CATCH CERTIFICATE STANDARDS FOR TUNA EXPORTS FROM PNG TO THE US MARKETS

Gesling Lulupa Chee
National Fisheries Authority, CDCU, Papua New Guinea
gchee@fisheries.gov.pg (or) geslulupa@gmail.com

Supervisors:
Mr. Hordur Saevaldsson: hordurs@unak.is
Mr. Óttar Gautur Erlingsson: ottar.g.erlingsson@fiskistofa.is

ABSTRACT

The tuna industry in Papua New Guinea (PNG) is an important industry for the nation. The tuna products are mainly exported to the European Union (EU). PNG's export standards are based on EU import protocols and valid catch certificates are required. The US market is one of the largest consumer markets globally with a large population and high household spending. PNG's tuna exporters do not have access to the US market. This is mainly due to lack of standards to provide credible catch certificates for the market. Access to the US market could increase value and diversify risk for the PNG tuna industry. Unfortunately, US authorities have no simple guidelines on standards to issue an authentic catch certificate. Icelandic fishing companies have on other hand access to the US markets via valid catch certificates. In this research the catch certificate standards from Iceland will be used as role model to compare with PNG's standards for seafood traceability and data collection methods. The goal is to determine the required standards of the catch certification and traceability systems to be comparable to the US seafood import requirements. The findings of this study reveal that the procedures of producing catch certificates for the US and the EU to be similar, except that US authorities require additional information pertaining to the catch, landing, processing, and exporting records. This research answers the question regarding specific standards that PNG can adopt to enhance its national catch certification and traceability systems. This can be achieved through reviewing the current regulatory measures in PNG and enhancing the catch certification procedures through a review of data collection and traceability approaches.

Key words: tuna industry, export standards, catch certificates, traceability, Papua New Guinea

TABLE OF CONTENTS

TABLE OF FIGURES

ABBREVIATIONS

The following is a list of abbreviations mentioned in this research proposal document.

ACCD	Audit and Certification and Documentation
ASFIS	Aquatic Science and Fisheries Information System
BET	Bigeye
CDCU	Catch Documentation & Certification Unit
CDS	Catch Documentation Scheme
EC	European Commission
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization
FFA	Forum Fisheries Agency
FMA	Fisheries Management Act
IUU	Illegal Unreported and Unregulated
KRA	Key Results Area
MCS	Monitoring Control and Surveillance
MSC	Marine Stewardship Council
NEAFC	North-East Atlantic Fisheries Commission
NFA	National Fisheries Authority
NMFS	National Marine Fisheries Service
PNA	Parties to Nauru Agree
PNG	Papua New Guinea
NFA	National Fisheries Authority
PSM	Port State Measures
PSMA	Port State Measures Agreement
RFMOs	Regional Fisheries Management Organization(s)
SKJ	Skipjack Tuna
TMDP	Tuna Management & Development Plan
UN	United Nations
UK	United Kingdom
VMS	Vessel Monitoring System
WCPFC	Western & Central Pacific Fisheries Commission
WCPO	Western & Central Pacific Ocean
YFT	Yellowfin Tuna

1. INTRODUCTION

Tuna is one of the most valuable fisheries in the global fishing industry in terms of catch quantity, economic value, and international trade. Annually global tuna fishery catches amount to about 7.9 million metric tons (FAO, 2020). The main targeted species of tuna with substantial volumes in the global market are skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*), bigeye (*Thunnus obesus*), albacore (*Thunnus alalunga*), and Pacific bluefin (*Thunnus orientalis*) (FAO, 2020). Tuna fisheries take place around the tropical areas in the Pacific, Indian, and the Atlantic oceans. While there are different fishing gears and methods designed for fishing tuna, commercial fishers primarily employ purse seines and longlines, along with gillnets, pole and line and trolling. Purse seining is the most used method in the Western and Central Pacific Ocean (WCPFO), (Allain, et al., 2016).

The fisheries industry is an important sector in Papua New Guinea (PNG) which is in the southwestern Pacific. PNG has an exclusive economic zone (EEZ) of 3.12 million km^2 and Archipelagic Waters (AW) of 0.68 million km^2 (Figure 1), (FAO, 2018; FFA, 2011). PNG purse seine and longline including handline fisheries for tuna accounts for about 200,000-250,0000 within the WCPFC convention area (WCPFC, 2020). The main targeted tuna species include skipjack, yellowfin (*Thunnus albacares*), and bigeye (*Thunnus obesus*).

Figure 1. PNG EEZ and AW (Source: Fisheries Management System (FIMS) ATS)

PNG is a signatory to various regional and subregional organization agreements to regulate the access to the tuna fishery within the WCPO. PNG is an active member in the parties to the Nauru agreement (PNA) which took effect in the 1980s, the Palau Agreement in the 1990s, and the regional fisheries access Federated State of Micronesia Arrangement (FSMA), created in 1990s. PNG regulates its tuna fisheries through licensing of domestic and locally based foreign (LBF) fishing vessels and the allocation of fishing days as defined in the Vessel Days Scheme (VDS) (Havice, 2010). The purse seiners (PS) and long-liners (LL) are allowed to fish

within the EEZ and AW and in the waters of neighboring island countries through the FSMA and PNA arrangements (Havice, 2010).

In 2019 an estimate of 190,000 metric tons of processed tuna were exported earning a total revenue of around US$ 398 million. The exports have been increasing with more fish processed onshore and this trend is likely to continue as more processing facilities are established in the country. The main export products are canned tuna and tuna loins. Currently there are six main tuna processors in PNG who export to the EU. Under the Economic Partnership Agreement (EPA) PNG has quota-free duty-free access to the EU. PNG seeks to access the US as one of the largest seafood markets to maximize the economic benefit of its tuna products (Ruaia, Gu'urau, & Reid, 2021).

The US market is one of the largest consumer markets globally with a population of around 334 million and household spending among the highest in the world (United States Census Bureau, 2022). The US market offers high prices for seafood products which makes it one of the most important seafood markets worldwide (NOAA, 2022; FAO, 2016). In 2018 there was an increase of 5% of the total seafood imports to the US which amounted to US $40.3 billion (NOAA, 2022). However, any country to export seafood products to the US will have to meet the necessary import requirements. The US markets demand quality products and have strict standards implemented by the US National Oceanic and Atmospheric Administration (NOAA). NOAA administers the Seafood Import Monitoring Program (SIMP) which demands credible catch certificates for every imported seafood product of the thirteen species including tuna (Juan, 2018).

Catch certificate is a non-tariff market access requirement for seafood imports to the US markets (NOAA, 2022). Although the US is still to grant PNG duty-free access for its canned tuna and other fisheries products pending negotiations at the diplomatic and political levels, PNG seeks to establish a catch certification and traceability system that meets the US seafood import standards. Approved data collection methods and a transparent and efficient traceability system from an assessment body is needed prior to issuing a US catch certificate. Therefore, the authorities in PNG must review their current national catch certification and traceability systems.

The scope of this research is to analyze what data and information is needed in terms of the catch certification standards to export tuna products from PNG to the US markets. In exploring the various import requirements to the US market, the following question will be answered: Which standards in catch certification, data collection and traceability are needed to export tuna products from PNG to the US markets?

2. RATIONALE

The fishing industry is of major economic importance for PNG. Tuna products exported to overseas markets bring significant revenue to the country. At this stage PNG has limited access to the US market as one of the most valuable global seafood markets. PNG needs to diversify its portfolio within the global seafood market to maximize the benefits of its increasing volumes of tuna products through improved market access.

Also, given the goal of diversifying trading portfolios in the fisheries industry, PNG now looks at accessing the US markets for the export of its tuna products to improve its economy. Utilizing the Treaty Text under Broader Cooperation with US, PNG can maximize its economic benefits from the tuna products. PNG seeks to have access to the US market as a reciprocal trade within the seafood space as US has been harvesting tuna resources in PNG waters and the Pacific for more than three decades. EU on the other hand, has given PNG duty-free access to its market under the EPA since 2008 but has no access to the PNG fishing grounds to source raw materials.

Accessing the US markets will mean more economical output at various levels. There will be more income from imposed levies because of increased export licenses. Increased exports imply that more jobs will be created within the industry and increased opportunities for small medium enterprises (SME) from spinoff benefits. Also, indirectly there will be an increased participation from small-scale artisanal fishers in the commercial space. The country's revenue will be increased through levies and taxation regimes.

Consistent with the PNG Fisheries Strategic Plan (FSP) 2021 – 2030 the emphasis is to update and enhance current systems and processes to increase market accessibility. The PNG FSP 2021 – 2030 makes references to the PNG Vision 2050 which resounds the United Nations Sustainable Goal (UNSDG) 14.4 "*to effectively manage fisheries resource in a sustainable manner and end overfishing, IUU fishing and destructive fishing activities.*" Hence, operational business units should take charge with specific responsibilities to ensure fisheries management is effectively delivered. One of the key priorities of the Audit and Certification and Catch Documentation (ACCD) business unit stipulated in the NFS FSP 2021 – 2030 is to improve its national catch certification, data collection, and traceability system to take advantage of the growing global demand for seafood to be able to sell increased volume of processed tuna.

PNG needs to better its catch certification and traceability systems to have access to the US market and it is only proper that PNG applies the recommended standards of catch certificate and traceability based on the ISO standard 12875:2011. Not only will PNG be able to maintain the current markets such as the EU and China markets, but the country will also be able to establish comparable national systems that can enable access to other markets for its seafood products.

This study will compare the systematic implementation of the data collection procedures, catch certification and traceability systems between PNG and Iceland focusing on the requirements that the US requires on catch certificates. To the best of my knowledge there have not been other studies that systematically compare different technical and governance aspects of catch certification and traceability systems applied in PNG to increase market accessibility and thus combat IUU fishing. The case study in this research is Iceland, considering its national data collection, catch certification and traceability system.

3. GOAL AND OBJECTIVES

3.1. Goal

The primary goal of this project is to review the national catch certification procedures, data collection approaches, and traceability system in PNG. Importantly, PNG will need to modify its national system to meet the standards required by the US for its tuna products by ensuring that sufficient information is provided as required in the SIMP Model Catch Certificate

(NOAA, 2022). Through enhancing of the current tools and systems the PNG Competent Authority (CA) and the industry can collaboratively participate to meet importing of any international market.

3.2. Research Question

What standards in data collection, catch certification and traceability will PNG need to adopt from Iceland to adjust its national data collection, catch certification and traceability systems to export tuna products to the US?

3.3. Main objective

The main objective of this research is to review the national catch certification and traceability systems of PNG, considering their relevance to the sustainable management of fisheries resources and importantly to combating IUU fishing and to provide recommendations on ways to improve its current practices to have access to the US market.

3.4. Specific Objectives

This research plans to achieve the following specific objectives:

3.4.1.   Perform a comparison between PNG and Iceland by identifying the status of implementation of catch certification, data collection, and traceability using comparative analysis; and

3.4.2.   Summarize with conclusions on common national best practices identified in the comparative analysis including the differences or similarities, implications for commercial operations and major challenges to improve on the catch certification, data collection, and traceability.

4. LITERATURE REVIEW

A literature review was performed to identify scientific papers analyzing the required standards for the catch certificate for seafood trade in the US market and the supporting standards and norms regarding data collection methods, certification, and traceability. Database searches includes ScienceDirect, Scopus, Google scholar and institutional websites. Searches were conducted in all fields from 2000 up to year 2022. The key words used in the searches included catch certification, traceability, and US seafood import requirements.

4.1. Catch Certificate

Catch certificate (CC) is a trade document that ascertains the authenticity of the way fish was moved through the entire supply chain. Established by RFMOs, catch certification is a function of the catch documentation scheme (CDS), issued at the point of harvesting and covers all fish to be landed or transhipped (FAO, 2002). FAO defines catch documentation scheme as a system that tracks and traces fish from the point of capture through unloading and through the supply chain. The CDS records verify information that identifies the origin of the fish caught and ensures they were harvested in a manner consistent with relevant national, regional, and international conservation and management measures. The objective of the CDS is to combat IUU fishing by limiting access of IUU fish and fishery products to (FAO, 2022). Catch certificates accompany export documentations for fish and fish products through international trade (FAO, 2002; Mundy, 2018). Based on concerns surrounding resource sustainability and food security, the US imposed stringent import requirements to prevent seafood products aminating from IUU fishing activity from entering the US market through monitoring programs

and import procedures reflected in the report on the implementation of SIMP (NOAA, 2021; NOAA, 2022).

