

# Groundwater and Soil Related Crop Analysis of Marudaiyar Sub-Basin, Tamil Nadu

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**Abstract:** *In this paper an effort has been made to analysis the groundwater and soil related crop of Marudaiyar sub-basin. There are 14 soil series were identified in the study area by Soil Survey and Land use Organization. Thirumanur and Pullambadi blocks are more suitable for paddy cultivation. Soils of Alathur and Veppur blocks are highly suitable for cotton cultivation. The soil series of Perambalur, Thirumanur and Pullambadi blocks are highly suitable for sugarcane cultivation. Oil seeds are cultivated in T.Palur, Perambalur, Alathur, Veppur and Ariyalur blocks. Pulse, millets and other crops are cultivated only in a few limited parts of the study area.*

**Keywords:** Soil series, Cropping pattern, Groundwater chemistry, Suitability, Integrated analysis

## 1. Introduction

An increased research activity in the field of groundwater pollution has resulted in a recent growing awareness of the large number of cases of soil contamination. It seems that only very recently, the total magnitude and impact of the worldwide soil pollution problem is becoming visible.

To deal with these soil problems, research programs and legislative implement similar to these developed during the last decade for water contamination problems are needed. After, the present phase of collecting data on the occurrence of groundwater and on the sources of contamination, the next step inevitably is to answer the question of which cases need to be handled with the highest priority and for what reasons. For this latter purpose, a better insight into the possible effects of soil contamination on the soil ecosystem and on public health has to be developed in conjunction with methods to predict the transport and behavior of groundwater contaminants.

Food and water are two of the most essential requirements for human life. Moreover, agriculture, the means of food production and water are intimately connected. Pollution of groundwater has resulted in a recent growing awareness of the large number of cases of soil contamination. It seems that only very recently, the total magnitude and impact of the worldwide soil pollution problem is becoming visible.

The effect of particular quality water on soil plant system depends upon the total salt concentration, relative proportion of cations and anions soil properties and salt tolerance characteristics of the plant. These properties are influenced by the texture type and depth of soil, swelling characteristics of the clay and lime content of the soil. Soil fertility also influences crop growth by the way of soil fertilizer interactions. The long-term effect of irrigated water on different types of soil depends on the properties of their soil

itself and especially on drainage conditions and on the balance of sub-soil water and salts.

The soil salinity may increase considerably after irrigation with saline water. Sodium in irrigation water influences the physical properties of the soil, particularly permeability by affecting the swelling and dispersion of the clay. Generally, the suitability of water for irrigation is decided by considering the factors like electrical conductivity and ionic composition of water, soil texture, range and tolerance of crops towards salts. Many research papers were discussed in detailed about the analytical aspects of detecting contaminants in groundwater and the behavior in the soil. This paper deals these terms briefly and also focuses the effects on soil crop suitability.

## 2. Study Area

Marudaiyar sub-basin, the study area is located in the central part of Tamil Nadu state concerning an areal extent of 623 sq.km. It is geographically located between the latitudes 11°02' - 11°15' N and the longitudes 78°48' - 79°15' E (Fig.1). The area is composed of series of plains, valley bottoms, undulating uplands and broken chains of eastern - ghats viz., Pachamalai. The average height of Pachamalai hill is 100 meters. But few of its peak above 1020 meters from MSL. The elevation of the basin ranges from 250-400 meters. The Marudaiyar sub-basin has its origin from the Pachamalai hills, and its flow in the southeastern direction, passing through the Perambalur, Kunnam, Ariyalur Udaiyarpalayam and Lalgudi taluks of Perambalur and Tiruchirappalli District before joining the Coleroon Rivers. On the northern side the study area is bounded by Chinnar basin and on the eastern side, it is bounded by Udiyarpalayam minor basin. On the southern and western side it is located by Nambiyar and Swedhanadhi minor basin respectively.

