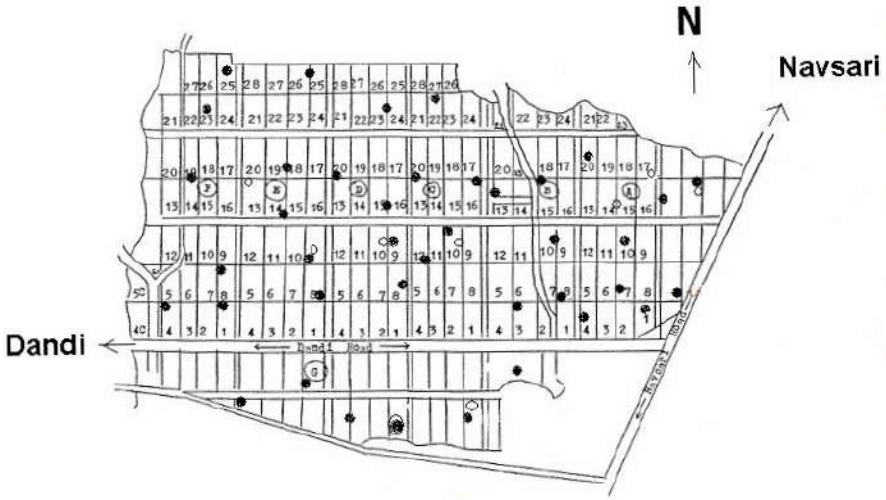

Fig.: Bore well / Open well locations

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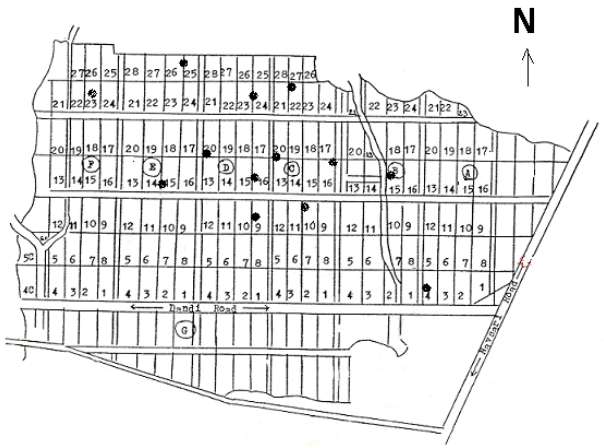

Fig: Well water quality measurement points

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Fig.: Water table observation points (open wells)

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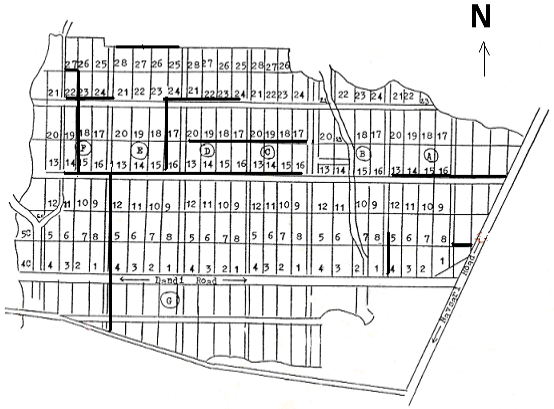


Fig. Irrigation pipe line

Salient Findings of long term study on watershed management

- **The long term progressive development regarding rain water harvesting, increased use of pressurized irrigation methods along with other scientific watershed management practices clearly showed overall improvement or helped in maintain the ground water quality, in spite of increase in cropping intensity, human and animal population within and outside campus.**
- **Water quality of only those wells was found to be deteriorating which are catering larger cropped area, located on higher elevation and away from any water body.**
- **Farms which follow better method of irrigation, precision farming, organic cultivation, Agro - Horti – Forestry – Fishery – Dairy modules along with rain water harvesting by a pond / percolation pits / percolation wells / trenches / sub soiling have maintained or checked the previously declining ground water quality.**

Recommendation : To maintain quality of water of NAU farms

- The study indicates to **harvest as much rain / canal water**, adopt **efficient irrigation methods**, crop rotation, use of organic fertilizers and **tree plantation especially in northern strip of University campus.** Model of Forestry — Dairy - Horticulture should be adopted in the strip.
- Adoption efficient irrigation methods & recommended irrigation schedules
- **Imposition of ban on new boring in the campus**. Permission of boring should only be given after evaluating the monthly ground water quality for a year, of the existing bore well in the neighborhood and its distance from the proposed well.
- The study also suggests that **monitoring of water quality** of selected wells (Research Farms) must be carried out on regular basis as it will help in strategizing management of water within the farming unit.

