HYDROGEOLOGICAL VARIATIONS OF GROUND WATER IN DIFFERENT GEOMARPHIC UNITS OF KRISHNA EASTERN DELTA, ANDHRA PRADESH

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ABSTRACT

The Krishna Eastern delta is located South of Vijayawada City in Andhra Pradesh. The area of the Krishna Eastern delta enclosed between Latitude $15^0$42'N – $16^0$42' N and Longitude $80^0$42' E – $81^0$36' E. The present study is done on Krishna Eastern delta separately because the physiographic and lithological configuration of this part of the delta varies widely with that of the Western part. Moreover, the aquifer of this region has unique hydrochemical characteristics. In recent years the ground water in this region has been subjected to intensive exploitation for both irrigation and domestic purposes and accordingly high seasonal hydrochemical modulations were noticed in this part of the delta region. Kulakarni KM et.al. (1998) have studied drinking water salinity problem in Coastal Orissa.

In this context a detailed study has been made to update the hydrogeochemical information of the aquifer system of this region. In addition to the earlier works carried out by Nageswara Rao, K. et.al. in the year 1979 and 1985. The details viz., land form locations in the delta region were taken from the study. The seasonal variation of groundwater quality in different geological units in Krishna Eastern Delta has been subjected to study by collecting water samples in different open wells in the study area and subjecting them to detailed chemical analysis. This data has been utilized to draw contour diagrams of different water quality parameters for different seasons.

The present study is an attempt to visualize the spatial water quality variations in different geomorphic units present in the deltaic environment. The chemical parameter of Electrical Conductivity was taken as the prime parameter to focus the seasonal spatial variations of different geomorphic forms and the data was used to draw contours for different seasons. The detailed studies of Ground Water Department, District Office were also studied in many unpublished reports for understanding the nature of the Krishna delta system. The Schematic representation of water quality parameters were studied from the book entitled Groundwater Hydrology John Wiley & Sons inc., New York (Todd-1959). Geochemical conceptual approaches for the study of different land forms and the important

logistics of water quality parameters were drawn from the book entitled Groundwater Assessment Development and Management by K.R. Karanth, 1987.

The inferences of the present study may help in identifying the response of different landforms for precipitation and for identifying the shallow fresh water aquifers to cater the domestic needs in the drinking water problematic areas of the Krishna Eastern delta region.

Key words: Geomarphic, intrusion, conductivity,lithological.

1. INTRODUCTION

The Krishna delta system originated from Vijayawada and extends to East and Western side of the River. The area of the Krishna Eastern delta enclosed between Latitude $15^0$42'N – $16^0$42' N and Longitude $80^0$42' E – $81^0$36' E. The delta originated from Prakasam barrage constructed across the River Krishna. The barrage provides assured irrigation facility for nearly 4.88 lakh. hectares of land both in Krishna and Guntur district areas.

As far as the cropping pattern is concerned the predominant crop in the delta area is paddy and the other prominent crops are sugarcane, fruits and vegetables. The total geographical area of the delta is 6200 sq.km, of which the Krishna Eastern delta occupies an aerial extent of 3980 sq.km.

Mostly the coastal landforms are treated that they would not have water shortage, as the depth to water table is shallow and the influence of River recharge will be quite adequate to maintain the ground water at safe levels with high potentials.

But the fact is that out of 3980 sq.km. of area in the Krishna Eastern delta 2541 sq.km (nearly 64%) is filled with brines/ saline waters and over 630 sq.km. (nearly 16%) is filled with brackish waters which are not suitable for drinking and irrigation of sensitive crops. The remaining fresh water pocket of this part of the delta is only 808 sq.km. i.e., nearly 20% only. These statistics will through light on the critical situation of the deltaic ground water regime and emphasize on the necessity for elaborate study on the nature and mode of ground water quality in different landform of the delta system.

The other component of ground water regime in the delta that makes the study interesting is the presence of floating fresh water pockets in these saline and brackish zones, which are being independent and unique with regard to the water chemistry and more prone to the monsoon vagaries.

