FACTORS INFLUENCING THE EFFECTIVENESS OF SUPPLY CHAIN TRACEABILITY SYSTEM IMPLEMENTATION FOR SHARK AND RAY PRODUCTS IN PAHANG, MALAYSIA: INSIGHTS FROM KEY INFORMANT INTERVIEWS

Roba'a Yusof ♣
*Institute of Tropical Agriculture and Food Security,
Universiti Putra Malaysia, Malaysia*

Ahmad Shuib
School of Business and Economics, Universiti Putra Malaysia, Malaysia

Sridar Ramachandran
School of Business and Economics, Universiti Putra Malaysia, Malaysia

Ahmad Ali
*Southeast Asia Marine Resources Institute (ISMAT), Taman Perikanan Chendering,
21080 Kuala Terengganu, Terengganu, Malaysia*

Illisriyani Ismail
*International Institute of Aquaculture and Aquatic Sciences,
Universiti Putra Malaysia, Malaysia*

ABSTRACT

The objective of this study is to obtain experts' opinions in identifying factors influencing the implementation of supply chain traceability for shark and ray products in Pahang, Malaysia. The information was obtained through structured key informant interviews (KIIs), which were conducted one-to-one and face-to-face with relevant experts from government agencies and Malaysia's National Plan of Action (NPOA-Shark) committee members. From the text discourse analysis, the study has identified seven indicators that need to be improved and explored before developing the full implementation of the supply chain traceability system in Pahang. The indicators are as follows: (i) policy and strategic management; (ii) acts and regulations; (iii) shark and ray resources; (iv) manpower and capability; (v) infrastructure and management information system; (vi) collaboration efforts; and (vii) buy-ins from stakeholders. It is recommended that the government reviews the current policy, acts, regulations, and strategic initiatives to increase the commitment from all relevant stakeholders to ensure sustainable utilisation of shark and ray species.

Keywords: supply chain, traceability, shark and ray products, key informant interviews, Pahang, Peninsular Malaysia

♣ Corresponding author: Institute of Tropical Agriculture and Food Security, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia; Tel: +60139341842; Email : GS48497@student.upm.edu.my

1. INTRODUCTION

Sharks and rays are highly acknowledged as ecologically and economically important species for their significant roles in food security, and the source of nutrition and income. They are considered the key factor in the marine food web's health and maintenance in which all fisheries depend on (Fowler, 2002; Clarke, 2004; Dent & Clarke, 2015). Due to their significance in the ecosystem, the international trade of these endangered species is controlled by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Clarke, 2004). The CITES has listed 48 shark and ray species in Appendix I and II of CITES from 2002 until 2019. Most CITES-listed shark species are targeted primarily for their fins (Okes & Sant, 2019; Momballa, 2020).

The total declared value of the global trade of shark products is nearly USD 1 billion annually. Due to the higher demand for shark fin among high-income consumers, it is one of the highest-priced seafood products per unit weight in the world. The traded products have been reported by The Food and Agriculture Organization of the United Nations (FAO) for many decades through FishStatJ. The world's top 20 catchers of sharks and rays were monitored and reported from 1990 to 2019 (Okes & Sant, 2019). The traded products include meat and fins (fresh, frozen, dried, or salted), cartilage, teeth, jaw, liver oil, skin, and other internal organs (Vannuccini, 1999; Ahmad et al., 2004; Musick, 2005; 2011).

Despite being the world's most threatened species, there is a growing global demand for diversified shark and ray products. However, the data on their utilisation and trade is extremely limited. This complex data collection is used because these products have to undergo various processing stages and pass-through lengthy supply chains before consumption (Clarke, 2004; Bräutigam et al., 2015; Dent & Clarke, 2015; Lehr, 2015; 2016; Booth et al., 2018; Martins et al., 2018; Okes & Sant, 2019; MMAF, 2019; Pavitt et al., 2021). Therefore, the International Plan of Action for Sharks (IPAO SHARKS) and CITES are committed to improving the conservation management of shark and ray resources by strategizing short- and long-term plans for sustainable utilisation of the species.

Thus, there is a need for top catchers and importers to provide accurate, consistent, and precise reporting and tracking of the supply chain of shark and ray products to improve the management and conservation capacities (Dent & Clarke, 2015; Bräutigam et al., 2015; Booth et al., 2018; Okes & Sant, 2019; Momballa et al., 2020, Pavitt et al., 2021). Many have recommended government interventions to explore traceability implementation opportunities, from fishery to the point of export. Traceability is important to eliminate illegal fishery activities, especially the CITES-listed species (Lehr, 2015; Mundy & Sant, 2015; Lehr, 2016; Hosch & Blaha, 2017; Andre, 2018; Booth et al., 2018; Martins et al., 2018; Okes & Sant, 2019; Pavitts et al., 2021) and how it connects to the key requirements of environmental sustainability and social responsibility. However, there is no one-size-fits-all approach for traceability (Lewis & Boyle, 2017). Hence, each country should assess the current situation to understand its special needs and differences in implementing traceability in building its capacity based on those needs (Andre, 2018).

1.1. Background

There are at least 84 ray and 63 shark species, four skates, and one chimaera inhabiting the Malaysian waters including freshwater habitat (Ahmad & Lim, 2012). Sharks and rays contributed

an average of 22,398 mt (1.72%) out of the total landing volume of 1,300,952 mt from 1991 to 2019. (DOF, 2021). These species are important and listed in the International Trade in Endangered Species Act 2008, Federal Fisheries 1985 Act, and (Control of Endangered Species of Fish) Regulations 1999. They are namely *Prestidae* sawfish family as shown in Appendix I. *Cetorhinus maximus* (basking shark), *Carchadon carcharias (*great white shark), and *Rhincodon typus* (whale shark) are listed in Appendix II. Malaysia is aware of the seven new listing species proposed by CITES in their recent conventions, which include porbeagle sharks, hammerhead sharks, silky sharks, thresher sharks, and manta and devil rays.

Malaysia was identified as one of the top catchers and importers of shark and ray products in the world (Clarke, 2004; Dent & Clark, 2015; Bräutigam et al., 2015) with an average catch of 21,459 mt/year and import of 2,556 mt/year from 2000 to 2016 (Okes & Sant, 2019). Malaysia, which is one of the participating countries of relevant international parties, is fully committed to monitoring the utilisation of the products through NPOA-Shark; it was developed in 2006 and revised in 2014. Deficiency in data collection on trade was highlighted as one of the issues that contributed to ineffective trade controls of shark and ray products in Malaysia (DOF, 2014). Thus, the supply chain traceability system for shark and ray products should be explored because it has not been examined in Malaysia to identify the endangered shark and ray species in trade. In addition, the target is to improve trade monitoring and avoid illegal supply chain activities even in domestic markets. Supply chain traceability study is needed to balance the trilogy of the market, resources, and environment sustainably (Fatimah et al., 2017; Ahmad, et al., 2019a).

Although numerous studies have been conducted on the supply chain traceability systems for many different products (Duan et al., 2017; Lehr & Jaramillo, 2017; Lewis & Boyle, 2017; Khan et al., 2018), there were limited studies on the traceability of the supply chain of shark and ray products (Lehr, 2015; 2016; Mundy & Sant, 2015). Rigorous studies were conducted in the 1990s on shark and ray species in Malaysia involving states with high shark and ray landings in Sarawak, Sabah, Perak, and Pahang. However, most earlier studies and literature focused on biological, taxonomy and socio-economic perspectives; the focus was related to the utilisation, marketing, or trading aspects to identify key industry players, product types, domestic marketing channels, and trade patterns (Fowler et al., 2002; Ahmad et al., 2004; Ahmad & Lim, 2012; Ahmad et al., 2014; Fatimah et al., 2017; Ahmad et al., 2017; Ahmad, et al., 2018; Ahmad, et al., 2019a; 2019b).
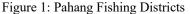
Hence, this exploratory qualitative study intended to obtain the opinions of experts in identifying the factors that influence the effectiveness of the supply chain traceability system of shark and ray products in Pahang, Malaysia. The findings of this study were useful in designing the questionnaires for the focus group discussions (FGDs) and surveys for relevant stakeholders, particularly the industry players, who are involved in the supply chain activities of shark and ray products. The findings can also facilitate the policymakers to develop the framework for the supply chain traceability system for the sustainable conservation management of shark and ray species. In addition, the methodology of the present study can be replicated in future studies for other products.