Multiple Uses of Harvested rain water, canal water and recycling water for irrigation at NAU Campus, Navsari

Irrigation

Water quality improvement &
Check on sea water ingress

Duckery

Biodiversity

Fishery

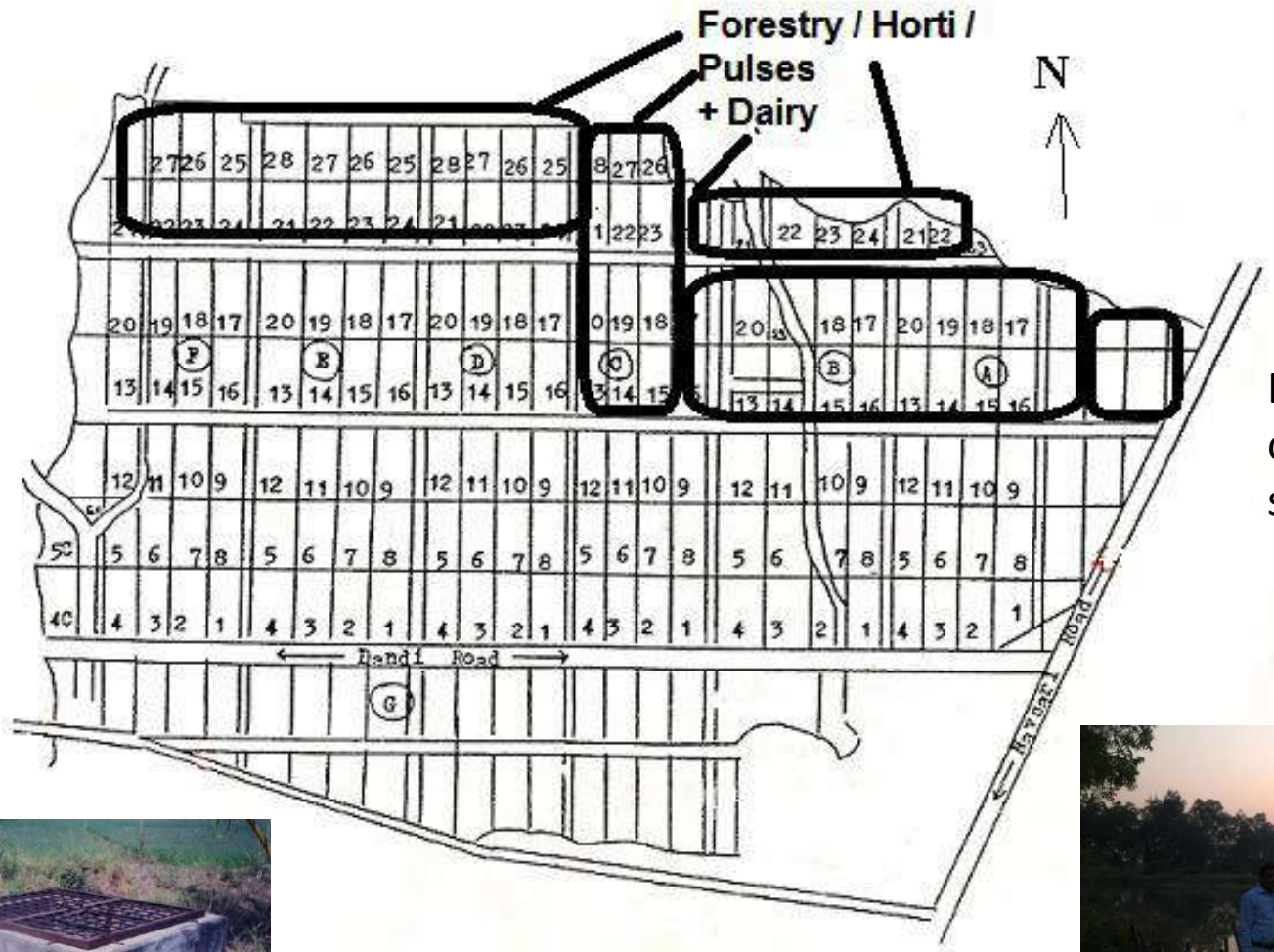
Cattle willowing

Proposed land Use with respect to Water Management

