

Identification of Active Infiltration Zones in Grand Anicut Canal Irrigated Area in Southern Part of Thanjavur Delta Using Gis.

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Abstract

The irrigation canal network systems have contributed to the availability of water not only for agriculture but also for domestic use by urban and rural households. Irrigation canal seepage and infiltration provide an important contribution to groundwater recharge. This saves a substantial amount of water that can be used to extend the irrigation area so more people can benefit from the available irrigation water. However, in the currently irrigated areas lining will have impacts by lowering groundwater levels due to a reduction in percolation from canals. This percolation contributes to the recharge of underground water in both shallow and deep bore well used by the people to obtain water for drinking and agriculture purpose during alternate season of six months in a year. In this study, the positive effects of subsurface conditions on recharge zones by infiltration from Grand Anicut canals are evaluated. The soil, geomorphology and geological data along with slope of the canal command Area in Thanjavur and Pudukottai districts are used to identify the infiltration zones influenced by Grand Anicut canal and branch canals. The analysis thus carried out has revealed that the areal extent of zones in the canal irrigated area with poor, moderate, good and excellent infiltration process zones are 30.99 sq.km, 1191.16 sq.km, 2325.87 sq.km and 327.50 sq.km respectively.

Key Words: Active Infiltration Zone, Canal network, Ground water Recharge, Irrigation area, GIS.

1.INTRODUCTION

Grand Anicut canal or Kallanai canal - the engineering marvel of Southern Thanjavur – It was designed by British engineer, Colonel W M Ellis and completed in 1934, the canal irrigates the rainfed areas of erstwhile Southern Thanjavur including the taluks of Pudukottai district. The project managed to convert 2.5 lakh acres of otherwise arid lands into fertile paddy fields in this period. Tamil Nadu's Kallanai dam that exemplifies the

architectural skill of Karikaalan, the famed King of early Chola dynasty. This is the story of the man-made river, the Kallanai canal, that split as the fourth river from the Kallanai dam and flows into the Thanjavur and Pudukottai districts. The Architecture of this great achievement of human endeavour, that flows for 148.43Km from Kallanai till it meets the sea at Munpalai in Manalmelkudi, Pudukottai district, is a pinnacle of human imagination. While all river currents generally flow towards a slope by nature, this man-made river is designed to flow from a slope towards an uphill terrain. This feat is achieved by meticulously designing the river to flow evenly in uphill and downhill using overhead structures and tunnels. The river also has provisions to prevent sewage water contaminating the river. Similarly, the 'drops' have been set up in 550 places across its length to drain excess water and keep the flow at a constant level.

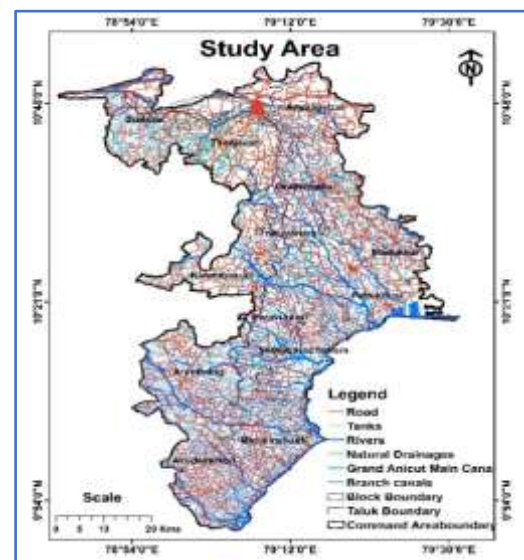


Fig -1: Study Area

The Kallanai canal that was built for agricultural irrigation has not failed its purpose to carry water to the irrigation ponds. The design is in a way that the excess water from the pond returns to the canal again 2.5 lakh acres of land in region of Thanjavur, the taluks of

Budalur, Thanjavur, Orathanadu, Pattukottai and Peravurani and Aranthangi taluk, Manamelkudi and Nagakudi in the district of Pudukottai are being irrigated by the water. The flow of canal from Grand Anicut to Munpalai is depicted in the study area map (Ref Fig 1)

2.METHODOLOGY

To identify the active infiltration zones, thematic layers of soil, geology, geomorphology, canal density and slope of the study area was considered. In order of importance the weightage and rank assigned to the various layers using ArcGIS software are given in table 1.1. The logical reasoning adopted for categorization and weight assignment for each of the thematic features are detailed below.