1.2.   Study Area

Pahang was selected because it is one of the major contributors of shark and ray landings from 1991 to 2019 in the Peninsula Malaysia besides Perak. It has the highest shark and ray landings in

the East Coast of Peninsula Malaysia with an average annual landing of 2,171 mt, which equals 9.75% of shark and ray catches in Malaysia (DOF, 2021). Kuantan was the highest in Pahang's total shark and ray landings of 6,947 mt, followed by Rompin (6,149 mt) and Pekan with 1,912 mt from 2009 to 2016. Kuantan and Rompin are among the highest shark and ray landings for fishing districts in Malaysia. In addition, Kuantan's traders are actively involved in the shark market and distribute the product to other states. Shark and ray products that are marketed in Pahang include fresh shark meat, salted shark meat, dried shark meat, dried shark fin, dried shark cartilage, dried shark jaw, fresh ray meat, dried ray meat, and ray skin (Ahmad et al., 2004; Ahmad, et al., 2019b). Furthermore, Kuantan port is recommended to be included in the Catch Documentation and Traceability (e-CDT) system study as a parallel port, together with Tok Bali port in Kelantan for the consolidation plan for multiple government platforms regarding domestic and international supply chain of seafood products (USAID, 2018). Figure 1 shows the Pahang state and its three fishing districts, namely Kuantan, Pekan, and Rompin.

Figure 1: Pahang Fishing Districts

Source: http://www.wonderfulmalaysia.com

2. LITERATURE REVIEW

Traceability is important to trace food, feed, food-producing animal, or substance that should be included in all foods, through various stages of production, processing, and distribution; it enables

product recall after the product is placed on the market by implementing a verifiable safety and quality compliance programme. It can provide information on what the products are made of as well as the effects on them after several important processes of food safety, quality, and labelling (ISO, 2011; ITC, 2015; Duan et al., 2017; Hosch & Baha, 2017). Traceability also enables the sharing and use of data for the development of solutions to enhance supply chain security, quality, and safety by identifying the past or present locations as well as identifying an item's history (GS1 GTS, 2017; Khan et al., 2018). Furthermore, it can identify shark products in the trade, whether they are sustainable, transparent, authentic, and in compliance with the regulations by supporting the monitoring and control throughout the trade chain, by facilitating the custom's verifications or inspections to improve shark trade reporting (Lehr, 2015; 2016; Mundy & Sant 2015; Bräutigam et al., 2015; Lewis & Boyle, 2017; Friedman et al., 2018; Martins et al., 2018; Pavitt et al., 2021). Besides that, it is a tool that can ensure the fish and fishery products in the supply chain do not come from illegal, unreported, and unregulated (IUU) fishing activities to promote sustainable fisheries management (Lehr & Jaramillo, 2017; Lewis & Boyle, 2017; Hosch & Blaha, 2017; Andre 2018). Hence, the traceability system is significant for government agencies in exploring opportunities of intervention that can increase the complexity of traceability systems; it introduces new elements such as data-sharing, confidentiality of information, governance, and regulatory compliance (UNECE, 2016; Duan et al., 2017). At the same time, policymakers have to balance the need to control the legality of material resources and the practicalities of businesses (Lehr & Jaramillo, 2017; USAID, 2018).

Table 1 shows the summary of the international guidelines and previous studies of the supply chain traceability implementation for seafood and sharks. This integrated supply chain traceability system for sharks and rays is needed to establish the principles and requirements for the design and implementation of data and information management. For better understanding, the information should be collected and made available at each stage, starting from the point of harvest. Several elements have to be investigated before implementing the traceability system as follows: (i) level of implementation either at national, regional, or global integration; (ii) commitment and buy-ins from relevant stakeholders; (iii) barriers for participation; (iv) needs for incentives; (v) integration with existing systems and processes; (vi) cost or administrative burdens; (vii) technical or logistical challenges (Mundy & Sant, 2015; Lehr, 2015; Lehr & Jaramillo, 2017; Andre, 2018; USAID, 2018); (viii) to explore the latest technology to allow a national fisheries authority to make decisions in a timely manner (Lewis & Boyle, 2017; André, 2018) and finally, to explore the right tools, appropriate key initiatives (Lewis & Boyle, 2017), and critical success factors (CSFs) (Khan et al., 2018) for the traceability system.

Table 1: Supply Chain Traceability System Elements

Framework/Guidelines	Methods	Recommended Elements
Sharks		
Lehr (2015) 3-traceability elements (unique identification, critical tracking events (CTEs), and key data elements (KDEs)	Expert consultancies and desk reviews.	CITES legislation on trade monitoring, existing traceability system, non-detriment and legal acquisition findings, buy-ins from government and industry players.
Mundy & Sant (2015) CITES-context traceability framework	Expert opinions via questionnaires, email, and phone discussions.	Barriers to participating, incentives, system and process integrations, cost/administrative burden, technical/logistical challenges,

Framework/Guidelines	Method	Recommended Elements
Lehr (2016) CITES-listed catch documentation scheme	Expert opinions, site visits, workshops.	monitoring, control, and surveillance (MCS) system, regulatory and enforcement regimes. Vessel monitoring system (VMS), law enforcement, consultation with stakeholders, environmental and socio-economic impact, responsive fishery management, user-friendly technology tools.

Fish/Seafood/Food/Agricultural

International Trade Centre (2015) ISO and food traceability system framework	Desk reviews.	Drivers: legislators, private sectors, consumers. Challenges: cost, skills, implementation, multiple processes, information systems, and developing countries.
UNECE (2016) UNECE and UN/CEFACT buy-ship-pay model	Expert opinions.	Policy claim, traceable asset, entry and exit points, conditions and rules, audit agency, and traceability types.
Duan et al. (2017) Framework of food traceability systems in China	Desk reviews and surveys, exploratory factor analysis.	Law, regulations and standards, government support, consumer knowledge, and support, top management, company-wide and vendor support, effective management and communication, information quality, and system quality.
GS1 (2017) GS1 global traceability standard for supply chain (GTS), identify-capture-share model		An interoperable system with other stakeholders, data management, key enablers identification, sufficient business context for data sharing.
Lewis & Boyle (2017) Seafood traceability tools and initiatives	Desk reviews.	Harvester tools, software, due diligence measures, consumer facing, initiatives, and cross-sector collaborations.

Framework/Guidelines	Method	Recommended Elements
Hosch & Blaha (2017) FAO catch documentation scheme (CDS)	Expert opinions and desk reviews.	Catch certification, port configuration, processing organization, CDS support mechanisms, and verifications.
Lehr & Jaramillo (2017) UNECE traceability framework, unique identification, CTEs, and KDEs	Expert opinions, peer reviews, and workshops.	Buy-ins from public and private sectors, socio-economic impacts, existing system improvement.
Andre (2018) FAO IUU framework	Desk reviews of 20 good practice case studies and workshops.	Fleet management, catch landing management, and verifiability.
e-CDT USAID (2018) Electronic catch documentation scheme USAID Oceans CDT 101 and CDT 201	Assessment and appraisals, desk reviews, discussions, workshops, and field visits.	Socio-economic drivers, policy, existing technologies, stakeholders' engagements.

Halal

Khan et al. (2018) Critical success factors (CSFs) Total interpretive structure model (TISM)	Expert opinions.	Training, communication, infrastructure, halal assurance, management support, technology, awareness, customer satisfaction, collaboration, government

| | | | | support, competitive advantage, standardisation and codification. | | | | |

The identified elements from the literature are summarized for the development of the questionnaires as shown in Table 4.

3.   METHODOLOGY

This study used an exploratory qualitative research design to establish the meaning of a phenomenon from the views of respondents through in-depth interviews (Creswell & Poth, 2018; Creswell & Creswell 2018). The choice of the right experts is fundamental to the quality and reliability of data gathered (Tongco, 2007; Palinkas et al., 2015). The selection criteria for the respondents are based on their potential contributions to the study (Gardner et al., 2019).

The identification and selection of relevant government agencies are guided by the supply chain traceability system study on e-CDT USAID (2018) as shown in Table 2. This study has used purposive sampling to select the key informants through the discussions with relevant management teams at the Department of Fisheries (DOF), the Fisheries Development Authority of Malaysia (LKIM), the Malaysian Quarantine and Inspection Services (MAQIS), the Royal Malaysian Customs Department (RMCD) and the National Plan of Action for Sharks (NPOA-Sharks); the respondents are directly responsible for the management of supply chain of shark and ray products in Pahang.

Table 2: Fish Supply Chain Management by the Government Agencies

Agencies	Fishers /Vessels	Jetty	Transit	Transhipment	Importer	Buyer /Broker	Processor	Exporter
DOF	License	LOV, Logbook					Catch Certificate for EU	
LKIM		e-declaration form		Trading license	Trading license	Trading license		
MAQIS			Approval from DG	Transit form	Import permit (via dagang.net)			Export Permit (via dagang.net)
Customs Marine Dept.			KS form	K6 form	K1 form Port clearance Certificate			K2 form Port clearance Certificate
MOH							Health Certificate	

Source: USAID Oceans Analysis (2018)

Table 3 shows the identified key informants' job position and years of work experience. They are either attached to the state or federal government agencies, depending on the related tasks and the level of authority in decision making, for their direct involvement in the supply chain for shark and ray products in Pahang. Letters of approval from relevant agencies were sought and agreed upon by all the department heads before the interview sessions.

