Management and Monitoring Strategy of Groundwater in Sri Lanka

R.S.Wijesekera
General Manager
Water Resources Board

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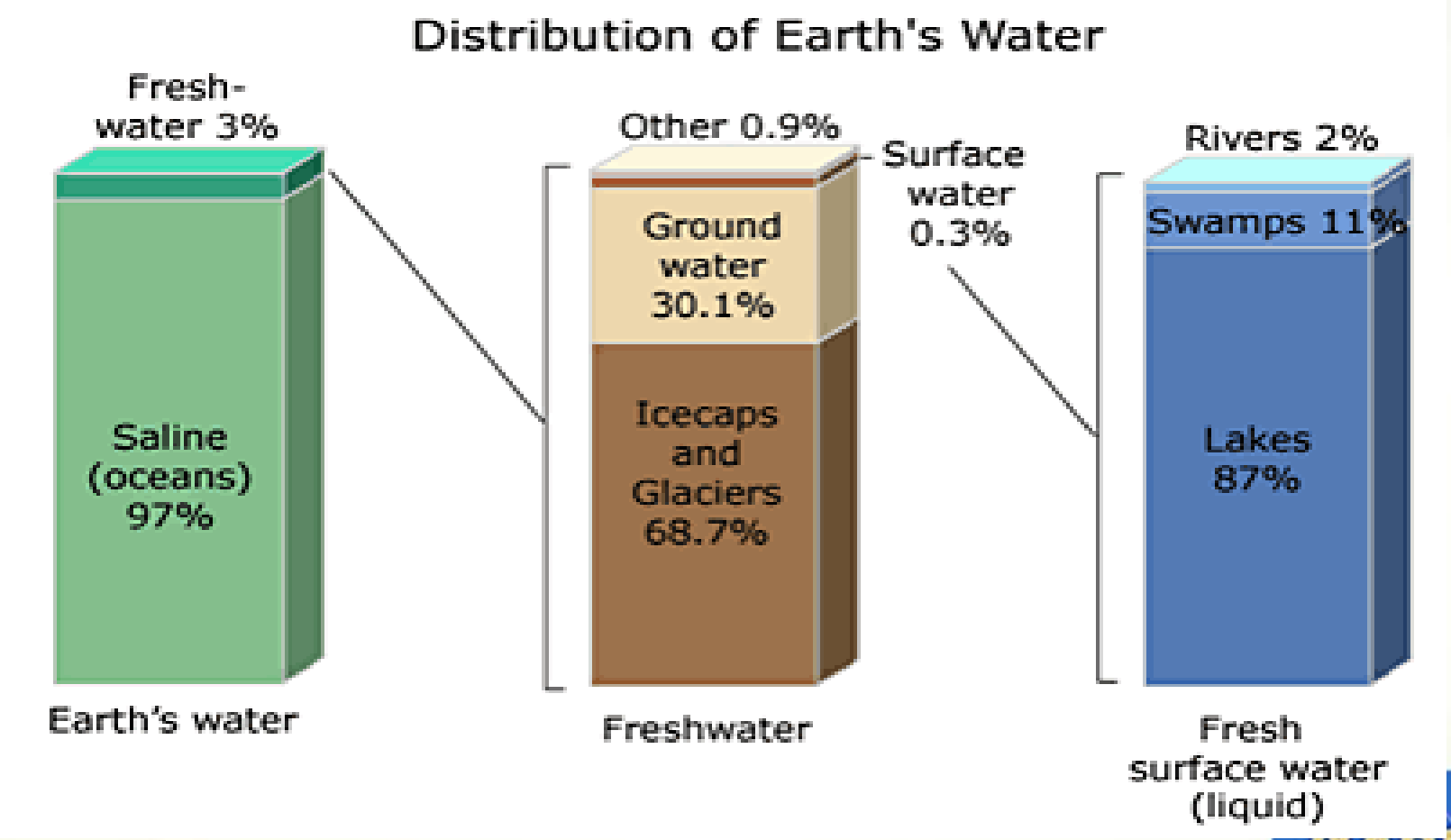
Distribution of Earth's Water



Two Types of Water Exist in the world

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Surface water

Water in Rivers, streams, lakes and ponds

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Groundwater

Groundwater **is water that exists in the pore spaces and fractures in rock and sediment beneath the Earth's surface**

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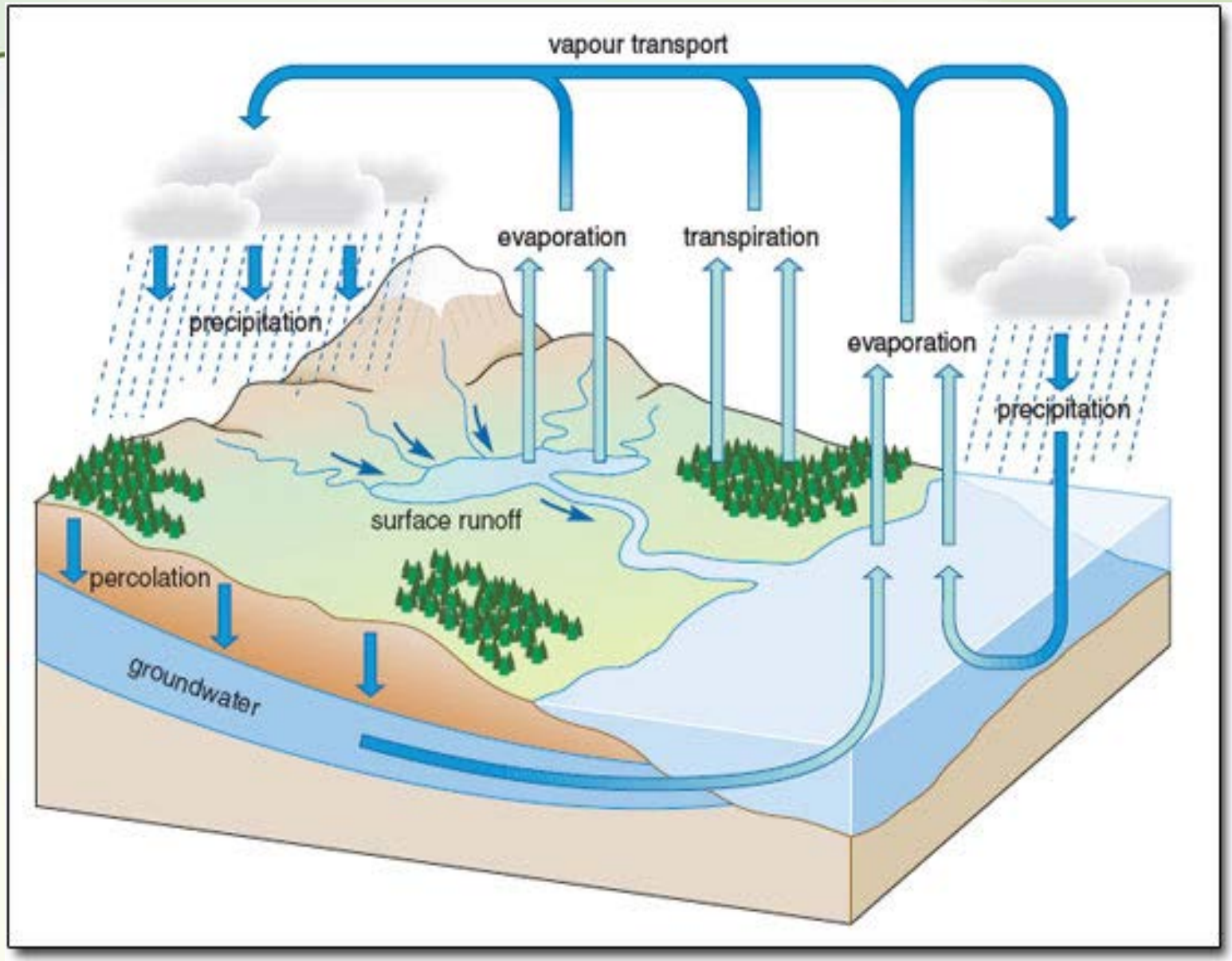
Hydrological Cycle



An Aquifer

Aquifer is an underground layer of water-bearing permeable rock or unconsolidated material (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.

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Aquifer types

There are two end members in the spectrum of types of aquifers;

confined

and

unconfined

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Confined and Unconfined Aquifers

Confined Aquifer

An aquifer that is bounded above and below by formations of distinctly lower permeability than that of the aquifer itself.

Unconfined Aquifer

An aquifer with no upper confining layer so the system is not under pressure, and it's water table fluctuate both seasonally and from year to year.