Table-1:Weightage and Ranking

Theme	Basis of Categorization
Soil	Soil types compared to infiltration values
Canal Density	Canal density value
Geomorphology	Type, areal extent and associated vegetation
Geology	Rock type, weathering characteristics, thickness of weathering, joints and fractures
Slope	Slope per cent value

2.1 Soil

Among the various Soil types of the study area fine sand, loamy sand was assigned the maximum weightage (50) owing to their infiltration nature.

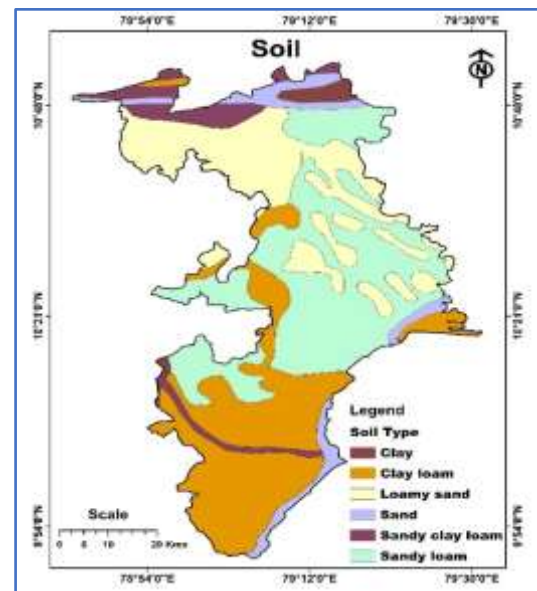


Fig -2: Soil

The weightage values assigned for the other categories in a progressively decreasing order, sandy loam (40), Sandy clay loam (35), clay loam (30), clay (25). Thus the lowest weightage value was assigned for clay in view of their poor infiltration rate (Refer Fig 2).

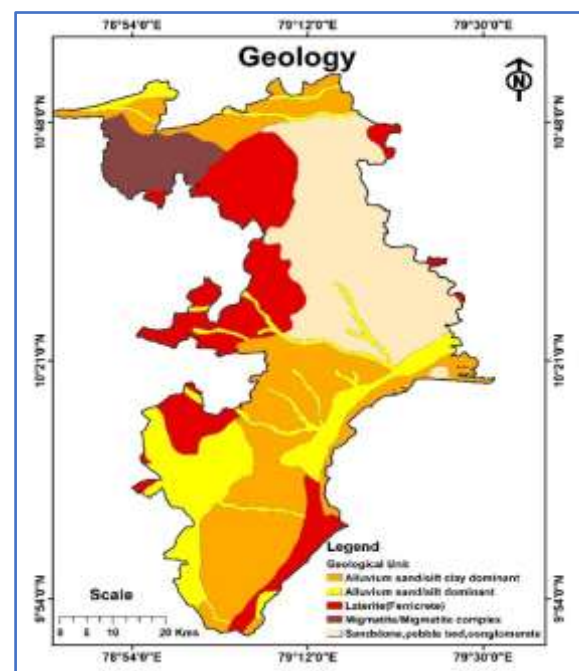


Fig -3: Geology

2.2 Geology

Among the various rock types of the study area alluvium sand, sand with silt was assigned the maximum weightage (50) owing to their unconsolidated nature, high porosity and permeability. The weightage values assigned for the other categories in a progressively decreasing order, sandstone with shale (40), Laterite (35), Charnockite (30), Migmatite (25), Granite (20).

Thus the lowest weightage value was assigned for granite in view of their highly massive water and varies poor porosity and permeability (Refer Fig 3)

2.3 Geomorphology

Among the various landforms of the study area alluvial plains, flood plain and coastal plain were assigned the maximum value (50) in view of the fact that this landform is essentially composed of alluvial materials, which are unconsolidated and highly porous, and permeable. More over as this landform is very close to the rivers and canals, these alluvial plains get recharged very often and hence naturally this land form possesses excellent groundwater. The Deltaic plain, which are the unconsolidated materials of varying sizes are also rich in groundwater, as this landform possess favourable constituent in consolidated materials, which facilitates instant infiltration of groundwater hence it was assigned a weightage of 45. Progressively lower weightage were assigned to landforms such as coastal plain (35), Pediment (35), Lateritic (35), deltaic(10)(Refer Fig 4).