The interviews were conducted in Kuantan, Putrajaya, and Terengganu during Malaysia's NPOA-Sharks committee members meeting in April 2019.

Table 3: List of Key Informants

Informant	Job Positions/Functions	Years of Experience
A	Marine Resources Manager, DOF, Putrajaya, and NPOA-Sharks Committee Member	17 years
B	Manager, DOF Sabah, and NPOA-Sharks Committee Member	28 years
C	Senior Researcher, Fishery Research Institute, Perak and NPOA-Sharks Committee Member	27 years
D	Senior Officer CITES Management Authority Representative, DOF, Putrajaya, and NPOA-Sharks Committee Member	14 years
E	Manager, e-CDT USAID Traceability Project Tok Bali Representative, DOF, Putrajaya	13 years
F	Enforcement Assistant Officer, MAQIS, Kuantan, Pahang	14 years
G	Officer, Landing Data Collection Unit, DOF, Kuantan, Pahang	10 years
H	Officer, E-*Pengisytiharan* System Unit, LKIM, Kuantan, Pahang	20 years
I	Enforcement Officer, Royal Malaysian Customs Department, Kuantan, Pahang	4 years
J	Logistic Operation Officer, Pahang Fishermen Association (PERNEPA), Kuantan, Pahang	4 years

The data collection was conducted one-to-one and face-to-face by using a structured and open-ended questionnaire proforma sheet for the in-depth interviews. This approach allowed informants to provide their views and opinions openly (Creswell, 2014; Creswell & Poth, 2018; Creswell & Creswell, 2018). The researcher also conducted observations at fishery landing sites and fish markets to record the presence of shark and ray traded products and species.

Table 4 shows the ten sections in the questionnaire sheet according to the elements mentioned in the literature review. The questionnaire proforma sheet is shown in Appendix 1.

Table 4: Sections in the Questionnaire

No.	Sections
1.	Respondent Particulars
2.	Governance and Management (Functions, Acts/Regulations, Level)
3.	Shark and Ray Resources
4.	Human Resource Management
5.	Infrastructure
6.	Data Management System
7.	Perception of Industry Players
8.	Competitive Advantage
9.	Conclusion
10.	Others

These Key Informant Interview (KII) sessions were written, audio-recorded, transcribed, and summarised for inductive text discourse analysis and interpretation (Ussher & Perz, 2014; Kamalu & Osisanwo, 2015; Creswell & Creswell, 2018; Suciu, 2019). The text discourse analysis steps are shown in Table 5.

Table 5: Discourse Analysis Steps

Reading	Read through transcripts and listen to interview tape recordings to gain an overview of the data.
Coding	Select the materials for analysis using research questions as the basis of selection. Develop coding from reading and re-reading of your data.
Analysis	Read through the coded data. Focus on the functional aspects of the discourse or text.
Writing	Write the analysis to present your results and findings.

The researcher used the inductive process by working back and forth (Creswell & Creswell, 2018) between the pre-defined elements and the summarised transcriptions to present the results.

4.　RESULTS AND DISCUSSION

From the inductive text discourse analysis, the researcher has identified seven indicators that influence the implementation of supply chain traceability system for shark and ray products in Pahang, Malaysia as follows: (i) policy and strategic management, (ii) acts and regulations, (ii) shark and ray resources, (iv) manpower strength and capability, (v) infrastructure and management information system, (vi) collaboration efforts, and (vii) top management buy-ins.

4.1.　Policy and Strategic Management

The respondents indicated that shark and ray species were not a familiar subject matter and were not given higher priorities in their conservation efforts by the top management compared to turtles and corals.

"When it comes to shark and ray species, less priority is given as compared to other listed initiatives in the DOF's headquarters. Top management support and commitment for shark and ray species are still lacking. Having said that, in the latest revision of NPOA-Sharks, the need to explore the opportunities of a traceability system is included in the initiatives."

"Top management as policymaker has to prioritise the sustainability of the endangered species."

"Top management as policymakers must prioritise and agree on the same vision for all agencies. If keep in silo, then difficult to get buy-ins."

The respondents also indicated that various agencies are involved in the supply chain management of shark and ray products. Each agency has different functions and objectives, but it is not integrated for the long-term vision of sustainable management of shark and ray products, which is currently under DOF. These comments confirmed the conclusion made by USAID's (2018) study on e-CDT traceability policy highlighting different agencies develop their own resources, capacities, and processes that might lead to a siloed approach in data collection, management, and sharing; thus, limiting efficient traceability transactions within the government agencies.

"Agencies must sit together and construct new regulations for sharks' and rays' traceability. Otherwise, it will be hard to implement."

"Too many red tapes throughout the management and implementation."

"Fragmented and working in silos."

"LKIM focuses more on the marketing of fish and is involved in fishery economics, not to control the fishes but more on the livelihood and socio-economics of the fishers. The sustainability or other aspects of fisheries are under DOF jurisdictions."

"MAQIS is more on providing regulatory documents relating to inspection, quarantine, and enforcement on exports and imports of plants and animals. However, so far, there is no focus or priority given to shark and ray species."

"The customs focus more on tariffs and tax, not so much for export transactions as no duty is attached to it. Data are not for sustainability purpose; they are more on statistics and tax collection and legality of the trade. No regular integration meeting at the state level involving supply chain matters with other agencies unless there is any regulatory related investigation triggered due to major non-compliance."

With this finding, there is a need to review the current policy and strategic initiatives, specifically under DOF's NPOA-Sharks, to have an expanded collaboration effort among all relevant agencies' top management to gain their support and buy-ins. It is hoped that shark and ray species can have the same or higher priority as turtles and corals. This effort includes developing measures through a series of consultations for sustainable utilisation and productive fisheries, regulatory instruments, and conventions (Friedman et al., 2018). In addition, the strategies and initiatives should improve the reporting of sharks and rays and promote the compliance of international catch and data collection requirements (Pavitt et al., 2021).

4.2. Acts and Regulations

According to the respondents, the current acts and regulations related to the supply chain of shark and ray products in Pahang include the following: (i) Fisheries Act 1985; (ii) International Trade in Endangered Species, Act 2008 (Act 686); (iii) Fisheries (Prohibition of Method of Fishing) Regulations 1980; and (iv) Federal Fisheries (Control of Endangered Species of Fish) Regulations 1999. For fish marketing and distribution, the relevant acts are LKIM Act 1971, Fish Marketing Methods 2010, Fish Marketing Regulations 2010, LKIM Regulations 2010, Fishermen's Associations Act 1971, MAQIS Act 2011 (Act 728) of Customs Act 1967, and Customs Duty Order 2017.

The respondents indicated that the awareness programme on the acts and regulations related to the endangered species of sharks and rays are still lacking at all relevant agencies namely DOF, LKIM, MAQIS, and RMCD.

"Awareness is still a concern among agencies on shark and ray products."

"DOF has printed the latest revised posters of endangered species; however, they are not distributed to all stakeholders just yet. Will distribute them accordingly."

"No posters to disseminate to fishers and marketplaces are available at LKIM jetties."

"Most may be aware that certain sharks are endangered species but not rays."

"In the MAQIS guideline books, brochures, and posters, there are no shark and ray species included in the listing under endangered species for information sharing purpose."

"Awareness programmes should be conducted in Pahang to follow Perak's initiative which was the 'Say No to Shark Fin Consumption' campaign in 2016."

"Almost all fishers are aware of the banning of gill nets with a mesh size of 25cm (or 10 inches) and above, which is also known as Pukat Pari. They are also very much aware of the fishing ban of turtle species but are not familiar with shark and ray species."

"Shark finning restriction was introduced and stated in the fisher's license renewal procedure since 2014, which is not allowing the fins to be removed from sharks and discarding the rest of the shark back into the ocean. All the cutting must be done onshore to avoid any wastage."

The respondents highlighted that there was no mandatory reporting of supply chain data, specifically for shark and ray species, to any government agencies. There was also no dedicated initiative to register shark and ray vessels, products, and industry players throughout the supply chain process, starting from the fishers up to the consumer markets.

"There is no dedicated landing site for shark and ray species as they are by-catch and the quantity is comparatively small."

"There is no dedicated vessel or fisher for shark and ray species category to differentiate the importance in identifying them during the vessel or fisher license/registration process."

