



Evaluating the Technical Feasibility of Introducing Thalassotherapy to Promote Tourism in the Southern Province of Sri Lanka

N.Y.S. Premarathna¹, S. Munasinghe^{2*}, U.H.G. Rorigo³, and G.D.H. Dharmasooriya⁴

¹*Provincial Ayurveda Department, Southern Province, Sri Lanka*

²*Department of Tourism Management, Faculty of Management Studies, Sabaragamuwa University of Sri Lanka*

³*Faculty of Geomatics, Sabaragamuwa University of Sri Lanka*

⁴*Faculty of Indigenous Medicine, University of Colombo, Sri Lanka*

Received 7 July 2025

Revised 9 October 2025

Revised 17 November 2025

Accepted 19 December 2025

Abstract

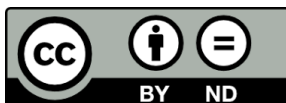
Although Sri Lanka is renowned for its rich wellness tourism offerings, including Ayurveda, yoga, and meditation, a pilot survey of 30 Ayurveda practitioners across Sri Lanka revealed a notable absence of thalassotherapy practices using seawater. This indicates a market gap for this wellness service. Therefore, this research adopts a feasibility assessment framework (FAF) based on the Project Domain Framework (PDF) to evaluate the technical feasibility of introducing Thalassotherapy in southern Sri Lanka, while accounting for essential environmental and infrastructural requirements. A systematic approach was employed, incorporating a preliminary investigation, reference standard assessments, Geographic Information System (GIS)-based site selection, and field verification. The findings indicate that the three locations identified (Yala, Dickwella, and Koggala) possess the necessary environmental and seawater conditions to support thalassotherapy, with some modifications required. The Southern Province of Sri Lanka has strong potential for Thalassotherapy-based tourism. Furthermore, Yala is the most suitable location, whereas Dikwella can be improved by implementing pollution-control measures. Koggala currently does not meet the required standards, but can be developed in the long term with proper interventions. The findings of this research have implications in introducing Thalassotherapy to the Sri Lankan bundle of wellness tourism products.

Keywords: Thalassotherapy, Tourism, Sri Lanka, Technical Feasibility, Wellness Tourism, Health Tourism

*Corresponding author: sarath@mgt.sab.ac.lk

ORCID: <https://orcid.org/0000-0001-7898-6242>

South Asian Journal of
Tourism and Hospitality
© Faculty of
Management Studies
Sabaragamuwa
University of Sri Lanka
ISSN: 2756-911X



Articles in SAJTH are licensed under a Creative Commons Attribution-No Derivatives 4.0 International License (CC BY-ND 4.0). This license allows reusers to copy and distribute the material in any medium or format in unadapted form only so long as attribution is given to the creator.

INTRODUCTION

Thalassotherapy, derived from the Greek words "Thalassa" (meaning "sea") and "therapeia" (meaning "treatment"), refers to the therapeutic use of seawater and marine products such as algae, mud, and sand for health and wellness (Smith, 2010; Munteanu & Munteanu, 2019). This practice has been historically popular in coastal regions of Europe, particularly in France, where it has been integrated into both wellness and medical treatments (Johnson & Brown, 2012). The therapeutic benefits of thalassotherapy are widely documented, including improved skin conditions, reduced stress, and enhanced respiratory and circulatory health (Martin, 2011).

Globally, thalassotherapy has evolved into a significant niche within the wellness tourism industry, attracting millions of tourists annually. Studies have shown that wellness tourists often spend more than the average tourist, with thalassotherapy centres becoming key attractions in destinations like the French Riviera, Spain, and Tunisia (Hall, 2014). The economic benefits of integrating thalassotherapy into the tourism sector are substantial, contributing not only to direct revenue but also to the broader development of coastal regions (Jones, 2015).

The Southern Province of Sri Lanka is known for its pristine beaches and diverse marine life, making it a prime tourist destination. However, while beach tourism is already well-established, there is a growing need to diversify the tourism offerings, including health and wellness tourism (Fernando, 2017). The Sri Lankan government has identified wellness tourism as a potential growth area, with initiatives to develop Ayurveda-based tourism (Kumar, 2018).

The introduction of thalassotherapy in the Southern Province of Sri Lanka represents a promising opportunity to enhance the region's tourism appeal. By leveraging its natural coastal resources and integrating thalassotherapy with existing wellness offerings, Sri Lanka could attract a new

segment of high-spending tourists, thereby contributing to economic development. Therefore, the objective of this study is to assess the technical feasibility of this initiative and to develop a comprehensive strategy for its implementation, if such studies prove its feasibility. The study area includes the coastal belt stretching from the Galle to Hambantota districts, covering a distance of 150km.

LITERATURE REVIEW

Thalassotherapy is an emerging facet of health tourism worldwide, particularly in countries situated along coastlines and near the sea (Munteanu & Munteanu, 2019). The therapeutic applications of seawater trace their origins to ancient Egypt and are underscored by a longstanding tradition across numerous cultures. Thalassotherapy encompasses a wide array of practices, including not only immersion in seawater but also the utilisation of seaweed and sand baths, exposure to sunlight, inhalation of marine aerosols, and any controlled interaction with marine ecosystems and their inherent elements aimed at promoting health (Antonelli & Donelli, 2021). Key minerals such as magnesium, calcium, potassium, sodium, and iodine are absorbed through the skin, enhancing circulation, detoxification, and vitality (Palasiet, 2023). Warm seawater baths dilate blood vessels, improve blood flow, and ease joint and muscle pain, benefiting conditions like arthritis and fibromyalgia (Fluidra, 2024). The mineral-rich environment also supports skin hydration, elasticity, and repair, while iodine and sodium chloride provide antiseptic effects, aiding wound healing and soothing eczema or psoriasis (Springer, 2024). Additionally, magnesium calms the nervous system, reducing stress and improving sleep, while iodine supports thyroid balance and metabolism (Sofitel Accor, 2024). Marine extracts, such as algae and mud, provide antioxidants and bioactive molecules that enhance immunity and cellular health. Collectively, thalassotherapy combines relaxation, musculoskeletal support, skin

regeneration, and endocrine regulation, making it a holistic therapy for improving physical and emotional well-being. While France is the birthplace of modern thalassotherapy centers, its methods and practices have transcended national boundaries, with centers established in countries such as Egypt, Morocco, Tunisia, Spain, Portugal, Italy, Greece, Crete, the Canary Islands, the Balearic Islands, Romania, Bulgaria, Ukraine, Russia, Albania, Turkey, Poland, Jordan, Malaysia, Thailand, and Japan (Forsyth, 2000). There are 276 thalassotherapy hotels and centres across 30 countries.

Existing research on the feasibility of thalassotherapy highlights environmental, regulatory, and cultural factors across different regions. In a global context, the Global Wellness Institute in 2018 identified seawater purity, mineral concentration, and stable climatic conditions as essential environmental prerequisites for thalassotherapy, drawing on evidence from Mediterranean and European coastal practices. Standardisation and safety have also been addressed through international guidelines such as ISO 17680:2022, developed by the Sri Lanka Standards Institution, which underscores the need for structured protocols in spa and wellness services. Regionally, the University of the West Indies Health and Wellness Consultancy Team (2020) conducted studies in the Caribbean, emphasising that successful adoption requires alignment with local environmental resources and cultural practices. Furthermore, in Uganda and other African contexts, Ssegawa and Muzindaba (2021) proposed the Feasibility Assessment Framework (FAF) to evaluate technical, financial, and social aspects of wellness and development projects. Collectively, these country-specific insights demonstrate that feasibility research on thalassotherapy must integrate environmental, clinical, and socio-cultural considerations to ensure practical and sustainable implementation.

Health tourism is a broad category that includes both medical and wellness tourism; the latter is more specialised. Medical tourism focuses on specific medical procedures, whereas wellness tourism focuses on holistic well-

being and preventive care (Connell, 2006; Bookman & Bookman, 2007; Lunt et al., 2011; Voigt et al., 2011; Smith & Puczko, 2014). Health Tourism, a segment of tourism, is primarily driven by the need for medical treatment, often involving travel across borders. It includes medical tourism, where individuals travel to receive specific medical, dental, or surgical care that might be unavailable, more expensive, or less timely in their home countries. Additionally, health tourism encompasses other forms of therapy and rehabilitation services aimed at treating specific health conditions. For instance, individuals may travel for spa therapies that address physical ailments or specialised facilities offering treatments such as Thalassotherapy, which utilises seawater and marine resources for therapeutic purposes (Connell, 2006; Smith & Puczko, 2014). Wellness Tourism differs from health tourism; it is more preventive in nature, focusing on maintaining or improving overall well-being. It involves activities that promote physical, mental, and spiritual health, such as yoga retreats, meditation sessions, spa treatments, and nutritional guidance. Wellness tourists seek to enhance their quality of life through experiences that promote relaxation, stress reduction, and a healthy lifestyle. This form of tourism is often linked with holistic approaches that integrate body, mind, and spirit, and it is increasingly popular among individuals looking to rejuvenate and disconnect from their daily routines (Voigt et al., 2011; Global Wellness Institute, 2020).

Sri Lanka, an island in the Indian Ocean, is renowned for its stunning beaches, rich biodiversity, and cultural heritage. Moreover, wellness tourism is well-established in Sri Lanka due to its status as a Buddhist country and its traditional Ayurvedic health system (Ranasinghe & Deyshappriya, 2010). Currently, the tourism sector in Sri Lanka is expanding primarily in the Southern province; however, there is a noticeable lack of focus on diversifying into wellness tourism.

Sri Lanka offers a myriad of health tourism products to both domestic and international tourists. These include physical fitness programs, relaxation techniques, meditation practices, beauty treatments, nutritious cuisine, and holistic well-being practices, with a strong emphasis on its renowned Ayurvedic treatments and Yoga traditions (Niluka & Kottage, 2021). The Southern Province of Sri Lanka spans approximately 200 kilometres, with its coastal belt extending about 150 kilometres. This region includes a multitude of beaches and coastal attractions and is geographically comprised of the districts of Galle, Matara, and Hambantota (Sri Lanka Tourism Development Authority, 2020)

Despite the nation's abundant marine resources, thalassotherapy has not received sufficient attention from researchers or other stakeholders, and there is a noticeable lack of studies examining the feasibility of establishing thalassotherapy centres in Sri Lanka. Despite the extensive wellness offerings available at health clinics, Ayurveda resorts, hotels, and spas across the country, thalassotherapy remains notably absent from Sri Lanka's health tourism portfolio. This oversight is surprising, given the country's considerable potential to support such initiatives. This research identifies this gap as both an empirical and a knowledge void within the context of Sri Lankan tourism. Accordingly, the overall purpose of this study is to assess the feasibility of introducing thalassotherapy as a health tourism product in three selected coastal regions of Sri Lanka. Therefore, these insights may be instrumental in facilitating the implementation of wellness tourism in these regions as a viable alternative to the prevailing intensity of traditional tourism activities (Tourism, 2022). Offering marine healing programs and facilities that align with consumer preferences is crucial for developing the marine healing tourism industry, especially for citizens unfamiliar with this sector. Such alignment significantly influences travellers' decision-making when selecting travel products, potentially encouraging repeat visits to thalassotherapy centres (Chae & Lee, 2024).

RESEARCH METHODOLOGY

This feasibility study followed the Feasibility Assessment Framework (FAF), developed based on the Project Domain Framework (PDF), which guides the development of a project business case (Ssegawa & Muzindab, 2021). This framework suggests assessing feasibility across five generic areas known as TELOS (technical, economic, legal, operational, and schedule), as indicated below. The sequencing of areas in the list does not necessarily prescribe that the assessment proceeds linearly.