2. PHYSIOGRAPHY OF KRISHNA EASTERN DELTA:

The major part of the Krishna delta is a flat area with gentle slope towards Bay of Bengal. It has some undulations in the middle present in the form of deltaic lobes, beach ridges and flood plains. The highest elevation is about 16 meter above mean sea level near Vijayawada city and minimum is 3.50 m. level at Machilipatnam. The general climatic conditions of the delta are with hot summer and cold winter. The delta area receives precipitation from South-West monsoon and Northeast monsoon, of which the Southwest contributes 89% of the rainfall remaining, is from North-East monsoon. The location map of the study is shown Plate-1.

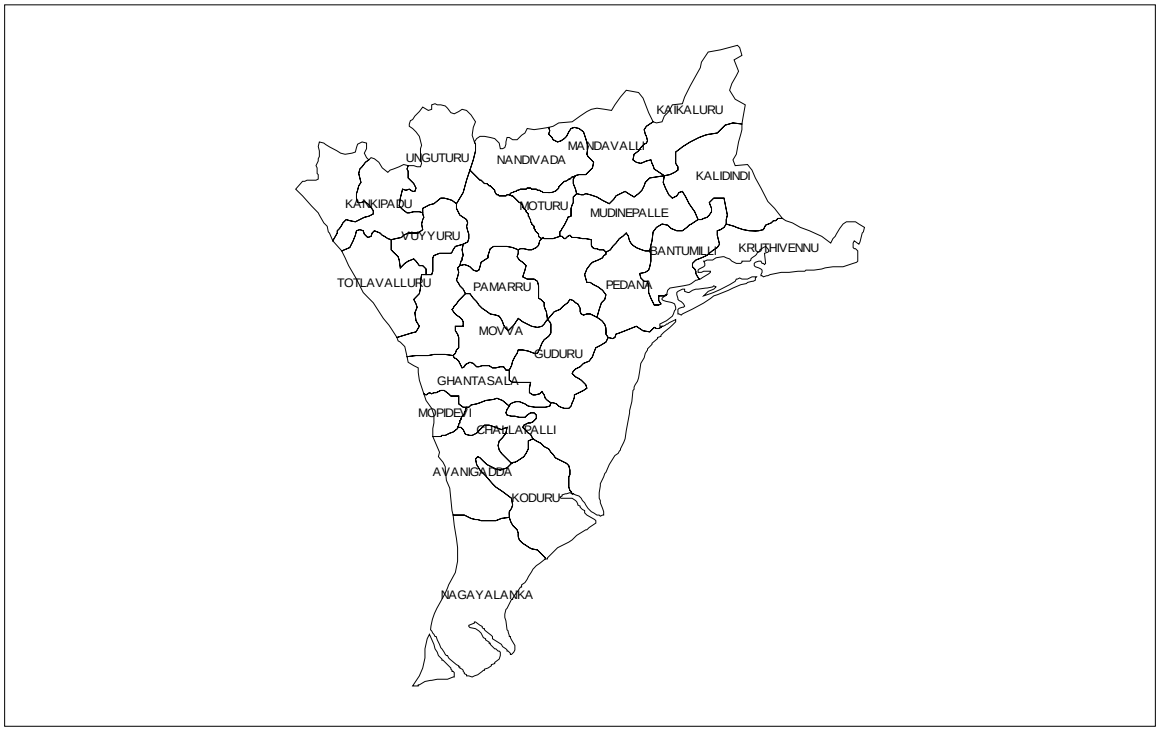

Fig 1: Krishna Eastern Delta Map Plate -1

3. METHODOLOGY:

In the Krishna delta area ground water is being extracted by means of filter point wells, open wells. Most of the multi-layered aquifer is being extracted by means of filter point wells, the landforms that area supporting this kind of aquifer is paleo-channels. The rest of the landforms the ground water extraction is through shallow filter point wells or ring wells (reinforced concrete cement rings lowered down to the depth of good water quality, the depth will be ascertained by making a trial pit with augur and testing the water quality variation vertically).