"To apply for LKIM's license (e-lesen), there is no requirement for domestic fish wholesalers, retailers, or traders to declare the type of specific species that they are dealing with."

"Under LKIM regulations, there is no mandatory declaration on processing, labelling, packaging or distribution requirement for the domestic market to specify either "shark" or "ray" species. The regulations only require to classify general items as "fish" category."

"No reporting is required for LKIM, and no statistical data is available for other shark and ray products such as dried or any derivatives in the domestic supply chain. Even the industry players who are involved in these processed products did not require any license from LKIM in marketing the products."

"Any person who is engaged in catching, harvesting; a fish processor, handler, or dealer with other requirements is qualified to become a member of the fishermen association. No specific fish species are mentioned in the Act."

"Regulations for import and export for all products are under Customs Duty Order (2017). Tariff code based on permit approvals by DOF and MAQIS. There are codes for shark fin import, for example, 030571, 030292, 030392."

"The government has to review the need to impose mandatory reporting to all fishers; the same as the river fishers where they have their own system for them to claim their cash incentives."

The awareness programmes on the inclusion of new endangered species of sharks and rays under CITES listing (DOF, 2014) and the information dissemination using social media, posters, and brochures need to be improved at all agencies to emphasise their socio-economic importance and their significance to the ecosystem and regulatory compliance (Cripps, 2015; Lewis & Boyle, 2017; MMAF, 2019). The governance of shark and ray products should be appropriate to protect the endangered species and align them with international conventions and instruments (Momballa, 2020). As such, government authorities need to increase awareness programmes and consider mandatory registering and licensing for shark and ray industry players throughout their supply chain activities. This approach will increase the mandate to collect and verify the information to provide reliable statistics and detect any illegal transaction.

4.3.   Shark and Ray Resources

The respondents agreed that shark and ray species play important roles in contributing to environmental and social responsibilities. Even though the annual average of shark and ray landings from 1991 to 2019 was within the 2% of total marine fish in Malaysia (DOF, 2021), sharks and rays are important for ecotourism, balancing the ecosystem, and the sources of income and protein to communities. At the same time, this socio-economic importance has to be balanced with regulatory and environmental impacts as several shark and ray species have been listed under CITES-listed endangered species for sustainable utilisation (Ahmad et al., 2004; Fatimah et al., 2017; Ahmad et al., 2018; 2019a; 2019b).

"Even though the catch of these species is relatively small, they are important for balancing the ecosystems. Sharks are top predators in the marine food chain. If fewer in numbers, the predators lower in their food chain will increase and will cause imbalance in the ecosystem. At present, in Malaysia, the big fishes are now declining due to sharks and rays are being utilised in terms of food and souvenirs. The price is also comparable with other species, which give good income."

"As food, protein, and income resources to fishers. The fish catching is quite challenging, even sharks and rays will be consumed more due to shortage of fish supplies."

"Sharks and rays are now a part of global concern in terms of exploitation and extinction. They serve many purposes not only in socio-economic for the industry players but as an ecotourism opportunity."

"Shark and ray species are very important species due to Malaysia's obligation to comply with CITES regulations for sustainability."

"To give priority to shark and ray species towards sustainable utilisation and consumption for socio-economic purposes as well as the need to balance the ecosystems."

The respondents agreed that sharks and rays are by-catch species. Almost all fishers indicated that sharks and rays in Pahang are by-catch fishing (Ahmad et al., 2004; Ahmad et al., 2019b).

"Shark and rays are not targeted but by-catch species, and all species are mixed at landing sites and are recorded as general identifications which are "shark" and "ray" species."

"Since they are not targeted species, it is difficult to trace the sources from which vessel."

Respondents from relevant agencies confirmed that the information on shark and ray processed products in the domestic market in Pahang is not readily available. There is no special requirement to declare or report processed shark and ray species, except for the international trade data. However, there is also no transaction recorded for the import and export of shark and ray products in Pahang. At the same time, it does not mean that there are no processed products marketed in Pahang as the products may come from ground transportation through domestic routes via other states.

"Sharks and rays are not identified as top 20 species landed in Malaysia and not categorised as popular demanded species or "Ikan Rakyat.""

"There is a general shark and ray product category in the i-MAQIS system. However, there are no transactions reported for permit approval under shark and ray products either at airport or Kuantan port."

"Based on the customs' SMK in Kuantan port database, for 2008-2018, there was no import and export transaction for shark and ray products."

During the researchers' field visits in Pahang, several wholesalers, processors, and retailers process and sell products locally to wholesalers in Johor and Kuala Lumpur and export them to Singapore and Thailand. There are also endangered species that are landed and by-caught at LKIM Kuantan by commercial trawlers such as hammerhead sharks and manta and mobula rays. According to the trawlers and processors, these species are consumed by locals. These species are listed in the CITES force in 2017 (Pavitt et al., 2021). A fishing ban for whale sharks and all sawfish has been enforced since 2008. Manta rays, great hammerhead, and oceanic whitetip will soon be listed with the continuous zero quota on import and export for all CITES-listed species (Friedman et al., 2018).

The supply chain analysis evaluated the linkage of activities from fishing to processing and distribution of shark and ray products in Pahang. The types of products and their marketing channels were also mentioned by Ahmad et al. (2019b). Figure 2 shows the shark and ray products that were processed and marketed in Pahang during the field visits.

Figure 2: Shark and Ray Products that were Processed and Marketed in Pahang

1. Fresh whole ray (market)	2. Fresh whole shark (market)	3. Dried jaws (retail store)	4. Dried ray meat (processor)
5. Dried shark meat (processor)	6. Ray skin (fresh market)	7. Shark skin (processor)	8. Shark fin (retail store)
9. Shark fin (retail store)	10. Shark fin cartilage (retail store)	11. Shark cartilage (retail store)	12. Ray meat (retail store)

Source: Photos taken by the researcher during site visits in Kuantan and Kuala Pahang in 2019.

The products were not properly labelled with information such as the name of the product, type of species, name of the processor, and their origins. Traceability information is needed for the suppliers to ensure that the products are correctly identified and labelled for effective tracking (Lewis & Boyle, 2017). Furthermore, there is a need to improve the collection of catch and trade data to disaggregate the reporting by species-specific commodities at different levels of processing throughout the supply chain of shark and ray products (Pavitt et al., 2021). As such, the government should consider to include new proposed CITES listing endangered species into the current acts and regulations and have mandatory tracking declaration and accurate labelling specifying species-specific and type of products in any documentation on the movement of shark and ray products in both domestic and international markets.

4.4.   *Manpower Strength and Capability*

The respondents raised a concern on the limited technical capability and manpower to identify sharks and rays for species level in Pahang, specifically in terms of management, enforce ement, research, and biology expertise.

"For commercial vessels for Zone C and C2, most crew are foreigners. Should have graphical posters in English as well and in hardcopy. But need to focus on how to train and educate the fishers, especially on the species identification and how to use digital input using computers."

"Not enough capability to identify the species level and for data verification. The landing data need more manpower to record distribution as there are too many but in small quantities and require fast transactions to preserve the freshness of fish."

"Technical capabilities are lacking to verify the endangered species specimens, which include sharks and rays. Furthermore, there may not be enough manpower to verify the document if the implementation of full traceability is in place. However, for data entry, it is still adequate."

"Limited career development and succession planning within DOF with relation to regulatory enforcement. For example, in Putrajaya, only one focal point for management authorities under fisheries for CITES with only a subordinate to assist operational CITES permit issuance."

"Succession planning is an issue as currently I am the most senior researcher and nearing retirement. Working with one subordinate who is very new to this job."

"Random checking will be conducted on some occasion but not often due to shortage of manpower."

"Enforcement teams such as MAQIS and customs may face challenging tasks to verify the products due to lack of staff, capability, and tools (DNA tools), especially on processed products after being cut and packed."

Capability training such as awareness programmes, technical training, and succession to all relevant agencies need to be properly planned out in providing capable and adequate manpower. This is also to increase the level of knowledge on the importance of supply chain traceability of shark and ray products as this subject matter is quite new and unfamiliar to almost all stakeholders (Ahmad et al., 2004; DOF, 2014; Lewis & Boyle, 2017; Pavitt et al., 2021). As such, there is a need for Malaysia's scientific authority and the management team to prepare a strategic plan to conduct a specific capability programme to relevant state-level agencies before implementing the traceability system.

4.5. Infrastructure and Management Information System

4.5.1. Infrastructure

The respondents generally agreed that the current DOF and LKIM administration buildings for licensing, landing, and data collection centres are adequate to cater to future supply chain traceability systems. However, there are limitations in the research, quarantine, and rescue facilities because sharks and rays require big spaces.

