Water Quality in River Basin

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INTRODUCTION

To analysis the quality of water in river basin with the following objectives.

OBJECTIVES OF A WATER QUALITY

1. For enhancing good quality water to consumers.
2. For Passage of sufficient water to the desired area.
3. For easy availability of water to consumers so as to promote hygiene in the environment

PROPOSED METHODOLOGY AND DISCUSSION:

PLANNING OF A WATER SUPPLY IN BASIN

I. FIXING THE DESIGN PERIOD:

Water supply projects are normally designed to meet the requirements over 30-year period after their completion. The southwest monsoon rainfall is highly erratic and summer rains are negligible. Rainfall data from seven stations over the period 19012001 were utilised and a perusal of the data shows that the normal annual rainfall over the district varies from about 570 mm to 740 mm. It is the minimum around Arasadi (577.4 mm) and Thoothukkudi (582.8 mm) in the central eastern part of the district. It gradually increases towards south, west and north and attains a maximum around Kayattar (722.5 mm) and Kovilpatti (734.8 mm) in the northwestern part.

The district enjoys a hot tropical climate. The high relative humidity prevail through out the year between 60 and 75%. The annual mean minimum and maximum temperature are 23°C and 29°C respectively.

II. PLANNING AND ESTIMATING GOOD QUALITY OF WATER:

This involves determining the number of people who will be served and the per capita water consumption together with an analysis of the factors that may affect the rate of consumption and total consumption.

GEOMORPHOLOGY AND SOIL TYPES

Geomorphology

The prominent geomorphic units identified in the district are 1) Fluvial, 2) Marine, 3) Fluvio-marine, 4) Aeolian and 5) Erosional landforms depending on the environment of formation. Taruvaikulam- Tuticorin surface, Kulattur surface, Vaippar surface, Nagalapuram-Vedanattham surface and Volinokkam-Vembar surface are some of the erosional geomorphic units in the northern part of the district. Karamaniyar surface, Tambraparni surface, Tiruchendur-Kayapattinam surface and Vallanadu surface are the geomorphic units in the southern part of the district.

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The number of red sandy tracts formed of the sand dunes locally known as Ten'sand complex are the important feature in the coast. These Teri sands extend in width from 6 to 8 km from the coast. Adaippanvilai Teri, Kudiraimozhi teri and Vaippar-Vembar Teri are some of the important Teri areas, which are having elevation in the range of 15 to 62m above MSL.

PRESENTATION OF THE MAIN CONTRIBUTION OF THE PAPER:

Soils

The district is covered by Black Cotton soil in the west with isolated red soil patches in high ground. The sandy soil is present in the coastal tract. Alluvial soil is restricted to river flood plain and coastal part. Alkaline and saline soils are also noticed at places.

GROUND WATER SCENARIO

Hydrogeology

The district is underlain by both porous and fissured formations. . The important aquifer systems in the district are constituted by i) unconsolidated & semi-consolidated formations and ii) weathered and fractured crystalline rocks

The porous formations in the district include sandstones and clays of Recent to subrecent and Tertiary age (Quaternary). The Recent formations comprising mainly sands, clays and gravels are confined to major drainage courses in the district. The maximum thickness of alluvium is 45.0 m bgl, whereas the average thickness is about 25.0 m. Ground water occurs under water table and confined conditions in these formations and is being developed by means of dug wells and filter points. The productive zones are encountered in the depth range of 29.5 to 62 m bgl. Alluvium, which forms a good aquifer system along the Vaippar and Gundar river bed which is one of the major sources of water supply to the villages

The water-bearing properties of crystalline formations which lack primary porosity depend on the extent of development of secondary intergranular porosity. The occurrence and movement of ground water in these rocks are under unconfined conditions in the joints & fissures and dependent on the nature and extent of pores and interconnection of fractures zones. The morpho-tectonic analysis of the crystalline tract indicates the presence of deep seated tensile and shear fractures particularly along the fold axes. These tension joints and fractures and shear fractures at deeper depth of 30 to 100 m have been acting as conduits for ground water movement.

The depth of the wells in crystalline rocks ranged from 10.00 to 15.00 m bgl. The yield of large diameter wells in the district, tapping the weathered mantle of crystalline rocks ranges from 40 to 110 lpm and are able to sustain pumping for 2 to 6 hours per day. The Specific capacity of large diameter wells tested in crystalline rocks ranges from 3.0 to 141 lpm/m. of drawdown. The yield characteristics of

wells vary considerably depending on the topographic set-up, lithology and nature of weathering.
The depth of wells drilled in crystalline rocks ranged from 26 to 200 m bgl various state agencies mainly for domestic purposes and the yield wells ranged from 10 to 250 lpm. The yield of successful bore wells drilled down to a depth of 750 m bgl during the ground water exploration programme of Central Ground Water Board ranged from 3 to 10 lpm. The aquifer and well parameters of the wells show wide variation, both in crystalline and sedimentary formations.
The depth to water level in the district varied between 1.20 - 12.12 m bgl during pre-monsoon (May 2006) and varied between 0.33 - 9.24 m bgl during post monsoon (Jan 2007). The seasonal fluctuation shows a rise in water level, which ranges from 0.20 to 8.41 m bgl. The piezometric head varied between 2.40 to 11.00 bgl during pre monsoon (May 2006) and 0.33 to 9.24 m bgl during post monsoon (Jan 2007).

