

ABSTRACT

Saurashtra is a peninsular region of Gujarat. Geographically Saurashtra has an extent of about 60,000 km² lying on the Arabian Sea coast. There are total 71 rivers flowing in all the directions from the central portion of the plate and meeting the sea. All these rivers are short in length and getting flashy flood. The permeable geological formations along Saurashtra coast have produced rich aquifers of sweet water in low rainfall region but the over-exploitation of groundwater has resulted into seawater intrusion.

The tidewater through creeks mixed up with groundwater has further deteriorated the quality of the groundwater. Because of erratic and irregular rainfall with frequent droughts, big gap between two consecutive rainfall during monsoon and lack of availability of freshwater for irrigation, farmers are compelled to use the poor quality of water to protect their crops which has resulted into damaging the soil structure. From 1971 to 1983 the area affected by seawater intrusion has increased from 34,624 ha to 8,09,400 ha. Approximately 10,79,733 people living in the 534 villages of the area (as per census 1981) were affected which has further resulted into the migration of people from their motherland.

In addition, with reference to geological condition, the availability of natural resources such as the Miliolite Limestone found in coastal belt is considered as the best in India so number of big cement and other soda ash chemical industries has been established in the coastal belt.

Looking to the alarming situation at all levels GoG (Government of Gujarat) has taken immediate action along the 160 km long coast between Madhavpur to Una and started construction of Seawater Intrusion Preventive (SIP) Structures to check the seawater intrusion into coastal aquifers and establish a special section known as Salinity Ingress Prevention Circle (SIPC) under the Irrigation Department to deal with the situation. The work was started in 80's. From that period onwards number of SIP structures like Tidal Regulators (12), Bandhara (17), Recharge Reservoirs (03), Recharge Tanks (06), Recharge Wells (389), Spreading Channels (55.20 km), Check Dams (546), Nala Plugs (4,487) have been constructed.

Before the implementation of these structures the seawater intrusion was found to be approximately 5.0 to 7.0 km inland from coast and rate of advancement of intrusion was judged approximately at 0.5

km/year. As these many structures have been constructed to check the seawater intrusion, it is necessity of the time to check the efficacy of these structures, assess their functional efficiency and temporal behaviour by scientific approach. It is necessary to develop simple and efficient method to check effectiveness of any structure.

In chapter 1, availability and demand of national and state level water resources with future projected availability & demand upto 2050, Seawater Intrusion, its causes, effects, basic principle, its prevention and control methods and finally objectives of the study is discussed.

As main objective of the study is to check the efficacy of seawater intrusion preventive structures, in chapter 2 – Review of Literature, extensive study of various seawater intrusion control schemes throughout world is carried out. In depth study of injection barrier constructed in Los Angeles & its effectiveness is studied. Moreover, monitoring methodology, literature survey of various kind of techniques adopted to combat seawater intrusion in the study area, usefulness of models in study of seawater intrusion and karstic geology has been studied. With all this in background suitable methodology is selected to develop the necessary parameters.

In chapter 3, detailed study of coastal Saurashtra has been done by studying and collecting the detail literature related to the physiography, geohydrology, geomorphology, drainage, rainfall pattern of at least last 20 years, geology and stratigraphic sequence. The data is presented graphically by maps.

A huge database pertaining to salient features of each and every structures, rainfall data from 1981 onwards, Index plan of major Seawater Intrusion Preventive Structures, Geohydrological details of all coastal talukas of Saurashtra, pre-monsoon and post-monsoon observations data for water level fluctuation and water quality for nearly 800 wells was collected. Moreover a Hercules task to observe water level fluctuation in observation wells and reservoirs for 3 years has been carried out. Finally to know geohydrology of the area surrounding the structures, pumping test has been done to get aquifer parameters. Moreover, daily rainfall data from 1998 onwards has also been collected to get number of rainy days, rainfall intensity etc. which is very much useful in determination of recharge rate of the structure under study.

For different structures recharge rate formulas have been developed in the chapter of analysis of Seawater Intrusion Preventive Structures. Moreover, to get impact of structure on water quality, geochemical ion ratio maps and graph correlating Chloride content

with Chloride to Carbonate and Bicarbonate Ratio has been developed. Also, Volume of water stored and volume of water recharged, % recharge efficiency has been worked out and it is found that these structures are having recharge efficiency ranging from 74% to 90%. Transition zone is found for some of the structures. Because of the availability of freshwater from the structures and wells for irrigation, the crop production has been increased upto 141% in this area.

This thesis clearly indicates that SIP structures are still effective after two decades and hence it is recommended to construct of such structures. Moreover it is recommended to construct spreading channel, radial channel and linking canal along the coastal strip so that static recharge barrier is available along the coastline and set back of seawater intrusion line is possible.

The outcome of the study will provide an insight of the existing situation and can also be used as an aid in decision making for planning issues such as issues related to remediation of the seawater intruded aquifer. The issues include attention towards impending salinity hazards.