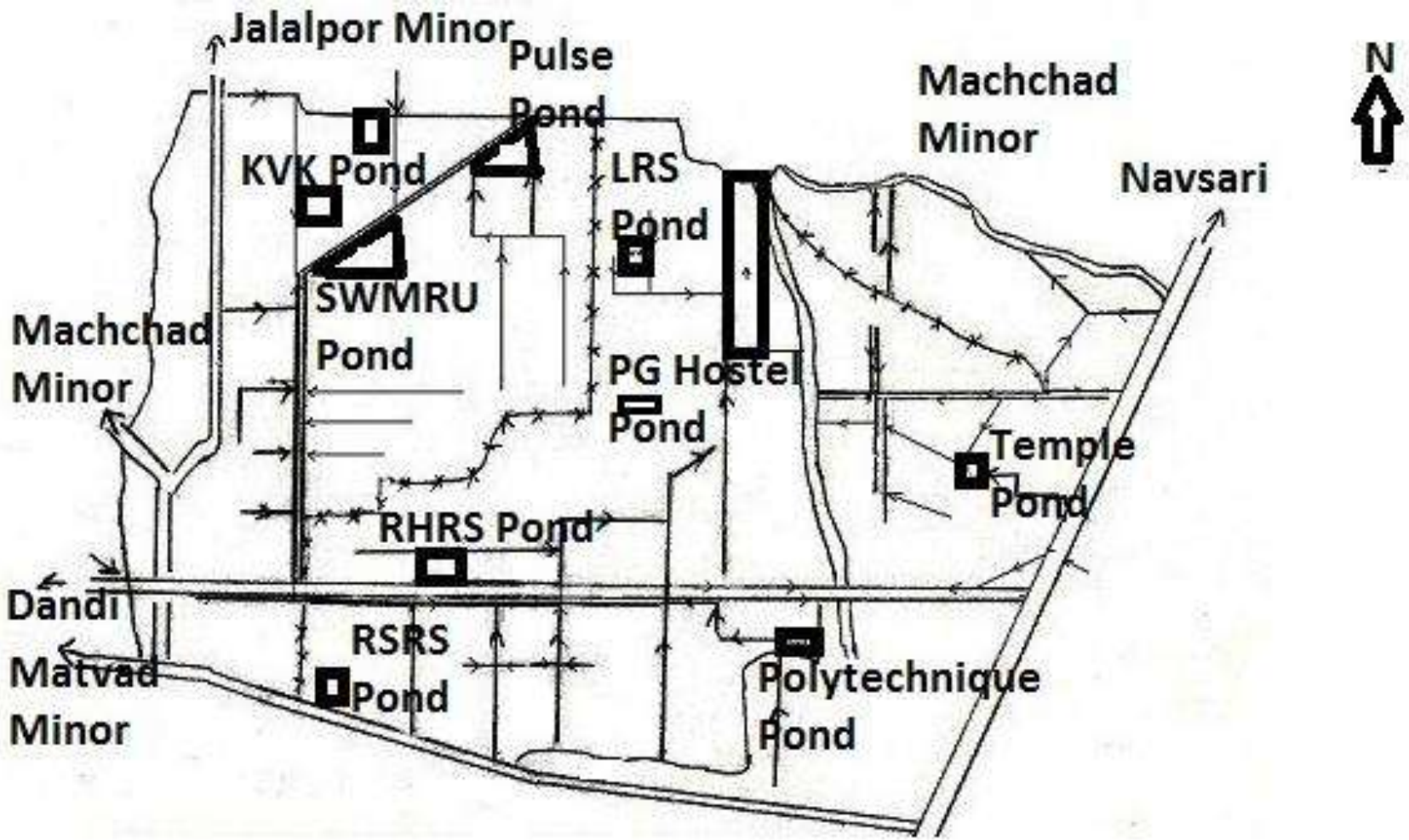
Planation of forest species

Pressurized irrigation in horticulture and sugarcane crops

Kharif paddy to conserve rain water

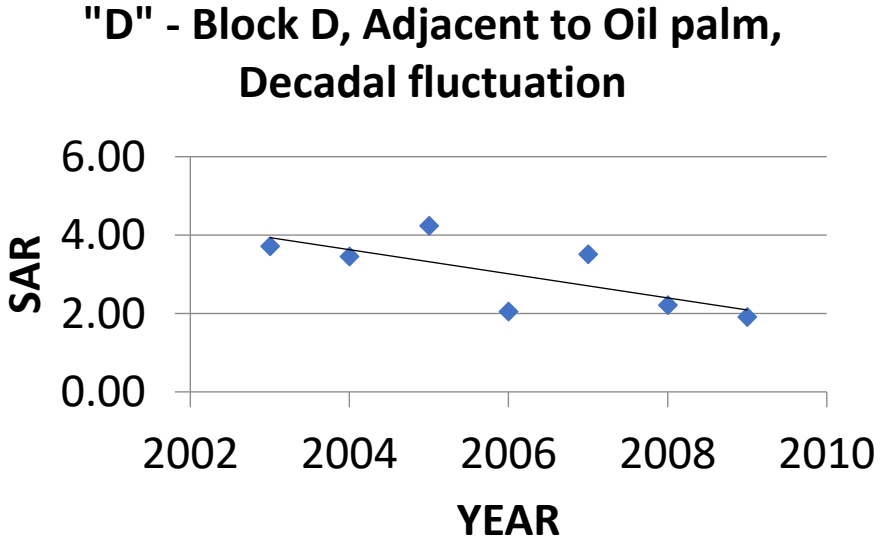


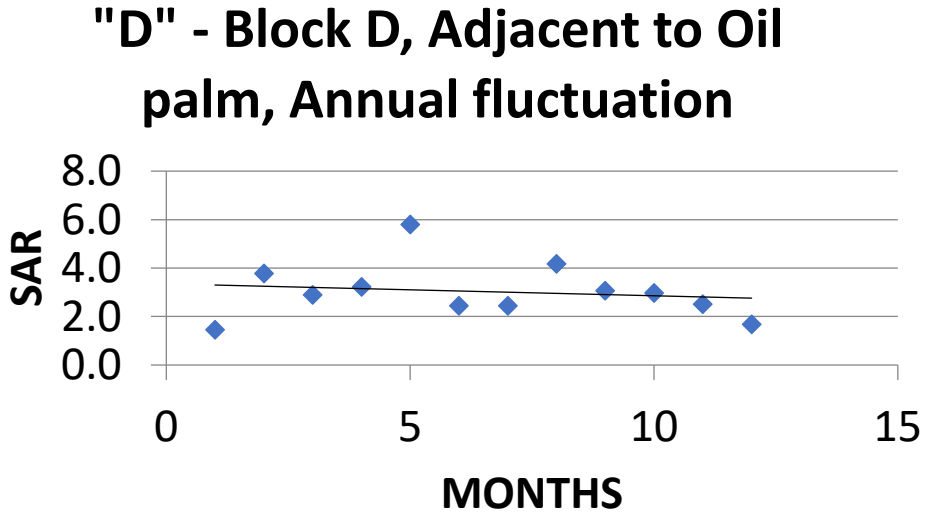
Recommendation of creating of waterbodies to sustain ground water quality