- Technical - Assess alternatives for buildability, functionality/performance, reliability/availability, capacity and maintainability.
- Economic- Assess whether benefits exceed costs using appraisal methods (e.g. CBA, breakeven, NPV, IRR or payback).
- Legal- Determine project's ability to surmount various regulatory and ethical requirements (e.g. EIA, permits, etc.)
- Operational- Determine the project's synergetic environmental fitness (e.g. culture, structure, systems, policies and stakeholder acceptance).
- Schedule- Assesses whether the alternative/options can be completed within the desired or mandatory time

This research holds that technical feasibility is the essential component to be assessed before other areas of feasibility. Accordingly, a technical feasibility study was conducted to evaluate the primary criteria to be met to assess the possibility of introducing Thalassotherapy in the geographical area concerned. The technical areas assessed in the study were guided by the standards set by the following documents.

1. Water quality assessment – SLS ISO 17680: 2022 (ISO 17680: 2015)
2. Meteorological data assessment - UWI Health and Wellness Consultancy Team - Development of Standards for the Regional Health and Wellness Sector

A systematic approach, including site selection, environmental assessment, and water quality analysis, was used to establish a sound evaluation framework. The following steps were taken along the process.

Preliminary Investigation

A preliminary study was conducted to assess the availability of thalassotherapy-related services for tourists in Sri Lanka. A group of 30 Ayurvedic doctors was selected from across Sri Lanka, representing diverse age groups and categories. Among them were lecturers, government and private-sector Ayurvedic medical officers, and doctors working in Ayurvedic Spas. An online Google form was sent to collect data. The results showed that thalassotherapy is not practised anywhere using seawater and, although treatments are performed in some places using mud, sand and algae, such practices are not classified as thalassotherapy.

Choosing Locations through a GIS application

Optimal locations were identified using a GIS-based analytical system, guided by a multi-criteria evaluation framework. The selection criteria included the following;

- Land areas within 1 km of the coastline with sufficient vacant or bare land for necessary infrastructure
- Emphasis was given to choosing non-polluted seawater with low sediment levels
- Ideally situated approximately 500 meters offshore
- Away from major urban centres.

This GIS-based analysis identified three sites as the most feasible locations. The location identification process consisted of several stages as described in the following sections.

Satellite Image Selection and Downloading

The first step was to select appropriate Sentinel-2 (2A) satellite images. These images were downloaded from the Copernicus Open Access Hub. The

selection criteria were:

- Images with low precipitation dates to reduce interference from rain-related sediment disturbances.
- Images with cloud cover less than 15% for better visibility.
- Time periods of January, February, March, July, and August 2024, as these months generally have favourable weather conditions in the southern region of Sri Lanka.

The selected images sufficiently covered the southern coastline of Sri Lanka.

Band Extraction

After the satellite images were downloaded, Bands 3 (green) and 4 (red) were extracted from each image using the study area shapefile. These bands were considered critical for sediment analysis as they highlighted water clarity and sediment presence. The shapefile was used to clip the relevant area of interest along the southern coastline, as shown in Figure 1.

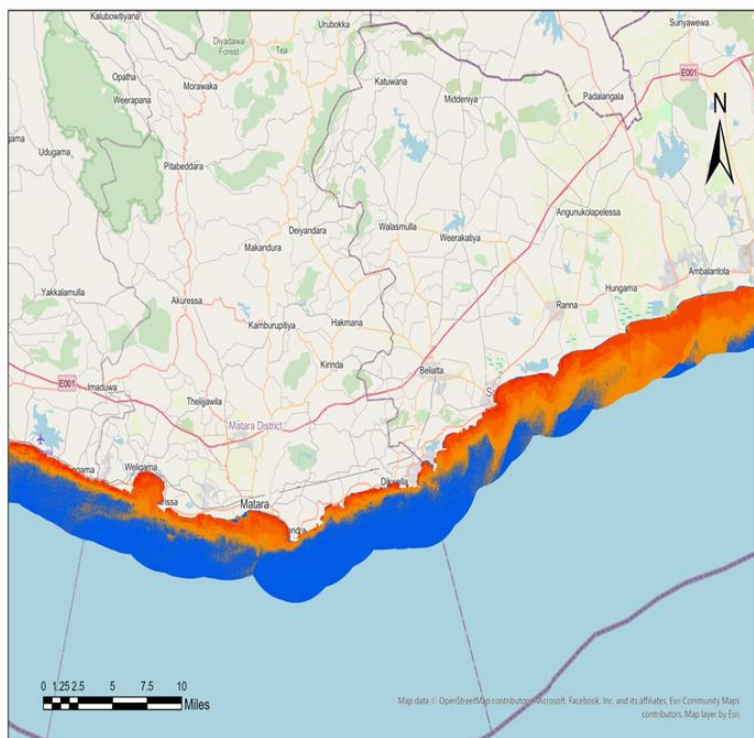


Figure 1: The study area

Source: Adapted from OpenStreet base maps (2025)

Sediment Index Calculation

Using ArcGIS Pro software, the sediment index formula was applied:

$$\text{Sediment Index} = (B3 - B4) / (B3 + B4)$$

B3:-Band 3 (Green Band)

B4:-Band 4 (Red Band)

This calculation was performed using the Raster Calculator tool for each of the six satellite images. The sediment index values helped identify areas with low sediment concentration.

Identification of Suitable Areas

The resulting sediment index maps displayed sediment concentration levels. Areas with lower index values were identified as potential zones with low sediment concentration. These areas were filtered further to ensure they were within 500 meters of the southern coastline. Accessibility to these areas from the coastline was also considered, as shown in Figure 2. Based on the results, three suitable areas were identified:

- One location near Nilwella, Sri Lanka.
- Two locations near Yala National Park.



Figure 2: Suitable places

Source: Adapted from OpenStreet base maps (2025)



Figure 3: Detailed map of the identified areas

Source: Adapted from OpenStreet base maps (2025)

Detailed maps of the identified areas were created using ArcGIS Pro. These maps were used to highlight the suitable zones and their proximity to the coastline. To facilitate fieldwork, the shapefiles for these areas were converted to KML format. The KML files were opened in the Google Earth mobile application to enable visualisation and navigation to the exact locations in the field.

Field Verification and Sample Collection

Using the Google Earth mobile application, the identified locations were navigated to. The field verification process involved:

- The longitude and latitude coordinates of the three suitable places were extracted for navigation.
- The locations were visited to ensure they were accessible and met the criteria for seawater quality.

For this study, seawater analysis was conducted to facilitate thalassotherapy

research, necessitating the collection of samples from relatively deep marine environments. Accordingly, three sampling locations were identified using GIS, and those sites were visited on December 16, 2024, as shown in Figure 3.

The first sampling site (Site-1) was situated approximately 300 meters offshore near the Dikwella coastline in Sri Lanka. Seawater was collected from a depth of 9.5 meters using a specialised Water Sampler. The standard method for obtaining seawater for thalassotherapy is from a depth of 9-10 meters. The second and third sites were initially selected as two distinct locations along the Yala seashore, approximately 10 kilometres apart. However, upon in-situ assessment, it was determined that both locations exhibited similar environmental conditions and terrestrial influences, rendering them effectively indistinguishable for this study. Consequently, sample collection was restricted to a single, optimal site within the Yala region (Site-2).

For the third sampling location, surface seawater was collected from a point 3 meters offshore near the Koggala coastline (Site-3). This site, characterised by a high sediment load, was selected through GIS analysis and served as a comparative sample representing the Galle district.

First Sample:

- Latitude and longitude location: 5°57'27.09"N,80°43'26.10"E
- Location: Near Nilwella, Dickwella, Sri Lanka
- Distance from coastline: Approximately 300 meters.
- Quality: Low sediment concentration as identified through analysis.

Second Sample:

- Latitude and longitude location: 6°17'38.60"N,81°27'10.59"E
- Location: Between the two suitable areas near Yala National Park, Sri Lanka
- Distance from coastline: Approximately 600 meters.
- Quality: Low sediment concentration and good accessibility.

Comparison Sample:

- Latitude and longitude location: 5°59'8.96"N,80°19'37.12"E

- Location: Koggala Beach.
- Distance from coastline: 3 meters.
- Purpose: To compare the quality of seawater from areas with high sediment concentration to those with low sediment concentration.

Selection of parameters for Thalassotherapy

The evaluation was based on SLS ISO 17680:2022, Tourism and Related Services – Thalassotherapy Service Requirements. However, as this document does not provide specific standards for meteorological data reference ranges, the team referred to the Global Wellness Institute (GWI) Guide to Hydrothermal Spa & Wellness Development Standards, 3rd Edition.

Meteorological data collection

Meteorological data for this study were primarily sourced from the Sri Lanka Meteorological Department. The data obtained was officially certified, ensuring its reliability and accuracy for analysis. This certification process ensures that meteorological records adhere to standardised data collection protocols, thereby enhancing their credibility for scientific and research applications.

Environmental parameters are vital for effective thalassotherapy. Rainfall (50–150 mm/month) maintains salinity and treatment continuity, though excess disrupts outdoor therapies (Global Wellness Institute, 2018; Medici et al., 2019). Humidity between 50% and 70% supports respiratory health, with maritime climates averaging 70%–80% (Nesbitt et al., 2014). Optimal wind speeds (3–5 m/s) and sea-to-shore directions aid marine aerosol dispersion (Nesbitt et al., 2014). Air temperatures of 20°C–30°C enhance relaxation, circulation, and therapeutic response (SpringerLink, n.d.; Global Wellness Institute, 2018). Adequate sunlight exposure facilitates vitamin D synthesis, regulates calcium metabolism, and improves bone and muscle recovery (Holick, 2004; Global Wellness Institute, 2018).

Secondary Data collection of meteorology

In the initial phase of this research, five years of monthly rainfall data (2019–2024) were analysed to identify periods of minimal precipitation. This analysis facilitated the selection of months with the lowest sediment levels, ensuring optimal conditions for water quality assessment. Given the research submission timeline, sampling was constrained to December and January. While December typically records lower rainfall in Galle and Tangalle (Matara District), Hambantota experiences even less precipitation in January (Table 1).

