



Scientifically
Validated for
Re-Computation
of the Area of
Sri Lanka

Re-Computation of the Area of Sri Lanka

Preface

It is with great pleasure and a deep sense of accomplishment that we present this report titled “Re-Computation of the Area of Sri Lanka.”

In a world where precision and accuracy are paramount, the delineation of territorial boundaries holds immense significance impacting governance, planning, resource management, and diplomacy. Recognizing the importance of maintaining up to date and accurate geographic data, the Survey Department of Sri Lanka embarked on a mission to re-calculate the country’s total extent with meticulous attention to detail and adherence to rigorous geodetic and cartographic standards.

This endeavor was not merely a technical exercise, but a testament to our commitment to excellence and our dedication to serving the nation. The process involved multidisciplinary collaboration, the use of cutting-edge technologies, and the application of internationally recognized methodologies. From the initial data collection to the final computation, every step was carried out with precision and care, guided by a shared vision of producing reliable and authoritative results.

One of the key challenges encountered during this re-computation was the absence of certain smaller islands in the original database. To address this limitation, innovative approaches were adopted, including the integration of multiple data sources and the use of advanced mapping techniques. Special attention was also given to sensitive areas particularly the maritime boundary between India and Sri Lanka—to ensure the accuracy and integrity of the final outcome.

As we present the findings of this re-computation, we gratefully acknowledge the collective efforts of all those involved from field surveyors to GIS specialists whose dedication and expertise made this achievement possible. We also extend our sincere appreciation to the stakeholders and partner institutions whose invaluable support and collaboration greatly contributed to this process.

It is our earnest hope that this report will serve not only as a benchmark for accurate geographic data but also as a vital resource for informed decision-making, sustainable development, and peaceful coexistence in Sri Lanka and the wider region. As we look ahead, let us continue to uphold the highest standards of professionalism, integrity, and innovation in our ongoing pursuit of excellence in surveying and mapping.

Surveyor General

Survey Department of Sri Lanka

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1. Introduction

1.1 Background of the Study

Sri Lanka, a continental island situated in South Asia, lies in the Indian Ocean southwest of the Bay of Bengal and southeast of the Arabian Sea. According to Article 121 of the United Nations Convention on the Law of the Sea (UNCLOS), an island is defined as a naturally formed area of land, surrounded by water, which remains above water at high tide. As an island nation, Sri Lanka's maritime claims include a territorial sea of 12 nautical miles (nm), a contiguous zone of 24 nm, an exclusive economic zone (EEZ) extending up to 200 nm, and a continental shelf of 200 nm or to the edge of the continental margin, as outlined in international maritime law.

A clearly defined and accurately measured land area is essential for any country to support national planning, policy formulation, and scientific research. In Sri Lanka's case, the officially accepted land area has long been cited as 25,332 square miles or 65,610 square kilometers. However, the original basis for this widely accepted figure remains unclear, and it has been used for decades without documented verification or recalculation using modern techniques.

Historically, the Ceylon Blue Books, published annually from 1821 to 1937 during the British colonial period, served as comprehensive statistical records encompassing population data, trade figures, land use, and administrative details. These reports often included estimates of the island's extent under sections such as "Land and Agriculture" or "Statistical View of the Progress of Ceylon." Although precise numerical values from these publications are not always readily available, multiple sources indicate that the figure of 25,332 square miles (65,610 km²) was consistently referenced and gradually adopted as the de facto standard in official records.

In the mid-1980s, the Centre for Remote Sensing of the Sri Lanka Survey Department (SLSD) undertook efforts to re-calculate Sri Lanka's Extent using new methods. The study conducted by Somasekaram, T. and Sangakkara, S. M. P. P. (1986) utilized an "electronic area meter" in combination with a base map at the scale of one inch to one mile. This approach yielded a revised figure of 65,150 km². Interestingly, another map produced by the SLSD specifically a forest map recorded a slightly different area of 65,110 km².

To address these discrepancies, the researchers employed a triangulation method for further verification, which resulted in a new estimate of 65,525 km². Despite these findings, none of the revised figures were officially published or adopted, and the traditional value of 65,610 km² continued to be recognized as the country's official land extent.

In view of these historical inconsistencies and with advancements in geospatial science, the Survey Department of Sri Lanka initiated a formal re-computation of the country's area. Utilizing high-resolution digital base maps, geographic information system (GIS) technology, and the latest geodetic standards, this effort aimed to derive a more accurate, transparent, and scientifically grounded measure of Sri Lanka's total land area. The outcome of this re-computation will not only enhance national datasets but also support evidence-based decision-making across a wide range of administrative, economic, and environmental sectors.

1.2 The Need for Re-Computation

Accurate determination of a country's extent is fundamental to informed decision-making, effective governance, disaster preparedness, and national planning. For Sri Lanka, the traditionally accepted total land area has long been cited as 65,610 square kilometers. However, the original methodology or data sources that led to this figure remain undocumented, raising questions about its validity in today's context.

In recent history, Sri Lanka has experienced a series of natural and anthropogenic changes that may have affected the physical extent of its territory. The country's vulnerability to natural hazards—particularly tsunamis, landslides, and coastal erosion—is on the rise. Notably, the 2004 Indian Ocean tsunami caused considerable coastal transformation, while ongoing development projects such as the Olivil and Hambantota harbours and the Colombo Port City have led to significant modifications along the shoreline. These incidents have contributed to a growing perception among the public, administrators, and researchers that the country's land extent may have changed, warranting a fresh and authoritative reassessment.

Furthermore, under the Survey Act, No. 17 of 2002, the Surveyor General is entrusted with the legal responsibility for all surveying and mapping activities in Sri Lanka. One of the key mandates of the Surveyor General is the calculation and official declaration of the country's total land area. In fulfilling this obligation, the department produces and maintains national spatial datasets at various scales and accuracies. Recognizing the importance of up-to-date spatial information, and responding to national requirements, the Survey Department has undertaken a re-computation of Sri Lanka's land area.

This initiative also directly supports coordination with the Department of Census and Statistics, which relies on accurate and current land extent figures for population density calculations, land use analysis, and national development planning. The lack of clarity surrounding the historical figure and the notable geographical changes that have occurred in recent decades further justify the need for this effort.