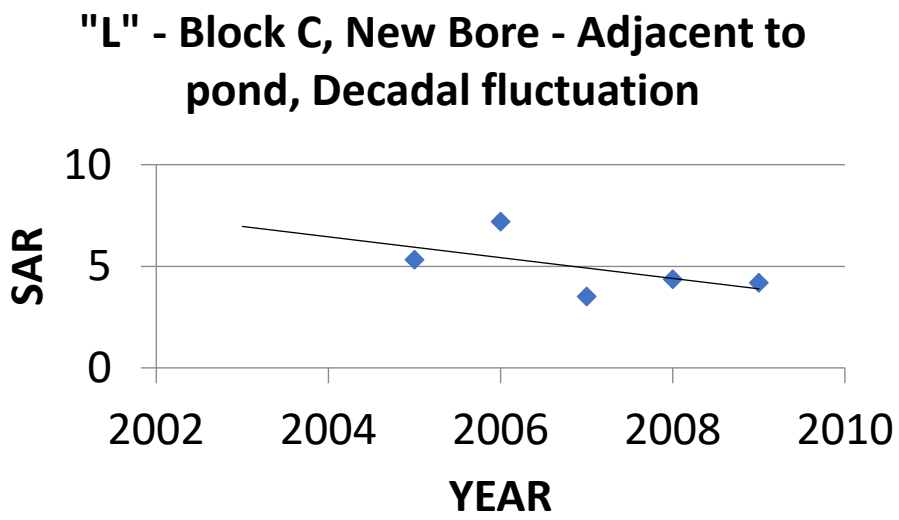


Ponds constructed in NAU campus to harvest rain water and canal waste water

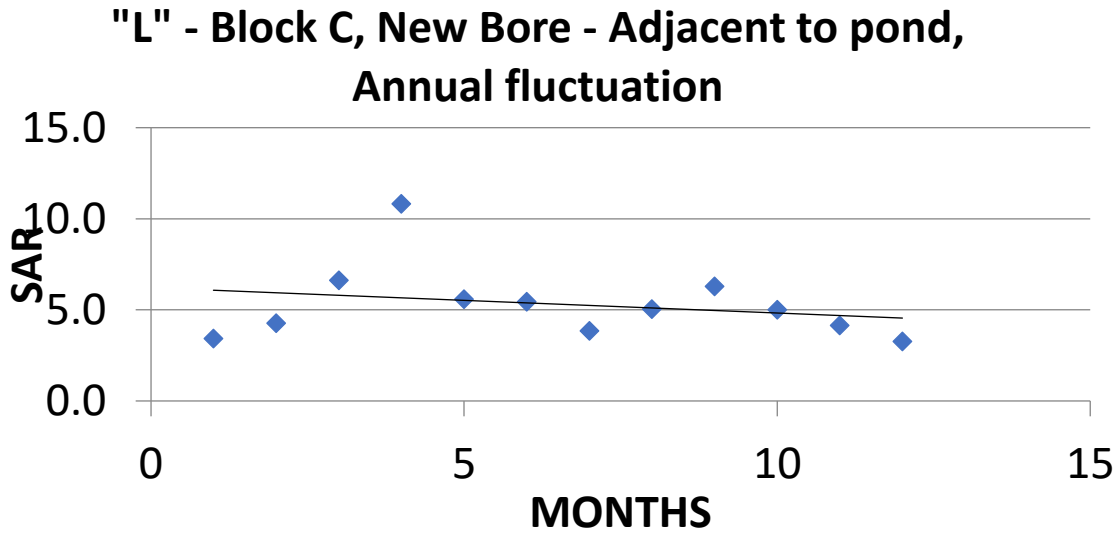
Harvested rainwater used for supplementary irrigation in kharif paddy


"D" - Block D, Adjacent to Oil palm, Decadal fluctuation
6.00
4.00
2.00
0.00
SAR
2002
2004
2006
2008
2010
YEAR


"D" - Block D, Adjacent to Oil palm, Annual fluctuation
8.0
6.0
4.0
2.0
0.0
SAR
0
5
10
15
MONTHS


"L" - Block C, New Bore - Adjacent to pond, Decadal fluctuation
10
5
0
SAR
2002
2004
2006
2008
2010
YEAR

Near pond


"L" - Block C, New Bore - Adjacent to pond, Annual fluctuation
15.0
10.0
5.0
0.0
SAR
0
5
10
15
MONTHS

Benefits derived :

- Supplementary irrigation
- Management of good quality water
- **Ground water recharging**
- **Restricting the movement of saline water**
- Fish harvest
- Demonstration of multi farming system to deal with climate change
- Waste land (saline / saline sodic / water logged) is utilized for water conservation work