Table 1: Rainfall data (Humidity)

Monthly Rainfall/mm													
Station name	Yr	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TANGALLA	2019	19.3	9.3	69.7	56.2	105.6	65.5	110.6	235.8	373.1	410.7	174.7	119.8
TANGALLA	2020	5.4	3.6	20.1	121.7	154	NA	NA	NA	NA	NA	NA	NA
TANGALLA	2021	98.2	38.2	170.3	47.4	167.7	94.2	167.1	69.2	267.3	248.9	186.6	105.3
TANGALLA	2022	9.2	37.6	56.1	88.2	167.8	133.3	124.5	69	21	123.2	175.1	74.5
TANGALLA	2023	57	156.2	47.7	123.3	187.2	61.6	58	124.6	663.3	488	182.5	318.1
TANGALLA	2024	136.4	15.6	43.2	2.1	176.6	287.1	67.2	196.8	189.5	NA	NA	NA
GALLE	2019	27.7	120.7	148.2	88.4	269.8	177.4	124.5	426	592.6	604.3	309.4	135.3
GALLE	2020	44.2	27.4	17.7	182.5	314.4	138.2	311.3	164.9	448.8	160.2	233.3	155.1
GALLE	2021	195.8	15.4	122.4	407.5	294.8	215.4	202.1	140	140.8	216.2	473.7	210.6
GALLE	2022	72.9	118.1	144.2	257	505.8	192.7	61.5	184.4	74.6	749.9	162.3	190.4
GALLE	2023	91.1	277.6	230.3	134.2	320.6	240.6	129.4	187	695.2	833.7	394.3	408.2
GALLE	2024	275.2	30.7	64.7	171.7	455	178.9	362.3	342	145.1	550.4	317.5	NA
HAMBANTOTA	2019	1.6	100.1	4.2	79.1	50.6	29.5	28.6	164.5	460.3	363.1	197.3	255.2
HAMBANTOTA	2020	16.2	29.2	7	91.8	25.9	44.2	91.8	68	164.4	11.7	101.5	65.8
HAMBANTOTA	2021	75.5	2.3	111.7	29.7	122	23.2	112	54.5	81.3	160.7	229.2	205
HAMBANTOTA	2022	21.3	15.8	99.3	108.7	NA	41.7	85.5	20.3	5.5	42.6	144.1	80.9
HAMBANTOTA	2023	72.4	138.4	23.3	40.4	104.8	3.7	10.2	30.1	468	508.6	238.1	403.9
HAMBANTOTA	2024	187.7	8.1	43.2	26.7	96.6	79.3	32.2	106.6	66.5	154.4	NA	NA

Source: Sri Lanka Meteorological Department (2025)

Data collected from the Galle and Hambantota meteorological centres in Sri Lanka on the monthly minimum and maximum humidity are shown in Table 2.

Table 2: Humidity data

Monthly Rh (Relative Humidity) max & Min (values in %)														
Station name	abbreviation	yyyy	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GALLE	RHMAX	2019	90	88	86	87	86	85	85	89	89	92	91	91
GALLE	RHMAX	2020	86	82	84	89	NA	87	90	89	91	89	NA	90
GALLE	RHMAX	2021	91	88	88	86	89	87	87	89	91	89	88	90
GALLE	RHMAX	2022	87	87	88	88	NA	87	90	91	89	90	89	90
GALLE	RHMAX	2023	89	89	89	89	88	89	90	86	90	86	94	93
GALLE	RHMAX	2024	89	85	86	89	90	88	89	88	86	NA	NA	NA
GALLE	RHMIN	2019	79	78	74	76	82	82	80	85	80	84	80	80
GALLE	RHMIN	2020	74	71	70	76	85	83	85	84	86	84	79	80
GALLE	RHMIN	2021	82	78	76	78	82	83	85	87	85	83	84	78
GALLE	RHMIN	2022	77	78	79	81	NA	83	85	86	85	84	79	80
GALLE	RHMIN	2023	80	79	78	78	83	85	86	81	86	83	83	83
GALLE	RHMIN	2024	79	73	73	77	84	85	84	84	82	NA	NA	NA
HAMBANTOTA	RHMAX	2019	83	87	86	87	89	88	88	91	91	93	93	NA
HAMBANTOTA	RHMAX	2020	87	86	86	88	88	87	88	89	90	89	89	88
HAMBANTOTA	RHMAX	2021	90	84	88	87	88	87	88	89	91	89	90	89
HAMBANTOTA	RHMAX	2022	87	83	87	88	NA	89	86	90	88	85	88	88
HAMBANTOTA	RHMAX	2023	85	86	88	86	89	88	88	87	91	94	93	94
HAMBANTOTA	RHMAX	2024	91	87	89	88	91	90	91	91	91	NA	NA	NA
HAMBANTOTA	RHMIN	2019	69	74	72	74	80	77	76	82	82	83	81	81
HAMBANTOTA	RHMIN	2020	73	72	71	74	79	75	75	79	81	83	77	76
HAMBANTOTA	RHMIN	2021	79	70	73	73	76	76	77	78	80	79	78	77
HAMBANTOTA	RHMIN	2022	73	69	73	76	NA	78	71	78	75	70	75	77
HAMBANTOTA	RHMIN	2023	72	76	76	72	80	77	73	74	87	84	82	85
HAMBANTOTA	RHMIN	2024	79	73	74	75	80	83	81	82	82	NA	NA	NA

Source: Sri Lanka Meteorological Department (2025)

Wind speed

Data collected from the Hambanthota and Galle meteorological centres in Sri Lanka on wind speed and direction for each month are indicated in Tables 3 and 4.

Table 3: Resultant wind data in Hambanthota(2020-2024)

Year	2020		2021		2022		2023		2024	
	Dir./360 ⁰	Speed/ms- 1	Dir.	Speed	Dir.	Speed	Dir.	Speed	Dir.	Speed
January	057	8.9	048	4.9	040	4.7	022	7.3	038	7.4
February	047	10.1	050	6.3	038	4.7	030	8.0	044	9.5
March	074	6.7	066	5.7	286	4.2	048	5.7	032	11.5
April	112	6.3	219	6.5	246	3.5	081	6.1	038	7.5
May	228	7.3	222	6.1	250	6.3	239	9.5	238	9.1
June	224	7.9	225	8.8	252	6.4	230	10.9	232	12.1
July	226	8.0	227	8.5	252	5.3	231	9.5	229	10.0
August	222	8.4	226	8.1	236	5.3	227	10.0	232	8.6
Sep.	227	7.9	219	8.2	250	6.7	232	6.4	238	8.9
Oct.	224	7.9	224	6.1	245	4.1	212	6.7	234	9.5
November	177	5.7	224	4.2	232	1.9	050	4.5	226	5.9
December	055	6.7	066	6.0	032	3.5	030	7.2	NA	NA

Source: Sri Lanka Meteorological Department (2025)

Table 4: Resultant wind data in Gallle (2020-2024)

Year	2020		2021		2022		2023		2024	
	Dir.	Speed	Dir.	Speed	Dir.	Speed	Dir.	Speed	Dir.	Speed
January	092	4.3	102	2.7	245	2.7	315	4.4	026	1.9
February	114	4.0	321	3.0	308	2.9	324	5.4	045	8.1
March	121	4.2	073	4.0	285	NA	021	5.1	078	7.1
April	082	4.0	284	5.0	282	1.9	217	11.0	056	6.5
May	293	5.0	NA	NA	268	6.2	240	12.5	262	12.2
June	293	7.6	290	7.0	273	5.0	240	12.5	241	13.1
July	299	6.4	294	9.0	298	7.3	267	NA	284	11.3

August	301	6.0	295	11.0	284	5.8	264	5.0	258	11.1
September	291	5.9	281	12.1	283	10.1	237	5.5	260	10.9
October	308	5.8	284	NA	296	10.4	206	1.9	260	5.4
November	039	1.0	317	5.3	307	7.1	262	1.7	342	4.0
December	296	1.7	289	NA	334	5.7	343	1.9	NA	NA

Source: Sri Lanka Meteorological Department (2025)

Temperature

Data collected from the Galle and Hambanthota meteorological centres in Sri Lanka on the monthly minimum and maximum temperatures are indicated in Table 5.

Table 5: Monthly temperature values in Celsius

Station name	Abbreviation	yyyy	Monthly Tem Max & Min (values in Celsius)											
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GALLE	TMPMAX	2019	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4
GALLE	TMPMAX	2020	31.3	31.7	32.3	32	30.3	NA	NA	29	28.8	29	30.5	29.9
GALLE	TMPMAX	2021	29.3	30.2	31.1	30.7	30.4	29.7	29.2	28.6	29.3	29.2	29	30.3
GALLE	TMPMAX	2022	30	30.1	30.3	30.4	NA	29.5	28.8	28.3	28.9	29.2	29.7	29.3
GALLE	TMPMAX	2023	29	29.9	31.1	31.3	30.3	29.8	29.1	29.8	29	29.2	30.3	30.4
GALLE	TMPMAX	2024	30.1	32.1	31.8	32.3	30.7	29.8	29.9	29.6	30.2	29.5	30	NA
GALLE	TMPMIN	2019	23.9	24.6	25.1	25.9	26.8	26.7	27.5	24.3	24.3	24.8	24.3	NA
GALLE	TMPMIN	2020	24.5	24.8	25.5	25.7	26.2	26.8	25.6	25.9	24.9	25.7	24.7	24.3
GALLE	TMPMIN	2021	24.2	24.6	24.5	25.9	26	26.3	25.8	25.5	25.9	25.6	24.8	24.5
GALLE	TMPMIN	2022	24.4	24.6	25.7	25.6	NA	26.1	26.1	25.5	25.9	24.9	24.6	24
GALLE	TMPMIN	2023	23.5	24	24.8	25.5	26.6	26.5	26.1	26.9	24.8	24.8	25	25.2
GALLE	TMPMIN	2024	24.5	25.1	25.8	26.5	26.2	26.5	26.2	26.1	26.5	25.6	24.8	NA
HAMBANTOTA	TMPMAX	2019	32.3	32.4	32.1	32.9	31.9	32	31.8	30.3	29.8	29.7	30.8	30.2
HAMBANTOTA	TMPMAX	2020	31.9	32.2	32.2	32.9	32.1	32.5	31.1	30.6	30.2	31.4	31.8	31.4
HAMBANTOTA	TMPMAX	2021	30.3	32.3	31.8	32.4	32.4	32	31.3	31.3	30.2	31.4	31	30.9
HAMBANTOTA	TMPMAX	2022	31.1	32.2	32.2	31.6	NA	31.5	32.9	31.1	31.5	32.5	31.6	30.4
HAMBANTOTA	TMPMAX	2023	30.8	30.7	31.4	33.1	32.1	32.1	32.7	32	29.9	29.9	30.9	30.3
HAMBANTOTA	TMPMAX	2024	30.6	32.5	33.1	33.6	32.2	30.8	31.3	30.8	31.2	31.1	NA	NA
HAMBANTOTA	TMPMIN	2019	23.6	24.9	24.9	26	26.8	26.7	26.2	25.2	25.1	22.4	24.3	24.6
HAMBANTOTA	TMPMIN	2020	24.2	24.4	25.2	26	26.7	26.7	25.8	25.7	25.2	25.3	24.9	24.1
HAMBANTOTA	TMPMIN	2021	23.9	24.1	24.2	25.9	26	26	25.5	25.5	25.1	24.7	23.9	NA
HAMBANTOTA	TMPMIN	2022	23.9	24.3	25.3	25.6	NA	25.7	25.7	24.8	25.2	25.2	24.2	23.8
HAMBANTOTA	TMPMIN	2023	22.9	23.6	24.9	25.8	26.3	26.5	26.1	26.1	24.6	24.9	24.9	NA
HAMBANTOTA	TMPMIN	2024	24.1	25	25.1	26.6	26.5	26.1	25.7	25.4	25.9	25.4	NA	NA

Source: Sri Lanka Meteorological Department (2025)

Hours of Sunshine (Solar radiation)

Data collected from the Weeravila Meteorological Centre in Sri Lanka on the number of sunshine hours for each month is indicated in Table 6.