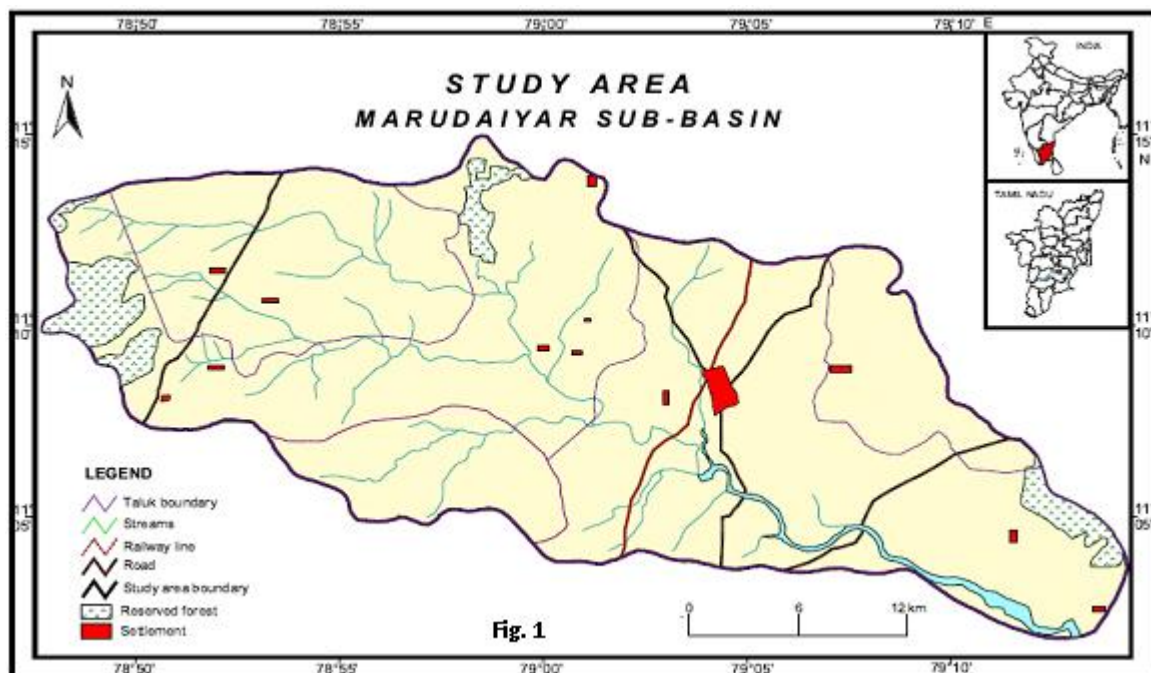


Fig. 1

Geologically, the river basin is mainly occupied by Archaean group of rocks composed of gneisses and charnockites. The Marudaiyar river basin, especially in its eastern part is composed almost entirely of sedimentary rocks especially calcareous rocks (limestone, gypsecous sandstone, calcareous sandstone etc.). Alluvium and black soils are mostly occupied in the entire basin. The southern parts of the study are mostly occupied by black soil.

### 3. Database and Methodology

For the analysis of integrated groundwater and soil related crop, we used the groundwater chemistry, soil series and cropping pattern and calendar of the study area. The quality of soil and its condition for cultivation is even more important as this is equally significant to groundwater. Even if groundwater is good in its quality, the growth of the crop is controlled by the soil condition. In Marudaiyar sub-basin, five major types of soil are observed. They are alluvium, red soil, red sandy soil, black soil, and thin red soil. Further, they are divided into micro level around twenty-five soil series (Table 3). Northern half of the study area is mostly occupied by red sandy soil and black soil. Northeastern part is occupied by river alluvium and it is also observed in central part of the study area. South-western part is occupied by red soil and southern part of the study area is covered by thin red soil. Taking these into account, detailed crop suitability analysis is done.

Generally, the suitability of water for irrigation is decided by considering the important factors in relation to irrigation water quality to be noted are salinity, sodicity and toxicity (Handa, 1979). Electrical Conductivity (EC) and Exchangeable Sodium Percentage (ESP) are the two important chemical parameters taken into consideration for the analysis of different salt tolerant crops in the study area.

### 4. Results and Discussion

#### Distribution of Crops

For understanding the crop distribution pattern of the study area, data relating to the crops cultivated in the study area were obtained for the year 2001-2002 from the Statistics Department of Perambalur and Tiruchirappalli District. The important crops cultivated in the study area are paddy, cotton, sugarcane, oilseeds, millets and Pulses. A detailed account of the crops grown in the study area, their areal extents and crop calendar are given in table 1 and 2. From the table it is content that paddy occupies greater areal extend than rest of the other crops.

#### Soil Suitability for Crops

Irrigation water, whether diverted from surface streams or pumped from wells, carries some chemical substances in solution dissolved from the rocks and soils over which the water has passed. The concentration of the major dissolved constituents decides the quality of water for irrigation uses. Therefore, the chemical composition of the soil certainly affects the quality of groundwater. Sodium is one of the major constituents in irrigation water. If sodium is predominant in irrigation water, continued use of such water may adversely affect the physical condition of the soil (Gopalsamy et al., 1973).

