DROUGHT ASSESSMENT IN AGNIYAR RIVER BASIN IN TAMILNADU

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ABSTRACT

The present study is aimed to establish information on the groundwater potential zone and Water balance in Agniyar river basin, Tamil Nadu, The total geographical area of basin is 4663.15 Sq.km. (It falls in the Survey of India degree sheets 58'J', 58 'N' and 58'O'' on 1:250,000 scale). The thematic maps such as geology, geomorphology, soil hydrological group, land use / land cover and drainage map were prepared for the study area using Land sat 8 images. The Digital Elevation Model (DEM) has been generated from the Shuttle Radar Topography Mission (SRTM) data with 30 m resolution and contour lines from toposheets and obtained the slope (%) of the study area. The information about groundwater potential zones of the study area were developed by overlaying all the thematic maps in terms of weighted overlay methods using the spatial analysis tool in Arc GIS 10.3. Ranking has been given for each individual parameter of each thematic map and weights were assigned according to the influence over such as soil -12%, geomorphology - 35%, geology - 20%, land use / land cover - 8%, slope - 2%, lineament - 8% and drainage - 15% and the resulting maps presents the groundwater potential zones in terms of Good (602.48 Sq.km), Moderate (353.27 Sq.km) and Poor zones (44.25 Sq.km) respectively. The result depicts the groundwater potential zones in the study area and found to be helpful in better planning and management of groundwater resources. Sustainable water management in a river basin requires knowledge of the water availability and water requirements of the basin in the present and future for various purposes. The complexity of the water system in the region can be understood by calculating the regional water balance in a distributed scale considering the factors that affect it.

Key words: *ground water, GIS, topography, potential zones*

1. INTRODUCTION

1.1 GENERAL

C.V. Raman, the Nobel Laurate of India described water as the 'Elixir of life' water is the gift of nature for all living and nonliving things. Water occurs as sea water, surface water, groundwater and has a significant presence in the atmosphere too. Each form of water has its own immense role to play, not only in sustaining life on earth but in delineating the cantors of earth and determining its geological, geographic, climatic and environmental characteristics. In world water resources about 97.3% is salt water, mainly accumulated in the oceans and only 2.7% is available as potable water. Out of this, 2.3% forms the surface water and 0.7% is stored as

groundwater. From this 0.7% of groundwater, about 0.4% can be obtained through latest technology. At present nearly one fifth of all the water used in the world is obtained from underground sources (Thondimuthu 2008), especially in semi-arid regions. Ancient civilizations had sprung up near the great rivers, which imply the importance of rivers. Conquering these rivers and other sources for better utilization has remained one of the most important activities in human history with the construction of dams and reservoirs and other man-made water management systems. Ancient men slowly learnt the advantages of water and had developed effective methods in taking groundwater through spring wells and storage tanks.

Water-ecology has become a primary area of study and its dynamics have come to acquire an importance felt never before among researchers towards the end of 20^{th} century. It is interesting to note that groundwater is the only source of water supply in some countries of the world like Denmark, Malta, and Saudi Arabia (Igor Zektser *et al.* 2004). But groundwater management is unbalanced with reference to its use between advanced countries and other developing world. Water management issues are becoming essential and important in terms of planning and implementation. Managing surface water to the best of our capacities, harnessing the excess water of the monsoon season, better and effective control mechanisms and such other related strategies would lead to increasing groundwater levels, conservation and better utilization. Water is one of the most important and key element in the socio-economic development of a country. The quality and quantity of water needed by mankind vary from region to region and depend entirely on the living standards. Water is needed for domestic, industrial, agricultural, natural habitats, environmental control, recreation, navigation and so on. Out of these requirements, agricultural (irrigation) need is the most important and major need in arid and semi-arid regions to be met from the available water resources. Demand for water in various sectors goes on increasing due to increase in population, industries and food grain requirement. But the available water resources remain almost constant. Hence, greater emphasis is being laid on the efficient use and better management of the available water. Realizing the importance of water management, the government of Tamil Nadu has initiated several projects under the auspices of water resources management study.

