

**REPORT**  
**ON**  
**RAIN WATER HARVESTING STRUCTURES IN PONDICHERRY UNIVERSITY CAMPUS**

The sources for drinking water are mainly from groundwater and surface water resources. Though these sources accounts for about 40% of total precipitation there are considerable prospects for collecting rainwater during its happening. The collection of rainwater termed as rainwater harvesting (RWH) is of considerable significance in impending decades to eradicate water related issues due to escalating population. RWH is a simple technique or process by which rainwater is conserved before surface runoff, infiltration and contamination. There are two prevalent RWH techniques, surface runoff rainwater harvesting (SRWH) and rooftop rainwater harvesting (RRWH). In SRWH, rainwater as surface runoff are collected in pits, recharge shafts and structures and in RRWH, rainwater is collected directly from roof structures of building, transported and stored in tanks or directed to aquifers. Both the techniques aid in improving water levels, groundwater quality of shallow aquifers and to restrict sea water intrusion in coastal areas. Attempt has been made in Pondicherry University campus to develop RWH system so as to augment rainwater harvesting.

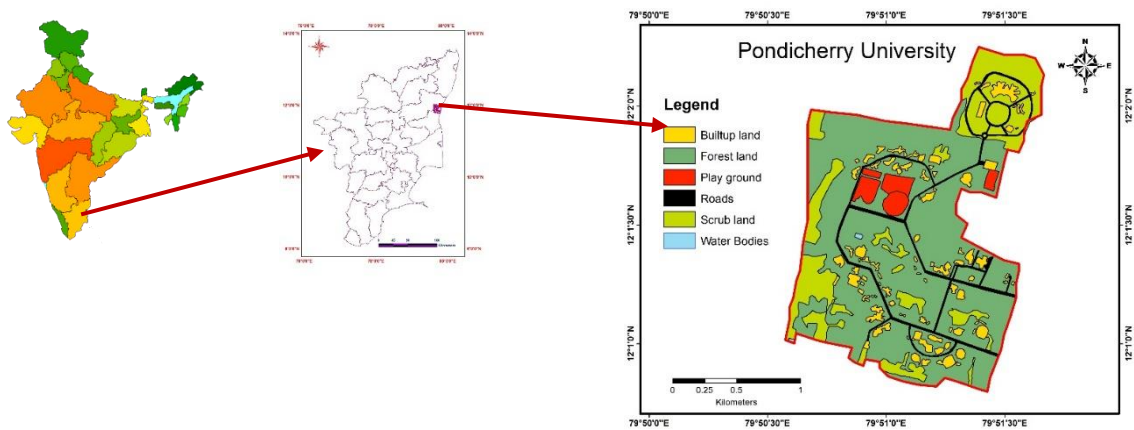
Puducherry University (PU) is one of the most prominent central university of South India located in Kalapet, Puducherry, Union Territory of Puducherry, India between 12° 01' and 12° 2' N latitudes and 79° 50' and 79° 52' E longitudes located in a campus spread of about 32, 17,080 m<sup>2</sup> facing the Bay of Bengal on the East coast Road (Fig.1). The normal annual rainfall is 1383 mm year<sup>-1</sup>(CGWB, 2013). The area is underlined by semi-consolidated and unconsolidated sedimentary formations ranging in age from cretaceous to recent. The climate is hot and humid with temperatures varying between 26°C and 38°C. The major shallow aquifer of PU is the tertiary Cuddalore sandstone formation of Mio-Pliocene comprising of sandstone, sands and gravels with groundwater occurrences noted under confined conditions. Laterite soil occurs as capping over the Cuddalore sandstone aquifers. The elevation ranges between 40m to 12 m AMSL with steep slope noted towards the sea.

