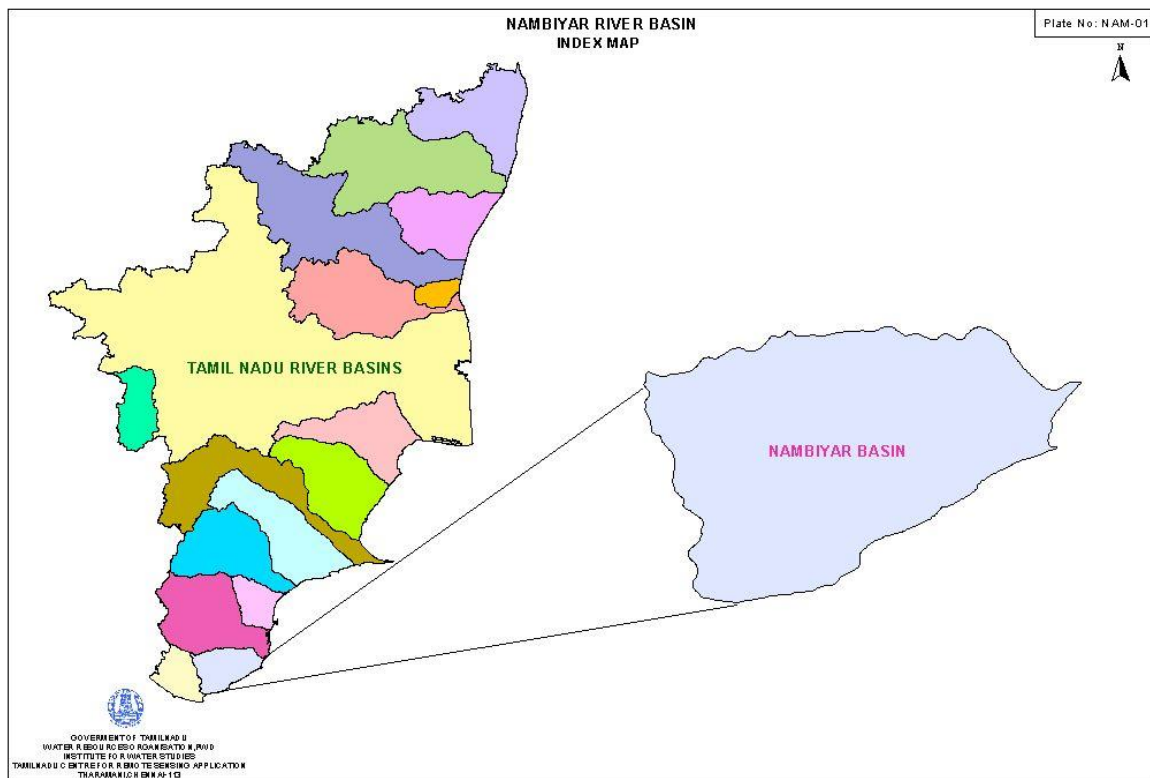


Nambiyar River Basin

Introduction

The Nambiyar basin falls in Tirunelveli, Thoothukudi and Kanyakumari districts. There are three rivers in this basin. The Karamaniyar is in the northern part of the basin and Hanumanadhi river is in the southern part of the basin and the Nambiyar river is in between these two rivers. Tamiraparani basin on north and Kodaiyar basin on south and the Gulf of Mannar on the east surround this basin. The Nambiyar river basin falls in part of the Survey of India toposheets 58H and 58L and it lies between the following co-ordinates. North-Latitudes $08^{\circ} 08' 00''$ - $08^{\circ} 33' 00''$ and East - Longitude $77^{\circ} 28' 00''$ - $78^{\circ} 15' 00''$. The index map of Nambiyar river basin is shown in Fig.1.



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Fig.1 Index map of Nambiyar river basin

This basin is sandwiched between Tamiraparani basin on the north and Kodaiyar basin on the west. The total area of the basin is 2018.4 sq.km and it covers the part of Kanyakumari, Tirunelveli and Thoothukudi districts. The base map of Nambiyar river basin is shown in Fig.2.



Fig.2 Base map of Nambiyar river basin

The administrative setup of the Nambiyar basin is given in Table-1 and the administrative map of this basin is given in Fig.3.

Table-1: Administrative setup of Nambiyar river basin

S l · N o ·	District	Taluk	Block	Block area falling in the basin in sq.km
1	Tirunelveli	1.Nanguneri 2.Radhapuram	1. Nanguneri (P) 2. Kalakadu (P) 3.Radapuram (F) 4.Valliyur (F)	363.322 185.687 458.572 433.425
2	Thoothukudi	3.Tiruchendur 4.Sattankulam	5.Tiruchendur (P) 6.Alwarthirunagari (P) 7.Udankudi (P) 8.Sattankulam (F)	4.438 68.187 134.413 294.43
3	Kanyakumari	5. Thovalai 6. Agasteeswaram	9. Thovalai (P) 10. Agateeswaram (P)	68.169 7.798

