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IDENTIFICATION OF INDICATORS FOR THE IMPLEMENTATION OF A TRACEABILITY SYSTEM FOR SHARK AND RAY PRODUCTS AMONG INTERMEDIARIES IN PAHANG, MALAYSIA

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Abstract: Traceability system implementation has been suggested to improve data collection in shark and ray product supply chains, thereby supporting their sustainable utilisation and trade. By providing sufficient supply chain information, this system can help to prevent illegal, unreported and unregulated (IUU) fishing and the extinction of these important species. This study aimed to identify the indicators for implementing a traceability system for shark and ray products among intermediaries in Pahang. The study employed a descriptive analysis utilising a reliability test, Exploratory Factor Analysis, and frequency analysis. Individual interviews were conducted using semi-structured questionnaires. The study identified 21 indicators categorised from four dimensions: Shark and ray resources, regulatory compliance and collaboration effort, commitment and skills, and information technology infrastructure. The government is recommended to enforce mandatory registration of intermediaries, require species-specific reporting, invest in management and financial support, increase awareness and training, improve current information system infrastructure, and maintain good collaboration with all stakeholders. Future studies should include consumers and the community to raise awareness about shark and ray products and promote their sustainable utilisation and trade.

Keywords: Sustainability, traceability, shark and ray, indicators.

Introduction

Shark and Ray's products have reached a total world declared value of USD1 billion traded per year. They provide important sources of protein and economic and cultural values worldwide. The global and domestic demands for fins, meat, liver oil and gill plates are still strong, resulting in resource decline with 37.5% of this chondrichthyan species being threatened with extinction. The decline of shark and ray populations could have significant ecological impacts, as these species play important roles in marine food webs and ecosystems. These species are also a crucial source of livelihood for many coastal communities, providing employment and sustenance for individuals involved in shark fishing, ecotourism, and related industries (Dulvy *et al*., 2014; Brautigam *et al*., 2015; Dent & Clarke, 2015; Booth *et al*., 2018; Martins *et al*., 2018; Pavitt *et al*., 2021).

Malaysia has been ranked as the eighth-largest catcher and the second-largest shark fin importer in the world from 2007 to 2016. Being a member of the International Plan of Action for the Conservation and Management of Sharks (IPOA-SHARKS) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Malaysia is committed through its 2014 National Plan of Action for Sharks (NPOA-Sharks) to provide accurate, consistent and precise reporting and tracking of the supply chain of shark and ray products to improve management and conservation capacities. However, a deficiency in data collection on the supply chain has been highlighted as one of the issues that contribute to ineffective trade controls of shark and ray products in Malaysia (DOF, 2006; 2014; Bräutigam *et al*., 2015; Dent & Clarke, 2015;

Booth *et al*., 2018; Ahmad *et al*., 2019a; Okes & Sant, 2019; Pavitt *et al*.,2021).

The complexity of data collection also arises because shark and ray products must undergo various processing stages and involve many countries throughout the supply chain. This complexity contributes to the insufficiency and not fully established supply information, which will make it challenging to monitor the sustainability and legality of these products to ensure their compliance with regulations and standards (Brautigam *et al*., 2015; Davidson *et al.*, 2015; Dent & Clarke, 2015; Mundy & Sant, 2015; Okes & Sant, 2019).

Subsequently, many experts have suggested that a traceability system is a significant tool for government agencies and private sectors to obtain reliable, relevant information to verify that seafood products comply with regulations, safety, quality, transparency, authenticity, accurately labelled and sustainable along their supply chain activities. It also provides catch statistics to cater to environmental concerns about the depletion of fish stocks. Therefore, it is recommended that policymakers identify the indicators for implementing a traceability system among all stakeholders, including the intermediaries throughout the supply chain. The participation of intermediaries is crucial as they play a major role in providing traceability information (Lehr, 2015; 2016; Mundy & Sant, 2015; Hosch & Blaha, 2017; Lewis & Boyle, 2017; André, 2018; Booth *et al.,* 2018; Friedman *et al.*, 2018; Martins *et al.*, 2018; Okes & Sant, 2019; Borit & Olsen, 2020; Corallo *et al*., 2020; Pavitt *et al.*, 2021; Virdin *et al*., 2022).

Narrowing the study to Pahang, one of the biggest sharks and ray markets in Malaysia, reveals a lack of information on its utilisation and supply chain which requires further empirical evidence. Additionally, the annual market intelligence report by the Fisheries Development Authority of Malaysia (LKIM) and annual landings data by the Department of Fisheries Malaysia (DOF) lack detailed information on species-specific and types of shark and ray products traded along the supply chain in Pahang, Malaysia. Moreover, very limited research has been conducted in Pahang, with previous studies primarily focusing on biology, taxonomy, and marketing in Kuantan rather than covering all fishing districts within Pahang. These limitations carry significant implications for the sustainability of the industry and the conservation of these important marine species (Ahmad *et al*., 2004; Abdul Haris *et al*., 2017; 2021; Ahmad *et al*., 2019a; Roba'a *et al*., 2022a; 2022b; LKIM, 2023; DOF,2023). Therefore, this study aims to identify the indicators for implementing a traceability system for shark and ray products among intermediaries in Pahang.

This study defines intermediaries as commercial fishers, wholesalers, retailers, auctioneers, transporters and processors involved in the supply chain of shark and ray products, as per LKIM Fish Marketing Regulations 2010. The findings of this study will add knowledge on shark and ray traceability studies. Furthermore, the intermediaries involved in this study will have a greater awareness of their roles and will be able to contribute to the relevant supply chain traceability processes. It will assist policymakers and other stakeholders who are concerned with environmental interests to develop appropriate measures to ensure products in trade along the supply chain are traceable, transparent, authentic, and compliant with regulations to achieve sustainable utilisation of shark and ray products towards effective conservation management of shark and ray species. Additionally, the methods used in this study may also be customised for other stakeholders, products, or locations.

Literature Review

A traceability system is a platform that is accessible by all relevant stakeholders to obtain the flow of product information that records the production, product movement (Donnelly & Olsen, 2012), the property or ingredients in all its forms at all points across the supply chain (Hofherr *et al.,* 2016). Traceability has a long history, dating back over 3,000 years to the discovery of a labelled wine in the tomb of

King Tutankhamun in 1992 (Islam & Cullen, 2021). The seafood traceability system has been developed worldwide by the government, non-governmental organisations, and private businesses to provide information about the identity, property, and history of seafood products (He, 2018) and to improve transparency across the seafood industry (Virdin *et al*., 2022). According to ISO 12875:2011, traceability is increasingly essential for legal, commercial, environmental, and social purposes, providing detailed information on the nature and origin of food products. Karlsen *et al.* (2013) and Leal *et al*. (2015) emphasised that seafood supply chain activities are more complex than other industries as their shelf lives are more vulnerable, perishable and the highest traded food commodity in the world.