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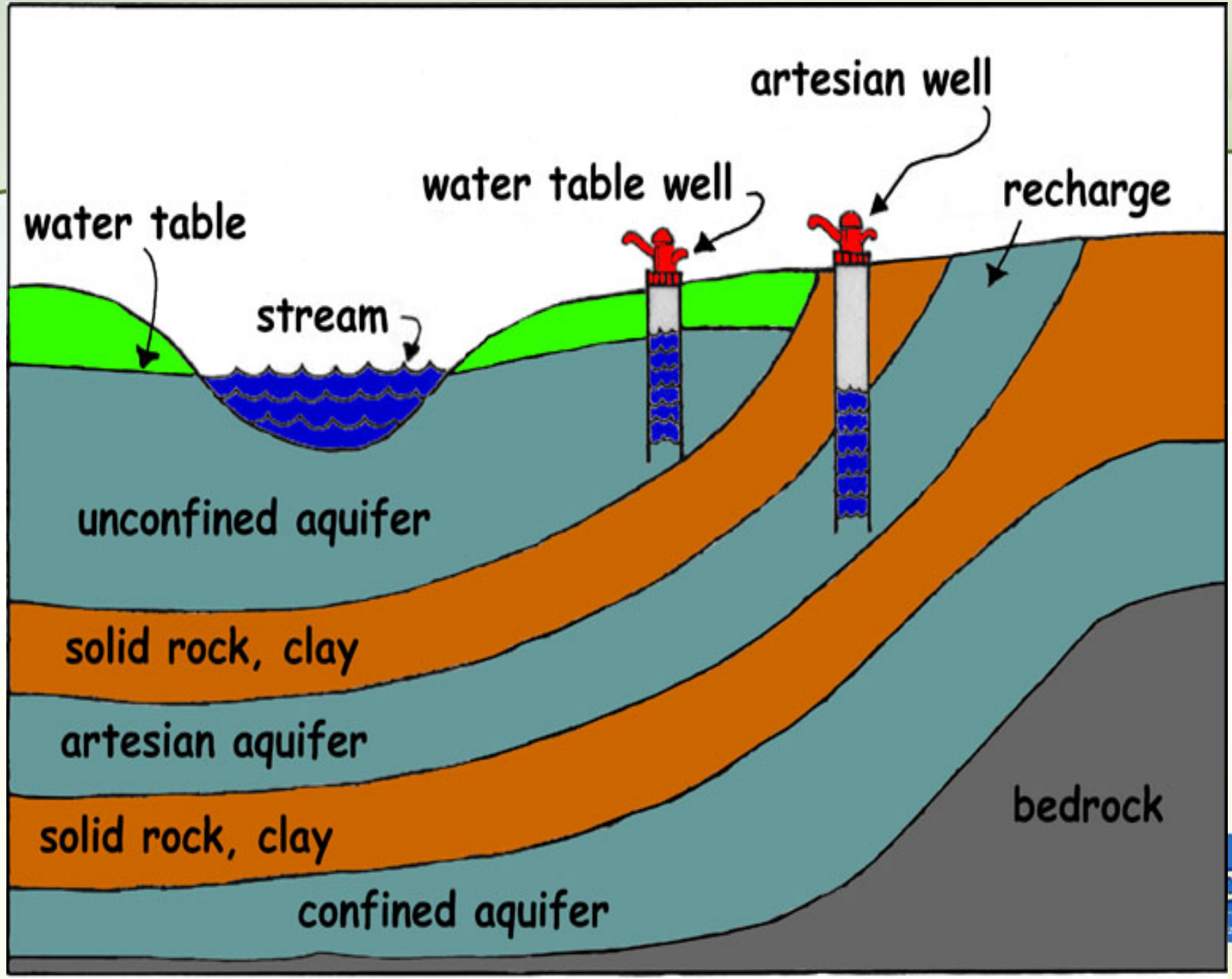
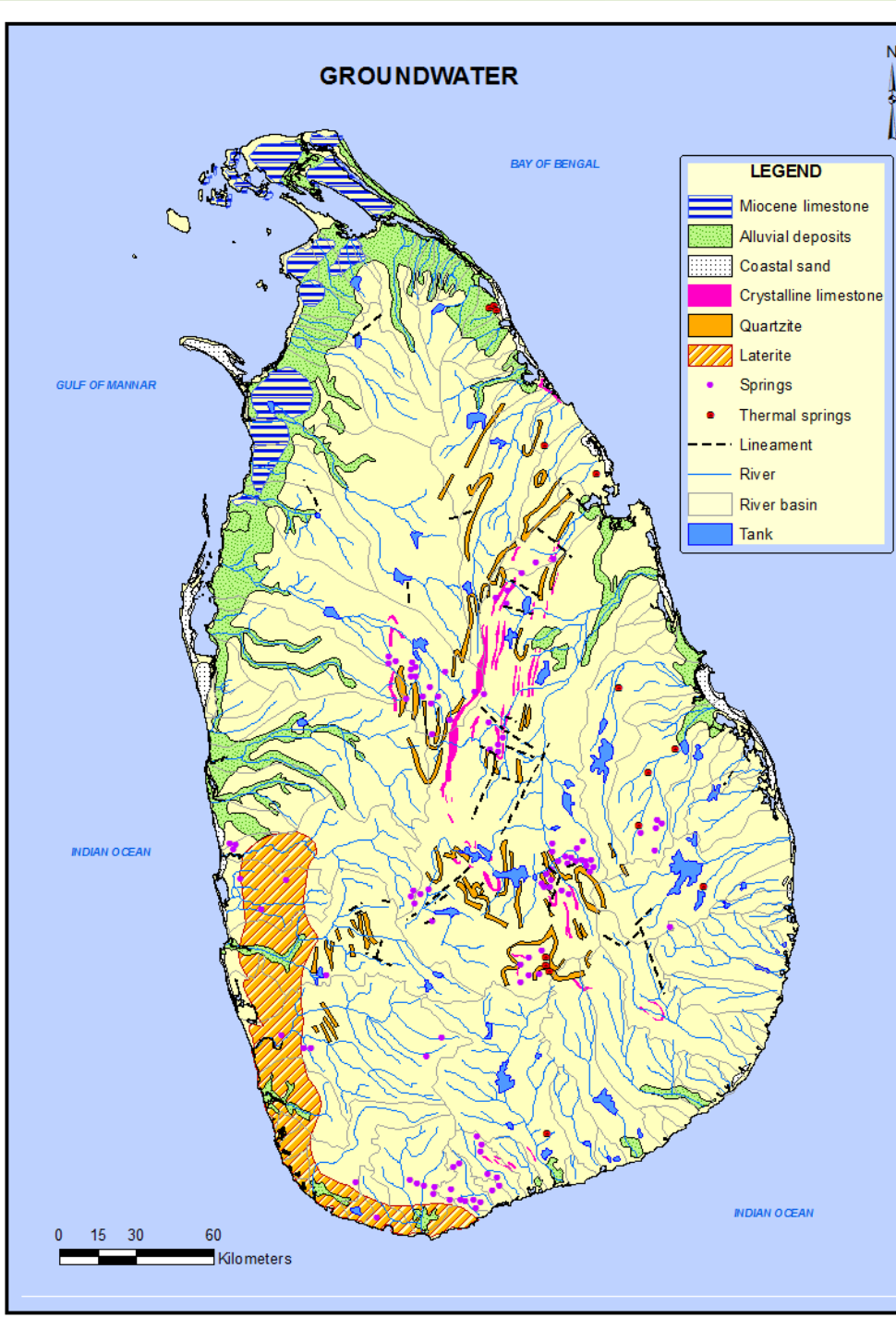

artesian well
water table well
recharge
water table
stream
unconfined aquifer
solid rock, clay
artesian aquifer
solid rock, clay
bedrock
confined aquifer

Main Aquifer Types of Sri Lanka

- Shallow Karstic limestone Aquifer - Jaffna Peninsula
- Coastal Sandy Aquifers
- Deep Confined Limestone Aquifers in Mannar
- Lateritic Aquifer
- Alluvial Aquifers
- Shallow Aquifers of the hard rock Region
- Deep Aquifers of the Hard rock Region



Issues in Groundwater

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1. Over Extraction of groundwater

Impacts

- Depletion of groundwater levels

- Salinization of groundwater in coastal areas

- Dry out wells in surrounding areas

- Water quality changes

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Groundwater contamination

Groundwater contamination is mainly due to

Human Activities – Sand mining, Over extraction of Groundwater

Industrial Activities – Waste water disposal, dumping of garbage

Intensive Agriculture – Nitrate pollution due to application of fertilizer, Pesticides etc