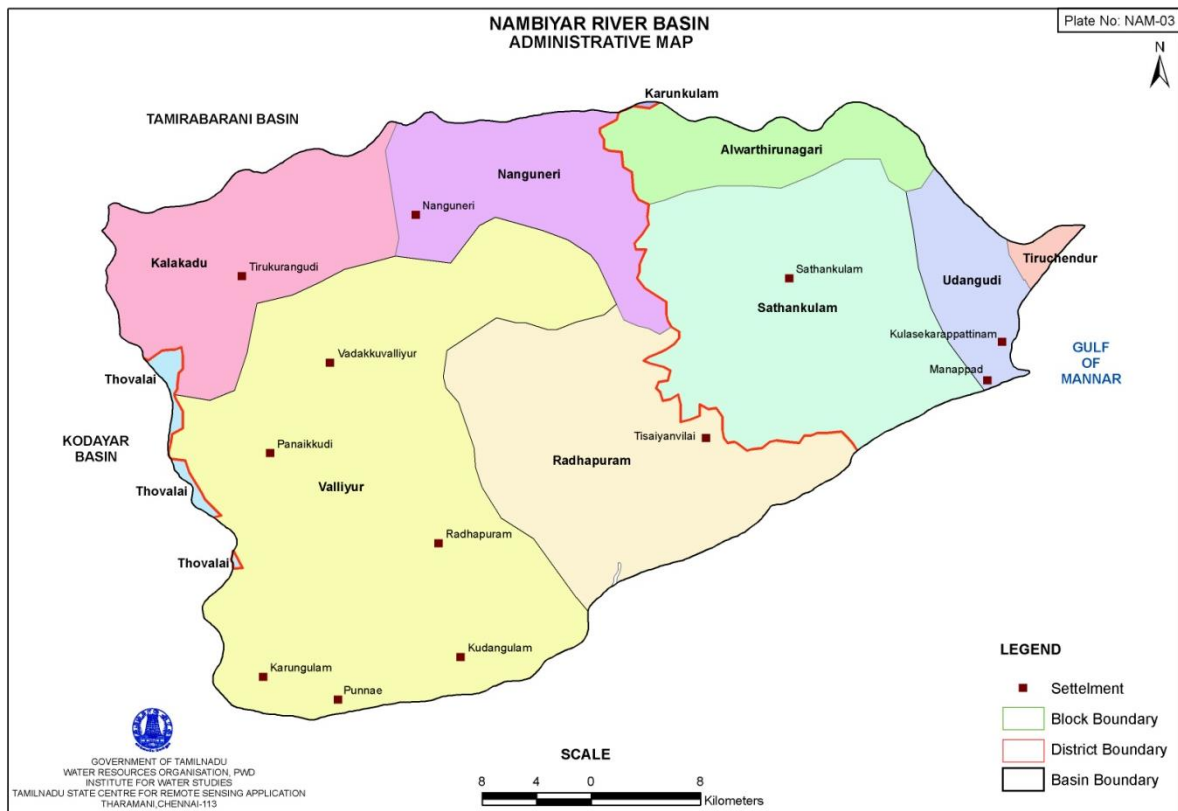


Fig.3 Administrative map of Nambiyar river basin

Physiographically, Nambiyar basin is divided into western hilly region and eastern plain undulating topography. Western hilly region extends from Agasthayarmalai in the north and Kanyakumari town in the south and it acts as the western boundary of the basin. All the rivers flow from the eastern slope of Western Ghats at various altitudes.

The elevation of the Western ghats ranges from +300m to +1200m above MSL in this basin area. There are several peaks which are raised above +1000m MSL. They are Kaniyini mottai ▲1663 m, Mahendragiri hills ▲1657m, Kottankaitatti mottai ▲1530m and Thiruvannamalai hills ▲1402m. The eastern plain is an undulating topography with its elevation varying from +100m to +15m. All the rivers starting in the Western Ghats regions flows in the plains towards east, southeast and south direction. There are two reservoirs in Nambiyar basin, the first one Nambiyar and the other Kodumudiyar. There is one big tank located at Vijayanarayanam village called Vijayanarayanam Eri.

In the eastern part of the basin, two patches of sand dunes are noticed and they are deposited by wind action. These sands are reddish white in colour and they are locally called as "Teri sands". One patch of Teri sand dunes occur north of Tisaiyanvilai called Ittamalai Teri, and another one which occur at the northeast of Sattankulam is called Kudiramoli Teri, with considerable thickness ranging from 20 to 30 m above ground level. Ittamalai Teri rises 60m above MSL.

Drainage

Nambiyar river basin is constituted by rivers like Nambiyar, Karamaniyar, Hanumanadhi. Nambiyar and Hanumanadhi originates in the eastern slopes of the Western Ghats at an altitude of about 1000m MSL. Karumaniyar river originates from the surplus

water from Vijayanarayanan tank of about 100 m. The watershed area comprises hilly region of Mavadirottai, Kakamunikal mottai, Thiruvannamalai and Mahendragiri hills.

Sub Basins Description

Karamaniyar River

It has a number of small seasonal streams and gets its flows mainly from the surpluses of Vijayanarayanan tank and from monsoon rainfall. Manimuthar main canal joins with the river near Pillaikulam village. After traversing a total distance of 56.5 km, the Karamaniyar river flows into the Gulf of Mannar near Manapadu village in Tirunelveli district. The Karamaniyar river feeds about 75 tanks and has a registered ayacut of 2976 hectares. The total extent of this sub basin is 903.93 sq.km. Covering blocks are Alwarthirunagari, Tiruchendur, Sathankulam, Udankudi, Kalakkadu, Nanguneri and Radhapuram either part or full.

Nambiyar river

Nambiyar river originates in the eastern slopes of the western ghats near Nalikkal Mottai about 9.6 km west of Thirukkarangudi village at an altitude of about 1060m. This river is constituted by three branches of seasonal streams, like Tamaraiar, Kombaiar and Kodumudiar. Kombaiar and Kodumudiar originates at the eastern slope of western ghats at an altitude of about 1600 mm near Mahendragiri hills. Nambiyar then takes an easterly course up to the Tirunelveli-Nagercoil trunk road crossing and flows in a south-easterly direction. Parattaiyar originates in the eastern slopes of the western ghats at an altitude of about 1200 m near Kakamunjikai Mottai and joins with another arm of Nambiyar at the foot of the hills. After feeding number of small tanks, this finally joins with Nambiyar again near Ervadi at 18.5 km. Kalankal odai is another tributary which originates near Kannallur area in Nanguneri taluk of Tirunelveli district. It gets flows from the surpluses of a few tanks dependent on other streams. After traversing a distance of 6.5 km and finally joins with the Nambiyar near Kovankulam.

Another tributary which originates near Vadakku Valliyur area in Nanguneri taluk of Tirunelveli district at an altitude of about 90m gets flows from the surpluses of small tanks dependent on other streams. After traversing a distance of 10.5 km finally the tributary joins with Nambiyar near Sankarapuram village. Finally the Nambiyar river flows into the Gulf of Mannar after traversing a total distance of 59km from the origin of Nambiyar river.

The Nambiyar river has a total of 9 small anicuts viz. 1. Mailannani anicut, 2. Dalavaipuram anicut, 3. Rajakkamangalam anicut, 4. Malapudur anicut 5. Kannanallur anicut, 6. Vijayan anicut, 7. Kovankulam anicut, 8. Islapuram anicut, 9. Pulimangalam anicut. The total extent of this sub basin area is 604.32 sq.km covering blocks of Kalakkadu, Nanguneri, Valliyoor, Radhapuram in Tirunelveli district and Thovala block in Kanyakumari district, either part or full.