For the purpose of present study existing wells both irrigation and drinking water were selected on different landforms and samples were collected from the ring wells. The selection is made based on the historical data with the Ground Water Department of Krishna District. The values of Ec **f**or electrical conductivity of 500, 1000, 2250 were taken into consideration as the 500 shows potable ground water quality and the values <1000 indicate relatively fresh water, the 2250 is the upper limit of agricultural suitability.

The sample collection was made at 20 different locations and the geomorphic units that are present in the collection are deltaic plain, paleo-channels, beach ridge and coastal plain. The sample collection was made in the 1 liter pet bottle and measurement of Electrical Conductivity has been done with the help of portable electrical conductivity instrument.

For all these selected well locations the latitude and longitude were recorded using a portable (GPS) Global Positioning System. The GPS projections were transferred under respective locations and the Electrical Conductivity values of the corresponding stations were plotted on Excel sheet. This file was later converted into a grid file and by using Kriging technique contours were generated for the pre and post monsoon periods.

The landforms were identified based on the work done by earlier scientists in the Krishna delta area. Maps available with Ground Water Department were also utilised for the identification of the landforms and the land forms for the respective sample sites were shown in Table-1. The contours drawn on different land forms for the water years of the pre and post monsoon periods of 2007, 2008 and 2009 were shown in the Plates (2 to 5).

4. RESULTS & DISCUSSION:

4.1. Electrical Conductivity Contour Map of May-November, 2007- Plate 2:

The map (Plate-2) drawn for this period shows that the poor quality groundwater (above 2250 EC) extends from East to West covering the beach ridges, deltaic plain, coastal plain and parts of the paleo channels of the delta area. The potable water quality is restricted to the upper reaches of the Krishna Eastern delta upto Thotlavalluru on

the North-West and available as a floating fresh water pocket encircling Telaprolu, Guraja and Mandavalli. Similar floating of fresh water pocket was also observed South-West of Machilipatnam. During the post monsoon period of this year heavy dilution is observed along the beach ridge area east of the delta and the unsuitable water quality area above 2250 was largely restricted between Pamidimukkala and Avanigadda. However the small patch of poor water quality appears on the Northern tip of the delta.

PLATE-2

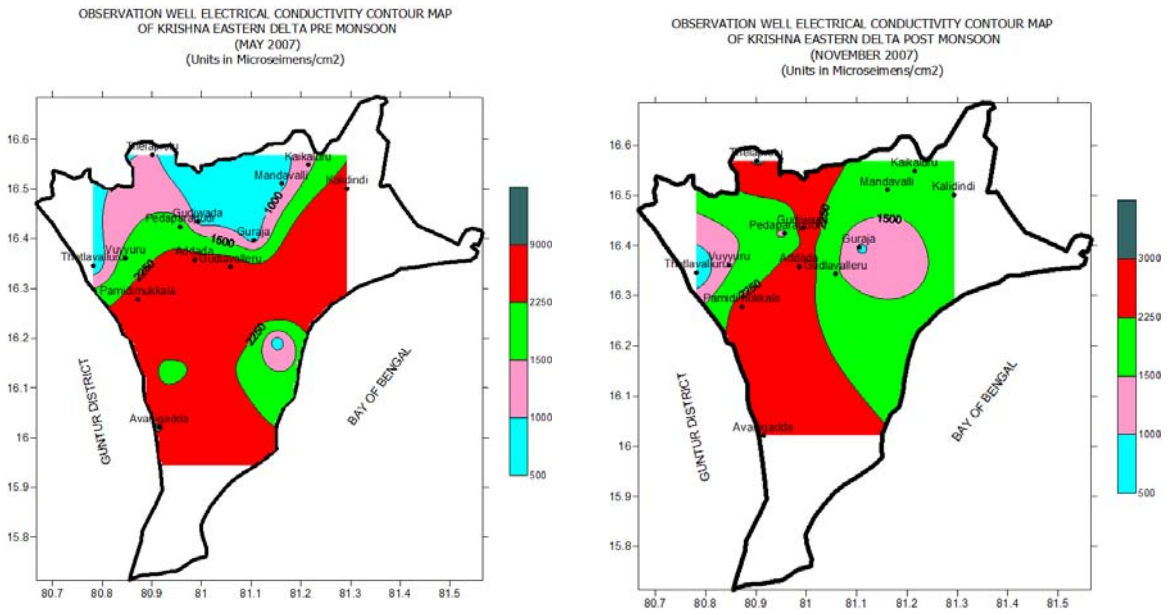

Fig 2: Electrical Conductivity Contour Map of May-November, 2007 Plate - 2

Table-1: Location of Water Sample From Different Landforms of Krishna Eastern Delta
(Water Table Aquifer)