### **Preparation of Thematic maps**

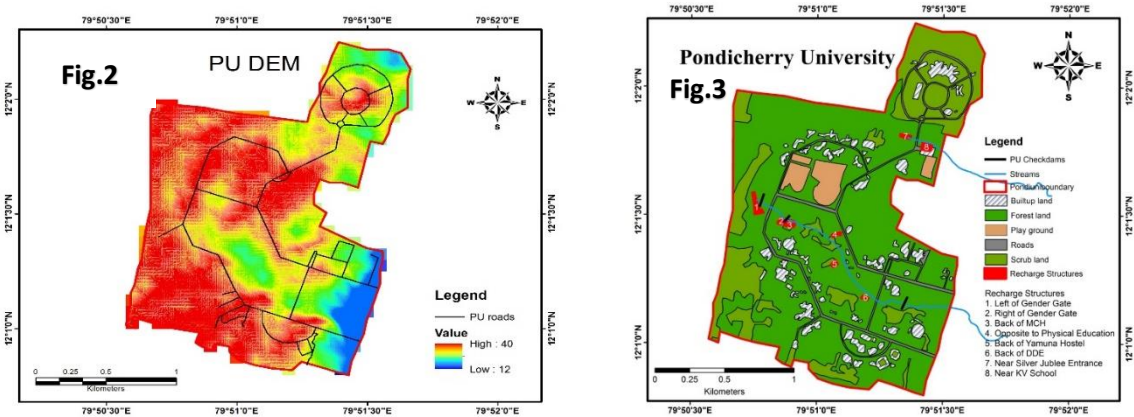
Preparation of thematic maps like Geology, Geomorphology, Land use Land change, Slope, bore well locations and categorization of university campus based on land use to possibly demarcate appropriate Rainwater harvesting structures (Fig.2 and Fig.3)

### **Numerical modeling**

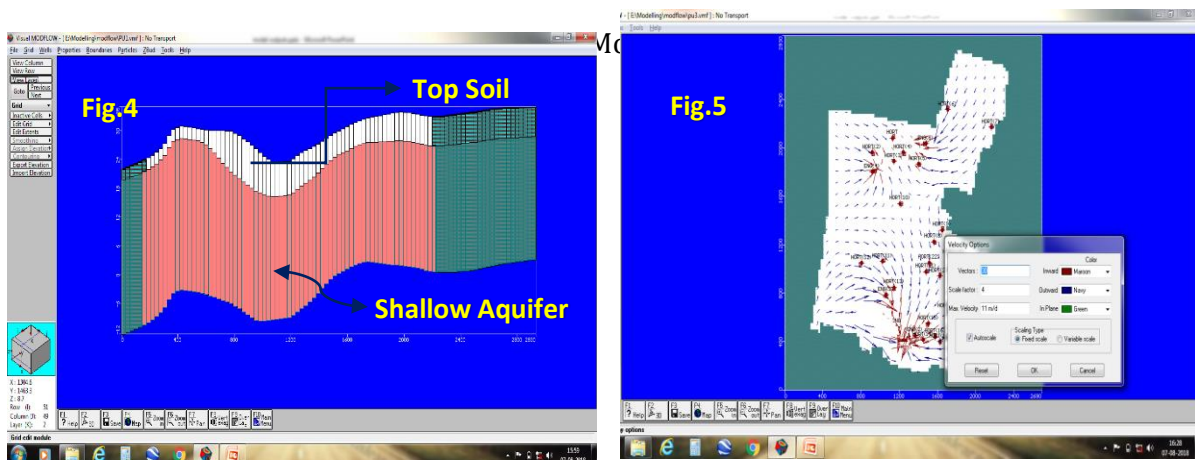
Numerical modelling attempted by considering data's like rainfall (recharge), groundwater level, groundwater drafting for 10 years (2008 to 2018) along with considering aquifer properties predicted groundwater flux at a maximum of 11.0 m d<sup>-1</sup> with a correlation coefficient of 0.95 between observed and calculated heads which clearly demarcates the high velocity of groundwater with no significant traces of saline water intrusion (Fig.4 and Fig.5).



