

STUDY ON IMPACT OF AQUACULTURE ON GROUNDWATER QUALITY USING GIS IN NAGAPATTINAM DISTRICT, TAMILNADU STATE, SOUTH INDIA

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Abstract: Aquaculture is a highly profitable venture in India. Also, it has increased the availability of nutritive food for the growing population. Designing of spatial modeling of various impact zones in various block of Nagapattinam district, Tamilnadu, India with the help of GIS software and study their implications. To analyze the sociological impact associated with aquaculture farms in various blocks of Nagapattinam district. The study area comprises of profile of Nagapattinam district, Meteorological Information, Details of Hydrology, Geology, and Hydrogeology, the current circumstances of Ground water quality scenario and maps of Village boundaries of various blocks of Nagapattinam district. Database comprises of primary and secondary data which are being collected from the study area and various government organizations. In this study, the ground water samples and pond water samples from different locations of the study area of Nagapattinam district, Tamilnadu were collected during pre-monsoon and post-monsoon periods and their chemical parameters were analysed. The GIS-Kriging interpolation techniques were employed to understand the spatio-temporal variability of water quality parameters. The type and intensity of damage due to seepage of saline water from the ponds into the natural system making unsuitableness for irrigation and drinking water system is deeply analysed in the study areas.

Key words: Aquaculture, Groundwater quality, GIS-Kriging, Spatial modelling

I. INTRODUCTION

Aquaculture is a highly profitable venture in India. Also, it has increased the availability of nutritive food for the growing population. The advent of aquaculture is mainly due to depletion or standstill of capture fishery since the seventies, and availability of vast stretches of brackish water lands (1.2 million sq.km). The industry has grown enormously, leading to purchase of agricultural and fallow lands by entrepreneurs for setting up small and large-scale aqua farms in Tamilnadu. However, the rapid expansion of intensive aquaculture in Tamilnadu has severely damaged the adjoining ecosystems, leading to socio-economic and environmental problems in the coastal areas of Tamilnadu. The environmental impact of aquaculture includes Eutrophication, oxygen depletion and pollution of the surrounding waters and their biota, which have made these waters and the associated ecosystems less suitable for other purposes like further culture and harvesting of natural stocks. Water with required quality and quantity is required for different stages of shrimp farming. In the shrimp hatchery unpolluted seawater is required for brood stock maintenance, spawning, larval rearing and culture of food organism. Potable water is required in sufficient quantities for drinking and cooking food for the workers. The grow out farm ponds need sea/brackish water, free from agriculture, domestic and industrial pollution and also within the required salinities, pH and temperature ranges. The quality of water and even the impacts from external environmental changes pose threat to the sustainability of shrimp culture. The higher water demand of more intensive culture is such that demand can easily outstrip supply in areas with poor tidal flushing. Therefore, people are of the opinion that the deterioration of drinking water quality is due to aquaculture. However, this fact that drinking water quality is affected by shrimp culture in coastal habitats is not true since seawater intrusion is also found to attribute salinization in coastal areas of Nagai district. The salinisation of surface water is another water quality impact from shrimp farms to the receiving waters. It is reported that shrimp farm construction can potentially alter surface water flow patterns and water quality. Water flows were found to be affected by the temporary blockage of permanent division of canals and discharge of untreated pond effluents into the natural system was known to hinder the water quality.

II. OBJECTIVES OF THE STUDY

- To evaluate the impact on groundwater and surface water by analyzing, examining in various Physico – chemical characteristics
- Designing of spatial modeling of various impact zones in various block of Nagapattinam district with the help of GIS software and study their implications
- To analyze the sociological impact associated with aquaculture farms in various blocks of Nagapattinam district.

- To recommend suitable remedial measures and management strategies for establishment of eco-friendly aquaculture unit.

III. STUDY AREA

Nagai district is one of the coastal districts of Tamilnadu comprising 5 taluks with a total area of 2714.82 km². The district lies between N latitudes 10° 10' and 11°20' and E longitudes 79° 14' and 79° 50'. The coast line is 187 km long with MSL of 9 m. A greater part of the district consists of deltaic plains of the Cauvery river with very rich fertile soil. Agriculture is the main stay of rural populace. The chief sources of irrigation are canals and tube wells.