By utilizing modern geospatial technologies, high-resolution base maps, and current administrative boundaries, the Survey Department aims to provide a scientifically verified and legally defensible measurement of the country's total land area. This re-computation is not only essential for addressing historical uncertainties, but also vital for ensuring national datasets reflect the contemporary physical and administrative landscape of Sri Lanka.

1.3 Objective of the study

The primary objective of this study is to more accurately determine the Country extent of Sri Lanka using modern geospatial technologies and standardized methodologies. In alignment with the legal responsibilities of the Survey Department under the Survey Act, No. 17 of 2002, this re-computation aims to produce a scientifically validated figure that reflects the present-day physical and administrative extent of the country.

1.3.1 The specific objectives

- i. To re-calculate the total extent of Sri Lanka using up-to-date digital base maps and geospatial datasets, ensuring accuracy, consistency, and transparency in the methodology.
- ii. To collect and validate geospatial data such as national boundaries, inland waters, and baseline definitions.
- iii. To compute the updated area using GIS-based tools and international standards.
- iv. To prepare an official report and data set for future reference and policy-making.

1.4 Expected Outcomes

Updated and Verified Country Extent: A precisely recalculated total extent of Sri Lanka using the available geospatial datasets in Sri Lanka Survey Department, replacing the long-standing figure of 65,610 sq.km.

Evidence-Based National Boundary Definition: A clearly delineated and technically supported national boundary, taking into account physical coastal changes, natural events (e.g., tsunami), and man-made developments (e.g., harbors, reclaimed lands).

Standardized and Reproducible Methodology: A detailed methodological framework for area computation that adheres to modern cartographic and geodetic standards, usable for future boundary reviews and national updates.

Reliable Data for National and Sectoral Planning: Accurate, authoritative area statistics made available to key agencies such as the Department of Census and Statistics, Disaster Management Centre, and other national planning bodies.

Support for Legal, Administrative, and International Reference: A legally and scientifically sound figure for Sri Lanka's area that can be adopted for use in legislation, administrative records, and international reporting.

Increased Institutional and Public Confidence: Enhanced credibility and trust in the Survey Department's capabilities and outputs through transparent, evidence based geospatial analysis.

1.5 Deliverables

Technical Report: detailing the background, methodology, results, and recommendations of the area re-computation study.

Updated Digital Data set: in GIS-compatible formats (e.g., Shapefile, KML).

2. Literature Review

Accurate national area computation depends on the interplay of geodesy, cartographic conventions, legal definitions, and natural coastal dynamics. This review compiles foundational concepts and authoritative definitions that guide the re-computation of Sri Lanka's total area.

2.1 Geodetic and Cartographic Foundations

Mapping the Earth, which is curved and oblate spheroidal, onto flat surfaces requires projections that inevitably introduce distortions in shape, area, distance, or direction (Snyder, 1987). For Sri Lanka, the **Transverse Mercator projection** is most appropriate, providing minimal distortion for the country's elongated north-south alignment (Survey Department of Sri Lanka, 1993).

From a geodetic perspective, the most accurate representation of a country's area is: “**The area of the curved surface obtained by projecting the physical surface onto the Geoid, which corresponds with the Mean Sea Level (MSL).**”

The **geoid**, a surface coinciding with the mean sea level, represents the Earth's gravity field and minimizes vertical and topographic distortions (Hofmann-Wellenhof & Moritz, 2006). It forms the most reliable base for national area calculations.

2.2 Definitions of Boundaries

2.2.1 Country Boundary

As outlined in cartographic principles by the Survey Department of Sri Lanka (Sciambi, 1993), the **country boundary**, especially in tidal areas, is defined by the **mean high-water line**, representing the average high tide level over time. This delineation is essential in defining the legal land extent and resolving ambiguities in coastal zones affected by erosion, sedimentation, and coastal development.

2.2.2 Shoreline

The **shoreline** refers to the real-time boundary between land and water, shifting with tidal activity and coastal changes. It is a dynamic feature that differs from fixed cartographic boundaries (Boak & Turner, 2005).

2.2.3 Coastal Line

The **coastal line** broadly represents the interface between terrestrial landmasses and marine environments. While often used synonymously with the shoreline, in this study, the coastal line refers more generally to the land-sea boundary (International Hydrographic Organization [IHO], 2019).

2.3 Definitions of Baselines and Maritime Zones

Under the **United Nations Convention on the Law of the Sea (UNCLOS)**, baselines are the reference from which all maritime zones are measured (United Nations, 1982).

Sources:

https://upload.wikimedia.org/wikipedia/commons/a/ae/Maritime_Zones_under_International_Law.png