The chloride and sodium are mainly causing the salinity of soil salts present in the water. The consideration of salts in irrigation water is dominant factor relating to the quality of irrigation water (Gopalsamy et al., (1973), Dewis and Freitas (1970) and Agarwal et al, (1982). It is the salinity of the soil solution rather than that of irrigation water that directly affects the crop production. Therefore, different aspects of soil, groundwater potential and groundwater chemistry and their suitability to crops have been analyzed for the study area.

Soil Survey and Land Use organization, Government of Tamil Nadu, has classified the soil types of the study area into 14 soil series. Classification and description of each soil

series is tabulated (Table 3). Further, block-wise soil suitability for different crops in the study area is given in the table (Table 4).

From the table 4, it is observed that the soil suitability for paddy is observed in Thirumanur, Perambalur, Alathur and T.Palur blocks are receiving attention to take little care in using paddy cultivation. On the contrary, parts of Pullambadi block show moderately suitable soil condition for paddy cultivation. The alluvial soil is highly suited for paddy cultivation, whereas the red soil is moderately suited for paddy cultivation. The shallow to medium red calcareous, non-calcareous and black soil types are poorly

suited for paddy cultivation. The insitu black soil is, however, not suited for paddy cultivation.

Cotton is an important commercial crop in the Perambalur District. Compared to other Districts of Tamil Nadu, cotton is intensively cultivated in Thirumanur, Pullambadi and Veppur blocks. The insitu black and red non calcareous soil types are highly suitable for cotton cultivation. The medium to deep red non-calcareous and shallow to medium red calcareous soil types are moderately suitable for cotton cultivation. The alluvial, red non-calcareous and transported black soil types are poorly suited for this cultivation.

**Table 1: Cropping Pattern & Cropping Calendar of Marudaiyar Sub-basin**

Sl. No	Crops		Irrigated / Rainfed	Area in sq.km		Total Area in sq.km	% of the Total Area Sown	Months	
				Irrigated	Rainfed			Irrigated	Rainfed
1	<b>Paddy</b>		Both	117.70	28.84	146.54	34.33	June – Oct.	Sep. –Feb.
2	<b>Sugarcane</b>		Irrigated	101.65	00.00	101.65	23.81	Jan. – Dec.	-
3	<b>Cotton</b>		Both	7.00	107.64	114.64	26.85	Feb. – Aug.	Sep. –Feb.
4	Pulse	i. Blackgram	Both	1.08	2.78	8.39	1.96	Jan. – Mar.	Jan. – Mar.
		ii. Greengram		1.18	3.35				
5	Millets	i. Maize	Both	3.54	8.21	39.12	9.16	Jan. – Mar.	Aug. –Feb.
		ii. Cholam		2.58	8.19				
		iii. Cumbu		2.72	5.66				
		iv. Ragi		2.22	6.00				
6	Oil Seeds	i. Groundnut	Both	1.81	0.77	9.95	2.33	June – Dec.	June – Nov.
		ii. Gingelly		0.86	2.45				
		iii. Sunflower		2.21	1.85				
7	Others	i. Chilly	Both	0.351	0.875	6.55	1.53	Jan. – Dec	Aug. –Feb.
		ii. Cashew		0.340	2.221				
		iii. Onion		0.878	0.803				
		v. Turmeric	Irrigated	0.452	0.00				
		vi. Banana	Irrigated	0.635	0.00				
<b>Total</b>				247.206	179.628	426.84	100.00		

Source: Statistical Department of Perambalur & Tiruchirappalli

**Table 2: Area Cultivated by Major Crop in the Study Area (% of the Cultivated Area of different Blocks)**

Name of the Block	Paddy	Cotton	Sugarcane	Millets	Oilseeds	Pulses	Others	Total Area (in sq. km)
Perambalur	25.08	16.05	15.04	7.17	2.34	1.10	1.02	67.80
Alathur	21.35	14.15	12.05	5.72	2.13	2.1	1.5	59.00
Veppur	19.49	17.76	16.97	3.3	1.28	1.13	1.72	61.65
Ariyalur	16.38	15.04	13.13	9.02	1.11	1.01	0.64	56.33
Thirumanur	31.08	19.01	17.51	4.3	1.04	1.00	0.28	74.22
Pullambadi	13.12	18.9	14.25	6.1	1.02	1.03	1.14	55.56
T. Palur	20.04	13.39	12.7	3.51	1.03	1.02	0.25	51.94
Total area with (percent)	146.54 (34.33)	114.64 (26.85)	101.65 (23.81)	39.12 (9.16)	9.95 (2.33)	8.39 (1.96)	6.55 (1.53)	426.84 (100)

Source: Statistical Department, Perambalur and Tiruchirappalli

Sugarcane is also cultivated in equal proportion to cotton in the study area; it is mostly cultivated in the paddy region. The same paddy cultivated lands are used to cultivate the sugarcane crop. In the blocks of Thirumanur, Veppur and Perambalur and Alathur are showing best suitable conditions for sugarcane cultivation, where availability of groundwater is also more when compared to other areas. The alluvial soil is more suited for the sugarcane cultivation. The red and black sub group soil types are not suitable for sugarcane cultivation.