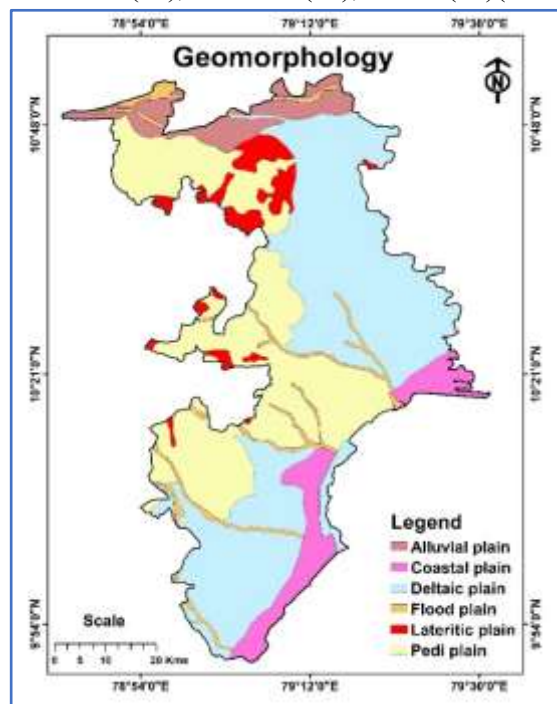


Fig -4: Geomorphology

2.4 Canal Density

High canal density reflects the higher surface runoff and low infiltration of surface water with the ground. But low canal density reflects poor surface runoff and high infiltration of surface water into the ground or subsurface flow. This fact was considered in assigning the weightage for the various drainage density classes

of the study area. Canal density class less than 3 km/sq.km was assigned the maximum weightage value (50); lower weightage were assigned to the drainage density classes of 3-5 km/sq.km (40); 5-7 km/sq.km (30); and above 7 km/sq.km with least weightage of 10 (Refer Fig 5).

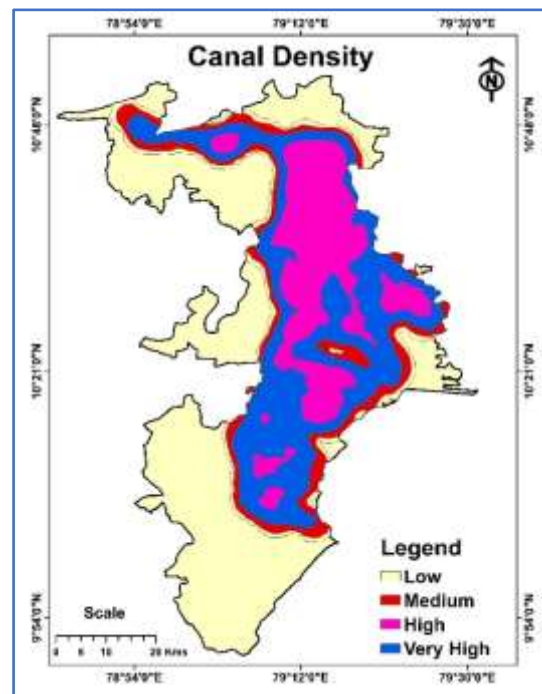


Fig -5: Canal density

2.5 Slope

In areas with higher slopes, the water, which flows on the surface rapidly, drains off, greatly reducing the chances of water infiltrating into the ground. On the other hand in flat areas/plains, water which flows on the surface with lower velocities has the possibility of water infiltrating into the ground which is more and hence it is natural to expect plain areas with higher groundwater recharge than areas with higher percentage of slopes. This fact was considered while assigning the weightage for the various slope classes. Thus area with slopes less than 4% were assigned higher weightage (50) and progressively lower weightage was assigned to the slope classes of 4-8% (40), 8-12% (30), 12-16% (20) and over 16% (10) (Refer Fig 6).

