

## **THIRD REPORT**

### **Project Concept Document**

#### **Promoting Sustainable Growth in the Blue Economy Program (PE-L1270)<sup>1</sup>**

**Consultant to conduct Costing of Design and implementation of data management system, systematizing data collection processes and digitalization, and revamping of Fisheries Department's website that includes capabilities to process and emit licenses, permits, and other services for the CSD/RND Division in Belize**

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Project Concept Document

PROMOTING SUSTAINABLE GROWTH IN THE BLUE ECONOMY  
PROGRAM

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## 1. Executive Summary

The CSD/RND Division supports the Bank's operations in areas related to the agricultural sector, rural development, management of natural resources, tourism development, and disaster risk management. It contributes to better management and sustainable use of natural capital, food production and improved productivity as the basis for economic growth in the region. The Division also advises borrowing member countries in the development of Policies and Strategies in areas of its competence. During project execution, the Division provides technical advice to borrowing member countries, executing agencies, Country Offices, and other Bank units.

The Government of Belize (GoB) requested the Bank's support through a Specific Investment Loan (ESP), to promote the development of a sustainable and a more diversified fishing portfolio by testing and assessing empirically the economic, technical, social, and natural resource management viability of a new operation in the fisheries sector, as well as the required feasibility measures for that purpose; and to identify scale-appropriate, optimal value chain investments.

The Fisheries Department has the challenge to eliminate the barriers hindering the fisherfolks to improve incomes and the sector to reduce profitability, resilience, and sustainability threats and as part of those barriers, the weak data management is one of the most relevant problems to avoid.

## 2. Main Objective

The Fisheries Department (FD) in Belize has requested support from the bank in implementing a sustainable and diversified fishing portfolio. As part of this initiative, the FD aims to upgrade its IT systems to manage the sector more efficiently and effectively by systematizing data collection, processing, and analysis. The proposed consultancy will focus on identifying the needs and gaps in MBECA and the FD's current information management systems and proposing a Route Map based on a list of activities, equipment, personnel, and training required to address them. This report provides a proposal of the listing of services, activities, and outputs necessary for the FD to achieve its objectives and the cost implications of implementing them.

The main activities to do in this consultancy are:

1. Implement a diagnostic to identify MBECA and the FD's needs and gaps regarding an information management system; the revamping of their website that includes a platform to provide different e-services (i.e., licenses, permits, etc.); as well as other additional needs to collect, process, and analyze data from multiple sources.
2. Make a proposal of a list of activities, services, equipment, software, hardware, personnel, and training that is needed to address the needs and the gaps identified in the diagnostic.
3. Determine the monetary cost for the implementation of this information management system, including an IT package as well as the human and physical capital to support it.

### 3. Methodology

In order to prepare the Roadmap that allows identifying the needs and gaps in the current information management systems of MBECA and FD and proposing a Roadmap based on a list of activities, equipment, personnel and training necessary to address them, this consultancy collect the information from the interviews with the FD's Team and collects the primary sources they make available to us.

To carry out the development of this consultancy, several meetings were held with the Fisheries Department team, specifically with the following officials: Maxime Monsanto, Adriel Castañeda and Gisel Correa, who provided the primary sources of information considered for the elaboration of the diagnosis and proposal, as well as with the officials of the Central Information Technology Office - CITO: Ian Smith, Alvan Owland, Bruce Flowers and Caleb Peña, who provided us with information on the characteristics and scope of CITO services, as well as the cost of their services related to this project. In this sense, the proposal made in this document has been previously validated by the Fisheries Department work team and also by CITO staff, In this sense, the proposal made in this document has been previously validated by the Fisheries Department work team and also by CITO staff, and includes all inputs and requests from MBECA/FD.

For this purpose, five fronts are considered, each of these fronts contains dimensions that directly contribute to the implementation of the Information Management System and the development of advanced analytical capabilities, based on standards and best market practices. The five fronts considered are:

#### 1. Development methodology:

1. Implement an Agile development methodology and continuous integration and delivery.
2. Ensure the Version control and Code reviews.

#### 2. Vision and Data Estrategy:

1. Design a vision for the data and analytics strategy aligned with the institutional strategic objectives.
2. Translate this vision into activities and data use cases, in a roadmap.

#### 3. Data Architecture:

1. Develop a data architecture aligned to the main use cases, according to the priorities defined by the organization.
2. Design the approach for the implementation of the data architecture aligned to these use cases.

#### 4. Information Security

1. Implement access controls and encrypt sensitive data.
2. Regularly update and patch software.
3. Define and implement a Data Security framework.

#### 5. Change Management and Training

1. Implement the development of skills in data management and analytics through an agile way of working.

2. Establish an organizational training methodology to support the diffusion and democratization of the new information management culture.

For the development of the analysis, we carried out the following activities:

- Meetings with leaders of the Fisheries Department
- Meetings with the Fisheries Department work teams
- Meetings with officials of the Central Information Technology Office – CITO
- Review of primary sources provided by the fisheries department team and the CITO's Team as well.

#### 4. Limitations

Among the limitations found is the request of the Fisheries Department, through a letter dated 01/24/2023, from Kennedy Carrillo, Chief Executive Officer of the Ministry of Blue Economy and Civil Aviation, addressed to Santiago Bucaram of the IDB, requesting that the Information Management System be implemented at through the hiring of full-time personnel in order to create internal capacity and provide support to the solutions, indicating the required positions, as indicated below:

1. Systems Analyst
2. Software Developer
3. Software Engineer
4. Database Administrator

As identified in the information gathering, the Fisheries Department does not have a systems or processes area, therefore the information needs are identified based on the interviews and documentation provided by the work team designated by the Fisheries Department.

In coordination with the Fisheries Department Team, the needs related to the Vessel Monitoring System are out of the scope of the project.

In addition, this report takes as valid the information received from the Fisheries Department work team such as documentation, presentations, as well as interviews and questionnaires, taking as reference the information available on the Fisheries Department website.

#### 5. Diagnostic of MBECA and FD's needs and gaps

As is defined at the BL-L1042 Project Description, "the Managed Access Program requires fishers to fill out logbooks. The Fisheries Regulations requires fishers to populate information on catch per trip, days fished, area fished, gear used, and cost incurred per trip.

Subsequently, vessel owners are required to deliver these filled-out logbooks to the Fisheries Department or to any marine reserve office. The hard copies are sent to the central office in Belize City and housed by the Capture Fisheries Unit of the Fisheries Department.

However, several challenges have been detected with the logbook program. One of the challenges is the validity or biasness of the data that is collected in the logbooks, because many fisheries officers have observed fishers filling out logbooks with unrealistic data just to comply with the Fisheries Regulations.

The other challenge is the management and analysis of logbook data that is stored at the Belize Fisheries Department. Given the latter, the Belize Fisheries Department requires additional personnel with competent skills to manage and analyze the data sets. In addition, Belize's Fisheries Regulations stipulates that all fishing cooperatives and fish companies must submit monthly production and export data to the Fisheries Department. This data is compiled from copies of the cooperatives and fish companies' purchase slips. Purchase slips are populated by personnel from each cooperative and company, then the data collectors from the Fisheries Department eventually amass and copy the relevant data onto a formal data sheet without confirming their reliability, for example, data on lobster include tails weight, whole lobster weight and lobster head weight, and this data is aggregated to have a global production value.

A big issue with this aggregation is that it only considers partial weights (the weight of tails or heads) and does not include the weight of the whole individual. This means the production data is underestimating the catch and the landings of lobster if used without proper transformation (see Gutierrez, 2020).

To sum up, the Belize Fisheries Department does not have a sound information management system that integrates the various data collection programs. The lobster, conch and finfish datasets have been digitized in an Excel spreadsheet and stored in a folder within a desktop computer.

The absence of an appropriate information management system limits the Belize Fisheries Department from fully utilizing the datasets to guide policy development and to develop harvest strategies.

All these conclusions are supported by several studies that advocate the need for a coordinated approach to monitoring the main target species and by-catch, centered on catch and effort data that serves the management and ultimately enables the calculation of fisheries indicators to support science-based decision-making and the design of management policies (Ohshimo and Yamakawa 2018; Fernandes et al. 2021; Kritzer 2020)."

## **5.1 Current situation of the Belize's Fishing Industry**

Based on the information provided by the Fisheries Department, the current situation of the Belize's Fishing Industry is described by the following points:

- Small-scale fishing, artisanal level.
- Consists of approximately 3,171 licensed fisheries.
- It consists of 872 licensed craft vessels.
- 15,000 Belizeans direct beneficiaries.
- The fishermen are organized in fishing cooperatives.
- There are 9 Fishing Zones established in territorial waters.
- Fishing is done in shallow waters of the barrier lagoon and 3 offshore atolls (20mt.).
- Fishing is done exclusively by free diving (the use of SCUBA is prohibited) and the use of traps and hand lines.



- Focused mainly on reef species: lobster, conch, fish.
- Capture fisheries contribute to approx. 3% of GDP, with a total export value of US\$15.3 million.
- Major export products include Caribbean spiny lobster and queen conch.
- Lobster export values that represent 74.8%.
- Conch export values representing 24%.
- Other 1.2% includes: King Crab, Whole Fish, Aquarium Fish, Sharks.
- The total volume exported: 1.62 million pounds.

Otherwise, the Sector Challenges are the following:

- Need for diversification and value addition.
- Minimize illegal, unreported and unregulated fishing.
- Minimize pollution and habitat degradation.
- Eradicate unsustainable and destructive fishing practices.
- Develop the economy of coastal communities.
- Minimize the impact of climate change and storms.
- Enable financial support from annual government budget allocations.
- Strengthen the capacities to comply with the Fisheries Laws throughout the territory of Belize, particularly in distant waters, in the southern and outer atolls.

Moreover, the Fisheries Department Principles and Goals are:

1. Empower fishermen to steward resources, comply with regulations, and grow their businesses.
2. Promote sustainability of fish stocks and support development for job creation, revenue generation and foreign exchange.
3. Protect the coral reef system.
4. Build national capacity as a global leader in oceans management.
5. Support the national interest by protecting maritime territory and ensuring food security.

The National Fishery framework consider three fronts:

1. Institutional Legal & Policy Framework
  - Model framework for innovative fisheries management.
  - Policy & Management Plan.
  - Modern Law consistent with international principles.
2. Conservation and Management
  - Protect important habitats.
  - Support biodiversity.
  - Rebuild fisheries.
  - Resilience to climate change.
  - Replenishment zones/MR network.
3. Managing Access
  - Manage Catch and Effort.
  - Area-based Management & Licensing.
  - Incentives for fishermen to steward resources.

Finally, the Fisheries Department leads the following Key Programs:

**1. Capture Fisheries Unit**

- Research and Education.
- Fisheries Development.
- Statistics and Data Management.

**2. Ecosystems-based Management Unit**

- Marine Reserves.
- Ecosystem's health monitoring (mangroves, coral reef, fish, sea grass).
- Endangered Species Management (turtles, groupers, spawning aggregations).
- Invasive species Management (lionfish).
- Management of CITES data.
- Education & Outreach.

**3. Conservation Compliance Unit**

Goal

- To prevent, deter and eliminate illegal fishing within Belize's national waters.

Primary Objectives

- To ensure the effective management of the Marine resources through compliance with the Fisheries laws.
- To increase the rate of conviction of fisheries offenders.
- To maintain an effective enforcement information system.
- To promote stakeholder engagement for voluntary compliance with the fisheries regulations.
- Conduct patrols and operations within the Belize territorial waters.
- Gather intelligence on illegal fishing activities.
- Use of innovative and modern technologies for enforcement.
- Conduct regular searches of establishments.
- Conduct operations at road check points.
- Inter-agency coordination for executing targeted joint operations.
- Arrest and prosecution of offenders.
- Fisheries Law empowers Officers to stop, search, detain, arrest, prosecute persons.

**4. Policy and Planning Unit**

- Policy and Planning.
- Resource Mobilization.
- Research permits.
- Liaison to meet national and regional obligations.
- Rep at NEAC.

The following image depicts the Fisheries Department current situation and goals, according to the information provided.

	Where we are today?	What is the goal?
Fisheries Act	Act legislated in February 2020	Enactment of updated subsidiary regulations
Managed Access	National roll-out to all territorial waters in 2016, including licensing system and fisherman committees	Accountability of catch per area from fisher logbooks and data incorporated into science to manage fisheries and fishing areas sustainably
Marine Protected Areas and Replenishment Zones	23.5% MPA 7.6% RZ /territorial waters 6.28% RZ/EEZ	30% of territorial waters
Community Empowerment	Fisherman organizations formed and functioning	Increased capacity in fisher organizations for more active participation and collaboration
Business Development (Access to markets & value adding)	Potential revenue and financing opportunities for fishers Traceability system at National Fishermen Cooperative Supply and value chain analysis	Business plan development and implementation for new revenue opportunities for the seafood industry Diversify existing and regional markets to access specific retail opportunities for sustainable seafood
Adaptive Management framework	Fishery management plans (FMPs) to prevent overfishing and rebuild stocks for Conch and Lobster	Update of FMP's for conch & lobster 2021 management plan for finfish and adaptive management framework employed in all main fisheries

**Image 01:** Fisheries Department current situation and goals  
**Source:** Ing. Adriel Castañeda, Fisheries Officer.

## 5.2 Needs and gaps identified

The Fisheries Department performs its tasks predominantly manually. Although there are processes that can be started by obtaining information from its website, users are required to find the forms in PDF format on the website, download them, print them and fill them out manually, having to present them physically at the offices of the Fisheries Department.

### 5.2.1 IT equipment and technology

During the information gathering has identified the following:

1. The FD does not have its own technological equipment or the necessary ones to meet the needs for optimization and systematization of processes.
2. The Fisheries Department use equipment and the support provide by the Central Information Technology Office – CITO, which provides Information Technology and Information Systems services for the Government of Belize-Wide Area Network and the wider public service.
3. The FD uses a desktop application called the Fisheries Department Licensing Database, which is used for the BackOffice management of licenses and which needs to be improved to meet all the current needs of the Fisheries Department.

### 5.2.2 Services

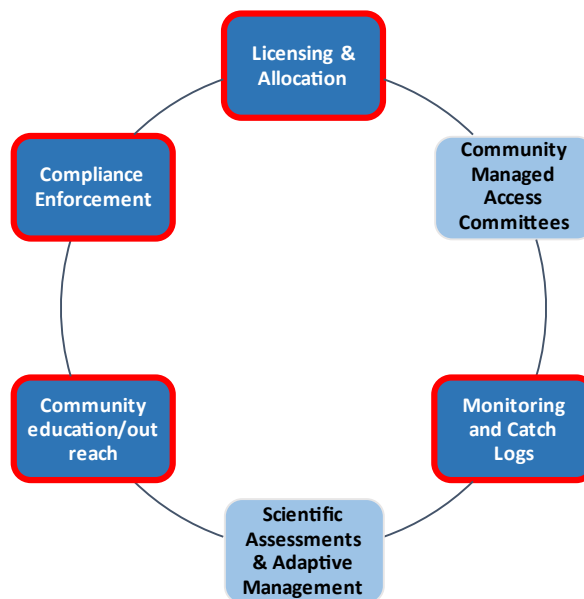
To identify the main services related to the Fisheries Department we need to understand the Managed Access committees. Managed Access committees have played a crucial role in implementing effective fisheries management that empowers fishers. These committees are composed mainly of representatives from fishing

communities, selected by the fishers themselves, along with Fisheries Department officials and co-managers. Their main goal is to empower fishers to take responsibility for the resources they rely on and to provide a platform for constructive collaboration between fishers and managers.

The committees have several responsibilities, including representing the rights and interests of the fishers from their respective communities, making recommendations for the improvement of the Managed Access program, reviewing and approving license applications, ensuring the fair and accountable implementation of the Managed Access framework, and reporting committee proceedings to their communities and addressing community concerns within the committee.

