

Terms of reference (ToR) for the procurement of services below the EU threshold

CONFIDENTIAL

Integrated Land and Seascape Indicator Dashboard Development	Project number/ cost centre: G-011982-004
	Tender number 10031407

0.	List of abbreviations	2
1.	Context.....	3
2.	Tasks to be performed by the contractor	4
3.	Concept.....	7
	Technical-methodological concept	7
	Project management of the contractor (1.6)	7
	Further requirements (1.7).....	8
4.	Personnel concept.....	8
	Team leader - Dashboard Architect (1 person).....	8
	Key expert 1: Programmer Expert (1 person)	9
	Key expert 2: Dashboard Designer (1 person).....	9
	Key expert 3: GIS and Data integration expert (1 person)	10
	Key expert 4: System Operations Expert (1 person).....	10
5.	Costing requirements	11
	Assignment of personnel and travel expenses	11
	Sustainability aspects for travel	11
	Workshops, events and trainings.....	13
6.	Inputs of GIZ or other actors.....	13
7.	Requirements on the format of the tender	13
8.	Annexes	13
	Integrated Land and Sea Management Performance (Year)	14
	Administrative Area (Province, District/City, Village).....	15
	Performance Summary: Total Score, Status, Color	17
	Recommendations	18

0. List of abbreviations

AG	Commissioning party
AN	Contractor
AVB	General Terms and Conditions of Contract for supplying services and work
FK	Expert
FKT	Expert days
KZFK	Short-term expert
LaS	Landscape and Seascape
ToRs	Terms of reference
UI/UX	User Interface/User Experience

1. Context

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is an international cooperation enterprise for sustainable development with worldwide operations on behalf of the German Government. We work to shape a future worth living in over 120 countries around the world.

The project “Solutions for Land- and Seascape Management in Indonesia (SOLUSI)” aims at developing and deploying an ecosystem approach for land and seascapes in three regions in Indonesia. As such, its focus lies on biodiversity conservation and ecological restoration, including efforts to strengthen the sustained provision of eco-system services, strengthen blue and green economies as pathways to sustainable development, including agroforestry, aquaculture, and the promotion of ecotourism. SOLUSI promotes enhanced climate-resilient livelihoods through public-private-community partnership (PPCP), policies, and investments and facilitates learning among partner provinces and scaling-up to others using an inter-provincial knowledge sharing platform. This project is a partnership between the Government of Germany (BMUKN) and the Government of Indonesia (BAPPENAS) and will be implemented by a consortium consist of GIZ, ICRAF, SNV, and Yayasan KEHATI Indonesia.

SOLUSI project will achieve its objectives through 4 main outputs: (1) National policies and guidelines on LaS development incorporating the aspect of climate resilience and biodiversity are developed and provide support for innovative development models and planning processes at the national and sub-national levels. (2) Innovative financing and investment mechanisms for integrated LaS management are designed for the national and sub-national levels. (3) LaS planning laboratories which integrate the nexus on climate resilience, biodiversity and development, are implemented at national and sub-national levels. (4) Key stakeholders have improved their capacity and knowledge on integrated LaS management are able to promote and share experiences.

As part of the implementation of the SOLUSI Project, particularly under Output 1, the project has initiated the development of an Integrated Land and Seascape (LaS) Indicator Dashboard. This dashboard is intended to support evidence-based decision-making by policymakers and planners through the integration of land-based and marine indicators at the watershed scale, recognizing the ecological connectivity between upstream and downstream systems. This also supports Output 4 in the context of capacity development for integrated Land and Seascape (LaS) management, including training for government users to operate and manage the dashboard in the future.

The dashboard will serve as a strategic planning and monitoring tool to assist decision makers in designing, prioritizing, and aligning integrated programmes and interventions across sectors. By consolidating relevant biophysical, socio-economic, and governance indicators into a single, accessible online platform, the dashboard is expected to enhance coordination, improve data transparency, and strengthen the effectiveness of integrated land–sea management approaches promoted under the SOLUSI Project.

In this context, this Terms of Reference (ToR) has been prepared to enable the procurement of expert consultancy services to support the design, development, and operationalization of the online Integrated Land and Seascape Indicator Dashboard for SOLUSI. The consultancy will provide the necessary technical expertise to ensure the dashboard is functional, user-friendly, scalable, and aligned with project objectives and stakeholder needs.

2. Tasks to be performed by the contractor

The contractor is responsible for providing the following services:

1. Preparation and Planning

The contractor shall undertake the following activities during the preparation and planning phase:

- Review relevant SOLUSI Project documents, Output 1 results framework, indicator lists, existing land, watershed, and seascape datasets.
- Conduct technical and functional requirement assessments through consultations with the SOLUSI Project team and relevant stakeholders.
- Define clear dashboard use cases for policy, planning, monitoring, and reporting at the watershed scale.
- Develop a detailed technical design document, including:
 - System architecture and technology stack
 - Data flow and integration mechanisms
 - Security and access control framework
 - Hosting, scalability, and performance considerations
- Prepare an inception report and implementation workplan with milestones, deliverables, and risk mitigation measures.

2. Online-Based Structure Development

The contractor shall design, develop, and deploy the online-based Integrated Land and Seascape (LaS) Indicator Dashboard, including:

- Develop a web-based dashboard platform accessible via standard web browsers without proprietary software dependencies.
- Design a modular and scalable dashboard architecture that supports:
 - Visualization of land, watershed, and marine indicators
 - Spatial and non-spatial data (maps, charts, tables, and dashboards)
 - Upstream–downstream and land–sea connectivity analysis
- Develop user-friendly UI/UX designs appropriate for government decision makers and technical users.
- Integrate agreed datasets and indicators, including automated or semi-automated data update mechanisms where feasible.
- Ensure compliance with open standards and interoperability principles to facilitate future system integration.