IUU fishing is an overly complex global issue which is described by FAO as "a manner not consistent with national, regional, and international conservation and management measures." The FAO addresses three distinctive categories of IUU fishing as follows: 1) Illegal fishing which refers to fishing activities by foreign vessels without permission in waters under the jurisdiction of another state or which contravenes its fisheries laws and regulations in some other manner. 2) Unreported fishing refers to fishing that is not officially recorded; and 3) Unregulated fishing refers to fishing activities in areas where there are no applicable management measures to regulate the catch (FAO, 2022).

The existing literature indicates that marine fish stocks have declined over the past half century in part due to overfishing and IUU fishing. The percentage of fish stocks that are within biologically sustainable levels has declined from 90% in 1974 to 65.8% in 2017 (FAO, 2020). FAO introduced its code of conduct for responsible fisheries in 1995. Its objectives include establishing principles and criteria for elaborating and implementing national policies for responsible conservation of fisheries resources (FAO, 2022). A tool to sustainably manage fisheries resources is to produce a credible catch certification through the functions of a CDS with the aim to combat IUU fishing (Lue, Makino, & Asari, 2022).

The catch certificates are produced through a verification and validation process. This procedure is guided by a set of requirements. For EU catch certificates, the EU regulation 1005/2008 provides the guide on the elements to verify (EUROPA, 2008). A catch certificate usually contains the relevant information of the fish from harvest to landing, and then exports. As a certification body, a consortium of seafood certification and ratings programs holds that fisheries certificates must validate whether a product has been produced/sourced sustainably and complies with the relevant social chain of custody standards (Certification and Ratings Collaboration, 2022). Proper documentation of imported seafood products to the US creates a barrier for developing countries access the US market (Anders & Westra, 2012). Exporting countries to the US need to produce proper documents of the seafood products to avoid rejections at the boarder inspection (Juan, 2018).

4.2. Data collection

A data collection method is the process of collecting relevant information based on a set of requirements. The collected information needs to have a third party or external assessment body to evaluate its relevance, accuracy, and the entire process and its content making necessary reference to a set of requirements. The ability to acquire accurate, authentic, and credible results in any given system, depends on many factors that make up a system. Therefore, in the context of seafood trade, any information that is collected needs to be able to demonstrate reliability and accuracy through periodical evaluation practices. An approach to acquire credibility is by submission of annual reports to respective RFMOs. Commission members and cooperating non-members are obliged to provide scientific data of catches during each calendar year to the Commission as a regional approach of managing the fisheries resource (WCPFC, 2016).

Data is usually provided as reports and are stored in a database. The submission of data can be electronic, or paper based. Databases add value and credibility to national systems if they hold information on seafood landings, imports and exports and are able to trace the flow of seafood from its source for both aquaculture and wild capture. A setback in data management through

databases is the inability to provide accessibility of relevant information. Databases should be able trace both ways from capture to export and back (Love, et al., 2021). Also, the information in the database is made up of various reports and may include trading networks to the country where seafood was exported to and consumed. A good database complements the quality of the data being collected if reports submitted match with the raw data provided (Watson, Nichols, Lam, & Sumaila, 2017).

The data provided in the documentation of seafood import to the US is subject to an assessment criterion established through the US SIMP. The NOAA is the authority that is responsible for verification of import documentation into the US. The assessment criteria are listed in the US model catch certificates (NOAA, 2022). It is highly likely that the standards established through NOAA, will positively influence the establishment of national systems in seafood production and documentation in developing countries. The results imply that meeting the import requirements to the US will contribute to sustainable management of fisheries resources. This is also seen as a step towards addressing IUU fishing through seafood trade between the US and the processing states (Fang & Asche, 2021).

4.3. Traceability

Traceability is "the ability to access any or all information relating to that which is under consideration, through its entire life cycle, by means of recorded identifications" (Olsen & Borit, 2013). According to the International Standard Organization (ISO) there are increasing demands for detailed information on the nature and origin of food products and that traceability is becoming a legal and commercial necessity. The generic basis for traceability is to provide a guide to collect much needed information of fish products at any one time since there is an enormous variety of fish species and products that engage in the supply and value chains (ISO, 2022). Consistent with the ISO standards, the key elements that are essential to support credible transparency initiatives within a traceability system include clear and well-defined public commitments, regular progress reporting against those commitments and audits to verify progress (Koehler, 2020). Utilization of key identification or unique IDs will allow for both forward and backward trace of records within any traceability system. This can be adopted by operators and authorities to close the gaps of the possible infiltration of fish and fishery products originating from IUU fishing (ISO, 2022).

5. METHODOLOGY & STRUCTURE

This research was a desk study conducted in Akureyri, Iceland during the GRÓ Fisheries Training Program between December 2021 to February 2022. The data that was used in this research was sourced from both PNG and Iceland. Data collected was both quantitative and qualitative. The qualitative data was collected through in-depth interviews with relevant official employees of the Icelandic Directorate of Fisheries and the PNG National Fisheries Authority. The nature of external factors, namely weather and Covid-19 safety protocols, influenced the schedule of this research, therefore, virtual meetings were appropriate for conducting the interviews.

The interviews were open ended and varied depending on the interviewee's line of duty within the fisheries authorities of PNG and Iceland.

Most materials sourced from Iceland were available in Icelandic. One of the supervisors in this research, an employee of the Directorate of Fisheries, translated most of the materials into

English A comparative analysis was used to analyze the collated information through an evaluation framework.

5.1. Qualitative method

A qualitative design was chosen to acquire information on the status of the implementation of the catch certification, data collection, and traceability standards from both PNG and Iceland. The qualitative methods utilized questionnaires and semi-structured interviews. Due to the limited availability of data from both countries this research adopted the qualitative approaches described by Pritha Bhandari (Bhandari, 2020) and Kirsti Malterud (Malterud, 2012). Open-ended interview questions were designed and used in this research for the qualitative data. The questions used in the interviews are included in Appendix I.

Using open ended questions, semi-structured interviews were undertaken with key officials from the PNG NFA and the Icelandic Directorate of Fisheries. The questions used in the interviews were focused on the content, and procedures of producing catch certificates, data collection approaches, and traceability standards from respective countries (PNG and Iceland). The feedback from the interviews were circulated to the interviewees for confirmation of the responses before it was regarded as approved data.

5.2. Quantitative method

Datasets, and data collection forms from both countries were looked at and compared against each other to determine what data is available referring to the focus of this research. The reports collected include reports on catch, landing, processing, and exports.

6. RESULTS

It must be understood that PNG is yet to have direct access to the US market in terms of exporting its tuna products. In 2020 US was the third biggest export market accounting for almost 9% of Icelandic seafood products (Radarinn, 2022). As Iceland has long experience of exporting seafood products to the US, its experience of the minimum requirements to produce an authentic and credible catch certificate of fish products can be utilized at least to suggest the way forward for the PNG competent authority (PNG NFA) and the industry including the relevant stakeholders.

The interviews revealed that Iceland went through a process of trial and error before it finally succeeded in satisfying the US market import requirements of fishery products. The process involved continuous dialog and consultations with various US importing companies. By establishing the required standards comparable to the US import requirements, Iceland is able to export fish and fishery products to the US.

6.1. Directorate of Fisheries in Iceland – Fiskistofa

The Directorate of Fisheries is the government institution responsible for implementing the Icelandic Government policy on fisheries management and handling of seafood products. The Directorate enforces the laws and regulations regarding fisheries management, monitoring of the fishing activities and imposition of penalties for illegal catches. In addition, the Directorate is the competent authority responsible for implementing the fisheries management rules regulating the activities of harvest, processing and export of fish and fishery products. The monitoring, control, and surveillance (MCS) team overseas the enforcing of laws and

regulations while the Icelandic Customs ensures that the operation of boarder inspections and control of exports of fishery products are consistent with the various market requirements including the US and the EU. The collection and publication of fisheries data is also the responsibility of the Directorate in collaboration with Statistics Iceland (Fiskistofa, 2022).

The Directorate of Fisheries is an independent institution under the Ministry of Fisheries that performs its mandatory functions according to the relevant Laws and Regulations that are set by the Icelandic Parliament and Ministry of Fisheries respectively. To ensure that relevant information is collected the Directorate of Fisheries regulates all fisheries from harvest and until export including the activities that are involved along the supply and value chain. The Directorate monitors the landing and processing activities and facilitates with the export documentation by issuing catch certificates and process statements. To collect the relevant information, the Directorate issues certain forms specific to the activities of the fishery and ensures that the forms contain data fields of the necessary information and are completed and submitted electronically through an Electronic Registration System (ERS) which it operates.

6.1.1. *The Supply Chain Data Flow – Iceland*

The following is the process involved in the data collection approaches specific to catch certification and traceability systems and the utilization of data in producing catch certificates and the data flow along the supply chain in Iceland:

1. Licensed Icelandic fishing vessels are obliged to report all catch activities and to unload all catches at authorized landing ports. The vessel operator(s) submit an electronic logsheet (eLogsheet) to the Directorate via the ERS before calling into port for landing. The vessel operator submits the catch report comprising of the eLogsheet that contains all necessary catch information from the fishing trip. To verify the catch records, the Icelandic Coast Guard conducts inspections on board the vessel by checking the vessel holds to ensure the accuracy and consistency of the records made by the fishing operator. It is also common that the inspector from the Directorate of Fisheries monitors the landing and compares it to the logsheet.

2. Landings are only allowed in official ports with accredited scales, that are approved by legal authority. At the landing sites authorized harbor officials monitor the landing of catches from the fishing vessels. These harbor officials are trained by the Directorate to conduct landing monitoring including reading the weighing scales. The officials collect all necessary information from the fishing vessel operator and complete the landing forms and submit them to the Directorate via the ERS. If the catch is landed for sales through an auction, then a landing report will be compiled and submitted by the auction market to the Directorate operated ERS. The officials (inspectors from the directorate) are there by their own accord to monitor and audit. The harbor official must weigh and report the landing but has no say over inspections and monitoring.

3. The landed fish is later taken in for processing by the processor. The processor then compiles a processing record using the approved form specific to fish processing and submits to the Directorate via the ERS. In addition, the processor also submits relevant export documents to the Customs for customs related checks. The Customs are responsible for monitoring the export documentation and ensure compliance through boarder inspections for all exports.

4. The exporter prepares and submits either a Catch Certificate (CC) or a Process Statements (PS) to the Directorate for validation. These certificates accompany the

export documents as a trade Certificate. The catch, landing, and processing reports are collated on the ERS which makes up a complete traceability of the information from the stages along the supply chain. This process is utilized through the adoption of the ISO standards such as the ISO 12875:2011 (ISO, 2022). The procedure must be approved by an assessment body or agencies to ensure the validity and transparency in the entire system that is utilized. The data available on the ERS is accessible by the public, fishers, fish processors, exporters, and other line agencies such as customs, Fisheries Ministry, and relevant institutions. These stakeholders provide scrutiny of the data that is made available as a form of assessment of the data and procedures that relate to data collection, storage, and utilization. The Directorate produces CCs and PSs through the verification and validation process via the ERS. This is where a catch certificate is produced which the processors and exporting company will have access to via exporters/processors portal in the ERS.

6.2. Papua New Guinea (PNG) National Fisheries Authority (NFA)

The PNG NFA is a state agency that was established in 1999 and operates in accordance with the Fisheries Management Act 1998, the Fisheries Management Regulations (Amended) 2016 and various Fisheries Management Plans. NFA is the competent authority under the Ministry of Fisheries and Marine Resources that is responsible to regulate the fisheries sector in PNG in implementing its regulatory functions in a manner consistent with PNG's international obligations and cooperation in the management of highly migratory and shared fish stocks. NFA's roles are reflected in the implementation of its functions in managing the fisheries resources by means of monitoring of fishing activities, enforcement of the rules including collection of relevant data for certification functions on licensed facilities in accordance with food safety and certification requirements for both export and import of the fish and fishery products to domestic and international markets.

PNG implements the Tuna Fisheries Management and Development Plan 2014 to manage its tuna fishery and collaborates with other Pacific Island Countries (PICs) to regulate the tuna fisheries through the office of the Parties to the Nauru agreement (PNO), which also includes various regional and sub-regional agreements and alliance arrangements. PNG issues commercial fishing licenses to domestic and foreign flagged vessels which are categorized under different fishing vessel licenses namely Domestic (PNG flagged) or Locally Based Foreign (LBF). These vessels except the ones under the US treaty are issued fishing licenses that are valid for twelve months and are operated by the onshore processors under individual and company business arrangements. PNG tuna fishery management is effort-based therefore onshore processors and vessel owners/charterers are granted certain number of fishing days (effort) as a percentage of the total number of days that are administered by the PNO through the VDS.