1.2 AGNIYAR SUB BASIN

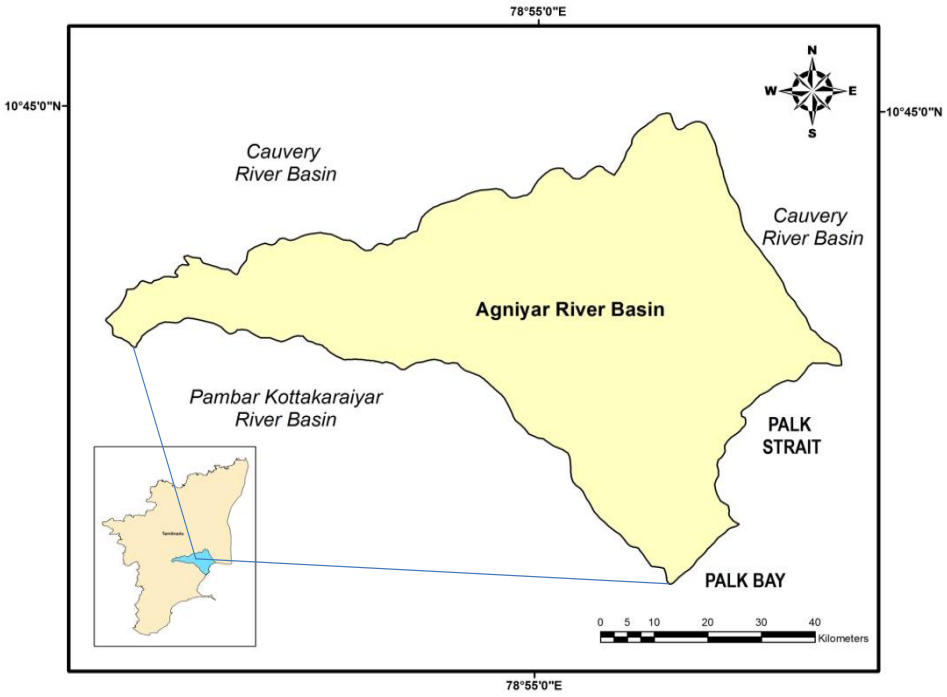
This Agniyar river, otherwise known as 'Agnanavimochana' originates from the surplus of Kulathur tank in Kulathur village, Kulathur taluk of Pudukkottai district at latitude of 10° 35'N and longitude of 78° 46'E and at a distance of 36 km from Tiruchirappalli along Tiruchirappalli-Pudukkottai road. The river runs for a distance of about 80 km from its origin and joins the Bay of of Bengal at about 5 km south of Rajamadam village of Pattukottai taluk. The popular Grand Anicut canal (GA Canal) crosses the river at 52.85 km of the river by a syphon aqueduct. The area of Agniyar sub basin is 1875.17 km^2. Total number of system and non-system tanks in this sub basin is 958 and the total registered command area works out to 17,304.12 ha. There are three tributaries confluencing with Agniyar namely Nariar-I, Nariar-II and Maharaja Samudram of which Maharaja Samudram river is a major tributary. The ayacut under Maharaja Samudram is 6768.63 ha.The catchment area of Maharaja Samudram is 662 km^2. The total registered command area in Agniyar sub basin including Maharaja Samudhram river basin is 24,072.72 ha.