The following managed access components are identified:

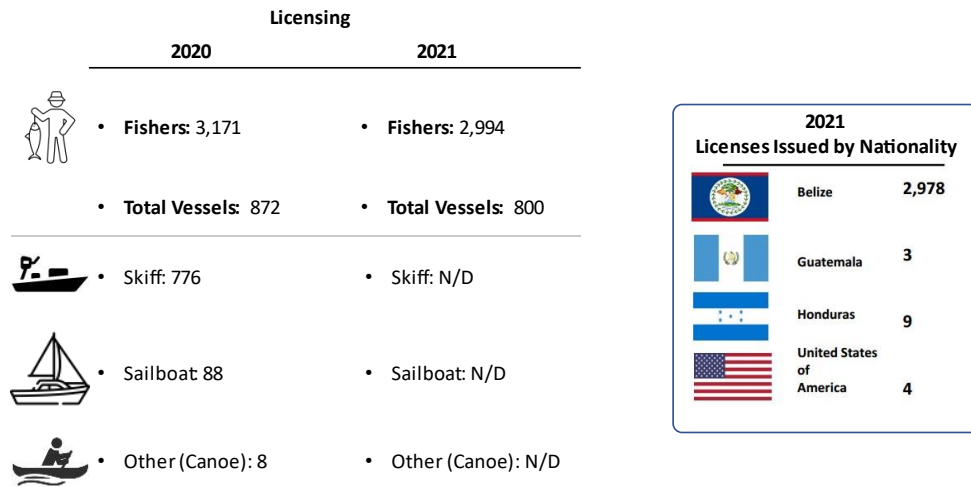
1. Licensing & Allocation
2. Community Managed Access Committees
3. Monitoring and Catch Logs
4. Scientific Assessments & Adaptive Management
5. Community education/outreach
6. Compliance Enforcement



**Image 02:** Managed Access Components of the Fisheries Department  
**Source:** Fisheries Management Presentation, Belize Fisheries Department, 2023

Considering these components and in coordination with the Fisheries Department Team, the following needs were identified:

1. **Licensing registration and Permits.** Services are performed manually. Users can download PDF files from the web, however, all the process carried out by the user must be done manually, while the Fisheries Department has a desktop software where they record the data submitted by users called the Fisheries Department Licensing Database, but it needs to be improved in order to meet all the requirements of the Fisheries Department.



**Image 03:** Licensing numbers in Belize  
**Source:** Fisheries Department

This process is not as convenient or efficient as it could be, and it also presents some security risks. There is potential for errors or delays in processing the physical forms and payments, and the manual handling of sensitive personal and financial information increases the risk of fraud or data breaches.

A better practice would be to fully digitize the license application and payment process, utilizing a secure online platform with built-in validation checks and encryption protocols to protect user data. This would streamline the process, reduce the risk of errors and fraud, and make it easier for users to apply for and obtain licenses.

2. **Fisheries Assets inventory Logs.** The current process of managing fisheries assets and license information is inefficient and prone to errors. Fisheries assets inventory logs are captured manually by fishermen, while license information is managed separately. This fragmented approach to managing data results in a lack of consistency, accuracy, and control of information. The disjointed management process also limits the ability of fisheries managers to make informed decisions about the management of the fishery.

To address this problem, it is recommended to integrate the Fisheries Assets inventory Logs with license information for more efficient and effective management of fisheries data. By integrating the two data sources, we can consolidate and streamline the process of capturing and analyzing data. This will provide a more accurate and complete picture of the fishery, enabling fisheries managers to make informed decisions about the management of the fishery. Additionally, automation of the data capture process will help reduce errors, improve accuracy, and provide real-time insights, enhancing overall performance of the fisheries management system.

Ultimately, the integration of these data sources will lead to better control, management, and decision-making in the management of the fishery.

3. **E-library of publications from Belize.** The required solution must manage the digital dissemination of the publications of the Fisheries Department

through the Institutional Portal. The development of a content management module is proposed, as part of the relaunch of the Portal.

Is recommend developing a content management module as part of the relaunch of the Institutional Portal. This module will enable efficient digital dissemination of Fisheries Department publications, allowing for easy access to information by stakeholders in the fishing industry. The module will also enable the Fisheries Department to manage and update their publications effectively, ensuring that the information provided is up to date and accurate. The proposed solution will improve the Fisheries Department's ability to communicate critical information to stakeholders in the fishing industry, enhancing their overall performance.

By providing easy access to important publications, stakeholders can make informed decisions and take action based on the latest information available. Ultimately, the development of a content management module for the Fisheries Department's publications will be a vital tool for effective information dissemination and knowledge management.

4. **Cooperative Traceability data.** There is a problem with the current traceability system used by Cooperatives. While the current system allows for some level of traceability, it does not meet the requirements of the Fisheries Department, as it does not include all the necessary fishing information. This results in incomplete and inaccurate data, limiting the ability of the Fisheries Department to effectively manage and regulate the fishing industry.

Therefore, the Fisheries Department need to collect more information by developing its own solution, in order to meet all their requirements and needs.

In that sense, the following image depicts the value chain that should be considered in the traceability Data and involves the following steps:

1. **The starting process:**

- 1.1. Harvesting: Fishermen belonging to cooperatives go out to sea to catch fish and other seafood.

2. **In the Port:**

- 2.1. Weighing and Grading: When the fishermen bring their catch back to shore, it is weighed and graded based on species, size, and other relevant criteria.

- 2.2. Tagging: Each fish is tagged with a unique identifier, which will be used to track it throughout the rest of the chain.

3. **Processing Instance:**

- 3.1. Processing: The fish are then processed and packaged, ready for sale.

4. **Export:**

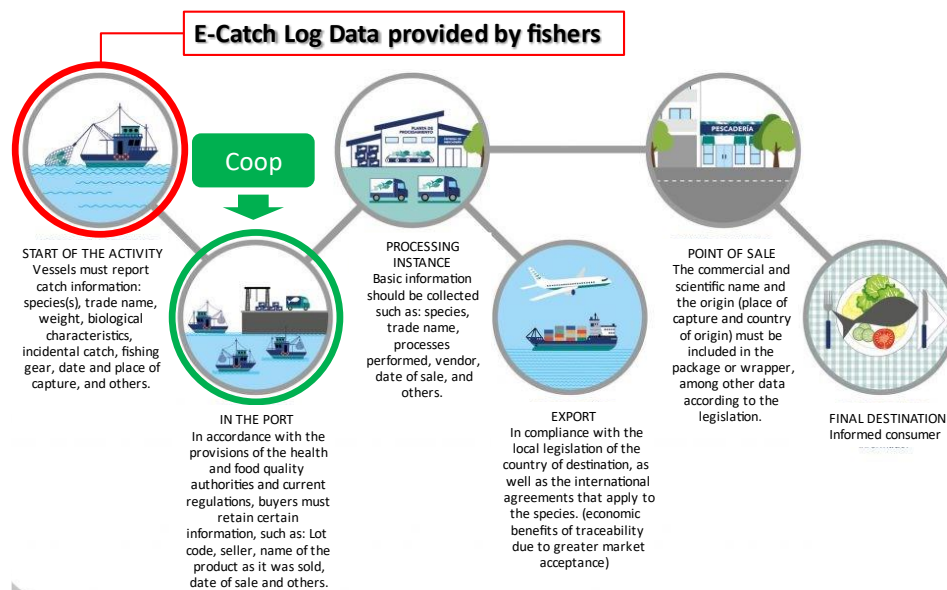
- 4.1. Transportation: The packaged fish are transported to a storage facility, where they await distribution.

- 4.2. Distribution: The fish are distributed to retailers and other customers.

5. **Point of Sale:**

- 5.1. Sale: The fish are sold to end customers.

Throughout this chain, data will be collected and recorded, including information about the species, weight, and origin of each fish, as well as the identity of the fishermen who caught them. This data will be tracked using the unique identifiers assigned to each fish, which will enable the Fisheries Department to monitor the entire supply chain, from harvesting to sale. The data will be entered into a centralized system, such as the traceability system being implemented, and will be accessible to authorized stakeholders, including the Fisheries Department and the cooperatives themselves. Data quality verification mechanisms, such as regular audits and inspections, can also be put in place to ensure the accuracy and completeness of the data.



**Image 04:** Licensing numbers in Belize  
**Source:** Fisheries Department

To implement an effective traceability system, the Fisheries Department will need to trace key information related to the fishing industry, such as catch logs, fishing gear and equipment, and fishing vessel information. The data should be collected from fishers and fishing cooperatives.

The department will need to ensure that the collected data is accurate, complete, and standardized. This can be achieved by implementing data validation rules and using software solutions that automate data collection and entry.

Once the data is collected, it should be stored in a centralized database that can be accessed by the Fisheries Department and other stakeholders such as fishers, fishing cooperatives and regulatory authorities. The data should be displayed through a user-friendly and easily accessible interface, such as a web portal or mobile application.

The Fisheries Department will be responsible for receiving and processing the data, ensuring that it is accurate, up-to-date, and compliant with relevant regulations. The department can use the data to monitor fishing activities and enforce regulations, such as catch limits, gear restrictions and closed



seasons. The data can also be used to inform policy decisions and resource management strategies.

For example, the Fisheries Department can use catch data to track fish stocks and identify trends and patterns in fish populations. This information can be used to develop sustainable fishing practices and inform decisions on fishing quotas and restrictions.

Overall, the implementation of a traceability system will benefit the Fisheries Department and fishing cooperatives by improving the accuracy and completeness of data, enabling better management and regulation of the fishing industry, and promoting sustainability and competitiveness.

The proposed solution will improve the accuracy and completeness of data, enabling the Fisheries Department to effectively manage and regulate the fishing industry. The implementation of a user-friendly and efficient traceability system will also benefit the Cooperatives, enabling them to improve their overall performance and competitiveness.

To implement an effective system, it should track the entire journey of the fish, from catch to consumption. This includes information such as the vessel that caught the fish, the location and date of catch, the method used to catch the fish, the weight and species of the fish, and the processing and distribution information. All parties involved in the fishing industry, including fishers, cooperatives, processors, distributors, and retailers, should be responsible for tracking the necessary information and entering it into the traceability system.

The data could be delivered through a web-based platform or mobile application that allows stakeholders to enter the required information in real-time. The Fisheries Department would be responsible for receiving and processing the data.

It is important to implement data quality verification mechanisms to ensure the accuracy and completeness of the data. This can be achieved through data validation rules, data audits, and regular data quality checks. The Fisheries Department should establish a system to regularly review and verify the accuracy of the data.

By providing a comprehensive traceability system that meets the requirements of the Fisheries Department, Cooperatives can enhance their credibility and reputation, leading to increased customer trust and loyalty. Ultimately, the implementation of an effective traceability system will be a vital tool for the sustainable management of the fishing industry.

5. **E-Catch Log Data provided by fishers.** Currently this process is a paper record, the management is expensive and inefficient and there is a lot of loss of information and deficiencies in information management. This results in difficulties in managing and regulating the fishing industry, limiting the ability of stakeholders to make informed decisions based on accurate and timely data.

It is recommended to develop an application to fill the E-Catch Log data electronically. This will enable the Fisheries Department to capture accurate and comprehensive information in a timely and efficient manner, reducing the risk of loss of information and other deficiencies associated with manual processes. The application should be user-friendly, efficient, and accessible on a variety of devices to ensure maximum participation from fishers.



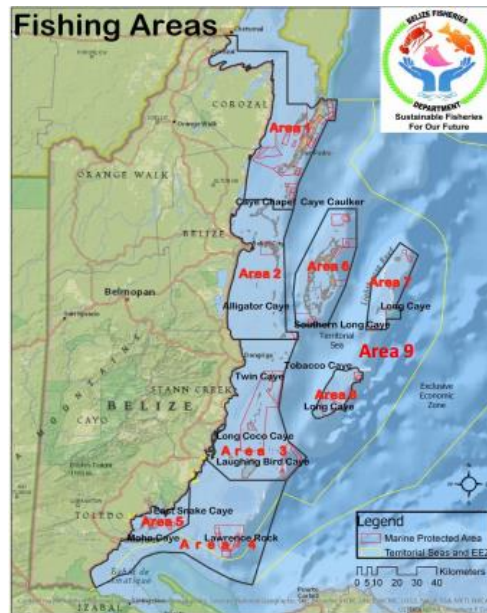
The proposed solution will improve the accuracy and completeness of E-Catch Log data, enabling stakeholders to make informed decisions and effectively manage and regulate the fishing industry. The implementation of an electronic log system will also benefit fishers, enabling them to improve their overall performance and competitiveness. By providing a user-friendly and efficient application for filling E-Catch Log data, fishers can save time and resources, allowing them to focus on other critical aspects of their operations. Ultimately, the implementation of an effective E-Catch Log application will be a vital tool for the sustainable management of the fishing industry.

6. **Enforcement data.** We have identified a problem with the current manual process for capturing enforcement data in the fishing industry. The lack of an effective system for capturing data on patrolling, area coverage, fuel consumption, personnel and boats involved, registered infractions, and sanctions has led to inefficiencies and inaccuracies in the management of the fishing industry. Without accurate and comprehensive enforcement data, it is difficult to make informed decisions, monitor compliance with regulations, and identify areas for improvement.



**Image 05:** Illustrative. Enforcement Activities in Belize.

There are nine marine protected areas where fishing activities must be carried out according to the areas specified in the license according to the following map (image 06). In addition, vessel captains must ensure that all fishermen on board are licensed according to the areas assigned to the vessel's license. The marking of vessels must be in accordance with Regulation 41 of the Fisheries Law and the color code assigned for each fishing area and the submission of catch data is mandatory.



**Image 06:** Fishing Areas in Belize.

In the Fisheries Department of Belize, the Fisheries Enforcement Unit (FEU) is typically responsible for the enforcement of fisheries regulations and the protection of Belize's marine resources. The FEU is responsible for conducting patrols, inspections, and investigations to ensure compliance with fisheries laws and regulations, and for taking appropriate enforcement actions when violations are detected.

To address this challenge, it is recommended to implement a fully automated solution that captures and systematizes all necessary enforcement data. The solution should also be integrated with the licensing system, ensuring that all relevant information is linked and easily accessible to stakeholders. This will enable effective monitoring and regulation of the fishing industry, ensuring compliance with regulations and promoting sustainable practices.

In addition to the software solution, physical equipment may also be required to support the automation of the data capture process. This could include hardware such as cameras, GPS devices, and other monitoring equipment to provide accurate and comprehensive data on patrolling and other enforcement activities.

The proposed solution will streamline the process of capturing and systematizing enforcement data, enabling stakeholders to make informed decisions and improve the management of the fishing industry.

By implementing a fully automated solution, the fishing industry can reduce inefficiencies, improve accuracy, and enhance overall performance. With the right system and equipment in place, stakeholders can effectively monitor compliance, promote sustainable practices, and support the long-term viability of the fishing industry.

7. **Marine Protected Areas Monitoring data to include co-managers.** “Belize has a network of 14 marine protected areas (MPAs), with an additional 13 protected fish Spawning Aggregation sites, covering some 23.5 per cent of the country’s marine waters.