The pulse crops of black gram and green gram are highly cultivated in Alathur and Veppur blocks of the study area.

The rest of blocks are receiving attention to take little care in using them for pulse crops. The medium to deep red calcareous, black soil and colluvial soil types are suitable for pulse crop cultivation.

The cholam, chumbu, maize and ragi of millet crops are highly cultivated in Ariyalur, Perambalur and Alathur blocks. The other blocks are moderately suitable for millets crop cultivation. The medium to deep red calcareous, black soil and colluvial soil types are more suitable for millet cultivation. The insitu black, red non-calcareous, medium to deep red soil types soil is poorly suited for millet cultivation.

The red non-calcareous and transported black soils are non-suited for the millet cultivation.

Oilseeds crop is an important in the study area. The block s of Perambalur, Alathur and Veppur are highly cultivated in oilseeds crops. It includes groundnut, gingelly and sunflower. The rest of the blocks viz Ariyalur, Pullambadi and Thirumanur moderately cultivated in the above said crops. The red soil and colluvial soil types are highly suited for this cultivation because these soil series are dry soils. The alluvial soil is poorly suited where as the black soil are not suited for this cultivation.

Other crops are included in this study are, it is chillie, cashew, onion oil palm, turmeric and banana. Veppur, Pullambadi and Alathur blocks are highly suited for the above said crop cultivation. Chillie, banana and onion are commercial crop, mostly cultivated in the paddy region of the study area. In case of banana, cultivation is unsuitable in Perambalur, Alathur and Ariyalur blocks. Because, these blocks are located away from the river course and may be due to the same, they are not qualitatively suited for banana cultivation. Almost the other crops are cultivated in limited

areas in the study area. Generally, the paddy regions are used for this cultivation.

### Crop Suitability in Relation to Groundwater Chemistry

The crop analysis related to groundwater chemistry has been carried out for both pre-monsoon and post monsoon periods of the study area. The main factors or parameters taken into consideration for the present study are EC (Electrical Conductivity) and ESP (Exchangeable Sodium Percentage). The good yield of paddy is reported with SAR (Sodium Adsorption Ratio) value for this cultivation because these soil series are dry soils. The alluvial soil is poorly suited where as the black soil are not suited for this cultivation.

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**Table 3:** Description of Soil Series in Marudaiyar Sub-basin

Name of the Soil Series	Colour	Soil Depth (General)	Nature of Soil, Drainage and Permeability	Limitations (Level of alkalinity)
Pilamedu (Plm)	Dark brown to very dark grayish brown	Deep to very deep	Clay, well drained, moderately slow permeability	Fine calcareous, moderately alkaline soils
Madukkur (Mdk)	Yellowish brown to reddish brow	Very deep	Loamy sand to sandy clay, loam well drained, moderately rapid permeability	Non calcareous, acid soils-iron concretions present
Puttukottai (Pkt)	Yellowish brown to reddish brown	Deep to very deep	Loamy sand to sandy clay loam, well drained and rapid permeability	Slightly acidic, Non-calcareous
Kallakudi (Klk)	Dark grayish brown	Very deep	Clay loam and clay, moderately well drained, rapid permeability	Calcareous, neutral to alkaline
Irugur (Igr)	Red to dark red	Moderately deep	Sandy clay loam to clay, well drained and moderate permeability	Non-calcareous slightly acid to neutral
Alathur (Alt)	Dark brown to very dark grayish brown	Very deep	Clay loam to sandy clay	Calcareous, neutral to moderately alkaline soils
Ariyalur (Alu)	Grey to dark grey	Very deep	Sandy clay loam to clay loam, moderately drained, slow permeability	Non-calcareous
Kallagam (Kgm)	Red to dark reddish brown	Very deep	Sandy clay loam to fine loamy, well drained, moderate permeability	Non-calcareous, Strong to slightly acid in reaction
Adanur (Adr)	Very dark grey to yellowish brown	Very deep	Silty clay, moderately well drained, slow permeability	Calcareous, mild to moderately alkaline
Alangudi (Alg)	Dark grayish brown	Very deep	Sandy clay loam to clay moderately drained and slow permeability	Calcareous, alluvial soils, Saline-alkaline soils occur on nearly level lands
Padugai (Pdg)	Light yellowish brown	Along the river and stream courses, Very deep	Loamy sand to sandy clay, well drained and rapidly permeable	Calcareous, undeveloped with stratified layers
Mixed-alluvium	-	Deep	Fine loamy to clayey, well drained	Stratification, wetness of the soil calcareous
Palathurai (Pth)	Dark red to dark brown	Moderately deep to deep	Fine loamy to clayey, well drained with moderate to rapid permeability	Calcareous mildly to moderately alkaline
Madukulam (Mkm)	Yellowish red to red	Moderately deep	Sand to sandy clay loam, well drained slow permeability	Latertic soils Non-calcareous