Pulse Research Station

Recharge pond - Temple

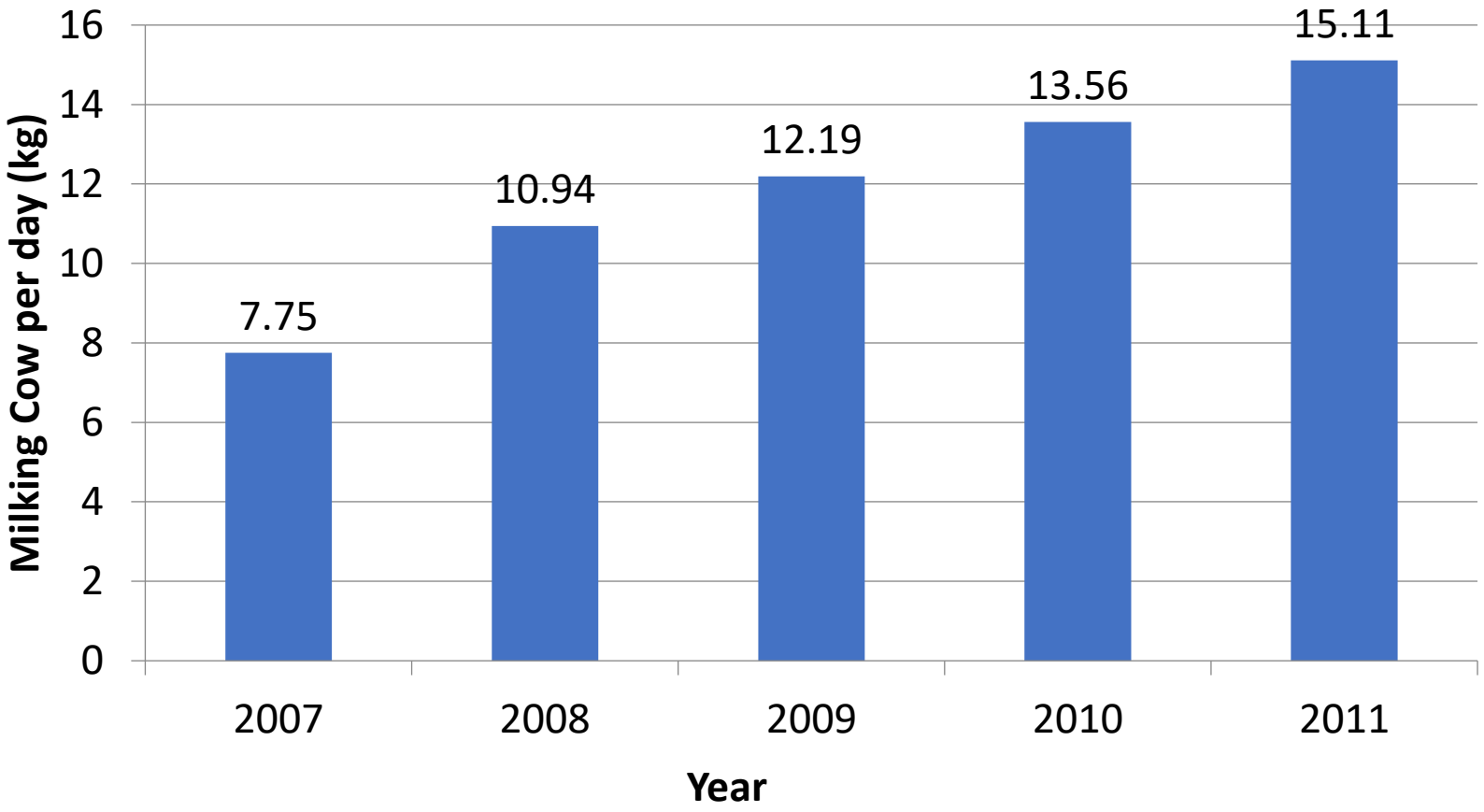
Waste land utilized for rain water harvesting to improve water quality, check sea water intrusion, Irrigating in Pulse crops and teak production, Pulse Research Station, NAU, Navsari

Before - 2008

2010

After - 2020

Annual changes in milk production of cow after supply of harvested rain water and removal of water stagnation through drainage system, during monsoon



Pond at Livestock Research Station

Study on Rain water harvesting

- Farmers of the South Gujarat coastal region are recommended to harvest as much rain water as possible to maintain ground water quality below (EC=2 dS/m) as per catchment area as tabulated below. The suggested modes of harvesting in decreasing order of preference could be Pond, Check dam, Percolation pit, Percolation well, Trenches and Sub soiling, as per availability of land, catchment area, water demands, financial capacity, topography, rainfall pattern, soil type, vegetative cover and nearness to sea.

S.No	Area (ha)	Mode of Harvesting
1	> 2	Pond & Check Dam
2	2 to 1	Percolation pit
3	1 to 2	Percolation well
4	< 0.5	Trenches & Sub soiling

Pond for irrigating *rabi* crops in KVK, NAU, Dediapada, Narmada District

Before

After

Two demonstration ponds constructed for improving ground water quality, aquaculture and supplementary irrigation in KVK, NAU, Navsari

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Case Study – Agricultural Experiment Station, Paria, NAU, District Valsad

Before

Water logged cashew plot

Chocked canal escape

Site selection for a pond

Cleaning and Desilting of drains

Water storage behind the check dam

After

Pond

Check Structure in canal escape

Harvested rain water use

- Mango grafts survived (Pot & Drip irrigation)
- Supplementary Irrigation (lifting) in paddy (4ha)
- Increase in cashew production

Before

Pitcher irrigation in young mango Crop in hilly tracts of South Gujarat

After

Development / Benefits

- Mango survived due to irrigation
- Area reclaimed – 6 ha
- Yield increase in onion, and cashew
- Irrigation possible in paddy and mango
- Drain clearing – 2 km
- Reduction in theft

Benefits due to different Developments in the watershed

S.No.	Development	Benefit
1	Check dam & Pond	Irrigation possible in paddy and mango Mango survived Increase in production (Onion, Paddy, Cashew)
2	Drip System (10 ha) & Pitcher Irrigation (1ha)	Survival & Enhanced growth
3	Land reclamation (6 ha)	Area brought under cultivation
4	Culvert & Kachha Road	Fast transportation within and towards border Check on theft
5	Drain cleaning (6000 m)	Water stagnation prevented
6	Fencing + bund + trench + live hedge of fever nut	Reduction in theft

Expenditure Incurred

S. No.	Measure	**Approximate Cost (Rs)**
1	Check Dam	17,000
2	Pond	9,000
3	Drip System	5,00,000
4	Culvert & Kachha Road	10,000
5	Fencing	30,000
6	Jungle clearing + Bund + TrenchTotal	48,000
	Total	**6,14,000**

Pitcher irrigation in young mango plantation

The farmers of AES– II of South Gujarat heavy rainfall zone are advised ***to adopt pitcher method of irrigation in newly planted mango orchard. They are recommended to fill either 1 pitcher of 10 L capacity or 2 pitchers of 7 L capacity per week***, resulting in 50 % and 30 % water saving respectively, as compared to ring method of irrigation.