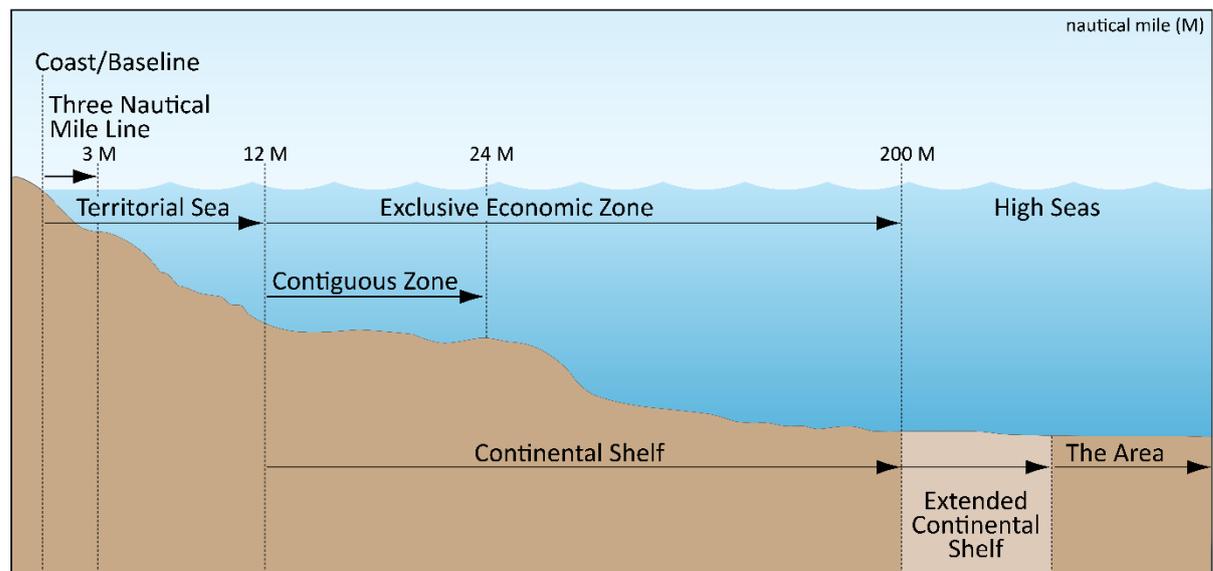


Figure 1: Maritime Zones Under International Law

2.3.1 Normal Baselines

Normal baselines follow the low-water line along the coast as marked on large-scale, officially recognized nautical charts. They serve as the default starting points for delimiting maritime zones such as the Territorial Sea, Contiguous Zone, Exclusive Economic Zone (EEZ), and Continental Shelf (United Nations, 1982; Bateman, 2011).

2.3.2 Straight Baselines

In areas where the coast is deeply indented or fringed with islands, straight baselines may be drawn by connecting fixed points along the low-water line. This simplifies baseline demarcation in irregular geographies and is permissible under international law (United Nations, 1982; Bateman, 2011).

2.3.3 Nautical Mile

A nautical mile is defined as one minute of arc along a meridian of latitude and equals 1,852 meters (International Hydrographic Organization [IHO], 2019).

2.3.4 Maritime Boundary

A maritime boundary legally demarcates a nation's jurisdiction over adjacent marine spaces, regulating rights over exploration, resource management, environmental protection, and national security (United Nations, 1982; Prescott & Schofield, 2005).

2.3.5 Regime of Islands (UNCLOS Article 121)

According to Article 121 of UNCLOS, an island is a naturally formed landmass, surrounded by water, and above water at high tide. Rocks that cannot sustain human habitation or economic life do not qualify for an EEZ or continental shelf (United Nations, 1982). This distinction was reaffirmed in international maritime adjudications (International Court of Justice [ICJ], 2012).

2.3.6 Territorial Sea (12 nm)

The Territorial Sea extends up to 12 nautical miles from the baseline. A state has full sovereignty over this zone—including the airspace above and the seabed below—similar to its land territory (United Nations, 1982).

2.3.7 Contiguous Zone (24 nm)

Extending up to 24 nautical miles from the baseline, excluding the territorial sea, is called the Contiguous Zone. It allows a coastal state to enforce regulations relating to customs, taxation, immigration, and sanitation (United Nations, 1982).

2.3.8 Exclusive Economic Zone – EEZ (200 nm)

The Exclusive Economic Zone (EEZ) reaches 200 nautical miles from the baseline. Within this zone, a state has exclusive rights over marine resources, energy production, scientific research, and environmental preservation (United Nations, 1982).

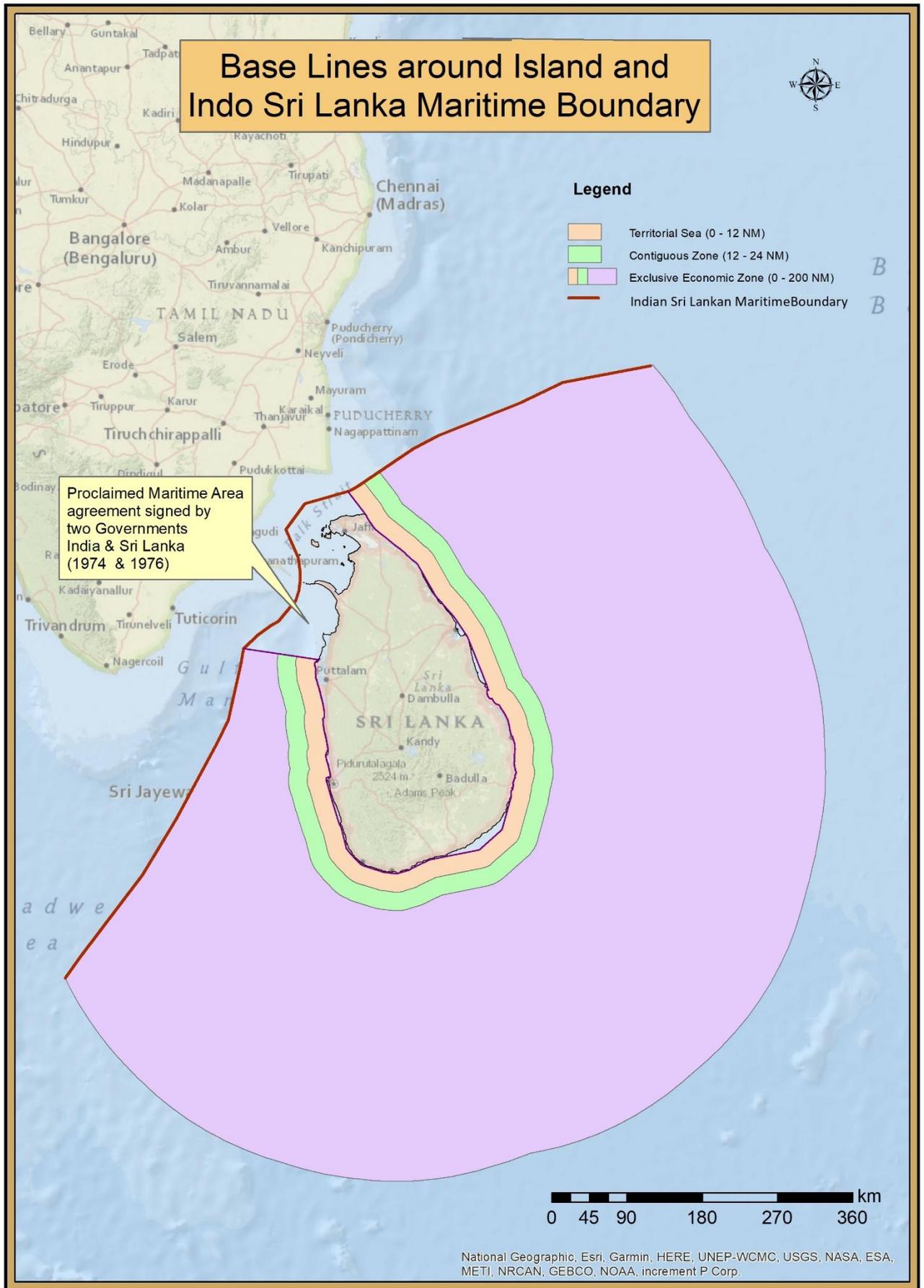


Figure 2 : Maritime Boundaries of Sri Lanka (UNLCOS)

2.3.9 Legal Definition of Bays and the Semi-Circle Test

The **Territorial Sea and Exclusive Economic Zone (TS/EEZ) Act – Section 6** defines criteria for a coastal indentation to qualify as a **bay**, which may be legally enclosed using baselines:

"An indentation in an area of coastline that has an area as large as, or larger than, that of the semi-circle whose diameter is a line of 24 nautical miles drawn across the mouth of that indentation."

