

CENTRAL GROUND WATER BOARD
DEPARTMENT OF WATER RESOURCES,
RIVER DEVELOPMENT AND GANGA REJUVENATION,

MINISTRY OF JAL SHAKTI

GOVERNMENT OF INDIA



INCEPTION REPORT

**Groundwater contamination in Lakshadweep Islands: Detailed Mapping in
Amini and Minicoy Islands**

(NAQUIM-2.0)

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ABOUT STUDY AREA

The Lakshadweep Islands located off the western coast of India, have hydrogeological settings different from that of the mainland. These islands are almost entirely devoid of surface water resources, making groundwater the only natural source of freshwater for all uses. The Lakshadweep group consists of a string of 36 tiny islands of which only ten islands are inhabited. Each of the ten inhabited Islands will have a Dweep Panchayat. The detailed mapping studies with groundwater contamination have to be conducted in two inhabitant islands viz. Amini (2.60 Sqkm) and Minicoy (4.8 Sq Km) of U.T. of Lakshadweep. Amini is the third smallest island in the Lakshadweep archipelago whereas Minicoy Island, the southernmost and second-largest inhabited island. The entire Amini island area lies between 11°07' N latitudes and 72°44' E longitudes. Amini has submerged sand banks around the island (Amini-Pitti) which has a lagoonal area of 155.09 sq.km. Minicoy is the only major island that is located south of the nine-degree channel. Geographically, it is located at the latitude of 08°16' N and longitude of 73°03' E. It is a crescent-shaped island with an area of 4.80 sq.km, elongated in the N-S direction and has a vast lagoon on its western side that covers an area is 30.60 km². The base map of Amini and Minicoy islands is shown in Fig.1.

Geomorphologically, the islands have lagoonal beaches, beach ridges, sand dunes and hinterlands. The island is generally flat with localized depressions and sand mounds, which are largely man-made. The groundwater resource availability in these islands is restricted to the top few meters of the phreatic aquifers, composed of coral sands and coral limestone. The coral sands and the coral limestone form the principal aquifer in the island. Groundwater which is existing under phreatic conditions at a depth of 2 – 3 m below ground level is seen as a thin lens floating over and in hydraulic continuity with the sea water. The absence of surplus monsoon run off narrows down the options for water management to limiting extraction to sustainable levels and enhancing water use efficiency, apart from desalination of sea water.

Groundwater is extensively developed through dug wells, filter point wells, and traditional step-wells from the thin freshwater lens floating over the seawater. Groundwater in Amini and Minicoy islands are generally alkaline. The electrical conductivity (EC) ranges from 1180 to 13800 $\mu\text{S}/\text{cm}$ at 25° C in Amini islands and the EC values in Minicoy islands are generally in the range of 340 - 2500 $\mu\text{S}/\text{cm}$ at 25°C. The salinity is the highest of the southwestern part of the island where it is 12200 $\mu\text{S}/\text{cm}$ at 25°C.

Increasing demands of fresh water for a growing population have put the limited ground water resources in many of the islands under increasing stress. Unsustainable extraction of ground water, mainly to cater to the needs of increasing urbanization and life style changes .and improper sanitation have made the aquifers vulnerable to quality deterioration and sea water ingress in some of the islands. The anticipated impact of climate change is expected to have serious implications to the fresh water resources in these low-lying tiny islands. Proper management of the precious ground water resources in these islands is of paramount importance to ensure their long-term sustainability.