**Fig. 1. Location of Pondicherry University**



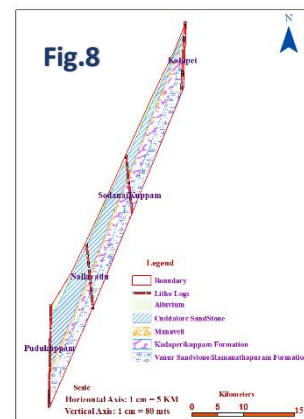
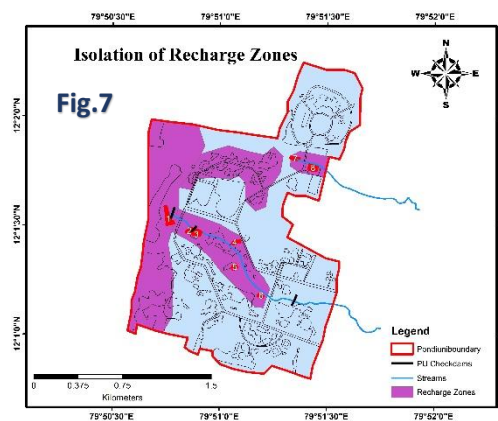
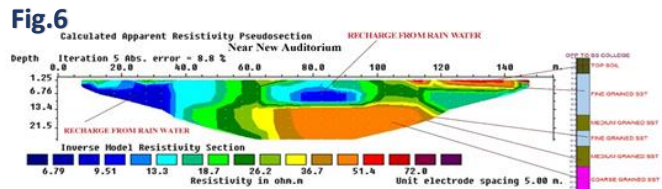
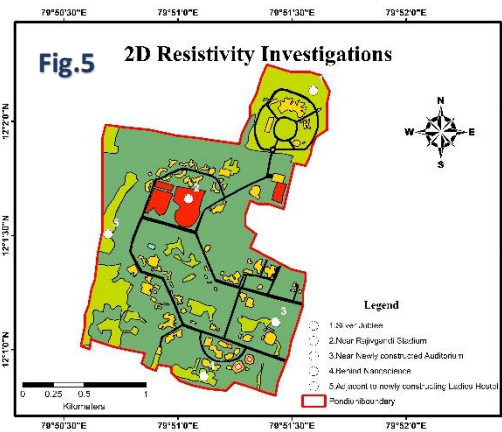
**Fig.2&3. Digital Elevation model and Land Use of PU**



**Fig. 4&5. Subsurface cross section and Groundwater Velocity in PU**

## Isolation of Recharge zones in university campus

Resistivity imaging attempted in site specific locations to demarcate recharge zones. Based on the survey recharge zones were confined along the NW parts of the study area and along the two drainages isolated within the University campus (Fig.6). From the results of the survey no traces of saline water intrusion have been isolated within the university campus. Cross section of PU has been generated from the survey to demarcate depth of significant aquifers (Fig.5, 6, 7and 8).



**Fig. 5 Locations for Resistivity surveying, Fig.6. 2 D imaging result, Fig.7. Isolation of Recharge zones, Fig.8 Lithological cross section of the study area.**

## Rainwater harvesting structures

Based on various inflows and outflows the quantum of groundwater availability in PU has been calculated by considering the groundwater resource estimation methodology (MoWR, 2009) and found to be  $1.18 \text{ MCUM Year}^{-1}$ . The following techniques of RWH has been proposed and implemented successfully in the campus premises.

### Roof top harvesting

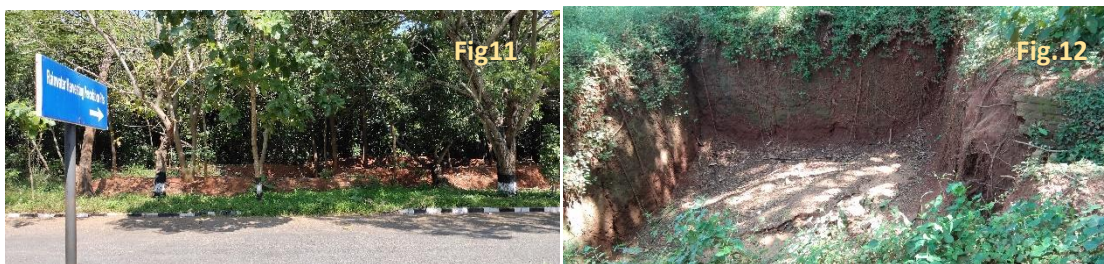
Roof top rainwater harvesting structures available in selective buildings (Silver Jubilee Campus, Aurobindo hostel, New ladies' hostel) found to harvest rainwater of about  $38,101.11 \text{ m}^3 \text{ year}^{-1}$  (Fig.9 and 10)