EXPERIMENTAL RESULTS:

Long Term Fluctuation (1998-2007)

The long term water level fluctuation for the period 1998-2007 indicates rise in water level in the area 0.0153 - 2.8106 m/year and fall in water level ranging between 0.0123 - 0.3996 m/year.

Aquifer Parameter

Formation	*Transmissivity (m^2/day)*	*Storativity*	*Specific Yield (%)*
Weathered Crystallines	-	-	<2%

Formation	*Transmissivity (m^2/day)*	*Storativity*	*Specific Yield (%)*
Fractured crystallines	7-135	1.32×10^{-3} to 1.88×10^{-3}	-
Porous Formation	20-610	-	1-8%

Ground Water Resources

The ground water resources have been computed jointly by Central Ground Water .
The chemical characteristics of ground water in the phreatic zone in the concerned district has been studied using the analytical data of ground water samples collected during May 2006 from Network Hydrograph Stations of Central Ground Water Board. The study of quality of ground water in deeper aquifers in the district has been attempted using the data collected from exploratory bore/tube wells constructed in the district.
Ground water in phreatic aquifers in district, in general, is colourless, odourless and slightly alkaline. The specific electrical conductance of ground water in phreatic zone (in Micro Seimens at 25° C) was in the range of 280|iS/cm to 12020|iS/cm in the district and major parts are having multiplayer aquifer system. Hence the water quality varies with respect to depth of taping.
It is observed that the 50 percent samples of ground water is suitable for drinking and domestic uses but depth of the well should be properly designed, depending on the multilayer aquifer system.

With regard to irrigation suitability based on specific electrical conductance and Sodium Adsorption Ratio (SAR), it is observed that ground water in the phreatic zone may cause high to very high salinity hazard and medium to high alkali hazard when used for irrigation. Proper soil management strategies are to be adopted in the major part of the district while using ground water for irrigation.

Status of Ground Water Development

The estimation of groundwater resources for the district has categorized the blocks as given below.Over Exploited - 7 Critical - 1 Semi Crtical – 2 Safe - 2
The shallow alluvial aquifers along Vaippar and Gundar rivers serve as an important source of drinking water irrigation development for Thoothukkudi district. Dug wells are the most common ground water abstraction structures used for irrigation in the district. The yield of dug wells range from <50 to 200 m3/day in weathered crystalline rocks, 20 to 100 m3/day in Tertiary formations and up to 400 m3/day in Recent alluvial formations along major drainage courses.

GROUNDWATER MANAGEMENT STRATEGY

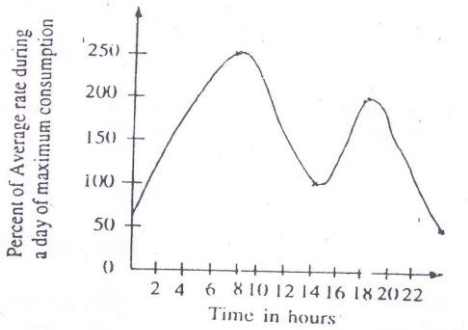
Groundwater Development

In view of the comparatively high level of ground water development in the major part of the district and the quality problems due to lithogenic and anthropogenic factors, it is necessary to exercise caution while planning further development of available ground water resources in the district.
The yields of dug wells in crystalline and Tertiary formations are improved at favorable locations by construction of extension bores which are 20 to 40m. deep. In recent years, a large number of bore wells have also been drilled by farmers for irrigation purposes.
The development of ground water for irrigation in the district is mainly through dug wells tapping the weathered residuum or recent alluvial deposits. Bore wells have also become popular as the source for irrigation in the district in recent years. Dug wells with extension bores wherever necessary is ideal for hard rock areas whereas large diameter dug wells with radials is suitable for alluvial areas. The map showing the development prospects for the district is shown in Plate VI.

Variations in the rate of consumption

In practice it can be seen that the rate oc consumption will vary depending upon the season or month, day and hour. These are termed as given here:
1. Seasonal or monthly variation
2. Daily variation
3. Hourly variation

Hourly variation for an average city is plotted m Fig.