1.3 OBJECTIVE

To findout the Drought assessment in Agniyar river basin

2.1 LOCATION AND EXTENT OF STUDY AREA

There are 34 river basins in Tamil Nadu and the 34 river basins are grouped into 17 major river basins. Agniyar river basin is one of them. The area chosen in the present study is Agniyar river basin and the Agniyar river basin is located in between latitudes 9° 55’ N and 10° 48' N and longitudes 78° 14' E and 79° 30' E. Cauvery river basin lies north and west of Agniyar river basin. Pambar river basin is in the south and Bay of Bengal is in the east of Agniyar river basin. It consists of three sub basins namely Agniyar, Ambuliar and South-Vellar sub basins. The total geographical area of Agniyar river basin is 4663.15 Sq. km and lies entirely within Tamil Nadu State. Major portion of the basin lies in Thanjavur and Pudukkottai districts and a small portion lies Tiruchirappalli district. In this basin, tank irrigation plays an important role and there are about 4000 irrigation tanks irrigating about 76350 ha. The location map of Agniyar river basin is shown in Figure 2.1.



2.2 Schematic diagram of Agniyar sub basin

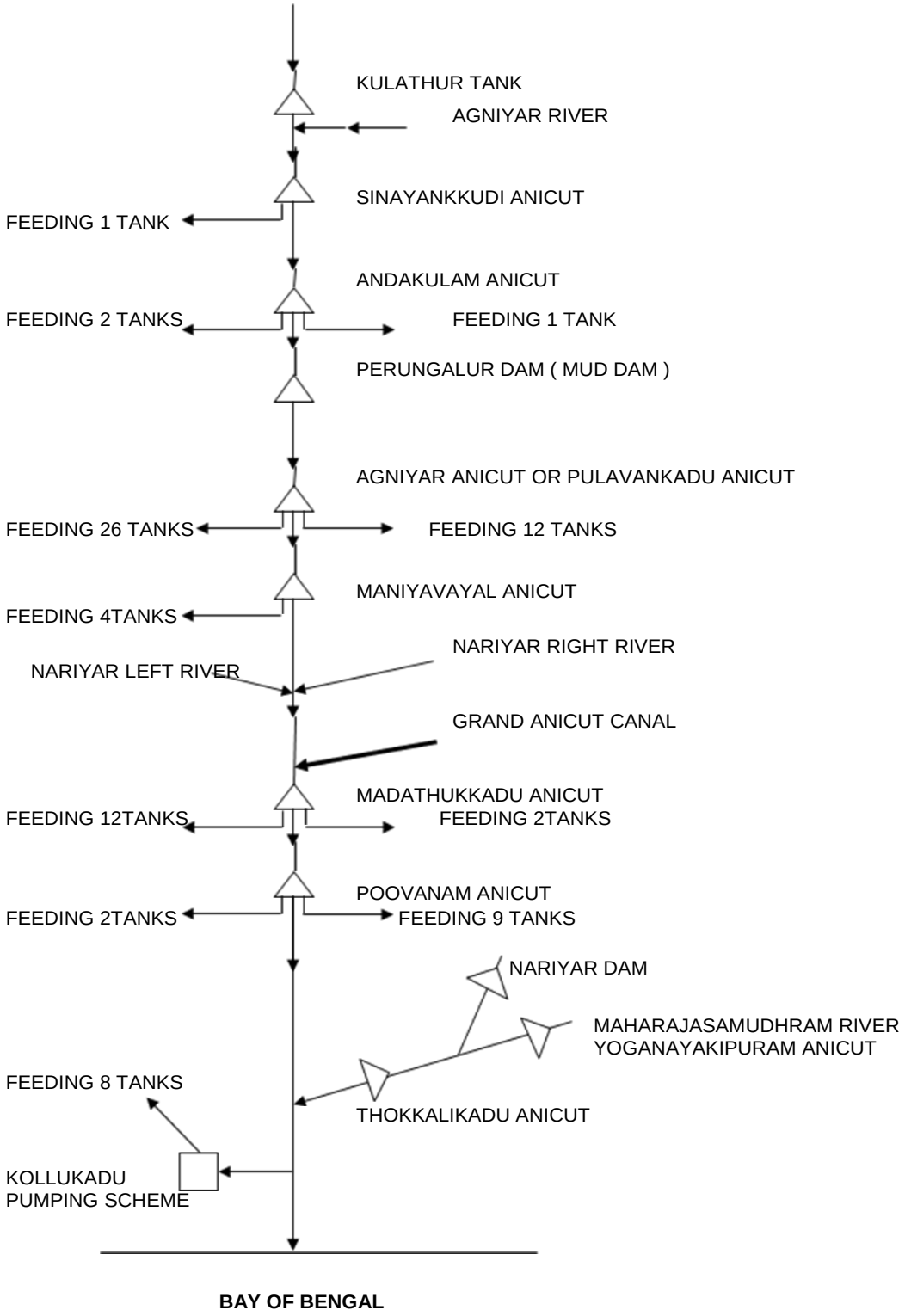


Figure 2.2 Schematic diagram of Agniyar sub basin

2.3 TRANSPORT AND COMMUNICATION

The area is connected to various places by roads and good communication network. The important railway stations are Pudukkottai, Tiruchirappalli and Thanjavur are junction which is also the district headquarters and has some important towns which are well connected to the study area. The entire study area is interconnected with major district, other district and panchayat roads.

2.4 Origin Point of Agniyar River

Figure 2.3 origin point view of Agniyar river basin

3.1 DROUGHT

Drought is one of the leading natural disasters in India in terms of loss of money. Direct issue due to results from reduced crop yields, scarcity in drinking water availability and death of livestock, which include reduced returns of most of the agricultural products. Financial losses results from transport of emergency food supplies, establishment of emergency water supplies. Estimates for indirect losses result from crops not planted and production from animals not