Advantages of Pitcher Irrigation:

- Water saving
- More production
- Environment friendly
- Simple Technique
- Cheap
- Provides employment to village artisan
- Electricity not required
- Good for horticultural crops
- Poor quality water can be used

Limitations:

- Susceptible to breakages
- Porous need to be cleared by reheating if water quality is poor

Cost:

- 7 liter capacity costs 15 Rs / piece in bulk
- 10 liter capacity costs 20 Rs / piece in bulk

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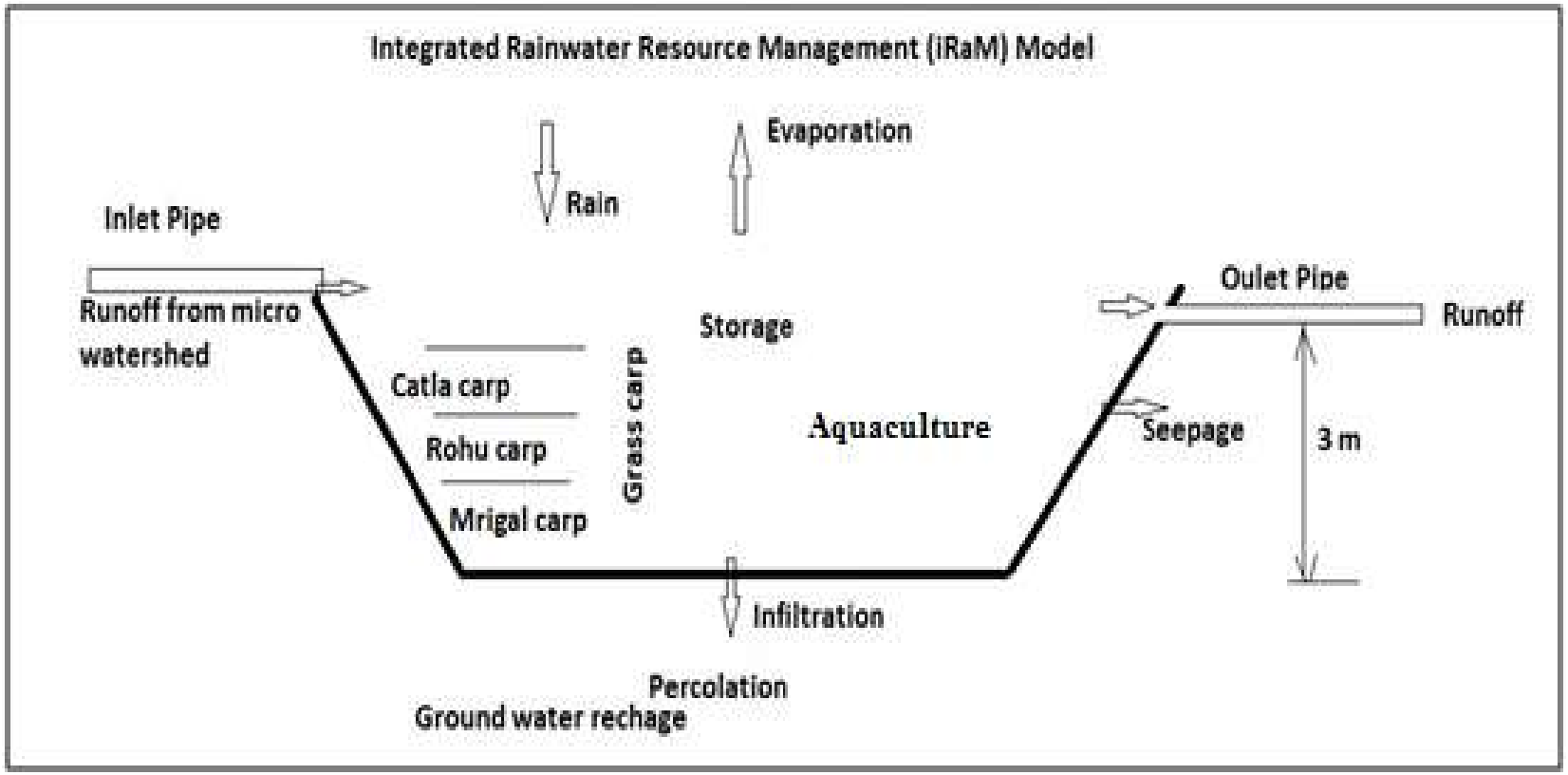
Integrated Rainwater Resource Management (iRaM) model

To conserve “rain water” while evaluating the potential of raising fish in small pond through harvested rain water.