**Source:** Soil Survey and Landuse Organization, Thanjavur region

**Table 4:** Block-wise Soil Suitability for Different Crops in Marudaiyar Sub-basin

Name of the Block	Part of the Block and Soil Series	Sources of Irrigation	Crop Suitability		
			Highly suited	Moderately suited	Poorly suited
Perambalur	Plm – Mlt Kbr-Colluvium Plm Kbr-Plm, Plm-Pdt	Wells, tanks	Paddy Groundnut Sugarcane	Sorghum Cotton Chillies	Pearl millet Finger millet
Alathur	Plm, Kbr, Pth Klm-Mlt Kgm-Klt Kgm	Wells, tanks	Paddy Groundnut Cotton Black& red gram	Pearl millet Sugarcane Sorghum Chillies	-
Veppur	Klk Klk, Kgm Plm Klk, Klk-Mlt	Wells, tanks	Paddy Cotton Groundnut	Sugarcane Chillies Black& red gram	Sorghum Pearl millet Finger millet
Ariyalur	Pth, Alu Agr Pkt, Alu, Mlt Pth Plm, Aci	Canal, wells and tanks	Paddy Sorghum Pearl millet	Chillies Groundnut Sugarcane Cotton	Finger millet
Thirumanur	Ptj, Aci, Vlm, Npm Vlm, Mdk, Plm Klt Klt, mixed alluvium	Canal, tanks	Paddy Sugarcane	Groundnut Pearl millet Cotton	Finger millet Sorghum Banana
Pullambadi	Klk, Alp, Mlt Klk, Mlt Omd, Igr Igr, Mixed-alluvium	Wells, Canal and tanks	Paddy Chillies Sugarcane Cotton	Banana Fingermillet Groundnut	Sorghum Pearlmillet
T.Palur	Pkt, Mdk, Mkm Mdk, Mkm Mdk, Pkt Kit, Mixed alluvium	Canal, tanks	Red gram Pearl millet Groundnut	Chillies Paddy Sugarcane Cotton	Banana Sorghum

**Source:** Soil Survey and Landuse Organization, Thanjavur region

away from the river course and may be due to the same, they are not qualitatively suited for banana cultivation. Almost the other crops are cultivated in limited areas in the study area. Generally, the paddy regions are used for this cultivation.

#### Crop Suitability in Relation to Groundwater Chemistry

The crop analysis related to groundwater chemistry has been carried out for both pre-monsoon and post monsoon periods of the study area. The main factors or parameters taken into consideration for the present study are EC (Electrical Conductivity) and ESP (Exchangeable Sodium Percentage). The good yield of paddy is reported with SAR (Sodium Adsorption Ratio) value

**Table 5:** Crop Tolerance to Salinity (values in millisiemens / cm)

Crop	Decrease in yield				
	0 % EC <sub>e</sub>	10 % EC <sub>e</sub>	25 % EC <sub>e</sub>	50 % EC <sub>e</sub>	100 % EC <sub>e</sub>
1. Cotton	7.7	9.6	13	17	27
2. Paddy	3	3.8	5.1	7.4	11.5
3. Sorghum	4	5.1	7.4	11	18
4. Sugarcane	-	3	5	8.5	-
5. Groundnut	3.2	3.5	4.1	4.9	6.5

**(Source:** As referred by Handa 1979)

$$EC_e = 1.5 \times EC_{iw}$$

Where EC<sub>iw</sub> = EC of irrigation water.

below 10 but when the yield declines as the SAR value increases (Palanisamy and Dhanapalan Mozi, 1978). The

deleterious effects of excessive sodium on crop growth are not as closely related to the absolute amount of Soluble Sodium in the soil water as to the Exchangeable Sodium Percentage (Handa, 1979). Hence, instead of using the SAR, the application of ESP would be more effective. The following table 5, 6 and 7 shows the limits of the crop tolerance to salinity, tolerance level of major crops and crop tolerance to exchangeable sodium percent of the study area.