conceived. Also included would be the losses due to abandonment of lands and changes in land use. The rainfall in this basin appears to be normal in all years. But the available rainfall runoff water cannot be stored in water bodies during the rainy season due to inadequacy of storage tanks. Some portions of the basin in Agniyar have necessity water bodies to store water during rainy seasons. So during the drought season's water has to be supplied to the town from the existing water bodies.

3.2 DROUGHT ASSESSMENT

India Meteorological Department method for drought assessment is simple and widely used. In this method, drought is assessed on the basis of percentage of deviation of rainfall from the long-term annual mean rainfall. The percentage deviation (Di) is given by

$$Di = \frac{Pi - \overline{P}}{\overline{P}}$$

where Pi is the annual rainfall in the year i and P is the long-term annual mean rainfall. The percentage deviation of rainfall and the category of drought assessment as per IMD are given below:

Table 3.2 Percentage deviation of rainfall and the category of drought assessment

Sl. No	Range of Di	Classification of drought	Category
1.	> 0	M0	No drought
2.	0 to - 25	M1	Mild drought
3.	-25 to -50	M2	Moderate drought
4.	< - 50	M3	Severe drought

Drought assessment has been carried out for all the 12 rain gauge stations. The drought severity such as no, mild, moderate and severe drought for 12 stations for the available data were found out and presented in Table 6.2 and an abstract is also given in Table 6.3. It is observed from the

Table 3.1 and 3.2 that M0 (No Drought) is more than the M1, M2 and M3 (Mild, Moderate and Severe Drought). Severe drought occurred in Iluppur for 4 years, in Kurungulam, Perungalur and Pudukkottai for 3 years and in Adiramapattinam, Alangudi, Keeranur, Pattukkottai and Thirumayam for 2 year. Moderate drought occurred for more than 10 years in Alangudi, Pattukkottai and Pudukkotai.

Table 3.2 Meteorological drought in Agniyar river basin using IMD method

(M0 – No Drought, M1 – Mild Drought, M2 – Moderate Drought, M3 – Severe Drought)