**Fig.9 &10 Roof Top harvesting structures**

### Recharge pits

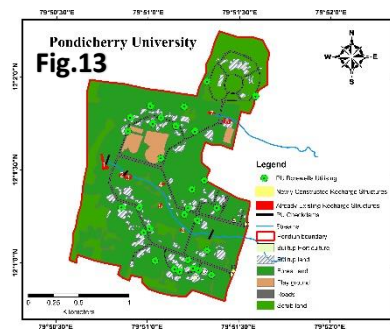
Due to shallow nature of aquifers attempt has been made to RWH through recharge pits. A total of 12 recharge pits (Table 1) were constructed in the university premises by due consideration to the recharge areas already demarcated (Fig.11 and 12). Recharge pits were found to recharge groundwater at a rate of  $14,328 \text{ m}^3 \text{ Year}^{-1}$ . The location of Recharge pits and quantum of recharge to sandstone aquifers is noted below (Fig.13).



**Fig. 11&12 Model of Recharge pit and Dimensions**

**Table 1. Dimensions and RWH by Recharge pits**

<b>Id</b>	<b>Area (m<sup>2</sup>)</b>	<b>Height (m)</b>	<b>Volume (m<sup>3</sup>)</b>	<b>Water holding capacity (in Liters)</b>	<b>Recharge to sandstone</b>	<b>Location</b>
1	4732.01	6.00	28,392.07	2,83,92,072.34	34,07,049	RS1 Left of Gender Gate
2	1481.20	6.00	8,887.23	88,87,229.38	10,66,468	RS2 Right of Gender Gate
3	2399.15	6.00	14,394.91	1,43,94,909.57	17,27,389	RS3 Back of MCH
4	1254.38	6.00	7,526.31	75,26,309.78	9,03,157	RS4 Opposite to Physical Education
5	1240.81	6.00	7,444.85	74,44,847.87	8,93,382	RS5 Back of Yamuna Hostel
6	663.21	6.00	3,979.24	39,79,244.05	4,77,509	RS6 Back of Distance Education
7	1624.66	9.00	14,621.94	1,46,21,940.13	17,54,633	RS7 Silver Jubilee Proximity
8	3257.55	9.00	29,317.96	2,93,17,957.29	35,18,155	RS8 Near KV
9	900.12	5.00	4,500.6	45,00,600.06	54,007	RS9 Gate No.2 Out Road
10	5184.23	6.00	34,885.38	3,48,85,380.38	4,18,625	RS10 Gate No.2 Near Banyan Tree
11	900.32	5.00	4,501.6	45,01,600.6	54,019	RS11 Gate No.1 In Road
12	900.54	5.00	4,502.7	45,02,700.7	54,032	RS12 Gate No.1 Near Performing arts
<b>14,32,8425 Liters or 14328 Cubic meters of RWH through Recharge pits</b>						



**Fig.13 Locations of Recharge Pits in PU**

### Borehole recharge

Two borehole recharge structures were constructed near ladies hostel and Madanjeet School of Green Energy Technology between (north latitudes 12°01' and east longitudes 79°50' and north latitudes 12°00' and east longitudes 79°51' respectively) tapping shallow aquifers with dimensions (10x10x10 ft) with proper well casings, slotted with arrangements made to collect rain water from roof top buildings and diverted to pits capable of groundwater recharge of about 3016.0 m<sup>3</sup> year<sup>-1</sup> (Fig.14 and 15).