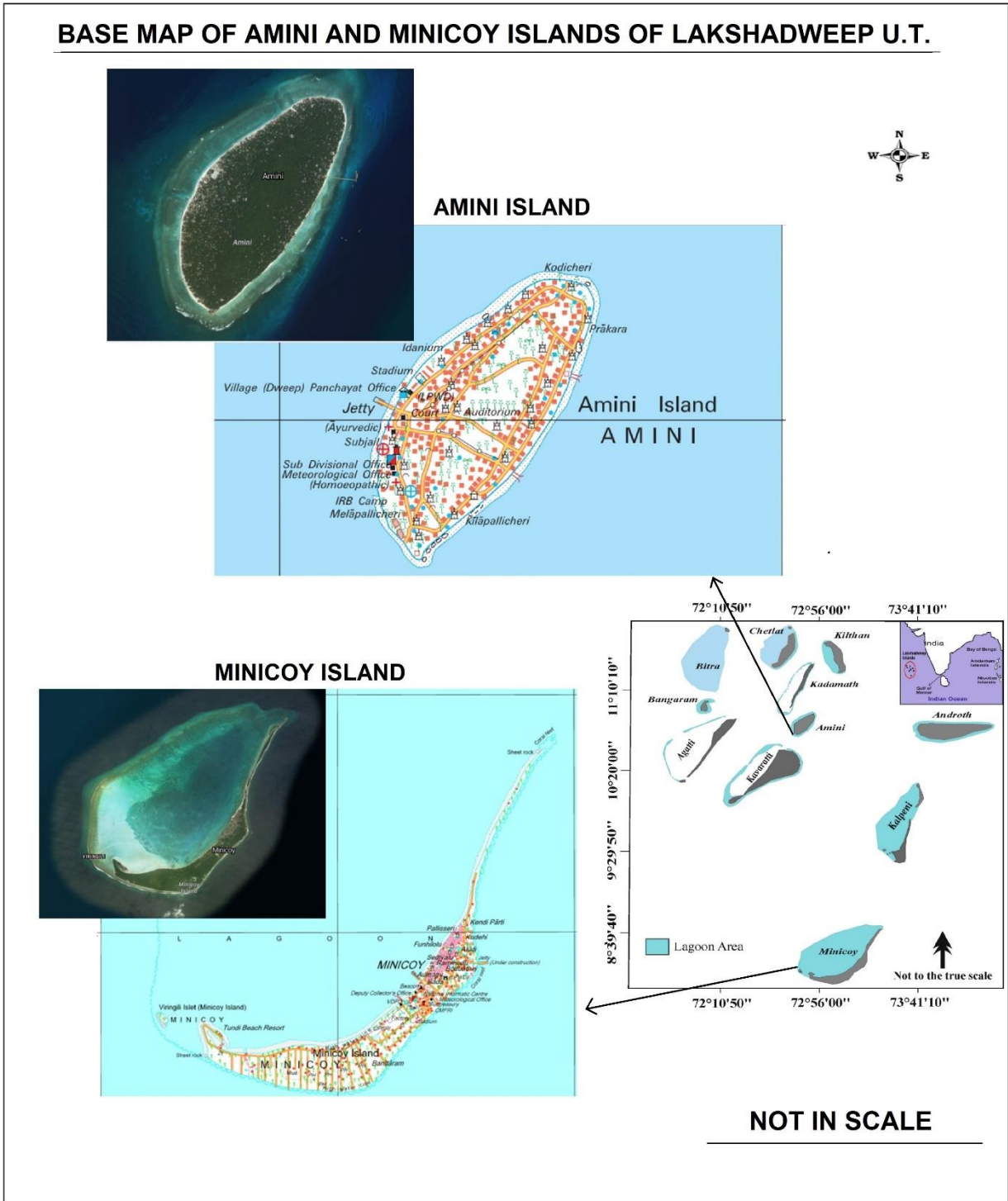


Fig.1 Base map of Amini and Minicoy Islands of Lakshadweep U.T.

Priority Types

- As per the request from District collector & Chairman of GEC ,Lakshadweep U.T. to taken up Groundwater pollution study in Amini & Minicoy islands.
- Groundwater contamination: Groundwater Quality in Habitations of Amini and Minicoy islands
- Aquifer Dispositions and aquifer wise groundwater levels
- Ground Water Quality Management Interventions including demarcation of safer aquifers.
- Identification of potential aquifers for drinking water supply and a plan for drinking water source sustainability