PNG adopted the EU standards in 2009 (EUROPA, 2008) and has since been implementing its monitoring and catch certification functions. PNG monitors the fishing activities through the Catch Documentation & Certification Unit (CDCU) which is the unit responsible for data collection and catch certification. The CDCU's operations has recently been put under the Audit and Certification Division (ACCD) due to its nature of activities that are to ensure export requirements in terms of documentation such as the catch certificates, process statements, and non-process statements, are met by the industry when exporting tuna products with respect to market access requirements.

The CDCU's responsibility is to physically monitor all transshipment and landing activities within the designated domestic ports and to provide independent landing and transshipment reports after the reconciliation of records with the vessel operator's records from each unloading activity. To ensure that relevant information is collected, the CDCU collects all fisheries data from harvest – which is covered under the Port Statement Measures (PSM) procedures – and up to export stage where necessary certificates are produced. Also, included in the data collection steps are the activities that are involved along the supply and value chain such as the verification of the processing and production records and movement of raw materials between various processors.

The CDCU allocates officers (referred to as "catch monitors" or "monitors" hereafter) who are trained, and full-time employees of PNG NFA, to physically monitor the landing, transshipment, and undertake regular verification exercises of processing records. To collect relevant information, the CDCU uses forms to ensure all necessary information is collected and submitted as verified paper-based records. The same unloading reports are collected electronically and is submitted to the Fisheries Information Management System (FIMS) for storage purposes. The FIMS is operated by the PNO, and PNG has access to the system as a PNA member. However, at this stage the FIMS is underutilized since most of its data collection and user features and functions are still undergoing major technical developments.

6.2.1. The Supply Chain Data Flow – PNG

The following is a description of the process involved data collection, catch certification and traceability thus illustrating the data flow along the supply chain in PNG:

1. The licensed fishing vessels are obliged to report all catch information, and to unload all catches at designated domestic landing sites for processing and later exported. The vessel operator(s) submits an electronic log sheet via email to the PNG NFA and sends an electronic version of the log sheets (eLogsheet) to FIMS. The log sheets sent via emails accompany Port Call requests that are received by the relevant officials who manually register the catch information into LAR13, an offline LAN shared access database operated by PNG NFA. The catch report comprises of the eLogsheet containing all necessary catch information from the start date to end date of the fishing trip together with relevant vessel documents. The responsibilities to submit catch reports is captured in the PSMA implementation, where catch records are thoroughly analyzed for any compliance risk through the process of intelligence analysis that is done electronically via FIMS. In this step the vessel's track, and positions are analyzed by trained officials employed by the PNG NFA.

2. At the designated port, the monitors physically monitor unloading of catches from the fishing vessels for either landing or transshipment. The port officials collect all necessary information from the fishing vessel operator and complete the landing or transshipment form. The monitors physically monitor the unloading from start to finish each day depending on the unloading plan of the vessel. The monitors then submit the completed forms as a landing or transshipment report by manually entering it into the local excel registries and make submission to FIMS via the electronic application (transshipment or landing FIMS eForms).

3. Once the landed fish is taken in for processing the processor compiles a processing record but maintains it in an internal (company) registry or an isolated database operated by the individual processor. The processor submits the compiled CC, PS or

NPS with relevant export documents to the export officials in PNG NFA for documents checks and issuance of export approval. Customs are not necessarily involved at this stage of the document processing but do collect the compiled documentation after PNG NFA completes its part in validating the documents. Although there are records of the processing information available on FIMS, there is still work to be done to incorporate and link the necessary processing information for ease of accessibility.

4. The catch, unloading, and processing reports are collated on standalone databases systems apart from FIMS and LAR13. Given that most datasets and reports are collected manually, PNG through CDCU verifies and validates the CC, PS and NPS via a paper-based system. Therefore, the processed CC, PS and NPS are prepared and issued as printed certificates. The CDCU standard operating procedure (SOP) involved here is based on the EU Regulation 1005/2008 as the current standard that is implemented. A couple of audits have been done by the EU so far in the last decade which have brought about some improvements. The EU depends on the internal systems that PNG has in terms of the assessment of the system and database from the collaborative efforts with other PICs and RFMOs and commissions within the WCPO.

6.3. Relevant Legislative Instruments – Iceland and PNG

Legislative instruments relating to fisheries management in both Iceland and PNG provide legal support for the implementation of programs and systems within the responsible institutions. In this research there are legislative instruments that make provisions for data collection, catch certification and traceability systems. These tools are important, as they are the driving forces to ensure sustainable management of the fisheries resources.

In Iceland it is mandatory for all vessel operators, processors, and exporters to provide data to the Directorate of Fisheries. The regulations contain articles that make data submission an obligatory responsibility of the industry. The articles contained in the regulations outline the actions to take and the details/information that needs to be provided as and when required specific to the fishing activity. The following are the most relevant Icelandic regulations and article(s):

i. Regulation 994/2013 – Article 4 (*Weighing report*) and Article 5 (*processing report*) *Regulation on reporting on trade in marine catch.*

ii. Regulation 745/2016 – Article 10 and 17 – *Regulation on weighing and registration of marine catch23.*

iii. Regulation 298/2020 – Article 3 – *Regulations and electronic submission of catch information.*

In Iceland, the regulation provides for the collection of necessary catch information as an integral part of the implementation of the quota system. Traceability is a new inclusion to the fisheries management, and it has been prioritized in the state budget and regulatory framework for the purpose of resource management sustainability.

In PNG, the current legislative framework provides support for the data collection, catch certificate and traceability system, but it is not explicit on the implementation aspects. There has never been any specific policy relating to traceability programs. Nonetheless, in the absence of any policy framework, the licensing conditions recognizes the EU Regulation 1005/2008 as the basis for establishing traceability systems.

Below are the relevant legislative instruments that provide for data collection and catch certification systems of fisheries data:

1) Fisheries Management Act 1998
   a) Part II Division
      i) Section 1 Subsection (l) - *Implementation of any monitoring control and surveillance scheme including cooperation agreement or arrangement with other state or relevant international regional or subregional organization in accordance with the FMA 1998.*
      ii) Section 6 - *Functions and powers of the authority to collect data.*

   b) Part III Fisheries Management, Conservation and Development
      i) Division 1 Administration of fisheries management and development
      ii) Section 25 – *Management objectives and principles (a – h) - The management of the aquatic resources to achieve economic growth and sound ecological balance.*
      iii) Section 29 - *Records, returns and other information*; Subsection *(1) (a – b) - Maintain and furnish is such manner and form of all relevant data and information including fishing and effort, landing, processing, sales and other related transactions and accounts, records, returns, and documents and other information.*
      iv) Section 40 - *corporation on high seas fishing for highly migratory fish stocks. Cooperation with states that are fishing at high seas for the purpose for achieving compatible conservation and management measures.*

2) Fisheries Management Regulation (Amended) 2000
   a) Part IV Reporting, Port Calls and Transshipment
      i) Section 23 – *Vessels reporting requirements*; Subsection (1) (a – c) - *the vessel master or operator are responsible to provide accurate information of the fishing activity.*
      ii) Section 23 *Vessel Reporting Requirements*; Subsections 1 (a – b), 2, 3, 4 (a – c)
      iii) Section 24 *Port Calls*; Subsections 1, 2, 3, 4, 5
      iv) Section 25 –*Transshipment of fish and transshipment reports*; Subsections (1) – (6)
      v) Section 26 – *Fish Buyer, storage fish factory, export facility reports.*

3) Tuna Fisheries Management and Development Plan 2014
   a) Division 3 – *Management of Tuna fishery*
      i) Section 15 – *Tuna Management Plan tools, agreement, and strategies. The implementation of the TMP shall consider and utilize several tools for the purpose of tuna fisheries conservation and management including combating IUU fishing, food safety standards, and food security at the national level which includes traceability among others.*
   b) Division 5 – *Monitoring and research*
      i) Section 5 (a) – (b) *Electronic reporting to be introduced*
      ii) Section 28 – *Measures to enhance, and combat and eliminate IUU fishing*
      iii) Section 32 – *Catch Documentation Scheme (CDS)*

4) Licensing Policy – Fishing License Conditions
   a) Section 5 *Licensing Conditions*
      i) Subsection 5.2 *Pre-conditions for license issue* Table 6 (Page 14 of 32) – *Preconditions that must satisfied for all vessel licensed under access agreement. Point 2 - The vessel must keep accurate and timely reports, catch data and other*

information as required by the FMA and the applicable access agreement and this shall have been provided for any previous licensing period.

The current CDCU Standard Operating Procedures (SOPs) outlines the collection of the unloading data in port and the responsibilities of vessel operators and the monitors. Also included is the PSM procedures which covers the collection of the catch data from the vessel's operators and the steps involved to conduct intelligence analysis. In the Certification SOP, the procedures for verifying and validating of the CC, PS, and NPS are provided which describes the steps involved in verify and validating the certificates as trade documents.

Refer to Appendix II for the list of relevant legislative references that exists in each country that supports the implementation of a national catch certification and traceability system.

6.4. Catch Certification - PNG and Iceland
6.4.1. Standards of Catch Certification

The existing international standards for catch certification that Iceland implements include the following:

i. Icelandic Fisheries Management Standards. The Icelandic Fisheries Management Program is operated by the Icelandic Fisheries Foundation. The program has two complimentary standards which are: (1) Icelandic Responsible Fisheries Management Standard, and (2) Icelandic Responsible Fisheries Management Chain of custody. These standards were derived from *inter alia* the FAO (2005/2009). Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture and the 1995 FAO Code of Conduct for responsible Fisheries (FAO CCREF) which provides the guide to practice catch certification, data collection monitoring and traceability. These standards are achieved through an accreditation by an international accreditation forum (IAF). The IAF is an assessment body that ensures the credibility and transparency of the implemented systems in Iceland thus the comparability of the Icelandic national systems to international markets such as the EU and US as the largest global markets.

ii. US Model Catch Certificate – NOAA Seafood Import Monitoring Program (SIMP) 2018. The NOAA SIMP is also a traceability program and market access requirement for the US seafood importers for reporting and record keeping. Iceland implements a catch certification and traceability system that is comparable to the minimum expectation from the US SIMP.

iii. European Union Regulation 1005/2008 – Catch Documentation Scheme (CDS) Iceland implements the EU regulation which aims to prevent, deter, and eliminate all trade of fishery products into the EU deriving from IUU fishing. Iceland has an existing trade agreement with the EU that also facilitates with access of the EU market.

On the other hand, PNG implements the following standards for catch documentation and certification:

i. European Union Regulation 1005/2008 – Catch Documentation Scheme (CDS) To access the EU market, PNG adopted the EU regulations since 2008 through the EPA trade agreement that PNG has with the European Union. The EU regulation 1005/2008 concerns the implementation of the catch documentation scheme as the standard to improve certification and traceability of all marine fishery product traded with the EU

irrespective of means of transport and at all stages of the production chain from net to plate.

ii. Voluntary Guidelines for Catch Documentation Schemes – FAO 2017
The measures to establish throughout the supply chain whether fish originated from catch taken consistent with applicable nation, regional and international conservation, and management measures, established in accordance with relevant international obligations.

iii. Marine Stewardship Council (MSC)
The MSC certification is a fishery certification program that provides certification of the fishery products based on the rules that are consistent with the chain of custody along the supply chain. This non-governmental run program set the standards to ensure consumer confidence on the products from harvest to plate. The PNG Fisheries Industry Association (FIA) is the custodian of MSC in PNG who operates this certification program thus capitalizing on the PNG current national standards for documentation and certification.

iv. National Plan of Action (IUU fishing) – PNG
This standard was adopted by PNG from the International Plan of action to prevent, deter, and eliminate illegal, Unreported and Unregulated Fishing (IPOA) by FAO (2001) as a measure to address IUU fishing within the PNG jurisdiction.

6.4.2. Qualitative – Interview responses

To access the US market, a catch certificate is needed, along with other export documentation. The Directorate of Fisheries prepares the catch certificate through an online web portal which the Directorate operates.