3. Operations, User Management, and Maintenance

The contractor shall establish robust operational and maintenance mechanisms, including:

- Develop a role-based user management system, defining user levels (e.g. administrator, editor, viewer) and access rights.
- Implement system security measures, including authentication, authorization, and data protection protocols.
- Develop integrated analytical tools and indicators into the platform including trend analysis, status tracking, and scenario visualization
- Conduct comprehensive testing and validation (system testing, user acceptance testing, and data accuracy checks) with relevant stakeholders to ensure functionality, reliability, and usability in supporting LaS management monitoring and decision-making.
- Establish regular data and system backup procedures, including recovery mechanisms and documentation.

- Provide system maintenance support, including:
 - Bug fixing and performance optimization
 - System updates and version control
- Prepare and deliver standard operating procedures (SOPs), user manuals, and technical documentation.
- Conduct training sessions for designated SOLUSI personnel on system use and basic administration.

4. Transferability Assessment

The contractor shall ensure and assess the transferability and adaptability of the dashboard, including:

- Design the system using modular components to enable replication or adaptation to other platforms or contexts.
- Assess compatibility with other dashboards, data platforms, or government systems, including the ability to:
 - Export and import data using open formats
 - Integrate via APIs or other standardized interfaces
- Ensure all dashboard components, training materials, and documentation can be reused or adapted without significant reconfiguration.
- Deliver a transferability assessment report, outlining:
 - Technical requirements for replication
 - Dependencies and limitations
 - Recommendations for scaling or integration into other platforms

Certain milestones, as laid out in the table below, are to be achieved during the contract term:

Milestones/partial works	Deadline/ place/ person responsible	Criteria for acceptance	Estimated Payment
OUTPUT 1 Inception report and Technical Design Document a. Review LAS management and Indicator document, including indicators, datasets, and stakeholder requirements for the LaS Dashboard. b. Develop technical and interface design document covering system architecture, data flow, security, and dashboard framework and visual interface.	15 August 2026	• Assessment of different dashboards (ex: AKSARA), including clear transfer processes, technical requirements, and integration considerations for each platform. • Technical design covering system architecture, design interface and visuals, data flow, security framework, user access, and dashboard structure submitted • Dashboard interface and visual design developed with interactive data visualization features aligned with user needs.	Interim payment 1, after approved of output 1
OUTPUT 2 Web-Based Integrated LaS Dashboard	5 October 2026	• Dashboard accessible online and functional across standard web browsers.	Interim payment 2,

Developed and Operational - Develop and deploy a web-based dashboard for visualization of land, watershed, and marine indicators. - Integrate spatial and non-spatial datasets including maps, charts, tables, and trend analysis. - Develop responsive UI/UX and data update mechanisms for dashboard operation.		- User-friendly and responsive dashboard interface and visual design developed and operational, with interactive data visualization features aligned with user needs. - System testing and user acceptance testing completed and approved - Role-based user management, security, backup, and maintenance systems.	after approved of output 2
OUTPUT 3 Operational System, User Management, and Capacity Building - Develop SOPs, user manuals, and technical documentation. - Conduct training for User on dashboard operation and administration.	20 November 2026	- User management and security systems are fully operational and maintenance - SOPs, manuals, and technical documentation available. - Training participants demonstrate readiness to operate and manage the dashboard system independently	Interim payment 3, after approved of output 3
OUTPUT 4 Transferability and Integration Dashboard - Integrated dashboard operational within existing government platforms with demonstrated scalability, interoperability, and compatibility with external systems. - Develop data import/export and API integration recommendations using open standards.	30 May 2027	- Dashboard successfully integrated and functional within existing government platforms, including operational data exchange and compatibility with external systems. - Open-format data exchange and integration mechanisms documented. - Source Codes, configuration files and all developed materials handed over	Final payment, after approved of final report.

Period of assignment: from **20 July 2026** until **30 June 2027**.

3. Concept

In the tender, the tenderer is required to show *how* the objectives defined in Chapter 2 (Tasks to be performed) are to be achieved, if applicable under consideration of further method-related requirements (technical-methodological concept). In addition, the tenderer must describe the project management system for service provision.

Note: The numbers in parentheses correspond to the lines of the technical assessment grid.

Technical-methodological concept

Strategy (1.1): The tenderer is required to consider the tasks to be performed with reference to the objectives of the services put out to tender (see Chapter 1 Context) (1.1.1). Following this, the tenderer presents and justifies the explicit strategy with which it intends to provide the services for which it is responsible (see Chapter 2 Tasks to be performed) (1.1.2).

The tenderer is required to present the actors relevant for the services for which it is responsible and describe the **cooperation (1.2)** with them.

The tenderer is required to present and explain its approach to **steering** the measures with the project partners (1.3.1) and its contribution to the **results-based monitoring system** (1.3.2).

The tenderer is required to describe the key **processes** for the services for which it is responsible and create an **operational plan** or schedule (1.4.1) that describes how the services according to Chapter 2 (Tasks to be performed by the contractor) are to be provided. In particular, the tenderer is required to describe the necessary work steps and, if applicable, take account of the milestones and **contributions** of other actors (partner contributions) in accordance with Chapter 2 (Tasks to be performed) (1.4.2).