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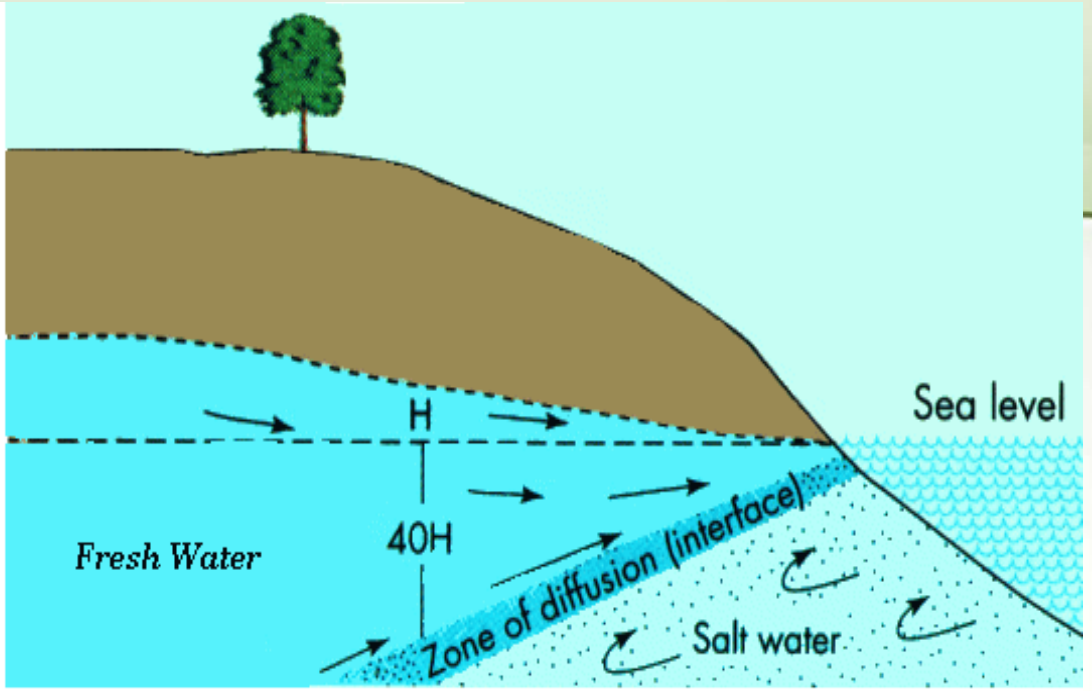
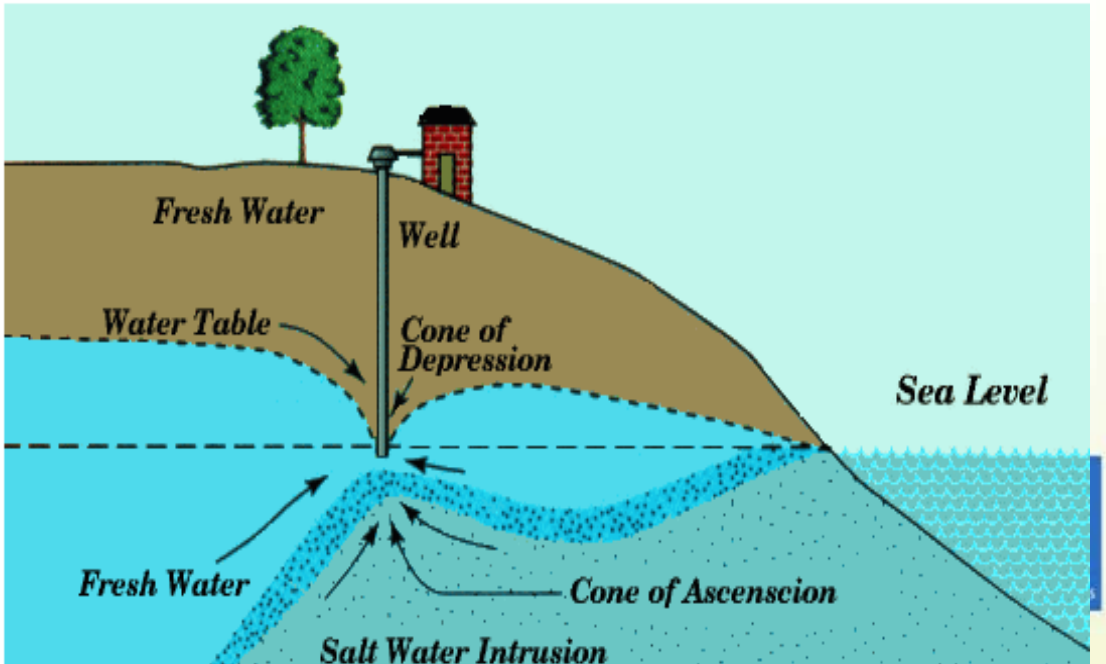
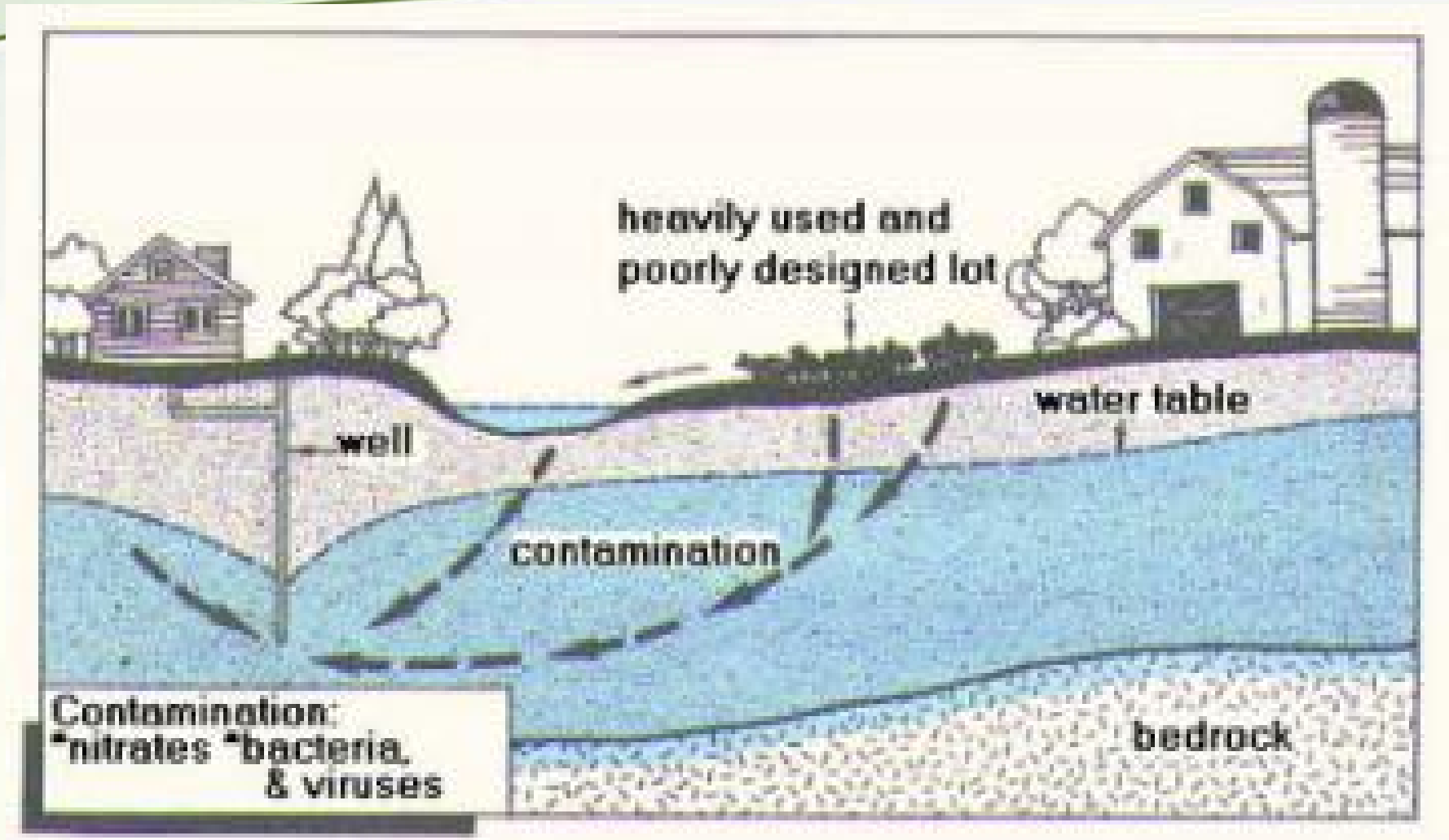
Salinity intrusion due to over Extraction of groundwater in coastal areas





Contamination of groundwater due to human activities



2. Groundwater Pollution

- INTENSIVE AGRICULTURE
- INDUSTRIAL ACTIVITIES

News Paper/ Web page articles on groundwater issues

Daily News
Sri Lanka's National Newspaper Since 1918

Daily News 9th August 2013

NCP ground water polluted

NimalWijesinghe - Anuradhapura Additional District group corr

ColomboPage
Sri Lanka Internet Newspaper

Sat, Aug 3, 2013, 12:20 am SL Time, ColomboPage News Desk, Sri Lanka.

Sri Lankan government appoints a committee to probe ground water contamination

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22nd September 2013The Times

Excessive use of agrochemicals pollutes groundwater in many places

SUNDAY OBSERVER
Sri Lanka's English Newspaper with the largest circulation

Sunday Observer, 1st September 2013

Groundwater contaminated in many districts - *WRB Report*

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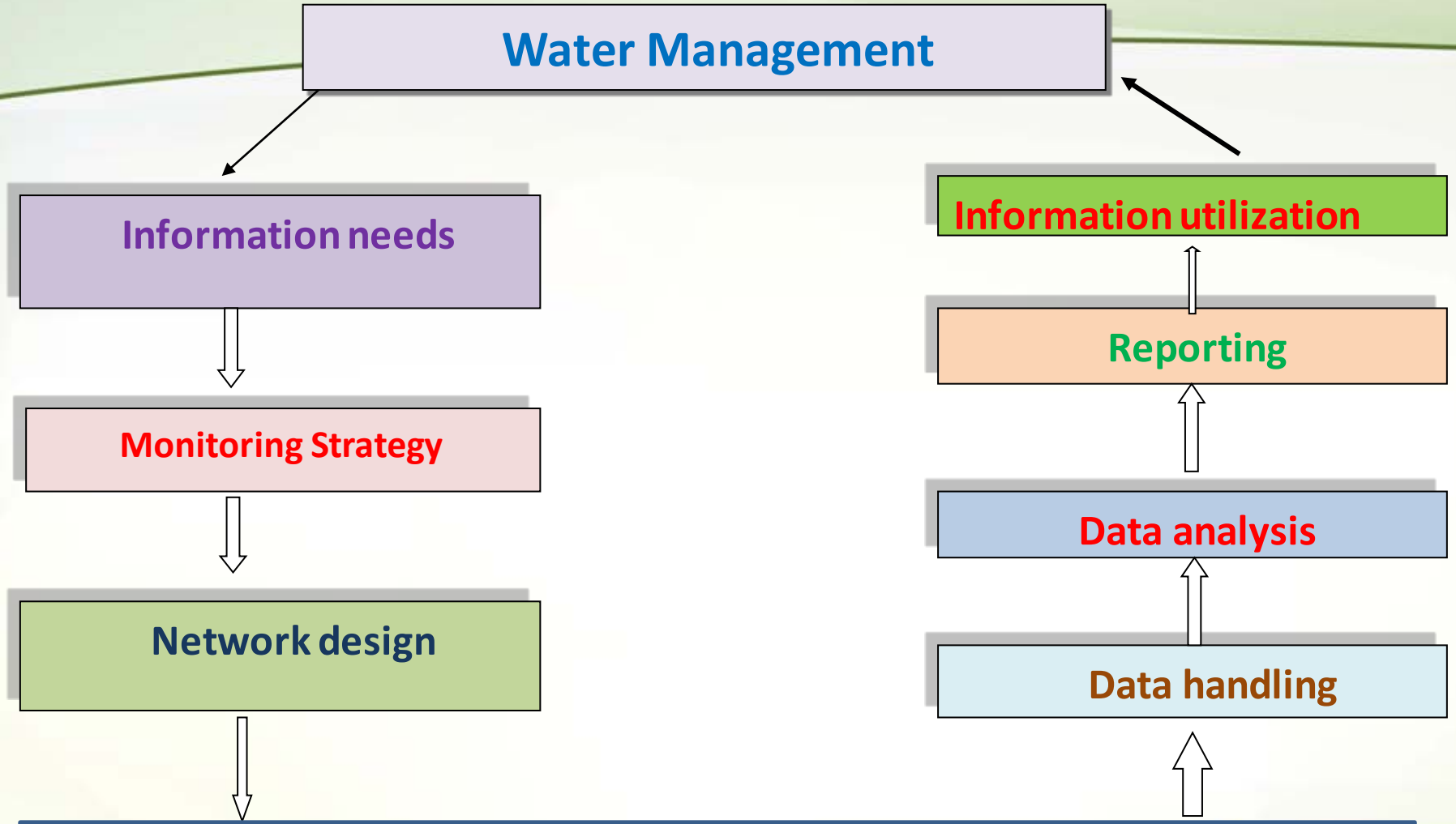
Role of monitoring data in the water management