Belize has a long history of marine protected area (MPA) establishment and management, with an MPA network covering some 23.5 per cent of the Territorial Sea (which covers the area extending out to ~12 nautical miles from Halfmoon Caye). The network comprises:

- Nine Marine Reserves under the mandate of the Belize Fisheries Department (BFD), which are zoned: Preservation zones (no extraction); Conservation zones (recreational activities including sport fishing and scuba permitted); General Use zones (artisanal commercial fishing permitted but use of SCUBA is prohibited – fishing using free diving, traps and handlines is allowed);
- Two Wildlife Sanctuaries, two Natural Monuments and one National Park, under the mandate of the Forest Department.
- Thirteen fish Spawning Aggregation sites, under the mandate of the BFD.<sup>2</sup>

The scattered data on monitoring Marine Protected Areas (MPAs)<sup>1</sup>, which hinders effective analysis and decision-making. Monitoring data on MPAs is currently scattered across various sources, making it difficult to analyze and manage. Co-managers are not included in the data capture process, resulting in incomplete and potentially biased information. Lack of standardization in data capture and management makes it challenging to compare and analyze data effectively.

According to the information provided in the Commonwealth case study on Belize's MPA system<sup>1</sup>, one of the key challenges highlighted is the lack of an effective information management system, particularly regarding enforcement, for the Belizean Fisheries Department. This deficiency can have significant implications for the sustainable management and protection of marine resources within the country's MPAs. To address this issue, a better solution would involve the implementation of a robust and integrated information management system with a focus on enforcement.

The current lack of an information management system poses several limitations and hinders effective enforcement efforts. These limitations can include:

- **Incomplete and Disorganized Data:** Without a comprehensive information management system, the Fisheries Department may struggle to collect, organize, and analyze crucial data related to fishing activities, compliance, and violations within MPAs. This can result in incomplete information and make it challenging to assess the effectiveness of enforcement measures or identify areas of concern.
- **Limited Monitoring and Surveillance:** An inadequate information management system can hamper the department's ability to monitor and track fishing activities within MPAs. Without real-time data and effective surveillance, it becomes difficult to detect illegal fishing practices, including overfishing, use of destructive gear, or encroachment into protected areas.

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<sup>2</sup> Case study: Belize – Towards Expansion of No-Take Areas in the MPA System (URL: <https://thecommonwealth.org/case-study/case-study-belize-towards-expansion-no-take-areas-mpa-system>)

- **Inefficient Reporting and Communication:** Without a streamlined information management system, reporting mechanisms may be fragmented and inefficient. This can lead to delays in reporting violations, sharing important updates, and coordinating enforcement actions among different stakeholders, including enforcement agencies, park rangers, and local communities.

The solution, therefore, is to systematize the data capture and generate a specific monitoring process that includes co-managers. This can be achieved through the implementation of a comprehensive MPA monitoring system that captures data from all stakeholders, including co-managers, in a standardized and centralized manner. The system should be designed to allow for easy access and analysis of the data to enable informed decision-making and effective management of the MPAs.

The solution should consider the following:

- Implement a comprehensive MPA monitoring system that captures data from all stakeholders, including co-managers, in a standardized and centralized manner.
- Use modern technology, such as mobile applications and cloud-based platforms, to enable real-time data capture and sharing.
- Develop clear protocols and guidelines for data collection, management, and analysis to ensure consistency and accuracy.
- Train all stakeholders, including co-managers, on the use of the system and the importance of accurate data collection and management.
- Use the data collected to inform decision-making and management of the MPAs, such as identifying areas of concern and implementing appropriate interventions.

8. **National Fisheries Survey Data.** The Fisheries Department in Belize lacks a unified platform to implement and disseminate national fisheries surveys, and there is currently no centralized repository for historical survey data. This fragmented approach to data management makes it difficult to analyze and interpret survey results, hindering effective decision-making and resource allocation. The problem at hand is that the National Fisheries Survey Data is currently collected and stored in various Excel spreadsheets, leading to inconsistencies and difficulties in data management. Additionally, the historical survey data is not easily accessible as it is scattered across different sources.

To solve this problem, it is recommended to implement a centralized platform for survey data collection and dissemination, allowing for easier data management and analysis. This platform should also include a repository for historical survey data from 2003 onwards, allowing for easier access and analysis of trends over time. By implementing such a platform, the Fisheries Department can improve its decision-making processes and better monitor the status of fisheries resources in Belize. This platform should have the capability to capture real-time data, enable remote data collection, and allow for efficient data management and analysis.

By centralizing survey data, decision-makers will have a more complete understanding of the state of Belize's fisheries and be able to make informed management decisions based on accurate and up-to-date information.

### 5.2.3 Hardware and Software

From the gathering information and in coordination with the Fisheries Department, specific needs are identified for the development of technological capacities in the Fisheries Department, such as:

#### For the Fisheries Department:

- 4 Desktop for Data Management System
- 3 Tablet for E-catch logs data entry
- 20 Tablet for Enforcement and field data collection
- 5 Tablet for Field Data Collection
- 3 Desktop for Licensing Registry
- 4 Tablet for Monitoring and Enforcement
- 8 Desktop for Registry
- 4 Desktop for Vessel Monitoring System

#### For the MBECA:

- 4 Desktop for Data Management System
- 4 Tablet for field data entry
- Mobile equipment for enforcement

On the other hand, regarding software needs, we identified that the optimization of asset management is necessary, as defined below:

9. **Government Assets inventory Logs.** The Fisheries Department of Belize is currently facing a challenge in managing their government assets due to the lack of an effective inventory management system. This has resulted in inefficient tracking and utilization of assets, leading to increased costs and decreased productivity.

To address this problem, it is recommended to implement an existing inventory management system that is available in the market. This system will help to effectively manage the government assets of the Fisheries Department, streamline their tracking and utilization, and ensure that they are being used to their fullest potential. It is crucial to acquire and implement this system in a short time to minimize any further disruptions to the operations of the Fisheries Department.

The Fisheries Department can consider acquiring and implementing an existing inventory management system from the market, which can streamline their inventory management process, reduce the risk of errors and losses, and improve their overall operational efficiency.

### 5.2.4 Personnel and Training

Currently there is no area or qualified personnel to lead digital development in the Department of Fisheries. The Support is provided by the Central Information Technology Office - CITO, however, through its Director General, Mr. Ian Smith, defined its scope as follows:

- Colocation hosting services whereby the CITO leases space and provides hosting for servers, both physical and virtual (IaaS). The clients own the servers and maintain full authority over the hardware and software. CITO is responsible for maintaining a secure server environment. The secure server environment is administered using a set of information security, privacy protection, and cyber security controls based on internationally recognized best practices (ISO/IEC 27001:2013 and ISO/IEC 27002:2013).
- Web or application hosting services provide infrastructure as a service, platform as a service, software as a service, and backup on Microsoft Azure.
- A backup power supply system that includes UPSs and a diesel generator that can ensure the continuity of services when utility power is lost in the main facility.
- A disaster recovery (DR) site that provides data replication and backup services for the main site. It includes redundant UPSs and a diesel generator to provide power to the DR site infrastructure when utility power is lost.
- A precision cooling system dedicated to the data center equipment.
- Redundant ACs for cooling the data center UPSs.
- Armed 24/7 security guards.
- Security access controls to the entire building and the main data center.

In addition, as defined on its website (<https://cito.gov.bz/>), CITO also has the following Services:

1. **Database:** Uses the following applications

- **SmartStream:** is the Enterprise Level Application used by the Government of Belize (GoB) for its finance, accounting, personnel and payroll processes
- **GICS** (The Government Integrated Cashiering System): Functional authority and responsibility for cash handling activities is vested in the Accountant General's Office of the Treasury Department. The Treasury delegates this authority to the Finance Officers of the Sub-Treasuries who in turn delegates this authority to the Cashiers of their Sub-Treasury.
- **SIGTAS:** is a software designed to administer different type of taxes. It is a client server solution that utilizes Oracle in the front and back end. The application owners are the Belize Tax Services of Belize

2. **System Administration:**

- Maintaining technical documentation of the operating systems in use
- Keeping up to date on relevant and important technologies, such as disaster recovery methodologies
- Developing policies, focusing on system security and documenting processes
- Always trying to keep software up to date and implement new solutions to automate and make tasks easier.

3. **Network Administration:**



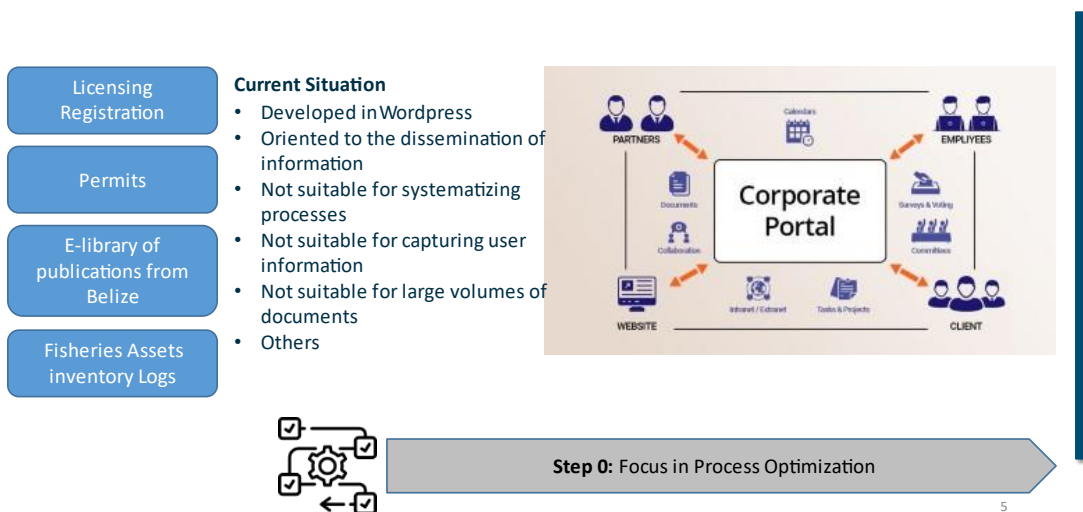
- Planning & coordinating the installation of in-house and remote network hardware & software across the organization’s network.
- Implement short & long-term strategic plans to make certain network capacity meet existing & future requirements.
- Managing & ensuring optimal operation of all networking hardware, including routers, switches, firewalls etc.
- Managing and ensuring effectiveness of security solutions including firewalls, antivirus solutions and intrusion detection & protection systems;
- Conducting research and make recommendations on network products, services, protocols and standards in support of network procurement and development efforts.
- Practicing network asset management including maintenance of network component inventory and related documentation.
- Ensuring the network infrastructure and applications supported are available 24/7

**4. Software:**

- Website Development
- Web Application Development
- Website Modifications
- Website Maintenance
- System Analysis and Design:

**5.3 Current Situation of the Fisheries Department Website and services given trough**

The evaluation of the Fisheries Department's website (<https://fisheries.gov.bz/>) is based on several criteria such as design, functionality, security, and user experience.



**Image 07:** Current Situation of the Fisheries Department website

## Platform:

The Fisheries Department website is developed in WordPress, which is a popular and widely used content management system (CMS) for building websites, including government websites. However, while WordPress is a powerful tool for creating and managing content, it may not always be the best choice for transactional oriented government websites.

WordPress has some limitations when it comes to building transactional oriented websites that require more complex functionality, such as handling sensitive data, processing payments, and integrating with government databases.

While it is possible to extend WordPress with various plugins and third-party integrations to add transactional functionality, this can increase the complexity of the website and potentially introduce security vulnerabilities. In addition, WordPress websites can be more vulnerable to hacking attempts if not properly secured and updated regularly.

Therefore, while WordPress can be a good option for certain types of government websites, it may not be the best choice for highly transactional sites that require advanced functionality and security measures. Other platforms and technologies, such as custom web application frameworks or enterprise-level CMS platforms, may be more suitable for these types of websites.

## Design:

The website's design is simplistic and have a professional look. However, the design is not visually engaging or responsive to different devices, and there is no use of modern design principles, such as minimalism or flat design.

The results of the responsive test are available in the following link:

Responsive Test (by google): <https://search.google.com/test/mobile-friendly/result?id=MvHB1pV-q33qm3cdqgqrmQ>

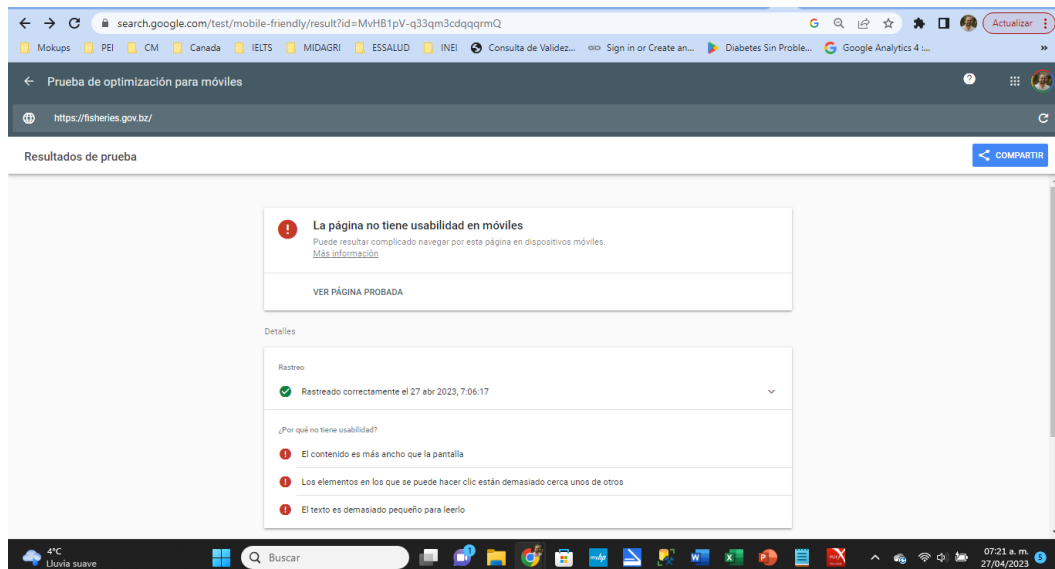


Image 08: Results of the responsive test

## Functionality:



The website's functionality is limited, with no advanced features or interactive elements. There are no search filters or categories to help users find the information they need easily. The website does not have any additional features such as a discussion forum, a chatbot, or a social media integration.

The Fisheries Department website is designed for informational purposes, and not for transactional purposes.

The website allows users to download license application forms, but the process for submitting and paying for the license is not fully digital. Users are required to print and fill out the form manually, then submit it in person or by mail, along with a cashier's check or money order for the license fee.

As mentioned, this process is not as convenient or efficient as it could be, and it also presents some security risks. There is potential for errors or delays in processing the physical forms and payments, and the manual handling of sensitive personal and financial information increases the risk of fraud or data breaches.

Overall, while the Fisheries Department's website shows some progress in terms of digitalization, there is still significant room for improvement in terms of process automation and e-government best practices.

### Security:

The website's security measures appear to be adequate. The website is secured with an SSL certificate, ensuring that all communications between the website and the users are encrypted. However, there is no information available on the website about other security measures that have been implemented, such as firewalls, intrusion detection systems, or data encryption protocols.

### Content:

We found some template content: *"Lorem ipsum dolor sit amet"*.