The tenderer is required to describe its contribution to knowledge management for the partner (1.5.1) and GIZ and to promote scaling-up effects (1.5.2) under **learning and innovation**.

Project management of the contractor (1.6)

The tenderer is required to explain its approach for coordination with the GIZ project. In particular, the project management requirements specified in Chapter 2 (Tasks to be performed by the contractor) must be explained in detail.

The tenderer is required to draw up a **personnel assignment plan** with explanatory notes that lists all the experts proposed in the tender; the plan includes information on assignment dates (duration and expert days) and locations of the individual members of the team complete with the allocation of work steps as set out in the schedule.

The tenderer is required to describe its backstopping concept. The following services are part of the standard backstopping package, which (like ancillary personnel costs) must be factored into the fee schedules of the staff listed in the tender in accordance with Section 3.1 of the GIZ AVB:

- Service-delivery control
- Managing adaptations to changing conditions
- Ensuring the flow of information between the tenderer and GIZ

- Assuming personnel responsibility for the contractor's experts
- Process-oriented steering for implementation of the commission
- Securing the administrative conclusion of the project

Further requirements (1.7)

The dashboard development process will integrate principles of **Gender Equality and Social Inclusion (GESI)** to ensure meaningful participation and representation of women, men, youth, and marginalized or vulnerable groups. The development methodology will apply an inclusive and participatory approach, incorporating gender- and inclusion-responsive measures such as disaggregated data collection, targeted stakeholder consultations, and participatory assessment methods. This approach is intended to ensure that diverse perspectives and user needs are adequately reflected in the dashboard design and functionality, resulting in outputs that are equitable, accessible, inclusive, and responsive to local contexts.

4. Personnel concept

The tenderer is required to provide personnel who are suited to filling the positions described, on the basis of their CVs (see Chapter 7), the range of tasks involved and the required qualifications.

The below specified qualifications represent the requirements to reach the maximum number of points in the technical assessment.

Team leader - Dashboard Architect (1 person)

Tasks of Team Leader:

- Provide overall technical leadership and coordination for the development of the Integrated LaS Indicator Dashboard.
- Lead system architecture design, ensure alignment with project objectives, and oversee delivery of all phases.
- Develop a detailed project plan, scope, timeline or roadmap
- Assign tasks and track progress using project tools
- Communicate with team and stakeholders
- Monitor risks, issues, and ensure quality standards

Qualifications of Team Leader:

- Education (2.1.1): Bachelor of Information Systems, Computer Science, Management or communication or other relevant study
- Language (2.1.2): C1 - level language proficiency in English
- General professional experience (2.1.3): 8 years of experience in leading the development of online dashboards or decision-support platforms
- Specific professional experience (2.1.4): 5 years of proven experience in the information system design, web-based platforms, or decision-support systems
- Leadership/management experience (2.1.5): 5 years of proven experience in leadership on similar projects
- Regional experience (2.1.6): *not applicable*
- Development co-operation experience (2.1.7): Experience in DC projects
- Other (2.1.8): *not applicable*

Key expert 1: Programmer Expert (1 person)

Tasks of Programmer:

- Develop and implement the online-based dashboard platform, including front-end and back-end components.
- Integrate datasets, visualizations, and APIs as defined in the technical design.
- Support system testing, deployment, and performance optimization.
- Enable and configure core modules
- Develop custom plugins, blocks, or modules based on specific needs.
- Create or modify themes to meet branding and UI/UX requirements.
- Conduct unit testing, integration testing, and regression testing.
- Identify and fix bugs related to functionality, layout, and performance.
- Monitor and maintain database integrity and backups.
- Implement automated backups and system monitoring scripts.

Qualifications of Programmer:

- Education (2.2.1): Bachelor of Computer Science, Information Technology, Software Engineering, Educational Technology or other degree in a related field
- Language (2.2.2): *not applicable*
- General professional experience (2.2.3): 5 years of proven experience in the field of programming and IT-related applications
- Specific professional experience (2.2.4): 5 years of proven experience in similar projects in the field of Web-based Dashboard development
- Leadership/management experience (2.2.5): *not applicable*
- Regional experience (2.2.6): *not applicable*
- Development co-operation experience (2.2.7) *not applicable*
- Other (2.2.8): *not applicable*

Key expert 2: Dashboard Designer (1 person)

Tasks of Dashboard Designer:

- Create infographics, animations, icons, and illustrations
- Customize dashboard themes to align with project branding
- Design branded course templates, certificates, and visual identities for learning modules
- Record and edit videos, screen captures, and voiceovers
- Optimize media for web-based dashboard

Qualifications of Dashboard Designer:

- Education (2.3.1): Bachelor of Graphic Design, Multimedia Arts, Digital Media, Visual Communication Design, or other degree in a related field
- Language (2.3.2): *not applicable*
- General professional experience (2.3.3): 5 years of proven experience in the field of graphic design
- Specific professional experience (2.3.4): 5 years of proven experience in similar projects in developing web-based dashboard
- Leadership/management experience (2.3.5): *not applicable*
- Regional experience (2.3.6): *not applicable*
- Development co-operation experience (2.3.7) *not applicable*
- Other (2.3.8): *not applicable*

Key expert 3: GIS and Data integration expert (1 person)

Tasks of GIS and Data Integration:

- Support the operationalization of the indicator framework through integration and harmonization of spatial and non-spatial datasets from multiple sources.
- Develop and manage spatial data layers, interactive maps, dashboards, and geospatial visualizations to support analysis, monitoring, and reporting.
- Data Analyst for Integrated Landscape and Seascape (LaS) Indicators
- Ensure data quality, consistency, interoperability, and alignment with agreed standards, metadata protocols, and governance requirements.
- Develop and maintain live-update spatial information systems for LAS indicators, including automated data integration and web-based GIS platforms for real-time monitoring and visualization.