Hanumanadhi River

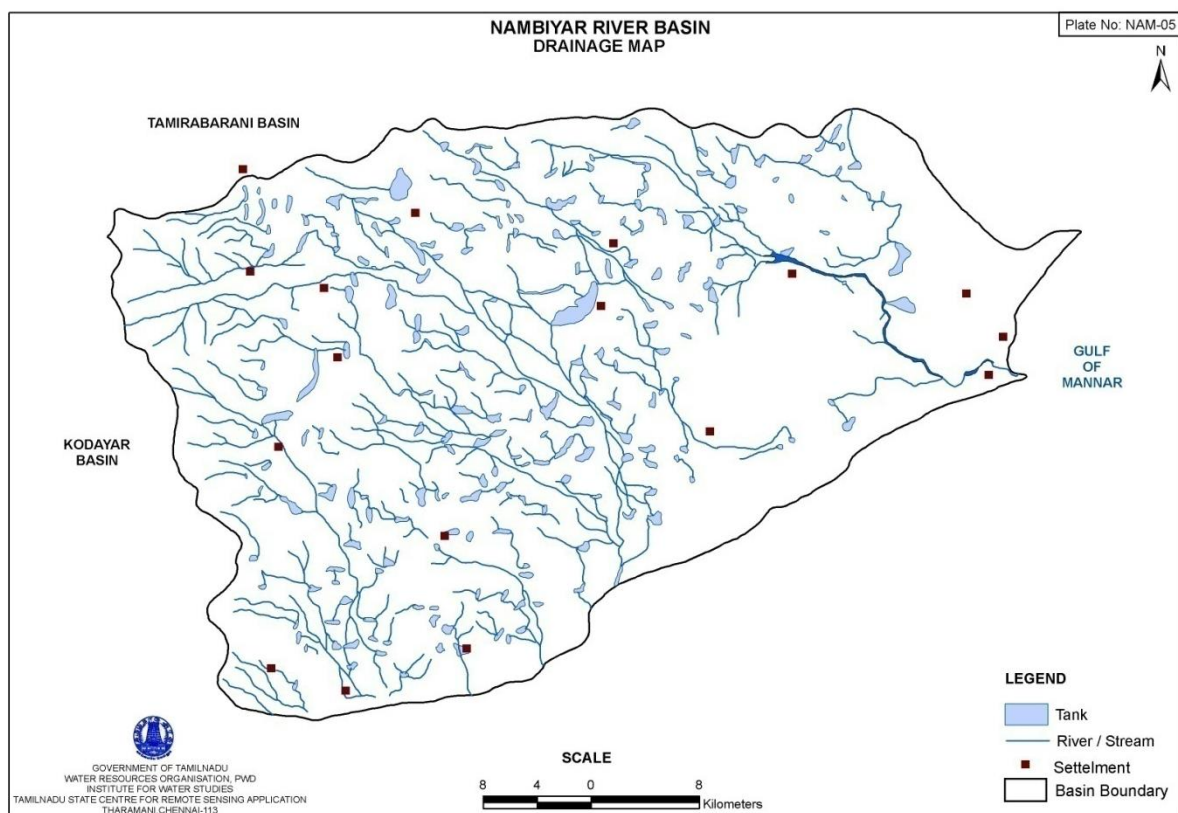
Hanumanadhi originates in the eastern slopes of the western ghats at an altitude of 1100m in the Mahendragiri hill region on the north west of Panakkudi village in Nanguneri Taluk of Tirunelveli district. It has a number of jungle streams. After feeding a few tanks, they join with Hanumanadhi river at various points. It flows in the hill ranges for about 5.6 km and reaches 6.4 km west of Panakkudi village in Nanguneri taluk. It traverses entirely in Nanguneri taluk for a distance of about 32km and flows into the Gulf of Mannar. There are 11 small anicuts across this river viz. 1. Sivanpilli anicut, 2. Senthilkathayan anicut, 3. Thandayarkulam anicut, 4. Sanjetti anicut, 5. Perungudi anicut, 6. Vadakkankulam anicut, 7. Adankarkulam anicut, 8. Sakkilianparai anicut and 9. Kanjaneri anicut 10. Alaganeri Anicut, 11. Koliankulam Anicut The total area of the sub basin is 510.179 sq.km covering

blocks of Kalakkadu, Valliyur, Radhapuram in Tirunelveli district and Thovala in Kanyakumari district either part or full.

Further Description of the basin:

A canal known as Radhapuram canal crosses into this basin from the adjacent Kanyakumari district. Radhapuram canal starts from Pechiparai reservoir in Kanyakumari district. At its starting point this canal is called Kodayar left bank canal. Another canal from Perunchani dam joins this Kodayar left bank canal at the 17th km. After the confluencing point the downstream of the canal is called Thovalai channel. After entering Tirunelveli district near Thirumulangar village, it is called Radhapuram canal. After feeding a number of tanks through supply channels, it crosses Hanumanadhi river near Adankarkulam anicut. Finally the canal feeds Mahendrakulam near Radhapuram after feeding one supply channel in Hanumanadhi basin.

The drainage map of Nambiyar river basin is shown in Fig.4.



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Fig.4 Drainage map of Nambiyar river basin

The relief map of Nambiyar river basin is shown in Fig.5.