Salt tolerance depends upon types of plants, soil, water and environment variables. These have been given as a simple function EC<sub>e</sub> that is electrical conductivity of maturation extract, which is tabulated in table 5. From the table 5, one can observe that cotton gives good yield till EC<sub>e</sub> reaches 7.7 milliamperes per centimeter. There is a possibility for decreasing the yield to 50 per cent when EC is 17.0 milliamperes per centimeter. On contrary, yields of paddy, sorghum and groundnut decrease when EC<sub>e</sub> exceeds 3.0, 4.0 and 3.2 milliamperes per centimeter respectively.

The salt tolerance level of major crops are worked out and listed in table 6, based on the source given by Gopalsamy et al., (1973), Ragunath (1987), Bernstein (1964) and Ayers and Westcot (1994). In the study area, there are 10 important crops, which have been taken into consideration for analyzing the salt tolerance level. They are cotton, finger millet, paddy, sorghum, sugarcane, groundnut, pearl millet, banana, chilies and red gram. From the salt tolerance level table 6, cotton and finger millet are having tolerance level of even upto 16,000 mmhos per centimeter of electrical conductivity. But on the other hand, paddy, sorghum, sugarcane, groundnut, pearl millet, banana and chilies are

having tolerance level of 4,000 – 8, 000 mmhos per centimeter. And, therefore, they are categorized as semi-tolerant crops. In the study area, red gram is categorized under salt sensitive crop, as its tolerance level is between 2000 and 4000 mmhos per centimeter.

**Table 6:** Tolerance Levels of Major Crops in the Study Area

High Tolerant Crops EC = 8000-16000 (mmhos/cm)	Semi – Tolerant Crops EC = 4000-8000 (mmhos/cm)	Salt – Sensitive Crops EC = 2000-4000 (mmhos/cm)
Cotton Finger millet	Paddy Sorghum Sugarcane Groundnut Pear millet Banana Chillies	Red Gram

Source: Gopalsamy et al 1973 and Raghunath 1987

According to Handa (1979), crop tolerance and ESP are directly related. When ESP is ranging between 2 and 10, semi-tolerant crops are giving good yield. But all other sensitive, semi-tolerant and tolerant categories are related to stunted growth when ESP is ranging from 10 to 20, 20 to 40 to 60 respectively (Table 7).

**Table 7:** Crop Tolerances to Exchangeable Sodium Percent (ESP)

Tolerance Level	ESP and Range at which affected	Growth response under field conditions
1. Extremely Sensitive	2.0 to 10.0	Sodium Toxicity Symptoms even at Low ESP Values
2. Sensitive	10.0 to 20.0	Stunted Growth
3. Semi-Tolerant	20.0 to 40.0	Stunted Growth
4. Tolerant	40.0 to 60.0	Stunted Growth

Source: Handa 1979

Based on this evaluation, Perambalur (in Aranarai, Kavulpalayam and Kalpadi), Alathur (in Sirukanpur, Kottari, Kuttur, Killamathur, Irur, Naranamangalam, Kulattur and Nochechikulam), Ariyalur (in Ottakovil, Valajanagaram, V.Krishnapuram, Pudupalayam, Hasthinapuram, Reddipalayam, Periatirukkonam, Vilangudi and Sundakkudi), Pullambadi (in Garudamangalam), Thirumanur (in Pappancheri), T. Palur (in Ulliyakkudi) and Veppur (in Chittali) blocks are found to be suitable for all crops during both the seasons. Cotton is not affected even when  $EC_e$  goes upto 7.7. Other crops such as paddy, sorghum and groundnut are affected in their yield when  $EC_e$  exceeds 4. Based on this, the blocks Veppur (in Chittali) and Alathur (in Kuttur and Irur) need some remedial measures. The cultivation of red gram mainly depends on rainwater and it is not affected due to water chemistry.

The Electrical Conductivity exceeds 4000 mmhos per centimeter in some blocks. Veppur (in Chittali) and Alathur (in Sirukanpur) are seriously affected by the major ions in both the seasons. Except these two blocks, all other blocks are found to be more suitable for cultivating all the crops. However, cotton can be cultivated in all the blocks, which is not affected by high  $EC_e$  values.

## 5. Integrated Crop Analysis

The ten major crops in the study area have been analysed based on groundwater potential, groundwater chemistry and soil types. Keeping these in mind an integrated crop analysis for different blocks is examined in the basin.