Qualifications of GIS and Data Integration:

- Education (2.4.1): Bachelor of Geography, marine science, Environmental Science, or other degree in a related field
- Language (2.4.2): *not applicable*
- General professional experience (2.4.3): 8 years of proven experience in GIS, spatial analysis, or geospatial data management.
- Specific professional experience (2.4.4): 5 years of experience in integrating spatial datasets into online platforms, including the use of open-source GIS tools and web mapping technologies to support scalable, interactive, and user-friendly spatial data visualization and management systems.
- Leadership/management experience (2.4.5): *not applicable*
- Regional experience (2.3.6): *not applicable*
- Development co-operation experience (2.4.7) *not applicable*
- Other (2.4.8): *not applicable*

Key expert 4: System Operations Expert (1 person)

Tasks of System Operations:

- Establish system operations, user management, security, and maintenance procedures.
- Develop SOPs, user manuals, and technical documentation.
- Support the transferability assessment and system handover
- Lead training and knowledge transfer activities to users.
- Troubleshoot technical issues with users and developers

Qualifications of System Operations:

- Education (2.5.1): Bachelor of Computer Science, Information Systems, Network Administration, or other degree in a related field
- Language (2.5.2): *not applicable*
- General professional experience (2.5.3): 5 years of proven experience in the field of IT administrative management and platform management
- Specific professional experience (2.5.4): 5 years of proven experience in similar projects in the field of Web-based Dashboard operation, develop security system, and handover management
- Leadership/management experience (2.5.5): *not applicable*
- Regional experience (2.5.6): *not applicable*

- Development co-operation experience (2.5.7) *not applicable*
- Other (2.5.8): *not applicable*

Soft skills of team members

In addition to their specialist qualifications, the following qualifications are required of team members:

- Team skills
- Initiative
- Communication skills
- Socio-cultural skills
- Efficient, partner- and client-focused working methods
- Interdisciplinary thinking

5. Costing requirements

Assignment of personnel and travel expenses

Per diem allowances are reimbursed as a lump sum up to the maximum amounts permissible under tax law for each country as set out in the country table in the circular from the German Federal Ministry of Finance on travel expense remuneration (downloadable from the [German Federal Ministry of Finance – tax treatment of travel expenses and allowances for international business travel as of 1 January 2026 \(GERMAN ONLY\)](#)).

Accommodation allowances are reimbursed as detailed in the specification of inputs below.

With special justification, additional Accommodation costs up to a reasonable amount can be reimbursed against evidence.

All business travel must be agreed in advance by the officer responsible for the project

Sustainability aspects for travel

GIZ has undertaken an obligation to reduce greenhouse gas emissions (CO₂ emissions) caused by travel. When preparing your tender, please incorporate options for reducing emissions, such as selecting the lowest-emission booking class (economy) and using means of transport, airlines and flight routes with a higher CO₂ efficiency. For short distances, travel by train (second class) or e-mobility should be the preferred option.

CO₂ emissions caused by air travel must be offset. GIZ specifies a budget for this, through which the carbon offsets can be settled against evidence.

There are many different providers in the market for emissions certificates, and they have different climate impact ambitions. The [Development and Climate Alliance \(German only\)](#) has published a [list of standards \(German only\)](#). GIZ recommends using the standards specified there.

Specification of inputs

Fee days	Number of experts	Number of days per expert	Total	Comments
Designation of TL/key expert/short-term expert pool:				Based on deliverable
Team Leader : Dashboard Architect	1	60	60	
Key expert 1: Programmer Expert	1	80	80	
Key expert 2: Dashboard Designer	1	80	80	
Key expert 3: GIS and Data integration expert	1	80	80	
Key expert 4: System Operations Expert	1	80	80	
Travel expenses	Quantity	Number per expert	Total	Comments
Per-diem allowance in country of assignment				
Travel days	20	5	100	Lumpsum (2 trips, 2 days 8-24 hrs)
Full days	10	5	50	Lumpsum (2 trips @1 day)
Overnight allowance in country of assignment				
In Jabodetabek	10	5	50	Lumpsum Jabodetabek GIZ travel regulation (2 trips @2 days, 1 night)
Transport	Quantity	Number per expert	Total	Comments
Travel expenses (train, car)				Lumpsum
• Car Rental Jabodetabek	2	1 unit	2	(1 unit car for 2 event trips@ 1 days, 5 Persons)

Workshops, events and trainings

The contractor implements the following workshops/study trips/training courses:

- Focus Group Discussion
- Technical Meeting

6. Inputs of GIZ or other actors

GIZ and/or other actors are expected to make the following available:

- *In special cases*, workstations on GIZ premises are subject to prior approval
- Transportation on site with own project vehicle
- Logistics for workshops: Cover by own GIZ project cost

7. Requirements on the format of the tender

The structure of the tender must correspond to the structure of the ToR. In particular, the detailed structure of the concept (Chapter 3) should be organised in accordance with the positively weighted criteria in the assessment grid (not with zero). The tender must be legible (font size 11 or larger) and clearly formulated. It must be drawn up in English (language).

The complete tender must not exceed 10 pages (excluding CVs). If one of the maximum page lengths is exceeded, the content appearing after the cut-off point will not be included in the assessment. External content (e.g. links to websites) will also not be considered.