Name of the stations	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Adiramapattinam	M0	M0	M0	M1	M0	M0	M0	M1	M0	M2	M0	M2	M0	M3	M1	M1	M1
Alangudi	M0	M0	M0	M1	M0	M0	M0	M0	M0	M2	M0	M2	M0	M2	M1	M2	M2
Aranthangi	M0	M0	M1	M2	M0	M0	M0	M0	M1	M2	M0	M2	M0	M0	M0	M2	M1
Iluppur	M0	M0	M1	M1	M0	M0	M0	M0	M0	M2	M1	M2	M0	M0	M0	M2	M1
Kattumavadi	M0	M0	M1	M2	M0	M0	M0	M1	M0	M2	M1	M2	M0	M1	M1	M2	M2
Keeranur	M1	M0	M0	M2	M1	M1	M1	M0	M0	M3	M1	M2	M0	M2	M0	M1	M1
Kurungulam	M0	M0	M1	M1	M0	M0	M0	M0	M1	M3	M0	M3	M0	M2	M2	M1	M1
Pattukkottai	M0	M1	M3	M2	M0	M0	M0	M0	M0	M2	M1	M2	M0	M2	M0	M0	M2
Perungalur	M0	M0	M2	M2	M0	M0	M0	M0	M0	M3	M0	M3	M0	M2	M1	M1	M1
Pudukkottai	M0	M1	M3	M2	M0	M0	M0	M0	M0	M2	M0	M3	M0	M2	M1	M0	M2
Thirumayam	M1	M1	M0	M2	M2	M2	M0	M1	M1	M2	M1	M1	M1	M1	M1	M0	M0
Manaparai	M0	M1	M2	M2	M0	M0	M0	M0	M0	M2	M0	M2	M0	M2	M1	M0	M1

Table 3.2 (Continued)

Name of the stations	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
Adiramapattinam	M2	M0	M1	M1	M2	M0	M1	M2	M0	M0	M0	M0	M1	M0	M1	M1	M0
Alangudi	M3	M2	M2	M2	M2	M0	M1	M2	M1	M0	M0	M0	M1	M0	M2	M0	M0
Aranthangi	M2	M0	M2	M1	M1	M0	M1	M2	M0	M0	M0	M1	M0	M0	M1	M0	M0
Iluppur	M1	M0	M3	M3	M0	M0	M2	M3	M2	M0	M0	M0	M0	M0	M0	M0	M1
Kattumavadi	M2	M0	M1	M1	M1	M0	M0	M2	M0	M0	M0	M1	M0	M1	M1	M2	M0
Keeranur	M2	M0	M1	M0	M1	M0	M1	M1	M0	M0	M0	M0	M0	M0	M1	M0	M1
Kurungulam	M2	M1	M1	M1	M0	M0	M1	M2	M0	M0	M0	M1	M1	M0	M2	M1	M0
Pattukkottai	M2	M2	M2	M1	M1	M0	M1	M2	M0	M0	M0	M0	M2	M0	M1	M0	M0
Perungalur	M2	M1	M2	M1	M0	M0	M1	M2	M0	M0	M0	M0	M2	M0	M1	M0	M0
Pudukkottai	M2	M2	M2	M2	M1	M0	M1	M2	M0	M0	M0	M0	M2	M0	M1	M0	M0
Thirumayam	M1	M0	M2	M3	M2	M0	M0	M1	M0	M0	M0	M0	M0	M0	M1	M0	M0
Manaparai	M2	M1	M2	M2	M1	M0	M1	M2	M0	M0	M0	M0	M1	M0	M1	M0	M0

Table 3.3 Abstract (Drought)

Sl. No.	Raingauge Stations	M0	M1	M2	M3
1	Adiramapattinam	16 Years	12 Years	4 Years	2 Years
2	Alangudi	15 Years	6 Years	12 Years	2 Years
3	Aranthangi	18 Years	7 Years	8 Years	1Year
4	Iluppur	21 Years	5 Years	6 Years	4 Years
5	Kattumavadi	14 Years	12 Years	9 Years	2 Years
6	Keeranur	15 Years	14 Years	5 Years	2 Years
7	Kurungulam	16 Years	13 Years	6 Years	3 Years
8	Pattukkottai	15 Years	5 Years	11 Years	2 Years
9	Perungalur	19 Years	8 Years	8 Years	3 Years
10	Pudukkottai	16 Years	4 Years	12 Years	3 Years
11	Thirumayam	17 Years	11 Years	7 Years	2 Years
12	Manaparai	18 Years	7 Years	8 Years	1 Year