Table 6: Monthly Average Sunshine Hours per day in Weerawila (2019-2023)

YEAR	2019	2020	2021	2022	2023
JAN	8	8.3	4.7	7.6	5.6
FEB	7.1	8.5	7.8	7	4
MAR	7.7	8.3	6.8	7.1	7.2
APR	6.8	7.7	8	8.1	7
MAY	8.3	6	5.9	5.9	6.5
JUN	7.1	7.5	NA	8.6	8.1
JUL	7.1	6.3	NA	7.1	7.2
AUG	4.2	7.3	NA	5.5	9
SEP	4.1	5	NA	6.7	4.1
OCT	4.8	8	NA	6.1	4.8
NOV	6	5.8	NA	5.5	5.5
DEC	3.6	4.8	NA	6.5	5.1

Source: Sri Lanka Meteorological Department (2025)

Primary and Secondary data collection of Seawater

Water samples were collected from three identified locations and analysed in accordance with SLS ISO 17680: Tourism and Related Services – Thalassotherapy Service Requirements. This standard specifies the water quality requirements, particularly at the water intake point, for thalassotherapy services. All water samples collected from the three study sites were submitted to the Industrial Technology Institute (ITI), Sri Lanka, for comprehensive analysis of the mentioned parameters. All collected samples were transported to ITI within 24 hours of collection to ensure the integrity of the results. The composition of microbial communities and the physical and chemical properties of seawater samples, including cations, anions, heavy metals, and polycyclic aromatic hydrocarbons, were systematically analysed. Laboratory facilities for testing Enterovirus, a microbiological parameter, and Average

Density, a physical parameter, were unavailable for seawater analysis. Additionally, analytical capabilities were lacking for bicarbonates, bromine, and nitrates as anionic constituents, as well as for total hydrocarbons and surface-active substances responsive to the Methylene Blue assay. All other parameters were assessed. The analysis included the following parameters and analysis methods as described in Table 7.

Table 7: Microbiological, Chemical, Toxicological, and Physical Analysis of Seawater Samples

Parameters	Significance in thalassotherapy	Reference
Microbiological Indicators	<ul style="list-style-type: none"> • Ensures safe therapeutic environments by preventing pathogen exposure. • Total Coliforms and Thermo-tolerant Coliforms indicate faecal contamination. • Intestinal Enterococci assess water quality and detect waste contamination. • Pathogens like Salmonella and Vibrio cholerae pose infection risks, requiring strict monitoring. 	Cabelli, 1983; WHO, 2021; Fujioka, 2001
Chemical and physical properties	<ul style="list-style-type: none"> • Salinity: Enhances osmosis, mineral absorption, circulation, detoxification, and skin hydration. • pH (7.5–8.5): Supports mineral absorption while preventing skin irritation. • PAHs: Industrial pollutants that pose health risks; require strict monitoring. 	Sakai et al., 2002; Neff, 2002
Heavy Metals	<ul style="list-style-type: none"> • Heavy metals (Cd, Pb, As, Hg, Se, Cr) pose health risks due to bioaccumulation. • Excess levels can cause neurotoxicity, kidney damage, and endocrine disruption. • Routine monitoring is essential to ensure seawater safety for therapy. 	Zhou et al., 2008

Essential Minerals	<ul style="list-style-type: none"> • Sodium (Na), Magnesium (Mg), Calcium (Ca), Potassium(K), Lithium (Li) contribute to skin nourishment, muscle relaxation, and balance. • Magnesium (Mg) alleviates stress and muscle cramps. • Calcium (Ca) promotes skin regeneration. • Potassium (K) aids in hydration. • Lithium supports mood stabilisation and neurological health. 	Hoffer & Osmond, 2001; Lodi et al., 2013
---------------------------	--	--

Source: Review of literature (2025)

Standard values for seawater samples used in Thalassotherapy, according to SLS ISO 17680, are listed in Table 8.

Table 8: Seawater Quality Parameters – Reference Values & Analysis Methods

Parameters	Reference Value	Analysis Method
Microbiological parameters of seawater: Limits of parameters		
Total coliforms	≤ 500 UFC/100 ml	APHA 9221 B: 2023
Thermo-tolerant coliforms/Faecal coliform	≤ 100 UFC/100 ml	APHA 9221 B: 2023
Intestinal enterococci	≤ 100 UFC/100 ml	ISO 7889/2-2000 (MF)
Salmonella	absence/1 l	ISO 1950:2010
Choleric vibrios	absence/1 l	SLS 516 part 7 section 1
Enteroviruses	absence/10 l	NA
Physical parameters in seawater		
Total salinity in g/l	20 ≤ S	APHA 2520 B
pH	7,5 ≤ pH ≤ 8,4	APHA 4500 - H+B
Average density	1,025 ≤ d ≤ 1,030	NA
Chemical parameters of seawater –		
Cation elements	Average composition	
Sodium (Na)	11 000 (mg/l)	APHA 3125 : B
Magnesium (Mg)	1 300 (mg/l)	APHA 3125 : B
Calcium (Ca)	400(mg/l)	APHA 3125 : B
Potassium (K)	350(mg/l)	APHA 3125 : B
Lithium (Li)	1 400(mg/l)	APHA 3125 : B
Chemical parameters in seawater - Anion elements		
	Average composition	
Chloride (Cl-)	18 000(mg/l)	APHA 4500 Cl- B
Sulfates (SO₄²⁻)	2 600(mg/l)	APHA 4500 SO ₄ ²⁻ B
Bicarbonates (HCO₃⁻)	150(mg/l)	NA
Brome (Br)	60(mg/l)	NA

Nitrates (NO ₃ ⁻)	3(mg/l)	NA
Chemical parameters in seawater - Heavy metals: Limits of parameters		
Cadmium (Cd)	≤ 0,05 (mg/l)	APHA 3125 : B
Lead (Pb)	≤ 0,05 (mg/l)	APHA 3125 : B
Arsenic (As)	≤ 0,05 (mg/l)	APHA 3125 : B
Mercury (Hg)	≤ 0,01 (mg/l)	APHA 3125 : B
Selenium (Se)	≤ 0,05 (mg/l)	APHA 3125 : B
Chromium (Cr)	≤ 0,05 (mg/l)	APHA 3125 : B
Chemical parameters in seawater -Hydrocarbons: Limits of parameters		
Total hydrocarbons	≤ 0,5 (mg/l)	NA
Polycyclic aromatic hydrocarbons	≤ 0,000 2 (mg/l)	RAL/MM/01/11/002 de
Surface active substances reacting with the Methylene blue (lauryl sulfate)	≤ 0,3(mg/l)	NA

Source: SLS ISO 17680: 2022 (ISO 17680: 2015)

Sea water data results are listed in Table 9 below.

Table 9: Seawater Quality Parameters – Reference Values & Results

Parameters	Reference Value	Result	Result	Result
Microbiological parameters of seawater: Limits of parameters				
Total coliforms	≤ 500 UFC/100 ml	Not detected	Not detected	1800
Thermo-tolerant coliforms/Faecal coliform	≤ 100 UFC/100 ml	Not detected	Not detected	1800
Intestinal enterococci	≤ 100 UFC/100 ml	Less than 1	6	98
Salmonella	absence/1 l	Present	Absent	Present
Choleric vibrios	absence/1 l	Absent	Absent	Absent
Enteroviruses	absence/10 l	NA	NA	NA
Physical parameters in seawater: Limits of parameters				
Total salinity in g/l	20 ≤ S	30	30	30
pH	7,5 ≤ pH ≤ 8.4	8	8	8
Average density	1,025 ≤ d ≤ 1.030	NA	NA	NA
Chemical parameters of seawater - Cation elements				
	Average composition			
Sodium (Na)	11 000 (mg/l)	8142	8880	8570
Magnesium (Mg)	1 300 (mg/l)	858	923	897
Calcium (Ca)	400(mg/l)	73.2	79.2	76.8
Potassium (K)	350(mg/l)	305	340	326
Lithium (Li)	1 400(mg/l)	0.1	0.1	0.1
Chemical parameters in seawater - Anion elements				
	Average composition			

Chloride (Cl⁻)	18 000(mg/l)	19079	18101	18590
Sulfates (SO₄²⁻)	2 600(mg/l)	2300	2300	2250
Bicarbonates (HCO₃⁻)	150(mg/l)	NA	NA	NA
Brome (Br)	60(mg/l)	NA	NA	NA
Nitrates (NO₃⁻)	3(mg/l)	NA	NA	NA
Chemical parameters in seawater				NA
- Heavy metals: Limits of parameters				
Cadmium (Cd)	≤ 0.05 (mg/l)	Not detected	Not detected	Not detected
Lead (Pb)	≤ 0.05 (mg/l)	Not detected	Not detected	Not detected
Arsenic (As)	≤ 0.05 (mg/l)	Not detected	Not detected	Not detected
Mercury (Hg)	≤ 0.01 (mg/l)	Not detected	Not detected	Not detected
Selenium (Se)	≤ 0.05 (mg/l)	0.001	0.001	0.001
Chromium (Cr)	≤ 0.05 (mg/l)	Not detected	Not detected	Not detected
Chemical parameters in seawater				
-Hydrocarbons: Limits of parameters				
Polycyclic aromatic hydrocarbons	≤ 0.000 2 (mg/l)	0.0052	0.0056	0.0051
Surface active substances reacting with the Methylene blue (lauryl sulfate)	≤ 0.3(mg/l)	NA	NA	NA

Source: Industrial Technology Institute (ITI), Sri Lanka (2025)

DATA ANALYSIS

Analysis of meteorological data - Average values

The average values of meteorological data were analysed as follows (See Table 10).

Table 10: Average values of meteorological data

Meteorological data	Standard value	Site-1	Site-2	Site-3
Monthly Rainfall	50mm -150mm	127.4mm	102.6mm	245.4mm
Humidity	50% - 80%	NA	83%	85%
wind speed	3–8 m/s (gentle to moderate breeze)	NA	5.85-7.72m/s	3.1-5.1 m/s
Room Temperature	20°C to 30°C	NA	25.2°C -31.5°C	25.4°C -30°C

Source: UWI Health and Wellness Consultancy Team - Development of Standards for the Regional Health and Wellness Sector (2025)

Rainfall data

Meteorological data indicate significant spatial and temporal variations in annual precipitation across the Galle, Matara, and Hambantota districts, as

shown in Figure 4 below. Among these, Galle receives the highest annual rainfall, followed by Matara; Hambantota experiences the lowest precipitation. Across all three districts, peak rainfall occurs in September, October, and May, with recorded precipitation levels exceeding the optimal threshold for thalassotherapy. Consequently, these periods are deemed unsuitable for conducting thalassotherapy treatments. In contrast, the months from November to March exhibit comparatively lower precipitation levels, which remain within the acceptable range for therapeutic interventions. Therefore, this period is considered the most suitable for thalassotherapy sessions.

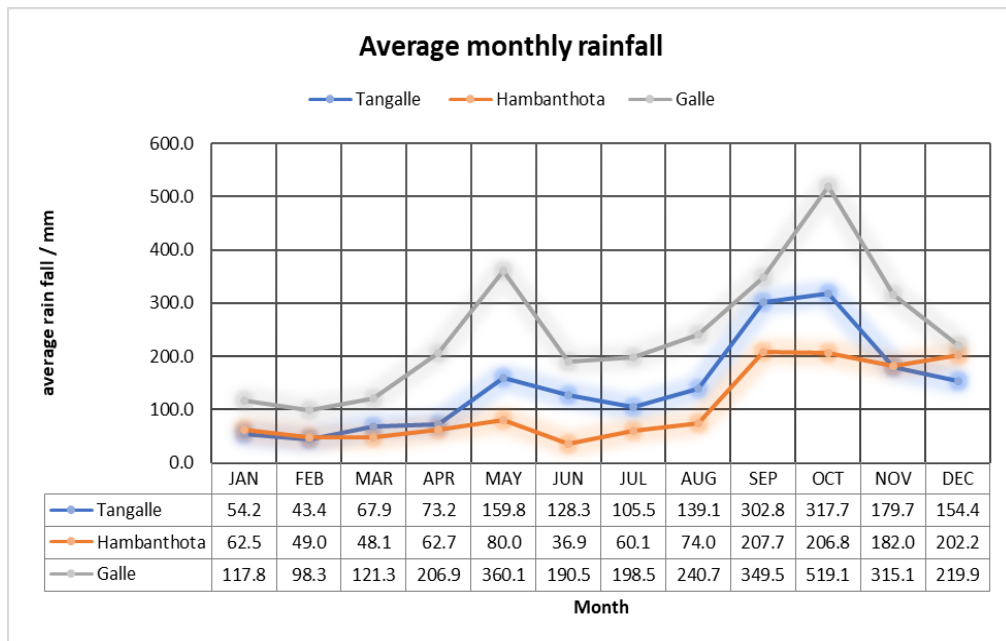


Figure 4: Monthly rainfall

Source: Sri Lanka Meteorological Department (2025)

Relative Humidity

At the time of data collection, no recorded data was available for Matara or Dickwella. Average humidity levels in the Galle and Hambanthota districts exceeded the optimal range (50%-80%) by a marginal extent. Over the past five years, the mean humidity in the Galle district has been 85%, while in the Hambanthota district, it has averaged 83%, as shown in Figure 5 below. This

deviation from the optimal threshold is relatively minor.