The CVs of the personnel proposed in accordance with Chapter 4 of the ToRs must be submitted using the format specified in the terms and conditions for application. The CVs shall not exceed 4 pages each. They must clearly show the position and job the proposed person held in the reference project and for how long. The CVs can also be submitted in English (language).

Please calculate your financial tender based exactly on the parameters specified in Chapter 5 Quantitative requirements. The contractor is not contractually entitled to use up the days, trips, workshops or budgets in full. The number of days, trips and workshops and the budgets will be contractually agreed as maximum limits. The specifications for pricing are defined in the price schedule.

8. Annexes

Dashboard Structure

The Integrated Land and Sea Management Performance Dashboard of Indonesia is developed as a comprehensive digital monitoring system to support the implementation of an integrated approach between terrestrial and marine ecosystems (Land-and-Seascape/LaS). This dashboard is designed to address the challenges of data fragmentation and governance that have long been obstacles to natural resource management in Indonesia, particularly in regions with strong ecological connectivity between watersheds, coastal areas, and marine environments. The dashboard will be piloting to cover three pilot provinces, namely the Bangka Belitung, Central Java, and Central Sulawesi. This dashboard presents 14 core indicators structured under 4 main principles: Positive Land-Sea Interconnectedness, Inclusive Governance, Sustainable Development, and Coastal Community and Ecosystem Resilience.

In addition to providing annual performance visualization, the dashboard is also equipped with a rapid monitoring feature for water quality, sediment, and chlorophyll to detect real-time changes in environmental conditions. Each dashboard component is described in detail below, accompanied by recommendations for improvement for each principle based on field findings.



Figure 1. Dashboard structure in portrait orientation (Example)

Integrated Land and Sea Management Performance (Year)

This section displays the performance of integrated land and sea management for a specific year selected by the user. This feature enables temporal performance monitoring, allowing users to see improvement or decline trends from year to year. Users can select the desired year through a dropdown menu, and the dashboard will automatically display data corresponding to that year. Additionally, this section can present year-on-year performance comparisons (e.g., current year compared to the previous year or target year) to measure sustainable development achievements. The year information is crucial for providing temporal contexts for all displayed indicators, as environmental conditions, governance, and community welfare can change dynamically over time. With the year selection feature, the dashboard becomes not only a static tool but also an adaptive one responsive to policy changes and field conditions.

Marine Information

The Marine Information section provides contextual data on the condition of coastal and marine ecosystems within the assessed watershed. This information includes the extent of mangrove, seagrass, and coral reef ecosystems, the status of marine protected areas (if any), and basic oceanographic conditions such as tides, currents, and waves. This information is important because marine conditions cannot be separated from watershed management. Seawater quality, for example, is strongly influenced by sedimentation and pollutants carried from upstream areas through rivers. By providing integrated marine information, users can

understand that marine ecosystem health reflects land-based environmental management. Furthermore, this information can include data on fishery potential, community economic activities (such as mariculture, marine tourism, and fishing), as well as anthropogenic pressures occurring in coastal areas such as ship pollution, uncontrolled coastal development, and destructive fishing practices.

Watershed Name (DAS)

This section displays the name of the watershed (Daerah Aliran Sungai/DAS) being assessed. Each watershed has unique hydrological, ecological, and socio-economic characteristics, so identifying the watershed name is a crucial first step in integrated land and sea management. The watershed name serves as the main geographical marker connecting all indicators and data presented in the dashboard. Users can select the desired watershed, and the dashboard will automatically adjust all information, maps, indicators, and recommendations according to that watershed. A further development idea for this section is to provide search and filter features based on watershed, as well as display brief information about the watershed, such as its area, main river length, population living within the watershed, and dominant economic sectors. Thus, users not only know the watershed name but also quickly understand the socio-ecological context of that watershed.

Watershed Area Map

The watershed area map is a crucial visual component for providing spatial understanding of land-sea connectivity. This interactive map displays watershed boundaries, river networks, land cover (forests, agricultural land, settlements, mines, etc.), as well as coastal and marine areas up to 12 nautical miles offshore. Users can zoom in and out, click on specific areas to view detailed information, and select layers to display, such as land cover layers, water quality monitoring point layers, or conservation area layers. A development idea for this map is to integrate it with real-time or periodic data, such as locations of flood events, landslides, river pollution, or coral bleaching. Additionally, the map can display the distribution of sampling points for rapid monitoring of water quality, sediment, and chlorophyll. With good spatial visualization, users can easily identify cause-and-effect relationships between land-based activities (e.g., sand mining upstream) and their impacts downstream and in coastal areas (e.g., estuary sedimentation and coral reef damage).

Administrative Area (Province, District/City, Village)

This section presents the administrative hierarchy covering the province, district/city, and village where the watershed is located. Integrated land and sea management is cross-administrative, as one watershed can span several districts/cities and even provinces. Therefore, this information is crucial for facilitating coordination among local governments. Users can select a specific province, district/city, or village to filter the displayed data. A development idea for this section is to provide information about the roles and responsibilities of each government level in watershed and coastal area management, in accordance with applicable laws and regulations. Additionally, this section can display contact persons or responsible agencies in each administrative area, facilitating cross-sectoral and cross-regional communication and coordination. Thus, the dashboard functions not only as a monitoring tool but also as a collaboration platform among stakeholders.