The Directorate prepares the CC by the steps as described below:

i. The exporter fills out the electronic form of the catch certificate and submits electronically to the directorate through the ERS web portal. Companies must be registered to have access to the catch certificate web portal.
ii. Automatic checks take place to confirm the information on catch certificate
iii. A catch certificate is then produced as a PDF document electronically signed through the exporter's portal

In the case of PNG, since there is no access to the US market at this stage, it processes only EU catch certificates. Below is the SOP which PNG practices:

i. The Exporter submits the EU CC together with relevant traceability documents.
ii. The Certification Officer receives the documents and confirms all required docs are intact.
iii. The certification Officer verifies the documents ensuring that the information provided on EU CC is accurate using the verification checklist.
iv. If satisfied with the details provided Officer requests a (through a template) for the Document Number which is centrally controlled at the Head Office
v. The Officer responsible to Document Number allocation assigns a unique number,
vi. Officer makes final checks to ensure Health Certificate and Export Permits have been approved by the Competent Authority
vii. The Officer stamps the Doc No on the EU CC
viii. Authorized Signatory signs section 9 of the EU CC
ix. The Officer makes copy of the CC and original is released to the exporter.

The Icelandic fisheries authority operates and utilizes a fully Electronic Register System (ERS) where information of the catch, landing, processing, and export are collected and stored. The ERS contains all data reports from catch to processing with necessary data elements that are required to produce, verify, and validate catch certificates of export of fish products that are destined for any market including the US and EU. This makes the validation and verification process efficient. On the other hand, PNG utilizes both paper-based and electronic data sources to verify and validate the EU catch certificates to meet the EU market requirements (Table 1).

Table 1 Data Collection mode utilized by the Directorate of Fisheries in Iceland and PNG

Data Collection modes by the Competent Authority	Iceland		PNG	
	Paper-based	Electronic	Paper-based	Electronic
Point of Catch		√	√	√
Landing		√	√	√
Transhipment		√	√	√
Processing		√	√	
Export		√	√	

6.4.3. Data

The required data fields for the US SIMP catch certificate are given in Table 2 below:

Table 2 The required data fields for the US SIMP catch certificate

Data Element	Mandatory/Optional	Format/Code for NMFS
Catch Document Identifier	Optional	Free form text
Wild Harvest	Mandatory	WC
Flag state of Vessel	Mandatory	Two (2) alpha ISO country code
Name of Harvesting vessel	Mandatory	Free form text
Unique Vessel Identifier (registration, or License number)	Optional	Free text
Catch Area	Mandatory	FAO fishing area with an additional note regarding withing or beyond the EEZ of a coastal state
Fishing Gear	Mandatory	FAO Gear Codes
Company name of landing recipient, Processor, or buying entity and contact information	Mandatory	Free from text
Facility or vessel landed/delivered to	Mandatory	Free form text In the case of transshipment vessels, the vessel name and Identifier (IMO#, flag state registration #) should be provided

Harvest date	Mandatory	Date format. Harvest date to be reported for wild fisheries is the date of landing/offloading at the end of at the end of a fishing trip or the date of transshipment at-sea or in-port
Landing Port or delivery location	Mandatory	Free form text
Species name and ASFIS code	Mandatory	ASFIS 2 alpha coding
Total weight of product at landing	Mandatory	Numeric value and the reporting unit
Product form at landing	Mandatory	Standard set of codes will be developed (e.g., round = RND; headed and gutted = H&G; gilled and gutted = G&G; other forms = OTH

In reference to the US catch certificate, Iceland produces catch certificate bearing the necessary information as per the model US catch certificate. The data fields on the catch certificate that are Directorate verifies and issues for fishery products exported to the US are as in Table 3:

Table 3 The US Catch certificate produced by Iceland

Data Element	Data Fields
i. Competent Authority information	Name, Logo, and contact details
ii. Provenance of Icelandic fishery products	Date of Issuance
	Reference number
	Certificate number
iii. Species of fish and product	Product code
	Description – species (scientific name)
	Processing (product form)
	Packaging and number of
	Net weight
	Sum of net weight
iv. Catch information	Vessel information
	Fishing area and gear
	Catch information
	Landing date and port
v. Destination of the fishery product	Exporter details
	Importer details
vi. Transportation details	Means of transport
	Country of exportation
	Container number
	Flight no.
	Electronic ID of exporter
vii. Attestation	Electronic signature of the exporter

To meet the EU import requirements PNG provides all necessary information as per EU Regulation 1005/2008 (Table 4).

Table 4 The EU catch certificate area and data fields

Area	Specific Data field
Authority	Document number
	Validating authority
	Name
	Address
	Fax number
	Telephone number
Fishing vessel	Fishing vessel name
	Flag
	Call sign
	IMO/Lloyd's number
	Registration number
	Home port
	Inmarsat number
	Telefax number
	Telephone number
	Email address
Licensing	Fishing license number
	Valid to
	Reference of applicable conservation and management measures
Catch	Description of product
	Type of processing authorized on board
	Species
	Product code
	Catch area(s)
	Catch dates
	Estimated live weight (kg)
	Estimated live weight to be landed (kg)
	Verified weight landed (kg) where appropriate
Skipper	Name of master of fishing vessel or representative
	Signature
	Seal
Transshipment at sea	
Donor	Name of master of fishing vessel
	Signature
	Date
Events	Date
	Area
	Position
	Estimated weight (kg)
Receivers	Master of receiving vessel
	Signature
	Vessel name

	Call sign
	IMO/Lloyds number
Transshipment authorization port area	Name of officer
	Authority
	Signature
	Address
	Telephone number
	Port
	Date
	Seal: (stamp)
Exporter	Name of exporter
	Signature
	Date
	Seal
Flag state authority validation	Name
	Title
	Signatory
	Date
	Seal (Stamp)
Importer declaration	Name of importer
	Address of importer
	Signature
	Date
	Seal
	Product CN number
Import control	Authority
	Place
	Importation authorized
	Importation suspended
	Verification requested – date
Customs Declaration (if issued)	Number
	Date
	Place
Transport details	Country of exportation
	Port/airport/other place of departure
	Vessel name and flag
	Number/airway bill number
	Container number

In determining the data gaps between PNG and Iceland, the catch certificate of US is compared to EU catch certificate (Table 5)

Table 5 Comparison of data fields and information collected by EU vs US

Area	Element	EU	US
Authority	Document number	Mandatory	Mandatory
	Validating authority	Mandatory	Mandatory

	Name	Mandatory	Mandatory
	Address	Mandatory	Mandatory
	Fax number	Mandatory	Mandatory
	Telephone number	Mandatory	Mandatory
Fishing vessel	Fishing vessel name	Mandatory	Mandatory
	Flag	Mandatory	Mandatory
	Call sign	Mandatory	Mandatory
	IMO/Lloyd's number	Mandatory	Optional
	Registration number	Mandatory	Optional
	Home port	Mandatory	Mandatory
	Inmarsat number	Mandatory	Mandatory
	Telefax number	Mandatory	Mandatory
	Telephone number	Mandatory	Mandatory
	Email address	Mandatory	Mandatory
Licensing	Fishing license number	Mandatory	Optional
	Valid to	Mandatory	Optional
	Reference of applicable conservation and management measures	Mandatory	Optional
Catch			
Catch	Description of product	Mandatory	Mandatory
	Type of processing authorized on board	Mandatory	Mandatory
	Species	Mandatory	Mandatory
	Product code	Mandatory	Mandatory
	Catch area(s)	Mandatory	Mandatory
	Catch dates	Mandatory	Mandatory
	Estimated live weight (kg)	Mandatory	Mandatory
	Estimated live weight to be landed (kg)	Mandatory	Mandatory
	Verified weight landed (kg) where appropriate	Mandatory	Mandatory
	Product form at Landing	Does not apply to EU	Mandatory
	Wild-capture or Farmed (Aquaculture)	Does not apply to EU	Mandatory
Fishing Gear	Type	Does not apply to EU	Mandatory
Skipper	Name of master of fishing vessel or representative	Mandatory	Mandatory
	Signature	Mandatory	Mandatory
	Seal	Mandatory	Mandatory
Transshipment at sea			
Donor	Name of master of fishing vessel	Mandatory	Mandatory
	Signature	Mandatory	Mandatory
	Date	Mandatory	Mandatory

Events	Date	Mandatory	Mandatory
	Area	Mandatory	Mandatory
	Position	Mandatory	Mandatory
	Estimated weight (kg)	Mandatory	Mandatory
Receivers	Master of receiving vessel	Mandatory	Mandatory
	Signature	Mandatory	Mandatory
	Vessel name	Mandatory	Mandatory
	Call sign	Mandatory	Mandatory
	IMO/Lloyds number	Mandatory	Mandatory
Transshipment authorization port area	Name of officer	Mandatory	Mandatory
	Authority	Mandatory	Mandatory
	Signature	Mandatory	Mandatory
	Address	Mandatory	Mandatory
	Telephone number	Mandatory	Mandatory
	Port	Mandatory	Mandatory
	Date	Mandatory	Mandatory
	Seal: (stamp)	Mandatory	Mandatory
Landing			
Landing port	Landing port	Does not apply to EU	Mandatory
1st Buying Entry	Company name of landing recipient	Does not apply to EU	Mandatory
	Facility or vessel landed/delivered to		Mandatory
Exporting			
Exporter	Name of exporter	Mandatory	Mandatory
	Signature	Mandatory	Mandatory
	Date	Mandatory	Mandatory
	Seal	Mandatory	Mandatory
Flag state authority validation	Name	Mandatory	Mandatory
	Title	Mandatory	Mandatory
	Signatory	Mandatory	Mandatory
	Date	Mandatory	Mandatory
	Seal (Stamp)	Mandatory	Mandatory
Importer declaration	Name of importer	Mandatory	Mandatory
	Address of importer	Mandatory	Mandatory
	Signature	Mandatory	Mandatory
	Date	Mandatory	Mandatory
	Seal	Mandatory	Mandatory
	Product CN number	Mandatory	Mandatory
	Official importer registration	Does not apply to EU	Mandatory
Import control	Authority	Mandatory	Mandatory
	Place	Mandatory	Mandatory
	Importation authorized	Mandatory	Mandatory

	Importation suspended	Mandatory	Mandatory
	Verification requested – date	Mandatory	Mandatory
Customs Declaration (if issued)	Number	Mandatory	Mandatory
	Date	Mandatory	Mandatory
	Place	Mandatory	Mandatory
Transport details	Country of exportation	Mandatory	Mandatory
	Port/airport/other place of departure	Mandatory	Mandatory
	Vessel name and flag	Mandatory	Mandatory
	Number/airway bill number	Mandatory	Mandatory
	Container number	Mandatory	Mandatory

6.5. Data collection methods – PNG and Iceland
6.5.1. Standards of data collection

Data collection needs to ensure accuracy, reliability and timeliness, safe storage, and improved accessibility of data.

The following are relevant international standards for data collection that Iceland implements in terms of data collection:

i. Icelandic Fisheries Management Standards
ii. Scientific Advisory Bodies (European Union):
Since Iceland implements the EU standards, it ensures that its data collection approaches are at standards that can be accepted by the US. The following are the committees that the EU involves in its data collection framework to collect, management and make available fisheries and aquaculture data that is needed for scientific advice:
   a. Scientific, Technical and Economic Committee (STECF)
   b. International Council for the Exploration of the Sea (ICES)
   c. Regional Fisheries Management Organizations (RFMOs) and regional fisheries bodies (RFBs)

On the other hand, PNG produces reports based on the data it collects from the various fisheries and the activities through country reports as an obligation to the Commission which it is member to, the WCPFC. The standard for reporting is captured within the commission convention member (CCM) responsibilities that the commission members and cooperating non-members are to provide scientific data of catches during each calendar year to the relevant RFMOs (WCPFC, 2016). Hence, PNG provides data through country reports to the commission annually.

In addition, other standards for data collection are as listed below:

i. South Pacific Regional Fisheries Management Organization (SPREFMO) – CMM 02-2018 – Conservation and Management Measure on Standards for the Collection, Reporting, Verification, and Exchange of Data
ii. Guidelines for collection and compilation of fishery statistics – FAO 1975
iii. Guidelines for designing data collection and sharing for co-managed fisheries – FAO 2005

    iv.   Guidelines for the collection of fisheries data for artisanal fisheries – Secretariat, Southeast Asian Fisheries Development Centre – 2022

    v.   Recreational Fishing Survey and Data Standards – NOAA 2020

    vi.   International Commission for the Conservation of Atlantic Tunas (ICCAT) Standards – NOAA

6.5.2. *Interview responses*

In Iceland it is mandatory for all vessels operators and processors and for all related fishing activities to submit data to the Directorate of Fisheries. Likewise, in PNG vessel operators and the processors are obliged to provide necessary data relating to the activities they are licensed to perform.