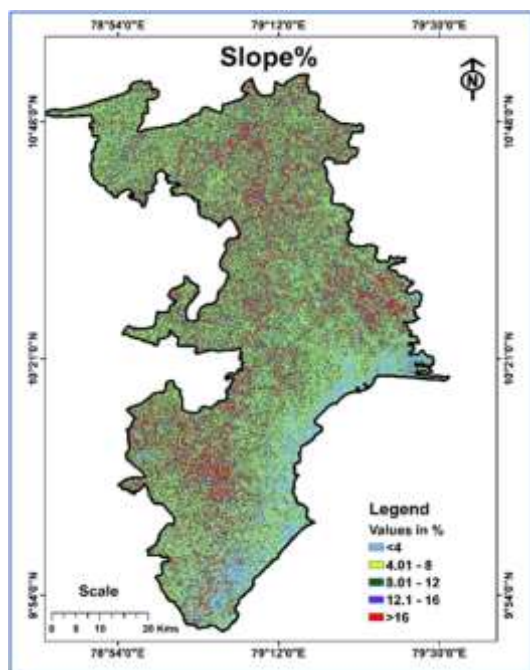


Fig -6: Slope

3. INTEGRATION OF PARAMETERS IN WEIGHTED OVERLAY MODEL USING GIS.

To identify active infiltration zones, all the thematic layers were integrated with one another according to their importance with respect to groundwater prospects through GIS overlay concept. The sequences adopted in the present exercise are as follows, (i) soil (ii) geology (iii) geomorphology (iv) canal density (iv) and slope. In the present study, the demarcation of groundwater storage zones through infiltration process was made by overlaying the polygons of integrated layers with weightage values into different infiltration process zones, such as low, moderate, high and very high . (Refer Fig 7)

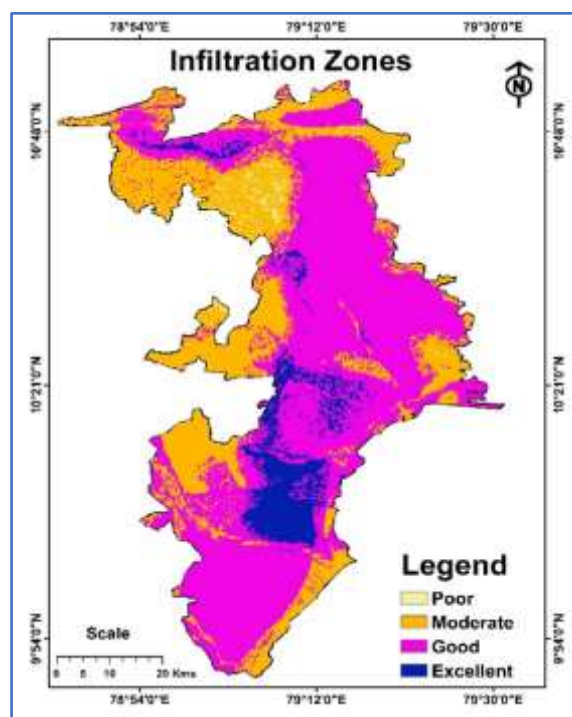


Fig -7: Infiltration Zones

4. CONCLUSION

In order to understand the active infiltration zone in the study area, thematic layers such as soil, geology, slope, geomorphology and canal density which improve the ground water storages are considered. All the above said layers were overlaid and analysed using ArcGIS software. For each of the above parameters suitable weightage values were assigned based on their ability to store water. As soil is concerned sand, loamy sand was assigned the maximum weightage value followed by sandy loam, Sandy clay loam, clay loam and clay in the decreasing order. Areas with less than 4% slope were assigned higher weightage and progressively lower weightages were assigned to the slope classes of 4-8%, 8-12%, 12-16% and over 16%. Among the various landforms of the study area maximum weightage value was assigned for alluvial plains, flood plain, coastal plain followed by Deltaic plain, Pediment, Lateritic and hill in the decreasing order. After assigning weightage values for various classes of each of these parameters, these thematic layers were integrated and the resultant map was re-classed showing zones of infiltration progressive area. The analysis thus carried out has revealed that the areal extent of zones in the canal irrigated area with poor, moderate, good and excellent infiltration process zones are 30.99 sq.km, 1191.16 sq.km, 2325.87 sq.km and 327.50 sq.km respectively. In general, it is found that in the study area, areas with

low, moderate, high and very high infiltration areas are spread towards the southern and north eastern parts, covering about 51.01 per cent and 4.89 per cent of Thanjavur and Pudukkottai District respectively.

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