Integrated Rainwater Resource Management (iRaM) model



Recharge = Rain – Storage - Evaporation – Runoff

Catchment area and Dimensions of ponds

Farm pond of Regional Horticultural Research Station

Catchment area = 6 hectares

Pond Dimensions = 56 m x 54 m

Depth = 3 m

Pond near College of Forestry

Catchment area = 1 hectare

Pond Dimensions = 27 m x 10 m

Depth = 1 m

Surface water management beside Forestry College

Lawn where water used to stand during monsoon and went as runoff

Salient findings

- Rain water harvesting in small or big ponds not only replenishes aquifers but also checks deteriorating water quality in addition to providing sweet water fish harvest for economic gain.
- Farmers who do not have facility to refill water into the pond should take the harvest in the first week of November, *i.e.* in four months time.
- Farmers who get excess water from canal or have facility to maintain the water level for longer period, may harvest fish for more economic return.
- Grass carp fish showed the highest increase in weight followed by Catla, Rohu and Mrigal.

Case Study : Pond dug for irrigating rabi crops in arid region, through lift irrigation, KVK, NAU, Dediapada, Dist. Narmada

Pond Capacity : 12240 cum

Pond digging
Surface Drains
Spreading of dug earth

Total Expenditure = Rs 3,71,959

Case Study : Watershed Developmental activities in Tribal Areas of Dang for sustainability of Livelihood under NAIP - III

Navsari Agricultural University, has constructed / renovated 14 small farm ponds, for the benefit of marginal farmers, in undulating hilly terrain of Sarvar cluster in Dangs

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Study on Roof Water Harvesting to Tackle Drinking Water Scarcity in Rural Areas of South Gujarat

Recommendation

Roof top rain water harvesting for potable use is recommended. Storage capacity of tank should be approximately 1000 L/ capita/yr., constructed in such a way that no light or air enters inside to prevent bacterial growth and the tank may at least 0.5 m above ground level to prevent direct entry of runoff water. Water from the tank could be pumped out by means of hand pump or electric operated self priming shallow lift pump.

Precautions to be adopted are:

- Roof tops and conveyance pipes should be thoroughly cleaned at the time of onset of monsoon. First flush of rain water should be allowed to bypass the storage tank, as well as during long gaps between two rainy events.
- Roof water may be allowed to pass through gravel – sand filter, consisting of layers (30 - 50 cm) of coarse sand, 25 mm gravel, 50 mm gravel to remove organic impurity.
- Lime or Calcium Carbonate powder kept in earthen pots (7 L capacity / 5000 L), tied with muslin cloth on the mouth may be submerged into the storage tank.
- Walls of tank could be white washed with lime solution.
- Anaerobic bacteria may develop with time which could be removed by boiling / adding 0.5 g tablet of chlorine in 20 L of water / storage of water in copper vessel for 8 – 10 hrs / by using commercially available UV filter.

Recommendation # 2

- To disinfect drinking water against any microbial activity, water could be safely stored in a copper vessel for 12 hrs and 24 h to remove MPN/100 ml by 85% and 90 % and CFU/100 ml by 67 and 81 % respectively.

Water Collection

College of Forestry (RWH)

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सत्यमेव जयते
Department of Science & Technology
Govt. of India

Demonstration of site specific water conservation technologies for improving deteriorating soil and water quality in the coastal South Gujarat

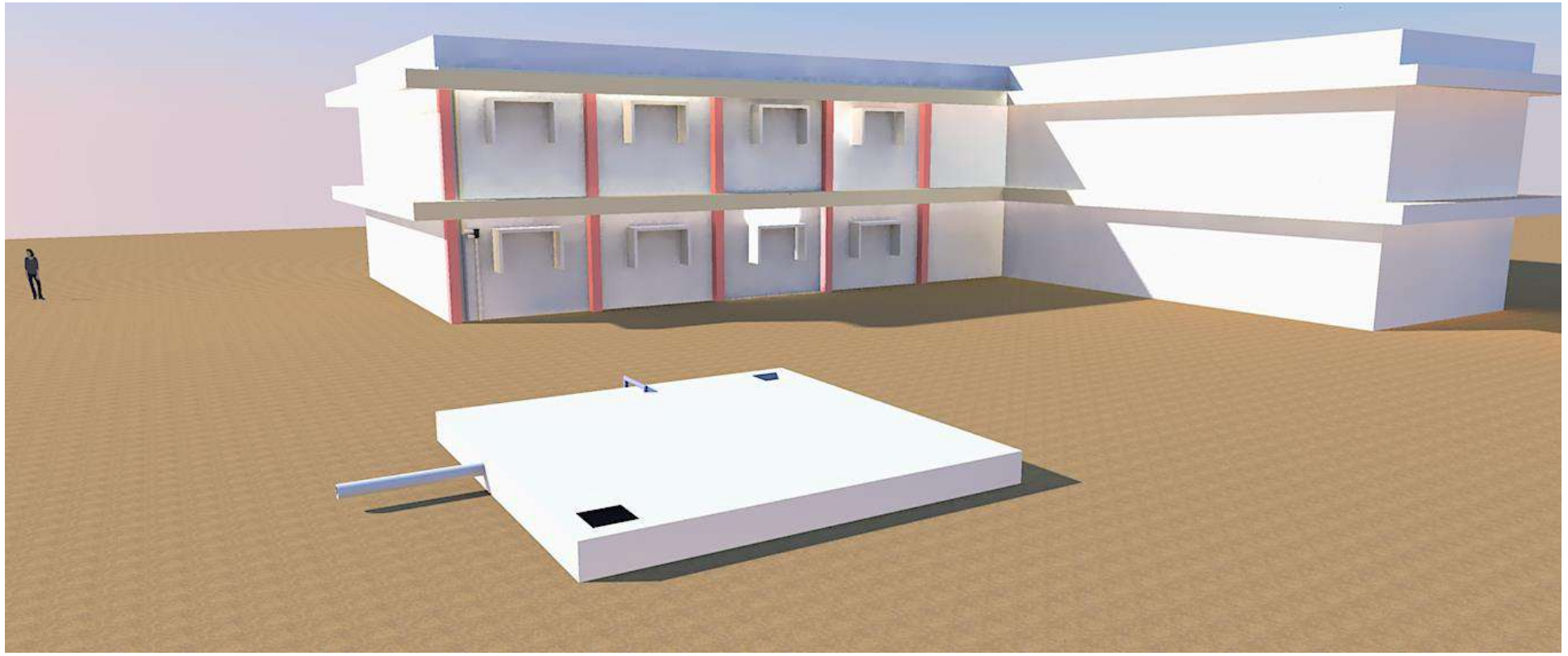
Project Funded
by
Department of Science & Technology
Government of India