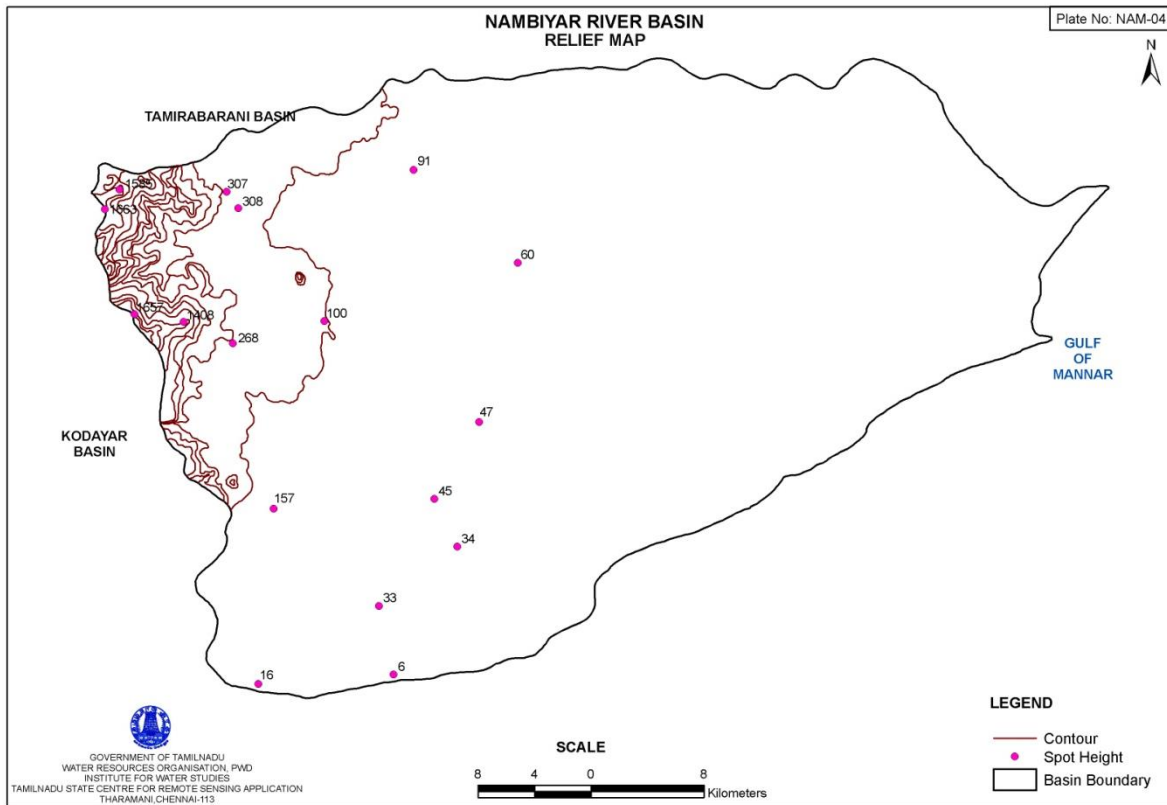


Fig.5 Relief map of Nambiyar river basin

Geology

The major part of the basin area comprises of rocks of khondalite and charnockite groups of Archaean age. Migmatite gneiss of Archaean age also occur in the plains. The coastal plains host rocks of Misocene, Quaternary and Recent age. Kankar and tuffaceous limestone of recent age occurs along the nallahs of the Karamaniyar, Nambiyar and its tributaries is seen over a width of 200m to 300m and extends over a length of 6 km and more. It is generally hard, massive and shown modular structure. In the southeastern part of the basin, beyond Sattankulam and Tisayanvilai, recent to sub-recent quaternary alluvial plains extends with isolated friable sandstone and shell limestone. Teri sands occur north of Tisaiyanvilai (Ittamali Teri) and Northeast of Sattankulam (Kudiramolli Teri) with a considerable thickness ranging from 20 to 35 m. These are reddish in colour and medium to coarse grained. The geology with lineament map of Nambiyar river basin is shown in Fig.6.

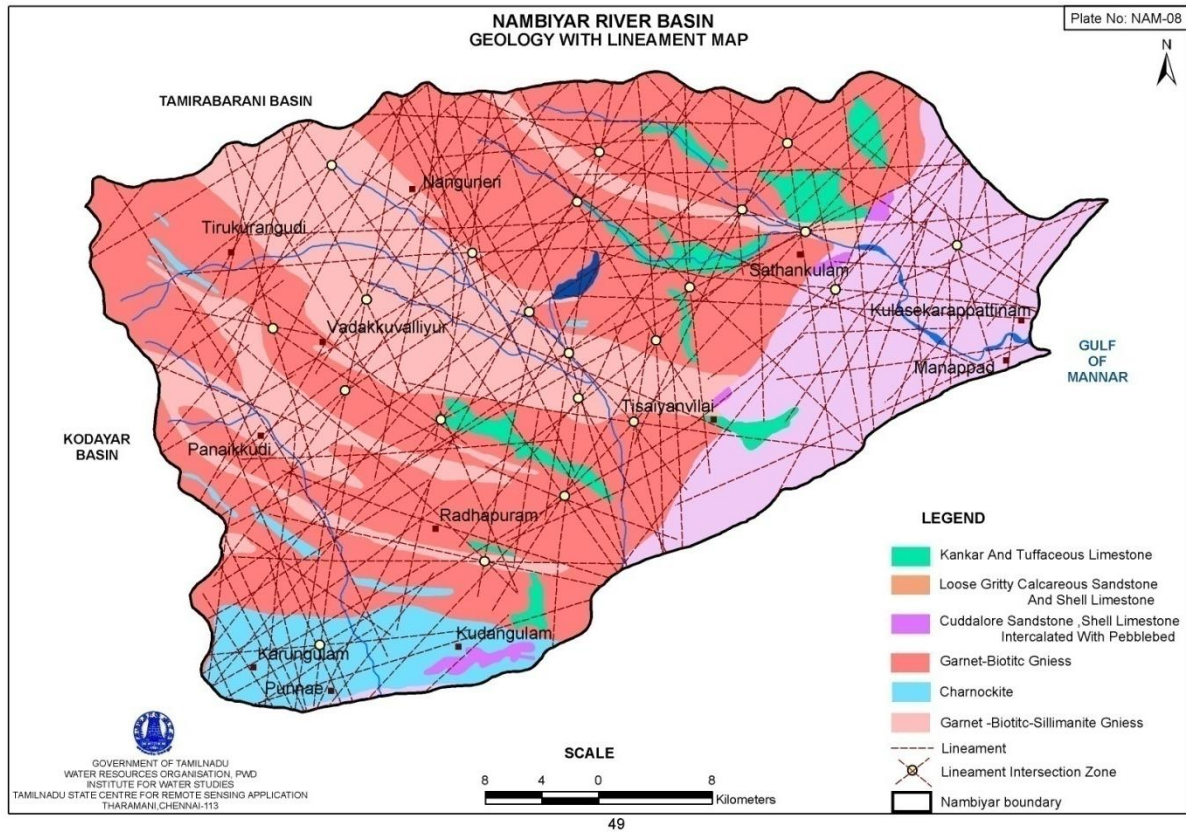
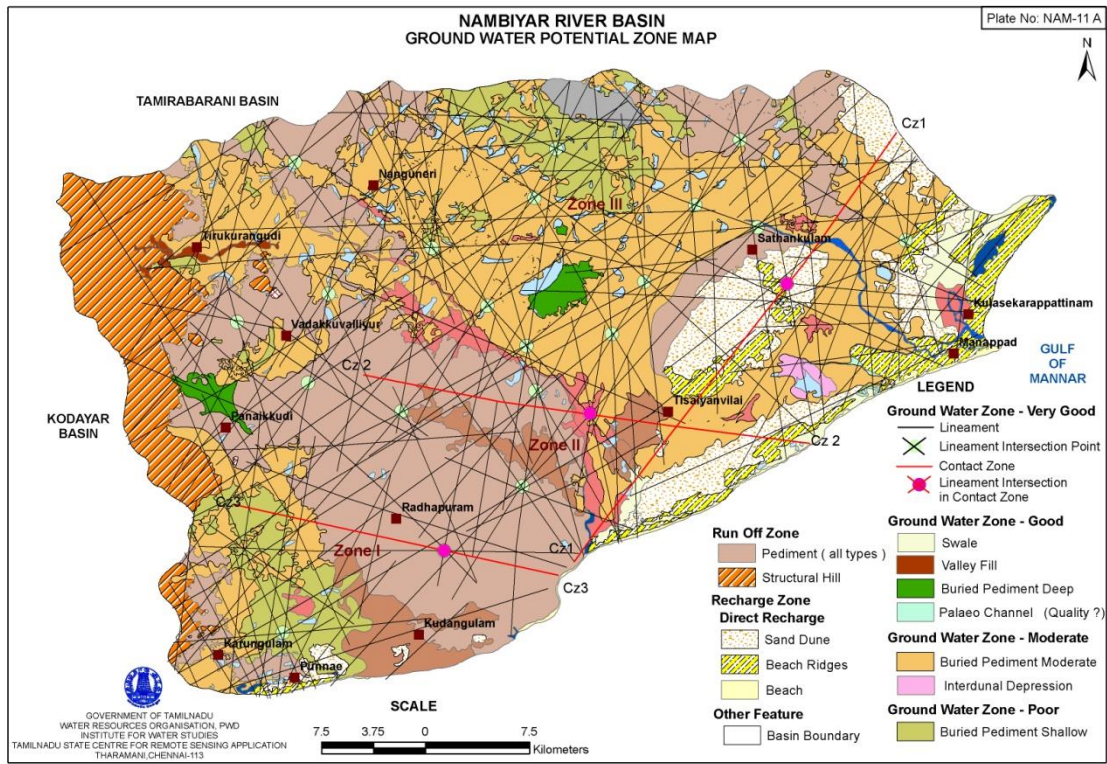