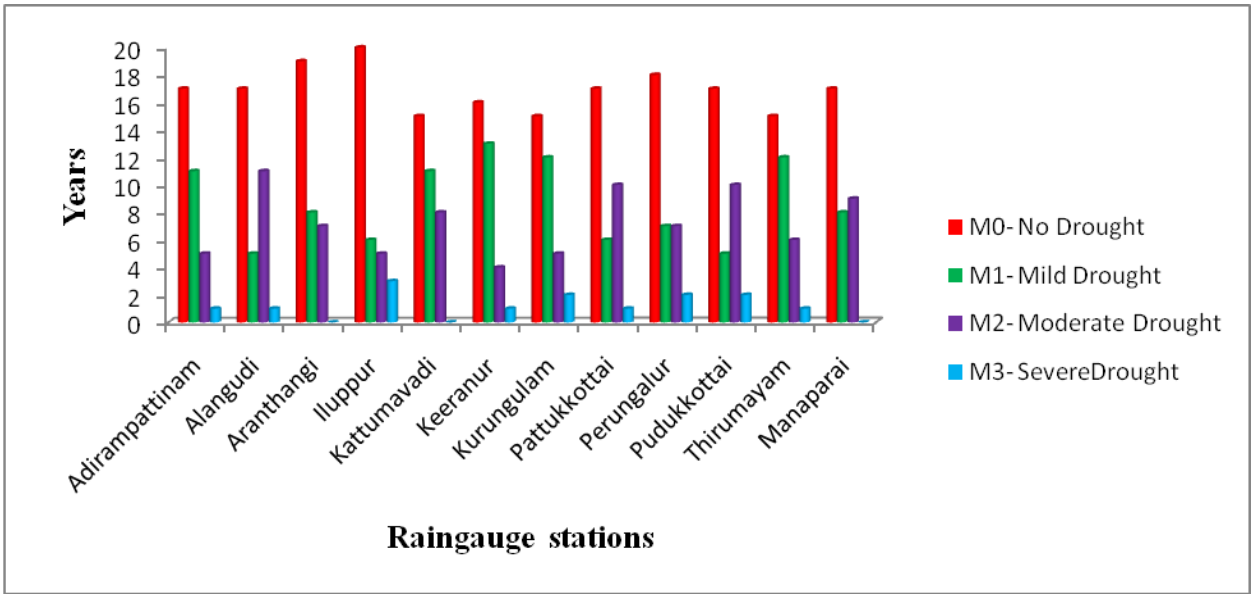


Figure 3.3 Rain gauge stations

3.4 DROUGHT MANAGEMENT

To mitigate the severity of drought, Drought Prone Area Program (DPAP) sponsored by the Government of India and the Government of Tamil Nadu has been in operation for over a decade. This has to be continued. Intensive activities should be strengthened to develop watershed on the short term and long term basis. Futher measures have to be implemented to recharge the groundwater during rainy season.

4. CONCLUSION

The basin is in semi-arid region. All the three major rivers and other small rivers are Drainage Rivers only. The drainage area of this basin is 4567.35 Km^2, and the total command area of the tanks in this basin is 76470 ha. There is also an import of water from Grand Anicut canal to command an area of 50,786 ha. Severe drought occurred in Iluppur for 4 years, in Kurungulam, Perungalur and Pudukkottai for 3 years and in Adiramapattinam, Alangudi, Keeranur, Pattukkottai and Thirumayam for 2 year. Moderate drought occurred for more than 10 years in Alangudi, Pattukkottai and Pudukkottai. There is a scope for construction of pumping scheme in Agniyar river basin. Agniyar river basin and it has been divided into three categories as good, moderate and poor zones .The groundwater potential zones have been findout for the entire.

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