Current Research Projects of WRB

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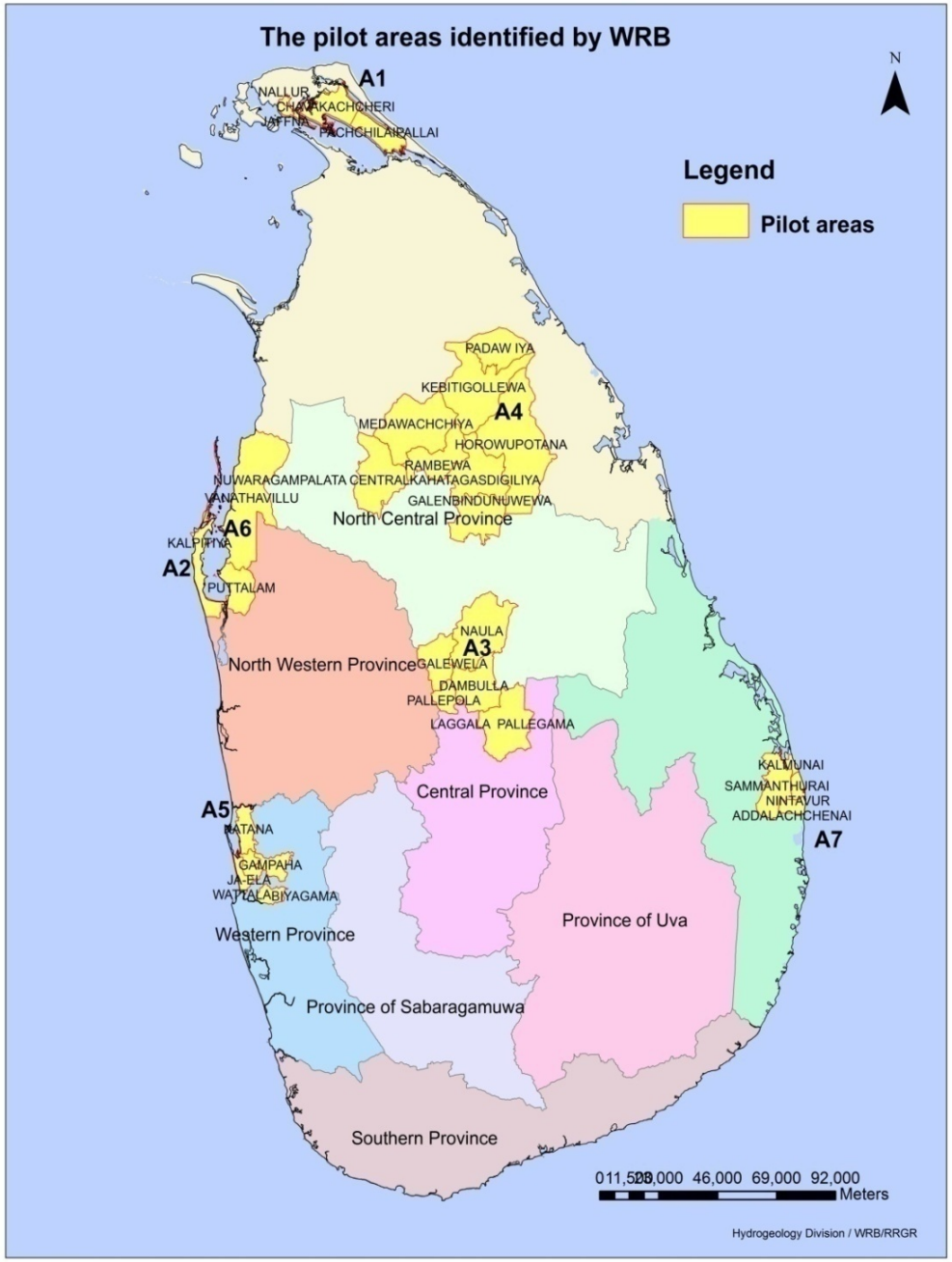
DSWRPP – under the GW Component

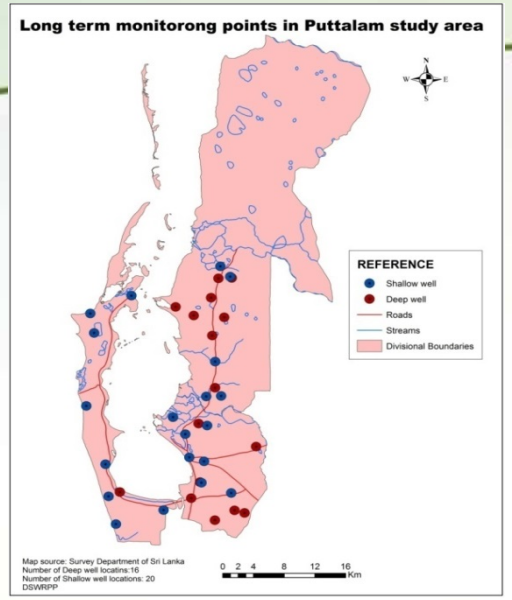
Implemented a project to Establish Groundwater Monitoring network for the selected DSD's of Jaffna, Anuradhapura, Puttalam, Gampaha, Matale and Ampara Districts.

Objective : To Identify long term water quality changes and groundwater level changes of the pilot areas.

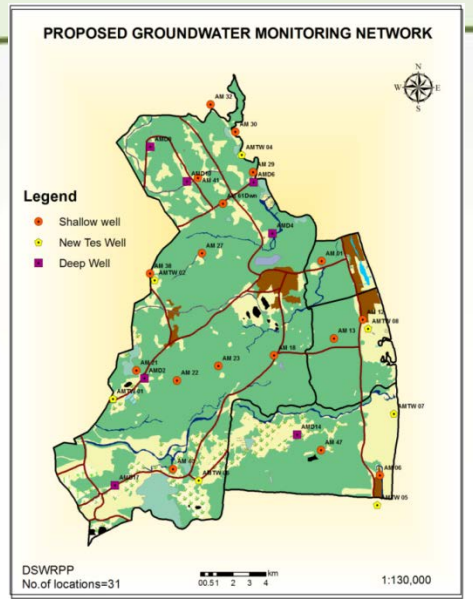


Groundwater monitoring network in pilot areas

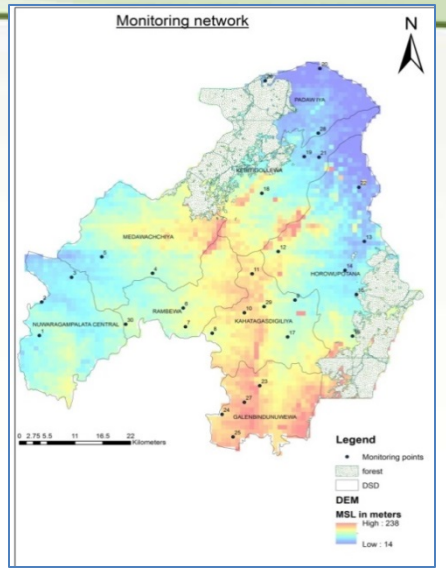
Puttalam



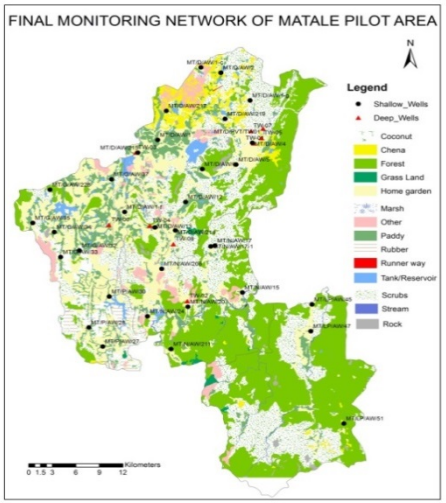
Ampara



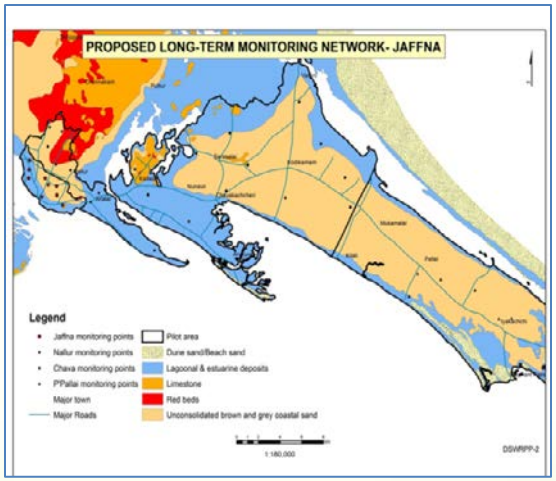
Anuradhapura



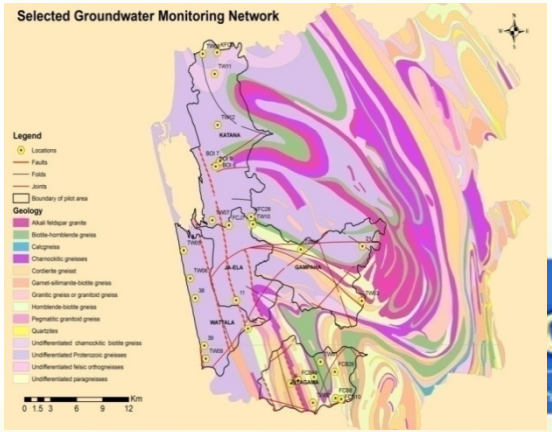
Matale



Jaffna



Gampaha



Pilot area	Identified issues/information	Zone (area)	Probable Reason
Gampha	No_3 pollution	Katana, Biyagama	Poor sanitation
	Acidity of water	Katana, Biyagama,Ja-Ela, Gampaha	Industrial soil characteristics and industrial pollution
	Mn pollution	Biyagama, Ja-Ela	Industrial pollution
Ampara	No_3 pollution	Samanthurai, Irakkamam, Addalachchena, Malwatta, Ninthauvr	Poor sanitation and excessive usage of NO_3 containing fertilizer
	Ion pollution	Central camp, Adalachchena,Malwatta, Ninthavur	Country rock weathering
	PO_4 pollution	All over the pilot area	Excessive agricultural activities
	Slinity	Chavalakkudai, Navithanveli	Sea water intrusion Geological conditions of the area.
	Mn pollution	Navithanveli, Samanthurai and Deegawapi	Usage of pesticides?
	Cd pollution	Navithanveli, Samanthurai and Deegawapi	Usage of pesticides?