Both Iceland and PNG own and regulate fishing areas for commercial fishing. Iceland's fishing grounds are within FAO statistical area no 27 and PNG waters in FAO area 71.

Fiskistofa, the Icelandic Directorate of Fisheries, receives verified electronic reports from various authorized persons including vessel operators and exporters. The Icelandic monitoring control and surveillance (MCS) team conducts onsite verification of the activities based on risk assessment. In the case of PNG, the vessel operators provide both electronic and paper-based records of the fishing activities before calling into port. The in-port activities such as the monitoring of unloading activities are conducted by port officials. The responsibilities of data collection at the distinct stages of the supply chain are listed in Table 6.

In Iceland the vessel operators are responsible for collecting and submitting catch records. At the point of landing, the authorized port officials submit the landing records. The harbor officials in Iceland ensure that the vessel operators complete the documentation and that the landed fish are weighed before being taken away for processing or brought to the auction market. The processors then provide weighing and processing records of all fish that are processed. These records are submitted electronically through the Electronic Report System (ERS) of the Directorate.

In PNG, the following are the key areas that the data is collected and reported: catch, transhipment, landing, processing, and export. The catch monitoring officers are responsible to monitor and collect unloading data as an independent source for the purpose of validating EU Catch Certificate. The collected data are either stored in standalone excel spreadsheet or Fisheries Information Management System (FIMS).

The PNG fisheries authority collects data by both electronic and paper-based modes. For Iceland, the system of data collection is fully electronic where all data reports are sent through to the ERS (Table 1). Both PNG and Iceland receive data at the four main stages along the supply chain. These activities include:

    i.   Fishing activity

    ii.   Unloading (Landing and Transshipment)

    iii.   Processing

    iv.   Export

Table 6 The records received by the fisheries authorities at each stage of the supply chain.

Records received by the CA at each stage of supply chain	Iceland	PNG
	Traceability documents received from the industry	*Traceability documents received from the industry*
Point of Catch	i. Electronic report system (ERS) ii. Electronic catch report iii. VMS (marine traffic)	Catch elogsheet Port call document
Landing	Landing report	Landing monitoring record
Transhipment	Not Allowed	Transhipment monitoring record
Processing	i. Weighing report and ii. Processing Report	Rebate Processing Record
Export	i. Catch certificates Export report (submitted to the Customs: not used for traceability by Iceland)	Catch Certificate/Process Statement Additional information

At each stage of the supply chain reports are collected that are required on catch certificates for both EU and US markets (Table 7).

Table 7 The key data elements collected at each state of the supply chain.

Key Data Elements collected at each state of supply chain	Iceland	PNG	
	Electronic	*Electronic (on FIMS)*	*Paper*
Catch activity - report	Catch area Species and estimated size Catch weight	Catch area Species and estimated size Catch weight	
Landing activity	Landing date Verified Landed weight Species and size Vessels details		Verified landed weight Species and size Vessel details Vessel authorization
Transhipment activity	Not allowed in Iceland		Estimated transhipped weight Species and size Vessel details Vessel authorization

Processing/weighing report	Verified processed live weight Verified processed weight Species and size	Verified processed live weight Verified processed weight Species and size	
Export report	Verified processed weight Verified product weight Species and size	Verified processed weight Verified product weight Species and size	

The data collection in Iceland includes all fisheries and species that are reported as caught at the time of catch. All vessels are obliged to land all fish being caught. The fish products that are exported from Iceland to the US markets include iced fish, fresh fish, fish meal or fish oil (Statistics Iceland, 2022). On the other hand, the data collection in PNG is only for the tuna fisheries for skipjack, yellowfin, and bigeye. The export products that the tuna fish processors produce are canned tuna and tuna loins. The persons/agency responsible for the collection of information and submission of reports are listed Table 8.

Table 8. The responsible parties or agencies of data collection.

Data Collection Methods Responsibilities (person/agency)	Iceland	PNG
Point of Catch	Vessel operator/captain/owner	Vessel operator/captain
Landing	Certified Harbor officials	Monitoring Officials conduct physical monitoring
Transhipment	Not allowed in Iceland	Monitoring Officials conduct physical monitoring
Processing	Industry submits	Industry provides while officials verify
Export	Industry submits	Industry submits

In Iceland, the data is made available on the official website of the directorate of fisheries and is accessible to almost anyone. The available data on the ERS is subject to internal scrutiny and is also available for assessment by external parties. For PNG, most data are verified manually by officials. The only external scrutiny of the data us through the country reports that are submitted annually to the RFMOs such as the WCPFC, Pacific Island Communities (SPC), and Forum Fisheries Agency (FFA) especially for scientific reporting purposes. Table 9 gives the details of the various responsible parties at each stage of the supply chain.

Table 9. The persons, agency or body that is responsible for data verification.

Data verification Responsible person/agency	Iceland		PNG	
	Internal	*External*	*Internal*	*External*
Catch Report	Directorate of Fisheries	Public Industry	NFA	RFMOS (SPC/FFA/WCPFC)
Landing report	Directorate	Public Industry	NFA	RFMOS (SPC/FFA/WCPFC)
Transhipment report	Not allowed in Iceland		NFA	RFMOS (SPC/FFA/WCPFC)
Processing/weighing report	Directorate of Fisheries		NFA	RFMOS (SPC/FFA/WCPFC)
Export report	Customs	Public Industry	NFA	RFMOS (SPC/FFA/WCPFC)

6.5.3. Quantitative - Data

Below is a comparison of the data and information that are collected by Iceland and PNG (Tabe10):

Table 10. Comparison of the data fields on the various reports from Iceland and PNG.

Data Elements	Data Fields	Iceland	PNG
i. Vessel Monitoring Systems (VMS) reports:	Area of catch	Collected data	Collected data
	Location (longitude and latitude) of the successful catch within the defined and regulated fishing zone for commercial fishing activity.	Collected data	Collected data
	Name and vessels particulars	Collected data	Collected data
ii. Electronic catch reports.	Name of ship and ship register number	Collected data	Collected data
	Fishing gear, type, and size	Collected data	Collected data
	Position (latitude and longitude)	Collected data	Collected data
	Catch by quantity and species	Collected data	Collected data
	Fishing day	Collected data	Data not collected
	Landing port and landing day	Collected data	Data not collected
	Seabird by number and species	Collected data	Data not collected
	Marine mammals by number and species	Collected data	Data not collected

iii. Landing report.	Ship name and registration number	Collected data	Collected data
	district number	Collected data	Collected data
	Landing port and landing day	Collected data	Collected data
	Name of selling, buyer consignee of catch or fish market	Collected data	Collected data
	Weighted catch broken down species	Collected data	Collected data
	undersized catch	Collected data	Data not collected
	number of containers, type, and weight (e.g., boxes, barrels)	Collected data	Optional
	registration number of the transport vehicle and unladen weight according to registration in the vehicle register	Collected data	Data not collected
	catch weight of reweighted	Collected data	Optional
	specify if fish is gutted/whole round/head & gutted etc	Collected data	Data not collected
iv. Transshipment	Transshipment date and time	Not applicable	Collected data
	Port of transshipment	Not applicable	Collected data
	Transferring Vessel name and details	Not applicable	Collected data
	Receiving Vessel name and details	Not applicable	Collected data
	Flag of vessel	Not applicable	Collected data
	Quantity on board by species (MT)	Not applicable	Collected data
	Quantity transferred by species (MT)	Not applicable	Collected data
	Quantity retained onboard by species (MT)	Not applicable	Collected data
	Product type (frozen/brine/fresh)	Not applicable	Collected data
v. Weighing Report	Name and ID number of the seller and the buyer	Collected data	Data not collected
	Delivery date	Collected data	Data not collected
	Fish species	Collected data	Data not collected
	Quantity of species	Collected data	Data not collected
	Condition of catch (gutted, decapitated, frozen, whole frozen, suitable/unsuitable)	Collected data	Data not collected

		Collected data	Data not collected
	Kilogram process of a species	Collected data	Data not collected
	If the buyer of the catch intends another party to handle the processing of the catch, processing party shall be specified	Collected data	Data not collected
	If catch is purchased directly from a fishing vessel, the following shall also be recorded	Collected data	Data not collected
	Name of ship and register number	Collected data	Data not collected
	Fishing gear and area	Collected data	Data not collected
	Landing port and day	Collected data	Data not collected
vi. Processing Report	Name of buyer	Collected data	Data not collected
	Processing plant	Collected data	Data not collected
	Condition of catch (gutted, decapitated, frozen whole frozen)	Collected data	Data not collected
	Fish species and quantity	Collected data	Data not collected
	Processing method	Collected data	Data not collected
	Inventories at the beginning of the period	Collected data	Data not collected
	Purchase of fish during the season	Collected data	Data not collected
	Amount of sale of unprocessed catch	Collected data	Data not collected
	To the processing plant	Data not collected	Data not collected
	For export in a container	Collected data	Data not collected
	For export by air freight	Collected data	Data not collected
	Quantity of sales for domestic consumption	Collected data	Data not collected
	If the buyer transfers the catch, he shall submit a report stating the name and ID number of the buyer, delivery date, fish species, quantity, and condition of catch	Collected data	Data not collected
vii. Export reports	export dates	Collected data	Collected data
	volume of export	Collected data	Collected data
	processor details	Collected data	Collected data
	the product types	Collected data	Collected data

PNG does not collect electronic catch reports, landing reports, weighing report, and processing report. On the other hand, there is also some information that may not be applicable to Iceland such as the transshipment information.

6.6. Traceability standards - PNG and Iceland
6.6.1. Standards for Traceability
The internationally recognized standards for traceability that Iceland is implementing in terms of its traceability include the following:

i.   Seafood Import Monitoring Program (SIMP) – NOAA 2018

The SIMP and the traceability system establishes good data collection and retention, sharing, and analysis among regulators and enforcement authorities - marking a significant step towards addressing IUU fishing and seafood fraud.

ii.   Chain of custody requirements – Iceland
"To meet the chain of custody requirements and get certified, applicants must be able to demonstrate compliance with the standard through and independent assessment by an approved certification body" (Iceland Responsible Fisheries, 2022). The contents of the Icelandic chain of custody include the following:
i.   General principles of traceability for chain of custody
ii.   Traceability within the supply chain
iii.   Traceability and labelling

Both Iceland PNG implement the Maritime Stewardship Council (MSC) certification whereby fishery products are certified through a certified system of certification and traceability system. This system is assessed and certified by an external an accreditation body.

In addition, other relevant standards for traceability are as listed below:

i.   GS1 Foundation for Fish, Seafood and Aquaculture traceability Implementation – 2012. This standard for traceability provides for the minimum traceability requirements across all stages of the supply and distribution chain to ensure information between the distribution channel for fish traceability.
ii.   A Guide to Traceability within the Fish Industry – EUROFISH and SIPPO

The guide to traceability within the fish industry as an industry-based traceability program that gives the listed traceability needs for companies, the type of information that should be available for tracing, the methodology to be utilized to achieve compliance, and how much it would cost to operate a traceability system.

6.6.2. Interview responses
Table 6 shows the different traceability documents that are received and issued by the fisheries authorities along the supply chain in respective countries. The Directorate issues catch certificate at the time when the company is preparing the export documentation. The processed US catch certificate contains all verified information, and the process of verification involves cross checking of information is at each stage of available on the ERS database.

On the other hand, PNG issues various traceability documents along different stages of the supply chain. PNG issues a port call authorization. Port use authorization contains a unique ID

code. In addition, the CA issues declaration of landing (DOL) and declaration of transshipment (DOT).

6.6.3. Quantitative – Data

In Iceland, the traceability documents that the fisheries authority receives are listed below:

   i.   VMS reports:
  ii.   Electronic catch reports.
 iii.   Landing report.
 iv.   Weighing/Processing Report
  v.   Catch certificates details (see) section 6.4.2
 vi.   Export reports – usually received after the consignment departs Iceland but is important for the Icelandic customs and is not used for traceability. Export reports are submitted to the customs.