"In Pahang, there are two categories of jetties, which are LKIM and private jetties. The review of the overall management of jetty is ongoing as the private jetties are more in numbers and not all are officially registered; thus, the monitoring of their operations is quite challenging."

"There is an EU-compliance bay, a special landing infrastructure, including ice machine provided by LKIM Kuantan jetty just beside the PENERPA office. However, since a vessel catches mixed species, it has to land at a different facility at the end of the jetty and also needs to land other caught species at a normal jetty. This may delay the landing activities as the vessel has to land twice for one trip."

"All shark and ray species are kept in a specimen freezer. For bigger size fish, they must be put into a big cold room for taxonomy study, which currently we don't have. The facility at Rantau Abang is only for mammals and all these specimens do not include processed shark and ray products. These processed products create more challenges as it is very difficult to differentiate after the species has been cut. Need special DNA tools for identification purpose."

"There is no adequate space at the rescue centre for all CITES species. Currently, the specimen will be buried while the skeletons are taken for exhibition. For instance, if the illegal animal is caught in KLIA, the species will be kept in the zoo and it is very costly to maintain."

"In the case of shark fin imports, DNA tools are required to verify the species to prove the DNA as listed endangered species."

"Lacking in quarantine facilities; but at the same time, costly to maintain."

The current reporting system and infrastructure in Pahang provide adequate platforms for full implementation by considering a few improvements. First, the mandatory registration and licensing of all shark and ray landing jetties which to include all privately-owned jetties, as they are the crucial providers for the traceability system information. Second, the government to explore all the return on investment (ROI) on all the required tools that need to be purchased for the traceability system (USAID, 2018), such as quarantine facilities, DNA tools, and relevant scanners so that the enforcement agencies can perform effectively.

4.5.2. Management Information System

The respondents shared about the current process of the supply chain traceability system for shark and ray products in Pahang. They have also highlighted some gaps by comparing them to ideal traceability concepts and provided several suggestions for improvement. Currently, the registrations of fishers, vessels, and catch documentation are under DOF's database. LKIM is responsible for monitoring and controlling catch landing complexes to ensure the comfort and quality of infrastructure; it is also responsible to produce fish marketing licenses for retailers and wholesalers using *e-Pengisytiharan* (*e*-declaration) and *e*-licensing systems. The international fishing permit approval is under i-MAQIS, where RMCD is responsible for the enforcement and data management at entry and exit points using the SMK database. For MAQIS and RMCD, the entry and exit points are located at Kuantan port and Kuantan Airport. The systems are fragmented and not integrated within all agencies. There is no standardisation in coding to identify shark and ray products movement either by species or type of products from fishers to domestic consumer markets in Pahang. The export customs use a 10-HTS code that is only up to the general species level.

"e-CDT system development is to identify moving documents, including catch certificates for all destinations. This will make the supply chain traceability for shark and ray species possible."

"To improve on the vessel management system (VMS), catch documentation scheme (CDS), and jetty management as they are important critical tracking events (CTEs) in the catch traceability system."

"Catch landing data in Pahang is recorded by general species which are "shark" and "ray" species. Currently, only Sabah and Perak recorded up to species level. Monthly updates are done in e-SMPP (DOF VMS and landing record system) for annual statistics. Landing of vessel (LOV) reporting is available for C2 Zone vessels (30nm up to EEZ)."

"*Currently, there is the LKIM e-Pengisytiharan, a voluntary catch declaration system for fishers to claim cash incentive and diesel subsidy. There is no requirement of data reporting up to the specific species level. However, there are a few common local species names available in the system."*

"Pahang Fishermen's Association (PENERPA) records the distribution from the LKIM Kuantan Complex only, with general identification of the type of fish and the destination. No verification is done. The declaration of destination form is for PENERPA to collect fees for the containers being transported out from the complex. Each container costs RM1/box regardless of the type of fish species. The hardcopy data provided by the transporter will be key into the PENERPA system."

"At LKIM Kuantan jetty, the surplus of fish will be packaged and tagged but the tag only has information regarding shipping destination and company but not from which vessels. The transporters do not have a direct relationship with the sellers. The transporters just transport the containers to the designated destinations based on the tags. Most fishers have special agreements with certain wholesalers where they both agreed on the prices, certain species, and quantities required by wholesalers from other cities such as Kuala Lumpur and Johor."

"For Pahang catch landing data recording, sharks and rays are recorded under general species not up to species level except in Perak and Sabah."

"Currently, the import data are based on the 10-HTS code. I would suggest improving the coding up to species level for CITES-listed species for easy monitoring and controlling of the supply chain traceability management."

"Malaysia uses the 10-harmonised tariff schedule (HTS) code with the first 4-digit world customs organisation (WCO) HTS code. Tariff codes for general shark and ray categories are available but not specified up to species level."

"i-MAQIS was launched in 2019. It is an integration system for agents, importers, or exporters to get online permit approval from MAQIS for the custom's requirement. Currently, only 'shark' and 'ray' general species identification are available in the fish species category."

"Servers are stable and internally managed by customs HQ Putrajaya. Custom Information System (SMK) can be viewed and sorted by types of products, species, agents, and companies. All the data will be transferred to various servers in Penang, Johor, and KLIA. They are all independent servers. A new U-customs with planned linkages with other agencies will be launched and may ease the supply chain traceability process."

Despite all the improvements to the digital systems, the accuracy of the data provided by the industry players is another issue as the current reporting is not mandatory.

"Very fragmented activities along the whole supply chain process with possible inaccurate data reporting."

"Data accuracy is only at 40-50%, which are good enough as the marketing data are provided by the suppliers. Some info might be confidential as it involves a pricing mechanism which is based on daily tendering process and price per kilogram that differs depending on the species type and size. The verification of the data accuracy is very difficult as the current data collection is not based on specific species of shark and rays."

"During distributions, the transporters record the general type of species, but the information does not link to the fishers but only states the destination. No verification of claimed species versus the actual species labelled. It's possible to generate reports through fish types and destinations, jetty, and wholesale markets but can't identify from which fishers/vessels. It's very difficult to track as the distribution is very complex due to small quantity but many transactions as it involves fish directly from the vessels and also from the auction markets."

The system integration of various agencies needs to be led by DOF to have an inclusive long-term vision of sustainable management of shark and ray products. There should be a dedicated traceability team to identify important KDEs and CTEs which need to be uniquely identified by registering dedicated licenses for shark and ray products as well as industry players (fishers, vessel owners, wholesalers, retailers, jetty owners, transporters, importers, exporters, processors, and agents) throughout the supply chain process, starting from the fishers up to consumer markets (MMAF, 2019).

It includes the commitment from LKIM to improve the current information systems to record species-specific information so they have a unique product code for each type of processed product (Cripps et al., 2015; Okes & Sant, 2019; Pavitt et al., 2021). In addition, LKIM needs to consider real-time recording as suggested by Okes and Sant (2019) to register and assign unique codes to private jetties, especially in Rompin, for traceability purposes as their catches are also higher compared to LKIM jetties. This LKIM system is linked to the international supply chain through i-MAQIS and U-Custom databases which can share the same coding for processed shark and ray products for easy tracking.

Overall, these agencies are moving towards a digital recording of the traceability system database to improve the current systems. However, these systems are developed independently by their own platforms and resources. A study on e-CDT USAID (2018) stated that there are initiatives by DOF to digitise elements of the catch documentation in Malaysia. However, the data collection is still under various databases across different ministries. The study also recommended performing a pilot study on commercial fishers. This proposed initiative is in line with shark and ray catches with most of the catches are from commercial trawlers.

Despite all these digital system improvements, the accuracy of data provided by the industry players is considered an issue. Mandatory reporting, frequent auditing, and enforcement are required to ensure a reliable traceability system. At the same time, there is the need to review the data-sharing requirements between government agencies and industry players as some information might be discreet (Pavitt et al., 2021). Furthermore, effective vessel records and landing documents are essential to establish a reliable traceability system (Andre, 2018).

4.6. Collaboration Effort

All respondents agreed that a collaborative effort among government agencies and industry players is a major success factor in supply chain traceability. They also highlighted that there is no issue at the state office regarding the leadership support from the headquarters in Putrajaya.

"Collaborative effort with all government agencies is a major success factor in traceability system implementation."

"The state (LKIM) is solely responsible for state regulations, while all other acts and regulations depend on the federal government. Will be supported by the federal in the event of anything happens outside of the state jurisdiction."

"No major challenges between state and federal leadership and support as it is more on a top-bottom approach."

"Cooperation between MAQIS and DOF is not a concern as agents need to play their roles to comply with regulations to operate their business."

"Industry player commitment and government support make for a win-win situation. But have to remember that this will involve politics in which the support from the top management is needed."