The supply chain of marine fish products traceability system is defined as a platform that can be accessible to acquire the information of a sequence in the distribution processes from the catch to the consumer markets which include the landing, trans-shipments, re-export, processing, and distribution activities (FAO, 2017). In addition, ISO 12875:2011 described that a particular product can be traced back to a uniquely identified vessel from origin to destination and can be identified through multiple processes and distribution channels. Besides, the industry players must be able to trace the flow of materials, identify necessary documentation, track each stage of production, ensure proper coordination, improve communication between all actors involved, and improve the reliability of information (ITC, 2015).

However, there are no clearly defined criteria for the traceability system success from the literature. In addition, there are very limited studies on the success factors of the traceability system success for food, seafood and particularly fisheries products. This is also due to the traceability system implementation is still new in the fisheries industry that it has only emerged after 2012 (Mat Aris & Soon, 2014; Mattevi & Jones, 2016; Duan *et al*., 2017; Hardt *et al.,* 2017; Hosch & Blaha, 2017; Khan *et al.,* 2018; Shankar *et al*., 2018). Specifically, for shark and ray products, the implementation of traceability systems is still relatively new, with a pilot program launched in Costa Rica between December 2015 and February 2016 to ensure sustainable utilisation and trade of the resources towards effective conservation management effort of the species (Lehr, 2015; 2016; Mundy & Sant, 2015).

Additionally, there have been studies on traceability systems in other industries and commodities; however, there is still much to be done to develop an acceptable and appropriate traceability system for shark and ray products. It is recommended before embarking on the design and implementation of a traceability system, the policymakers need to ensure all measures are in place in the context of product supply chain key processes and information, consultation with stakeholders along the supply chain to identify indicators which include barriers to participation, incentives, system integration, cost/administrative/technical/logistical challenges (Lehr, 2015; 2016; Mundy & Sant, 2015; Duan *et al.,* 2017; Lehr & Jaramillo, 2017; Lewis & Boyle, 2017, Khan *et al.,* 2018).

At the same time, there is a lack of research specifically focused on the traceability of shark and ray products in Malaysia (DOF, 2018; Roba'a *et al*., 2022a; 2022b). Research on sharks and rays has been conducted in Malaysia since the 1970s but limited research has been conducted in the state of Pahang. Previous studies in Malaysia have primarily focused on scientific aspects such as species identification, population structure, habitat use, and economic studies on the value of shark and ray fisheries. Other studies have focused on the utilisation and marketing channels for the domestic market (Teshima *et al*., 1978; Fowler *et al*., 2002; Ahmad *et al*., 2004; 2013; 2015; 2017; Ahmad & Lim, 2012; Fatimah *et al*., 2017; Vianna *et al*., 2018; Zimmerhackel *et al*., 2018; Ahmad *et al*., 2018; 2019a; 2019b; Abdul Haris *et al*., 2017; 2021; Booth *et al*., 2021; McCann *et al*., 2021; Seah *et al*., 2022).

Material and Methods

This study applied the mixed method based on the objectives of this study as both qualitative and quantitative data were deemed appropriate for collecting, analysing, interpreting, and presenting the study results. Both methods were required to provide a better understanding of this research problem than either type of itself, as suggested by Creswell (2014) and Creswell and Creswell (2018).

Study Area

Pahang was selected as a study area because it is one of the major contributors to the shark and ray fishing industry in Malaysia. Pahang shark and ray landing data amounted to 2,128 mt and contributed 9.6% of the total annual average of shark and ray landings in Malaysia from 1991 to 2020. Sharks (0.61%) and rays (1.25%) contributed 1.86% of the total annual average of marine fish landed in Pahang for the same period (DOF, 2021). In addition, Kuantan's traders are actively involved in the sharks' market; they buy from the fishers and distribute them to other states (Ahmad *et al.*, 2004; Ahmad *et al.,* 2019a). This study covers three fishing districts in Pahang, namely Kuantan, Pekan, and Rompin. Pahang is also one of the proposed locations for a pilot project to explore the traceability study for shark and ray products among the relevant stakeholders in the supply chain activities (DOF, 2018; USAID, 2018).

Instrument

The information was collected by face-to-face interviews with intermediaries using a semi-structured questionnaire sheet. The possible indicators were identified based on studies conducted by Duan *et al.* (2017), Khan *et al.* (2018) and Roba'a *et al.* (2022a; 2022b). The pre-defined indicators were shark and ray resources, regulatory compliance and collaboration effort, commitment and skills, and information technology infrastructure.

The questionnaire sheet was divided into six sections which were (i) respondent particulars, (ii) shark and ray products supply chain operations, (iii) shark and ray resources, (iv) regulatory compliance and collaboration effort, (v) commitment and skills, and (vi) information technology infrastructure. The first two sections were open-ended questions while the other four were close-ended questions with the 5-likert scale from one to five (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

The close-ended questionnaires were pre-tested, revised and validated using reliability and sample adequacy tests and Exploratory Factor Analysis (EFA).

Population

The respondents were the intermediaries who were familiar, knowledgeable, and directly involved in the supply chain of shark and ray products. The intermediaries must be engaged in either one or more in the supply chain process: the commercial fisher, wholesaler, auctioneer, transporter, processor, retailer, agent, importer, and exporter, as defined in LKIM's Fish Marketing 2010 Regulations. From 2019 LKIM's e-lesen database, 52 identified intermediaries resided in all Pahang fishing districts and had worked or have worked directly in shark fisheries and trade for over five years. This selection criterion has reduced the size of qualified respondents to obtain accurate information on the shark and ray supply chain over time. This is also because the business is very specialised and requires special skills and investment (Mohd Zulkhaidi Salim, FDAM's economic affairs assistant officer, personal communication, 18 February 2020).

The total respondents were 42 which included 22 commercial fishers cum wholesalers of fresh sharks and rays, 14 retailers (9 were wet market retailers, 4 were processed product retailers and 1 auctioneer), 4 processors and 2 wholesalers cum transporters. The other 10 respondents were reluctant to participate as the interview sessions were just before the restriction movement due to the COVID-19 pandemic. This resulted in a calculated response rate of 81%. According to Mundy (2002), a response rate of 70% is considered acceptable for purposive sampling, 80% would be regarded as good, and 90% would be excellent.

Data Collection and Analysis

All interview data were translated into English, coded into Microsoft Excel, and converted into the SPSS version 22 to run the reliability analysis, sample adequacy test, Exploratory Factor Analysis (EFA), scree plot and frequency analysis.

The reliability analysis indicated that Cronbach's alpha values for each dimension were above 0.7, ranging from 0.726 to 0.835 (Table 1). These values suggest that the questionnaires were acceptable and suitable for factor analysis. Coefficients below 0.5 are considered unacceptable, values above 0.5 are poor, above 0.6 are questionable, above 0.7 are acceptable, above 0.8 are good, and above 0.9 are excellent. The KMO values for all dimensions were above the suggested acceptable minimum value of 0.5, ranging from 0.503 to 0.645. A factor loading value above 0.5 was used to assess which factor affected the question the most to represent how much a factor can explain a variable in factor analysis. The scree plot was also used to support the results from the factor analysis (Koonce & Kelly, 2014; Yu & Richardson, 2015; Chan & Noraini, 2017; Zulkepli *et al*., 2017; Field, 2018).