### a) Paddy (*Oryzasativa*)

Generally more water is need for paddy crop cultivation, T.Palur, Thirumanur and Pullambadi blocks are located along the river basin. These blocks having more water and therefore, they are very much suitable for paddy cultivation. Coming to the quality aspect of groundwater for paddy cultivation, the above said blocks are good. These blocks are almost matching with the blocks found suitable based on groundwater potential. Mixed alluvium soil series is very much favorable for paddy cultivation. This type of soil series is found mostly along the basin and the blocks, which are located along the basin, are most suited for paddy cultivation. Therefore, it is inferred that the above blocks are more suitable for paddy cultivation as almost all the blocks coincide with the same results either based on groundwater potential or based on groundwater chemistry or soil suitability. The other blocks are found to be moderately suitable for paddy cultivation.

### b) Cotton (*Gossypium Species*)

This crop is most suited for the black soil types. Cotton is highly tolerant to high values of EC and ESP. The soil series suited for cotton crop are Pilamedu, Kallagam, Kallakudi and Kalathur in the study area. The above conditions are fulfilled in Alathur, Veppur, Perambalur, Ariyalur, Thirumanur and T.Palur blocks where cotton cultivation is moderated to highly suitable.

### c) Sugarcane (*Saccharum Officinarum*)

Generally, most of the conditions decided for paddy cultivation adapt to sugarcane, but the main difference is that the paddy is 3 to 4 month crop, while sugarcane is an annual crop. It needs more groundwater with low fluctuation in groundwater level through out the year. Based on this, Perambalur, Thirumanur and Pullambadi blocks are highly suitable for sugarcane cultivation. The blocks Alathur, Veppur, Ariyalur and T.Palur are moderately suitable while the rest of the blocks are found to be poorly suitable for sugarcane cultivation.

### d) Groundnut (*Arachis Hypogea*)

Groundnut is a semi-salt tolerant crop. The most suited soils for the groundnut cultivation are colluvial and red soil types. The soil series Pilamedu, Kallagam, Kallakudi, Palathurai, Ariyalur and Madukkur are very much suitable for groundnut. These conditions are found in Perambalur, Alathur, Veppur, Ariyalur and T.Palur blocks. Thirumanur and Pullambadi blocks are moderate to poorly suitable for the same.

### e) Sorghum (*Andropogon Sorghum*)

It is a semi-salt tolerant crop. Unlike paddy, sorghum does not need more water and also it does not accommodate in stagnating water condition. Therefore, the blocks with moderate groundwater potential, EC value of less than 4000 mmhos per centimeter and ESP value of less than 40 are

suitable for sorghum. Further, the soil series of Kallagam, Palathurai, Ariyalur, Madukkur, Pattukottai and Mudukulam are suitable for sorghum crop cultivation. Based on this, the blocks viz., Alathur, Ariyalur and T.Palur are highly suitable where the above conditions are exactly matching. On the other hand, the blocks Perambalur, Veppur, Thirumanur and Pullambadi are found to be moderate to poorly suitable for the sorghum cultivation.

**f) Pearl millet (*Pennisetum Typhoides*)**

Groundwater potential and groundwater chemistry suitability condition for pearl millet is almost the same as sorghum. Highly suitable soil series for pearl millet are Ariyalur, Palathurai, Pattukottai, Madukkur and Mudukulam. Considering all the above conditions, the blocks, Ariyalur and T.Palur are found to be suitable for pearl millet cultivation.

**g) Finger millet (*Eleusine Coracana*)**

Again, the finger millet does not accommodate stagnation of water which results decrease in yield. Hence, it needs moderate water potential and chemical quality keeping these as criteria, only Pullambadi block are found to be suitable for finger miller cultivation. The rest of the blocks are moderate to poorly suitable for the same.

**h) Red gram (*Cajanus Indicus*)**

As red gram is basically a rain fed crop, groundwater chemistry and groundwater potential do not play significant roles in red gram cultivation. The most suitable soil series are Madukkur, Mudukulam and Pattukottai for red gram. These are fulfilled only in the block of T.Palur, which are more moderately suitable for red gram cultivation.

**i) Chillies (*Capsicum Fruitescens*)**

Pilamedu, Kallagam and Kallakudi soil series are highly suitable for chilly cultivation. Moderately groundwater potential is sufficient for chillies. Based on this, Perambalur, Alathur and Pullambadi blocks are found to be suitable for chilly cultivation, while other blocks are moderate to poorly suitable for the same.

**j) Banana (*Musa Paradisiaca*)**

Similar to paddy, this also needs good groundwater potential. Kallakudi, Irugur, Mixed alluvium and Madukkur soil series are highly suitable for banana cultivation. Pullambadi, Thirumanur and T.Palur blocks are found to be highly suitable for banana cultivation.