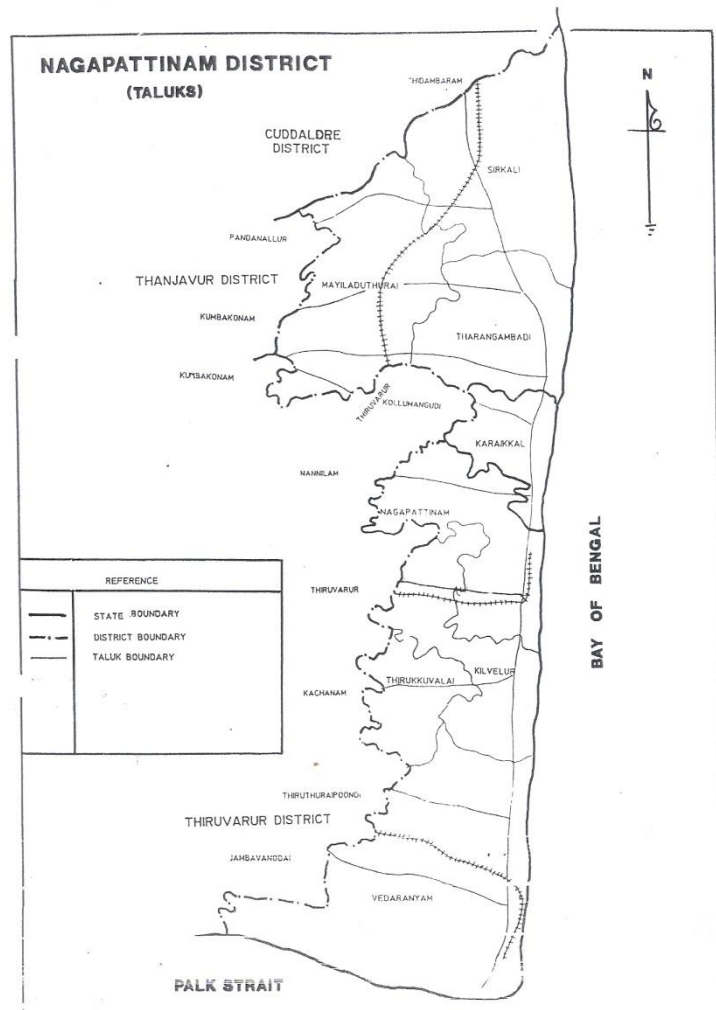


Figure 1 Location Map of Nagapattinam District

IV. METHODOLOGY

Database

Database comprises of primary and secondary data which are being collected from the study area and various government organizations. The following data are used in this study.

Primary Data

- Village maps
- Digitized Map with locations of water sample, Nagapattinam district
- Collection of water samples both ground water as well as pond water in the aquaculture pond during pre monsoon (28.09.2014 and 29.09.2014) and post monsoon (28.03.2015 and 29.03.2015)
- Socio economic data through questionnaires survey (20.04.2015)

Secondary Data

- Meteorological data

- Data on water quality parameters for Nagapattinam district obtained from Institute of water studies, Chennai (10 years data)
- Tangible and Intangible losses