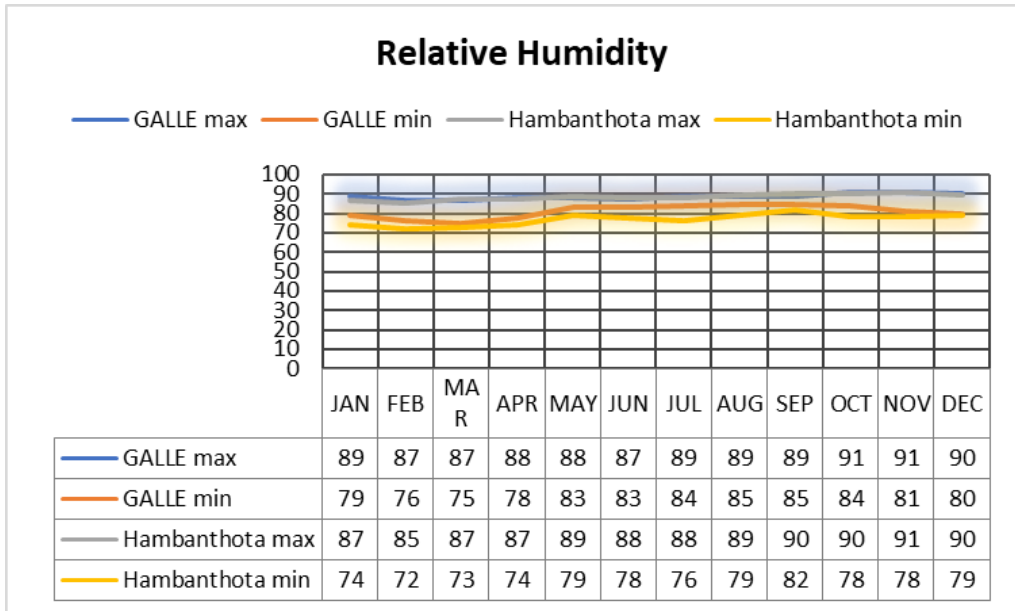


Figure 5: Monthly relative humidity

Source: Sri Lanka Meteorological Department (2025)

Wind Speed

Data for the Matara district in Sri Lanka is currently unavailable. However, based on data collected from the Galle and Hambantota districts, wind speeds exceed 8 m/s in June, July, and August, as shown in Figure 6. However, optimal wind conditions for halassotherapy are observed in Galle from October to March and in Hambantota during November and December, indicating seasonal suitability for therapeutic applications.

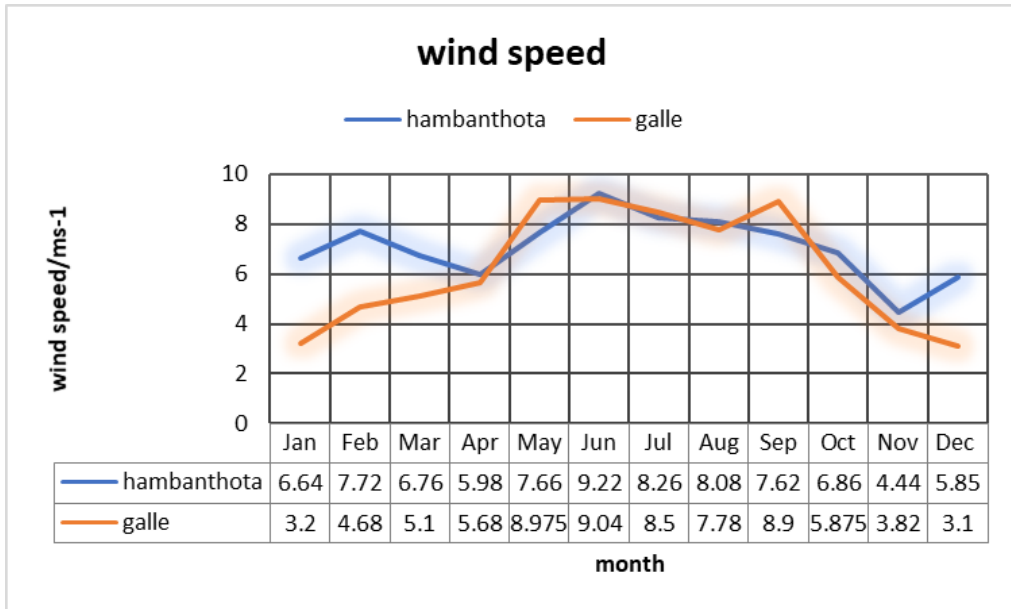


Figure 6: Monthly wind speed
Source: Sri Lanka Meteorological Department (2025)

Temperature data

The meteorological data obtained from the Sri Lanka Meteorological Department does not include specific records for the Matara district but does provide data for the adjacent Galle and Hambantota districts. The analysis indicates that the ambient temperature in the Galle district is within an optimal range (25°C -30°C) for thalassotherapy. In the Hambantota district, temperatures are slightly elevated by approximately 1–2°C in some months, especially March and April; however, this variation remains within an acceptable range for thalassotherapy treatments, as shown in Figure 7. Given that the Matara district is geographically positioned between Galle and Hambantota, it is reasonable to infer that its ambient temperature also falls within a suitable range for thalassotherapy applications.

Temperature data

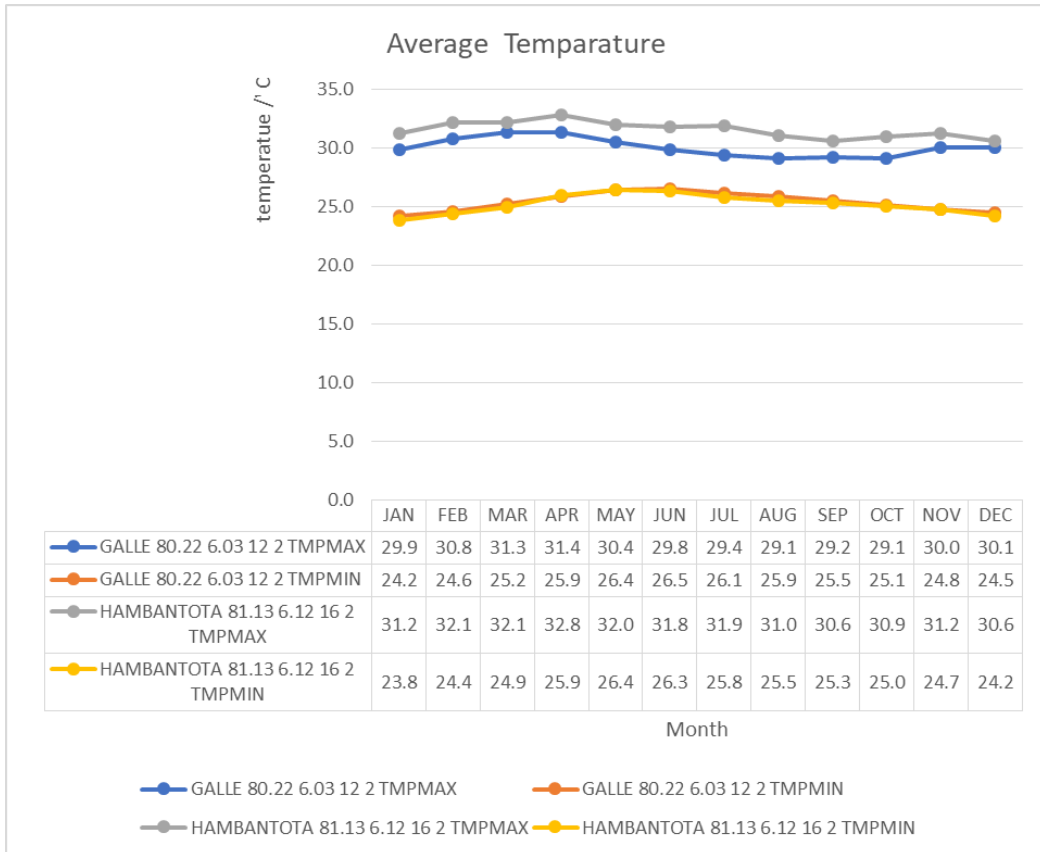


Figure 7: Monthly average temperature
Source: Sri Lanka Meteorological Department (2025)

Hours of Sunshine (Solar radiation)

Sri Lanka, situated near the equator, experiences consistently high levels of solar radiation throughout the year, as shown in Figure 08 below. This is reflected in the daily sunshine duration, which ranges between six and eight hours of intense sunlight. Given the potential adverse effects of prolonged exposure to ultraviolet (UV) radiation on human health, it is advisable to conduct thalassotherapy sessions in the morning or evening to mitigate risks while maximising therapeutic benefits.

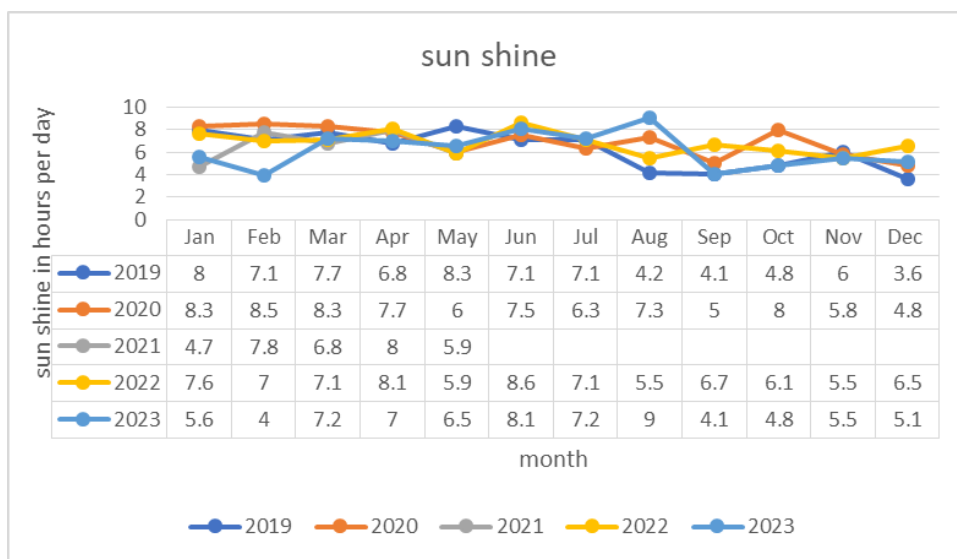


Figure 8: Monthly sunshine
Source: Sri Lanka Meteorological Department (2025)

Analysis of seawater

The compliance of the seawater samples with the standard composition is plotted using colour codes, as shown in Table 11.