Link: <https://fisheries.gov.bz/zzhome/>

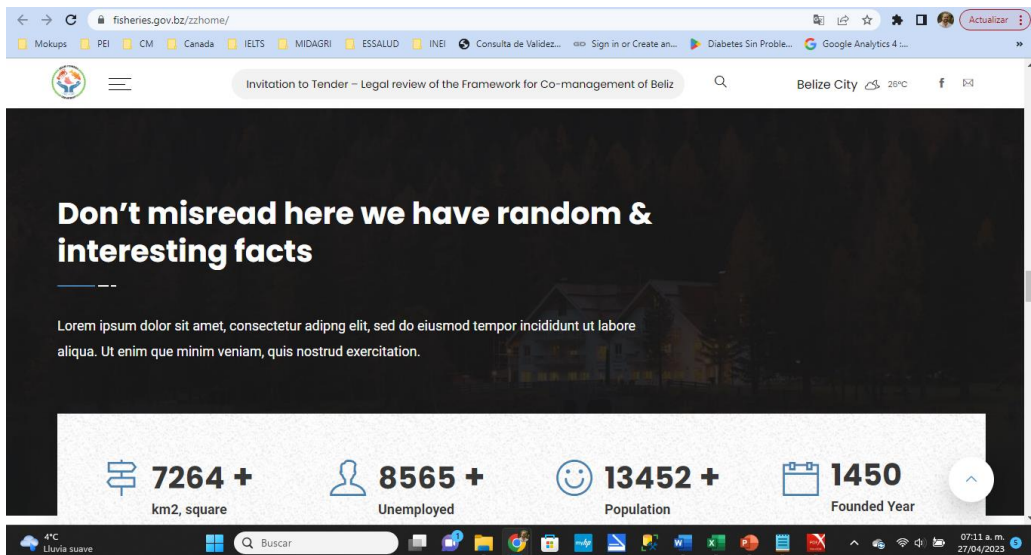


Image 09: template content founded.

Link: <https://fisheries.gov.bz/zzcirculares-and-documents/>

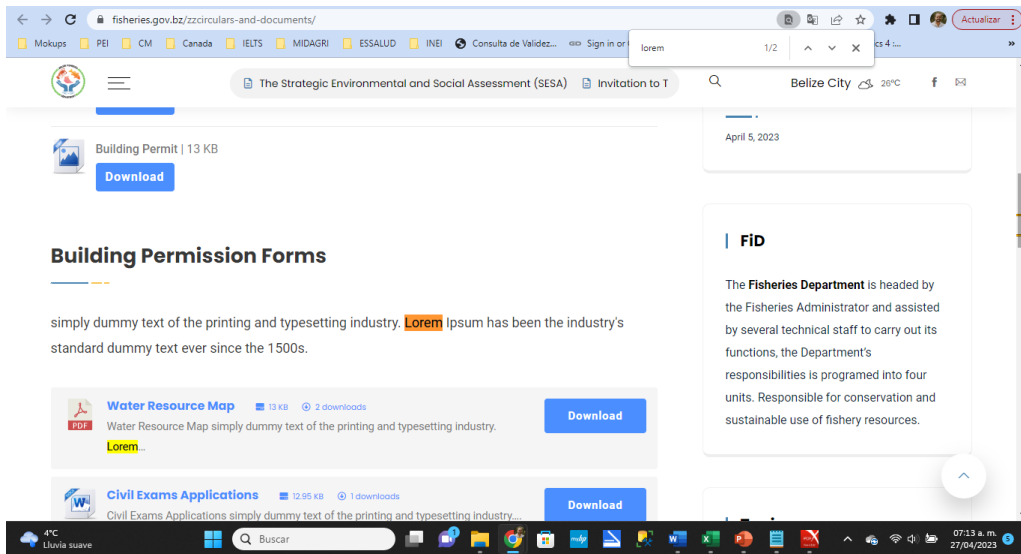


Image 10: template content founded.

Others Links with the same problem:

- URL: <https://fisheries.gov.bz/yelements/>
- URL: <https://fisheries.gov.bz/zzhome/>
- URL: <https://fisheries.gov.bz/zzhome-3/>
- URL: <https://fisheries.gov.bz/zzcontact-info/>
- URL: <https://fisheries.gov.bz/zzgovernment-city-counsils/>

### User Experience:

The website's user experience is poor. The website is not user-friendly and does not offer a good user experience. The website does not have a clear navigation structure, making it difficult for users to find what they are looking for. The website does not have any accessibility options for users with disabilities.

Overall, the website of the Fisheries Department of Belize requires significant improvements to meet modern web standards and provide a better user experience for its visitors.

To address these issues, a relaunch of the Portal is needed, to make it more visually appealing, responsive, and user-friendly. Additionally, the website should incorporate advanced functionality features such as search filters, discussion forums, and social media integration to enhance user engagement. Finally, I would recommend implementing additional security measures such as firewalls, intrusion detection systems, and data encryption protocols to ensure that user data is protected against cyber threats.

## 5.4 Needs and gaps regarding an information management system

Based on the current state of the Fisheries Department of Belize's information management system, there are several needs and gaps that need to be addressed to develop its digital capabilities. The key needs and gaps are as follows:

1. **Centralized Data Management:** The Fisheries Department of Belize requires a centralized data management system that would enable them to store, manage, and analyze data related to fisheries activities. Currently, data is stored in scattered excel sheets, making it difficult to access, process, and analyze.
2. **Digitalization of Transactions:** The Fisheries Department's website provides basic information and allows the public to download forms, but it is not currently possible to submit completed forms or complete transactions online. There is a need for a digital platform that can handle transactions such as licensing, renewals, and applications.
3. **Automation of Processes:** Many of the Fisheries Department's processes are still manual, leading to inefficiencies, errors, and delays. Automation of processes, such as catch log data collection and enforcement data collection, would lead to increased efficiency and accuracy.
4. **Integration with Other Systems:** The Fisheries Department's current solutions are not integrated with other government systems, making it difficult to share data with other departments. There is a need to integrate the Fisheries Department's system with other government systems, to improve the accuracy and consistency of data.
5. **Security:** The Fisheries Department of Belize's current system lacks the necessary security features to protect sensitive data. An upgraded system with security features such as access controls, data encryption, and regular security audits would be necessary to ensure data security.

The Fisheries Department of Belize requires a comprehensive information management system that is centralized, digitalized, automated, integrated, and secure. This system will improve the efficiency, accuracy, and effectiveness of the Fisheries Department's operations, enabling them to make data-driven decisions and support sustainable fisheries practices.

### **5.5 Needs to collect, process, and analyze data form multiple sources.**

The Fisheries Department of Belize requires a comprehensive data collection, processing, and analysis system to effectively manage its operations. The Fisheries Department currently collects data from multiple sources such as the national fisheries survey, enforcement data, cooperative traceability data, marine protected areas monitoring data, and electronic catch log data provided by fishers. These data sources are critical for decision-making processes and policy development. Therefore, it is imperative to collect, process, and analyze this data accurately and efficiently.

To achieve this, there is a need for a centralized data management system that can collect data from all the sources mentioned above. The system must also be able to process and analyze the data in real-time, enabling quick decision-making by the Fisheries Department's management. Additionally, the system must provide robust data visualization capabilities that enable stakeholders to understand the data's insights better.

Furthermore, it is crucial to establish proper data governance policies to ensure data quality and accuracy. The Fisheries Department must develop standard data

collection procedures and ensure data is collected consistently across all sources. This process will improve data reliability, accuracy, and reduce inconsistencies that may arise from manual data collection.

In conclusion, there is a critical need for a comprehensive data management system that can collect, process, and analyze data from multiple sources accurately and efficiently. The system must provide robust data visualization capabilities and adhere to proper data governance policies to ensure data quality and accuracy.

## **6. Proposal of the listing of services, activities and outputs needed to address the needs and the gaps identified in the diagnostic.**

As mentioned in the limitations of this document, the Fisheries Department requires that the following points should be considered as requirements for the implementation of the proposed solutions:

- Hire IT personnel for the design, development and implementation of the Information Management System, for the collection, processing, storage, analysis, visualization of all fishing data in real time or records for the generation of reports for the policy and decision making.
- The system is to either be built from scratch or the customization of an off the shelf system, however it is preferred for the customization of an off the shelf system. There is currently no Data/Information Management System at the Ministry and Fisheries Department.
- Adequate hardware and software required to operate the Data/Information Management System (software solution) such as servers computes software licenses, others.
- Hosting of the Data Information Management System at CITO as the system will be used on the network. As per Government of Belize, all the software solutions must be hosted at CITO. Therefore, the design of the system needs to comply with CITO's policies and procedures.
- The hiring of full staff to create an internal capacity that will provide support to MBECA and the Fisheries Department in the maintenance, management and operation of the system. As well as provide support to the Coastal Zone Management Authority and Institute. Currently there is no human capital to maintain de system. The staff should be hired early in the process so that they can be engaged in the design, the development and testing for knowledge transfer and flattening the learning curve that needs to be addressed, allowing for long term sustainability. The staff that needs to be hired include:
  - System Analyst
  - Software Developer
  - Software Engineer
  - Database Administrator
- training in the use, maintenance and operation of the system (software solution)

Therefore, in order to implement the services, activities and outputs needed to address the needs and gaps identified, taking in consideration the previously mentioned limitations, the following steps need to be taken:

## 6.1 Develop Capacities:

### 6.1.1 Hire Information Management System full-time staff.

In order to develop, manage and maintain the system, ensuring that it runs smoothly and efficiently, and following the requirements of the Fisheries Department, we recommend hiring the following staff:

- 1) 01 System Analyst
- 2) 02 Software Developer
- 3) 01 Software Engineer
- 4) 01 Database Administrator
- 5) 01 Data Entry Clerk

The criteria, considerations, and roles for each member of the staff to be hired for the Fisheries Department's Information Management System development is the following:

#### 6.1.1.1 System Analyst (01):

**Criteria:** The system analyst should have a degree in computer science, information technology or a related field. They should have experience in designing and implementing large scale software solutions and should have knowledge of the latest trends in software development.

**Considerations:** The system analyst will be responsible for gathering requirements from stakeholders, designing the software architecture, and overseeing the development and testing process. They will need to work closely with the software developers and database administrator to ensure that the system meets the needs of the Fisheries Department.

**Role:** The system analyst will be responsible for analyzing the business needs of the Fisheries Department, defining the requirements for the system, and designing the software architecture.

This person will be responsible for understanding and analyzing the requirements and needs of the Fisheries Department and developing functional specifications and user stories for the development team. The system analyst will also work with the project manager to ensure that the project stays on track and within scope.

In an Agile methodology, the system analyst works closely with the Product Owner to define and prioritize user stories and requirements.

#### 6.1.1.2 Software Developers (02):

**Criteria:** The software developers should have a degree in computer science, information technology or a related field. They should have experience in developing software applications using the latest programming languages and frameworks.

**Considerations:** The software developers will be responsible for writing the code that makes up the software solution. They will need to work closely with the system analyst to ensure that the system meets the requirements of the Fisheries Department.

**Role:** The software developers will be responsible for writing the code that implements the features of the software solution.

The software developers will be responsible for designing, coding, testing, and implementing software solutions based on the functional specifications and user stories developed by the system analyst. They will work collaboratively as part of a cross-functional team to deliver working software increments every iteration.

In an Agile methodology, the developers are responsible for estimating the effort required to complete a given user story or task and working with the team to ensure that they meet the sprint goals.

#### **6.1.1.3 Software Engineer (01):**

**Criteria:** The software engineer should have a degree in computer science, information technology or a related field. They should have experience in designing and building large-scale software solutions.

**Considerations:** The software engineer will be responsible for overseeing the software development process and ensuring that the system is scalable, reliable and secure. They will need to work closely with the system analyst and software developers to ensure that the system meets the needs of the Fisheries Department.

**Role:** The software engineer will be responsible for overseeing the development process, ensuring that the system is scalable, reliable and secure.

The software engineer will be responsible for ensuring the technical integrity and quality of the software solutions developed. They will work closely with the software developers to design and develop the architecture of the system, ensure code quality, and oversee the development of automated tests.

In an Agile methodology, the software engineer is responsible for ensuring that the team adheres to best practices and development standards.

#### **6.1.1.4 Database Administrator (01):**

**Criteria:** The database administrator should have a degree in computer science, information technology or a related field. They should have experience in designing, implementing and maintaining large-scale databases.

**Considerations:** The database administrator will be responsible for designing the database architecture, ensuring data security and integrity, and optimizing database performance. They will need to work closely with the software developers and system analyst to ensure that the database meets the needs of the Fisheries Department.

**Role:** The database administrator will be responsible for designing and maintaining the database architecture of the software solution.

The database administrator will be responsible for designing, implementing, and maintaining the databases that underpin the various software solutions developed. They will work closely with the software developers and software engineer to ensure that the databases are optimized for performance, availability, and reliability.

In an Agile methodology, the database administrator works closely with the team to ensure that data is effectively managed throughout the development lifecycle.

#### **6.1.1.5 Data Entry Clerk (01):**



**Criteria:** The Data Entry Clerk will be responsible for filling historical information in the developed solutions.

**Considerations:** Hiring a data entry clerk include their availability, location, and remuneration. It may be preferable to hire someone who is local to the Fisheries Department to facilitate communication and collaboration.

**Role:** The role of the data entry clerk will be to input historical data into the various solutions mentioned. This will involve transferring data from paper-based records, such as logbooks and permits, into digital formats. The clerk will be responsible for ensuring the accuracy of the data entered and for managing their workload to meet deadlines.

Overall, the hiring of these personnel will be critical to the successful implementation of the Information Management System for the Fisheries Department. They will need to work together to ensure that the system meets the needs of the Fisheries Department and provides real-time data for policy and decision-making. Proper training should be provided to ensure that all staff members are proficient in the use, maintenance, and operation of the system.

#### **6.1.2 Enable the budget for hosting and licensing.**

It is required that the Information Management System for the Fisheries Department be hosted at CITO, which is the centralized IT department for the Government of Belize. This is in accordance with the government policy that all software solutions should be hosted at CITO.

In terms of hosting, the Fisheries Department will need to work closely with CITO to ensure that the system is designed and developed in compliance with CITO's policies and procedures. This will include ensuring that the system meets the required security and data protection standards, as well as being scalable and able to handle the expected load.

Additionally, adequate hardware and software will be required to operate the system, which may include servers, computers, software licenses, and other related equipment. The Fisheries Department, through the Scrum Master and/or the Development Team, should work with CITO to determine the specific hardware and software requirements for the system, as well as to ensure that the necessary licenses are obtained and properly managed.

In terms of licensing, the Fisheries Department will need to ensure that it has the necessary licenses to operate the system and that these licenses are properly managed. This may include acquiring licenses for any third-party software used in the system, as well as managing licenses for any custom software developed for the system. The Fisheries Department should work with CITO to determine the specific licensing requirements for the system and to ensure that these requirements are met.

Overall, the hosting and licensing of the Information Management System for the Fisheries Department will require close collaboration between the Fisheries Department and CITO, with a focus on ensuring compliance with government policies and procedures, as well as meeting the specific needs of the Fisheries Department.

For the costing of the hosting and licensing, we used the prices provided by CITO and used referential prices from cloud services estimators like azure as well. The following items were considered:

ITEM	PROVIDER	QUANTITY
<b>Hosting</b>		
SSL Certificate	CITO Service /year	1
Public IP	CITO Service /year	1
Hosting	CITO Service /year	1
One (1) CPU Core/vCPU	CITO Service /month	8
One (1) GB of vRAM	CITO Service /month	16
One (1) GB of vHDD	CITO Service /month	4000
Backup	CITO Service /month	4
Dedicated Internet bandwidth	CITO Service /month	100
VPN services	CITO Service /month	5
Rack Space (11U - 21U)	CITO Service /month	1
<b>Licenses</b>		
Ms Office	Microsoft	5
SQL Server Standard	MS SQL Server	1
Others*	Service /month	1

**Table 01:** Costing for the Hosting and Licensing for the implementation of the Information Management System

\* Considering that there is no history on the information to be collected, the type and size of formats to be used and the processes to be systematized on the solutions to be implemented, it was considered an average referential flat budget for a medium solution, based on previous similar experiences for around US\$ 2,500 per month, but is important to say that this cost is not flat but exponential.

Therefore, the final budget is around US\$ 203,500 for the duration of the project, and it will leave a recurring cost US\$ 64,291 per year, including taxes respectively.