Results and Discussion

This section is divided into two parts: Marketing and identifying indicators for implementing a traceability system for shark and ray products.

Marketing

The common species traded in Pahang were 15 shark and 16 ray species, and they were non-targeted catches, as shown in Table 2 and Table 3, which include two CITES-listed endangered species, Great and Scalloped hammerhead.

Table 3 shows the common ray species traded in Pahang. None of the species were listed under CITES except for Giant and Kuhl devil rays.

These shark and ray species are caught and traded throughout the year. Sharks and rays remain non-targeted catch with commonly caught non-CITES-listed endangered species except hammerhead sharks and *mobula* devil rays.

All parts of sharks and rays were utilised and processed for various purposes, primarily for edible products, and were mainly sold as fresh, sun-dried, or salted meat. The shark and ray skins were sold to an exporter based in Kuala Lumpur. The jaws and teeth of sharks were also sold as souvenirs. The discarded parts, such as the head and internal organs, were used for baits and fertilisers, and the cartilage was used for medical purposes and in cuisine.

The pricing of sharks and rays depends on the type of species and sizes. The fish were sold

Table 1: Reliability and sample adequacy test

Results	Shark and Ray Resources	Regulatory Compliance and Collaboration	Commitment and Skills	Information Technology Infrastructure
Cronbach's Alpha	0.734	0.726	0.758	0.835
KMO values	0.555	0.503	0.633	0.645
Number of items	14	9	14	25

Table 2: List of commonly traded shark species in Pahang, Malaysia

No.	Scientific Name	Common Name	Local Name
1	*Carcharhinus limbatus*	Common blacktip shark	*Yu sirip hitam*
2	*Carcharhinus sealei*	Blackspot shark	*Yu pasir*
3	*Carcharhinus sorrah*	Spottail shark	*Yu sorah*
4	*Chiloscyllium hasseltii*	Brownbanded bamboo shark	*Yu cicak*
5	*Chiloscyllium indicum*	Slender bamboo shark	*Yu bodoh*
6	*Chiloscyllium plagiosum*	Whitespotted bamboo shark	*Yu bodoh*
7	*Chiloscyllium punctatum*	Indonesian bamboo shark	*Yu cicak*
8	*Galeocerdo cuvier*	Tiger shark	*Yu tenggiri*
9	*Hemigaleus microstoma*	Weasel shark	*Yu bintik putih*
10	*Rhizoprionodon acutus*	Milk shark	*Yu pasir*
11	*Rhizoprionodon oligolinx*	Grey sharpnose	*Yu minyak*
12	*Scoliodon macrorhynchos*	Pacific spadenose shark	*Yu padi*
13	*Stegostoma fasciatum*	Zebra shark	*Yu bintik kuning*
14	*Sphyrna lewini*	Scalloped hammerhead	*Yu tukul*
15	*Sphyrna mokarran*	Great hammerhead	*Yu tukul*

Table 3: List of common traded ray species in Pahang, Malaysia

No.	Scientific Name	Common Name	Local Name
1	*Aetomylaeus nichofii*	Banded eagle ray	*Pari helang*
2	*Aetomylaeus ocellatus*	Spotted eagle ray	*Pari helang*
3	*Gymnura japonica*	Japanese butterfly ray	*Pari kelawar/ Pari tembaga*
4	*Gymnura poecilura*	Longtail butterfly ray	
5	*Himantura uarnak*	Coach whipray	*Pari harimau/lalat*
6	*Maculabatis gerrardi*	Whitespotted whipray	*Pari pasir/bunga*
7	*Neotrygon orientalis*	Oriental blue spotted mask ray	*Pari bintik biru*
8	*Pastinachus gracillicaudus*	Narrow cowtail ray	*Pari daun*
9	*Pastinachus solocirostris*	Roughnosecowtail ray	*Pari daun*
10	*Rhinoptera javanica*	Javan cownose ray	*Pari susun*
11	*Rhynchobatus australiae*	Bottlenose wedgefish	*Yu kemejan*
12	*Taeniura lymma*	Bluespotted fantail ray	*Pari batu*
13	*Telatrygon zugei*	Pale-edge sharpnose ray	*Pari ketuka*
14	*Rhina ancylostoma*	Shark ray	*Pari yu*
15	*Mobula japanica*	Giant devil ray	*Pari hantu*
16	*Mobula kuhlii*	Kuhl's devil ray	*Pari hantu*

as a whole at the landing centres. The wholesale price of fresh shark ranged from RM3/kg to RM4/kg and the retail price ranged from RM10/kg to RM20/kg. The wholesale price of the dried salted shark meat was around RM20/kg. At the same time, the retail price of dried shark meat ranged from RM40/kg to RM50/kg. The sun-dried shark fin retail price ranged from RM700/kg to RM2,200/kg. The retail price of dried shark cartilage ranged from 200/kg. The shark jaw price ranged from RM50-100 per piece. The fresh ray wholesale and retail fresh ray prices ranged from RM 10 to RM30/kg. Meanwhile, the sun-dried salted ray meat ranged from RM50 to RM70/kg. The ray skins were sold at an average price of RM3,000 per box to a skin collector in Kuala Lumpur before exporting to Thailand to make bags and accessories. Comparing the prices in the study by Ahmad *et al.* (2004) and Abdul Haris *et al.* (2017), sharks'pricese remain similar to 2004 but ray prices increased significantly in recent years as the species were higher in demand. Most fresh sharks and rays were marketed domestically, while the dried fins and cartilage were mostly imported from Thailand.

Exploratory Factor Analysis (EFA) Results

The detailed results of the Exploratory Factor Analysis (EFA) are presented in the Appendix. In identifying the indicators, the Varimax Rotation Matrix (VRM) was chosen to produce the factors, and the Principal Component Analysis (PCA) was used to extract factors and reduce data by classifying the variables into factors within the construct (Williams *et al*., 2010; Hadi *et al*., 2016; Field, 2018; Taherdoost *et al*., 2020). This section describes 21 identified indicators based on four dimensions: Shark and ray resources, regulatory compliance and collaboration effort, commitment and skills, and information technology infrastructure.

Shark and Ray Resources

The PCA extracted five factors with 14 variables, which accounted for a total variance of 76.41%. All factors had Eigen values greater than 1.0 and ranged from 1.01 to 3.79, indicating that each factor explained a meaningful amount of variance in the data. The scree plot also suggested that five predominant factors were appropriate to be retained, as shown in Figure 1.

Factor 1

The first factor is labelled "Demand and contribution to livelihood", consisting of six variables that explain 27.04% of the variance in the data set. This factor suggests that it is crucial to consider the demand for shark and ray products, their contributions to household income, and their potential to determine the importance of the shark and ray industry and justify implementing a traceability system in Pahang.