S.No	Location	Type of Land
1	Telaprolu	Deltaic Plain
2	Gudivada	Deltaic Plain
3	Pedaparupudi	Deltaic Plain-near Paleo channel
4	Kaikaluru	Coastal Plain
5	Mandavalli	Beach Ridge
6	Kalidindi	Beach Ridge
7	Totlavalluru	Deltaic Plain
8	Vuyyuru	Deltaic Plain
9	Addada	Paleo-channel
10	Gudlavalleru	Deltaic Plain
11	Guraja	Deltaic Plain
12	Pamidimukkala	Paleo-channel
13	Chinamuttevi	Paleo-channel
14	Chinapandrika	Coastal Plain
15	Pedana	Beach Ridge
16	Guduru	Beach Ridge
17	Gantasala	Deltaic Plain-near Flood Plain
18	Machlipatnam	Beach Ridge
19	Challapalli	Flood Plain
20	Avanigadda	Deltaic Plain

4.2. Electrical Conductivity Contour Map of May-November, 2008 – Plate 3:

During the pre monsoon period of May, 2008 the poor quality water area is more are less similar to that of May, 2007 except marginal dilution in the beach ridge areas of the North-East area and there is no sign of floating fresh water pocket any where the near coast line. During the post monsoon the poor water quality patch remains the same with that of the pre monsoon period.