Previous Studies

Hydrogeological studies by Central Ground Water Board in Lakshadweep Islands dates back to 1978, when a reconnaissance investigation on the ground water resources of the of Union Territory of Laccadives, Minicoy and Aminidivi islands was carried out. In 1987, scientific investigations were taken up by the Board in Kavaratti Island to study the feasibility of water supply schemes as per directions of the Hon'ble High Court of Kerala. Based on detailed studies, it was suggested that extraction of large quantities of ground water from point sources was not feasible in view of the risk of up coning of saline water. All the inhabited islands except Bitra (0.1 sq.km) have been studied by Central Ground Water Board through systematic hydrogeological surveys and subsequently by micro level studies. Ground water Resources and Management in the Union Territory of Lakshadweep (Kavaratti, Agatti and Amini Islands), 1994. Ground water Resources and Management in the Union Territory of Lakshadweep (Androth and Minicoy Islands), 1995. Ground water exploration was carried out at five locations in Kavaratti Island down to the depth of 30 m below ground level through construction of zone wells tapping different aquifer zones at each site. Central Ground Water Board has also taken up implementation of three demonstrative rainwater harvesting schemes in Kavaratti Island through the Lakshadweep PWD under the Central Sector Scheme to popularize cost-effective techniques for water harvesting suitable for island conditions. Detailed mapping of aquifers of nine islands of the U.T of Lakshadweep is being taken up as part of the National Aquifer Mapping Programme of the Board during the XII Plan. This activity envisages delineation and characterization of aquifer zones and formulation of strategies for sustainable development of ground water for the islands. Ground water Resources and Management in the Union Territory of Lakshadweep (Kavaratti, Agatti and Amini Islands), 1994. Ground water Resources and Management in the Union Territory of Lakshadweep (Androth and Minicoy Islands), 1995. Ground water Resources and Management in the Union Territory of Lakshadweep (1997). Dynamic Ground Water Resources in Lakshadweep Islands, U.T of Lakshadweep as in 2009,2011 as per 1997 Methodology and in 2017,2020 and 2022 as per 2015 Methodology. The findings as per aquifer mapping study reveals that the hydrogeological conditions, problems, issues and its manifestations are identical in these islands with aspect ratio less than 0.5 are vulnerable to sea water mixing. The depth to water level is influenced by the tides. The water level fluctuation in these islands is significantly controlled by tides when compared to the ground water recharge and extraction. The fresh water lens in the Lakshadweep islands is fragile and the shape of islands plays a significant role on its occurrence and stability. Annual extractable resource of Amini is 53.86 ham and Minicoy Island is 79.47 ham. The percentage of groundwater utilization as on March 2022 in Amini Islands is 74.92 % (semi critical category). and Minicoy islands is 68.13 %. The quality variation is vertical, temporal and also lateral. Brackish water is present along topographic lows and in places where coarse pebbles and corals are

present. Important constraints in the sustainable development of the limited ground water resources in the Lakshadweep Islands include the absence of surface water resources in the islands putting stress on the limited ground water resources available, deterioration of ground water quality during summer months, rapidly increasing demands for drinking and domestic uses, indiscriminate ground water extraction at places, resulting in up-coning of saline water and consequent quality deterioration, lack of proper sanitation, resulting in large scale bacterial contamination. Burial places in the Island are potential microbial contaminant sources.

The indiscriminate extraction of ground water through electric pumps from tube wells needs to be regulated for protecting the limited water resources from salinization due to up-coning of seawater. The constitution of Lakshadweep Ground Water Authority under the Lakshadweep Ground Water (Development & Control) Regulation, 2001 needs to be expedited to achieve this objective. Pumping for water supply should be only from radial wells. Abandoned wells and pond are to be rejuvenated and protected and wells should not be converted into garbage disposal pit. Water supply through desalination plants is not to be taken as alternate source but it should be taken as supplementary source.

Objectives of the Present Study

- To identify the groundwater quality hotspots in Amini and Minicoy Islands of Lakshadweep U.T. (Bacteriological contamination, Basic Parameters and Heavy Metals)
- Identification of potential aquifers for drinking water supply
- A plan for drinking water source sustainability
- Ground water Quality Management Interventions including demarcation of safer aquifers. Relation of quality issues with land use, aquifers, rainfall etc.

Existing Data

Islands	EW/OW	VES	Monitoring Wells of LPWD	Water Quality of LPWD
Amini	0	VES-16	10	140
Minicoy	0	VES-0	10	25

LPWD: Lakshadweep Public Works Department

Data-Gap Analysis

Islands	EW/OW	VES/TEM/Profiling	Monitoring Wells	Water Quality
Amini	0	VES/TEM-10 Profiling-5	25	25
Minicoy	0	VES/TEM-15 Profiling-5	25	25

New Data Generation Plan

Month	Activity
May-2023	Pre-monsoon field work, key well establishment, water sample collection (for basic analysis, heavy metal and bacteriological study)
June-2023	Field data Collection, Sample Survey and users feedback, geophysical studies
July-2023	Data compilation and analysis: Preparation of Thematic maps, cross sections, Aquifer disposition etc
August-2023	Data validation and interpretation: Tabulation and correlation of hydrogeological and geophysical data of existing wells.
September-2023	Analysis and interpretation of chemical and geophysical data
October-2023	Analysis and interpretation of chemical and geophysical data and Mid-term review
November-2023	Post-Monsoon field data collection
December-2023	Data Analysis and Draft Report Preparation: Field work for verification and users feedback. Chemical Analysis of the post monsoon water samples (collected from selected wells for confirmation of issues)
January-2024	Preparation of groundwater management plans for source sustainability and Report preparation
February-2024	Field checks and Finalization of Report
March-2024	Sharing of the report.