Fig.6 Geology with lineament map of Nambiyar river basin

Geomorphologic units like valley fill, sediments, paleo channel are having good to very good groundwater potential. Sinking a well in these units will be sustainable for pumping, hence the farmers will be much benefited. Buried pediment deep, buried pediment moderate of denudational origin are having moderate to good groundwater potential where as the buried pediment shallow is poor to moderate ground water potential. Geomorphologic units like coastal sand, coastal ridges are of good groundwater potential units and swales are of moderate groundwater potential, with varying quality.

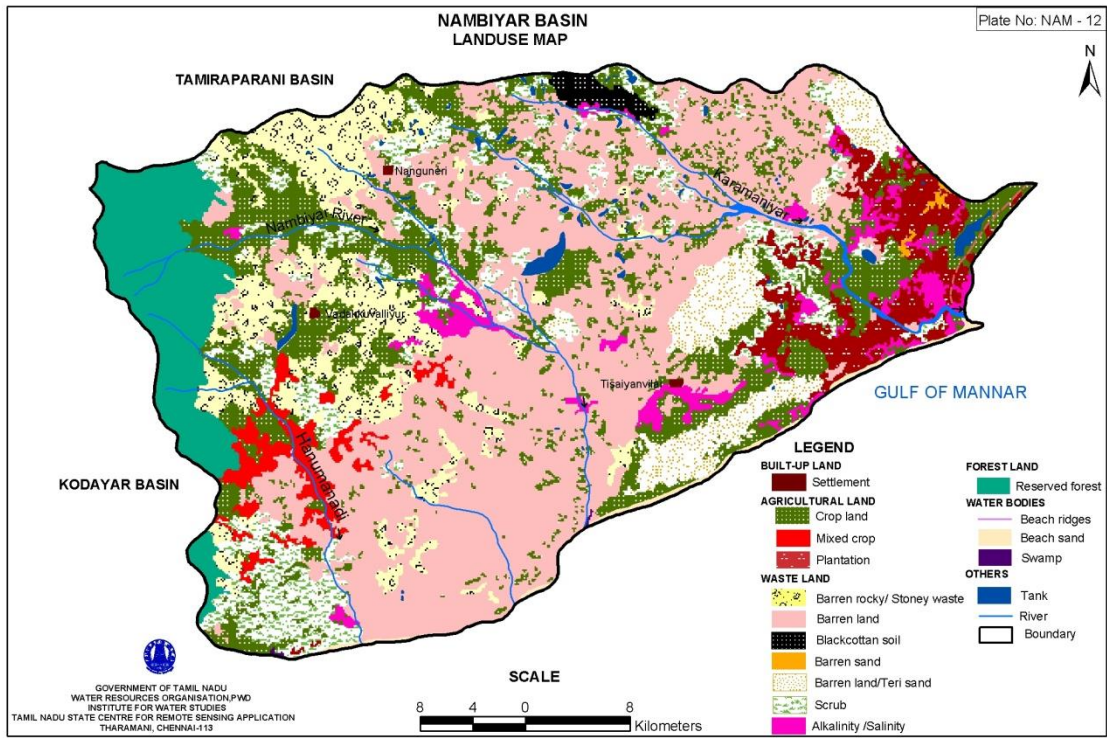
The groundwater potential zone map of Nambiyar river basin is shown in Fig.7.



52 a

Fig.7 Groundwater potential zone map of Nambiyar river basin

The landuse map showing the various types of lands in the Nambiyar basin is shown in Fig.8.



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Fig.8 Land use map of Nambiyar river basin

The types of soil in Nambiyar river basin is shown in Fig.9.