"LKIM now accommodates open catch landing operations at 4 am instead of 8 am, and LKIM needs to provide overtime manpower. Due to the nature of the business, the transactions and distributions need to be as early as possible to preserve the freshness of the fishes. Usually, almost all transactions close around 8 am."

"Need to have a good system and all agencies and stakeholders need to understand their functions throughout the traceability process as there are many agencies involved and also all levels of industry players, starting from fishermen to processors. The processing of a fish is at every level from the whole fish including the skin or turning it into other products that may be exported to Thailand."

"Traceability implementation can be challenging as it involves many industry players which include wholesalers, auctioneers, retailers, processors, and transporters. Their support and mental and financial readiness as industry players need to be studied as this involves their time, effort, and cost."

"Based on my engagements with private jetty owners at Tanjung Gemuk, Rompin, they admit that the accuracy of voluntary data reporting for cash incentive and fuel subsidy is only 40-50%. However, they highlighted that the incentive and subsidy encourage them to report the catch landings to LKIM."

"MAQIS doesn't have any issues with the agents' documentation as they are committed to fulfil the regulatory requirements for the sake of their business survival purposes. Agents have the capabilities and infrastructures and can provide details of data input, so far."

"The biggest opportunity to explore is to have the commitment from industry players to record up to species levels."

"Authorities need to explore the industry players' readiness and commitment to support as they are more market and business-driven but not so much on sustainability and supply chain traceability."

The other point to explore is the need for incentives as almost all respondents perceived that cash incentives and fuel subsidies succeeded in encouraging catch landing reporting.

"Currently, the incentives have been reduced by the government. No more cash incentive for Zone C2, which previously was 20 cents per kilo. For Zone C vessels, the maximum of RM1,500 is reduced to RM1,000/month. Zone A can claim 10 cent/kg based on quota."

"For improvement, I suggest MOF has to review the tariff or some tax if the industry players declare the transaction of shark and ray products under a special 'incentive' programme to trace their supply chain of shark and ray products."

"To introduce agreed compulsory reporting with some incentives."

"Same initiatives should be implemented for compulsory reporting for fresh water fishing by the federal, which is a monthly incentive programme. For example, in Sabah, it is one of the factors for successful accurate reporting."

"Incentive and subsidy for data reporting for a 'win-win' situation for the government and industry players and encourage them to report and deal with the 'what is it for me' mentality."

"All cash incentives must get approval from the Ministry of Finance (MOF). DOF used to pilot this compulsory reporting project before; but during that period, there was an 'awkward' trend as it seems the catches were higher. But there was no verification being done to ensure the accuracy of the figures since it requires physical and on-the-spot checking at the landing sites."

Hence, this incentive has to be balanced with regulatory and business impacts as this system may require additional cost, time, and effort from all stakeholders. For example, incentive programmes need to be an option in motivating industry players to provide traceability information.

4.7. Buy-ins from Stakeholders

In summary, all respondents agreed that a supply chain traceability system for shark and ray products is crucial for the sustainable utilisation of resources and a balanced ecosystem. It can also provide information on legality, statistic and mass balance purpose, stock management, food security, and safety.

"Ability to trace the sources and the end of the process of the species to achieve optimum utilisation. To control the capture of endangered species for sustainability, to identify the industry players of this species, its importance of utilisation, to identify any policy and system implementation and enforcement gaps to achieve effective implementation by agencies."

"Very important as the endangered species are getting extinct. This can also identify the supply chain of these two species for the optimal monitoring measures to be taken."

"To know the accurate quantity involved throughout this process for statistical purposes towards sustainability management of the resources."

"For the government to fight illegal activities and for the consumers to get more information on the sources of fish caught. For example, is it locally caught? As from near the shore is fresher as they fish on day trips and sometimes more expensive as compared to the deep sea."

"Traceability is fully supported by customs. However, integration among all agencies with adequate infrastructure is needed for optimum data sharing."

"Important for statistics and regulatory purposes."

"Traceability is important for legality and sustainability with a tagline 'towards sustainable fisheries industry'."

"To combat illegal operations, control, and manage the sustainable utilisation through environmentally friendly transactions which will contribute to the conservation of resources. Can contribute to food security as a whole."

"Traceability helps to record the mass-balance as we want to utilise all resources, at the same time, to manage extinction by having information on stock management not only for shark and ray species."

"Traceability is important to combat illegal operations to monitor a vessel location through detection by identifying unique identification, critical tracking events (CTEs), and key data elements (KDEs). And for statistics and mass balance for sustainability purpose."

Thus, the awareness of the traceability system's importance to get buy-ins and supports from all relevant agencies' top management is crucial to strengthen the current capacity of resources (Friedman et al., 2018; USAID, 2018).

5. CONCLUSION

In summary, all respondents indicated that traceability is important for the implementation in providing information on legality, statistics, i mass-balance, stock management, food security, and safety for the sustainable utilisation of shark and ray products in Pahang. From these seven indicators, all respondents indicated that collaboration efforts and commitments of government agencies and industry players are the major success factors in the supply chain traceability implementation. It is recommended for the government to perform the following: (i) review current policy and strategic initiatives to highlight the priority of shark and ray species, (ii) increase awareness programmes and capability training, (iii) implement mandatory registering and licensing of the shark and ray industry players throughout their supply chain activities, (iii) have mandatory tracking declaration and accurate labelling to specify species-specific and type of products, (iv) implement mandatory registering all privately owned jetties that land shark and ray species, (v) implement mandatory reporting, frequent auditing, and enforcement, (vi) explore all the ROI for additional traceability infrastructure, tools, and digital system improvements, and (vii) explore incentive programmes to motivate the participation of industry players. These recommendations are worth to be considered as Malaysia's shark industry has some competitive advantages of trade growth in the Asian region (Fatimah et al., 2017).

These identified factors from this study can be used as a guide to construct questionnaires for FGDs and surveys for quantitative future studies. The method and instruments used in this study can also be a guide for other products in the seafood industry. Furthermore, this information is beneficial to policymakers to develop a framework for traceability implementation for conservation efforts for the sustainable utilisation of shark and ray products in Pahang and other states in Malaysia. Therefore, future studies need to be expanded to include all industry players (fishers, vessel owners, wholesalers, retailers, jetty owners, transporters, importers, exporters, processors, and agents). This recommendation is to determine the industry players' perceptions on the factors influencing effective supply chain traceability implementation for the sustainable utilisation of shark and ray species.

ACKNOWLEDGEMENT

REFERENCES

Ahmad, A., & Lim, A. P. K. (2012). *Field Guide to Sharks of the Southeast Asian Region*. Marine Fishery Resources Development and Management Department, Southeast Asian Fisheries Development Center. SEAFDEC/MFRDMD/SP/18, pp 210.

Ahmad, A., Lim, A. P. K., Fahmi, D., & Krajangdara, T. (2014). *Field Guide to Rays, Skates and Chimaeras of the Southeast Asian Region*. Marine Fishery Resources Development and Management Department, Southeast Asian Fisheries Development Center. SEAFDEC/MFRDMD/SP/25, pp 289.

Ahmad, A., Lim, A. P. K., Fahmi, D., & Krajangdara, T. (2017). *Identification Guide to Sharks, Rays and Skates of the Southeast Asian Region.* Marine Fishery Resources Development and Management Department, Southeast Asian Fisheries Development Center. SEAFDEC/MFRDMD/SP/31, pp 33.

Ahmad, A., Abdul Haris, H. A. A, Albert, C. H., Ahemad, S., & Solahudddin, A. R. (2004). *Elasmobranch Resources, Utilization, Trade and Management in Malaysia*. Marine Fishery Resources Development and Management Department, Southeast Asian Fisheries Development Center. SEAFDEC/MFRDMD/SP/8, pp 47.

Ahmad, S., Aswani, F. M. N., Ahmad, A., Tai, S. Y. & Fatimah, M. A. (2019a). *A Study of Domestic Marketing Channel on Sharks and Rays in Selected Districts of Sarawak, Malaysia.* Unpublish Report submitted for Department of Fisheries Malaysia, Ministry of Agriculture and Agro-based Industry Malaysia. Putrajaya, pp 32.

Ahmad, S., Aswani, F. M.N., Ahmad, A., Tai, S. Y., Nurhafizah, M., & Lawrence, K. Jr. (2018). *A Study of Fishers Dependency on Sharks and Rays in Sabah, Malaysia*. Institute of Southeast Asia Marine Resources (ISMAT), SEAFDEC/MFRDMD/SP/38, pp 59.

Ahmad, S., Aswani, F. M. N., Ahmad, A., Illisriyani. I., Tai, S. Y., Fatimah, M. A., & Roba'a, Y. (2019b). *Domestic Marketing on Sharks and Rays in Perak and Pahang, Malaysia.* Unpublish Report submitted for Department of Fisheries, Malaysia, pp 36.