### 6.1.3 Apply software development best practices to also develop Analytical Capabilities.

In order to develop the proposed solutions and also taking in consideration the development of the advanced analytical capabilities in the Fisheries Department, we need to consider the following five fronts:

#### 6.1.3.1 Use an Agile methodology.

To effectively develop and implement the proposed solutions, it is recommended to use an Agile methodology, specifically Scrum, which is a framework for managing and completing complex projects. This methodology allows for the iterative and incremental delivery of high-quality software solutions while incorporating feedback from stakeholders.

In Scrum, the roles are divided into three categories: The Product Owner, the Scrum Master, and the Development Team, described as following:

1. **Scrum Master:** The Scrum Master is responsible for facilitating the Scrum process, removing any impediments to progress, and ensuring that the team adheres to Scrum practices and values. They act as a servant-leader to the team, coaching them on how to work together effectively and supporting their development. The Scrum Master also facilitates the Scrum events, such as the daily stand-up, sprint planning, sprint review, and sprint retrospective.



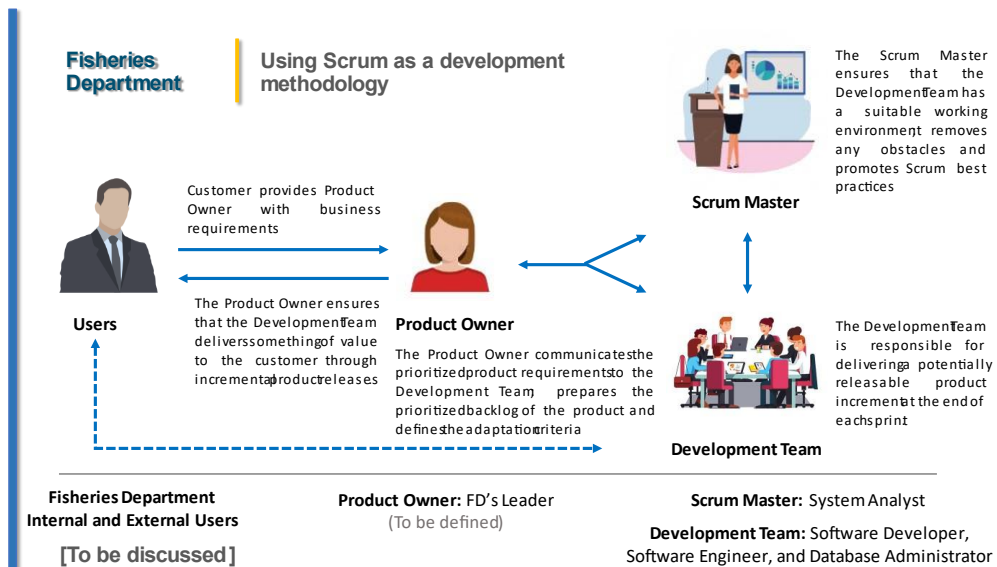
In this project, the System Analyst role would be the best fit for the Scrum Master, as they would have the necessary expertise to facilitate the process and ensure that the team is working towards the project's goals.

- 2. Product Owner:** The Product Owner is responsible for the vision of the product and the management of the product backlog. They work closely with the stakeholders to understand their needs and prioritize the work of the Development Team. The Product Owner also defines the acceptance criteria for each item in the backlog and accepts the work delivered by the Development Team. In this project, the Fisheries Department should appoint someone who has a deep understanding of their business needs and can effectively communicate these needs to the Development Team.

The best fit for this role would be the head of the Fisheries Department or a designated representative who has decision-making power and a clear understanding of the project's goals.

- 3. Development Team:** The Development Team is responsible for delivering a potentially releasable product increment at the end of each sprint. They are self-organizing and cross-functional, meaning that they have all the skills necessary to deliver the product increment. The Development Team is responsible for estimating the work and committing to delivering the work during the sprint.

In this project, the Software Developer, Software Engineer, and Database Administrator would make up the Development Team. They should have the necessary technical skills to design, develop, and maintain the system, as well as collaborate effectively with each other and the rest of the team.



**Image 11:** Proposal to implement Scrum as Development Methodology  
**Source:** Own elaboration

Using an Agile methodology like Scrum can help ensure that the proposed solutions are effectively developed and implemented in a timely and cost-effective manner while incorporating feedback from stakeholders. The Scrum framework provides a structured approach to software development that can help ensure that the project stays on track and delivers value to the stakeholders.

By having clearly defined roles and responsibilities, the team can work together more effectively towards the Fisheries Department’s goals.

### 6.1.3.2 Define a Data Vision and Strategy

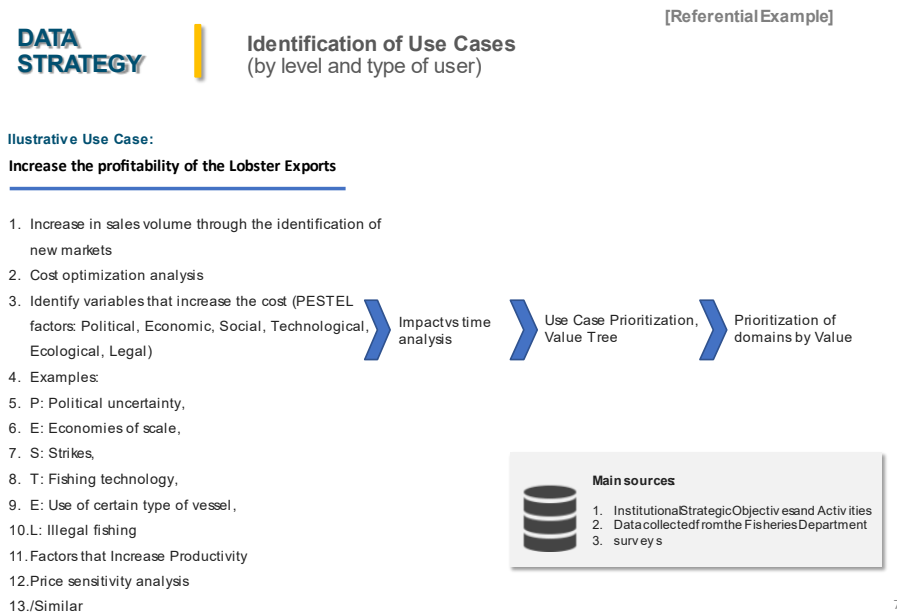
In order to start creating an Institutional Database for the Fisheries Department, it is necessary to start from the analysis of the needs of all business areas related to the scope of the solutions proposed in this report, and also consider that in a near future the scope should consider all the business areas of the Fisheries Department. Based on this understanding, is necessary to define a Vision in the use of data and analytics, clearly identifying the areas that own the data, the users of this information and the information needs to be addressed.

#### *Identify and prioritize Use Cases and Data Domains*

This Vision must be translated into a Data Strategy that establishes step by step the most relevant initiatives to implement in order to meet the needs of the organization, therefore, the next step is to translate it into Advanced Analytics Use Cases, value and prioritize them according to its impact and ease of implementation. In this way, the Fisheries Department data domains are identified and prioritized according to their value and thereby draw the roadmap to follow for the next three or four years.

The Data Strategy must contemplate the different levels of management and types of information users, starting from the strategic, tactical management level to the operational one.

The following example shows the analysis process that each use case should follow until the identification of its value and prioritization is shown for reference purposes.



**Image 12:** Use Case, non-exhaustive referential example

#### *Prioritize and implement Advanced Analytics Use Cases*

Analytical management based on Use Cases allows the analysis efforts to be directed towards meeting the Sector's priorities, therefore, once the Advanced

Analytics Use Cases have been identified, the value contribution of each one must be estimated to prioritize their implementation and implementation. progressive.

Once the use cases have been identified and defined in the design of the Data Strategy, they must be categorized and prioritized, so that the data domains are also prioritized according to the value for the business.

The Development Team is responsible for preparing the Data Vision and Strategy, in order to implement a Data Architecture capable of meeting all the requirements of the Fisheries Department.

### 6.1.3.3 Optimize the Data Architecture

The new data architecture must address all the data dimensions identified in the Data Strategy, to support the Fisheries Department Advanced Analytics Use Cases. It must consider the management of Master Data, as well as the Data Governance tools.

Based on the previous recommendations and the context of the Fisheries Department, it would be advisable to consider the creation of datamarts as a solution for data architecture, in order to address the analytical needs. Datamarts are a subset of a data warehouse, focused on a specific business area or subject, and can be created relatively quickly and at a lower cost than a full data warehouse.

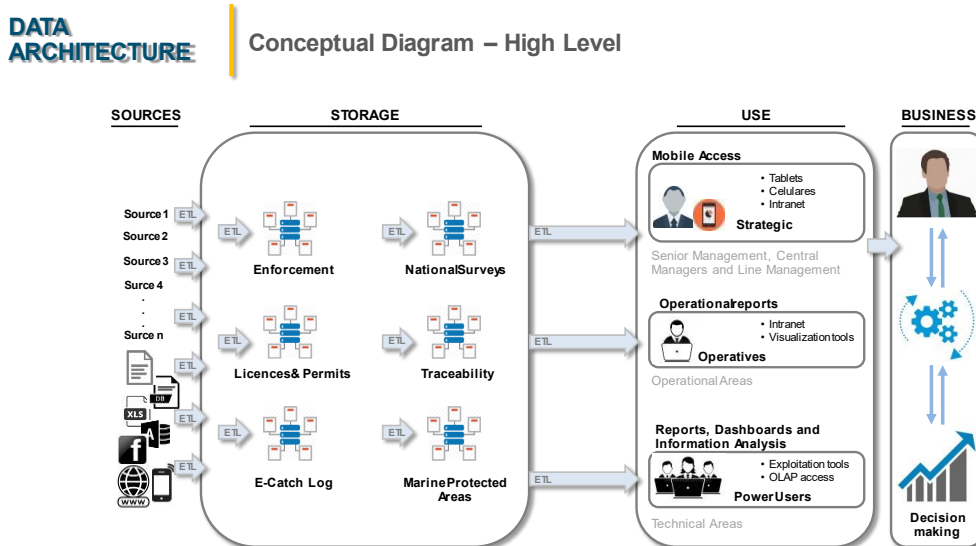


Image 13: Use Case, non-exhaustive referential example

To implement datamarts, the following steps can be taken:

1. **Identify the business areas or subjects that require analytics:** The Fisheries Department can identify the specific areas where they need to analyze data, such as catch data, licensing data, compliance data, or survey data. This step involves working with stakeholders to identify the key performance indicators (KPIs) and business questions that need to be answered.

2. **Define the data requirements:** Once the business areas have been identified, the next step is to define the data requirements. This includes identifying the data sources, the data quality requirements, and the data integration requirements. This step involves working with the Development Team to understand the data structures and sources, as well as with business stakeholders to understand the business requirements.
3. **Design the datamart:** The datamart design involves creating a data model that supports the business requirements and data sources. This step includes creating a schema that defines the data entities, attributes, and relationships. The design should also consider the reporting and analysis requirements, such as the frequency of data updates and the types of queries that will be run.
4. **Develop the datamart:** The development of the datamart involves building the database schema and ETL (Extract, Transform, Load) processes. This step requires collaboration between IT personnel and business stakeholders to ensure that the data is properly transformed and loaded into the datamart.
5. **Test the datamart:** Testing the datamart involves validating the data accuracy, completeness, and consistency. This step requires testing the ETL processes, data quality rules, and data transformation logic. It is important to involve business stakeholders in the testing to ensure that the datamart meets the business requirements.
6. **Deploy the datamart:** Once the datamart has been tested and validated, it can be deployed into production. This step requires collaboration between IT personnel and business stakeholders to ensure that the datamart is properly integrated into the analytics environment.
7. **Monitor and maintain the datamart:** Finally, the datamart needs to be monitored and maintained to ensure that it continues to meet the business requirements. This step involves creating a maintenance plan that includes data refresh schedules, data quality monitoring, and backup and recovery procedures. It is important to involve both IT personnel and business stakeholders in the maintenance of the datamart to ensure that it continues to support the business needs.

Based on the recommendations and the use of Scrum, the following roles could be established for the development of the new architecture:

- **Product Owner:** This role would be responsible for defining the vision for the data architecture, identifying the requirements, and prioritizing the work based on the business value. The product owner should have knowledge of the business processes and the data requirements.
- **Scrum Master:** This role would be responsible for ensuring that the Scrum process is followed, facilitating the Scrum events, and removing any impediments that may hinder the team's progress. The Scrum Master should have knowledge of the Scrum framework and should be able to coach the team in using it effectively.
- **Development Team:** The development team would be responsible for the design, development, and testing of the datamarts. The team would consist of the following roles:

- **System Analyst:** This role would be responsible for analyzing the business requirements and translating them into technical requirements for the development team.
- **Software Developer:** This role would be responsible for designing, coding, and testing the datamarts based on the technical requirements.
- **Software Engineer:** This role would be responsible for ensuring that the software meets the required quality standards and for implementing best practices for software development.
- **Database Administrator:** This role would be responsible for managing the data infrastructure, including database design, maintenance, and security.

On the other hand, the following criteria should be considered when developing the datamarts:

- **Data quality:** The data should be accurate, complete, consistent, and timely.
- **Data integration:** The datamarts should integrate data from various sources and provide a unified view of the data.
- **Data accessibility:** The data should be easily accessible and available to authorized users.
- **Data security:** The data should be secured and protected from unauthorized access.
- **Scalability:** The datamarts should be scalable to accommodate future growth in data volume and complexity.
- **Performance:** The datamarts should provide fast and efficient access to data.

By following these steps, the Fisheries Department can create datamarts that support their analytical needs at a lower cost and with fewer resources than a full data warehouse. This approach also allows them to focus on specific business areas or subjects and can lead to more agile and effective decision-making.

### **Recommendations – out of scope of this Mission.**

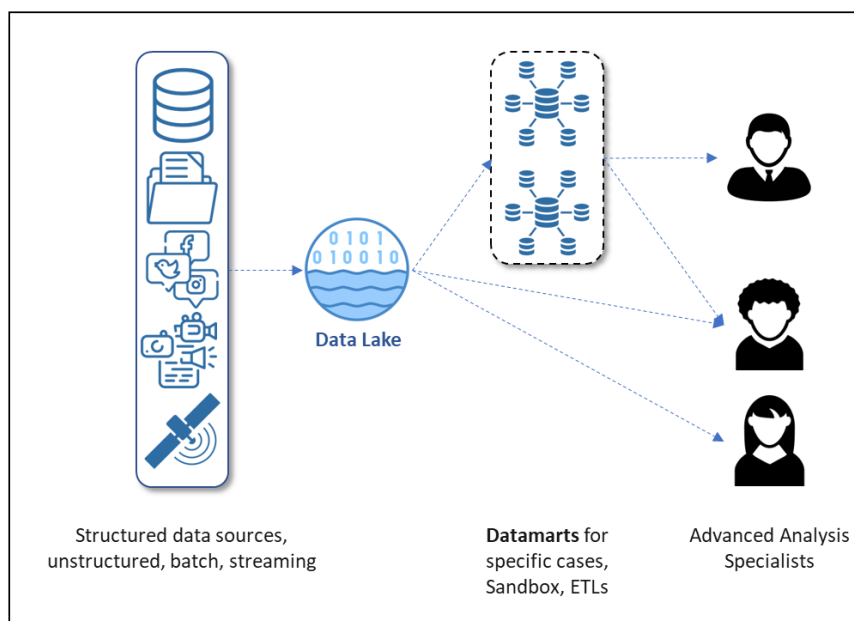
After the creation and consolidation of the datamarts, with which it would already be possible to have a centralized database for the Department of Fisheries, the next step would be to determine the best option for storing and integrating data from different sources. Both a data warehouse and a data lake can be viable options, but the choice depends on the specific needs and goals of the Fisheries Department.