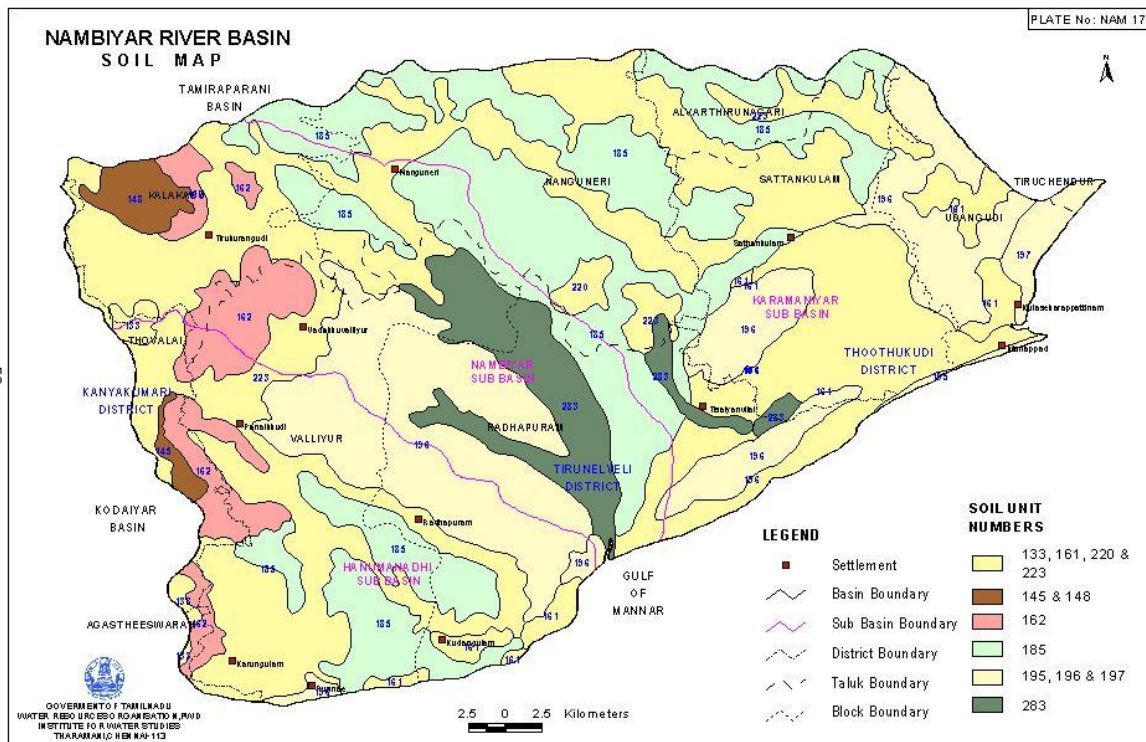


Fig.9 Soil map of Nambiyar river basin

Demographic details

The sub basin wise population of Nambiyar river basin is given in Table- 2.

Table-2: The Urban and Rural Population as per census 2001 (in Million)

Sl. No.	Name of the Sub basin	Urban Population	Rural Population	Total Population
1	Hanumanadhi	0.069	0.127	0.196
2	Nambiyar	0.084	0.103	0.187
3	Karamaniyar	0.093	0.203	0.296
TOTAL		0.246	0.433	0.679

Industrial Employment

There are about 15 Large and Medium industries in this basin at present. It has been estimated that the projected number of large and medium industries during 2010 and 2020 will be 19 and 31 respectively. There are about 5413 small scale industries available in the basin. The projected number of small scale industries during the years 2010 and 2020 will be 6712 and 11043 respectively.

Hydrometeorological characteristics

There are 16 non-recording rain gauge stations in and around the basin of which 11 stations are maintained by Public Works Department, 4 stations are maintained by Revenue Department and 1 station maintained by Salt Department. Considering the distribution of

rain gauge stations and the availability of data, only 9 rain gauge stations having long term records in and around the basin are considered for the detailed analysis. The annual dependable rainfall recorded in 9 rain gauge stations of Nambiyar river basin is given in Table- 3.

Table 3- Annual Dependable Rainfall

Sl. No.	Raingauge Stations	25%	50%	75%	90%
1	Hanumanadhi	87.22	67.31	54.17	33.17
2	Nambiyar	101.70	85.74	73.56	47.10
3	Karamaniyar	171.74	126.25	101.55	53.13

Climate

Climate data for analysis is taken from Nambiyar maintained by PWD (GW). The climatological parameters of this river basin are given in Table-4.

Table-4: Climatological Parameters

S. No	Climatological Parameter	Nambiyar
1	Average monthly temperature Maximum in ⁰ Celsius	33.16
2	Average monthly temperature Minimum in ⁰ Celsius	24.54
3	Average mean temperature in ⁰ Celsius	28.85
4	Average Pan Evaporation in mm	180.05
5	Average Relative humidity in %	72.17
6	Average Wind velocity in km/hour	4.59
7	Average Sunshine hours / day	6.08

Eto values (mm/month) of FCS for Nambiyar basin													
Name of the basin & FCS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average
Nambiyar basin - Aralvoimozhi FCS	154.0	146.0	171.0	161.0	180.0	156.0	162.0	175.0	169.0	139.0	112.0	131.0	154.7

Surface Water Data

In this basin, there are two newly constructed reservoirs namely Nambiyar reservoir and Kodumudiyar reservoir. Storage in Nambiyar reservoir commenced from 2000 and in Kodumudiyar reservoir, it commenced from 2003. The details of the reservoirs are given Table-5.

Table-5: Reservoirs and their capacities

Sl.No.	Name of the Reservoir	Capacity in Mcum	Annual storage in Mcum	Ayacut in Ha
1	Nambiyar	2.33	2.59	705.65
2	Kodumudiyar	3.58	7.56	2340.00

The sub basin wise last anicuts are furnished below for Nambiyar river basin.

1. Nambiyar sub basin - Pulimankulam Anicut
2. Karamaniyar sub basin - Sadayamangalam Anicut
3. Hanumanadhi sub basin - Kanchaneri Anicut

The influential rainfall stations having long-term records considered for analysis are given in Table-6.