Andre, V. (2018). *Good Practice Guidelines (GPG) on National Seafood Traceability Systems*. Fisheries and Aquaculture Circular No. 1150, pp. 24. Food and Agriculture Organization of the United Nations. Retrieved January 1, 2019, from http://www.fao.org/3/i8795en/I8795EN.pdf.

Booth, H., Mutaqqin, E., Simeon, B., Ichsan, M., Siregar, U., Yulianto, I., & Kassem, K. (2018). Shark and Ray Conservation and Management in Indonesia: Status and Strategic Priorities 2018-2023. *Wildlife Conservation Society. Bogor, Indonesia*. https://www.researchgate.net/publication/341119663.pdf

Bräutigam, A., Callow, M., Campbell, I. R., Camhi, M. D., Cornish, A. S., Dulvy, N. K., Fordham, S. V., Fowler, S. L., Hood, A. R., McClennen, C., Reuter, E. L., Sant, G., Simpfendorfer,

C. A., & Welch, D. J. (2015). *Global Priorities for Conserving Sharks and Rays: A 2015– 2025 Strategy* (pp. 26). https://www.researchgate.net/publication/322231648

Clarke, S. (2004). *Shark Product Trade in Hong Kong and Mainland China and Implementation of the CITES Shark Listing*s (pp.53). TRAFFIC East Asia, Hong Kong, China. Retrieved January 1, 2018, from https://portals.iucn.org/library/sites/library/files/documents/Traf-084.pdf.

Creswell, J. W. (2014). *Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research* (4th Ed). Boston, MA: Pearson.

Creswell, J. W., & Poth, C.N. (2018). *Qualitative Inquiry and Research Design. Choosing Among Five Approaches*. Fourth Edition. London, UK. SAGE Publications.

Creswell, J. W., & Creswell, J.D. (2018). *Research Design. Qualitative, Quantitative, and Mixed Methods Approaches.* Fifth Edition. California, USA. SAGE Publications.

Cripps, G., Harris, A., Humber, F., Harding., S. & Thomas, T. (2015). *A Preliminary Value Chain Analysis of Shark Fisheries in Madagascar*. Indian Ocean Commission. Ebene, Mauritius. SF/2015/34. Retrieved January 1, 2020, from Available at http://www.fao.org/3/a-az400e.pdf.

Dent, F. & Clarke, S. (2015). *State of the Global Market for Shark Products*. FAO Fisheries and Aquaculture, Technical Paper No. 590. Rome, FAO, pp. 187. Retrieved January 1, 2018, from http://www.fao.org/3/a-i4795e.pdf.

Department of Fisheries. (DOF) (2014). *Malaysia National Plan of Action for the Conservation and Management of Shark (Plan 2).* Ministry of Agriculture and Agro-based Industry Malaysia, Putrajaya, Malaysia. 50pp.

Department of Fisheries. (DOF) (2021). *Annual Fisheries Statistics*. Retrieved July 1, 2021, from https://www.dof.gov.my.

Duan, Y., Miao, M., Wang, R., Fu, Z. & Xu, M. (2017). *A Framework for the Successful. Implementation of food traceability systems in China*. Retrieved January 1, 2020, from http://core.ac.uk/download/pdf/81671493.pdf.

Fatimah, M. A., Kusairi, M. N., Tai, S.Y., Ahmad, S., Ahmad, A., Nurhafizah, M., Aswani, F. M.N., & Allia, F. R. (2017). *Marketing of Sharks and Rays in Sabah and International Trade of Malaysia's Sharks and Rays* (pp. 73)*.* Institute of Southeast Asia Marine Resources (ISMAT).

Fowler, S. L., Reed, T. M., & Dipper, F. A. (eds) (2002). Elasmobranch Biodiversity, Conservation and Management: *Occasional Paper of the IUCN Species Survival Commission No. 25, IUCN/SSC Shark Specialist Group, IUCN*, *Proceedings of the International Seminar and Workshop, Sabah, Malaysia, July 1997.* ISBN: 2-8317-0650-5. *(258 pp).* Gland, Switzerland and Cambridge, UK.

Friedman, K., Gabriel, S. Abe, O, Nuruddin, A. A., Ali, A., Hassan, R. R. B., Cadrin, S. X., Cornish, A., De Meulenaer, T., Dharmadi., Fahmi., Anh,L. H.T., Kachelriess, D., Kissol Jr., L., Krajangdara, T., Wahab, A.R., Tanoue, W., Tharith, C., Toress Jr., F., Wanchana, W., Win, S., Yokawa, K., & Ye, Y. (2018). Examining the Impact of CITES Listing of Sharks and Rays in Southeast Asian Fisheries. *Fish and Fisherie*s, 2018:19:662-676. Retrieved from January 1, 2021, from https://wileyonlinelibrary.com/journal/faf/DOI:10.1111/faf.12281.

Gardner, H., Green, K., Gardner, A., & Geddes, D. (2019). Maternal and Infant Health in Abu Dhabi: Insights from Key Informant Interviews. *International Journal of Environment Research and Public Health 2019,16*. Retrieved January 1, 2020, from https://www.mdpi.com/journal/ijerph/doi/10.3390/ijerph16173053.

GS1 Global Traceability Standard. (GIS GTS) (2017). *GS1's Framework for the Design of the Interoperable Traceability Systems for Supply Chains* (pp. 58). Retrieved January 1, 2020, from https://www.gs1.org/sites/default/files/docs/traceability/GS1_Global_Traceability_Standard_i2.pdf.

Hosch, G., & Blaha, F. (2017). Seafood Traceability for Fisheries Compliance. Country-Level Support for Catch Documentation Schemes. *FAO Fisheries and Aquaculture*, Technical Paper No. 619, pp. 102. Retrieved January 1, 2021, from http://www.fao.org/3/i8795en/I8795EN.pdf.

International Organization for Standardization. (ISO) (2011). *Traceability of Finfish Product. Specification on the Information to be recorded in Captured Finfish Distribution Chains*. 6pp. Retrieved January 1, 2020, from https://www.iso.org/obp/ui/#iso:std:iso:12875:ed-1:v1:en.

International Trade Centre. (2015). *Traceability in Food and Agricultural Products*. Bulletin No 91/2015. pp. 41. Retrieved January 1, 2020, from https://www.intracen.org/uploadedFiles/intracenorg/Content/Exporters/Exporting_Better/Quality_Management/Redesign/EQM Bulletin 91-2015_Traceability_FINAL 14Oct15_web.pdf.

Kamalu, I., & Osisanwo, A. (2015). *Chapter 8 Discourse Analysis*. Retrieved February 1, 2021, from https:\\www.researchgate.net/publication/343214812.

Khan, S., Haleem, A., Khan, M.I., Abidi, M.H., & Al-Ahmari, A. (2018). Implementing Traceability Systems in Specific Supply Chain Management (SCM) through Critical Success Factors (CSFs). *Sustainability*, 10(204), 26. Retrieved January 1, 2019, from https://www.mdpi.com/2071-1050/10/1/204 on 1 January 2020.

Lehr, H. (2015). *Traceability Study in Shark Products* (pp. 101). Report prepared for the CITES Secretariat, CITES. Retrieved January 1, 2018, from https://cites.org/sites/default/files/eng/prog/shark/docs/BodyofInf11.pdf.

Lehr, H. (2016). *Catch Documentation and Traceability of Shark Products in Costa Rica: A Case Study Report*, Report prepared for the CITES Secretariat, CITES. Retrieved from January 1, 2018, from https://cites.org/sites/default/files/eng/com/sc/66/Inf/E-SC66-Inf-11.pdf.

Lehr, H., & Jaramillo, L. (2017). *Applicability of Traceability Systems for CITES-Listed Medicinal Plants (Appendices II and III) – Greater Mekong: Preliminary Assessment* (pp. 77). United Nations Conference on Trade and Development (UNCTAD). Retrieved January 1, 2020, from https://unctad.org/system/files/official-document/ditcted2016d5en.pdf.

Lewis, S. G., & Boyle, M. (2017). The Expanding Role of Traceability in Seafood: Tools and Key Initiatives. Journal of Food Science Vol 82, Nr. S1, 2017. Retrieved January 1, 2020, from https://www.researchgate.net/doi.101111/1750-3841.13743.