Table 11: Sea water parameters and values

Colour Indication for the feasibility of intake of seawater			
Parameters	Site-1	Site-2	Site-3
Microbiological parameters of seawater (ufc/100ml)			
Total coliforms	Not detected	Not detected	1800
Thermo-tolerant coliforms/Faecal coliform	Not detected	Not detected	1800
Intestinal enterococci	Less than 1	6	98
Salmonella	Present	Absent	Present
Choleric vibrio	Absent	Absent	Absent
Physical parameters in seawater			
Total salinity in g/l	30	30	30
pH	8	8	8

Chemical parameters of seawater - Cation elements (mg/l)			
Sodium (Na)	8142	8880	8570
Magnesium (Mg)	858	923	897
Calcium (Ca)	73.2	79.2	76.8
Potassium (K)	305	340	326
Lithium (Li)	00.1.1	0.10.1	0.10.1
Chemical parameters in seawater - Anion elements (mg/l)			
Chloride (Cl-)	19079	18101	18590
Sulfates (SO ₄ ²⁻)	2300	2300	2250
Chemical parameters in seawater- Heavy metals (mg/l)			
Cadmium (Cd)	Not detected	Not detected	Not detected
Lead (Pb)	Not detected	Not detected	Not detected
Arsenic (As)	Not detected	Not detected	Not detected
Mercury (Hg)	Not detected	Not detected	Not detected
Selenium (Se)	0.001	0.001	0.001
Chromium (Cr)	Not detected	Not detected	Not detected
Chemical parameters in seawater-Hydrocarbons (mg/l)			
Polycyclic aromatic hydrocarbons	0.0052	0.0056	0.0051

Suitable without modification	Suitable with/without modification	Suitable with modification

Source: Authors' own

Microbiological parameters analysis

According to the microbial analysis reports, seawater samples from the deep-sea locations (Site-1 and Site-2) exhibited no detectable levels of total coliforms, thermotolerant coliforms, or *Vibrio cholera*. Additionally, intestinal

enterococci concentrations in these samples were significantly lower than the standard threshold. However, *Salmonella* spp. were detected in the sample from Site-1 but were absent in Site-2. In contrast, the control sample (Site-3) exhibited considerably higher concentrations of total coliforms and thermotolerant coliforms, presumably due to contamination from accumulated human faecal matter in the area. Nevertheless, intestinal enterococci levels remained marginally below the standard limit, while *Salmonella* spp. were present, and *Vibrio cholerae* was undetected (See Figure 9). Based on these findings, seawater from Site-2 is deemed suitable for thalassotherapy without requiring microbial purification. However, seawater from Site-1 necessitates *Salmonella*-specific microbial treatment prior to use. Site-3 may be utilised for thalassotherapy following comprehensive microbial purification to eliminate *Salmonella*, total coliforms, and thermotolerant coliforms

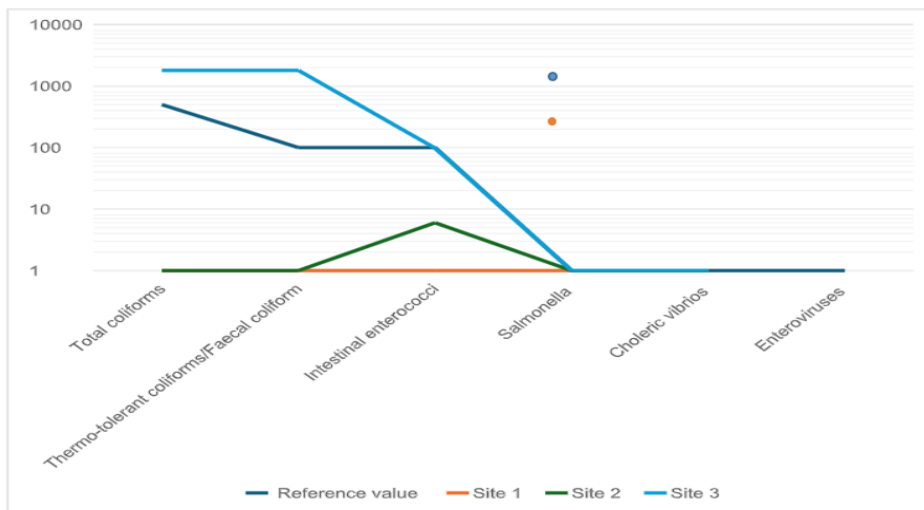


Figure 9: Microbiological parameters

Source: Authors' own

Physical Parameters analysis

The physical properties of seawater, specifically Salinity and pH, were analysed across three distinct locations, yielding identical values in each case. For seawater to be suitable for thalassotherapy, salinity should exceed 20, and pH should range from 7.5 to 8.5. These parameters remained within the

established standard range, indicating that seawater from these sites is suitable for thalassotherapy treatment without necessitating any physical modifications. (See Figure 10)

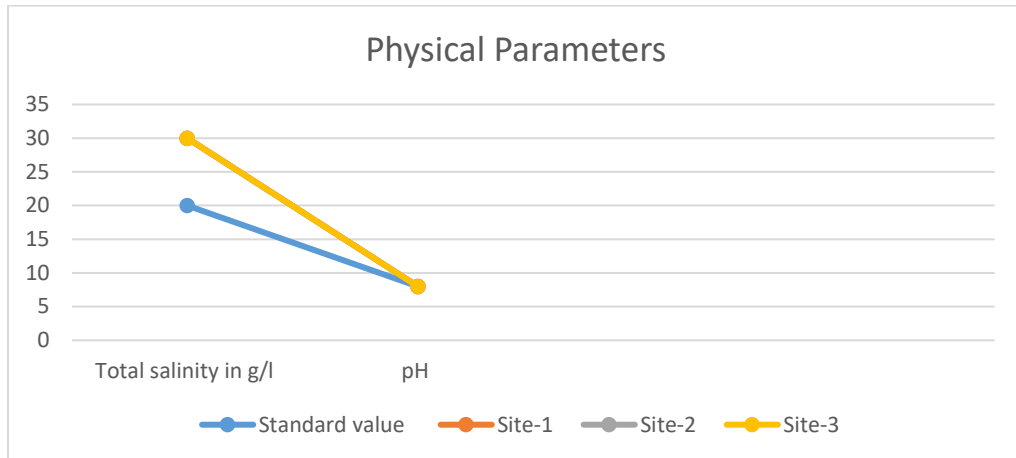


Figure 10: Physical parameters

Source: Author's own

Chemical parameters analysis

Cations composition

Since the cationic composition of seawater is crucial to its therapeutic efficacy, maintaining these ions at standard concentrations is essential. Although minor variations were observed among the three sampled locations, their cation levels remained within a comparable range. However, all measured values were below the established standards and should be modified before use for the thalassotherapy. Specifically, sodium, magnesium, and calcium concentrations were moderately lower than the standard levels, while potassium concentrations were slightly below the norm. Notably, lithium concentrations were markedly deficient. Consequently, supplementation of these cations is necessary when preparing seawater for thalassotherapy across all three locations. (See figure 11)

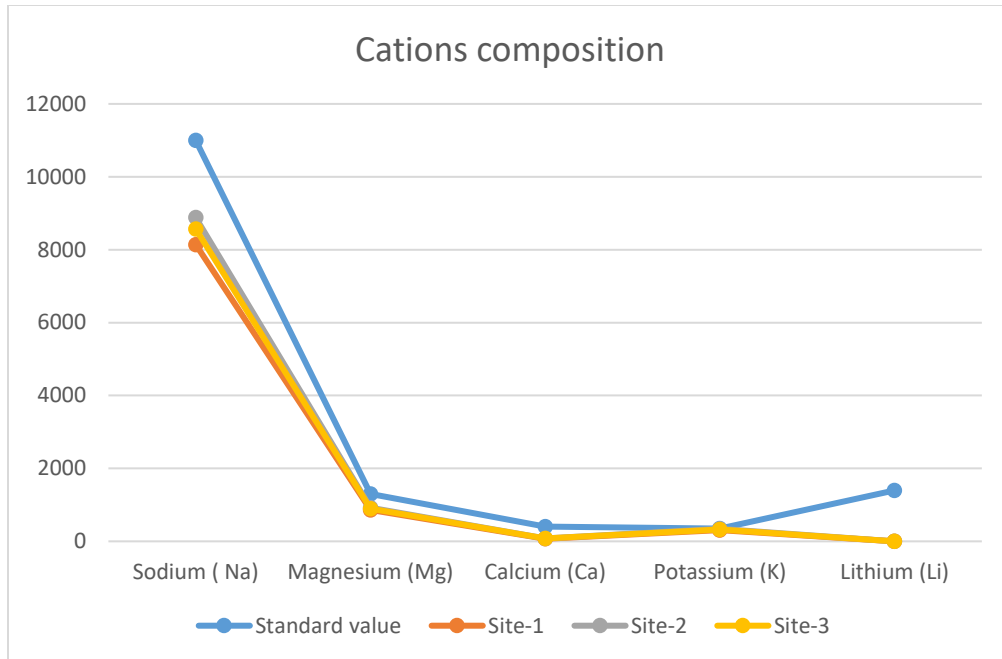


Figure 11: Chemical parameters

Source: Author's own

Anion analysis

In the anion analysis, the chloride concentration at Site-2 aligns with the standard value, whereas the levels at Site-1 and Site-3 are slightly elevated. However, these deviations from the standard remain minimal. Similarly, sulfate concentrations at all three locations are slightly below the standard level but remain close to it. Overall, the anionic composition of the collected samples exhibits only minor deviations from the standard values, with concentrations approximately equivalent to the established norms. Therefore, based on the anion analysis, seawater from all three locations can be utilised for thalassotherapy treatments without requiring additional anion supplementation. (See figure 12).

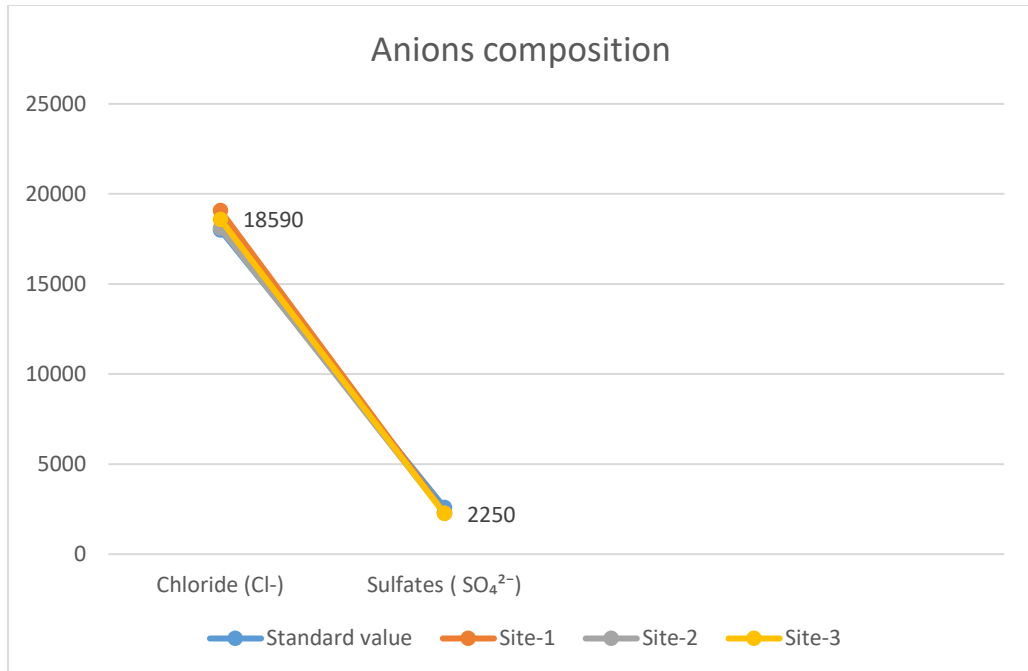


Figure 12: Anions Composition

Source: Author's own

Heavy metals analysis

The presence of heavy metals in seawater can pose significant environmental and health risks, potentially compromising its suitability for various applications. Therefore, strict adherence to established thresholds is imperative to mitigate adverse effects. This study conducted a comprehensive analysis of the concentrations of Cadmium (Cd), Lead (Pb), Arsenic (As), Mercury (Hg), Selenium (Se), and Chromium (Cr) in seawater samples. The findings reveal that the levels of these heavy metals across all three analysed samples exhibit comparable values and remain well within permissible limits. Consequently, in the context of thalassotherapy, additional purification measures for heavy metal removal would not be required at these specific locations. (See Figure 13).