Table-6: Raingauge stations considered for analysis

S. No.	Name of subbasins	Subbasin area (sq.km.)	Raingauge stations
1	Hanumanadhi	510.179	Aralvaimozhi, Nelaparai.
2	Karamaniyar	903.397	Radhapuram, Sathankulam, Srivaikundam, Tiruchendur, Kulasekarapattinam.
3	Nambiyar	604.324	Nanguneri, Kalakkadu
Total		2018.435	

Monthly Runoff Simulation (MRS) Model assesses the surface water potential for 75% dependable yield for southwest, northeast and non-monsoon periods and are given in Table-7.

Table-7: 75% Dependable Surface Water Potential for the Nambiyar River Basin

Sl. No.	Name of Sub basin	75% Dependable Surface Water Potential in Mcum			
		SW	NE	NM	Annual
1	Hanumanadhi	12.02	21.92	20.23	54.17
2	Karamaniyar	7.41	66.15	27.99	101.55
3	Nambiyar	5.49	40.63	27.43	73.56
Total		24.92	128.7	75.65	229.27

Surface Water Potential of Nambiyar Basin is 229.27 Mcum.

The Existing Surface Water Supply Systems

There are two reservoirs in this basin namely Kodumudiyar and Nambiyar reservoir.

Kodumudiyar Reservoir

Kodumudiyar Reservoir is constructed across the jungle streams, namely Kodumudiyar and Kombaiyar, at the confluence point where it is called Thamaraiyar, the

main tributary to Nambiyar river in Thirrukkurunkudi village of Nanguneri taluk in Tirunelveli District. The reservoir is having the capacity of 3.58mm³ (126.53Mcft) and provide assured supply to a total registered ayacut of 2340Ha under Thamaraiyar system, through existing three canals viz. Vallooorankal, Padalayarkal and Vadamalayankal and 44 tanks. The scheme provide irrigation facilities by stabilization of 791 hectares of land and bridging a gap of 799 hectares in Nanguneri taluk. The total cost of scheme is Rs.3050 Lakhs.

Nambiyar Reservoir

Nambiyar Reservoir is constructed across the river Nambiyar between 7th and 8th anicut, in Kottaikarungulam village of Radhapuram taluk in Tirunelveli District. The reservoir is having a capacity of 2.33mm³ and provide irrigation facilities to 705.64 hectare (ha) through two canals and 44 tanks in Radhapuram taluk. An extent of 368.64 ha gets stabilized, besides bridging the gap of 185.24 ha. 151.76 ha of new dry ayacut is also befitted by this scheme. The total cost of the scheme is Rs.2050Lakhs.

The surface water is drawn for usage from tanks. The tanks are classified as System tanks and Non system tanks. The non-system tanks use surface water of the direct runoff from their own catchments. Whereas the system tanks are filled from the canal flow diverted by the anicuts across the river apart from the direct runoff from their own catchments. There are about 559 system tanks and 38 non- system tanks by which 33,615 ha are being irrigated. The approximate storage capacity of these tanks is 94.54 Mcm. Hence the approximate total storage capacity of tanks and reservoirs in this basin is 100.45 Mcum.

The sub basin wise number of anicuts and tanks in Nambiyar river basin is given in Table-8.

Table-8: Sub basin wise no. of Anicuts and Tanks in Nambiyar river basin

Sl.no.	Name of the sub basin	No. Of Anicuts	Ayacut in Hectare	No. Of Tanks	Ayacut in Hectare
1	Nambiyar	11	4562.39	222	3024.04
2	Karumeniar	1	18.16	158	5803.6
3	Hanumanadhi	11	995.78	50	1000.21

Inter Basin Transfer Of Water

Karamaniyar sub basin of Nambiyar river basin receives water from Tamiraparani river basin through Manimuthar IX canal and surplus from the tanks fed by Manimuthar XI Distributory. Hanumanadhi sub basin receives water from Kodaiyar river basin through Radhapuran canal.

Occurrence of groundwater in the Three sub basins of Nambiyar River Basin

Nambiyar sub basin

There are thirteen observation wells in this sub basin. The winter water level varies from 4.50 to 19.00 m and the summer water level ranges from 19.00 to 19.40 m below ground level.

Hanumanadhi sub basin

There are four observation wells in this sub basin. The winter water level varies from 3.50 to 11.00 m and the summer water level varies from 11.00 m to 11.50 m

Karamaniyar sub basin

There are ten observation wells in this sub basin. The winter water level varies from 4.00 to 13.50 m and the summer water level ranges from 13.50m to 15.50 m.

Groundwater Potential in the Study Area

The total available groundwater potential as on Jan 2003 is worked out as 163 Mcum and the total extraction of groundwater is worked out as 116 Mcum and are shown in Table-9.

Table 9 Ground Water Potential Calculation as on Mar 2013

Name of District covered	Area covered in %	Net water available	Ground water potential District wise
Thoothukudi	21.96	50683.95	11130.2
Tirunelveli	72.17	90839.84	65559.11
Kanyakumari	5.88	23958.61	1408.77

Total 78098.08 Ha.m
 780.9808 M.cum

PRESENT AND FUTURE WATER DEMANDS

Domestic water demand

Projected domestic water demand is given in Table-12.

Year		Population	Demand	
			MLD	MCM
2001	Urban	246000	MLD	MCM
	Rural	433000		
2011 (as given by local bodies)	Urban	150994	10.57	13.22
	Rural	641578	25.66	
2017	Urban	170044	11.90	14.47
	Rural	693276	27.73	
2020	Urban	180452	12.63	15.13
	Rural	720667	28.83	
2030	Urban	219970	15.40	17.59
	Rural	820028	32.80	
2040	Urban	268142	18.77	20.47
	Rural	933090	37.32	
2050	Urban	326863	22.88	23.85
	Rural	1061739	42.47	

Livestock water demand

Table 13 shows the details of livestock water demand of Nambiyar basin respectively.

Table 13 Livestock water demand of Nambiyar basin

Name	Standard Norms in lpcd	Demand 2017	Demand 2020	Demand 2030	Demand 2040
Cattle	225	5.8	5.87	6.12	6.39
Buffalo	225	0.98	0.86	0.55	0.35
Sheep	5	0.15	0.15	0.15	0.15
Goats	5	0.21	0.22	0.28	0.35
Horses & Ponies	100	0.002	0.002	0.002	0.002
Donkeys	25	0.009	0.009	0.009	0.009
Pigs	206	0.23	0.2	0.12	0.08
Dogs	20	0.108	0.108	0.108	0.108
Rabbits	10	0	0	0	0
Poultry	0.05	0	0	0	0
Total		7.489	7.419	7.339	7.439

The irrigation system map of Nambiyar river basin is shown in Fig.10.