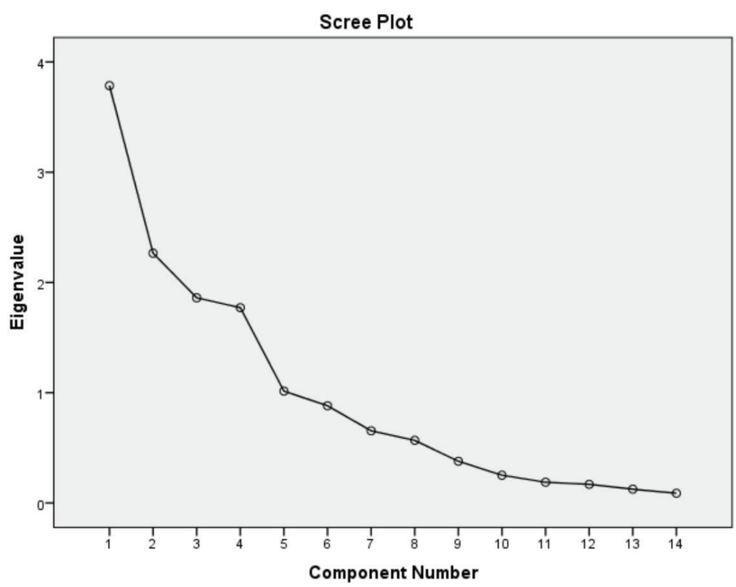

Figure 1: Scree plot for shark and ray resources dimension

The intermediaries perceived that the demand for shark and ray products is increasing, with mean scores of 3.40 and 2.95, respectively. The qualitative studies conducted in Perak, Sabah and Sarawak also suggested that the market demand for sharks and rays was relatively strong but limited supply (Fatimah *et al*., 2017; Ahmad S *et al.,* 2018; 2019a; 2019b). However, the respondents perceived that the contributions of shark and ray products as a main source of income were low, with mean scores of 2.50 and 2.86, respectively. Regarding future prospects, intermediaries had divided opinions on the good future of ray products, with a mean score of 3.12, compared to shark products, which only received a mean score of 2.81.

Factor 2

The second factor is labelled "Product supply," consisting of two variables that account for 16.18% of the variance in the data set. Almost all intermediaries stated that shark and ray products were supplied from domestic markets, with mean scores of 3.95 and 4.00, respectively.

Factor 3

The third factor is labelled "Product utilisation", consisting of two variables that account for 13.29% of the variance in the data set. The intermediaries agreed that the shark and ray resources were processed to many types of products, with mean scores of 3.48 and 3.40, respectively. Sharks were mostly marketed as fresh meat, sun-dried and salted meat. Sharks' jaws and teeth were also sold as souvenirs. Discarded parts or offal, such as the head and internal organs, were used for baits, fertilisers, and cartilage for medical purposes and in cuisine. These findings are consistent with the studies conducted by Ahmad *et al.* (2004), Abdul Haris *et al.* (2017), and Ahmad S *et al.* (2019a). However, the utilisation was not as diverse as listed in Indonesia, including shark liver oil and live sharks for aquarium exhibition and tourism (Booth *et al*., 2018; MMAF, 2019; Ichsan *et al.*, 2019).

Factor 4

The fourth factor is labelled "Declining resources", consisting of two variables that account for 12.65% of the variance in the data set. Most intermediaries suggested that shark and ray resources have declined over the last five years, with mean scores of 4.05 and 3.88, respectively. This supports the decline of the shark and ray landings data in Pahang between 2010 (2,506 mt) and 2019 (1,472 mt) (DOF, 2020).

Factor 5

The fifth factor is called "Product market" and consists of two variables that account for 7.25% of the variance in the data set. Most intermediaries agreed that shark and ray products were marketed domestically, with mean scores of 3.79 and 3.83, respectively. This aligns with the previous findings that Malaysia is not a major exporter globally (Dent & Clarke, 2015; Fatimah *et al*., 2017; Okes & Sant, 2019).

The declining resources and economic potential indicators can be justified by implementing a traceability system as recommended by many studies that the system provides the catch statistics information towards sustainable fisheries (Borit & Olsen, 2013; 2016; 2020; Bräutigam *et al.,* 2016; Bailey *et al.,* 2016; FAO, 2017; Hosch & Blaha, 2017; Hardt *et al*., 2017; FAO, 2018; He, 2018; Olsen & Borit, 2018; Fox *et al*., 2019; Virdin *et al*., 2022).

Product supply and market factors support the recommendation by previous studies that identifying the supply chain of the product from the point of harvest to the end of export is needed to improve data collection for sustainable utilisation. In addition, the product utilisation factor is important as each product type needs to be assigned a unique code for traceability recording and reporting purposes at every stage throughout the product supply chain. It also can provide a basis for the level of complexity of the traceability system implementation (NPOA,

Table 4: Shark and ray resources dimension

Statement		Percentage (%)					Mean
		1	2	3	4	5	
Factor 1: Demand and contribution to livelihood							
C120	The future of ray product trades is good.	0	42.9	7.1	45.2	4.8	3.12
C18	The demand for ray products is increasing	2.4	26.2	9.5	52.4	9.5	3.40
C118	Ray products are your main source of income.	2.4	54.8	0	40.5	2.4	2.86
C119	The future of shark product trades is good.	0	57.1	7.1	33.3	2.4	2.81
C17	The demand for shark products is increasing.	2.4	42.9	16.7	33.3	4.8	2.95
C117	Shark products are your main source of income.	2.4	71.4	0	26.2	0	2.50
Factor 2: Product supply							
C113	Shark products supply obtained from Malaysia.	0	2.4	0	92.9	4.8	4.00
C114	Ray products supply obtained from Malaysia.	0	4.8	0	90.5	4.8	3.95
Factor 3: Product utilisation							
C124	Shark can be processed to other type of products.	0	23.8	7.1	66.7	2.4	3.48
C123	Ray can be processed to other type of products.	0	26.2	9.5	61.9	2.4	3.40
Factor 4: Declining resources							
C13R	Compared to 5 years ago, shark resources are declining.	0	7.1	4.8	64.3	23.8	4.05
C12R	Compared to 5 years ago, ray resources are declining.	0	14.3	7.1	54.8	23.8	3.88
Factor 5: Product market							
C115	Shark products are marketed only within in Malaysia	0	11.9	0	85.7	2.4	3.79
C116	Ray products are marketed only within in Malaysia	0	9.5	0	88.1	2.4	3.83

Note: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree,5 = Strongly Agree.

2006; 2014, Lehr, 2015; Mundy & Sant, 2015; Ahmad *et al.,* 2019a).

Regulatory Compliance and Collaboration Effort

The PCA extracted four factors with eight variables, which accounted for a total variance of 76.73%. All factors had Eigenvalues above 1.0 and ranged from 1.08 to 2.93, indicating that each factor explained a meaningful amount of variance in the data. The scree plot also suggested that four predominant factors should be retained appropriately, as shown in Figure 2.

Factor 1

The first factor is named "Enforcement by authorities" and consists of two variables that account for 32.58% of the variance in the data set. The data shows that enforcement and active monitoring by the authorities are important in implementing a traceability system. However, the intermediaries have divided opinions on whether the authorities carry out their duties justly and fairly, with a mean score of 3.0. They also perceived that the officers did not actively enforce the regulatory requirements for shark and ray products, with a mean score of 2.98.