Principle 1 Indicators: Positive Land-Sea Interconnectedness

This section displays indicators that measure the extent to which positive connectivity between land and sea ecosystems is achieved. This first principle emphasizes that land-based activities (such as mining, deforestation, waste management, and agriculture) have direct impacts on the health of coastal and marine ecosystems. Indicators included in this principle encompass sediment management (river normalization and sand mining), integrated waste management (availability of TPS, TPST, waste banks), and the health status of migratory biota or bioindicator biota in estuaries such as shellfish and phytoplankton. Each indicator is assessed on a scale of 1 to 7 based on data from PODES, monitoring reports, or other sources. A development idea for this section is to add connectivity visualizations, such as flowcharts showing how upstream activities (e.g., sand mining) impact estuary sedimentation and subsequently affect coral reef health. Additionally, case studies or best practices from other regions that have successfully managed positive land-sea connectivity can be added. With a good understanding of these indicators, users can identify the most effective intervention points to improve positive connectivity between land and sea.

Principle 2 Indicators: Inclusive Land-Sea Governance

This section presents indicators measuring the quality of governance in integrated land and sea management. The inclusive governance principle emphasizes the importance of participatory planning, cross-sectoral collaboration, transparency, and accountability. Indicators included in this principle encompass the availability of budget allocation for LaS management (budget tagging), the level of integration of land and sea spatial planning, the intensity of deliberations involving vulnerable groups, and the existence and effectiveness of multi-stakeholder working groups. Data for these indicators are sourced from regional planning documents (RKP, RTRW Regional Regulations), PODES data, as well as establishment decrees and activity reports of working groups. A development idea for this section is to add a feature to assess the quality of planning documents, for example, whether the provincial RTRW document has integrated the marine spatial plan (RZWP3K) and whether the document has been periodically evaluated. Additionally, indicators on grievance mechanisms for communities affected by natural resource management activities can be added, as well as the level of participation of women and persons with disabilities in decision-making processes. With these indicators, the dashboard can provide a comprehensive picture of how inclusive and collaborative LaS governance is in a region.

Principle 3 Indicators: Sustainable Development

This section displays indicators that measure the balance between environmental, economic, and social aspects in land and sea management. The sustainable development principle emphasizes that economic growth should not come at the expense of environmental sustainability and community welfare. Indicators included in this principle encompass the ratio of critical land to total land area, river water quality (physical, chemical, biological parameters), seawater quality, the health of coastal ecosystems (mangroves, seagrass, coral reefs), and community access to clean water. Data for these indicators are sourced from the Ministry of

PPN/Bappenas, Regional Environmental Quality Index (IKLHD) documents, monitoring reports from Marine and Fisheries Agencies, and PODES data. A development idea for this section is to add indicators on the productivity of leading sectors based on natural resources, such as capture fishery productivity, agricultural productivity, and community income from marine tourism. Thus, users can see the relationship between environmental conditions and economic performance. Additionally, indicators on greenhouse gas emissions and carbon sequestration from mangrove and forest ecosystems can be added, which are relevant to Indonesia's Nationally Determined Contribution (NDC) targets in addressing climate change.

Principle 4 Indicators: Coastal Community and Ecosystem Resilience

This section presents indicators measuring the resilience level of coastal communities and ecosystems in facing climate change, natural disasters, and other anthropogenic pressures. This resilience principle emphasizes the ability of communities and ecosystems to adapt, recover, and even transform towards better conditions after experiencing shocks or stresses. Indicators included in this principle encompass disaster management capacity (disaster-resilient village status), household livelihood diversification (not solely dependent on fisheries or agriculture sectors), community preparedness for climate change impacts, and the existence of community-based monitoring and management systems. Data for these indicators are sourced from PODES data as well as reports from BPBD and relevant agencies. A development idea for this section is to add indicators on the existence of agricultural or fisheries insurance that can protect communities from crop failure due to disasters or climate change. Additionally, indicators on community compliance with conservation rules (e.g., no-take zones) can be added, as well as the existence of climate-resilient livelihood empowerment programs. With these indicators, the dashboard can help identify the most vulnerable areas requiring priority intervention.

Performance Summary: Total Score, Status, Color

This section presents a summary of LaS management performance in aggregate form through total score, status, and color. The total score is calculated from the accumulation of scores from all 14 indicators (each indicator has a scale of 1–7, so the total score ranges from 14 to 98). This total score is then converted into three status categories: High (good), Medium, or Low (poor), with predetermined intervals. This status is visualized with colors: green for high performance, yellow for medium performance, and red for low performance. Additionally, a trend indicator (upward, stable, or downward arrow) can be added to show performance change compared to the previous period. A development idea for this section is to add a comparison feature between watersheds or between provinces, allowing users to see relative performance rankings. Additionally, performance targets to be achieved in future years can be added, for example, a target of 10% score increase each year. With this simple yet informative visualization, users (including high-level policymakers) can quickly understand the condition of LaS management performance without having to read all the detailed indicators.

Rapid Monitoring: Water Quality, Sediment, Chlorophyll

This section is a highly innovative additional feature to provide real-time or periodic monitoring data with high frequency. This rapid monitoring covers three main components: (1) water quality (parameters such as dissolved oxygen/DO, pH, temperature, turbidity, as well as nitrate and phosphate concentrations), (2) sediment (Total Suspended Solids/TSS, sediment composition, organic matter content, and heavy metal concentrations if available), and (3) chlorophyll-a (chlorophyll-a concentration as an indicator of algal biomass/eutrophication, spatial distribution from satellite or in-situ measurements, and seasonal variation patterns). Data for this rapid monitoring can come from automatic monitoring stations (real-time), periodic field measurements, or satellite imagery (e.g., Sentinel, Landsat, MODIS). A development idea for this section is to integrate data from citizen science, where local communities can report water quality conditions in rivers or coastal areas through a simple mobile application. Additionally, an early warning system can be added if certain parameters exceed quality standard thresholds, for example, if chlorophyll-a concentration is too high, indicating toxic algal blooms. With this rapid monitoring, the dashboard is not only an annual reporting tool but also a monitoring system responsive to real-time changes in environmental conditions.