A data warehouse is a centralized repository that stores structured data from various sources and is optimized for querying and analysis. It typically involves a schema-on-write approach, where the data is cleaned, transformed, and loaded into the warehouse in a predefined structure. This approach can be well-suited for organizations that have a well-defined and stable set of data sources and need to perform complex analytics on their data. However, building a data warehouse can be expensive and time-consuming, and may require significant upfront investment in infrastructure and data modeling.

On the other hand, a data lake is a large, flexible repository that stores both structured and unstructured data in its raw form, without any predefined schema. It typically involves a schema-on-read approach, where the data is transformed and structured

at the time of analysis, rather than during the data ingestion process. This approach can be well-suited for organizations that need to store and analyze large volumes of diverse and rapidly changing data and want to avoid the cost and complexity of building a rigid data model upfront. However, working with a data lake can be more challenging, as it requires more effort to structure and organize the data for analysis.

In the case of the Fisheries Department, a data lake may be a more feasible option. This would allow the Fisheries Department to store and integrate a wide range of data sources, including structured and unstructured data, and to perform exploratory analysis and experimentation on the data without the need for a predefined schema. However, it is important to note that a data lake requires strong data governance and management practices to ensure the quality, security, and privacy of the data, and to prevent it from becoming a data swamp.



**Image 14:** Referential, Recommendation to implement a Data Lake (Out of Scope)

#### 6.1.3.4 Optimize Information Security

The Fisheries Department should work closely with CITO to ensure that appropriate security measures are in place to protect their data. In this way, some recommendations are considered:

1. **Data Classification:** Data should be classified based on its sensitivity, such as confidential, sensitive, public, or private. Access controls, encryption, and monitoring should be applied according to the classification level.
2. **Access controls:** Access controls should be implemented to ensure that only authorized personnel have access to the data. This includes user authentication, authorization, and auditing.
3. **Encryption:** Data should be encrypted both in transit and at rest to ensure that it cannot be accessed by unauthorized individuals.



4. **Network security:** The Fisheries Department should ensure that their network infrastructure is secure, and that firewalls, intrusion detection and prevention systems, and other security measures are in place.
5. **Employee training:** All employees who have access to sensitive data should have training on cybersecurity best practices, including how to identify and respond to security threats.
6. **Incident response:** The Fisheries Department should have an incident response plan in place to respond to any cybersecurity incidents that occur. This plan should include procedures for detecting, containing, and mitigating the impact of a security incident.
7. **Compliance:** The Fisheries Department should ensure that their cybersecurity practices comply with all applicable laws and regulations, such as the General Data Protection Regulation (GDPR) and the Cybersecurity Information Sharing Act (CISA).

It is recommended that the Fisheries Department work with CITO to implement a strong cybersecurity posture to ensure the confidentiality, integrity, and availability of their data. They should also regularly review and update their security measures to address new threats and vulnerabilities.

### **Data protection and privacy**

The Fisheries Department should consider the data protection and privacy regulations that are applicable in Belize. The '**Data Protection Act 2019**', which came into force in 2020, is the primary legislation governing data protection in Belize. It sets out the requirements for the collection, processing, storage, and transfer of personal data, and the rights of individuals with respect to their personal data.

Under the Data Protection Act, personal data must be processed lawfully, fairly, and transparently. Individuals have the right to know what data is being collected about them, how it will be used, and who it will be shared with. They also have the right to access their data, correct inaccuracies, and request that their data be deleted in certain circumstances. The Fisheries Department should ensure that it complies with these requirements and that it has appropriate measures in place to protect personal data from unauthorized access, use, or disclosure.

In addition to the Data Protection Act, the Fisheries Department may also need to comply with other regulations and guidelines related to sensitive data protection. For example, if the system will process financial data, the Fisheries Department may need to comply with the requirements of the Financial Intelligence Unit. If the system will process data related to protected species, the Fisheries Department may need to comply with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or other regulations related to the protection of wildlife.

It is important for the Fisheries Department to conduct a thorough assessment of the applicable regulations and guidelines and ensure that its system and processes comply with all relevant requirements.

#### **6.1.3.5 Change Management and Training**

Considering that the hired personnel should guide the change management and give the training, the following recommendations are considered:

1. **Develop a Change Management Plan:** The Scrum Master should develop a comprehensive change management plan that outlines the scope of the

changes to be implemented, the objectives of the changes, and the timeline for implementation. This plan should include strategies for communicating with stakeholders and users, training and development plans, and metrics for measuring the success of the changes.

2. **Conduct a Stakeholder Analysis:** It is important to identify all stakeholders who will be affected by the changes and understand their needs and concerns. The Fisheries Department should engage stakeholders in the process of designing and implementing changes, and make sure that their input is incorporated into the plan.
3. **Design a Communication Plan:** A comprehensive communication plan is essential for ensuring that all stakeholders are informed about the changes and their impact. The plan should identify key messages, target audiences, channels for communication, and a timeline for communication activities.
4. **Develop a Training Plan:** The Fisheries Department should develop a training plan that outlines the skills and knowledge required for the new systems and processes, the target audience for the training, and the delivery method (e.g., in-person, online, self-paced). The Scrum / Development team should be responsible for the development and delivery of the training and should work closely with the product owner to ensure that the training is aligned with the objectives of the changes.
5. **Engage Leaders and Managers:** Leaders and managers within the Fisheries Department should be involved in the change management process from the beginning. They should be trained to communicate the changes to their teams, and to support their teams during the transition. The product owner, who is a leader within the Fisheries Department, should be particularly involved in the change management process, as they will be responsible for ensuring that the changes meet the Fisheries Department's objectives.
6. **Monitor and Evaluate Progress:** It is important to monitor and evaluate the progress of the changes, and to adjust as needed. The Fisheries Department should establish metrics for measuring the success of the changes and should regularly review progress against these metrics.
7. **Provide Ongoing Support:** After the changes have been implemented, ongoing support should be provided to ensure that users are able to use the new systems and processes effectively. The Scrum / Development team should provide ongoing support to users and should be available to answer questions and address issues as they arise.

The Fisheries Department should develop a comprehensive change management and training plan that engages stakeholders, communicates the changes effectively, provides training and support to users, and monitors progress against established metrics. The Scrum / Development team should work closely with the product owner to ensure that the changes meet the Fisheries Department's objectives, and that users are able to use the new systems and processes effectively.

The suggested roles of each member of the Scrum team for Change Management and Training are the following:

1. **Product Owner:** The Product Owner will be responsible for defining the vision for the implementation of the solutions and recommendations. They will also be responsible for ensuring that the change management and training plans align with the business goals and objectives. They will work



closely with the Scrum team to identify training needs, develop training materials, and ensure that the change management plan is being implemented effectively.

2. **Scrum Master:** The Scrum Master will be responsible for facilitating the change management and training process. They will ensure that the team is following the Scrum framework and that the training and change management plans are being executed effectively. They will also be responsible for coaching the team members on the best practices for change management and training.
3. **Development Team:** The Development Team will be responsible for creating the necessary training materials and delivering the training sessions to the organization and its users (fishermen). They will work closely with the Product Owner to identify the training needs and develop the necessary materials. They will also be responsible for delivering the training sessions and monitoring the effectiveness of the training program.
4. **Stakeholders:** The stakeholders will play an important role in the change management and training process. They will provide feedback on the training materials and the change management plan, and they will also be responsible for communicating the changes to their teams. The Scrum team will work closely with the stakeholders to ensure that the training and change management plans meet their needs and expectations.

Overall, the Scrum Team will work together to ensure that the change management and training plans are developed and executed effectively. The Product Owner will define the vision, the Scrum Master will facilitate the process, the Development Team will create and deliver the training, and the stakeholders will provide feedback and support.

By following these steps, the Fisheries Department can develop advanced analytical capabilities that can help to inform policy and decision making, improve fishing practices, and promote sustainable fisheries management.

## 6.2 Relaunch the Fisheries Department website:

### 6.2.1 Solutions to be implemented in the new website.

The website should be redesigned to turn it into a transactional site. The website should provide an online platform for systematizing the following solutions:

1. **Licensing and Permits processes:** The new website should allow to the applicants to apply and receive approval digitally. Therefore, to systematize the Licensing and Permits processes, there are some technical details and considerations that should be taken into account, as following:
  - **Design the user interface:** The user interface should be designed to be user-friendly, mobile-responsive, and accessible to the public. The design should consider the different types of licenses and permits that the Fisheries Department offers and make it easy for applicants to find and apply for the appropriate one.
  - **Create a centralized database:** A centralized database should be created to store all the information related to the licensing and permit processes. This will

ensure that all the data is organized and easily accessible to the staff responsible for approving applications.

- **Develop an online application system:** An online application system should be developed to allow applicants to apply and receive approval digitally. The system should be integrated with the centralized database, so that all the information entered by the applicants is automatically stored in the database.
- **Implement a workflow management system:** A workflow management system should be implemented to automate the process of reviewing and approving applications. The system should allow staff to assign tasks, set deadlines, and track the progress of applications through the approval process.
- **Implement a notification system:** A notification system should be implemented to notify applicants of the status of their application. The system should send automated emails or text messages to applicants when their application has been received, when it is being reviewed, and when it has been approved or denied.
- **Integrate the licensing and permit system with the Fisheries Assets inventory logs:** The licensing and permit system should be integrated with the Fisheries Assets inventory logs to ensure that applicants are aware of the availability of the assets they need to operate their fishing activities.
- **Ensure data security:** Data security should be a top priority when designing the licensing and permit system. This includes implementing security measures such as encryption, access controls, and regular data backups.

In terms of the required technical skills for the software developers, they should have experience in web development, database design and development, workflow management systems, and data security. They should also be familiar with the Azure hosting environment and have experience working with cloud-based solutions. Additionally, they should have strong problem-solving and communication skills, as well as the ability to work collaboratively in a team environment.

2. **The Fisheries Assets Inventory Logs:** The Fisheries Department needs to implement a solution for the inventory of fishing assets, which must be available in the new Institutional Portal and its data must be visible to the license and permit modules. To address this need, the following steps can be taken:
  1. **Define the data model:** The first step is to define the data model for the inventory of fishing assets. This will involve identifying the key data elements that need to be captured and how they relate to each other. The data model should be designed in a way that allows easy integration with the licensing and permit modules.
  2. **Develop the registration module:** The registration module should be developed in a way that allows users to register their fishing assets easily. This can be achieved by providing an intuitive interface that guides users through the registration process. The module should also include data validation and error handling to ensure that the data entered is accurate and complete.
  3. **Integration with the institutional portal:** The registration module should be integrated with the institutional portal to ensure that the data entered is visible to the license and permit modules. This can be achieved by using APIs or other integration mechanisms.

4. **Implement security measures:** The registration module should be designed with security in mind. This will involve implementing measures such as authentication, authorization, and encryption to ensure that the data entered is secure.
5. **Implement data quality controls:** The system should implement data quality controls to ensure that the data entered is accurate and complete. This can be achieved by implementing data validation rules, data profiling, and data cleansing.
6. **Develop reporting and analytics:** To ensure that the data entered is useful for decision-making, reporting and analytics should be developed. This will involve developing dashboards, reports, and other visualizations that provide insights into the data entered.
7. **Train users:** Finally, users should be trained on how to use the registration module. This can be achieved by providing online training materials, webinars, or in-person training sessions.

In terms of technology, the registration module can be developed using a variety of technologies, including ASP.NET, Java, or Node.js. The data can be stored in a variety of data storage solutions, including SQL Server, MySQL, or MongoDB. It is recommended to use a cloud hosting service such as Azure to ensure scalability, reliability, and availability.

3. **E-library of publications from Belize:** It is proposed to implement a content management module for the publications of the Fisheries Department through the Institutional Portal.

To systematize the E-library of publications from Belize on the new Fisheries Department website, the following steps could be taken:

1. **Content Management System (CMS):** The website should have a CMS in place to allow the Fisheries Department staff to easily create, edit, and publish content, including publications. The CMS should also have a user-friendly interface to make it easy for non-technical staff to manage the content.
2. **Publication Categorization:** The publications should be categorized and organized in a logical manner, such as by publication type, subject matter, and date of publication. This will make it easier for users to find the publications they are interested in.
3. **Search Functionality:** A search functionality should be implemented on the website to allow users to search for publications by keywords or other relevant criteria.
4. **Publication Format:** The publications should be available in a variety of formats, such as PDF, HTML, and e-book, to cater to different user preferences.
5. **Version Control:** A version control system should be implemented to ensure that the latest versions of the publications are available on the website. This will also help to maintain the accuracy and integrity of the content.
6. **Security:** The website should have appropriate security measures in place to protect the publications and prevent unauthorized access or modification.
7. **Analytics:** Analytics should be implemented to track the usage of the E-library of publications. This will provide valuable insights into the popularity of certain publications and user behavior, which can be used to inform future content creation and website improvements.

Some examples of how this solution could be implemented include the following:

- Using a CMS like WordPress or Drupal to manage the content on the website.
- Implementing a search engine like ElasticSearch or Solr to provide advanced search functionality.
- Using a version control system like Git to manage the different versions of the publications.
- Implementing security measures such as SSL encryption, firewalls, and user authentication to protect the website and its content.
- Using analytics tools like Google Analytics or Matomo to track website usage and user behavior.

### 6.2.2 Development Considerations

The website should be redesigned to turn it into a transactional site, in that sense, I suggest considering the following considerations:

1. **Define the scope and objectives:** The first step is to define the scope of the project, including the features and functionality required to systematize the licensing and permit processes. This should be done in collaboration with the stakeholders, including the product owner, users, and other relevant parties. The objectives of the project should also be clearly defined, including the timeline, budget, and expected outcomes.
2. **Design the user interface and user experience:** The website should be user-friendly, mobile-responsive, and accessible to the public. The design should be based on the best practices for user interface and user experience (UI/UX), taking into consideration the needs and preferences of the target audience. The design should also be consistent with the branding and messaging of the Fisheries Department.
3. **Choose the appropriate technology stack:** The technology stack should be chosen based on the requirements of the project, including the scalability, security, and compatibility with other systems. The development team should consider using a web development framework, such as React or Angular, to speed up the development process and ensure consistency in code structure and design.
4. **Implement agile methodology:** The development process should follow the Scrum framework, which includes defining the product backlog, sprint planning, daily stand-up meetings, sprint review, and retrospective. This will ensure that the project is completed on time, within budget, and with the required quality.
5. **Ensure security and data protection:** The website should be designed with security and data protection in mind. The development team should consider using encryption and other security measures to protect user data and prevent cyber-attacks. The team should also comply with relevant regulations and guidelines, such as GDPR and ISO 27001.
6. **Integrate with other systems:** The website should be integrated with other systems, such as the E-Library Publications and the Fisheries Assets inventory Logs, to streamline the licensing process and provide a seamless experience for the users.
7. **Provide training and support:** The development team should provide training and support to the Fisheries Department staff and users to ensure a smooth transition

to the new system. The team should also develop documentation and online resources to assist users with the new platform.

8. **Measure and optimize performance:** The performance of the website should be measured and optimized on an ongoing basis. The development team should use tools such as Google Analytics to monitor user behavior and identify areas for improvement. This will help to ensure that the website continues to meet the needs of the users and the objectives of the project.

Overall, the relaunch of the Fisheries Department website should be approached as a strategic initiative that requires a holistic view of the organization, the users, and the technology. By following best practices, using agile methodology, and ensuring security and data protection, the Fisheries Department can develop a transactional website that provides a seamless and efficient experience for users, streamlines the licensing and permit processes, and supports the overall objectives of the organization.