PLATE-3

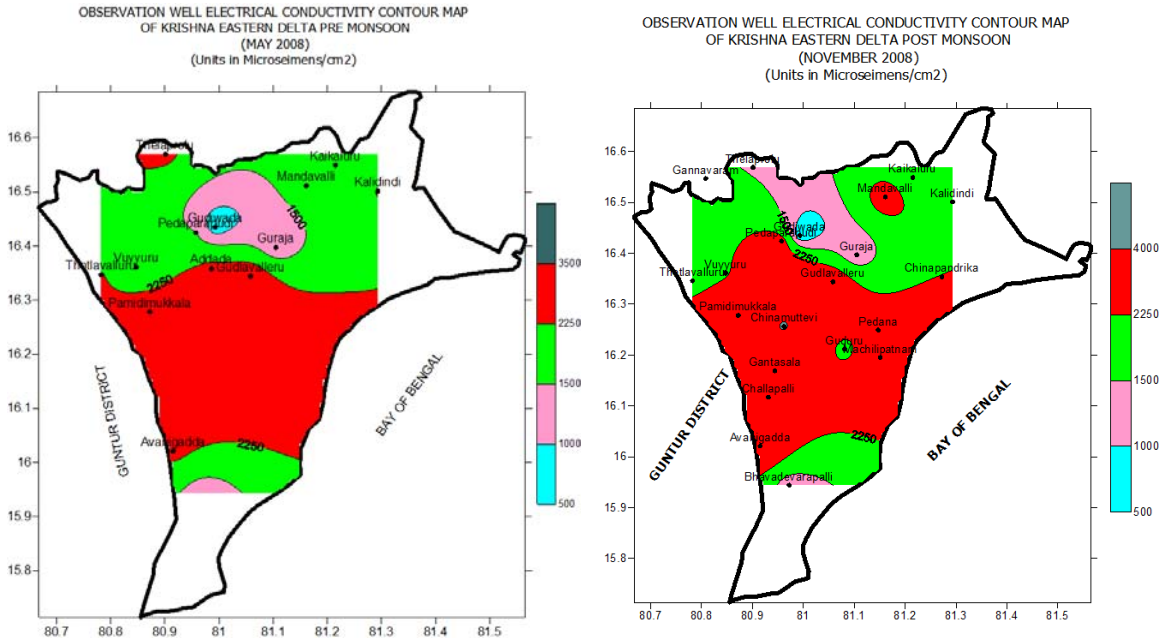

Fig 3: Electrical Conductivity Contour Map of May-November, 2008 Plate - 3

4.3. Electrical Conductivity Contour Map of May-November, 2009 – Plate 4:

During the pre monsoon of May, 2009 the poor water quality area remains the same in addition to this an extended local contamination was found in between Telaprolu and Gudivada. During the post monsoon of November, 2009 high dilutions were observed in the paleo channel, deltaic plain and beach ridge areas. The poor water quality's restricted to the flood plain areas and beach ridges. Apart from two small areas of local contamination near Telaprolu and Gudivada. In the rest of the delta area the Electrical Conductivity ranges from <500 to 1500.

PLATE-4

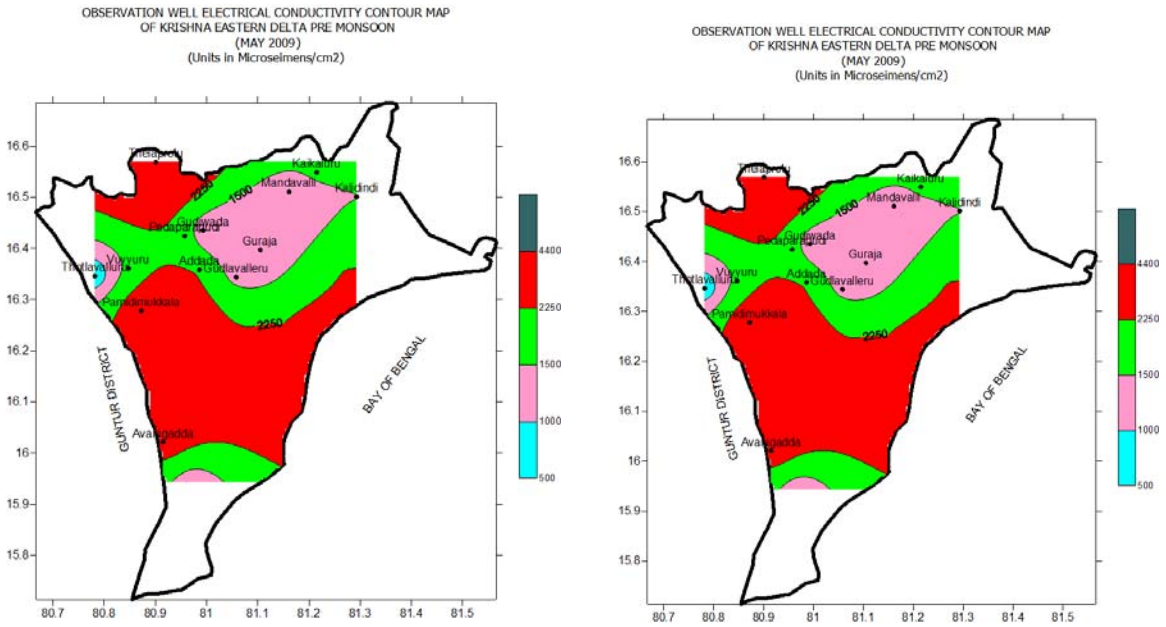

Fig 4: Electrical Conductivity Contour Map of May-November, 2009 Plate - 4

5. CONCLUSION:

By the study of contour maps it is evident that the beach ridges, paleo channels, coastal plains are more reactive to the effect of precipitation. The floating fresh water pockets are found to appear in fairly good areas over these land forms. Though the effect of precipitation was not so conspicuous on the flood plain areas an attempt of artificial recharge may help in creating shallow fresh water aquifer which is covered with thick black impervious clayey soil over the top. This study of these water quality contour maps are thought provocating and helps in the identification of permanent poor quality areas and the nature of reflection of different land forms to precipitation. More studies with regard to quality variation Vs water table fluctuation on different land forms have to be made in order to aim for a comprehensive approach on artificial recharge there by creating venues for developing potable water resources in the very much established saline pockets of delta aerial.

6. REFERENCES:

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