Key interpretations and visual clarifications include:

If the **area of the bay** is less than that of the semicircle, the bay **cannot be closed**.

If the bay's area is **larger**, it **can be closed** using a straight baseline.

When the **mouth of the bay exceeds 24 nautical miles (nm)**, a closure may still be valid by locating a point where the width narrows to 24 nm, as long as the semicircle area test is satisfied.

Islands within the indentation contribute to the total area of the bay and count toward the semicircle test.

These provisions are essential in delineating **internal waters**, establishing **territorial sea boundaries**, and protecting **sovereign rights** over strategic bays and inlets.

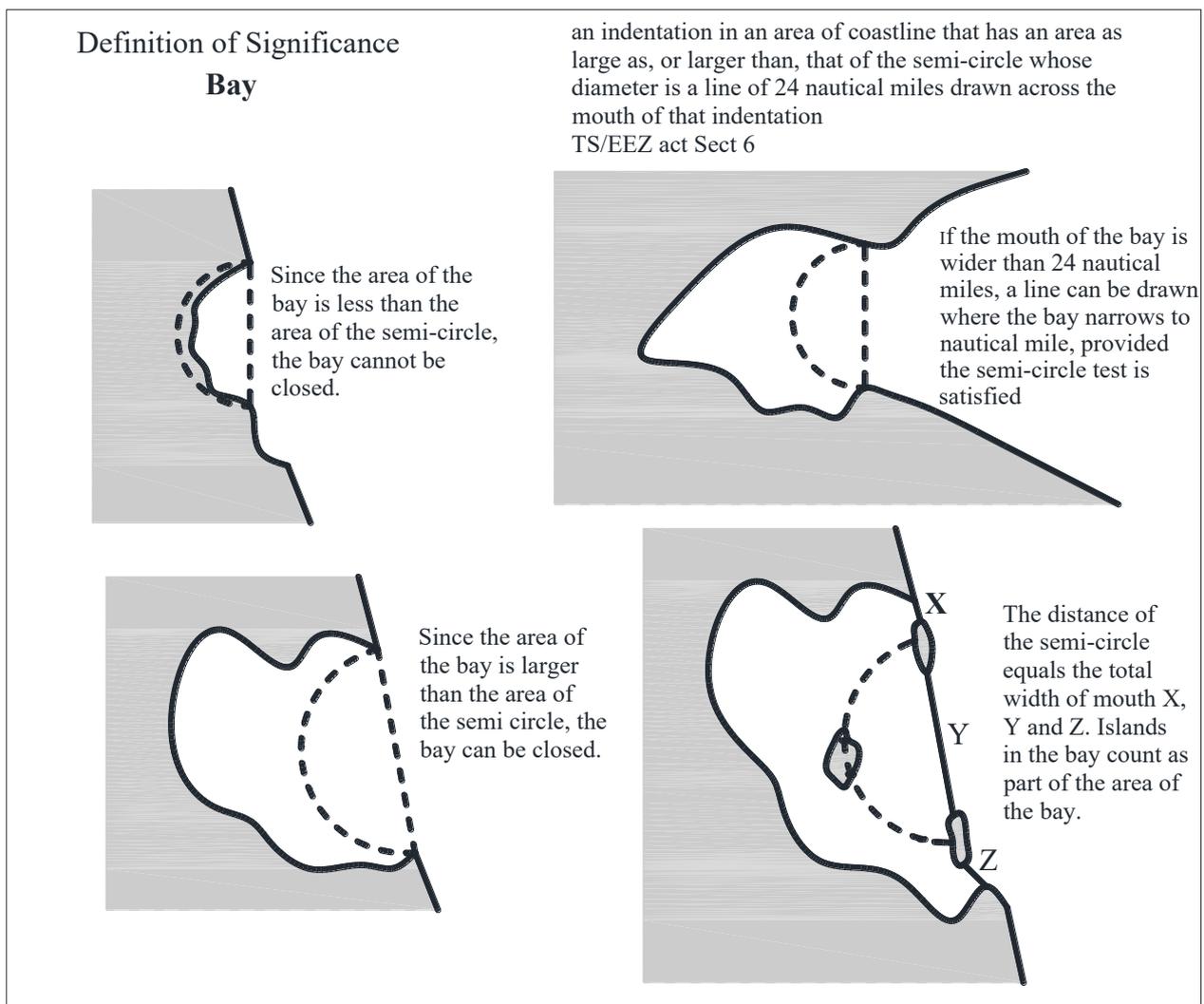


Figure 3 : Definition of Significance Bay

2.4 Relevance to Sri Lanka's Area Re-Calculation

Sri Lanka's coastal boundary has evolved due to natural and anthropogenic changes, requiring systematic updates. This study applies the above principles to:

- i **Re-establish** national boundary lines using high-resolution spatial data.
- ii **Confirm and document** shoreline shifts and coastal developments.
- iii **Legally interpret** and apply UNCLOS and national legislation to maritime boundaries.
- iv **Ensure consistency** between terrestrial and marine extents in national databases.

By applying these well-established legal, geodetic, and cartographic definitions, the study aims to generate a legally defensible and scientifically accurate total area for Sri Lanka.

