

Design and Establishment of Groundwater Monitoring Network in selected Pilot areas of Sri Lanka

The groundwater resources in Sri Lanka have been under threat over the past three decades with the increased industrial development and extensive application of fertilizer in agricultural activities together with high extractions resulting rapid groundwater depletion, saline intrusion and groundwater pollution. The early identification of these issues and implementation of remedial measures are of vital importance since the groundwater contamination is irreversible if significant damages have already occurred.

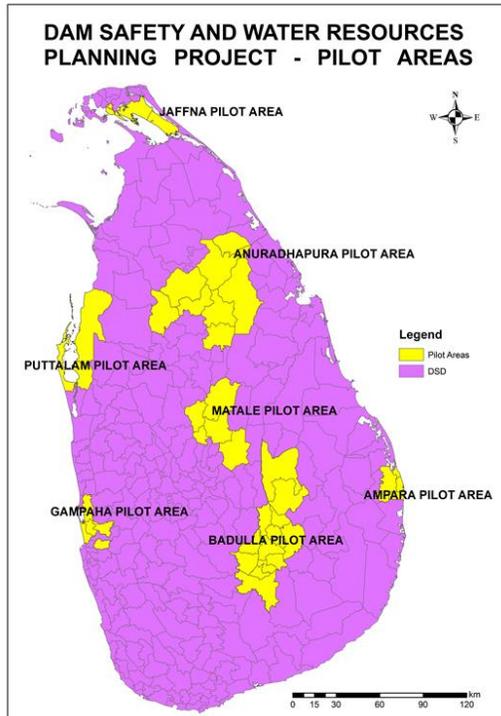


Fig1: Pilot areas of groundwater monitoring program

Geophysical surveys, test bore hole constructions, pumping tests, water quality analysis (physical, chemical, heavy metal, bacteriological and pesticides) and DGPS levelling of monitoring points were among the major activities carried out on each pilot area to identify impacts and establishing the groundwater monitoring points.

The Jaffna peninsula is one of the pilot area which is geologically underlain by Miocene limestone formations of karstic nature. The study reveals the high NO_3 (12 to 30 ppm range) content in groundwater of Kondavil lateritic formation where the major water supply scheme is existed. Elevated levels of NO_3 could also be detected at the areas of Kopai, Thirunalveli, Nallur, Kaithadi in the region. This is an alarming threat and continuous monitoring and mitigatory measures are required since these hazardous zones may be rapidly spread out to the entire Jaffna and Nallur areas as well due to karstic nature of the limestone. The high mineral enrichment is encountered in the areas towards the lagoonal boundaries possibly a

The spatio-temporal assessment of hydrogeological setup and present water chemistry of the groundwater resources of the country is off prime importance before the establishment of systematic long term groundwater monitoring network which is essential before the implementation of any remedial plans.

In this respect, Water Resources Board has identified 07 Pilot areas as an initiative to identify threats, impact on these groundwater resources through comprehensive studies under component-2 of DSWRPP and subsequently the establishment of operational groundwater monitoring network. The identified pilot areas are selective DSD's of Jaffna, A'pura, Mathale, Puttalam, Gampaha, Ampara and Badulla Districts.

Awareness programs, Preliminary field investigations, base map preparations, water sampling, groundwater level monitoring, in-situ water quality testing, 1-D & 2-D