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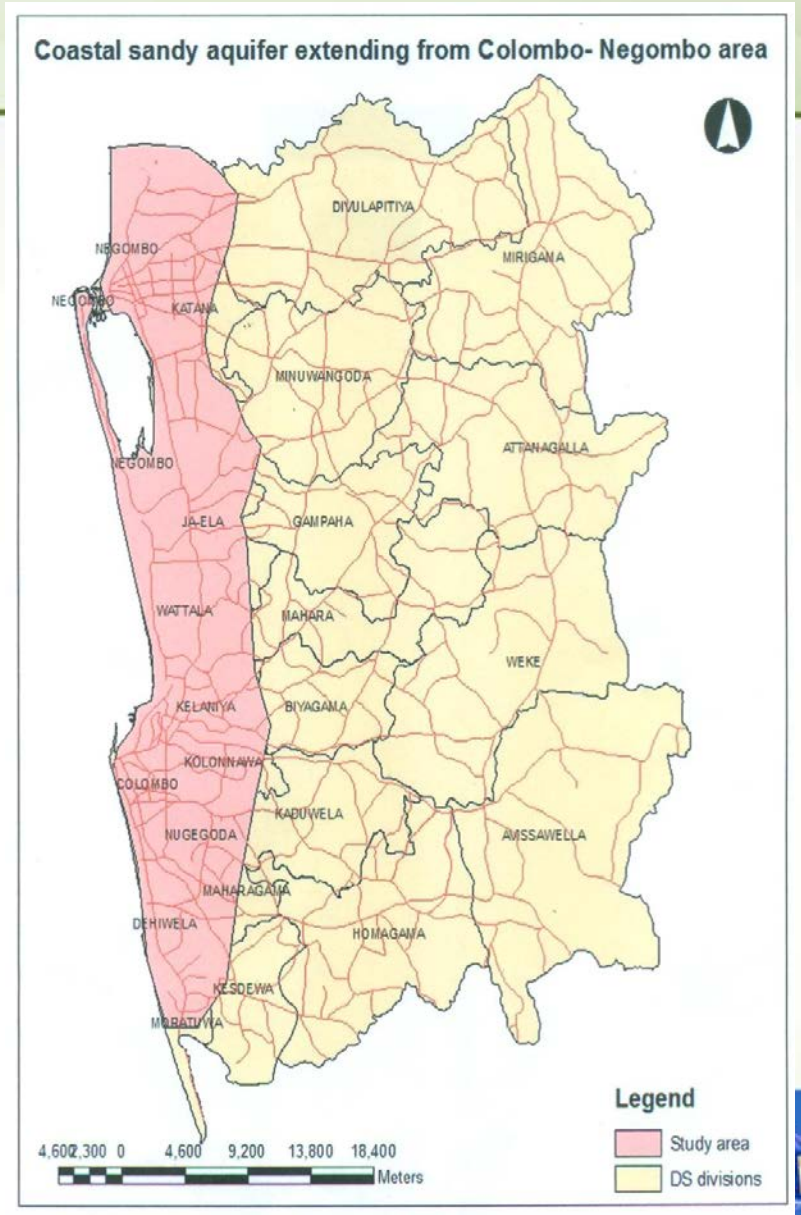
Anuradhapura	Fluoride pollution	Kebithigollawa, Kahatagasdigiliya , Padawiya, Galenbidunuwewa	Rock weathering/inherited soil properties
	Total alkalinity		High hardness
	No_3 pollution	Scattered zones	Poor sanitation and fertilizer
Jaffna	No_3 pollution	Kopai, Thirunaveli, Nallur, Kaithadi	Excessive use of fertilizer
	High salinity	Ariyalai	Sea water intrusion?
	Fresh groundwater zones	Iyakkathchi to Kadeikadu	Associate with isolated sand lenses
Puttalam	NO_3 pollution	Kalpitiya, Puttalam town area	Poor sanitation and excessive use of agrochemicals
	PO_4 pollution	Vanathavillu	excessive use of agrochemicals
	Salinity	Aruwakkalu	Seawater intrusion logon influence
Matale	Groundwater depletion in the Agro wells is the key factor to be identified.		
	High fluoride	Dewahuwa, Digampathaha	Rock weathering/ inherited soil characteristics

2.Hydrogeological study on the coastal sandy aquifer extending from Colombo to Negombo.

Objective – To identify aquifer geometry, aquifer properties, groundwater potential , Recharge and discharge areas etc and finally to develop a groundwater model.



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3. Water quality study at Anuradhapura district covering (Modaragam Aru, Malwathu Oya, Yan Oya Kala Oya and Ma Oya basins).

Objective

To identify different kind of minerals present in water resources

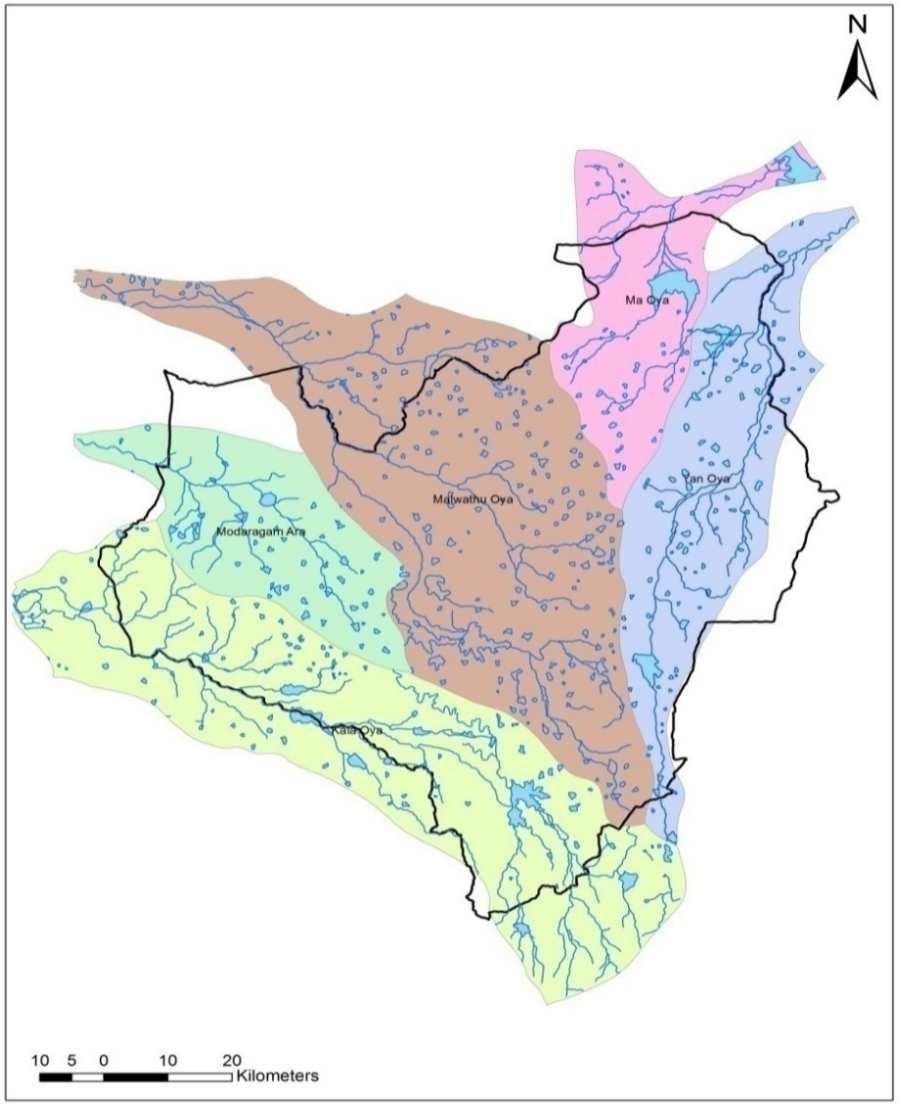
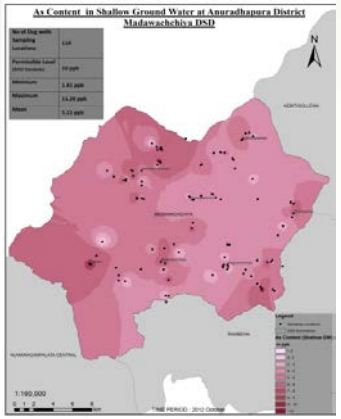
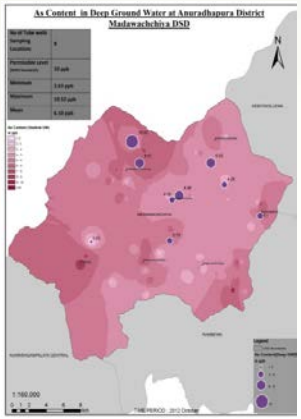
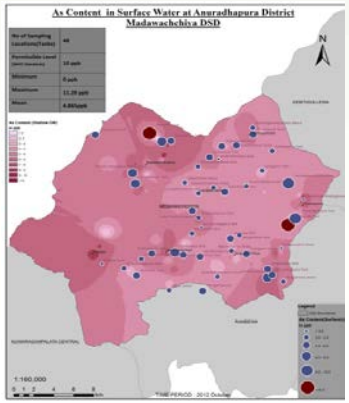