Figure 2: Scree plot for regulatory compliance and collaboration effort dimension

Factor 2

The second factor, "Conservation management and sustainable utilisation" comprises two variables explaining 18.52% of the variance in the data set. The data suggest that the intermediaries' understanding of the importance of conservation management and sustainable utilisation of shark and ray resources is crucial for supporting the implementation of traceability systems. The intermediaries perceived both variables as important, with mean scores of 3.86 and 3.83, respectively.

Factor 3

The third factor, "Cooperation and trust", explains 13.55% of the variance in the data set and consists of two variables. The data suggests that cooperation and trust between industry players are crucial for implementing a traceability system that provides accurate information. The intermediaries reported good levels of collaboration and trust between each other in providing precise information, with mean scores of 3.79 and 3.62, respectively.

Factor 4

The fourth factor is called "Collaboration and enforcement" and accounts for 11.97% of the variance in the dataset. The data suggests that cooperation between industry players and authorities and efficient enforcement by the authorities are important in implementing a traceability system. Most intermediaries perceived that they cooperated well with authorities, with a mean score of 3.9. In addition, they generally suggested that enforcement was done effectively, with a mean score of 3.34.

In summary, these four indicators support the previous studies that regulatory compliance and good collaboration with frequent audits in traceability system implementation are necessary to minimise fraud in supply chain activities. Furthermore, the intermediary's understanding of the importance of conservation management and sustainable utilisation of the resources towards a balanced ecosystem and food security are important factors concerning traceability system implementation (Bräutigam *et al.,* 2015; Bailey *et al.,* 2016; Borit & Olsen,

Table 5: Regulatory compliance and collaboration effort dimension

Statement		Percentage (%)					Mean
		1	2	3	4	5	
Factor 1: Enforcement by authorities							
C311	Enforcement on shark and ray endangered species are conducted justly and fairly.	0	38.1	23.8	38.1	0	3.00
C310	Relevant agencies conduct active enforcement of rules and regulations regarding sharks and rays.	0	42.9	19	35.7	2.4	2.98
Factor 2: Conservation management and sustainable utilisation							
C312	Management of conservation of shark and ray resources is important to assure the balance of the ecosystem.	0	2.4	9.5	88.1	0	3.86
C313	Sustainable utilisation of shark and ray resources is important to guarantee future supply.	0	4.8	9.5	83.3	2.4	3.83
Factor 3: Cooperation and trust							
C33	Cooperation within the industry players is good.	0	9.5	4.8	83.3	2.4	3.79
C34	Information given between supplier and buyer is correct and trustworthy.	0	16.7	4.8	78.6	0	3.62
Factor 4: Collaboration and enforcement							
C32	You have good cooperation with relevant agencies.	0	4.8	4.8	85.7	4.8	3.90
C35	Relevant agencies do their enforcement and work efficiently.	0	31.0	2.4	66.7	0	3.34

Note: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree,5 = Strongly Agree

2016; 2020, Duan *et al.,* 2017; Hardt *et al.*, 2017; Hosch & Blaha, 2017; André, 2018; Khan *et al.,* 2018; USAID, 2020; Virdin *et al.,* 2022).

Commitment and Skills

The PCA extracted five factors with 14 variables, which accounted for a total variance of 71.24%. All factors had Eigenvalues above 1.0 and ranged from 1.16 to 3.96, indicating that each factor explained a meaningful amount of variance in the data. The scree plot also suggested that five predominant factors were appropriate to be retained as shown in Figure 3.

Factor 1

The first factor identified as "Awareness and commitment" comprises six variables that explain 28.27% of the variance in the data set. The findings suggest that awareness programs and exposure to shark and ray products are important in increasing knowledge. Commitment to record supply chain data is also crucial for implementing a traceability system. Most intermediaries perceived awareness programs, posters, information spread through social media, and exposure to identifying shark and ray products as important in increasing knowledge,

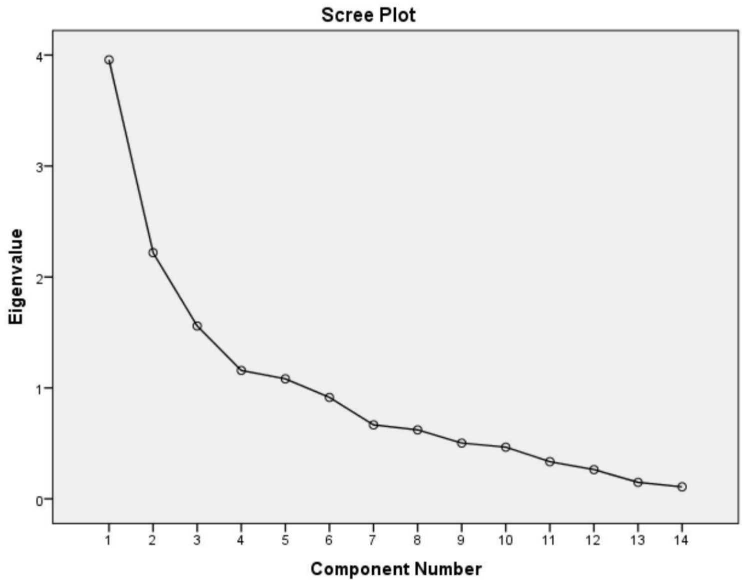

Figure 3: Scree plot for commitment and skills dimension

with mean scores ranging from 3.55 to 3.93. However, only 64.2% agreed to participate in recording the supply chain information of shark and ray products, with a mean score of 3.43.

Factor 2

"Understanding of regulatory requirements" comprises two variables and explains 15.85% of the variance in the data set. The data suggests that understanding regulatory requirements is crucial for successful traceability implementation. However, the intermediaries have divided their agreement and perceived that their understanding regarding banning capturing and selling shark and ray endangered species was still lacking, with mean scores of 3.24 and 3.10, respectively. They also mentioned that they were not well versed with the acts and regulations related to shark and ray species for conservation purposes, but they were very familiar with turtle species.

Factor 3

This factor is called "Willingness to participation" and consists of two variables that explain 11.13% of the variance in the data set. Most intermediaries (81%) agreed to provide accurate information with a mean score of 3.76, while 64.2% expressed a willingness to participate in awareness programs organised by the authorities, with a mean score of 3.43.

Factor 4

The fourth factor, "Species and product identification", comprises two variables and explains 8.27% of the variance in the data set. The results indicate that accurately identifying shark and ray products by species and type is crucial for implementing a traceability system. Most respondents reported having no difficulty identifying shark and ray products by species, with a mean score of 3.86. They also demonstrated awareness of the various types of shark and ray products traded in the market, with a mean score of 3.60.