**6. Reclamation Measures for Soil and Groundwater Chemistry**

In the study area, the soil series of Irugur, Madukkur, Palavidithi, Pattukkottai and Kallagam soil series are not affected by either salinity or alkalinity. The alkalinity and salinity problems are important in Marudaiyar sub-basin, which affect crop yield considerably. Groundwater quality and soil condition are poor in parts of Perambalur, Alathur and Pullampadi blocks where both groundwater quality and soil conditions are affected. The requirements of gypsum for different types of water have been clearly explained in figures (Fig. 2 and 3) for both seasons. While, several modifications have been published in USSL diagram,

Handa's (1964) modified one is superior to these in as much as it allows computation of gypsum requirements of high sodium water. From the figures it is observed that for every increase of 100 EC mmhos at 25° C there is a need for 0.12 to 10 or 120 kg. of gypsum.

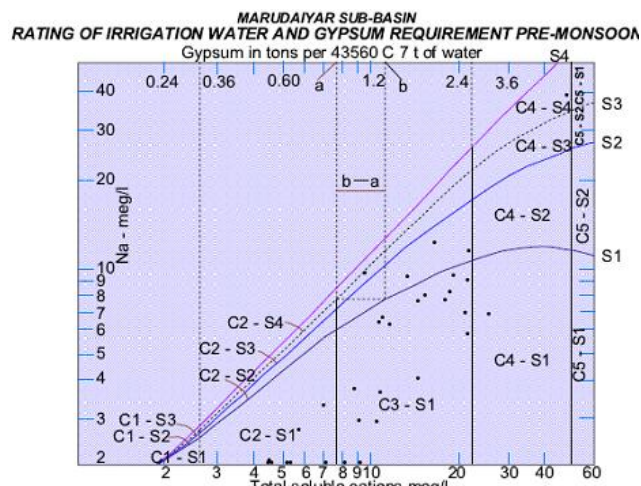


Fig. 2

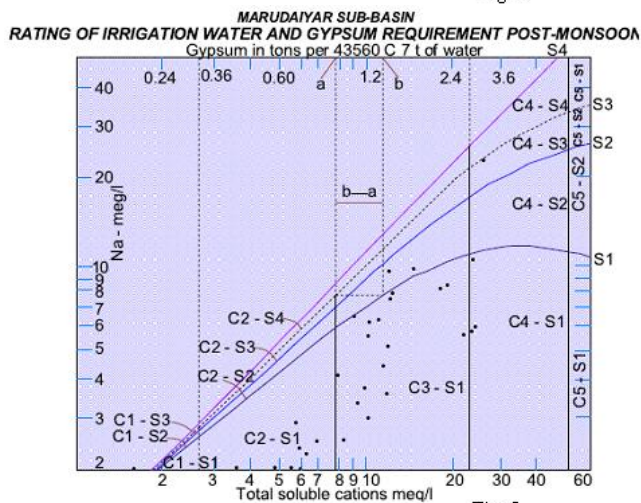


Fig. 3

As per USSL diagram, the water C3 S1 or less than that the generally good for irrigation (Sivanappan et al., 1973, Gopalswamy et al., 1973, Balasundaram et al., 1973 and Krishnamurthy, 1990). According to Handa's method, to convert C3 S1 water (at X =a) from C3S3 (at Y =b) the requirement of gypsum is = b-a.

Therefore, gypsum requirement to convert C3S1 at X from C3S3 at Y  
 = b - a  
 = 0.24 ton - 0.09 ton  
 C3 S3 at Y = 0.15 ton or 150 kgs.

Hence, in the study area, the requirement of gypsum is necessary for the parts of Pullambadi and T.Palur blocks only.

**7. Conclusion**

From the integrated analysis of crops, groundwater chemistry and groundwater potential, it is observed that unless the soil is in good condition, even if there is good groundwater potential with suitable chemical quality, there may not be good crop yield. The use of manure and other

organic manure, of course, would enhance the quality of soils to some extent. Even if the quality of water is moderate to poor and the soil is good, the use of gypsum or sulphur or other alternative measures would enhance the yield of crops. The good yield of cotton depends mainly upon the suitability of the soil, while for other crops, groundwater chemistry and potential also play an equally important role. In the study area, 14 soil series are identified by Soil Survey and Land use Organization. Thirumanur and Pullambadi blocks are more suitable for paddy cultivation. Soils of Alathur and Veppur blocks are highly suitable for cotton cultivation. The soil series of Perambalur, Thirumanur and Pullambadi blocks are highly suitable for sugarcane cultivation. Oil seeds are cultivated in T.Palur, Perambalur, Alathur, Veppur and Ariyalur blocks. Pulse, millets and other crops are cultivated only in a few limited parts of the study area.

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