### 6.2.3 Skills required.

Considering that the two software developers will work on the relaunch of the Fisheries Department website and will lead the entire development project and the training of end users, it is important to consider that they must have the necessary skills to guarantee the successful delivery of the project. Some of the essential skills includes:

1. **Front-end development skills:** The developers should be proficient in using front-end web development technologies such as HTML, CSS, and JavaScript to build the user interface of the website.
2. **Back-end development skills:** The developers should have knowledge of server-side programming languages such as PHP, Python, or Node.js to develop the back-end of the website.
3. **Database skills:** The developers should be familiar with database management systems such as MySQL or SQL Server and be able to design, develop, and maintain the website's database.
4. **Cloud computing skills:** Since the website will be hosted on Azure, the developers should have experience with cloud computing technologies and be proficient in using Azure services such as Azure App Service, Azure SQL Database, and Azure Blob Storage.
5. **Agile development methodology:** The developers should have experience working in an Agile development environment and be familiar with the Scrum framework.
6. **Security:** The developers should be knowledgeable in web security and implement best practices to ensure the website is secure from malicious attacks.
7. **Testing and Quality Assurance:** The developers should be skilled in testing and Quality Assurance to ensure the website functions correctly and is free from bugs and errors.
8. **Communication and collaboration:** The developers should be able to communicate effectively with the rest of the team and stakeholders and be able to work collaboratively to achieve project goals.

Overall, the developers should have a combination of technical, project management, and soft skills to ensure a successful project outcome.

### **6.3 Cooperative Traceability Data, including Catch Log:**

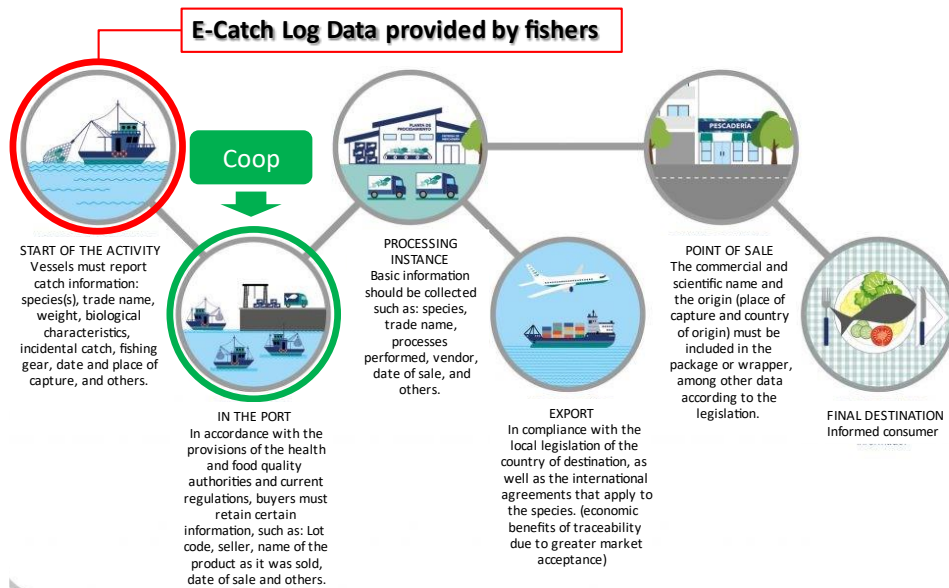
An application for cooperative traceability data, including a catch log, will help the Fisheries Department to collect and store data efficiently. It will also allow the Fisheries Department to track the entire supply chain, from the catch to the final product, providing transparency to the process.

As mentioned in point 5.2.2 (4), the chain to be considered for traceability include the following points:

- 1. The starting process:**
  - 1.1. Harvesting: Fishermen belonging to cooperatives go out to sea to catch fish and other seafood.
- 2. In the Port:**
  - 2.1. Weighing and Grading: When the fishermen bring their catch back to shore, it is weighed and graded based on species, size, and other relevant criteria.
  - 2.2. Tagging: Each fish is tagged with a unique identifier, which will be used to track it throughout the rest of the chain.
- 3. Processing Instance:**
  - 3.1. Processing: The fish are then processed and packaged, ready for sale.
- 4. Export:**
  - 4.1. Transportation: The packaged fish are transported to a storage facility, where they await distribution.
  - 4.2. Distribution: The fish are distributed to retailers and other customers.
- 5. Point of Sale:**
  - 5.1. Sale: The fish are sold to end customers.

Throughout this chain, data should be collected and recorded, including information about the species, weight, and origin of each fish, as well as the identity of the fishermen who caught them. This data will be tracked using the unique identifiers assigned to each fish, which will enable the Fisheries Department to monitor the entire supply chain, from harvesting to sale. The data will be entered into a centralized system, such as the traceability system being implemented, and will be accessible to authorized stakeholders, including the Fisheries Department and the cooperatives themselves. Data quality verification mechanisms, such as regular audits and inspections, can also be put in place to ensure the accuracy and completeness of the data.





**Image 04(2):** Licensing numbers in Belize  
**Source:** Fisheries Department

In this way, for the development of an application for cooperative traceability data, including a catch log, the Fisheries Department will need to consider the following technical aspects:

1. **Infrastructure:** Coordinate with CITO in order to have a reliable and secure infrastructure to host and store the data collected from the cooperative traceability system. This includes servers, databases, and networks.
2. **Equipment:** The Fisheries Department will need to have, provide, or ensure the equipment such as computers, tablets, and smartphones that can be used by fishermen to log their catches in real-time. This equipment must be rugged and able to withstand harsh marine environments.

There are several brands and models of equipment that could be used to log catches in real-time, depending on the specific needs and requirements of the Fisheries Department. Some examples include:

- **Garmin Striker Plus 7sv:** This fishfinder includes GPS and CHIRP sonar technology to provide accurate fish detection and mapping. It is also waterproof and designed for use in harsh marine environments. The average price for this unit is around **US\$500**.
- **Humminbird Helix 7 Chirp SI GPS G3:** This fishfinder also includes GPS and CHIRP sonar technology, as well as side imaging for detailed mapping of the ocean floor. It is also waterproof and rugged, with an average price of around **US\$700**.
- **Lowrance HOOK Reveal 7x TripleShot:** This fishfinder includes GPS and TripleShot sonar technology for accurate fish detection and mapping. It is also waterproof and designed for use in harsh marine environments. The average price for this unit is around **US\$500**.



- **Raymarine Axiom 7 RV:** This fishfinder includes GPS, CHIRP sonar, and RealVision 3D technology for detailed mapping of the ocean floor. It is also waterproof and rugged, with an average price of around **US\$1,200**.

It is important to note that the specific equipment chosen will depend on the requirements and budget of the Fisheries Department, having reserved around US\$ 30,000 for this purpose. It is also important to ensure that fishermen are trained on the use of the equipment to ensure accurate and consistent data collection.

3. **Data Collection:** Define the data that needs to be collected from the cooperative traceability system. This data should include information about the catch, such as species, weight, location, and time of capture.
4. **Data Storage:** Determine the best way to store the data collected from the cooperative traceability system. This includes the type of database, backup strategy, and disaster recovery plan.
5. **Data Analytics:** Develop or acquire tools that can be used to analyze the data collected from the cooperative traceability system. This includes tools for reporting, visualization, and predictive analytics.
6. **Security:** Implement a comprehensive security strategy to protect the data collected from the cooperative traceability system. This includes access controls, data encryption, and intrusion detection and prevention.
7. **Training:** Provide training to fishermen on how to use the equipment and software required to log their catches in real-time. They should also be trained on the importance of data quality and security.

### 6.3.1 Development Considerations

The Fisheries Department through the Development Team will need to develop (or acquire) software that can be used to collect and store the data generated by the cooperative traceability system. This software must be user-friendly and able to integrate with other systems, such as the licensing and permit modules. Also, the Fisheries Department will need to hire or train developers who have experience in developing applications for data collection and analysis. They should be familiar with technologies such as cloud computing, data analytics, and security.

### 6.3.2 Interoperability

On the other hand, it would be beneficial for the Cooperative Traceability Data application to work with other institutions in Belize, especially those that are involved in the supply chain of fish and seafood products.

The new Fisheries Department application could potentially be integrated with the systems used by the Belize Fisheries Department, the Belize Agriculture Health Authority (BAHA), the Belize Customs and Excise Department, and other relevant institutions. This would allow for the seamless transfer of data and information between these organizations, facilitating a more efficient and transparent supply chain.

Collaboration between institutions could help to ensure the accuracy and completeness of data, as well as reduce the risk of fraudulent or illegal activities. For instance, if a fisherman catches fish without a valid license, the catch log in the application could trigger an alert to the relevant authorities, such as the Belize Fisheries Department, and the fish could be seized before it enters the supply chain.

Overall, working with other institutions in Belize would enhance the effectiveness and impact of the Cooperative Traceability Data application, and contribute to a more sustainable and transparent fisheries industry.

Focusing in the project management, in a typical Scrum team, the Product Owner is responsible for defining and prioritizing the product backlog, which includes regulatory compliance requirements. Therefore, the Product Owner would be responsible for providing guidance on the regulatory requirements that need to be considered in the development of the system. The Development Team should work closely with the Product Owner to ensure that the system is compliant with all relevant regulations.

Finally, the development of an application for cooperative traceability data, including a catch log, will require a significant investment of time and resources from the Fisheries Department. However, the benefits of having a transparent and efficient supply chain will ultimately outweigh the costs.

#### **6.4 Develop a solution (app) for Compliance Enforcement:**

To address these challenges, a better solution would involve implementing an integrated information management system specifically designed for the Fisheries Department and MPA enforcement. This system should include the following components:

- **Data Collection and Analysis:** Develop standardized protocols and tools for data collection, ensuring consistent and accurate reporting of fishing activities, compliance, and violations. This can involve using technologies such as electronic logbooks, vessel monitoring systems, and remote sensing to gather real-time data.
- **Centralized Database:** Establish a centralized and secure database to store and manage all collected data. The database should be accessible to relevant stakeholders, including Fisheries Department staff, park rangers, and authorized enforcement agencies, allowing for efficient data sharing and collaboration.
- **Monitoring and Surveillance Tools:** Implement modern monitoring and surveillance technologies, such as satellite imagery, drones, and underwater cameras, to enhance the ability to monitor and detect illegal fishing activities within MPAs. This can improve the efficiency and effectiveness of enforcement efforts.
- **Information Sharing and Communication:** Develop a streamlined reporting and communication system that facilitates prompt and efficient sharing of information among stakeholders. This can include a web-based portal or mobile application for reporting violations, receiving updates, and coordinating enforcement actions.
- **Capacity Building and Training:** Provide training and capacity-building programs for Fisheries Department staff, park rangers, and enforcement agencies to ensure they are equipped with the necessary skills to effectively utilize the information management system and carry out enforcement activities.

By implementing such a comprehensive information management system, Belize's Fisheries Department can enhance its enforcement capabilities, improve data collection and analysis, streamline communication, and strengthen collaboration among stakeholders. This would ultimately contribute to more effective protection and sustainable management of the country's marine resources within the MPAs.

An application for compliance enforcement can help the Fisheries Department to track and monitor compliance activities. It will also allow the Fisheries Department to identify potential infractions, generate reports, and ensure that all activities are carried out in accordance with the regulations.

### 6.4.1 Development Considerations

Developing a solution for Compliance Enforcement for the Fisheries Department of Belize would require consideration of several factors, including:

1. **Regulatory framework:** The Product Owner should be familiar with the regulatory framework for fisheries management in Belize. They should have a clear understanding of the relevant laws, regulations, and policies governing fisheries in the country. Some of the regulations that may need to be considered include:
  - **Fisheries Act:** This is the primary legislation governing fisheries in Belize. It outlines regulations for the conservation, management, and sustainable use of Belize's fishery resources. It also includes provisions related to licensing, registration, and permits for fishing vessels and fishers.
    - **Fisheries Regulations:** These regulations provide further details and guidance on the implementation of the Fisheries Act. They cover areas such as fishing gear restrictions, closed seasons, and size limits for fish.
  - **Marine Protected Areas Regulations:** Belize has established several marine protected areas to conserve its fishery resources. The regulations for these areas may include additional restrictions on fishing activities.
  - **International Agreements:** Belize is a signatory to several international agreements related to fisheries conservation and management. These agreements may impose additional regulations and reporting requirements on the fishing industry.
2. **Stakeholder engagement:** It is important to engage with all stakeholders involved in the management of fisheries in Belize, including fishers, fishing communities, government agencies, and non-governmental organizations. This will help to ensure that the solution developed is aligned with the needs of all stakeholders.
3. **Data requirements:** The project manager should identify the data required to track and monitor compliance activities, as well as to generate reports. This may include data on fishing vessels, fishing gear, fish catch, and location data.
4. **Technology requirements:** The project manager should identify the technology required to develop and implement the solution. This may include hardware such as smartphones, tablets, and GPS devices, as well as software for data management, analysis, and reporting.

### 6.4.2 Relevant Solutions

Some relevant public and private solutions used in other governments and private organizations for fisheries compliance enforcement include:

1. **The Global Fishing Watch:** This is a public-private partnership that uses satellite data to track the location of fishing vessels in real-time. The platform enables fisheries managers to monitor vessel activity and detect potential violations of fishing regulations.  
**URL:** <https://globalfishingwatch.org/>
2. **FISH-i Africa:** This is a partnership of eight African countries that uses technology and data analysis to combat illegal fishing in the region. The platform

enables fisheries managers to share information and intelligence to improve compliance and enforcement efforts.

**URL:** <https://stopillegalifishing.com/initiatives/fish-i-africa/>

3. **eCatch:** This is a mobile application developed by the New Zealand government that enables fishers to record their catch in real-time. The platform enables fisheries managers to monitor catch and detect potential violations of fishing regulations.

**URL:** <https://ecatch.co.nz/>

#### 6.4.3 Functionalities

To develop a solution for Compliance Enforcement for the Fisheries Department of Belize, the Product Owner should consider the following functionalities:

1. **Vessel tracking:** The solution should be able to track the location of fishing vessels in real-time using GPS devices. This will enable fisheries managers to monitor vessel activity and detect potential violations of fishing regulations.
2. **Catch reporting:** The solution should enable fishers to report their catch in real-time using a mobile application. This will enable fisheries managers to monitor catch and detect potential violations of fishing regulations.
3. **Compliance monitoring:** The solution should enable fisheries managers to monitor compliance with fishing regulations using data on vessel activity and catch. This will enable fisheries managers to detect potential violations of fishing regulations and take appropriate enforcement action.
4. **Reporting and analysis:** The solution should enable fisheries managers to generate reports and analyze data on fishing activity, catch, and compliance. This will enable fisheries managers to make informed decisions about fisheries management and enforcement efforts.

#### 6.5 Implement the National Fisheries Survey Data System:

The National Fisheries Survey Data system should be implemented to store and manage all fisheries survey data in a single repository. The system should be designed to allow for easy data sharing, analysis, and collaboration between Fisheries Department staff.

##### 6.5.1 Development recommendations

To implement the National Fisheries Survey Data System for the Fisheries Department of Belize, the following features should be considered:

1. **Data Collection:** The system should be designed to collect, store, and manage all fisheries survey data in a single repository. It should allow for easy entry of data, with built-in quality control measures to ensure data accuracy.
2. **Data Sharing:** The system should be designed to allow for easy data sharing between Fisheries Department staff, with appropriate access controls and permissions. It should also be able to share data with external stakeholders such as researchers, NGOs, and other government agencies.
3. **Data Analysis:** The system should be able to analyze data in real-time, with built-in tools for data visualization, trend analysis, and predictive modeling. It should be able to generate reports and dashboards to provide insights into the state of fisheries in Belize.

4. **Collaboration:** The system should allow for collaboration between Fisheries Department staff, with features such as discussion forums, chat, and task management.
5. **Integration:** The system should be able to integrate with other systems used by the Fisheries Department, such as GIS mapping tools, and with external platforms such as “SurveyMonkey” or other data collection tools.
6. **Security:** The system should have strong security measures in place to protect sensitive data and prevent unauthorized access.