3. Methodology

Calculating the extent of a country involves delineating the outer boundaries of its national territory and measuring key geographic characteristics, such as minimum bounding coordinates, area, length, width, and geodetic extents. This is typically performed within a Geographic Information System (GIS) using data sources such as LiDAR, aerial photographs, satellite imagery and ground survey. A combination of these sources is often used for enhanced accuracy.

For Sri Lanka a geographically isolated island the national boundary is primarily defined using the **hydro line**, which represents the transition between land and water bodies. This natural boundary is especially relevant in coastal and riverine areas. Through the analysis of satellite imagery, topographic maps, and hydrological data, the extent of the country was precisely mapped.

The **1:50,000 scale Version 2.1 (50K V2.1)** vector dataset was used to recompute Sri Lanka's extent. This dataset, maintained by the **Survey Department of Sri Lanka**, provides standardized, updated geospatial layers including coastlines boundaries and water bodies. It forms the foundational dataset for national GIS and cartographic activities, supporting a broad range of applications such as:

- **Topographic Mapping** – Produces detailed maps for various stakeholders including government and private entities.
- **Spatial Analysis** – Enables land use planning, disaster risk assessment, environmental monitoring, and infrastructure development.
- **Data Integration** – Acts as a geospatial reference framework for aligning various thematic datasets.
- **Decision Support** – Provides accurate spatial context for policy-making and national planning.
- **Inter-agency Collaboration** – Ensures interoperability and standardized data sharing across institutions.

3.1 Use of Water Line

The shoreline from the 50K V2.1 dataset was used as the basis for computing the national extent. This shoreline is derived from authoritative imagery and field surveys, ensuring consistency and suitability for cartographic, statistical, and internal planning purposes.

However, this approach has **limitations**, including:

- **Natural variation** due to tides, erosion, or accretion.
- **Temporal inconsistencies** from differences in data capture times.
- **Legal limitations**, as this shoreline may not align with international maritime boundaries such as Exclusive Economic Zones (EEZs).

Thus, while this method is practical for defining Sri Lanka's physical extent on land, legal delineations must rely on maritime boundary definitions under international law.

3.2 Bays and Lagoons

Bay Closing Line – Semi-Circular Rule:

A water body is considered a bay if its area is equal to or greater than that of a semicircle drawn across the mouth, with the diameter equal to the mouth's width.

Lagoon and Island Delineation:

These features are mapped and defined following **Article 121 of the United Nations Convention on the Law of the Sea (UNCLOS)**, as detailed in sections 2.3.5 and 2.3.9 of this report.

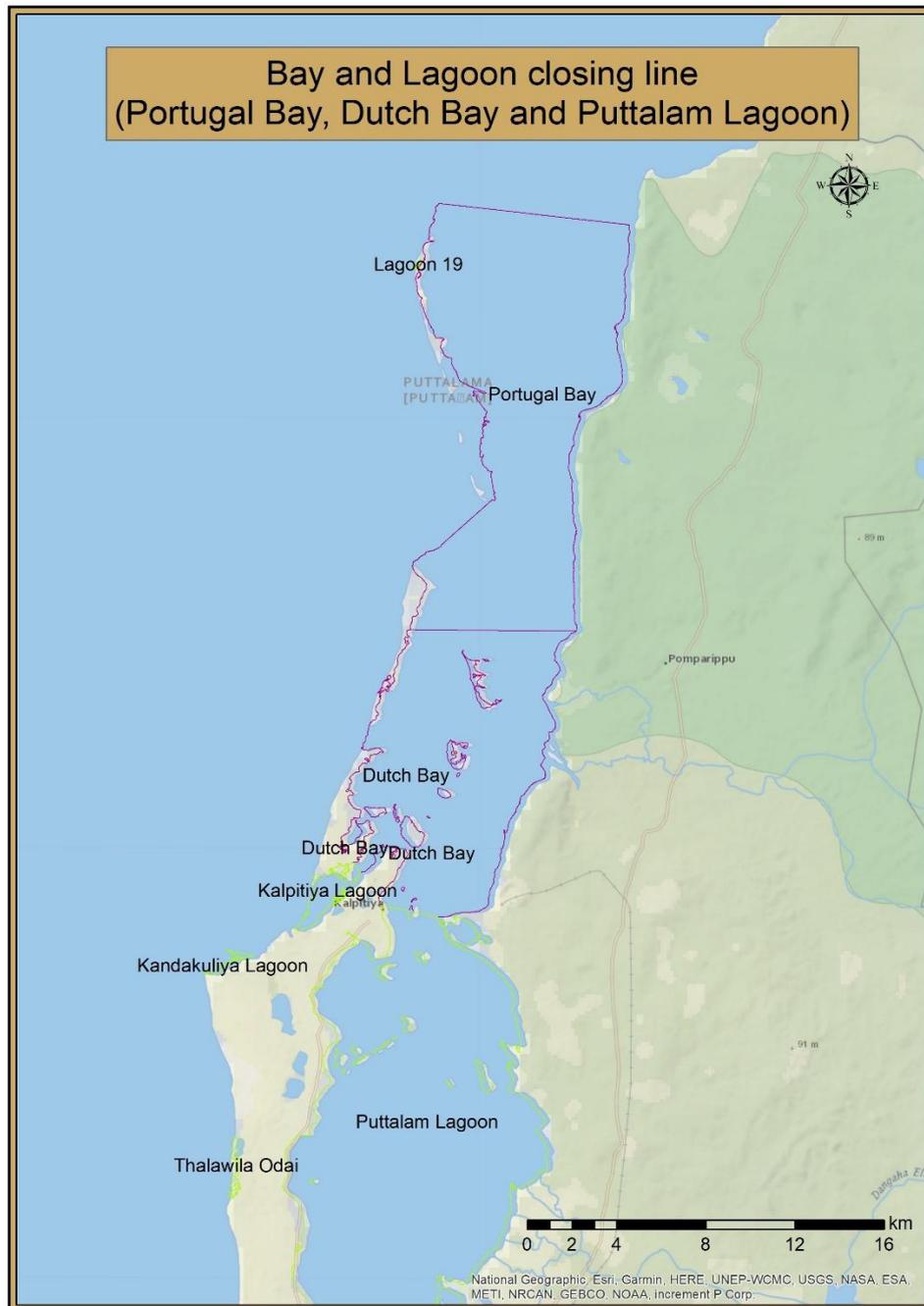


Figure 4 : Portugal Bay, Dutch Bay and Puttalam Lagoon

3.3 Coordinate System

A coordinate system is fundamentally important for calculating a country's spatial extent because it provides a consistent framework for identifying, measuring, and analyzing geographic locations on the Earth's surface. The Coordinate Reference System (CRS) determines how spatial data is projected and measured on the Earth's surface. Accurate area and extent calculations depend heavily on using the correct CRS.