Recommendations

Based on the performance assessment, the dashboard will generate automated recommendations specific to each principle. These recommendations are dynamically formulated based on scores obtained for each indicator, ensuring that the recommendations provided are contextual and actionable.

Recommendation: Land-Sea Interconnectedness

Recommendations for the land-sea interconnectedness principle focus on efforts to reduce negative impacts of land-based activities on marine ecosystems. If the sediment management score is low, recommendations given include: conducting periodic river normalization, stopping illegal sand mining in river channels, and rehabilitating critical catchment areas. If the waste management score is low, recommendations include: constructing adequate temporary disposal sites (TPS) and integrated waste processing sites (TPST), activating waste banks in every village, and socializing the reduction of plastic waste that ends up in the sea. If the estuarine biota health score is low, recommendations include: improving water quality monitoring in estuaries, controlling pollution from industries and households, and rehabilitating mangrove and estuarine habitats. These recommendations are prioritized based on urgency and feasibility of implementation.

Recommendation: Governance

Recommendations for the inclusive governance principle focus on strengthening institutions, planning, and public participation. If the budget allocation score is low, recommendations given include: encouraging local governments to conduct budget tagging for LaS management activities, allocating special funds for ecosystem restoration, and mobilizing innovative funding sources such as CSR and blended finance schemes. If the spatial integration score is low, recommendations include: finalizing and legalizing RTRW documents integrated with RZWP3K, harmonizing planning documents across central and regional levels, and establishing periodic joint evaluation mechanisms. If the participation and working group

scores are low, recommendations include: forming effective multi-stakeholder coordination forums, involving vulnerable groups (women, persons with disabilities, indigenous peoples) in planning deliberations, and providing transparent and easily accessible public information access.

Recommendation: Sustainable Development

Recommendations for the sustainable development principle focus on balancing environmental conservation, economic growth, and social welfare. If the critical land score is high, recommendations given include: rehabilitating critical land through reforestation and agroforestry, implementing conservation agriculture, and controlling land conversion from forests to plantations or settlements. If the river and seawater quality scores are low, recommendations include: constructing domestic and industrial wastewater treatment plants (WWTPs), controlling pollution from agricultural activities (fertilizers and pesticides), and restoring water quality through bioremediation and riparian revegetation. If the coastal ecosystem health score is low, recommendations include: rehabilitating mangroves, seagrass, and coral reefs through planting and transplantation, establishing stricter protection zones, and controlling destructive tourism and fishing activities. If the clean water access score is low, recommendations include: developing clean water supply infrastructure (pipes, boreholes, rainwater harvesting), protecting water catchment areas, and educating communities on good water management practices.

Recommendation: Community and Ecosystem Resilience

Recommendations for the community and ecosystem resilience principle focus on increasing adaptive capacity to climate change and disasters, as well as livelihood diversification. If the disaster management capacity score is low, recommendations given include: encouraging every village to obtain disaster-resilient village (Destana) status, developing contingency plans and early warning systems, and training communities in evacuation and first aid during disasters. If the livelihood diversification score is low, recommendations include: developing skills training programs outside the fisheries and agriculture sectors (e.g., fish processing, handicrafts, ecotourism), providing access to capital for micro, small, and medium enterprises (MSMEs), and building partnerships with the private sector for product marketing. If the climate change preparedness score is low, recommendations include: integrating climate change adaptation into regional planning documents (RPJMD, RTRW), developing adaptive social protection systems, and building green infrastructure such as mangroves as natural coastal protectors.

System Operation

Operator

The **dashboard administrator** is the party responsible for the overall operation, maintenance, and management of the dashboard system. Based on the findings and recommendations in the report, dashboard management should be coordinated at the provincial level through a working group (*pokja*), led by the Regional Development Planning Agency (*Bappeda*) as the leading agency.

The administrator has duties and authorities that include user management (adding, removing, or modifying user and contributor access rights), system configuration (setting technical parameters such as reporting periods and assessment scales), data validation (verifying and validating incoming data from contributors before publication), and system maintenance (software updates and troubleshooting technical issues).

In addition, the administrator is responsible for data security and the preparation of periodic aggregate reports (monthly, quarterly, or annually). The report recommends that institutional coordination for indicator assessment be implemented at the provincial level through the working group, with support from district/city governments and community representatives (NGOs/CSOs).

Therefore, the dashboard administrator should come from an institution with adequate mandate and technical capacity, such as the provincial *Bappeda* or another officially designated institution responsible for managing the LaS monitoring system.

User

The **user** is any party that accesses the dashboard to view information and utilize it for decision-making, development planning, or performance monitoring. Users have **read-only access** to data that has been validated and published by the administrator. They are not permitted to modify or input data into the system.

Based on the stakeholder framework identified in the report, dashboard users consist of various actors across different levels. At the national level, users include the Ministry of National Development Planning (*Bappenas*), the Ministry of Environment, the Ministry of Forestry, the Ministry of Marine Affairs and Fisheries, the Ministry of Agriculture, and the Ministry of Home Affairs.

At the provincial level, users include the provincial *Bappeda*, the Environmental Agency, the Marine and Fisheries Agency, and the Forestry Agency. At the district/city level, users include district/city *Bappeda* and relevant technical agencies.