Fig 2 ; Drainage Basins in Anuradhapura District

Water quality study at Medawachchiya DSD







Pesticides , chemicals placed unprotected way in the field

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Recommendations

- **Based on the sociological analysis, it is clear that 84% of the reported CKD patients in Medawachchiya DSD are above the age limit of 50 years.**

- **The presence of Arsenic in groundwater is ranging from 2.67 ppb to 11.28 ppb. It is obvious that the Arsenic add to the water from agro chemicals.**

- **The arsenic level of groundwater of 76 samples out of 128 (shallow dug wells and tube wells) reported within the range of 5ppb – 10 ppb.**

- **Aware the people and reduce the usage of Agro chemicals and fertilizer in agricultural practices.**

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- **The safe and environmental friendly agro chemicals should be listed out and farmers should not be allowed to purchase the low quality agrochemicals directly from the dealers.**

- **Usage of Carbonic fertilizer and heavy metal free high quality agro chemicals should be encouraged, and the supply of agrochemicals should be done through Department of Agriculture or Department of Agrarian serves.**

- **Encourage farmers to apply traditional methods to control pests by minimizing the application of agro chemicals**

Similar study was started at Padaviya DSD

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4. Awareness programmes and water clinics conducted by the Training Centre, Anuradhapura (2008 -2012)

3 day residential program

Participants
PHI, Midwives, GN,
Samurdhi officers, School teachers , Agr.Dev.officers,
Com.health dev.officers

- No. of programs: 50
- No. of participants: 947
- Subjects
  - Water quality, water borne diseases, water purificatio methods, water analysis, water management

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water clinics conducted by Anuradhapura Training centre (2008 -2012)

No. of water clinics: 60

- Anuradhapura: 43
- Polonnaruwa: 08
- Kurunegala: 04
- Moneragala: 05

No. of water samples analyzed - 5178

No. of people attended - 8102

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No. of fluoride filters distributed : 836

No. of set of clay pots distributed: 665

No. of Reverse Osmosis (RO) filters installed for selected schools: 06

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Conservation & Development of Natural Springs

No. of springs developed: 20

- Dambagaha ulpotha :200 families, 30,000-40,000 l/day
- Singhaya ulpotha :300 families, 45,000-50,000 l/day
- Kosgaha ulpotha :150 families, 50,000-60,000 l/day
- Yakalla ulpotha :50 families, 12,000-15,000 l/day
- Gonamariyawa ulpotha :200 families, 30,000-40,000 l /day
- Theladinnanwewa ulpotha :20 families, 10,000-15,000 l/day
- Garinda ulpotha :100 families, 20,000-25,000 l/day

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Developed spring in Anuradhapura district

Dambagaha ulpotha before development

Dambagaha ulpotha after development

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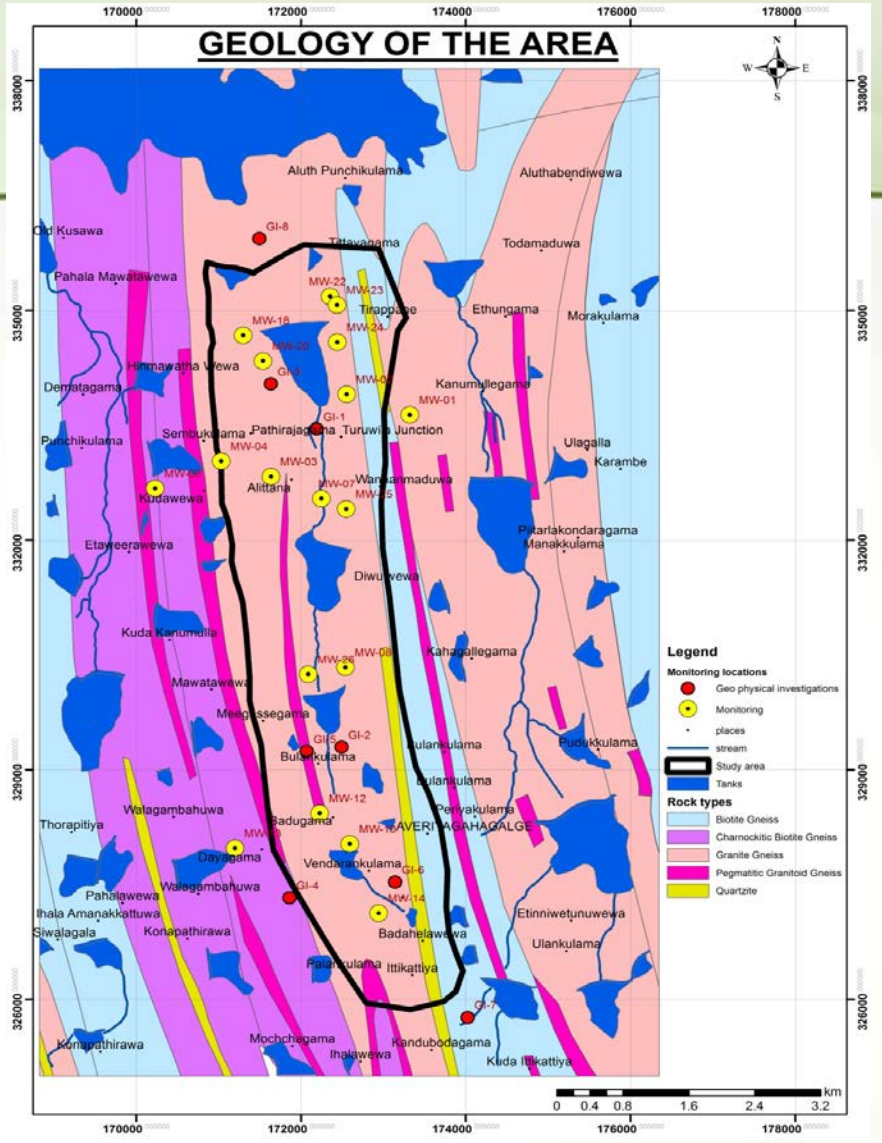
Groundwater Assessment Study at Thirappane cascade



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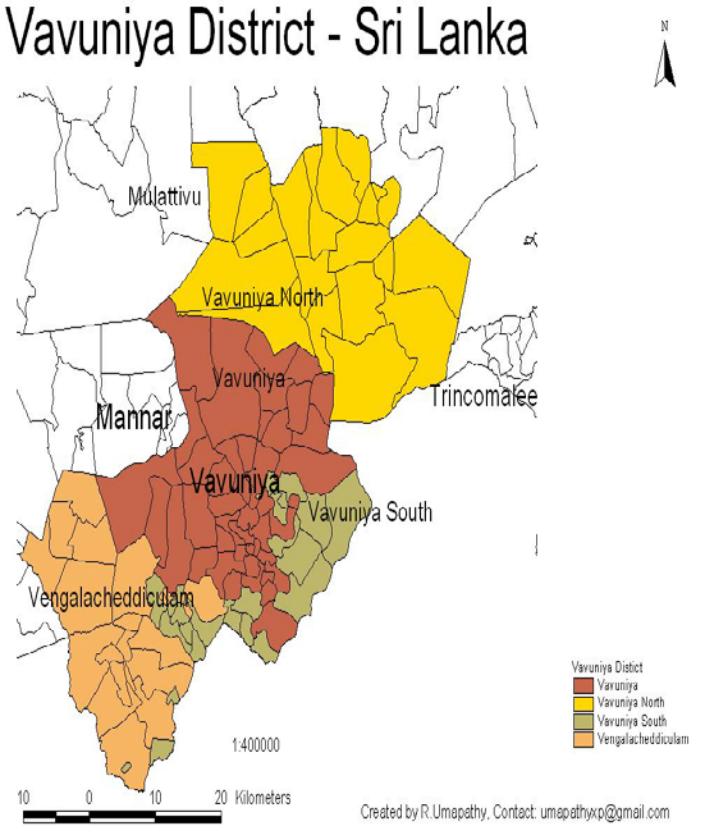
Hydrogeological study at Vavuniya and Kilinochchi districts