The traceability documents are like those collected in Iceland except that landing and transshipment records are independently collected by the officials who are full-time employees of the PNG NFA. The traceability documents are received by the vessel operators and processors/exporters. The PNG NFA also issues traceability documents to the vessel operators at the time of landing and transshipment monitoring and to the processors where necessary. These documents are issued only if the vessel's activities based on the analysis reports that the vessel is in compliant with the management laws and regulations. These traceability documents are listed as follows with the minimum relevant traceability details:

   i.   Port call Authorization
      a. Authorization code (ID)
      b. Vessel details
      c. Date of issuance
      d. Port intended to unload
  ii.   Port use Authorization
      a. Authorization code (ID)
      b. Date of issuance
      c. Vessels details
      d. Purpose of port call
      e. Port intended to unload
 iii.   Vessel Unloading Authorization
      a. Issued code (ID)
      b. Port of unloading
      c. Specifications of the catch being landed or transshipped.
         i. Species
        ii. Estimated or verified weight
       iii. Vessel details
       iv. Date of unloading
 iv.   Declaration of Landing (DOL)
      a. Date of landing
      b. Vessel Unloading Authorization Code (Issued code (ID))
      c. Specification of the catch being landed
      d. Port of landing

        e.   Vessel details
  v.   Declaration of Transshipment (DOT)
        a.   Date of transshipment
        b.   Vessel Unloading Authorization Code (Issued code (ID))
        c.   Specification of the catch being transshipped
        d.   Port of transshipment
        e.   Vessel details
          i.   Catcher/transferring vessel(s) details
         ii.   Carrier/receiving vessel(s) details

Table 11 below summarizes the traceability documents that are collected and issued at each stage of the supply chain.

Table 11 The traceability documents received and Issued by the CA

Traceability Documents Issued	Iceland		PNG	
	Traceability documents received by the CA	*Traceability documents issued by CA*	*Traceability documents by the CA*	*Traceability document Issued CA*
Point of Catch	i. Electronic report system (ERS) ii. Electronic catch report iii. VMS report Marine traffic		i. Catch elogsheet ii. Port call Document	Port Call Authorization
Landing	Landing report		Landing Monitoring record	i. Port use Authorization ii. Vessel Unloading Authorization iii. Declaration of Landing (DOL)
Transhipment	Not Allowed		i. Transhipment record ii. Monitoring record	i. Port use Authorization ii. Vessel Unloading Authorization iii. Declaration of Transhipment (DOT)
Processing	i. Weighing report and ii. Processing Report		Rebate Processing Record	

Export	i. Catch certificates ii. Export report (submitted to the Customs: not used for traceability by Iceland)	Validated Catch Certificate	i. Catch Certificate/Process Statement /Non-Process Statement ii. Tuna Export Additional Information	

7. DISCUSSION

7.1. Legislative Review – PNG

The current legislative framework of PNG's tuna fisheries management supports the implementation of data collection, catch certification and traceability systems. The main areas that are covered include data collection from capture, unloading (landing and transshipment), processing, and exports. Section 29 of the Fisheries Management Act 1998, and Section 23 of the Fisheries Management Regulations 2000, although not explicit, makes provision for the obligation of the industry or any person involved in fishing for that matter to report fishing and related activities including data to the authority. This is further strengthened under the Division 5, section 28 & 32 of the Tuna Management Plan 2014.

The legislative framework also covers the catch certification processes and supports the implementation of the catch documentation and certification program as a market access requirement. Since US requires vital information from capture, unloading, processing and exports, it is important that all necessary information is accurate and are submitted in a timely manner. The PNG NFA Licensing Policy covers the responsibilities of the vessel operators to provide accurate capture data, however, it does not specify the method of submission of data. For this reason, most vessel operators are inconsistent in their report of fishing activities.

In the current legislative framework, nothing is said about the traceability standards of PNG except that the CDCU operational SOPs outline the processes involved in the movement of documentations depending on the practical operations within the industry. Nevertheless, there is room for improvement within the legislative framework. The FAO in collaboration with PNG NFA have drafted a Fisheries Management Bill in 2019 and is yet to be enacted through the legislative process.

The Fisheries Management Bill explicitly describes all necessary activities under data collection and catch certification and it gives the legal support to establish the main elements that are vitally covered by a traceability mechanism. Contained in the Bill are the provisions of implementation of the catch certification procedures that corresponds to the market access requirements, the data collection approaches and responsibilities and the enhancement of the national traceability system. Enacting the Fisheries Management Bill will ensure compliance by all operators and relevant stakeholders. Also, a review of the licensing conditions to incorporate the identified additional information will expand on the scope of data collection, including the new improvements on the PSMA procedures. In addition, this paper proposes to review the current CDCU SOP and the forms that it contains.

7.2. Standards

The standards that Iceland uses are (1) the Icelandic Responsible Fisheries Management Standard and (2) Icelandic Responsible Fisheries Management Chain of custody. These standards were derived from *inter alia* the FAO (2005/2009). Guidelines for the Ecolabelling of Fish and Fishery Products from Marine Capture and the 1995 FAO Code of Conduct for responsible Fisheries (FAO CCREF) provide the guide to practice catch certification, data collection monitoring and traceability. These standards are achieved through an accreditation by an international accreditation forum (IAF). The IAF is an assessment body that ensures the credibility and transparency of the implemented systems in Iceland thus the comparability of the Icelandic national systems to international markets such as the EU and US as the largest global markets. These standards are accepted by all other markets including the US and EU.

PNG implements the Food Safety Standards for fish and fishery products which only covers the food safety aspects. PNG also implements the EU regulations for catch documentation and certification is a global standard for market access to the EU markets.

7.3. Catch Certification - PNG and Iceland

Iceland produces catch certificates according to the US market access requirements. Since there is no access to the US markets for PNG at this stage, the research focused on the current EU standards that it has in place in terms of producing catch certificate for tuna exports to the EU as stipulated in the EC Regulation 1178/2002 (EUROPA, 2002) and EC Regulation 1005/2008 (EUROPA, 2008).

PNG has in place procedures of verifying and validating CC that are common to that of Iceland, including: (1) exporter completes and submits CC with relevant export documentations to the CA; (2) the information on the CC is verified; and (3) the CC document is validated by signing and stamping it and releasing it to the exporter. However, the validation criteria are slightly as reflected in the US or EU catch certificate templates (Table 10). There are additional data fields on the US model catch certificate that are exclusive to the US: (i) Catch (Product form at Landing); (ii) Catch (Wild-capture or Farmed); (iii) Fishing Gear (Type); (iv) Landing Port; (v) First (1st) Buying Entry (Company name of landing recipient); (vi) First (1st) Buying Entry (Facility or vessel landed/delivered to); and (vii) Importer Declaration (Official importer registration).

There is a lack of compatibility between the EU and US systems. PNG needs to improve its catch certification and traceability system to make it compatible with US import requirements (Cazalet & Mostert, 2021).

The main difference in terms of procedure is in the way the CC is handled. The Directorate utilizes an electronic system to verify and validate the CC, hence the shorter turnaround time and efficiency to produce a credible CC. The import system in the US utilizes an electronic system that importers in either country of export or import are responsible to operate when submitting to the authorities in US for documentation verification (NOAA, 2022).

In Iceland, the Directorate contracts harbor personnel to collect data and provide reports of the landing activities. These harbor officials are trained to collect specific data including on how to operate and read weighing scales. The reports are electronically submitted to the central database operated by the Directorate. On the other hand, PNG utilizes trained officials who are full-time employees that conduct 100% physical monitoring from start to end of the activity.

This approach has many challenges to manage the human resources. More study is needed in the areas of managing the affairs of individual staff together with the cost associated with the materials and tools for the actual monitoring activities to maintain the efficacy of the traceability system. This is in line with the literature that emphasizes since manual practice is utilized along the supply chain, entities need to engage simpler approaches to provide an oversight of the activities at each stage. The more procedures there are the higher the risk of unexpected issues with the handling of documentation as a direct result of manpower inconsistencies and human error (Cazalet & Mostert, 2021).

Iceland thoroughly verifies and validates all catch certificates via the ERS which stores and manages all fisheries data. The catch certificates accompany the export documentations and is considered as an export document. The ERS produces electronic CCs in PDF format that accompanies the supporting export documents. This is in line with the literature that says that catch certificates are export documents at the time of exporting fish and fishery products (Mundy, 2018). The industry will need to produce credible and authentic catch certificates for tuna products that are intended for the US market (NOAA, 2022).

Exporting countries of seafood to the US will need to produce credible and authentic catch certificates (Juan, 2018). PNG will need to develop the process of verification and validation of catch certificates on an electronic system. Having an electronic database system will improve the turnaround time of issuing CCs, increase the accuracy of necessary checks on information that are provided, and ensure the storage of the records and files for ease of retrieval for the purpose of audits.

Therefore, for PNG to validate a catch certificate that is acceptable on US markets, it needs to incorporate additional data fields as per the model catch certificate. PNG needs to expand the scope of its verification and validation process to accommodate for the additional information as per the US model catch certificate. This is in line with the literature that there are differences between the EU and US catch certificate in terms of their respective data fields (Blaha & Johnson, 2019).

The CA needs to enhance the skills of the officials that are responsible to process CCs. The responsible officers will be required to understand the improved procedures to verify the information that is presented on the catch certificate documents. Also, these appointed officials will need to understand how to operate an electronic fishing information management system in the event the CA makes a transition to use a fully electronic system to produce catch certificates.

However, a growing issue with the increasing number of exports, and consequently the rise in catch certificates for processing, is the handling of these documents by verification officers. This is potentially problematic given the use of both electronic and paper-based approaches in processing CCs where there is a lack of visibility along the supply chain.

This paper suggests for a review of the CDCU certification SOP to include the additional information for verification of the catch certificate. Electronic processing of the CC will increase the level of efficiency and credibility of the processed CC and export documents. Verification officers need to be trained on the improved procedures to understand the US market requirement and of how to use an electronic data base to improve capacity building

through training. There needs to be more collaboration with institutions that are already exporting seafood products to the US.

7.4. Data collection methods - PNG and Iceland

The data that is collected from stages along the supply and value chains can be utilized for different purposes. Data collection conducted by the authority plays a vital role in ensuring the independence of the data for the purpose of verifying information especially for catch certification and documentation. In producing catch certificates, the data must always be consistent with the required information that needs to be on the catch certificates depending on which market the exporter is consigning its products to.

The approaches in collecting data vary depending on the activity along the supply chain. In Iceland all reports are submitted electronically through the electronic report system (ERS) which is operated by the Directorate. This makes it efficient to produce authentic catch certificates. PNG's data management needs to be reviewed to improve in terms of policy framework, capacity, and technology so that it can store, access, and disseminate all vital information. This finding agrees with the literature that there are risks in producing catch certificates that bear unverified data due to the limited scope of data collection (Cazalet & Mostert, 2021).

Therefore, without proper data collection and management, it can be difficult to obtain accurate information needed to verify catch certificates. This adds to the findings in the study conducted by Love et (2021) that the very reason most seafood products intended to enter the US markets are disallowed by the relevant authorities is due to lack of information on the import documents at the US BIPs.

The records provided by fishing activities in specific fishing areas is vital for the national fisheries management and the regional fisheries management organizations. The Icelandic catch areas are in the FAO 27 while PNG catch areas are in the FAO 71. These fishing areas are governed by respective RFMOs where specific conservation management measures (CMMs) apply. For Iceland, the NEAFC has oversight of the fishing activities within the area FAO 27 while for PNG the Western & Central Pacific Commission (WCPFC) oversees activities within the FAO 71. In providing information of the area of catch in annual reports to respective RFMOs, the practice is in line with the literature that commission members and cooperating non-members must provide scientific data of catches during each calendar year to the relevant RFMOs. This is a regional approach of managing the fisheries resource within the conventional area that is governed by the conservation management measures (CMMs) (WCPFC, 2016). In doing so, the Commission will have an oversight of the country's fisheries management thus providing for an external party to assess the data.

The mode of data collection in Iceland utilizes electronic means. All data reports along the supply chain in Iceland are submitted electronically to the Directorate of Fisheries through the existing database system. PNG's mode of data collection is both electronic and paper based. One of the setbacks of developing countries is the lack of visibility in the supply chain as in the case of PNG (Watson, Nichols, Lam, & Sumaila, 2017). Consequently, on most instances there is a duplicate of the records being submitted in both paper-based and electronic means. The practice of manual verification and validation may increase risks of fraudulent documentation in the supply chain. One of the threats to catch certification and traceability systems is the lack of capacity to handle a large volume of documentation (paper-based)

resulting in officials tending to overlook some of the details. This may create gaps for fish and fish products originating from IUU fishing mixing with the non-IUU fish in the process line (Cazalet & Mostert, 2021).