CONCLUSIONS:

Water Conservation and Artificial Recharge

CGWB had prepared a master plan to augment groundwater potential by saturating the shallow aquifer taking into consideration the available unsaturated space during post monsoon and available uncommitted surplus run off. Subsequently, computations have been made for Drought Prone Area Programme (DPAP) for over exploited and critical blocks in the districts warranting immediate attention. Institute of Remote Sensing, Anna University had prepared block wise maps demarcating potential zones for artificial recharge for the State of Tamil Nadu. Subsequently, State Government agencies have constructed artificial recharge structures with their own fund or with fund from Central Government, dovetailing various government programmes.

Ministry of Water Resources, Government of India has initiated Dug Well Recharge Scheme in the State. The scheme is being implemented by the Nodal Department (SG&SWRDC, PWD, WRO, Government of Tamil Nadu) with the technical guidance of CGWB. The subsidy of Rs4000/- for small and marginal farmers and Rs2000/- for the other farmers is credited to the beneficiaries' bank account through NABARD. The scheme after implementation will prove to be beneficial to the irrigation sector. The available uncommitted surplus run off has to be recomputed, taking into consideration the quantum of recharge effected through existing irrigation dug wells also. The existing structures and uncommitted surplus flow should be considered for further planning of artificial recharge programme.

On the basis of experimental studies, it has been found that desilting of existing tanks followed by percolation pond with recharge wells, recharge shafts are economical. There is considerable scope for implementation of roof - top rainwater harvesting in the district. Recharge pits / Shafts / trenches of suitable design are ideal structures for rainwater harvesting in such areas. Central Ground Water Board is also providing free technical guidance for implementation of rooftop rainwater harvesting schemes.

GROUNDWATER RELATED ISSUES & PROBLEMS

Ground water development in this district is mainly by means of dug wells and hand pumps. The shallow tube wells and dug cum bore wells in Panamparai Sandstone area has increased the agricultural activities locally. The district needs careful management practices in view of the vulnerable seawater intrusion problems and limited scope for artificial recharge schemes in saline tracts of the district.

Water Supply: Ground water development in hard rocks are mainly by means of dug wells and bore wells for irrigation and water supply respectively. Many bore wells are given low yield and are suitable for hand pump only. The irrigation dug wells are in better use. The urban water supply is mainly from the Tambraparni river and supply depends on the saturation of river bed. Scarcity is common in many towns.

Based on the limited fresh water availability in sedimentary areas as floating lenses, it is inferred that a major part of the coastal tract with Teri sands could be considered vulnerable to water quality changes. A considerable amount of ground water is being developed from the tube wells in the thin sedimentary zone in Surankudi area, multiqualty aquifer in Tiruchendur area and Teri sands in Kudiraimoli Teri. As the ground water in the alluvial/Tertiary aquifer in the eastern part of the district is in hydraulic connection with the sea, the district is also vulnerable to saline water ingress.

ACKNOWLEDGEMENT:

Awareness & Training Activity

Mass Awareness Campaign (MAP) & Water Management Training Programme (WMTP) by CGWB

Two WMTP was organized on "Rain Water Harvesting Training" at the meeting hall of District Collectorate complex, Thoothukkudi and Tiruchendur in Thoothukkudi district during the period 2002-03 and 2006-07 respectivily. Two Mass Awareness Campaign on "Ground Water Management, Regulation & Conservation" was organized at Pudukottai and Karungulam in Thoothukkudi district during the period 2002-03 and 2006-07 respectivily.

Area Notified by CGWA/SGWA

Central Ground Water Authority has not notified any area in the district. Government of Tamil Nadu vide G.O.No. 51 has restricted groundwater development for irrigation in the over exploited blocks of Tamil Nadu. The over exploited blocks in this district is Ettayapuram, Kovilpatti, Ottapidaram, Sathankulam, Thoothukkudi, Udangudi and Viltthikulam.

Recommendations

As the development of ground water has already reached an optimum stage in many of the blocks of this district, further development of ground water for creation of additional irrigation potential has to be carried out with extreme caution, considering the poor sub-surface storage capacity. Necessary measures for regulating the exploitation of ground water may be implemented in coastal blocks of the district. The Teri sands and fresh water bearing Tertiary sandstone area along the coast has to be notified as ground water sanctuaries and further development has to be only for drinking water purposes. Roof top harvesting and direct use from ground level storage is suggested for coastal habitations including Tuticorin town so that the public water supply from distant source can be managed in a better way. Modeling of coastal aquifer is needed for various stress conditions in view of brine water and fresh water development in this area. Intensive monitoring of ground water levels and water quality is to be taken up in the coastal areas of the district to monitor the movement of fresh water - saline water interface.

Artificial recharge of ground water through cost-effective rain water harvesting systems may be popularized in the district by providing incentives to individuals/communities embarking upon such initiatives. A concerted effort involving various Government agencies and NGOs can create the necessary awareness among the rural masses. Waste land development programme and micro irrigation system.

REFERENCES:

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