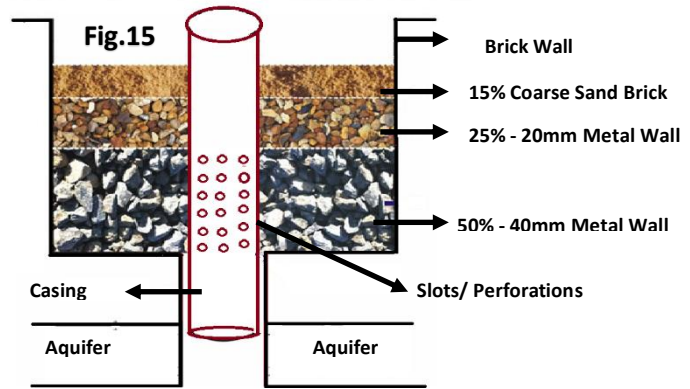


Fig.14 & 15. Bore hole recharge structures and Cross section

### Quantum of Rainwater recharge attempted in University campus

Existing water harvesting facilities were audited and found to harvest water in excess of withdrawal. The total rainwater recharges attempted presently were found to be (7, 87, 062.1 m<sup>3</sup> year<sup>-1</sup>) and the total water usage calculated were (2, 35,608 m<sup>3</sup> year<sup>-1</sup>). About 2.0 m raise in groundwater level has been observed after the erection of recharge pits, borehole recharge structures and roof top harvesting structures (Fig.16).

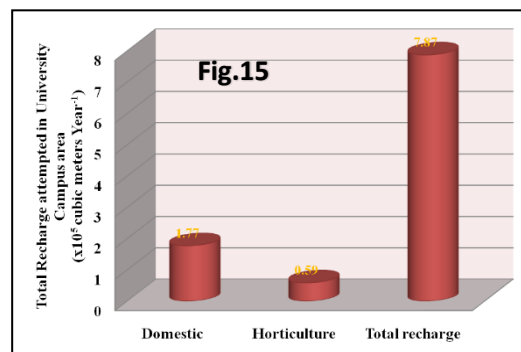


Fig. 16 Water Audit for PU

## Effective water management strategies at PU

- 1) Bore wells tapping excess Groundwater were isolated and made static from groundwater withdrawal.
- 2) Landscaping with minimum water requirement plants/trees.
- 3) Bore wells in coastal proximity were isolated to minimize water extraction to prevent possible sea water intrusion.
- 4) Hostel and Quarters inmates were instructed to restrict water usage and significance of groundwater in coastal regions were discussed. Team Jal Shakthi has been initiated.
- 5) HEFA, MHRD funding has been sanctioned for setting up of sewage treatment plant (STP) which will still reduce the horticultural water usage.
- 6) Periodic quality assessment of groundwater utilized for drinking and domestic utility in campus are being conducted annually so as to know the quality of water consumed.
- 7) Awareness camp organized in view of water management strategies to be adopted in the university campus to conserve water.
- 8) Water auditing is performed every calendar year to reschedule quantum of groundwater usage and recharge by RWH.
- 9) **The number of pits already dug up in the campus are adequate enough to retain the optimized amount of water and any further addition to these shall lead to submarine ground water discharge.**

### Miscellaneous

#### a. Interactive session on RWH



#### b. Water samples tested

Fig.b

Annexure - 1

SAMPLES	pH	DO (ppm)	Sal (ppm)	EC (µs)	TDS (ppm)	Ca	Mg	Na	K	Cl	HCO <sub>3</sub>	SO <sub>4</sub>	F	NO <sub>3</sub>	TH
Purified	7.4	4.2	430	196	467	81	5	55	10	135	237	37	0.75	15	223.0
Inlet	6.4	4.4	540	987	525	107	12	95	14	132	244	30	0.82	17	316.7

EC- Electrical Conductivity, DO-Dissolved Oxygen, Eh-Redox Potential, Ca-Calcium, Mg-Magnesium, Na-Sodium, K-Potassium, Cl-Chloride, HCO<sub>3</sub>-Bi-Carbonate, SO<sub>4</sub>-Sulphate, F-Fluoride and NO<sub>3</sub>-Nitrate, TH-Total Hardness (all values in mg/l<sup>1</sup>, Except pH EC in standard units)