Factor 5

The fifth factor, "Endangered species identification and incentive," comprises two variables and explains 7.73% of the variance in the data set. The data suggests that identifying endangered species and providing incentives are crucial for implementing a traceability system. However, the data shows that over half of the respondents (54.7%) reported difficulty identifying CITES-listed endangered shark and ray species, with a mean score of 3.17. This finding supports the opinions of experts who suggested that it can be quite challenging to identify endangered species after they have been processed or cut (Roba'a *et al*., 2022a)

Only 38.1% agreed that incentives could motivate them to provide traceability information, with a mean score of 2.9. According to them, the current amount given by the government is very minimal (10 cents for every kilogram of catch declared and limited to certain intermediaries only).

Table 6: Commitment and skills dimension

Statement		Percentage (%)					Mean
		1	2	3	4	5	
Factor 1: Awareness and commitment							
C24	Informative posters regarding shark and ray endangered species may provide more knowledge.	0	9.5	2.4	73.8	14.3	3.93
C29	Shark and ray awareness programs are important.	0	11.9	0	88.1	0	3.76
C217	You will participate if activity for supply chain information of shark and ray product recording is arranged.	0	33.3	9.5	57.1	7.1	3.43
C28	Awareness programs regarding sharks and rays can increase your knowledge.	0	7.1	0	92.9	0	3.86
C25	Information spread through social media regarding shark and ray endangered species may increase your knowledge.	0	21.4	2.4	64.3	11.9	3.67
C216	Exposure to identify types of shark and ray products traded in the market is important.	0	19	7.1	73.8	0	3.55
Factor 2: Understanding of regulatory requirement							
C21R	The banning of capturing shark and ray endangered species is unclear.	2.4	35.7	2.4	54.8	4.8	3.24
C22R	The banning of selling shark and ray endangered species is unclear.	2.4	42.9	0	52.4	2.4	3.10
Factor 3: Willingness to participation							
C27	You will consider joining awareness programs on shark and ray if proposed by involved agencies.	0	28.6	7.1	57.1	7.1	3.43
C211	You will work together to give accurate information regarding shark and ray products.	0	7.1	11.9	78.6	2.4	3.76
Factor 4: Species and product identification							
C215	You can identify types of shark and ray products marketed.	0	16.7	7.1	76.2	0	3.60
C213	Identifying shark and ray products based on species is easy.	0	7.1	0	92.9	0	3.86
Factor 5: Incentive							
C214R	Identifying shark and ray products based on endangered species is not easy.	0	45.2	0	47.6	7.1	3.17
C212	You will only give information if there is an incentive involved.	0	50	11.9	35.7	2.4	2.9

Note: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

The identified indicators which include knowledge, skills and commitment from relevant stakeholders as among the essential factors in ensuring the successful traceability system implementation, support the findings of previous studies (Brautigam *et al.*, 2015; Dent & Clarke, 2015; Bailey *et al.,* 2016; André, 2018; Shankar *et al.,* 2018; Corralo *et al.,* 2020; Rao *et al.,* 2022).

Regarding incentives, however, this finding contradicts the results of previous studies conducted by Pincinato *et al*. (2022), Lee and Viswanathan (2019), Islam *et al.* (2016), and Roba'a *et al*. 2022b, where incentives were identified as motivators for providing traceability information.

Information Technology Infrastructure

The PCA extracted eight factors with 21 variables, which accounted for a total variance of 76.10%. The Eigenvalues for all factors were above 1.0 and ranged from 1.14 to 6.11, indicating that each factor explained a meaningful amount of variance in the data. The scree plot also suggested that eight predominant factors should be retained appropriately, as shown in Appendix - Figure 4.

Factor 1

The "adequate facilities" factor, consisting of five variables, explains 24.42% of the variance in the dataset. The data suggests that having adequate facilities such as landing jetties, data collection centres, and marketplaces is crucial for implementing the traceability system. The intermediaries perceived that the facilities were satisfactory in supporting the traceability system implementation, with mean scores ranging from 3.35 to 3.49. Above all, they were generally satisfied with the facilities provided by the government authorities, namely administrative buildings, fish landing centres, data landing declaration centres, and wet markets.

Factor 2

This factor is labelled "user-friendly traceability system" and comprises three variables, explaining 14.38% of the variance in the dataset. The data suggests that a user-friendly, easily accessible, and up-to-date information system design is crucial for successful traceability system implementation. The intermediaries reported agreeing that the information system design should meet these requirements, as evidenced by the mean scores ranging from 3.71 to 3.79.

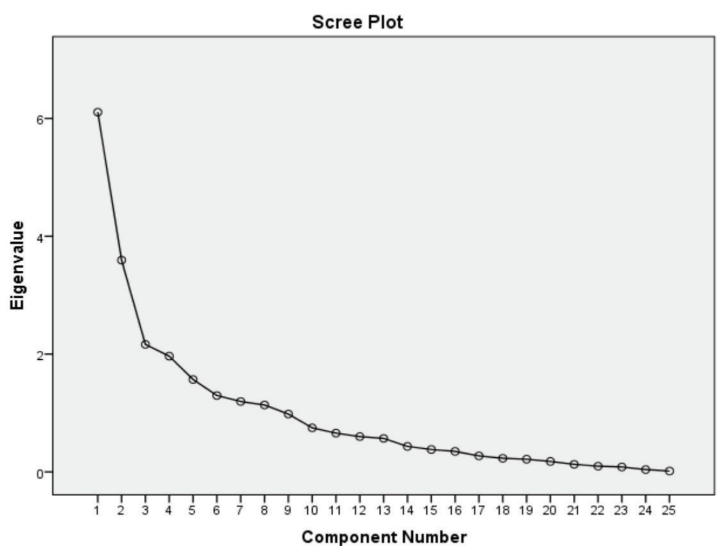

Figure 4: Scree plot for information technology infrastructure dimension

Factor 3

This factor, "benefits and labelling", consists of three variables that account for 8.66% of the variance in the data set. The data suggests that intermediaries' belief in the traceability system's benefits and willingness to provide and record supply chain information and label products at every stage of the process are crucial factors in the successful implementation of the traceability system. While the intermediaries generally agreed to provide and record supply chain information with a mean score of 3.43, there was a divided opinion on the importance of the traceability system and labelling the products at every stage of the supply chain activities, with mean scores of 3.24 and 3.12, respectively. This finding suggests that this divided acceptance was due to a lack of understanding of the benefits or rewards of traceability implementations.

Factor 4

The factor is called "species-specific reporting" and consists of two variables that explain 7.86% of the variance in the data set. The data suggests that ensuring legal trade and species-specific recording of products are important for implementing a traceability system. While intermediaries supported the importance of providing legally traded products with a mean score of 3.76, they were divided in their opinion regarding the need to record products up to the species-specific level, with a mean score of 2.95. They only record the species up to general shark and ray species.

Factor 5

The factor named "transparent data communication" consists of two variables and explains 6.28% of the variance in the data set. The data suggests that intermediaries' support in recording and sharing accurate information with authorities at each stage along the supply chain is important for implementing a traceability system. Generally, intermediaries agreed to record and share accurate information with authorities, with mean scores of 3.21 and 3.69, respectively.