7.5. Traceability standards - PNG and Iceland
In Iceland, the traceability system is fully electronic therefore, all checks and balances including the fish accountancy and risk assessments are done electronically. The PNG CA on the other hand, utilizes a paper-based system to verify and validate the catch certificates at the time of submission by the industry before the export consignment departs the country. This is the current practice for PNG for exports going to the EU market.

Any traceability system is required to be scrutinized by an assessment body both internally and externally for credibility purposes. In Iceland, since the data is readily available on the website that is run by the Directorate of Fisheries, the data is always being assessed by the stakeholders including the public, fishers and the processor and exporters. The Icelandic Audit bureau does an audit of systems as its mandatory function and may not necessarily be related to the assessment requirements of the database and the procedures involved. The audit bureau is the government authority that is responsible for performing a system audit of the existing systems and procedures. This is a gap in PNG as the data is kept in the FIMS data base and is not accessible to the main stakeholders including relevant line agencies.

The traceability system used in Iceland utilizes an electronic system, ERS. This makes the verification and validation process of the catch certificates efficient. This approach makes it convenient for both the fisheries authority and the industry since it reduces the turnaround time of the issuance of catch certificates. This prevents fraudulent practices in terms of the documentation as the data flow within the electronic system systematically analyzes all datasets thoroughly. All risks factors will have been identified and the authority will have been alerted. This type of approach is acceptable by the authorities in the importing states which agrees with the literature that the US through the US SIMP expects exporting countries to have a manageable traceability system (NOAA, 2022).

The interview responses indicated that some form of unique identification is issued at the time of receipt of the reports pertaining to the fishing activity and the later stages of the process. These unique identifications are important to trace the fish product as it passes through the supply chain. This is an important traceability element that gives value to any traceability system for efficacy and reliability of the data thus the credibility of the catch certificate as an output of a robust traceability system.

8. CONCLUSION

PNG intends to export its tuna products to US markets soon but needs to establish a national catch certification and traceability system to meet the import requirements in the US. Therefore, the PNG CA needs to establish the necessary standards in data collection, catch certification and traceability that are required to export tuna products to the US markets.

This research sought to find the standards which PNG will need to adopt from the experience of Iceland to adjust its national systems in terms of catch certification, data collection approaches and traceability system.

The research investigated what information is needed and what enabling capacities and capabilities are needed to produce an authentic catch certificate to guarantee the export tuna products to the US markets. PNG needs to develop an electronic platform with a supporting database and data collecting tools to enable the processing of CC to be eligible for the US market to ensure credibility of the document as an export document, upskilling of the officials who are directly involved in data collection and reporting, and those that are responsible for processing CCs. Also, it was noted that PNG needs to adopt the practice of making collected data accessible to relevant stakeholders and appoint assessment bodies for the purpose of external assessment.

Also, for PNG to establish a comparable national catch certification through comprehensive data collection approaches and a transparent traceability system, it needs to adopt internationally recognized standards specific to the data collection, traceability and catch certification practices.

Using the research to determine the way forward to establish comparable standards for exporting countries that intend to export seafood products to the US and produce credible catch certificates, thereby gaining access to the US market, future research can apply this methodology and aim for similar results in identifying the required standards.

9. RECOMMENDATIONS

PNG needs to consider the recommendations to improve its national system in establishing a catch certification, data collection approach and traceability system that is comparable to that of the US. This research proposes that PNG considers prioritizing the following actions:

- Develop a Responsible Fisheries Management Catch Certification and Traceability Standard with an inclusion of an accreditation plan from an International Accreditation Forum (IAF)
- Review current regulatory measures
- Develop Data Management Policy
- Re-assess current databases and establish an electronic database

See also Appendix IV which lists the priority actions with specific details.

10. ACKNOWLEDGEMENTS

11. REFERENCES

Allain, V., Pillling, G., Williams, P., Harley, S., Nicol, S., & Hampton, J. (2016). Overview of tuna fisheries, stock status and management framework in the Western and Central Pacific Ocean. In V. Allain, G. Pillling, P. Williams, S. Harley, S. Nicol, & J. Hampton, *Fisheries in the Pacific. The challenges of Governance and Sustainability* (pp. 19-48). Noumea: Pacific-credo Publications. Retrieved from Research Gate.

Anders, S., & Westra, S. (2012). *Barriers to Fishery Exports from Developing Countries: The Impact of U.S. FDA Food Safety Regulation.* Foz do Iguaçu: International Association of Agriculture Economics.

Bhandari, P. (2020, July 30). *SWhat is Qualitative Research? | Methods & Examples.* Retrieved from Scribbr: https://www.scribbr.com/methodology/qualitative-research/

Blaha, F., & Johnson, D. (2019). *Port State Measures and Market Access Requirements.* Honiara: Forum Fisheries Agency.

Cazalet, B., & Mostert, E. (2021). *Seafood Traceability: Aligning RFMO catch documentation schemes to combat IUU fishing.* United Kingdom: EU IUU Fishing Coalition.

Certification and Ratings Collaboration. (2022). *Certification and Ratings Collaboration: Data Tool Glossary.* Retrieved on Jan 23 from Certification and Ratings Collaboration: https://certificationandratings.org/sustainable-seafood-data-tool/glossary/

EU. (2022, January 26). *Eurropean Commission: Trade Policy Countries and Regions Pacific.* Retrieved from European Commision: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2009:272:FULL&from=EN

EUROPA. (2002). *EUROPA: Food Saftey Regulation 178/2002.* Retrieved on January 28 from EUROPA: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32002R0178&qid=1644255699245

EUROPA. (2008). *EUROPA: Catch DOcumentation and Certification.* Retrieved on September 29 from EUROPA: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32008R1005&qid=1644256169681

Fang, Y., & Asche, F. (2021). Can U.S. import regulations reduce IUU fishing and improve production practices in aquaculture? *Ecological Economics*, 107084.

FAO. (2002). *FAO: REVIEW OF THE CURRENT STATUS OF CATCH CERTIFICATION AND CATCH DOCUMENTATION.* Retrieved on January 11 from Food and Agriculture Organisation: https://www.fao.org/3/Y8252E/y8252e04.htm#bm04

FAO. (2016). *State of the World Fisheries and Agriculture.* Rome: Food and Agriculture Organisation.

FAO. (2018). *FAO: Fisheries And Aquaculture.* Retrieved on June 1 from FAO: https://www.fao.org/fishery/en/facp/png?lang=en

FAO. (2020). *FAO: The State of World Fisheries and Aquaculture 2020. Sustainability in action.* Retrieved on January 01 from Food and Agricuture Organization: https://doi.org/10.4060/ca9229en

FAO. (2022). *FAO: Code of Conduct for Responsible Fisheries.* Retrieved on January 23 from Food and Agriculture Organisation: The development of "Blue Seafood Guide," a sustainable seafood rating program, and its implication in Japan

FAO. (2022). *FAO: International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing.* Retrieved on January 18 from Food and Agriculture Organization: https://www.fao.org/documents/card/en/c/71be21c9-8406-5f66-ac68-1e74604464e7

FAO. (2022). *FAO: Report of the Expert Consultation on Catch documentation Schemes (CDS), Rome, 20-24 July 2015.* Retrieved on January 18 from Food and Agriculture Organization: https://www.fao.org/documents/card/en/c/c497fcf1-c89a-4721-85e6-59c9f288ac6e/

FFA. (2011). *Major Tuna Industry Status Report - 'Market and Industry Dynamics in the Global Tuna Supply Chain'.* Retrieved from Pacific Islands Forum Fisheries Agency (FFA): https://www.ffa.int/node/567

FFA. (2021). *Feasbility Study.* Honiara: Forum Fisheries Agency.

Fiskistofa. (2022). *FISKISTOFA: About the Directorate of Fisheries*. Retrieved on January 30 from FISKISTOFA - Directorate of Fisheries Iceand: https://www.fiskistofa.is/umfiskistofu/

Gillett, R. (2010). *Marine Fisheries Resources of the Pacific Ocean.* Rome: Food and Agriculture Organization. Retrieved from FAO: https://www.fao.org/3/i1452e/i1452e00.pdf

Havice, E. (2010). The structure of tuna access agreements in the Western and Central Pacific Ocean: Lessons for Vessel Day Scheme planning. *Marine Policy*, 979-987.

Iceland Responsible Fisheries. (2022). *Chain of Custody Standard Requirements*. Retrieved on February 20 from Iceland Responsible Fisheries : https://www.responsiblefisheries.is/certification/chain-of-custody-certification/requirements

ISO. (2022). *Online Browsing Platform*. Retrieved on Janaury 14 from Internatioanl Standard Organisation: https://www.iso.org/obp/ui/#iso:std:iso:12875:ed-1:v1:en

Juan, H. (2018). From country-of-origin labelling (COOL) to seafood import monitoring program (SIMP): How far can seafood traceability rules go? *Marine Policy*, 163-174.

Koehler, H. (2020). The case for industry transparency in supporting sustainable tuna fisheries. *Marine Policy*, 104087.

Love, D., Nussbaumeumer, E., Harding, J., Gephart, J., Anderson, J., Asche, F., Bloem, M. (2021). Risks shift along seafood supply chains. *Global Food Safety*, 100476.

Lue, M., Makino, M., & Asari, M. (2022). The development of "Blue Seafood Guide," a sustainable seafood rating program, and its implication in Japan. *Marine Policy*, 104945.

Malterud, K. (2012). Qualitative research: standards, challenges, and guidelines. *The Lancet*, 483-488.

Mundy, V. (2018). *THE IMPACT OF THE EU IUU REGULATION ON SEAFOOD TRADE FLOWS: Identification of intra-EU shifts in import trends related to the catch certification scheme and third country carding process.* Retrieved on February 1 2022 from IUU Watch: http://www.iuuwatch.eu/wp-content/uploads/2018/02/TDA_report_IUUwatch_LQ.pdf

NOAA. (2021). *NOAA: Report on the Implementation of the US Seafood Import Monitoring Program.* Retrieved on January 23 from National Oceanic & Atmospheric Administration: https://media.fisheries.noaa.gov/2021-05/SIMP%20Implementation%20Report%202021.pdf

NOAA. (2022, January 18). *NOAA RESOURCES: Compliance Guide for the Seafood Import Monitoring Program.* Retrieved from National Oceanic & Atmospheric Administration Fisheries: https://s3.amazonaws.com/media.fisheries.noaa.gov/2020-12/SIMPComplianceGuide_June2019.pdf?null=

NOAA. (2022, January 18). *NOAA Resources: Fisheries of the United States, 2018 Report.* Retrieved from National Oceanic and Atmospheric Administration: https://www.fisheries.noaa.gov/resource/document/fisheries-united-states-2018-report

NOAA. (2022, January 18). *NOAA: Model Catch Certificate for Seafood Import Monitoring Program.* Retrieved from National Oceanic and Atmospheric Administration: https://www.fisheries.noaa.gov/resource/form/model-catch-certificate-seafood-import-monitoring-program

NOAA. (2022, February 12). *NOAA: Understanding Bycatch.* Retrieved from National Oceianic and Atmospheric Administration: https://www.fisheries.noaa.gov/insight/understanding-bycatch

Olsen, P., & Borit, M. (2013). How to define. *Trands in Food Science and Technology*, 142-150.

Radarinn. (2022, February 9). *Radarinn: Trading Countries.* Retrieved from Radarinn: https://radarinn.is/Utflutningur/Vidskiptalond

Ruaia, T., Gu'urau, S., & Reid, C. (2021, July 21). *FFA: Economic and Development Indicators and Statistics: Tuna Fisheries of the Western and Central Pacific Ocean 2020.* Retrieved from Pacific Islands Forum Fisheries Agency: https://www.ffa.int/node/2596

Statistics Iceland. (2022, February 15). *Exports of seafood by product, fish species and countries 1999-2020.* Retrieved from Statistics Iceland: Hagstofa Islands: https://px.hagstofa.is/pxis/pxweb/is/Atvinnuvegir/Atvinnuvegir__sjavarutvegur__utf/SJA04903.px

United States Census Bureau. (2022, January 17). *The United States*. Retrieved from US and World Population Clock: https://www.census.gov/popclock/

USDS. (2020, January 21). *US department of State: PNG and US Relations with PNGH*. Retrieved from US Department of State: https://www.state.gov/u-s-relations-with-papua-new-guinea/

Watson, R., Nichols, R., Lam, V., & Sumaila, U. (2017). Global seafood trade flows and developing economies: Insights from linking trade and production. *Marine Policy*, 41-49.