In addition, users also include the general public (academics, researchers, students, NGOs, and journalists) as well as the private sector (plantation, mining, tourism, and fisheries companies).

Users are expected to utilize the dashboard to monitor the performance achievements of LaS management in their respective areas, identify indicators that require intervention or improvement, develop data-driven policies and programs, and report development achievements to the public and other stakeholders.

Contributor

The **contributor** is the party responsible for providing, uploading, or updating indicator data in accordance with their authority and capacity. Contributors have access rights to input and update data for specific indicators under their responsibility (*data custodian*).

Based on the indicator framework, each indicator has different data sources and contributors. For example, indicators on sediment management and integrated waste management are derived from *PODES* (Village Potential Statistics) data managed by the Central Statistics Agency (*BPS*). The indicator on budget allocation for LaS management is sourced from the

Regional Government Work Plan (*RKP*), which falls under the responsibility of *Bappeda*. The indicator on the level of integration between land and marine spatial planning is derived from Regional Regulations (*Perda*) on *RTRW* and *RZWP3K*, which are the responsibility of *Bappeda* and the Ministry of Agrarian Affairs and Spatial Planning (*ATR/BPN*).

Indicators related to inclusive consultation participation, access to clean water, disaster management capacity, and livelihood diversification are also sourced from *PODES* data (*BPS*). Indicators on river and marine water quality are derived from the Regional Environmental Quality Index (*IKLHD*), managed by the Provincial Environmental Agency. Indicators on the health of coastal ecosystems (mangroves, seagrass beds, and coral reefs) are based on monitoring reports from the Provincial Marine and Fisheries Agency or the Ministry of Marine Affairs and Fisheries (*KKP*). Meanwhile, the indicator on the ratio of degraded land is sourced from data provided by the Ministry of National Development Planning (*Bappenas*) and the Ministry of Environment.

The responsibilities of contributors include uploading data periodically according to the fixed frequency (annual, semi-annual, or other intervals), ensuring the accuracy and completeness of data prior to submission, providing metadata that explains data sources and collection methods, conducting internal verification, and coordinating with the administrator in case of changes in methodology or data sources.

The report also recommends that for key indicators where data are not yet available, the *SOLUSI* project should develop a data management system that includes data collection and reporting processes.

Dashboard Governance

The dashboard governance table outlines the distribution of roles, responsibilities, and tasks among the various parties involved in the management and utilization of the dashboard for monitoring LaS (Land-and-Seascape) indicators. Overall, this structure is designed to ensure that the dashboard functions not merely as a data display tool but as an effective and sustainable instrument for decision-making.

At the highest level, the Decision Makers, consisting of *Bappenas* and relevant technical ministries, are responsible for monitoring key performance indicators (KPIs) for strategic planning and evaluation of LaS management policies at the national level. They utilize the dashboard as a basis for determining corrective actions. Below them, the Administrator (*Bappenas* and a designated directorate) serves as the technical coordinator at the national level, responsible for system security, user access management, data integration across institutions, and overall dashboard maintenance.

At the provincial level, the Data Analyst/Reporter, originating from the Provincial *Bappeda*, is tasked with processing, validating, presenting, and reporting data to ensure the dashboard remains informative and accurate. They are supported by the Data Steward/Data Wrangler, a technical team appointed by the Provincial LaS Management Coordinator, who is responsible for data cleaning, quality control, and ensuring the completeness of metadata. These two roles are crucial because the quality of incoming data determines the reliability of the dashboard.

On the operational front, Frontline Users (Operational) are the parties who provide field data input, whether numerical, qualitative, or spatial. They come from a diverse range of institutions, including national technical institutions in the regions (central government vertical agencies), provincial and district/city technical agencies, civil and local communities, academics, NGOs, and other relevant parties. In addition to providing data, they also use the dashboard to monitor daily activities. Finally, the IT Technical Team/Developer is responsible for supporting the technical aspects of dashboard development, including adding new features, fixing bugs, and ensuring system scalability as user needs and data volumes grow. Overall, this governance structure reflects a collaborative and hierarchical approach that connects the national, provincial, and field levels. The clarity of each party's role is essential to prevent overlapping duties, ensure smooth data flow, and guarantee that the dashboard can function optimally as a monitoring and decision-support tool for sustainable LaS management.

Table 1. Dashboard Management

No.	Stakeholder	Role	Institution	Tasks
1	Decision Maker	Making national decisions regarding corrective actions for LaS management	Bappenas, Relevant Technical Ministries	Monitoring key performance indicators (KPIs) for strategic planning and evaluation of LaS management
2	Administrator	Coordinator of LaS Management at the national level	Bappenas, Designated Directorate	Responsible for the technical aspects of the dashboard: security, user access, data integration, and system maintenance
3	Data Analyst / Reporter	Coordinator of LaS Management at the provincial level	Provincial Bappeda	Processing, validating, presenting, and reporting data to ensure the dashboard is informative and accurate
4	Data Steward / Data Wrangler	Technical team supporting the reporter/data analyst at the provincial level	Team appointed by the Provincial LaS Management Coordinator	Responsible for data cleaning, quality control, and ensuring metadata is properly available
5	Frontline User (Operational)	Providing data input	National technical institutions in regions (central government vertical agencies in regions), provincial and district/city technical agencies, civil and local communities, academics, NGOs,	Providing field data input to the data analyst/reporter and using the dashboard to monitor daily activities, including numerical, qualitative, or spatial data

			and other relevant parties	
6	IT Technical Team / Developer	Information technology team	Appointed team	Supporting feature development, bug fixes, and system scalability