Factor 6

The factor named "buys-in and support" consists of three variables and explains 5.18% of the variance in the data set. The data shows that the difficulty in recording traceability information and the additional cost and time required to record supply chain information are important factors to consider when implementing a traceability system. The intermediaries were divided in their agreement that they had difficulty and needed extra time to record the information, with mean scores of 2.98 and 3.10, respectively. Only 38% agreed that the recording process requires additional cost, with a mean score of 2.76. Currently, they do not require major additional fees to be invested in the system implementation as the current business already has the necessary hardware to support the system, such as a computer or smartphone.

Factors 7 and 8 are named "user-friendly data recording", consisting of two variables with 4.78% and one with 4.54% of the variance in the data set, respectively. The data suggests that data recording and reporting up to the product type are important in implementing a traceability system. Intermediaries suggested that manual reporting, such as logbooks, would be easier than digital reporting, with a mean score of 3.81 and 2.57, respectively. They were divided in their agreement to report product movement up to the product type along the supply chain activities, with a mean score of 2.98, as according to them, the products involved are in small quantities as compared to other marine products.

The identified factors from this dimension support the findings from previous studies by Rao *et al.* (2022), Borit and Olsen (2020), Khan *et al.* (2018), Shankar *et al.* (2018), USAID (2018), Dent and Clarke (2015), and Mundy and Sant (2015). However, their divided commitment to record each product type up to species-specific and share traceability information may challenge the implementation of the traceability system. An effective system requires Unique Identifications (UIs) for each

Table 7: Information technology infrastructure

Statement		Percentage (%)					Mean
		1	2	3	4	5	
Factor 1: Adequate facilities							
C41	Administrative building for data collection is satisfactory.	0	21.4	11.9	64.3	0	3.35
C43	Jetty/building (Landing centres) infrastructure provided by relevant agencies is satisfactory.	0	26.2	4.8	69	0	3.43
C42	Facility (Ice/cold room/crane) provided at the jetty/buildings is satisfactory.	0	23.8	9.5	66.7	0	3.49
C44	Facility (Crane etc.) provided at the jetty/buildings by relevant agencies is satisfactory.	0	28.6	7.1	64.3	0	3.43
C45	Marketplace provided is satisfactory.	0	21.4	11.9	64.3	2.4	3.48
Factor 2: User friendly traceability system							
C419	User-friendly system is important for you.	0	9.5	7.1	83.3	0	3.74
C421	Information systems on sharks and rays by relevant agencies must be easily accessible.	0	9.5	9.5	81	0	3.71
C420	Information systems on sharks and rays by relevant agencies must be updated and current.	0	7.1	7.1	85.7	0	3.79
Factor 3: Benefits and labelling							
C430	Effective supply chain traceability for shark and ray products is important to you.	0	40.5	0	54.8	4.8	3.24
C410	To provide and record relevant supply chain information regarding shark and ray is important.	0	28.6	2.4	66.7	2.4	3.43
C425	Shark and ray product sold must be labelled at every stage of each process.	0	42.9	2.4	54.8	0	3.12
Factor 4: Species-specific reporting							
C429	Ensuring the products legally traded is important.	0	11.9	2.4	83.3	2.4	3.76
C422	Information systems regarding sharks and ray products must be recorded up to species level.	2.4	47.6	2.4	47.6	0	2.95
Factor 5: Transparent data communication							
C428	Every activity in the supply chain must be recorded at every stage.	0	2.4	35.7	61.9	0	3.21
C427	Supply chain information systems must be shared to relevant stakeholders	0	11.9	7.1	81	0	3.69

Factor 6: Buys-in and support							
C416R	Information recording process regarding shark and ray products are difficult.	0	50	2.4	47.6	0	2.98
C417R	Information recording process regarding shark and ray products waste your time.	0	45.2	0	54.8	0	3.10
C418R	Information recording process regarding shark and ray products needs extra cost.	0	61.9	0	38.1	0	2.76
Factor 7: User friendly data recording							
C414	Digital recording information is easy.	0	71.4	0	28.6	0	2.57
C423	Information systems regarding shark and ray products must be recorded up to the product types.	2.4	45.2	4.8	47.6	0	2.98
Factor 8: User friendly data recording							
C415	Recording information manually (logbook) is easy.	0	9.5	0	90.5	0	3.81

species within the supply chain and continuous data acquiring and sharing among stakeholders is crucial in traceability system implementation (EU, 2014; Lehr, 2015; 2016; Mundy & Sant, 2015; Hosch & Blaha, 2017; André, 2018; GDST, 2020; USAID, 2018; 2020).

Conclusions

In conclusion, there are 21 identified indicators for the implementation of a traceability system for shark and ray products among intermediaries in Pahang, which was based on four dimensions:

(1) Shark and ray resources
- (i) Demand and contribution to livelihood
- (ii) Product supply
- (iii) Product utilisation
- (iv) Declining resources
- (v) Product market

(2) Regulatory compliance and collaboration effort
- (i) Enforcement by authorities
- (ii) Conservation management and sustainable utilisation
- (iii) Cooperation and trust
- (iv) Collaboration and enforcement

(3) Commitment and skills
- (i) Awareness and commitment
- (ii) Understanding of regulatory requirement
- (iii) Willingness to participation
- (iv) Species and product identification
- (v) Incentive

(4) Information technology infrastructure
- (i) Adequate facilities
- (ii) User friendly traceability system
- (iii) Benefits and labelling
- (iv) Species-specific reporting
- (v) Transparent data communication
- (vi) Buys-in and support
- (vii) User-friendly data recording

Based on these indicators, several improvements should be considered to achieve effective traceability system implementation in Pahang, Malaysia. Government intervention is necessary to enable intermediaries to upgrade their products' quality and safety to support sustainable resources for future generations. Awareness and education programs including relevant acts and regulations should be conducted to raise appreciation and understanding of the importance of sharks and rays simultaneously to reduce current demand. Offering online programs can minimise the physical effort, time and money required for participation. Proper strategy and buy-in are important to training the intermediaries to accurately label and record products at all stages of the processes. The government should explore adequate human resources and DNA tools for audits and enforcement duties.

The government also to review whether to include the recent CITES-listed endangered species in Malaysia's current International Trade in Endangered Species Act 2008, the Federal Fisheries 1985 Act and the Control of Endangered Species of Fish Regulations 1999. This is to ensure sustainable utilisation and trade of these products as few CITES-listed endangered species were caught and traded in Pahang.

Policymakers should also strengthen acts and regulations by enforcing compulsory registration and licensing of intermediaries involved in the shark and ray product supply chain. This will improve regulation compliance, statistics, and socio-cultural and environmental considerations. Stricter enforcement should be exercised to avoid illegal business transactions of CITES-listed species. Compulsory declaration of species and product types should be implemented throughout the supply chain. Financial support, such as incentives or subsidies, should be provided to encourage participation in the implementation of the traceability system.

The government should propose a suitable strategy to motivate relevant stakeholders, emphasising the benefits of a traceability system. They also should review the type of information that can be shared in the traceability system. This information is crucial for statistical purposes in the sustainability management of resources and contributes to food security by preventing the extinction of shark and ray species.