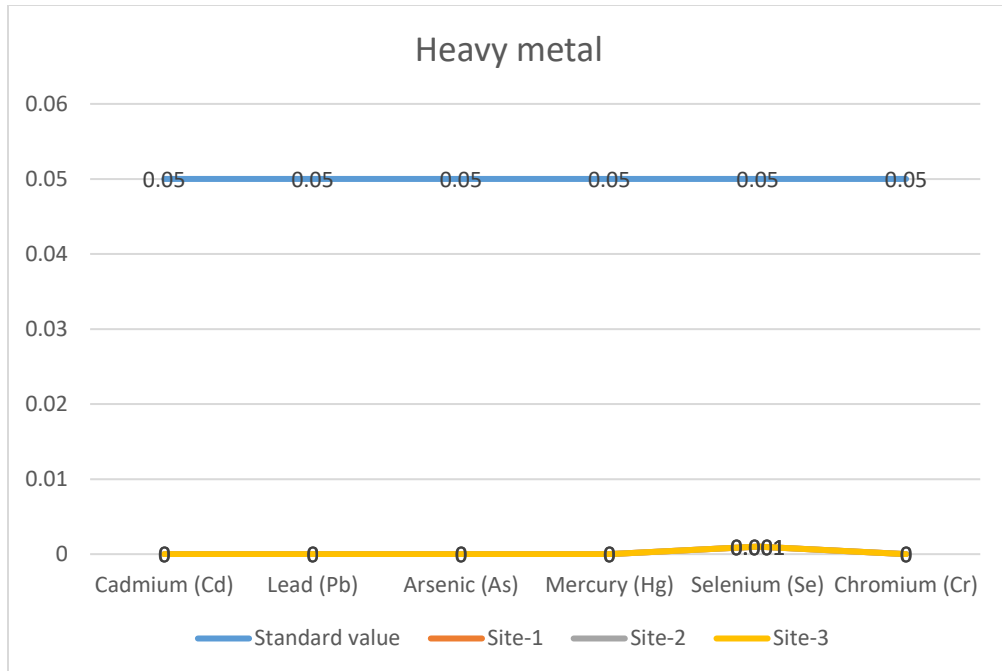


Figure 13: Heavy metal

Source: Author's own

Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of organic compounds composed of multiple benzene rings, commonly found in the environment as a result of combustion processes, oil spills, and industrial activities. The presence of polycyclic aromatic hydrocarbons (PAHs) in seawater used for thalassotherapy poses significant toxicological concerns, as these compounds are known to induce dermatological irritation, inflammation, and, in cases of prolonged or high-level exposure, an elevated risk of carcinogenesis. Given these potential health hazards, PAH concentrations in seawater designated for therapeutic purposes must remain within established regulatory thresholds. However, PAH levels are consistently elevated beyond permissible limits. Consequently, pre-treatment and purification processes are necessary to ensure seawater is suitable for thalassotherapy in these regions. (See figure 14)

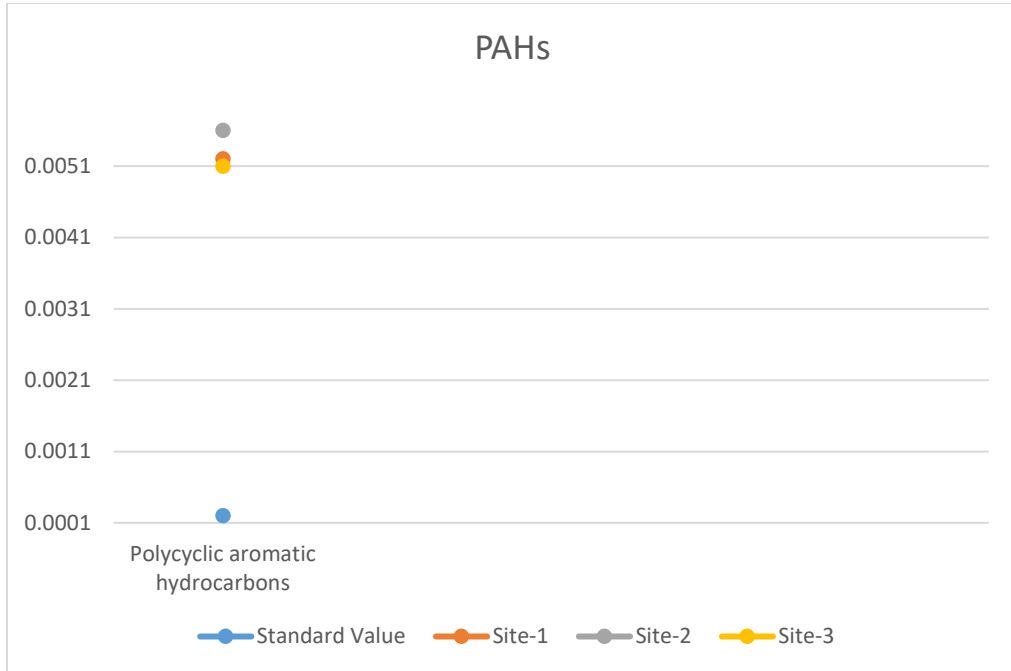


Figure 14: Polycyclic aromatic hydrocarbons

Source: Authors' own

DISCUSSION

This section categorises the results by sample collection site. The following site-wise assessment is based on microbiological, physical, chemical, and heavy metal parameters to determine the suitability of the seawater for Thalassotherapy.

Water Quality Assessment

To evaluate the suitability of selected coastal sites in Sri Lanka for thalassotherapy, a detailed water-quality assessment was conducted at Dikwella, Yala, and Koggala. The analysis focused on microbiological, physical, chemical and pollutant-related parameters, as well as overall feasibility for therapeutic applications. The parameters included microbial safety indicators (coliforms, enterococci, Salmonella and vibrios), physicochemical characteristics (pH, mineral composition), and contamination

risks (heavy metals and hydrocarbons). The findings for each site are summarised in Table 12 below, highlighting its potential for thalassotherapy and the recommended interventions to improve water quality where necessary.

Table 12: water quality assessment

	Dikwella	Yala	Koggala
Microbiological Parameters	Total Coliforms: Not detected Intestinal Enterococci: Less than 1 ufc/100 ml. Choleric Vibrios: Absent Salmonella: Present This finding about Salmonella was based on the detection of Salmonella bacteria in a seawater sample collected from the Dikwella area. Salmonella contamination can result from both human and fish faeces. Given the absence of major sewage contamination in this area, the presence of Salmonella in the sample may have been due to natural marine life, particularly fish inhabiting the region. This finding highlights the need for continuous monitoring and potential treatment measures to ensure microbiological safety in thalassotherapy applications. If it is properly done, the site is a feasible location for Thalasso therapy with respect to the said parameter.	Total Coliforms: Not detected (Safe for Thalasso therapy) Intestinal Enterococci: 6 ufc/100 ml (Acceptable) Choleric Vibrios: Absent (safe)	Total Coliforms: 1800 ufc/100 ml (Exceeds safety limits) Intestinal Enterococci: 98 ufc/100 ml (Borderline safe) Choleric Vibrios: Absent (Suitable)
Physical Parameters	pH: 8, which is ideal for skin therapy.	pH: 8 (Suitable)	pH: 8 (Suitable)
Chemical Composition	Magnesium: 858 mg/l (Lower than standard 1300 mg/l but still beneficial) Potassium: 305 mg/l (Slightly lower than the standard 350 mg/l) Sulfates: 2300 mg/l (Below 2600 mg/l but acceptable)	Magnesium: 923 mg/l (Slightly low but acceptable) Potassium: 340 mg/l (Close to standard 350 mg/l) Sulfates: 2300 mg/l (Below standard but still therapeutic)	Magnesium: 897 mg/l (Moderate but lower than optimal) Potassium: 326 mg/l (Acceptable range) Sulfates: 2250 mg/l (Slightly low)

Heavy Metals	Lead, Mercury, Chromium: Not detected (Safe)	Lead, Mercury, Chromium: Not detected (Safe)	Lead, Mercury, Chromium: Not detected (Safe)
Hydrocarbons	PAHs: 0.0052 mg/l (Exceeds the safe limit of 0.0002 mg/l – Contamination issue)	PAHs: 0.0056 mg/l (High contamination issue)	PAHs: 0.0051 mg/l (Exceeds safe limit)
Feasibility for Thalassotherapy	Moderate feasibility – Clean water, but hydrocarbon pollution needs mitigation.	High feasibility – Ideal mineral composition, but hydrocarbon levels require treatment.	Low feasibility – High microbiological contamination and hydrocarbon pollution.
Recommended Modifications	<ul style="list-style-type: none"> • Bio-remediation methods for reducing PAH contamination. • Dedicated water treatment zones to ensure pollution-free Thalassotherapy pools. 	<ul style="list-style-type: none"> • Increase natural seawater filtration zones to lower PAH levels. • Introduce mineral-enriched seawater pools to enhance therapy benefits. 	

Source: Authors' own

The seawater in Sri Lanka's Southern Province has low concentrations of heavy metals due to several factors. The region lacks heavy industries like battery manufacturing and large-scale metal refining, which are major sources of heavy metal pollution. Additionally, there are fewer industrial zones and less urban runoff than in other parts of the country, minimising contamination from waste discharge.

The strong ocean currents in the Indian Ocean help dilute pollutants, preventing their accumulation in coastal waters. Unlike regions with extensive mining activity, the Southern Province lacks significant metal-rich mineral deposits that could contribute to heavy metal contamination. Agricultural runoff, a common source of heavy metals, is also minimal due to the region's

lower reliance on chemical-intensive farming.

The substances not assessed for the study are seawater density, enteroviruses, hydrocarbons, surfactants, bicarbonates, bromine and nitrates. They can cause various effects on human health when exposed externally.