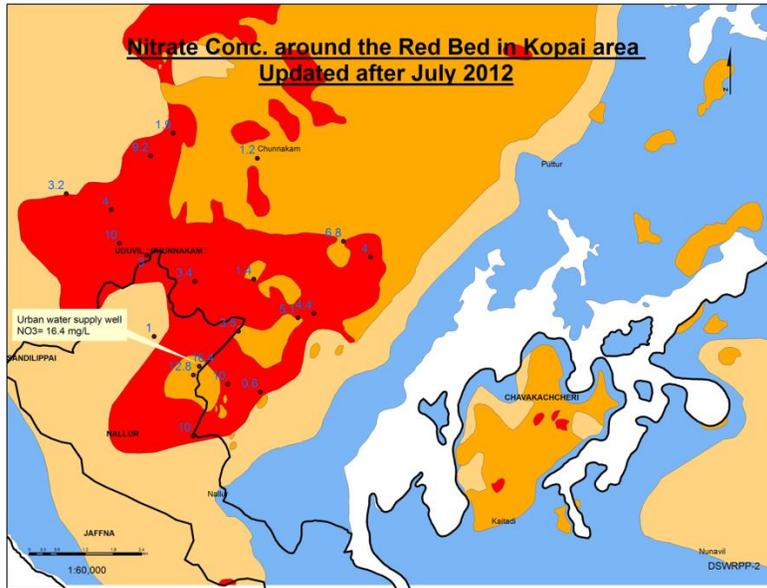


Fig2: High Nitrate levels in identified in Kondavil Water scheme area; the values are Plotted front of these monitoring points (black dots) and the background colors indicates the geology of the area (i.e. red color represents red earth formation)

threat indicating of saline water intrusion especially along the Karaveddi-Chavakachcheri DSD boundary.

The water chemistry in the selected DSD's of Mathale district (Dambula, Naula, Galewela, Laggala-Pallegama and Pallepola) are in desirable levels except few locations of high EC, total hardness, Iron, Fluoride. Domestic and agricultural uses are the main groundwater abstractions identified in the area. The groundwater flows dominantly along NW, SE and SW direction which controlled by the geomorphology and structure of the region.

The assessment of groundwater depletion due to over abstraction is in progress at selected thirty three locations of the monitoring network by spatiotemporal groundwater level monitoring.

The several localized zones of high phosphate, fluoride, nitrate and heavy metals and low pH were identified by the groundwater quality analysis in the Gampaha Pilot area. The impact on groundwater due to industrialization is not yet emerged as an alarming issue; however surveillance monitoring is required to identify any future threats. The sea water intrusion at the deeper levels was identified at the coastal stretch of Pamunugama to Negombo by exploratory borehole drilling.

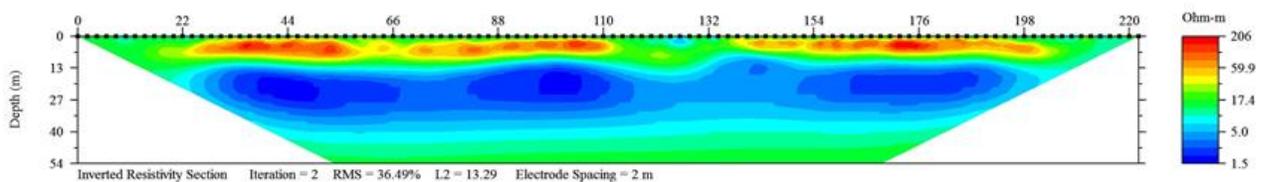


Fig3: High saline zone indicated below the depth of 10m at the coastal stretch of Pamunugama area (~ 100 m away from the coastal line)

Ampara is one of highest agricultural areas in the country and therefore extensive agriculture has a major impact on groundwater resources. The study reveals contaminated groundwater sources at high agricultural areas of Sammanthurai, Karathivu, Addalachchena, Ninthavur, Irrakkamam and Navithanveli DSD's in respect to FI, PO4, Cd, Mn pollution and also give some indication of the presence of As. This indicated the influence on groundwater due to heavy agricultural activities in the region with the