Above all, support and collaboration from all stakeholders, including government authorities and industry players, are essential for a successful traceability system. Active participation, frequent engagement, and consultations should be promoted to foster strong collaborative partnerships. Securing the resources will support legal and sustainable shark fisheries and trade.

Future Research

The developed questionnaires can be customised and used for future research by other stakeholders, including hoteliers, restaurateurs, consumers, and the public, as their roles and responsibilities are crucial in ensuring the sustainable utilisation of the shark and ray resources. In addition, future studies on traceability should also be extended to other species or locations for comparable studies. A pilot study for the traceability system implementation for shark and ray products can be done in other major shark and ray producers such as Sabah, Perak, or Sarawak with the inclusion of species-specific and type-specific recording for shark and ray products from harvesting to domestic and export markets.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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Appendices

Appendix 1: EFA results on shark and ray resources dimension

Factor/Variable	Factor Loading				
	F1	F2	F3	F4	F5
Factor 1. Product economic potentials					
C120. The future of ray product trades is good.	.870				
C18. Ray products demand is increasing.	.766				
C118. Ray products are your main source of income.	.764				
C119. The future of the shark product trade is good.	.762				
C17. Shark product demand is increasing.	.664				
C117. Shark products are your main source of income.	.602				
Factor 2. Products supply					
C113. Shark products supply obtained from Malaysia.		.913			
C114. Ray products supply obtained from Malaysia.		.890			
Factor 3. Resources utilisation					
C124.Ray can be processed into many types of products.			.942		
C123.Sharks can be processed into many types of products.			.925		
Factor 4. Declining resources					
C13R. Ray's resources have been decreasing for the last 5 years.				.805	
C12R. Shark resources have been decreasing for the last 5 years.				.757	
Factor 5. Products market					
C115. Shark products are marketed only in Malaysia.					.935
C116. Ray products are marketed only in Malaysia.					.867
Eigenvalues	3.79	2.27	1.86	1.77	1.01
% Variance	27.04	16.18	13.29	12.65	7.25
% Cumulative variance	27.04	43.22	56.51	69.16	76.41

Appendix 2: EFA results on regulatory compliance and collaboration effort dimension

Factors/Variables	Factor loading			
	F1	**F2**	**F3**	**F4**
Factor 1: Enforcement by authorities				
Enforcement of shark and ray endangered species is conducted justly and fairly.	.961			
Relevant authorities conduct active enforcement of rules and regulations regarding sharks and rays.	.942			
Factor 2: Conservation management and sustainable utilisation				
Management of shark and ray resource conservation is important to ensure the balance of the ecosystem.		.901		
Sustainable utilisation of shark and ray resources is important to guarantee future supply.		.871		
Factor 3: Cooperation and Trust				
Cooperation among the industry players is good.			.879	
Information given between supplier and buyer is correct and trustworthy.			.825	
Factor 4: Collaboration and enforcement				
You have good cooperation with relevant agencies.				.841
Relevant authorities do their enforcement and work efficiently.				.607
Eigenvalues	2.93	1.67	1.22	1.08
% Variance	32.58	18.52	13.55	11.97
% Cumulative variance	32.58	51.10	64.66	76.63

Appendix 3: EFA results of commitment and skills dimension

Variable/Factor	Factor Loading				
	F1	**F2**	**F3**	**F4**	**F5**
Factor 1: Awareness and commitment					
C24. Informative posters regarding shark and ray endangered species may provide more knowledge	.697				
C29. Shark and ray awareness programs are important	.692				
C217. You will participate in an activity to gather supply chain information on shark and ray product recordings.	.645				
C28. Awareness programs regarding sharks and rays can increase your knowledge	.604				
C25. Information spread through social media regarding shark and ray endangered species may increase your knowledge.	.599				
C216. Exposure to identify types of shark and ray products within the market is important.	.581				
Factor 2: Understanding of regulatory requirement					
C21R. The act banning capturing sharks and ray endangered species is unclear.		.910			
C22R. The act/regulation on the banning of selling shark and ray endangered species is unclear.		.903			
Factor 3: Willingness to participation					
C27. You will consider joining awareness programs on sharks and rays if proposed by involved agencies.			.832		
C211. You will work together to give accurate information regarding shark and ray products.			.777		
Factor 4: Species and product identification					
C215. You can identify types of shark and ray products marketed.				.864	
C213. Identifying shark and ray products based on species is easy.				.591	
Factor 5: Incentive					
C214R. Identifying shark and ray products based on endangered species is not easy.					.795
C212. You will only give information if there is an incentive involved.					.676
Eigenvalues	3.96	2.22	1.56	1.16	1.08
% Variance	28.27	15.85	11.13	8.27	7.73
% Cumulative variance	28.27	44.12	55.25	63.52	71.24

Appendix 4: EFA results for information technology infrastructure dimension

Factors/Variables	Factor Loading							
	F1	F2	F3	F4	F5	F6	F7	F8
Factor 1: Adequate Facilities								
C41.Administrative building infrastructure is satisfactory.	.890							
C43.Jetty/Building (Landing centres) infrastructure provided by relevant agencies is satisfactory.	.887							
C42.Facility (Ice/cold room) provided at the jetty/buildings is satisfactory.	.823							
C44.Facility (Crane) provided at the jetty/buildings by relevant agencies is satisfactory.	.787							
C45.Marketplace provided is satisfactory.	.665							
Factor 2: User-friendly traceability system								
C419.User-friendly system is important for you.		.954						
C421.Information systems on sharks and rays by relevant agencies must be easily accessible.		.953						
C420.Information systems on sharks and rays by relevant agencies must be updated and current.		.888						
Factor 3: Benefits and labelling								
C430.Effective supply chain traceability for shark and ray products is important to you.			.784					
C410.Provide and record relevant supply chain information regarding sharks and rays is important.			.744					
C425.Shark and ray products sold must be labelled at every process stage.			.641					
Factor 4: Species-specific reporting								
C429.Ensuring the products are legally traded is important.				.776				
C422.Information systems regarding sharks and ray products must be recorded up to species level.				.752				

Factor 5: Transparent data communication								
C428.Every activity in the supply chain must be recorded at every stage.					.831			
C427.Supply chain information systems must be shared with all important agencies.					.577			
Factor 6: Buys in and support								
C416R.Information recording process regarding shark and ray products is easy.						.805		
C417R.Information recording process regarding shark and ray products did not waste your time.						.736		
C418R.Information recording process regarding shark and ray products did not need extra cost.						.633		
Factor 7: User-friendly data recording								
C414.Digitally recording information is easy.							.691	
C423.Information systems regarding shark and ray products must be recorded up to the product types.							.626	
Factor 8: User-friendly data recording								
C415. Recording information manually (logbook) is easy.								.775
Eigenvalues	6.11	3.59	2.16	1.96	1.57	1.30	1.20	1.14
% Variance	24.42	14.38	8.66	7.86	6.28	5.18	4.78	4.54
% Cumulative variance	24.42	38.80	47.46	55.31	61.59	66.77	71.55	76.10