1. The density of seawater in the Indian Ocean varies with temperature, salinity, and depth. However, in general, surface density is 1.020 - 1.027 g/cm³ (1020 - 1027 kg/m³), and deep-ocean density is 1.027 - 1.030 g/cm³ (1027 - 1030 kg/m³). These values are within the standard range required for thalassotherapy.
2. Enterovirus: Although skin rashes and conjunctivitis (eye infection) can occur during external exposure, the water samples from Yala and Dickwella were taken from the deep sea. Furthermore, the coastal waters in those areas are free of human faecal contamination, especially near urban areas, so that the risk may be low. This risk can be ignored in those areas, especially since the periods of heavy rainfall are not used for thalassotherapy. However, since the Koggala area is highly populated and industrialised, and surface water is available, this risk may be present.
3. Hydrocarbons (oil and petroleum residues): These can cause skin and respiratory problems. Common sources include oil spills, industrial waste, and motorboat fuel spills. The Yala and Dickwella samples are unlikely to contain these substances because they were taken from the deep sea and are naturally floating on the surface of the water. However, these substances may be present in the Koggala sample.
4. Surfactants (surfactants, detergents): There is a risk of skin dryness and rashes (especially for people with sensitive skin). Common sources include household and industrial detergents, as well as personal care products that enter water sources. If the water appears foamy or has an unnatural colour, it

may contain surfactants. This is also associated with surface water and tends to be absent from Yala and Dikwella samples. However, these may be present in Koggala seawater.

5. Bicarbonate (HCO_3^-) and Carbonate: These are naturally occurring in seawater and therefore do not cause direct skin damage; bicarbonate is part of the natural buffering system of seawater.
6. Bromine (Br^-): High concentrations may cause mild skin irritation in humans. It may cause eye and respiratory irritation. Bromine is naturally present in seawater. Bromine in seawater is generally safe.
7. Nitrate (NO_3^-): Low risk to skin. Skin contact is generally not harmful at natural concentrations. If nitrate levels are very high (due to pollution), algal toxins can cause skin irritation. Common sources include agricultural waste, fertiliser, and waste disposal.

Recommended Modifications:

- The waters in the sites are not suitable for direct Thalassotherapy without interventions
- Improve wastewater management to reduce coliform levels.
- Conduct periodic microbial testing before any treatments.
- Consider alternative therapy methods (e.g., Ayurvedic marine herbal applications instead of direct seawater use).

Table 13 summarises potential modifications to the parameters.

Table 13: potential modifications

Parameter	Correction Solution	Reference
Microbiological <ul style="list-style-type: none"> • Total Coliform • Thermo-tolerant Coliforms • Salmonella 	Effective disinfection methods include <ul style="list-style-type: none"> • Chlorination: 0.5–1.0 mg/L residual chlorine for 30 minutes ensures bacterial inactivation • UV Disinfection: 40 mJ/cm² UV exposure effectively inactivates Salmonella • Ozonation: 0.3–0.5 mg/L ozone disrupts bacterial cell structures without chemical residues • Filtration: Ultrafiltration, reverse osmosis, and activated carbon remove bacteria and organic matter 	(Hijnen et al., 2006; Von & Gunten, 2003; Neff, 2002)
Chemical composition Cations <ul style="list-style-type: none"> • Sodium (Na) • Magnesium (Mg) • Calcium (Ca) • Potassium (K) • Lithium (Li) 	1. Mineral Supplementation <ul style="list-style-type: none"> • Sodium chloride (NaCl) or sea salt • Magnesium sulfate (Epsom salt) or magnesium chloride • Calcium chloride (CaCl₂) • Potassium chloride (KCl) • Lithium chloride (LiCl) 2. Reverse Osmosis (RO) 3. Ion Exchange Resins 4. Electrochemical Processes	WHO, 2021; Neff, 2002; Mouritsen & Styrbæk, 2017; Von Gunten, 2003
Polycyclic Aromatic Hydrocarbon (PAHs) Levels	<ul style="list-style-type: none"> • Carbon filtration • Ozonation • Bioremediation (using bacteria and fungi) 	Neff, 2002; Von Gunten, 2003

Source: Authors' own

RECOMMENDATIONS

1. Best Site for Thalassotherapy:
 - Yala (High feasibility)
 - Dikwella (Moderate feasibility with modifications)
2. Sites that Require Improvement:
 - Koggala: Needs water, sanitation, and pollution control before any Thalassotherapy applications.

3. Modifications to Improve Feasibility:

- Implement stricter wastewater treatment to reduce coliform contamination.
- Introduce bio-filtration techniques to lower PAH levels.
- Enhance mineral composition using marine extracts to optimise therapy benefits.

The Southern Province of Sri Lanka has strong potential for Thalassotherapy-based tourism. However, Yala is the most suitable location, while Dikwella can be improved by implementing pollution control measures. Koggala currently does not meet the required standards, but can be developed in the long term with proper interventions.

CONCLUSION

Concluding the findings, the following table summarises the results for the three sites selected for water sample collection. Considering the findings, the study team presents an overall assessment of the sites' technical feasibility. (See Table 14)

Table 14: Conclusion Table

Site	Microbiological Safety	Chemical Suitability	Heavy Metals	PAH Contamination	Overall Feasibility
Dikwella Site-1	Safe	Slightly low Mg/SO ₄ ²⁻	Safe	High PAHs	Moderate
Yala Site-2	Safe	Good mineral balance	Safe	High PAHs	High
Koggala Site-3	Unsafe (High coliforms)	Slightly low Mg/SO ₄ ²⁻	Safe	High PAHs	Low

Source: Authors' own

The feasibility study demonstrates that Sri Lanka's Southern Province has the essential natural resources required to establish thalassotherapy centres.

However, to maximise the therapeutic benefits and economic viability of these centres, modifications to the seawater composition should be considered. One key enhancement is the addition of lithium anions to thalassotherapy pools, which could significantly improve mental well-being, reduce stress, and provide neuroprotective benefits beyond traditional seawater bathing. Lithium has been extensively studied for its mood-stabilising effects and potential to enhance cognitive function, making it a valuable addition to therapeutic seawater treatments.

Additional modifications to seawater composition may include optimising mineral content by adjusting magnesium, calcium, and potassium levels to enhance skin hydration, muscle relaxation, and circulatory benefits. Moreover, controlled temperature regulation and seawater aeration can enhance the absorption of beneficial minerals and optimise therapeutic effects across various health conditions, including arthritis, skin disorders, and respiratory issues.

Furthermore, Sri Lanka's environmental regulations and conservation efforts help maintain the purity of coastal waters by limiting the disposal of industrial waste and promoting marine conservation. These factors make the seawater in the Southern Province suitable for thalassotherapy, ensuring a clean and safe environment for wellness tourism. With proper assessments and quality controls, this natural advantage can be leveraged to develop sustainable, high-quality thalassotherapy centres in the region.

Implementing these modifications would require adherence to international health and wellness standards, proper regulatory approvals, and rigorous quality control measures to ensure safety and efficacy. Future research should investigate the long-term health effects of modified seawater therapy, cost-effectiveness, and consumer preferences to determine the most sustainable approach. Additionally, integrating these enhanced thalassotherapy techniques with Ayurveda-based treatments could create a unique, holistic wellness

experience, further distinguishing Sri Lanka as a premier destination for health tourism.

REFERENCES

- Cabelli, V. J. (1983). *Health effects criteria for marine recreational waters*. U.S. Environmental Protection Agency.
- Fernando, P. (2017). Tourism trends in Southern Sri Lanka: Opportunities and challenges. *Sri Lanka Tourism Review*, 14(1), 50–67.
- Fujioka, R. S. (2001). Monitoring coastal marine waters for spore-forming bacteria of faecal and soil origin to determine the point from non-point source pollution. *Water Science and Technology*, 44(7), 181–188.
- Global Wellness Institute. (2018). *Global wellness economy monitor*. Global Wellness Institute. <https://globalwellnessinstitute.org/industry-research/>
- Global Wellness Institute. (2020). *Global wellness tourism economy report*. <https://globalwellnessinstitute.org>
- Hall, C. M. (2014). Economic impacts of wellness tourism: A case study of thalassotherapy. *International Journal of Tourism Economics*, 6(1), 23–39.
- Hijnen, W. A. M., Beerendonk, E. F., & Medema, G. J. (2006). Inactivation credit of UV radiation for viruses, bacteria and protozoan (oo)cysts in water: A review. *Water Research*, 40(1), 3–22.
- Hoffer, A., & Osmond, H. (2001). *How to live with schizophrenia*. Citadel Press.
- Holick, M. F. (2004). Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. *The American Journal of Clinical Nutrition*, 80(6), 1678S–1688S. <https://doi.org/10.1093/ajcn/80.6.1678S>
- Johnson, R., & Brown, A. (2012). Wellness tourism and thalassotherapy: A global perspective. *Tourism and Wellness Journal*, 8(2), 112–125.
- Jones, D. (2015). Thalassotherapy and coastal tourism development. *Journal of Coastal Tourism*, 10(2), 34–48.

- Kumar, S. (2018). Ayurveda and wellness tourism in Sri Lanka: A growth path. *Asian Journal of Tourism*, 7(3), 89–101.
- Lodi, A., Saha, R., & Carbone, M. (2013). *Marine bioactives and their health benefits*. Springer.
- Martin, L. (2011). Therapeutic benefits of marine-based treatments. *Health and Wellness Review*, 19(4), 78–90.
- Medici, G., Sarto, F., Zanardi, E., & Lucchini, R. (2019). Balneotherapy and thalassotherapy: Perspectives for health promotion and rehabilitation. *Annali di Igiene*, 31(6), 539–552. <https://doi.org/10.7416/ai.2019.2314>
- Michele, A., & David, D. (2024). *A narrative review of thalassotherapy and the health benefits of seawater and coastal climates*. Springer Nature.
- Mouritsen, O. G., & Styrbæk, K. (2017). *Seaweeds: Edible, available, and sustainable*. University of Chicago Press.
- Munteanu, C., & Munteanu, D. (2019). Thalassotherapy today. *Balneo Research Journal*, 10(4), 440–444. <https://doi.org/10.12680/balneo.2019.278>
- Neff, J. M. (2002). *Bioaccumulation in marine organisms: Effect of contaminants from oil well produced water*. Elsevier.
- OpenStreetMap contributors. (2025). OpenStreetMap. Retrieved Month Day, Year, from <https://www.openstreetmap.org>
- Sakai, H., Yamasaki, M., & Tsuji, T. (2002). Influence of seawater pH on skin permeability. *Journal of Dermatological Science*, 30(1), 35–41.
- Santos, S. A., Costa, M. C., & Almeida, J. (2021). Environmental contamination by polycyclic aromatic hydrocarbons in coastal areas: Impacts on human and marine health. *Marine Pollution Bulletin*, 167, 112309. <https://doi.org/10.1016/j.marpolbul.2021.112309>
- Smith, J. (2010). Thalassotherapy: The healing power of the sea. *Journal of Marine Health*, 12(3), 45–56.
- SpringerLink. (n.d.). *Thalassotherapy and climate influence on human health*. Springer Nature. <https://link.springer.com>
- Sri Lanka Meteorological Department. (2019–2024). *Official climate data records*. Department of Meteorology, Sri Lanka. <https://meteo.gov.lk>

- Sri Lanka Standards Institution. (2022). *SLS ISO 17680:2022 – Tourism and related services – Thalassotherapy – Service requirements*. Sri Lanka Standards Institution.
- Ssegawa, J. K., & Muzinda, A. (2021). Feasibility assessment framework (FAF) based on project domain framework (PDF) for developing project business cases. In *Elsevier* (pp. 377–385).
- Von Gunten, U. (2003). Ozonation of drinking water: Part I. Oxidation kinetics and product formation. *Water Research*, 37(7), 1443–1467.
- World Health Organisation. (2021). *Guidelines for drinking-water quality*. World Health Organisation.
- World Health Organisation. (2021). *Guidelines for safe recreational water environments*. World Health Organisation.
- Zhou, Q., Zhang, J., Fu, J., Shi, J., & Jiang, G. (2008). *Environmental heavy metals and health effects*. CRC Press.