CRS defines how spatial features are referenced, ensuring that all data aligns correctly on a map or within a Geographic Information System (GIS).

Moreover, coordinate systems ensure consistency across multiple datasets such as administrative boundaries, hydrography, land use, and infrastructure allowing them to be overlaid and analyzed together accurately. In legal, administrative, and planning contexts, the reliability of extent calculations and boundary definitions depends on the correct use of a standardized coordinate system, making it an essential component of all spatial data management and geospatial analysis activities.

You can use the coordinate system of the data source or of the data frame when performing calculations. In addition, if one or more records are currently selected, only the selected records are calculated.

Parameters for Coordinate Reference System (CRS) of the data.

SLD99 Sri Lanka Grid 1999

WKID	: 5235 Authority: EPSG
Projection	: Transverse Mercator
False Easting	: 500,000.0
False Northing	: 500,000.0
Central Meridian	: 80.77171308333334
Scale Factor	: 0.9999238418
Latitude of Origin	: 7.000471527777778
Linear Unit	: Meter (1.0)

3.4 Calculation Method

To calculate the extent of a country that is an Island, the most optimal method depends on the precision needed, tools available and format of the input data. However, in most GIS context, the boundary extent refers to the minimum bounding rectangle or geographic extent that completely encloses the Island.

The optimal method in GIS terms is using a vector polygon data (country boundary outline shape file) to calculate the extent. The software used for this calculation is Arc GIS version 10.3.

3.5 Accuracy Assessment

3.5.1 Using 10K dataset

To evaluate the accuracy of the country extent derived from the 1:50,000 scale (50K V2.1) dataset, a comparison was made with high-resolution geospatial data at a 1:10,000 scale (10K). The 10K dataset, which offers finer spatial detail and improved positional accuracy, serves as a reference benchmark for assessing the reliability of the country outline generated from the 50K dataset.

- **10K-derived total land extent:** 67,135.0 km²
- **Greater precision** due to capture of minor geographic features such as small islands and coastline indentations.

However:

- The total land extent of Sri Lanka calculated from the 1:10,000 scale dataset was 67,135.0 km².
- This figure is considered a more precise estimate of the actual land area due to the higher spatial resolution of the 10K dataset, which captures intricate coastline details, small islands, and minor indentations more accurately than lower-resolution datasets.

3.5.2 Findings and Implications

- The existing 10K dataset is not conformal and consist of different data sources hence not considered for calculating the country extent.
- Any discrepancy between the 50K-based and 10K-based extents can largely be attributed to scale generalization inherent in the 1:50,000 dataset, where fine geographic features may be simplified or omitted.
- The difference between the two datasets highlights the trade-off between scale and detail, while the 50K dataset is appropriate for national-scale applications, the 10K dataset provides higher precision suitable for local-level analysis and engineering-scale applications.
- The minimal variance between the calculated extents suggests that the 50K V2.1 dataset still provides a reasonably accurate representation of the country's boundary for most planning and analytical purposes, though it should be supplemented with finer-scale data when accuracy is critical.

The comparison confirms that the country extent derived from the 1:50,000 dataset is sufficiently accurate for medium to large scale geospatial analysis. However, for high precision applications such as coastal management, cadastral mapping, or legal delineation of boundaries the 1:10,000 data provides a more accurate and detailed reference.