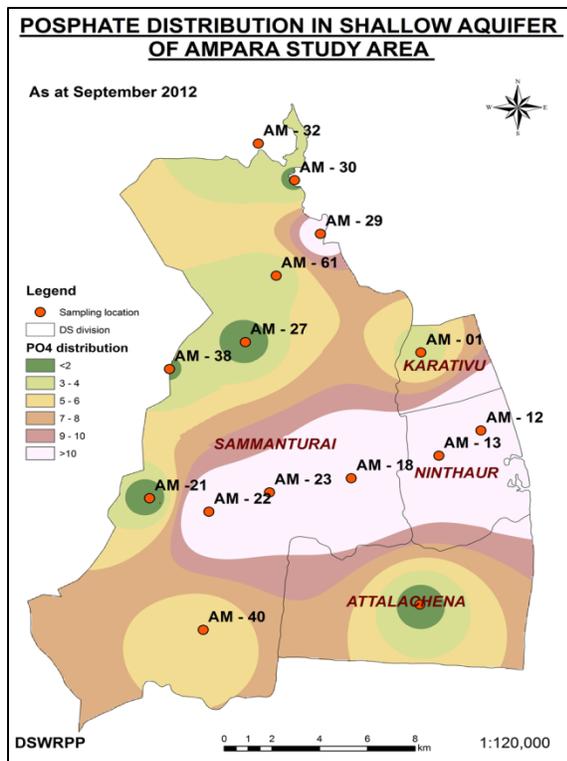


Fig4: PO₄ distribution is shown high levels especially along the central agricultural drainage line of Ampara Pilot area

Geophysical exploration cum test borehole drilling reveals the high complexity of hydrogeology and hydrogeochemistry of the limestone formations in the region.

The High Fluoride content in ground water is identified in many of DSD's of Anuradhapura District and it highly varies with spatially as well as temporally within the region. However, the areas of Asirikgama ,Kukulawa, Andaragollawa, Mahakumbuk wewa, Kahatagollwa, Moraoya and Manaketiya are identified as hazardous zones with high fluoride enrichment in groundwater. The high Nitrate and Phosphate levels were identified in Asirikgama and Habagama Areas respectively. The wastes disposal and gravel mining at potential recharge zones of quartzite ridges should be properly managed. The monitoring points were selected at strategic points on the surveillance monitoring approach to identify any emerging threats.

The Badulla Pilot area was selected based on the importance of potential recharge zone for the most of the river basins in the country. Test boreholes (cum hand pump tube wells)provides the spatial water chemistry in the region and analysis results indicated there is no major threat in context to groundwater quality.

extensive application of pesticides and weedicides. In urbanized areas, point sources of high NO₃ contamination were identified due to poor sanitation and partly attributed to high permeable formations encountered in the area. The possible seawater intrusion is envisaged by high salinity along the coastal stretch of Ninthavur and Navithaveli. However, high salinity zones at Malwatta and Deegavapiya may result due to inherited formation characteristics.

The pilot area comprised off Puttalam, Vanathavillu and Kalpitiya DSD's have identified a threat due to excessive application of fertilizers. This was confirmed by the high levels of NO₃ and PO₄ in groundwater of Kaltpitiya area. In most of groundwater sources of the Vanathavillu area were encountered with high PO₄ contamination which exceeded the maximum permissible level of drinking water standards. The occasional isolated zones with high EC, TH, NO₃ & SO₄ were also identified in the Vanathavillu area. The groundwater quality in Puttalam, Vanathavillu and Kalpitiya areas are shown predominantly of Na-K-Cl type with mixing towards Ca-Mg-HCO₃ type.

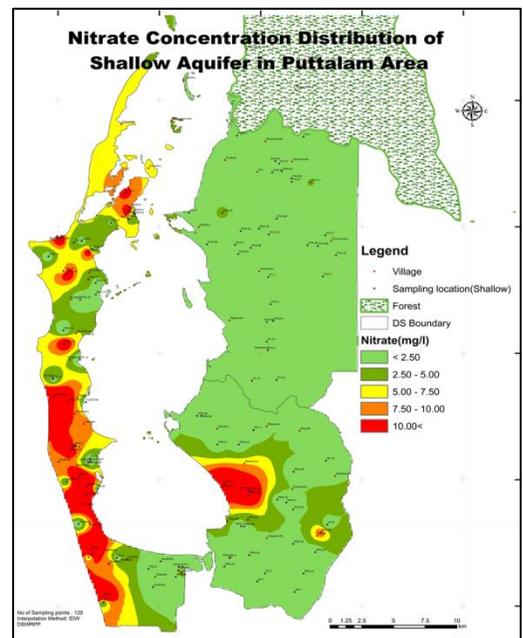


Fig5: NO₃ distribution in Puttalam area where elevated levels are appeared in the Kalpitiya split