## 6.6 Implement the Government Assets Inventory System:

The Government Assets Inventory System should be implemented to help the Fisheries Department manage its assets efficiently. The system should provide real-time tracking of all assets, including boats, equipment, and vehicles. This will help the Fisheries Department to ensure that its assets are being used optimally and to identify potential problems before they become serious issues.

### 6.6.1 Recommendations for the implementation

To implement a Government Assets Inventory System for the Fisheries Department, there are several features that should be considered. These include:

1. **Asset Tracking:** The system should allow for real-time tracking of all assets, including boats, equipment, and vehicles. This will help the Fisheries Department to know the location of all its assets at any given time.
2. **Asset Management:** The system should provide a centralized database to manage all assets. It should also allow for the creation of a maintenance schedule to ensure that assets are regularly serviced and maintained.
3. **Asset Reporting:** The system should provide reports on asset usage and maintenance, allowing the Fisheries Department to analyze data and make informed decisions about asset management.
4. **User Permissions:** The system should have user permissions that limit access to certain features and data. This will ensure that only authorized personnel have access to sensitive information.
5. **Integration:** The system should be able to integrate with existing systems used by the Fisheries Department, such as accounting software, to ensure that data is accurate and up-to-date.
6. **Mobile Access:** The system should provide mobile access to allow staff to easily update asset information from the field.

Some examples of existing platforms that could be used include:

- **Asset Panda:** This cloud-based platform allows for real-time tracking of assets, customizable reporting, and user permissions.

**URL:** [www.assetpanda.com](http://www.assetpanda.com)

**Pricing Reference:** Asset Panda offers different pricing plans depending on the features and number of users needed. The starting price is \$1,499 per year for up to 500 assets and 5 users. Higher-tier plans with more features and users are available for additional costs.

- **UpKeep:** This platform offers features such as work order management, asset tracking, and mobile access.

**URL:** [www.upkeep.com](http://www.upkeep.com)

**Pricing Reference:** UpKeep offers pricing plans based on the number of users needed, with a starting price of \$45 per user per month for the Professional plan. There is also an Enterprise plan with more features and customization options, and pricing is available by quote.

- **AssetCloud:** This platform provides asset tracking, maintenance management, and inventory control features.

**URL:** [www.waspbarcode.com](http://www.waspbarcode.com)

**Pricing Reference:** AssetCloud offers pricing plans based on the number of assets and users needed, with a starting price of \$60 per month for up to 100 assets and 5 users. Higher-tier plans with more features and users are available for additional costs.

It is important for the Fisheries Department Development Team to work closely with the vendor to ensure that the system is customized to meet their specific needs. The team should also provide adequate training for all staff who will be using the system and establish a plan for ongoing support and maintenance.

## 7. Expected results.

To guide the Fisheries Department of Belize into a successful implementation, it is essential to take the above steps. By implementing a comprehensive information management system, developing analytical capacities, relaunching the website, developing applications for cooperative traceability data and compliance enforcement, implementing the National Fisheries Survey Data system, and implementing the Government Assets Inventory System, the Fisheries Department can significantly improve its operations and outcomes, expecting the following results:

1. **Developing Capacities:** By hiring an Information Management System Full-Time Staff, investing in Hosting & Licensing, and following the recommendations to develop analytical capacities, the Fisheries Department will have the necessary expertise to manage their data and utilize it effectively. The Fisheries Department will be able to collect, process and analyze data from multiple sources, and generate insights to improve their operations.
2. **Website Relaunch:** By turning the website transactional and systematizing the licensing and permit processes, the Fisheries Department will streamline their operations, increase efficiency and reduce turnaround time for licensing and permits. This will lead to better customer service, improved stakeholder engagement, and increased revenue.
3. **Cooperative Traceability Data App:** Developing a solution for Cooperative Traceability Data, including Catch Log, will provide accurate, real-time data on the fishing industry in Belize. This will help the Fisheries Department manage the industry sustainably and provide insights for decision-making.
4. **Compliance Enforcement App:** The development of a Compliance Enforcement app will enable the Fisheries Department to monitor fishing activities, identify violations, and



take appropriate action. This will help to reduce illegal fishing activities and ensure compliance with regulations.

This app should help to prevent, deter and eliminate illegal fishing within Belize's national waters, ensuring the effective management of the Marine resources through compliance with the Fisheries laws, to increase the rate of conviction of fisheries offenders, to maintain an effective enforcement information system, to gather intelligence on illegal fishing activities and to promote stakeholder engagement for voluntary compliance with the fisheries regulations based in data-driven decisions.

5. **National Fisheries Survey Data System:** Implementing the National Fisheries Survey Data System will enable the Fisheries Department to manage and store survey data in a single repository, making it easily accessible for analysis and reporting. This will help the Fisheries Department to make informed decisions about the management of Belize's fisheries resources.
6. **Government Assets Inventory System:** Implementing the Government Assets Inventory System will enable the Fisheries Department to manage their assets more effectively, reducing loss and increasing efficiency. This will ensure that the Fisheries Department has the necessary equipment and resources to carry out their mandate.

Overall, the benefits of the Information Management System implementation for the Fisheries Department of Belize will be significant, including improved operations, better stakeholder engagement and more sustainable management of Belize's fisheries resources.

## 8. Budget and List of Costs.

The budget for the implementation of the Information Management System for the Fisheries Department amounted to US \$ 852,354, as is listed in the Scenery 01 – In house development.

Is relevant to mention that there was a budget restriction for costing of the Information Management System implementation, establishing a maximum amount of US\$853,000 taxes included.

In this way, we consider three scenarios, where the number one was accepted by the Fisheries Department, considering its requirements mentioned in the point 6 of this report.

### 8.1 Scenario 01: In house development (Approved by the Fisheries Department)

As required by the Fisheries Department, the Scenario 01 considers the hiring of a full staff for the development of the Information Management System and is based on the requirements made by the Fisheries Department, as mentioned in the point 6 (page 22).

EDT	Component/ Product/ Activity	TOTAL USD
1	<b>Implementing a Data Management System for the Fisheries Department in Belize</b>	<b>852,354</b>
1.1	Hosting & Licensing	203,514
1.2	Hire Full Time Staff for the IMS development	409,724
	Equipment	17,156
1.3	Relaunching Website & Systematizing Processes	-
	New Website for Fisheries Department	



	Systematizing Processes on the New Website	
	<b>Licensing Registration (08)</b>	
	<b>Permits (02)</b>	
	<b>E-Library Publications</b>	
	<b>Fisheries Assets inventory Logs</b>	
	Training	
	Technical Support	
	Enter historical data (Fisheries Assets Log)	
<b>1.4</b>	<b>Cooperative Traceability Data (including Catch Log)</b>	
<b>1.5</b>	<b>Compliance Enforcement</b>	<b>109,625</b>
	<b>Equipment (Desktop &amp; Tablets)</b>	79,313
	<b>Mobile Equipment for Enforcement (special for remote areas)</b>	25,313
	<b>Amount to Purchase Additional Equipment (complements)</b>	5,000
<b>1.6</b>	<b>National Fisheries Survey Data (Web/License, ref: Survey Monkey)</b>	
<b>1.7</b>	<b>Government Assets inventory</b>	<b>129,490</b>

**Table 02:** Scenario 01 - In house development (Approved by the Fisheries Department)

### 8.1.1 Recurring costs

The following table shows the referential recurring costs for the proposed solution, per year:

Recurring Costs	Total/year US\$
Hosting	46,174
Technical Support	7,401
Equipment renewal	23,490
Personnel	57,159
<b>Total</b>	<b>134,225</b>

Table 03: Recurring costs.

To estimate these recurring costs the following considerations was taken:

- Hosting:** All the services considered for hosting except the SQL licensing as it is not required. Twenty percent added as backup.
- Technical Support:** Yearly cost for technical support of the Government Assets Inventory solution. Twenty percent added as backup.
- Equipment renewal:** Partial (twenty percent) equipment renewal, after year five, adding twenty percent as backup.
- Personnel:** Considering the yearly cost of hiring one Business Analysts (System Analyst), one Software Developers and one Database Administrator, after year five.

### 8.2 Scenario 02: Hiring an IT Firm

Scenario two is faster and less risky than scenario one, considering that it does not generate dependency on developers due to potential staff turnover, in addition to being backed by a selection process that guarantees the existence of senior staff to lead the project, as well as that the firm meets solvency and success requirements in previous

similar projects, however, it does not cover the need of the Fisheries Department to strengthen its internal capacities, as mentioned on point 6.

EDT	Componente/ Producto/ Actividad	TOTAL USD
<b>1</b>	<b>Implementing a Data Management System for the Fisheries Department in Belize</b>	<b>852,190</b>
1.1	Hosting & Licencing	135,397
1.2	Relaunching Website & Systematizing Processes	247,895
	Hiring an IT Firm	203,684
	Training	6,316
	Technical Support	25,263
	<b>New Website for Fisheries Department</b>	
	<b>Systematizing Processes on the New Website</b>	
	<b>E-Library Publications</b>	
	<b>Fisheries Assets inventory Logs (New Form)</b>	
	Enter historical data (Fisheries Assets Log)	12,632
1.5	Cooperative Traceability Data (including Catch Log)	101,579
	Develop a new App to capture Traceability Data since Fishing	95,263
	Enter historical data into the system	6,316
1.3	Compliance Enforcement (App)	176,316
	Systematize the Compliance data capture & Marine Protected Areas Monitoring data (Personalization - SW development)	80,000
	Enter historical data into the system	3,316
	Equipment	70,500
	<b>MOBILE EQUIPMENT FOR ENFORCEMENT</b>	<b>22,500</b>
1.4	Product 5: National Fisheries Survey Data (Web/License, ref: Survey Monkey)	25,263
	Systematize the Compliance data capture	18,947
	Enter historical data into the system	6,316
1.6	Product 6: Government Assets inventory	71,053
	Implement a New Government Assets inventory (ERP)	67,895
	Assesment and Design	-
	Implementation SW ERP	47,000
	Training	2,105
	Technical Support	15,789
	Equipamiento	3,000
	Enter historical data into the system	3,158

Table 04: Scenario 02 - Hiring an IT Firm

### 8.3 Scenario 03: In house development without budget restrictions

As required by the Fisheries Department, the Scenario 01 considers the hiring of a full staff for the development of the Information Management System and is based on the

requirements made by the Fisheries Department, as mentioned in the point 6 (page 22), but without consider budgeted restrictions.

EDT	Componente/ Producto/ Actividad	TOTAL USD
<b>1</b>	<b>Implementing a Data Management System for the Fisheries Department in Belize</b>	<b>1,211,576</b>
1.1	Product 1: Hosting & Licencing	148,346
1.2	Hire Full Time Staff for the IMS development	721,505
	Equipment (Laptops & Desks)	24,400
1.3	Relaunching Website & Systematizing Processes	
	New Website for Fisheries Department	
	Systematizing Processes on the New Website	
	Licencing Registration	
	Permits	
	E-Library Publications	
	Fisheries Assets inventory Logs (New Form)	
	Training	
	Technical Support	
	Enter historical data (Fisheries Assets Log)	
1.4	Cooperative Traceability Data (including Catch Log)	
	Develop a new App to capture Traceability Data since Fishing	
	Enter historical data into the system	
1.5	Compliance Enforcement (App)	93,000
	Systematize the Compliance data capture & Marine Protected Areas Monitoring data (Personalization - SW development)	
	Enter historical data into the system	
	Equipment	70,500
	MOBILE EQUIPMENT FOR ENFORCEMENT	22,500
1.6	National Fisheries Survey Data (Web/License, ref: Survey Monkey)	
	Systematize the Compliance data capture	
	Enter historical data into the system	
1.7	Government Assets inventory	114,105
	Implement a New Government Assets inventory (ERP)	107,789
	Enter historical data into the system	6,316

**Table 05:** Scenario 03 - In house development without budget restrictions

Likewise, annex 01 is sent attached to this report, with the detail of the costing carried out for Scenario 01.

## 9. Potential Risks.

There are risks associated with deciding to develop an Information Management System in-house. Here are some of the potential risks:

1. **Lack of expertise:** Developing a complex information management system requires a wide range of technical skills and expertise, including software development, database design, user interface design, and project management. Hiring an in-house development team may not provide access to the same level of expertise as an external IT firm, which specializes in building such systems.

**Recommendation:** To address this risk, the Fisheries Department should consider hiring experienced professionals who can provide guidance and support in developing the system. This can help ensure that the system is developed in a timely and efficient manner, and that it meets the Fisheries Department's needs.

2. **Time and cost overruns:** Developing an information management system is a complex and time-consuming process that requires significant planning, design, and testing. Without the proper expertise and project management experience, an in-house development team may struggle to deliver the project on time and within budget, leading to cost overruns and delays.

**Recommendation:** To mitigate this risk, the Fisheries Department should develop a detailed budget and timeline for the project and ensure that it is closely monitored throughout the development process. Additionally, the Fisheries Department should consider using agile project management methodologies, which can help ensure that the project is delivered on time and within budget.

3. **Technical debt:** In-house development teams may be tempted to take shortcuts and make compromises to meet project deadlines or budget constraints. This can lead to technical debt, which is the accumulation of software development practices that make it harder to maintain and update the system in the future.

**Recommendations:** To address technical debt, it is important to prioritize technical excellence and quality in the development process. This can be achieved through a variety of means, such as:

- a. Conducting regular code reviews to identify areas where technical debt is accruing and addressing these issues as soon as possible.
  - b. Using agile development methodologies that emphasize collaboration, continuous improvement, and adaptability to help prevent technical debt from accumulating in the first place.
  - c. Ensuring that the development team has the necessary resources and support to prioritize technical excellence, such as adequate time for testing and debugging, access to modern development tools, and a supportive organizational culture that values technical excellence and innovation.
  - d. Also is desirable implementing automated testing and quality assurance processes, and investing in ongoing training and professional development for the development team to ensure that they are up-to-date on the latest best practices and technologies in the field
4. **Lack of scalability:** As the Fisheries Department grows and the Information Management System is required to handle more data and users, an in-house development team may struggle to scale the system to meet the growing

demands. An external IT firm may be better equipped to handle the scaling requirements of a complex information management system.

**Recommendations:** To address this risk, the Fisheries Department should work with professionals who have experience in developing scalable systems. Additionally, the Fisheries Department should consider using cloud-based technologies (through CITO), which can be easily scaled up or down as needed.

5. **Integration issues:** There is a risk that the in-house Information Management System may not integrate effectively with existing systems, which can lead to data silos and inefficiencies.

**Recommendations:** The Fisheries Department should ensure that the development team has a thorough understanding of the related existing systems and processes within or outside the institution. Additionally, the Development Team should consider using open APIs and other integration technologies to ensure that the new system can easily integrate with existing systems.

Developing an in-house information management system can be a risky endeavor, but with careful planning and execution, these risks can be mitigated. By working with experienced professionals, developing a detailed budget and timeline, using agile project management methodologies, and addressing integration and adoption issues, the Fisheries Department can successfully develop and implement an Information Management System that meets its needs and helps improve the efficiency and effectiveness of its operations.

## 10. Results Matrix.

The key result indicator (KRI) that can be used to measure the success of the development and implementation of an Information Management System for the Fisheries Department of Belize is:

- **User adoption rate:** This measures the percentage of users who have successfully adopted the new IMS.

KPI	Unit	Baseline	Baseline year	Year 1	Year 2	Year 3	Year 4	Year 5	End of Project	Means of Verification
User adoption rate	%	0	2023	0%	0%	0%	50%	90%	90%	Product Owner Report

**Table 05:** Results Matrix for the User Adoption Rate