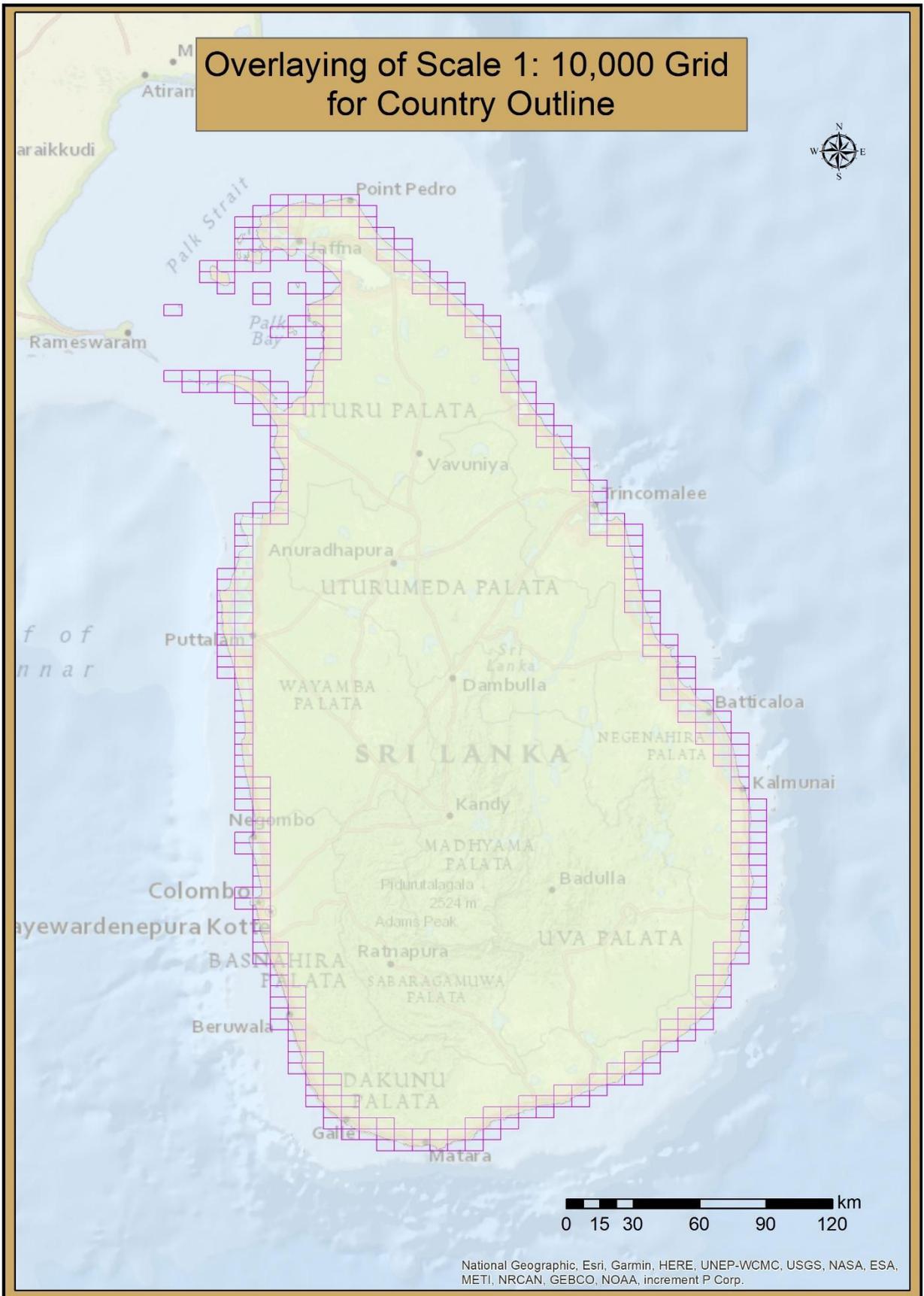


Figure 5 : Overlaying 1:10,000 Sheet to Country Outline

4. Results

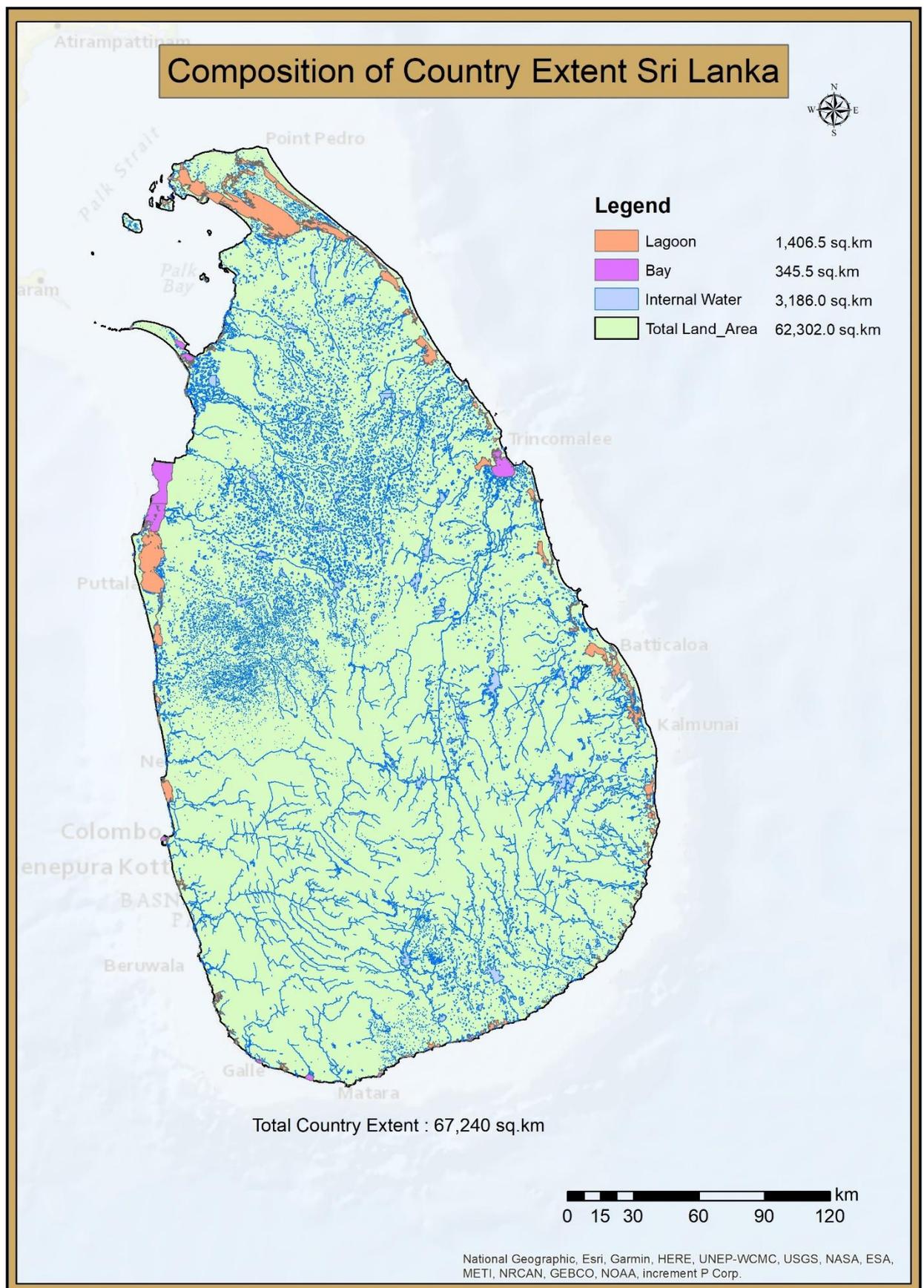


Figure 6 : Composition of Country Extent



Figure 7 : Lagoons of Sri Lanka

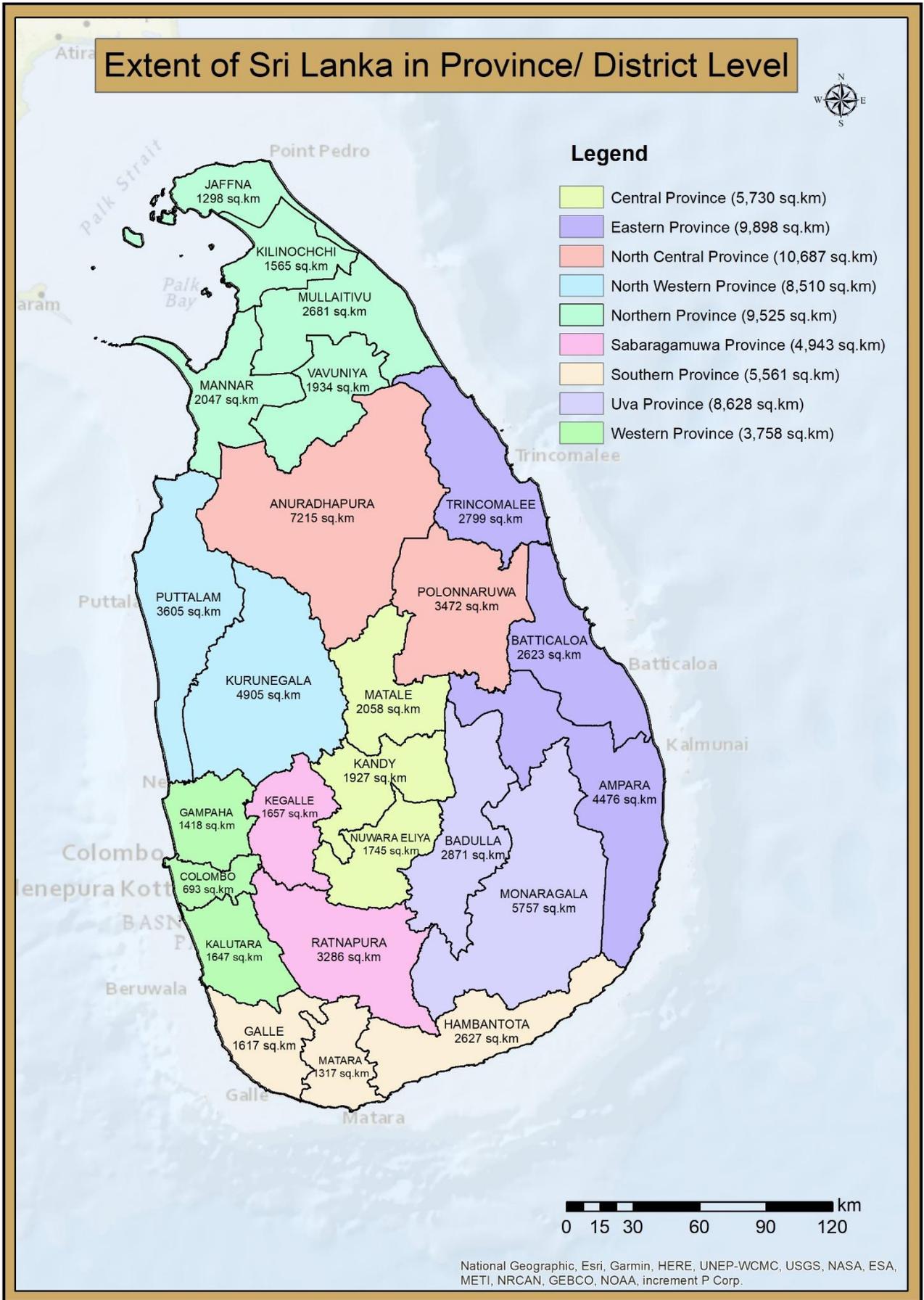


Figure 9 : Area Distribution in to Province/ District

Table 1 : Area Distribution in to Province/ District

PROVINCE	DISTRICT	Extent (Sq.km)
CENTRAL	KANDY	1927
	MATALE	2058
	NUWARA ELIYA	1745
EASTERN	AMPARA	4476
	BATTICALOA	2623
	TRINCOMALEE	2799
NORTH CENTRAL	ANURADHAPURA	7215
	POLONNARUWA	3472
NORTH WESTERN	KURUNEGALA	4905
	PUTTALAM	3605
NORTHERN	JAFFNA	1298
	KILINOCHCHI	1565
	MANNAR	2047
	MULLAITIVU	2681
	VAVUNIYA	1934
SABARAGAMUWA	KEGALLE	1657
	RATNAPURA	3286
SOUTHERN	GALLE	1617
	HAMBANTOTA	2627
	MATARA	1317
UVA	BADULLA	2871
	MONARAGALA	5757
WESTERN	COLOMBO	693
	GAMPAHA	1418
	KALUTARA	1647
TOTAL		67240



Figure 10 : Dimensions of the Country

5. Conclusion

As there is no verifiable source for previously published extent computations of Sri Lanka, it was decided to compute the country's extent using advanced modern technology and recent data available on digital platforms to ensure the accuracy and reliability.

The Survey Department possesses a recent digital dataset, 1:50,000 Version 2.1, and was used for the computation of the country's extent. In this dataset, the shoreline was digitized from satellite images captured between 2018 and 2020 to define the country's outline accurately.

International boundary definitions were applied to determine the outline of the country to be utilized for the computation. Bay Closure Rules, defined under UNCLOS (e.g., a bay is enclosed if its mouth is less than 24 nautical miles) were used to determine the closure or openness of bays (bay mouths) along the coast. This computation included all the islands located within the vicinity of the main island.