Objective

To asses the groundwater availability of the two districts



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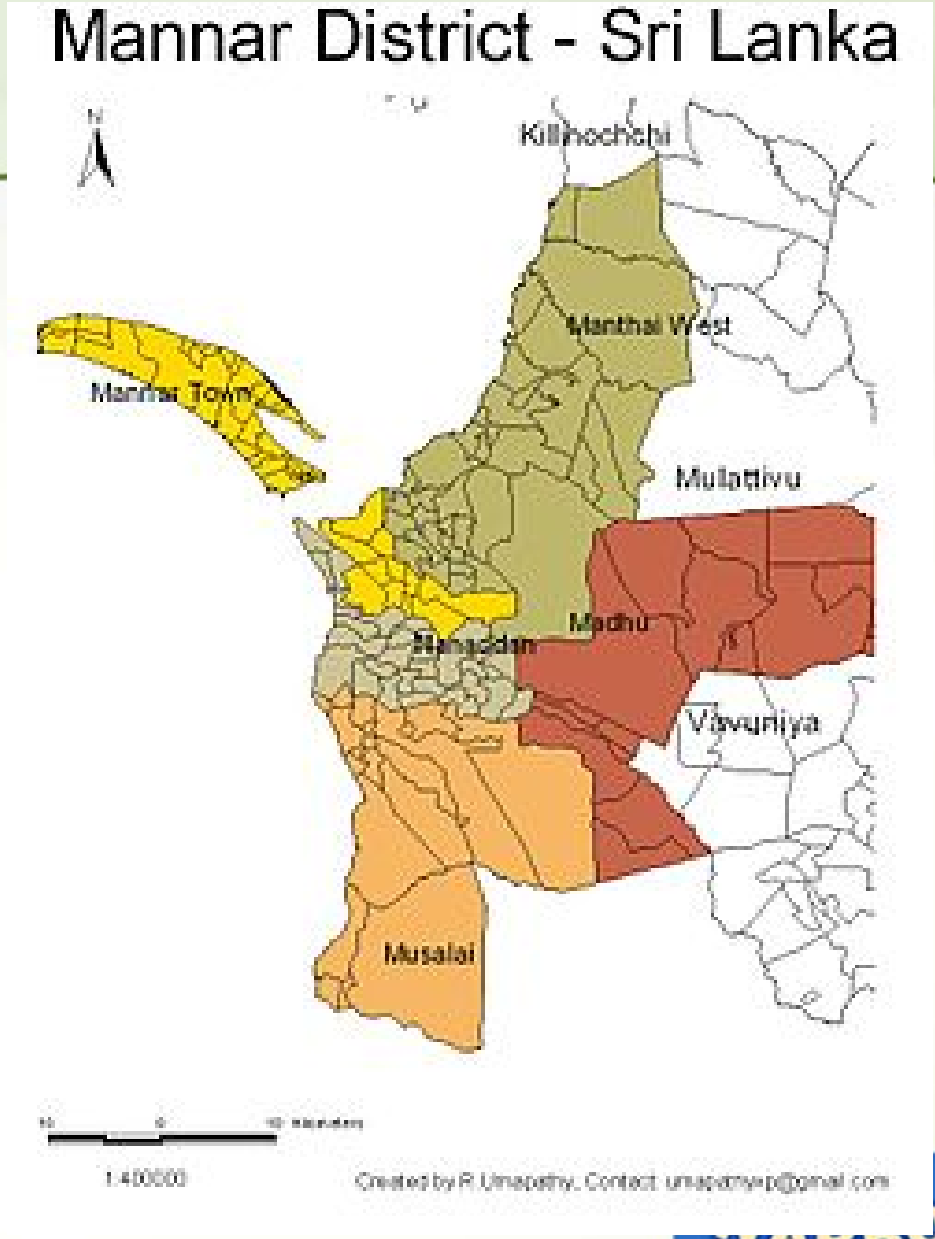
Hydrogeological study in Limestone aquifer at Mannar district

Objective

To determine the aquifer parameters, Groundwater potential zones and finally to develop a groundwater model



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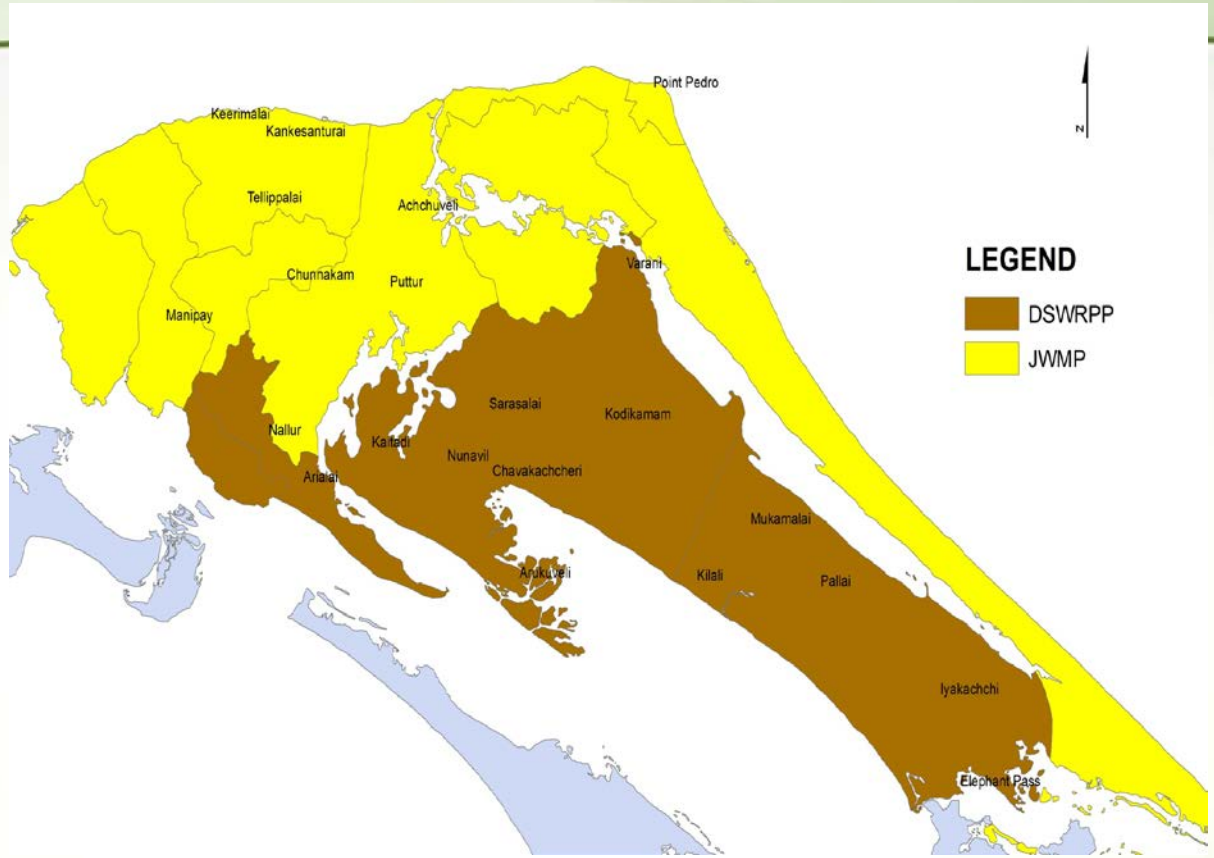
Hydrogeological study and establishment of long term monitoring net work for Jaffna Peninsula

Objective

To assess groundwater potential of the peninsula

And

Study water quality and water level changes in groundwater



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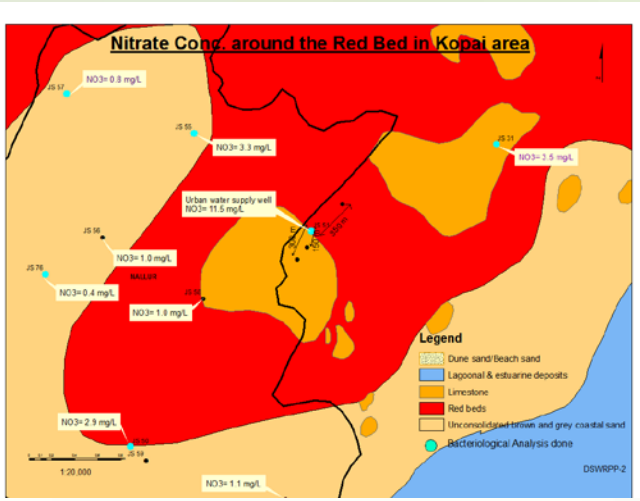

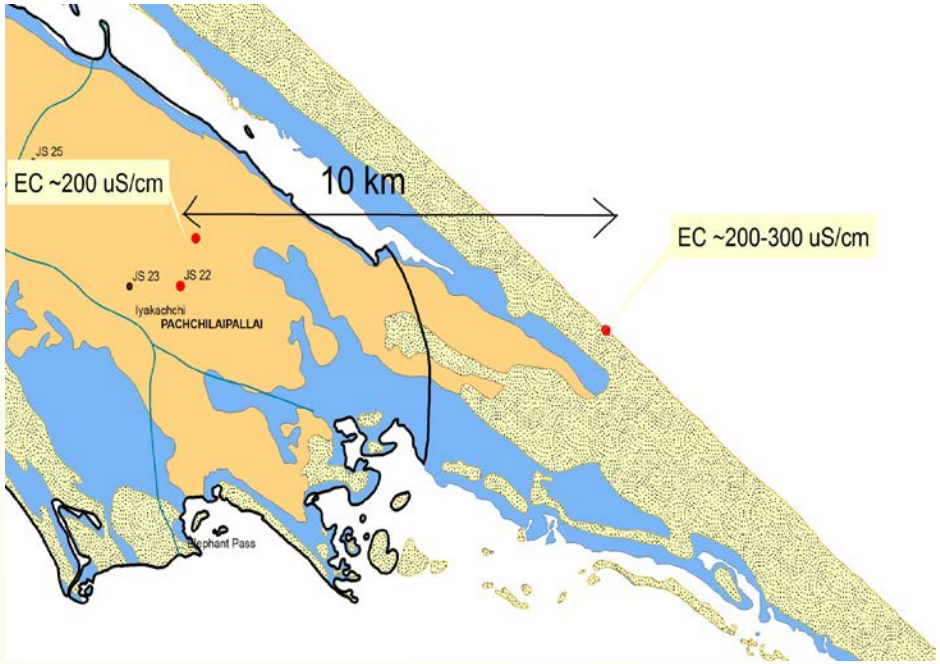

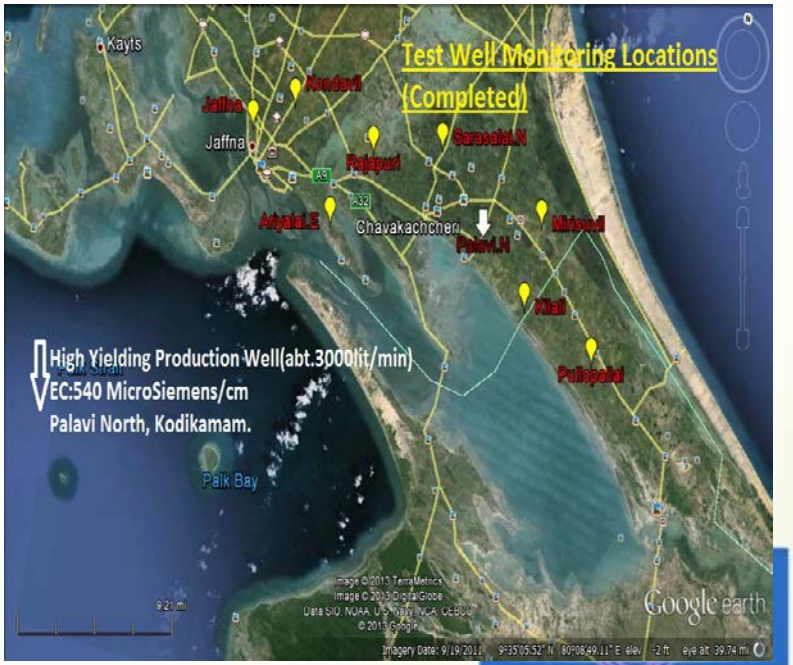

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To address all these issues

we need

-To establish a proper groundwater monitoring network covering the whole country

-Collect and submit real time data (water quality and water levels) through data transmission system (a wired modem or CDMA) to the head office.