Martins, A. P. B., Feitosa, L. M., Lessa, R. P., Almeida, Z. S., Heupel, M., Silva, W. M., Tchaika, L., & Nunes, J. L. S. (2018). Analysis of the Supply Chain and Conservation Status of Sharks (Elasmobranchii: Superorder Selachimorpha) Based on Fisher Knowledge. *PLoS ONE 13(3)*:e0193969. Retrieved January 1, 2020, from https://doi.org/10.1371/journal.pone.0193969

Ministry of Marine Affairs and Fisheries. (MMAF) (2019). *Effort and Challenges in Managing Sharks and Rays in the CITES Species in Indonesia.* Ministry of Marine Affairs and Fisheries, Jakarta, 28 pp. Retrieved January 1, 2020, from https://www.researchgate.net/publication/341433237/Indonesia-cites-implementation.pdf.

Momballa, M. C. (2020). *Rapid Assessment of the Artisanal Shark Trade in the Republic of the Congo*. Yaounde, Cameroon and Cambridge, UK. Retrieved July 1. 2020, from https://www.traffic.org/site/assets/files/13071/congo-sharks-final-web.pdf.

Mundy, V., & Sant, G. (2015). *Traceability Systems in the CITES Context: A Review of Experiences, Best Practices and Lessons Learned for the Traceability of Commodities of CITES-listed Shark Species* (pp. 90). TRAFFIC report for the CITES Secretariat. Retrieved January 1, 2018, from https://cites.org/sites/default/files/eng/prog/shark/docs/BodyofInf12.pdf.

Musick, J. A. (2005). Shark Utilization. *VIMS Books and Book Chapters. 25*. Retrieved January 1, 2020, from https://sholarworks.wm.edu/vimsbook/25.

Musick, J. A. (2011). Sharks. *FAO Fisheries and Aquaculture Reviews and Studies*. Rome, FAO. 2011. 13p. Retrieved January 1, 2020 from http://www.fao.org/tempref/FI/DOCUMENT/review&studies/sharks.pdf

Okes, N., & Sant, G. (2019). *An Overview of Major Shark Traders, Catchers and Species.* TRAFFIC, Cambridge, UK. Retrieved January 1, 2021, from https://www.traffic.org/site/assets/files/12427/top-20-sharks-web-1.pdf.

Palinkas, L. A., Horwitz, S.M, Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). *Purposeful sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. Administration and Policy Mental Health. PMC HHS Public Access*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4012002 on 12/4/2020.

Pavitt, A., Malsch, K., King, E., Chevalier, A., Kachelriess, D., Vannuccini, S. & Friedman, K. (2021). *CITES and the sea: Trade in commercially exploited CITES-listed marine species*. FAO Fisheries and Aquaculture Technical Paper No. 666. Rome, FAO. Retrieved from March 1, 2021, from https://doi.org/10.4060/cb2971en.

Suciu, L. (2019*). Introductory Chapter: Discourse and Discourse Analysis. A Retrospective Approach*. Retrieved February 1, 2020, from https://www.researchgate.net/publication/332181814.

Tongco, M. D. (2007). Purposive Sampling as a Tool for Informant Selection. *Ethnobotany Research & Applications 5:147-158*. Retrieved January 1, 2020, from https://scholarspace.manoa.hawaii.edu/bitstream/handle/10125/227/I1547-3465-05-147.pdf.

United Nations Economic Commission for Europe. (UNECE) (2016). *Traceability for Sustainable Trade. A Framework to Design Traceability Systems for Cross Border Trade* (pp. 13pp). Retrieved January 1, 2020, from https://unece.org/fileadmin/DAM/trade/Publications/ECE_TRADE_429E_TraceabilityFor SustainableTrade.pdf.

USAID (2018). Malaysia CDT Gap Analysis and Partnership Appraisal. Produced by the USAID Oceans and Fisheries Partnership for review and approval by the United States Agency. *The Oceans and Fisheries Partnership (USAID Oceans)*, pp. 38. Retrieved January 1, 2020, from https://www.seafdec-oceanspartnership.org/resource/malaysia-cdt-gap-analysis-and-partnership-appraisal/.

Ussher, J. M., & Perz, J. (2014). *Chapter 13 Discourse Analysis*. Retrieved February 1, 2020, from https://www.researchgate.net/publication/269575969.

Vannuccini, S. (1999). Shark Utilization, marketing and trade. FAO Fisheries Technical Paper. No. 389. Rome, FAO. 1999. 470p. Retrieved from January 1, 2020, from http://www.fao.org/3/x3690e/x3690e.pdf.

Appendix 1

Key Informant Interview Proforma Sheet
Factors Influencing the Effectiveness of Supply Chain Traceability System Implementation for Shark and Ray Products in Pahang, Malaysia

Respondent No: Interview:
Start time: End Time:
Date   :
Mode of Interview: 1) Voice Recording and Written Notes

1.0   Respondent's Particulars:

Name	
Position	
Years of Experience	
Department	
Address	
Phone No	
Email Address	

Key Informant Interview Proforma Sheet

2.0	**GOVERNANCE AND MANAGEMENT**
2.1	What are your roles and functions? Your department/agency functions? Is there any general/specific policy for the Supply Chain Traceability of Shark and Ray Products (SCTSRP) under your department/agency's jurisdiction? Are there any specific acts/regulations for the SCTSRP under your department/agency jurisdiction? What are the roles/functions of your department/agency with regards to the management of the SCTSRP? Agency/department level of involvement of the SCTSRP. State? National? Regional? International? Any concern with regards to the state and federal jurisdiction?
2.2	Any challenges in the management? 1. Limitation of authority; 2. Support - top management; 3. Financial; 4. Cooperation and coordination with other agencies; 5. Overlapping/Unclear functions with other agencies; 6. Fragmented; 7. Data management system; 8. Efficiency on enforcement.
2.3	Is there any specific SCTSRP programme? What is the objective of the programme?

To combat: 1. Illegal activities; 2. Statistics; 3. Mass-balance; 4. Food safety/security; 5. Competitive edge; 6. Quality; 7. Environmental impacts; 8. Socio-economic; 9. Certification; 10. Others.

3.0	**RESOURCES**
	Sharks and Ray Products?
	Species?
	Catch Volume?
	Markets?
	Supply Demand?

4.0	**HUMAN RESOURCES MANAGEMENT**
	Specific unit/department for SCTSRP.
	Any issues with 1. Skills, 2. Competencies, 3. Development and Training?

5.0	**INFRASTRUCTURE**
	Authority
	Location/Unit/Department
	Facilities provided by your agency for this programme
	Data management
	Type of communication tools

6.0	**DATA MANAGEMENT SYSTEM**
	Dedicated system-information system on SCTSRP
	Technology – selection and adoption of appropriate technology for traceability. If any (improvement traceability using barcoding?)
	System development and design
	Book keeping records of data on the supply chain of shark and ray products
	Type of reports/data
	At what level is the data information stored?
	What are the details do enterprises store? The traceability data required by law?
	Data entry/data collection/data transfer/data communication/data maintenance/data information sharing with other agencies?
	Data validation/quality assurance
	Data accessibility/data transparency
	Data verification/verifiability (internal? external?)
	Data security

7.0	**PERCEPTION ON INDUSTRY PLAYERS**
	Management and monitoring
	Registration? Unique ID?
	Success stories?
	Who? Possibility to include all? Limitation?
	Their roles in SCTSRP traceability implementation?

- Barriers to participate or possible barriers to participate
  - Awareness
  - Education
  - Capability building/training
  - Infrastructure
  - Cost administrative burden (percentage of the cost from total revenue to maintain IT record for this programme? (

> ➢ Do the enterprises have an IT system to support their economic activities, traceability of their products, and quality control? What is the product identification being used?
> ➢ Transparency and security
> ➢ Integration with the current system
> ➢ Technical/logistical challenges
> ➢ Incentives
> ➢ Socioeconomic on cost benefit for all industry players

Validation and verification

- Supply chain structure and organisation
  - Degree of collaboration between actors of the supply chain
  - Number of actors of the supply chain that achieves internal and external traceability
  - The ability of actors of the supply chain to identify product origin
  - The ability of actors to manage traceability systems
  - Compatibility between actors
- Destination of a product, identification of traceable lot unit, the time needed to trace a product, credibility of traceability method

8.0 COMPETITIVE ADVANTAGE

Assurance ISO? Certification?
Standardisation and codification between agencies/state/national/international standard framework for traceability
Reducing the process complexities

9.0 CONCLUSION

What would happen if the government to implement a new regulation to make the reporting compulsory throughout the supply chain of shark and ray species in Pahang?

Based on your input just now, what are the main success factors? Priority?
Any improvement may be necessary to the monitoring, control, and surveillance (MCS) systems and regulatory regime(s) to support the effective implementation of the traceability system.

Do you support the pilot study for SCT of shark and ray products in Pahang?

In conclusion, do you agree that traceability is important? In what way? Is there any possibility that your department would develop the SCTSRP framework in Pahang?

10.0 OTHERS