The total area of Sri Lanka, including all islands, lagoons, and bays, is 67,240 sq.km. The composition of this total area is as follows:

- Area of Lagoons : 1,406 sq.km (115 lagoons)
- Area of Bays : 345 sq.km (62 bays)
- Area of Main Island : 65,120sq.km
- Area of other islands (excluding main island) : 369 sq.km (296 Islands)

This updated computation provides a more precise and scientifically validated assessment of Sri Lanka's geographical extent, utilizing advanced digital platforms for enhanced accuracy.

6. Recommendations

1. Periodically Updates Using Advanced Technology
 - The country's extent should be periodically reassessed using the latest satellite imagery and GIS technology to account for natural changes such as coastal erosion, sea level rise.
2. Standardization of Computation Methods
 - A standardized methodology should be developed and documented to ensure consistency in future extent computations. This will enhance comparability and reliability over time.
3. Consideration of Climate and Environmental Factors
 - In future computations, its required to take into account the influence of coastal dynamics, sea-level changes, and environmental modifications when determining the country's extent.
4. Alignment with International Standards
 - Ensure that all data, measurement techniques and reporting formats conform to internationally recognized geographical and cartographical standards.
5. Collaboration with Relevant Authorities
 - Strengthen coordination among the Survey Department, coastal management agencies and research institutions to share data, expertise, and verification processes.

These recommendations will enhance the credibility, accuracy and usefulness of Sri Lanka's geographically calculated area for policy-making, land management and scientific research.

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