-Maintain a proper groundwater data base in Head office

-Analyze long term trend patterns and spatial distribution of groundwater level and groundwater quality

-Preparation and updating of hydrogeological maps/models

-Development of policies and regulations for sustainable groundwater management

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Proposed Projects

Establishment of groundwater monitoring network for Sri Lanka (2014 – 2017)

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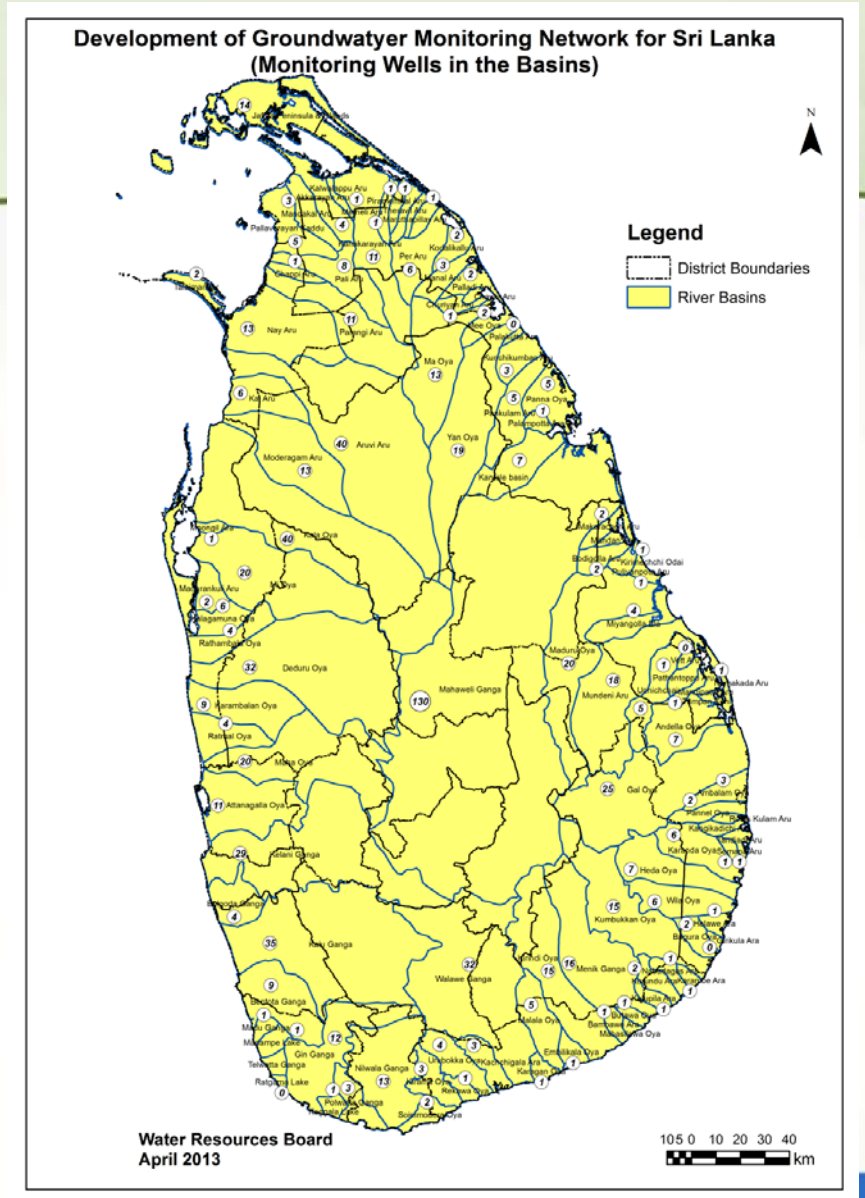
1310 Data loggers will be installed covering the whole country



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Groundwater monitoring network

Project coordination: Ministry of Irrigation & Water Resources Management

Executive board: Water Resources Board

Royal Eijkelkamp
Earth Sampling Group

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Monitoring Parameters

The main monitoring parameters are

1. **Groundwater Level**
2. **Electrical Conductivity**
3. **Temperature**
4. **Nitrate**

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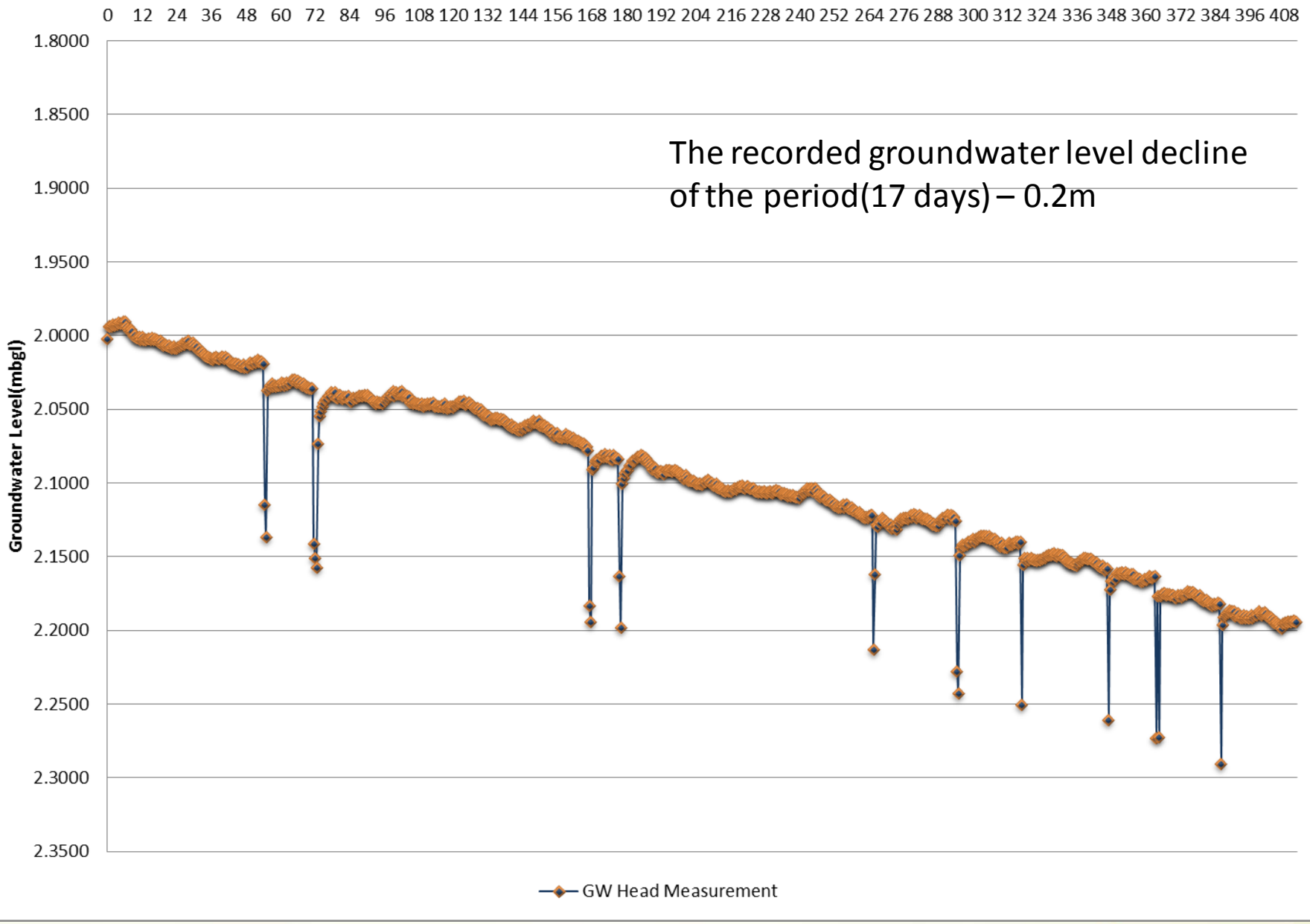
Data logger installation at KEPZ, Katunayake

Groundwater fluctuation from 26/2/2013 to 15/03/2013



Target Areas

- Community water supply schemes.
- Aquifers used to extract groundwater for Industries and industrial zones (mineral water industry, Beverage industry).
- Intensive agricultural areas.
- Areas subjected to groundwater pollution.
- Coastal Aquifers.

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Out come of the project

- Develop real time groundwater data base for Sri Lanka

-Forecast groundwater related issues

- Quick action to the groundwater related issues in the country

-Maintain a proper groundwater management system in Sri Lanka

- Provide data for the decision makers, researchers, stakeholders and general public

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Thank You

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