Rain water harvesting pond of 1.10 hectare constructed in Onjal village for multiple benefits.

Before

After

Schematic diagram of Roof Water Harvesting System for poor children in HSS, Dandi Village



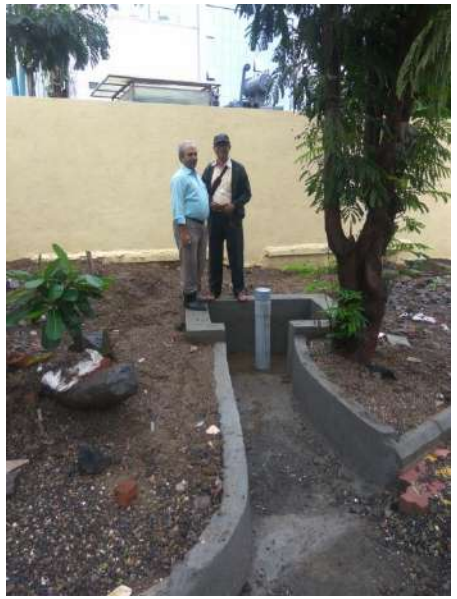
Roof water harvesting system to store 70,000 liter rain water constructed in higher secondary school, Dandi village, Navsari, catering poor children of coastal area

Before

After

Portable Water Harvesting Structure

Technology disseminated to General Public at their cost










Guidance to General Public about Rainwater Harvesting & Recharging

Roof water recharging in Vidya Kunj school

Recharge system
Jaltarang society

Recharge system
Sarvodaynagar society

Recharge system
Majurmahajan society

Recharge system
Pratiksha society

Recharge system
Pratiksha society

Recharge system
Saileshnagar society

Water Harvesting by establishing Forest Species for the region

Bambusetum

Arboretum

Biodiversity Park

Block Plantation of Forest species that helps in better water management and ground water recharge

Melia Composita

Palmyra Palm based inter cropping System

Tectona grandis

Casuarina equisetifolia

Ailanthus excelsa

Acacia Hybrid (derived from A auriculiformis + A. mangium

Saraca Ashoka

Medicinal Nursery

Melia Composita

Eucalyptus tereticornis

Ailanthus excelsa

Casuarina equisetifolia

Tectona grandis

Aqua – Agro – Forestry Model, Dandi

Silviculture trials on Melia

Palmyra Palm based Silvi – Horti System Dedvasan

Melia + Alovera trail at Paria

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Several technologies on Irrigation & Drainage, Irrigation Scheduling on various crops of South Gujarat Agro Climatic situation have been developed

Drip + black plastic in banana

Drip in sugarcane

Drip + Mulch in chillies

Bio – wall / Vertical Irrigation

High cost greenhouse

Drip irrigation + Black Plastic Mulch

Pitcher irrigation

Low tunnel

Conclusion

- In the first phase surface drains were made to remove water stagnation in the 400 ha campus.
- Water from main drains were diverted to ponds / check dams / percolation pits / percolation wells so that the rain water conserved within the campus.
- 11 ponds, 2 check dams, 6 percolation pits, 2 well recharge, 23 recharge shafts and 7 roof water harvesting tanks are constructed at appropriate places for rain water harvesting.
- Harvested rain water and excess water of canals is used for supplementary irrigation, ground water recharge, aquaculture, restriction of sea water ingress through aquifers especially in the northern strip of campus and aesthetic beauty.
- Site selection for water bodies is such that maximum advantages could be harnessed while utilizing the waste land or least productive lands.
- Irrigation scheduling, pressurized irrigation methods, poly houses, green net, mulches and state of art technologies are adopted to improve water use efficiency
- Multi Agriculture Models with combinations of Field crops – cereals – pulses – fruit – vegetables – cash crops – forestry – aquaculture – animal husbandry based on watershed management to sustain soil and water quality while maximizing returns.
- Organic waste of the farm is recirculated and organic fertilizers are added in the fields for improving soil structure, organic carbon to improve water infiltration in the soil
- Crop and variety selection is based on the recommended Land Use Plan
- On the basis of watershed concept water bodies are also made in 10 Research Stations of the University in South Gujarat.
- Free guidance is provided to the farmers and citizens who approach the University for watershed management and water conservation.

Jal Hai to Kal Hai

THANK YOU