WCPFC. (2016, December 9). *WCPFC: Scientific Data to be Provided to the Commission (revised at WCPFC4, 6, 7, 9, 10 and 13)*. Retrieved from Western and Central Pacific Commission: https://www.wcpfc.int/doc/data-01/scientific-data-be-provided-commission-revised-wcpfc4-6-7-and-9

WCPFC. (2016, December 9). *WCPFC: Scientific Data to be Provided to the Commission (revised at WCPFC4, 6, 7, 9, 10 and 13)*. Retrieved from Western adn Central Pacific Commission: https://www.wcpfc.int/doc/data-01/scientific-data-be-provided-commission-revised-wcpfc4-6-7-and-9

WCPFC. (2020, August 11-20). *WCPFC: Annual Report to the Commission Part1 Information on Fisheries, Research and Statistics*. Retrieved from Western & Central Pacific Commission: https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/34/3419333a3c3ef075dac311e2034f34b3.pdf?sv=2015-12-11&sr=b&sig=tBMVXlWoYrRL7kkm8fJ5TmUizhxz7oX2q7DlIdS5hlg%3D&se=2022-08-10T18%3A25%3A10Z&sp=r&rscc=public%2C%20max-age%3D864000%2C%20max-

12. APPENDICES

APPENDIX I METHODOLOGY AND MATERIALS

Qualitative data: The questions used in this research are as follows:

- What catch data a currently being documented?
- What catch data collection forms are being used? If any, note if these are paper based or electronic.
- How are catch data collected, kept, and stored (paper or electronically)?
- Does your national legislation and or regulatory framework supports and enables the development and implementation of Catch Traceability?
- Does the national catch certification and traceability Program have a Policy Framework?
- What are the mandatory activities or processes that are included in the data collection approaches?
- Explain briefly how the port monitoring/data collection methods is; (And Who provides the data at each step?)
- Under your national port monitoring program, who monitors the unloading.
- What fishery is covered in your national traceability system?
- What fish species of the regulated fishery is covered in the traceability system?
- Which catch areas does your country regulate for commercial fishing and fishing related activities?
- What is the information required on the catch certificate to export seafood to US?
- What is the process of completing a CC?
- Is the national traceability system:
    - Paper based? Fully Electronic? Both paper and electronic?
- What documents are collected at the time of:
    - Catch activity
    - Unloading (transhipment and landing)
    - Processing
    - Exporting
- List the key traceability documents that accompany catch from landing right through to processing and end market.
- Does the fish processing and export company in your country have an in-house electronic stock inventory and traceability system that can account for all the fish coming in and going out including the balance remaining for all product type?
- Can you list the certificates that are issued at the point of export/trade before the consignment leaves the control of the relevant national authority?
- Does your national traceability system cover the imports of fish and include information relating to its processing and distribution?
- Is there a system in place for the exchange of traceability information among relevant inter-agency (e.g., Customs) at the national and regional level?
- How is the collected data evaluated?
- Who evaluates the data?
- What are some areas within the national system that you think is lacking and needs improvement and suggestions of how it can be improved?

Quantitative Data: The following data sets were used in this study:

The following data sets were sought from both countries' institutions for a quantitative analysis:
- Fishing Vessels Inspection Reports
- Catch Log Reports
- Catch Monitoring Reports
- Catch Landing Report
- Catch Processing Reports
- Fish and Fishery Products Export Reports (Quantity and Value)
- Catch Certification records and forms
- Declaration of Landing and Transshipment (DOT & DOL)

Note that the datasets/forms to be requested will be of the data sets from 2018 to 2021.

APPENDIX II SUPPORTING LEGISLATIVE INSTRUMENTS FOR PNG AND ICELAND

Legislative Instruments: Key elements of the Data collection, Catch Certification and Traceability systems	
Iceland	**PNG**

i. Regulation 298/2020 – Article 3 – Regulations and electronic submission of catch information
 	
ii. Regulation 745/2016 – Article 10 and 17 – Regulation on Weighing and Registration of marine catch23
 	
iii. Regulation 994/2013 – Article 4 (Weighing report) and Article 5 (processing report) Regulation on Reporting on Trade in Marine Catch
	Fisheries Management Act 1998
	6 Functions and powers of the authority
	Part II Division 1 (l)
	Implementation of any monitoring control and surveillance scheme including cooperation agreement or arrangement or arrangements with other state or relevant international regional or subregional organization in accordance with the FMA 1998.
	
	Part III Fisheries Management, Conservation and Development
	Division 1 Administration of fisheries management and development
	25 Management objectives and principles
	(a – h)
	Talks about the management of the aquatic resources to achieve economic growth and sound ecological balance.
	
	29 records, returns and other information
	1 (a – b) maintain and furnish is such manner and form of all relevant data and information including fishing and effort, landing, processing, sales and other related transactions and accounts, records, returns, and documents and other information additional to that specified in the FMA 1998.
	
	40 corporation on high seas fishing for highly migratory fish stocks
	Cooperation with states that are fishing at high seas for the purpose for achieving compatible conservation and management measures.
	
	Fisheries Management Regulations 2000
	23 Vessels reporting requirements
	(1) (a – c) the vessel master or operator are responsible to provide accurate information of the fishing activity
	
	Part IV Reporting, Port Calls and Transshipment
	
	23 Vessel Reporting Requirements
	    (1) (a – b), 2, 3, 4 (a – c)
	24 Port Calls
	    (1) , 2, 3, 4, 5
	25 Transshipment of fish and transshipment reports
	(1), - 6
	26 Fish Buyer, storage fish factory, export facility reports

	Tuna Management Plan 2014 Division 3 – management of tuna fishery 15 tuna management tools, agreement and strategies The implementaion of the TMP shall take into account and utilize several tools for the purpose of tuna fisheries conservation and management including combating IUU fishing, food safety standards, and food security at the national level which includes traceability among others. Division 5 – Monitoring and research 28. measures to enhance, and combat and eliminate IUU fishing 5 (a) – (b) electronic reporting to be introduced **National Strategy for responsible sustainable development for PNG (StaRS)** The Corporate Plan is aligned to the national planning framework, which is guided by the 'Constitution' and the 'National Strategy for Responsible Sustainable Development for Papua New Guinea' (StaRS). The Constitution and Directive Principles, and the StaRS establish the long-term objectives, the development paradigm and principles, and then the operational strategy of the Government. Supporting national policies of the National Government and fisheries sector policies and regulations: • Government policy directions, political statements, accords; • UN Sustainable Development Goals (SDGs) – especially, SDG14; • Fisheries Regulations and Management Plans; • Tuna Development Plan; • NPOA for IUU Fishing; • Other fisheries and aquaculture policies, development plans, and • Provincial fisheries plans. Sub-regional, regional, and international, treaties, agreements, and arrangements; memoranda of understandings; and cooperative initiatives. **Fisheries Strategic Plan 2021 – 2030** Key Results Area: 9 Maintain and strengthen sustainable fisheries management and healthy ecosystems Strategic Action 9.3 (strengthen control and governance) Promote evidence-based advice, effective control and strong governance Target: (Effective MCS strategy and implementation) Strategic priorities (Propose activities/directives)

<table>
<tr><td></td><td>

a. adopt an integrated MCS strategy that aligns to regional and international arrangements to combat IUU

ii. maintain PNG CA status by meeting food safety and traceability requirements

iii. enhance the overall MCS capabilities to increase regulatory compliance

long term sustainable development of the sector and robust regulatory systems and procedures to ensure a well-managed and healthy ecosystem

National Plan of Action (IUU fishing)
This requires a whole of Government approach and NFA to play a lead role. The plan has a wide range of activities ranging from capacity building, development of new and ongoing improvement of systems, guidelines, action plans, policies, provision of services and large capital expenditures. A large financial investment is required by NFA and the Government in general to achieve this objective.

Corporate Plan 2021 – 2030

Minister's speech
Adhering to international market access conditions, maintaining the fight against Illegal, Unreported and Unregulated (IUU) fishing, and resilience to reduce and mitigate climate change impacts have emerged as some of the biggest challenges the NFA has ever undertaken. Therefore, strategic, and vibrant partnerships are required at the regional and international levels to harness cooperative approaches in fighting IUU fishing.

Goal 4 Robust monitoring control and surveillance for increased compliance with fisheries laws and policies and relevant international fishing obligations and standards
4.3 strategies for implementation in annual work plans
- appropriate MCS technology/platform to counter the increasing and changing challenges of IUU fishing activities in PNG waters.

Goal 5 maintaining NFA as robust competent authority
5.1 - 5.6

The agency's Corporate Plan, emphasise on the enhancement of systems and processes that increase market accessibility. To achieve this, PNG needs to establish an effective traceability system through a policy framework and create a PNG CC as the product of the system, to demonstrate the transparency and accountability within the country's fisheries management system.

</td></tr>
</table>

APPENDIX III EU AND US CATCH CERTIFICATE MODELS

Key Data Elements and specific Information contained on Catch Certificates: Iceland samples	
US	**EU**
Competent Authority information	Competent authority
Provenance of Icelandic fishery products Date Reference number Certificate number	Reference number Catch certificate number Country of dispatch Competent authority Inspection body
Species of fish and product - Product code - Description – species (scientific name) - Processing (product form) - Packaging and number of - Net weight - Sum of net weight	Details identifying the fishery products - Product code - Description – species (scientific name) - Processing (product form) - Packaging and number of - Net weight - Sum of net weight
Catch information - Vessel information - Fishing area and gear - Catch information - Landing date and port	Provenance of the fishery products - Registration number(s) - Name(s) of vessel(s) that caught the fishery product(s) - Landing date(s) of the catch to be exported - Fishing area - Operator of the vessel - Port of landing
Destination of the fishery product - Exporter - Importer	Destination of the fishery products - Names and address of the consignor - Name and address of the consignee
Transportation details - Means of transport - Country of exportation - Container number - Flight no. - Electronic ID of exporter	Transport details - Means of transport - Country of exportation - Container number - Flight number - Vessel and flag - Airway bill number
Attestation - Electronic signature of the exporter	Attestation - Electronic signature of the exporter

APPENDIX IV PRIORITY ACTIONS FOR PNG: STANDARDS

Areas for Standards	Item No.	Priority areas for Improvement Action
Regulatory Measures	1.	Review of Fisheries Management Act ▪ Enact the Draft Fisheries Management Bill of 2019
	2.	Review of Licensing Policy thus Licensing Conditions i. Factor data submission protocol ii. Factor data management iii. Factor allowance should there be improved approaches in data collection such as technology and other necessary improvement strategies
	3.	Review of general Standard Operating Procedures i. factor data collection methods ii. factor for training of officials iii. factor allowance should there be improved approaches in data collection such as technology
	4.	Development of Data Management Policy
	5.	Development of Traceability Policy Framework
Catch Certification	6.	Procedural improvements in CC verification and validation Expand scope of the areas of verification to include the following: i. Catch – Product form at Landing ii. Catch – Wild-capture of farmed iii. Fishing Gear – Type of fishing gear used iv. Landing – Name of Landing port v. Landing – First (1st) buying entry: Company name of landing recipient vi. Landing – First (1st) buying entry: facility of vessel landed/delivered to vii. Import declaration: official importer registration
	7.	Development of verification of CC on an electronic platform (database system)
	8.	Incorporate to national systems and implement the international standards for catch certification including the US NOAA SIMP guidelines.
Data collection	9.	Improve data collection i. factor in current e-forms of the additional information as per the identified additional data fields from the US model catch certificate ii. develop data collection protocol through an electronic management system
	10.	Introduce monitoring technology with data accessibility rights to the CA. i. weighing scales for transshipment ii. weighing scales in the process lines iii. electronic landing monitoring
	11.	Incorporate and implement the relevant and applicable data collection standards
Traceability	12.	Development of Traceability Policy Framework i. factor relevant ISO standard ii. include import protocols and iii. include export protocols

		iv. factor training programs of officials v. factor Cooperation with stakeholders (fishers, processors, exporters, company agents, government agencies, importers, fisheries associations, etc.) vi. factor data assessment protocols (internal and external) vii. study and research on seafood market requirements
	13.	Development of electronic database that supports data collection and certification procedures
	14.	Structural development of traceability mechanism on an electronic platform i. factor risk assessments (PSMA) ii. factor mass balancing iii. factor product movement and trade documentation iv. factor interoperability in the electronic system to be accessible by all stakeholders
	15.	Incorporate and implement the relevant and applicable standards for traceability systems