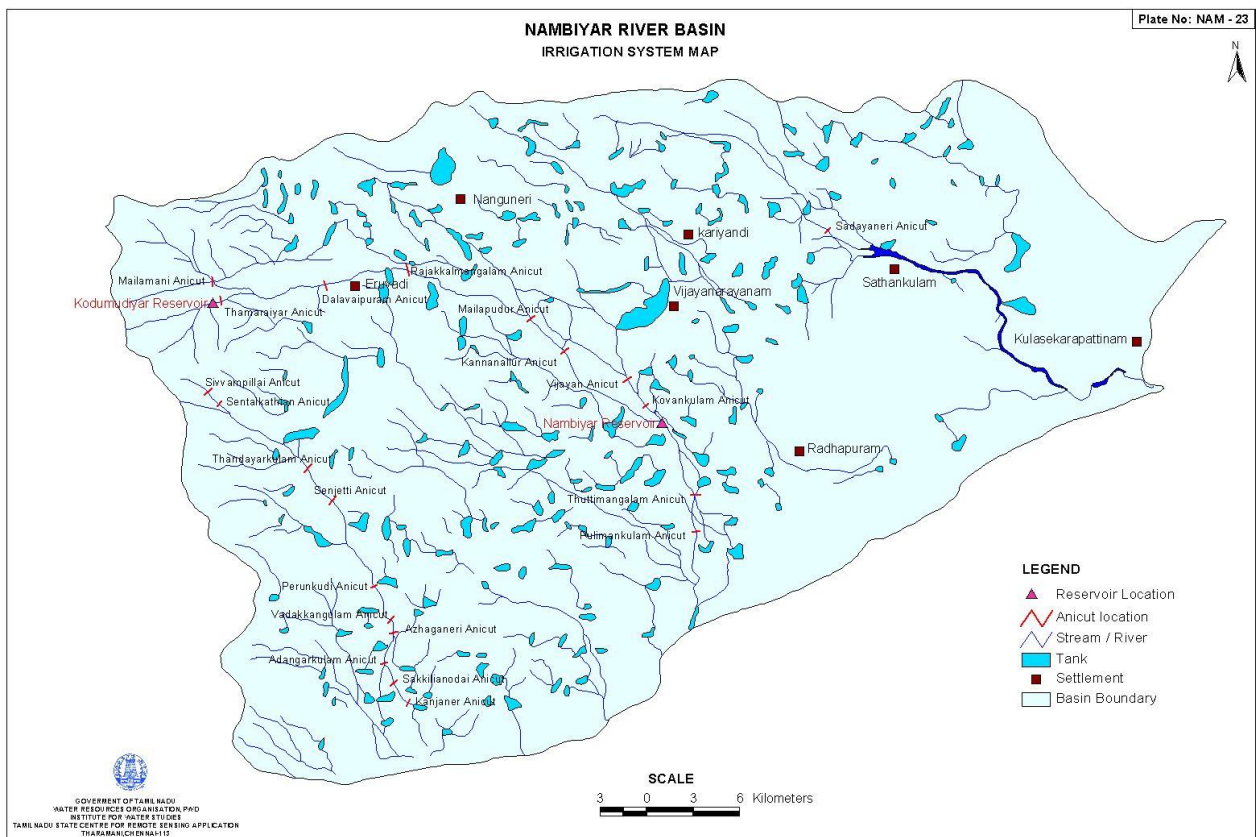


Fig.10 Irrigation system map of Nambiyar river basin

Industrial Water Demand

The Nambiyar basin comprises of 15 numbers of Large and Medium Industries and 5413 numbers of Small Scale Industries. The norms for water requirement is adopted as 2500 cum / day for large and medium industries and 2.5 cum / day for small scale industries. Accordingly, the yearly requirement of water for small scale industries during the year 2006 is assessed as 4.94 Mcum and for the large and medium industries it is assessed as 13.69 Mcum. Hence, the total annual water requirement for Industries in this basin is 18.63 Mcum.

For forecasting the water demand of Industries for future years, a simple arithmetic increase of 8% per annum over the present requirement has been adopted. The annual water demand for the Industries during the planning periods for each sub basin is given in Table-18.

Table-18: Projected Annual Water Demand for Industries

WATER DEMAND CALCULATION FOR SMALL, MEDIUM AND LARGE INDUSTRIES BASED ON INDUSTRY CENSUS AS TAKEN FROM IWS

Sl. No.	Type of industry	Average Rate of Water consumption as given in IWS m ³ /day	2010		2017		2020		2030		2040		2050	
			No. of industry as per IWS	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand
1	Small scale industry	2.5	6712	6.12	11503	10.5	11043	10.08	31284	28.55	67541	61.63	145815	133.06
2	Medium & large scale industry	2500	19	17.34	33	30.11	31	28.29	89	81.21	191	174.29	413	376.86
	Total Demand in M.Cum			35.43		40.61		56.91		109.76		235.92		509.92

At present there is no power generation unit in this basin except the proposed Koodankulam Atomic power plant in the Tirunelveli District.

WATER BALANCING

Water balancing for Nambiyar river basin at 75% dependability which includes water potential, demand and deficit for the projected years are given in Table-19.

Table-19: Water Balancing for Nambiyar River Basin

Sl. No	Name of the basin	Area of the basin (in Sq.Km)	No. of Sub basins	Year	Demand of water in various sectors (MCM)						Water availability (MCM)					Surplus / Deficit in Mcum
					Irrigation	Domestics	Industries	Live stocks	Others	Total	Surface water potential	Ground water potential	Quantity of recycled water from Sewage	Quantity of water from desilting	Total	
1	Nambiyar	2018.40	3	2017	356.88	14.47	40.61	7.49	0.00	419.45	203.00	780.98	117.57	0.89	984.87	565.42
				2020	356.88	15.13	56.91	7.42	0.00	436.34	203.00	780.98	117.57	0.89	984.87	548.53
				2030	356.88	17.59	109.76	7.34	0.00	491.57	203.00	780.98	117.57	0.89	984.87	493.30
				2040	356.88	20.47	235.92	7.44	0.00	620.71	203.00	780.98	117.57	0.89	984.87	364.16