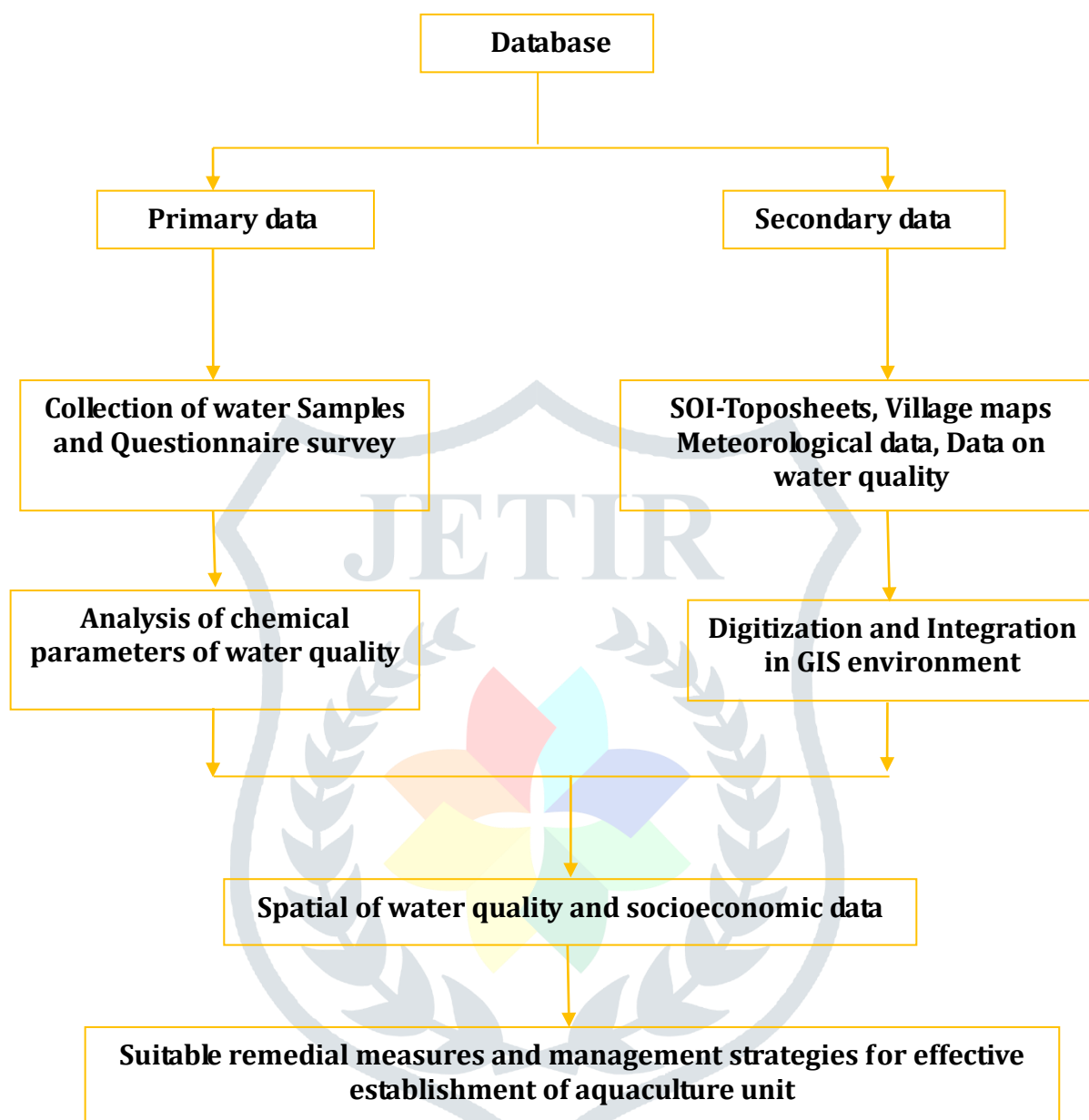


Figure 2 Flow chart showing the Methodology

V. RESULT AND DISCUSSION

Spatial Analysis of Water Quality

The samples were tested in Environmental laboratory of Civil Engineering Department, Annamalai University. The results of pre monsoon and post monsoon periods are given in Table 5-6 with tolerable limits proposed by ISS for drinking water quality and FAO irrigation standards. The spatial distribution of water quality is represented by using GIS Kirging techniques.

Interpretation of Water Quality

The results were compared with the limits proposed by FAO for suitability to use agriculture purposes and ISS for drinking purposes.

pH, DO, TDS, EC, Salinity, $\text{NO}_2^+\text{NO}_3^-$, SO_4 , Alakalinity, Pottasium, Cl, SAR, Na, Hardness

Social Impacts of Aquaculture

- The present chapter deals with the involvement and participation of the people in the protest against the impact of practice of aquaculture. A detailed study has been made by the use of questionnaires conducted with people at the study area of two important coastal villages in Nagapattinam District.
- The interviews were done using the two schedules.
- For those farmers who have sold their lands to aquaculture developers.
- For those who have not sold their lands but nevertheless suffer from the impacts of aquaculture.
- This chapter also presents some details of the officials view points and action as regards the impact of aquaculture.