Composition of the Team

Team Member	Name & Designation	Responsibility
Team leader	Sh.Roopesh G.Krishnan, Sc. C (HG)	<ul style="list-style-type: none">-Planning, Supervision and Execution of the Project- Work distribution and monitoring of activities of other team members- Preparation of the inception report.- Timely Delivery of the envisaged Outputs- Finalization of the management plan- Presentations at different forums, sharing of the outputs.- Preparation of the draft report as per the approved Quality Standards and its Final Submission.- Other members of the team will assist the team lead.
Team Member	Sh.Roopesh G.Krishnan, Sc. C (HG)	<ul style="list-style-type: none">- Field Data Collection- Sample collection for quality studies- Secondary Data collection-Entering data in database (WIMS)

		<ul style="list-style-type: none"> -Integration of data, preparation of thematic maps, preparation cross sections etc. -Consultation with allied experts like agriculture, irrigation etc. - Preparation of GIS maps and Management Plan
Team Member	Dr. N. Aneesh Kumar, (Asst. Chemist)	<ul style="list-style-type: none"> - Sample collection for quality studies - Analysis of samples. - Integration with existing data -Validation and interpretation of data - Entering data in database (WIMS) -Preparation of Tables, graphs and maps for reports - Assisting the Team Lead in preparing the reports
Team Member	Sh. V S T Gopinath, Sc. C (GP)	<ul style="list-style-type: none"> - Field Geophysical Surveys - Interpretation of field data - Entering data in database (WIMS) - Integration with existing geophysical and lithology data - Preparation of inferred lithologs, fresh- saline interface. - Suggesting potential sites for construction of water wells/artificial recharge - Preparation of Tables, graphs and maps for reports - Assisting the Team Lead in preparing the Report

Team-Member wise Monthly Target

Month	Activity	Name of the Officer
May-2023	Pre-Monsoon field work, key well establishment, water sample collection (for basic analysis, heavy metal and bacteriological study)	Sh. Roopesh G.Krishnan, Sc. C (HG) & Dr. Aneesh Kumar N, (Asst. Chemist)
June-2023	Collection of secondary data from State and Central Govt. Offices. Field data Collection, Sample Survey, geophysical studies	Sh. Roopesh G.Krishnan, Sc. C (HG) Sh. V S T Gopinath, Sc. C (GP) & Dr. Aneesh Kumar N, (Asst. Chemist)
July-2023	Data compilation and analysis: Preparation of Thematic maps, cross sections, Aquifer disposition etc	Sh. Roopesh G.Krishnan, Sc. C (HG) & Sh. V S T Gopinath, Sc. C (GP) Dr. Aneesh Kumar N, (Asst. Chemist)

August-2023	Data validation and interpretation: Tabulation and correlation of hydrogeological and geophysical data of existing wells.	Sh. Roopesh G.Krishnan, Sc. C (HG) & Sh. V S T Gopinath, Sc. C (GP) Dr. Aneesh Kumar N, (Asst. Chemist)
September-2023	Analysis and interpretation of chemical and geophysical data	Dr. Aneesh Kumar N, (Asst. Chemist) Sh. V S T Gopinath, Sc. C (GP)
October-2023	Analysis and interpretation of chemical and geophysical data and Mid-term review	Sh. Roopesh G.Krishnan, Sc. C (HG) & Sh. V S T Gopinath, Sc. C (GP) Dr. Aneesh Kumar N, (Asst. Chemist)
November-2023	Post-Monsoon field data collection	Sh. Roopesh G.Krishnan, Sc. C (HG) & Sh. V S T Gopinath, Sc. C (GP) Dr. Aneesh Kumar N, (Asst. Chemist)
December-2023	Data Analysis and Draft Report Preparation: Field work for verification and sample surveys and users feedback. Chemical Analysis of the post monsoon water samples (collected from selected wells for confirmation of issues)	Sh. Roopesh G.Krishnan, Sc. C (HG) & Dr. Aneesh Kumar N, (Asst. Chemist)
January-2024	Preparation of groundwater management plans for source sustainability and Report preparation	Sh. Roopesh G.Krishnan, Sc. C (HG) & Dr. Aneesh Kumar N, (Asst. Chemist)
February-2024	Field checks and Finalization of Report	Sh. Roopesh G.Krishnan, Sc. C (HG) & Dr. Aneesh Kumar N, (Asst. Chemist)
March-2024	Sharing of the report.	Sh. Roopesh G.Krishnan, Sc. C (HG)