#### COMPARISON OF GROUNDWATER QUALITY WITH STANDARDS

Water quality parameters	WHO (2006)		Bureau of Indian Standards BIS (2012)		Comparison of samples with standards	
	Acceptable	Permissible	Acceptable limit	Permissible limit	Inlet	Purified
pH	6.5-8.0	9.2	6.5-8.5	9.0	Slightly acidic	Within the limit
EC	1480	--	--	--	Within the limit	Within the limit
TDS	1000	1500	500	2000	Within the limit	Within the limit
Ca	75	200	75	200	Within the limit	Within the limit
Mg	50	150	30	100	Within the limit	Within the limit
Na	--	200	--	200	Within the limit	Within the limit
K	--	12	--	--	Slightly higher	Within the limit
HCO <sub>3</sub>	300	600	200	600	Within the limit	Within the limit
Cl	200	600	250	1000	Within the limit	Within the limit
SO <sub>4</sub>	200	400	200	400	Within the limit	Within the limit
NO <sub>3</sub>	--	10	--	45	Within the limit	Within the limit
F	--	1.5	--	1.5	Within the limit	Within the limit
Salinity	1000	1000	1000	1000	Within the limit	Within the limit
DO	2.0-12.5	--	--	--	Within the limit	Within the limit
TH	100	500	300	600	Within the limit	Within the limit

#### C. Jal Shakthi Campus

JAL SHAKTHI CAMPUS - PONDICHERRY UNIVERSITY  
SWACHHITA PAKHWADA - 2019

As per the directions of the Vice-Chancellor, it is proposed to constitute "Team Jal Shakthi" encompassing research scholars/students under SWACHHITA PAKHWADA - 2019 a Government of India, Ministry of Human Resource Development initiative to study and monitor the status of water conservation activities in Pondicherry University campus to address issues not limited to:

- Water conservation and rain water harvesting
- Renovation of traditional and other water bodies/tanks
- Watershed development

Interested research scholars/students can submit the duly filled application form enclosed to the undersigned or through the mail ID: [jalshakthi@pu.ac.in](mailto:jalshakthi@pu.ac.in) on or before 24/09/2019.

Fig.C

*(Signature)*  
Dr. K. Srirameshvaran,  
Co-ordinator- Team Jal Shakthi,  
Department of Earth Sciences,  
Pondicherry University

To:  
All students/scholars

Copy to:  
AR to Vice-Chancellor, Pondicherry University  
PS to Director- STI & DR, Pondicherry University  
PS to Director-C&CR, Pondicherry University  
AR to Registrar, Pondicherry University  
The System manager & Head with a request to host in our university website ✓

Forwarded *(Signature)* 18.09.19  
PROF & HEAD  
Dept. of Earth Sciences  
Pondicherry University  
Pondicherry - 605 004

#### d. Green Campus Initiative

Pondicherry University  
(Central University)  
Office of Green Campus  
Coordinator  
Dr. M. Nandhivaraman, M.Sc., MBL., PhD.  
R. Venkateshram Nagar, Kalaperi,  
Puducherry - 605014  
Mobile: 91 94432 53254  
E-mail: [coordinator.greencampus@pu.ac.in](mailto:coordinator.greencampus@pu.ac.in)

#### Call for Student Volunteers

Fig.d

Sub-Call for Volunteers for "PU - Green Campus Initiatives" - regd.

"PU - Green Campus Initiatives" in compliance to Green Protocol, Waste Management Rules and UGC Notifications is progressing at PU. Further to scale up and to sustain, expression of interest to participate as volunteers in this regard is appreciated from "Students and Scholars". Those who are willing to participate, may volunteer in any of the following domains of interest:

1. Water Management
2. Soil Protection and Food Production
3. Clean Air
4. Energy Conservation
5. Management of Waste Resources
6. Sustainability of Natural Resources
7. Biodiversity & Habitat Restoration
8. Sustainable Development Goals
9. Green Protocol Compliance
10. Entrepreneurship/ Green Business  
(Students apply - [volunteers@pu.ac.in](mailto:volunteers@pu.ac.in))

The 'Google Form' to enroll as 'member volunteer' is accessible through the link:

<https://forms.gle/soXw9y9z3dNz617>

(or) through enclosed hard copy.

Thanks,  
Sincerely,

Dr. M. Nandhivaraman, M.Sc., MBL., PhD.  
Coordinator