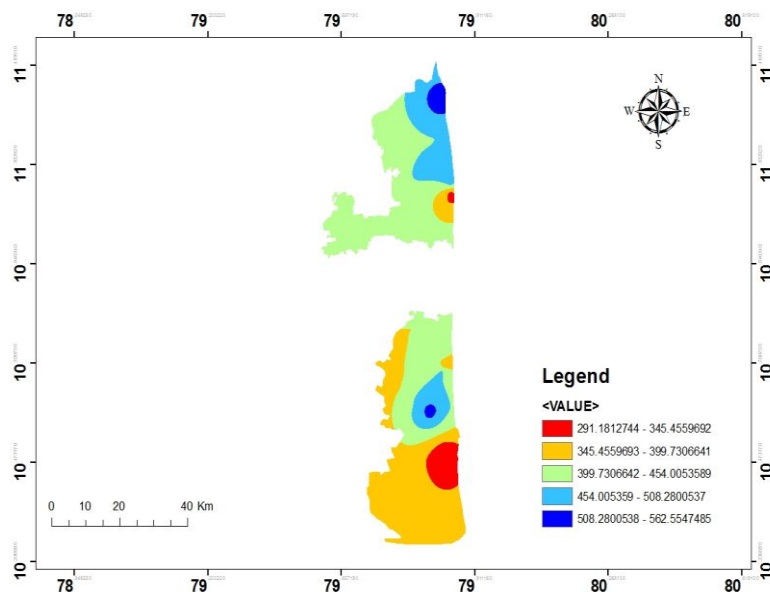


Figure 3 Concentration of Cl in Ground water during Pre-Monsoon period

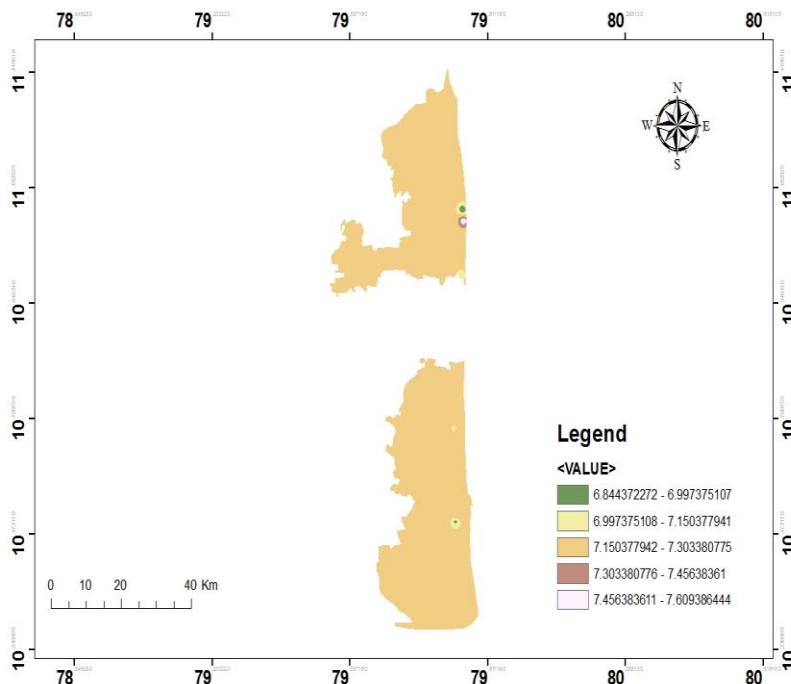


Figure 4 Concentration of pH in Ground water during Pre-Monsoon period

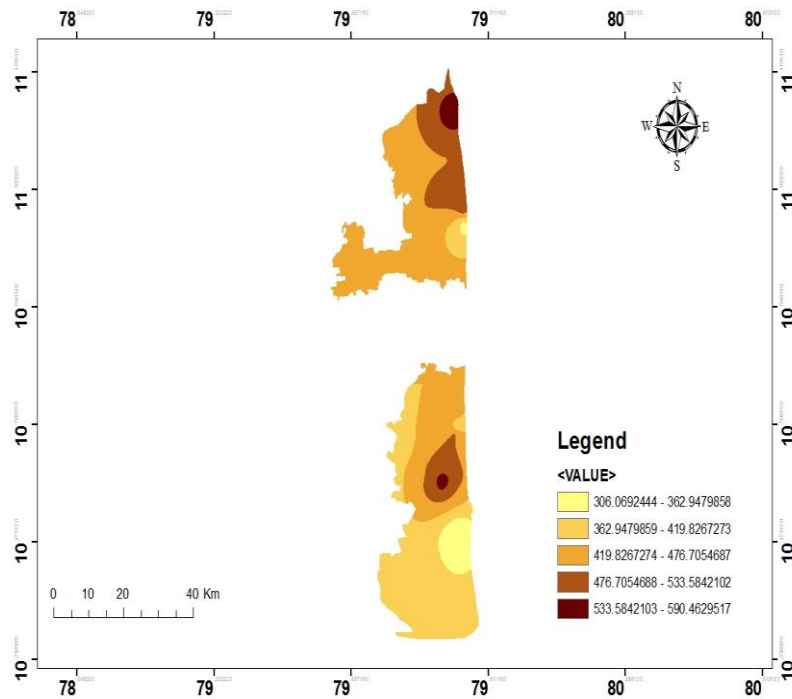


Figure 5 Concentration of Cl in Pond water during Post-Monsoon period

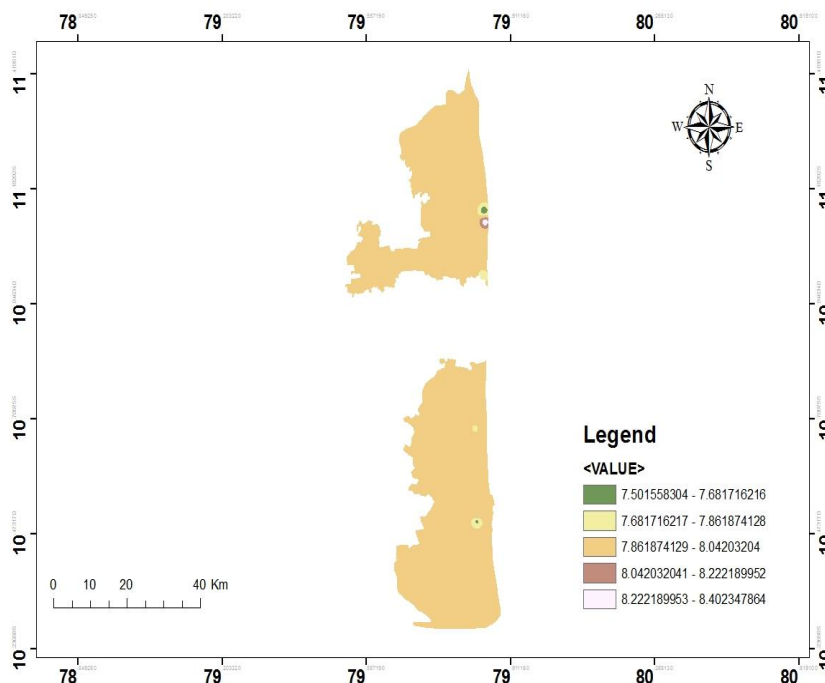


Figure 6 Concentration of pH in Pond water during Post-Monsoon period

VI. CONCLUSIONS

- In this study, the ground water samples and pond water samples from different locations of the study area of Nagapattinam district, Tamilnadu were collected during pre-monsoon and post-monsoon periods and their chemical parameters were analysed. The GIS-Kriging interpolation techniques were employed to understand the spatio-temporal variability of water quality parameters.

- The type and intensity of damage due to seepage of saline water from the ponds into the the natural system making unsuitableness for irrigation and drinking water system is deeply analysed in the study areas. The questionnaire reports were analysed for social impacts for the welfare of farmers and other persons.
- Ground water samples in the study area is not suitable for both irrigation and drinking purposes. Due to non availability of good quality water in the study area, people are compelled to use water from hand pumps and bore wells.
- Pond water samples in the study area is not suitable for irrigation purposes due to this higher salinity, higher SAR value, higher EC value.
- Officials generally confirms to the views that the aquaculture unit should be established at the maximum distance of 200m and more from agriculture field.
- Officials generally suggest that there is need to grow salt tolerant crops and making farmers aware of it. In their opinion, saline water needs to be treated for drinking purposes. Effluents from the shrimp farms must also be treated before disposal.

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