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Mapping Risks of Indonesian Tuna Supply Chain

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Abstract. Due to its high economic value and is produced by many countries, Tuna is considered as one of the world's popular fish. Demand for Tuna species are very high and it usually sells in three form: fresh, frozen or canned. Competition in Tuna trading is challengin with the potential risk of price and supply fluctuations. With recent focus of Indonesia government that see the future of Indonesia civilization depend on the oceans and as the three biggest Tuna producing country, Ministry of Marine Affairs and Fisheries should ensure sustainability and competitiveness of Indonesian tuna. Therefore, there is a great need to develop a proper and effective strategy to manage potential risks in Indonesian Tuna supply chain. This paper is aimed at identifying and mapping potential Tuna supply chain risks and its interrelationships that would assist government in determining proper strategies to manage Indonesian Tuna. A framework for identifying Tuna supply chain risks is proposed. Generic risk structure of Supply Chain Risk Identification System is adopted and modified to match with particular object, which is Indonesian Tuna. The proposed model consists of hierarchical and causal structure that encompass potential risks of Tuna supply chain operations from fishing, trading, processing and distribution. The causal structure consist of risk events and its risk agents which is the cause of risk events. To ensure the root cause of risk events are identified properly, five why's analysis is utilized to obtain risk agents. This proposed model also captures risk interrelationship between internal and external environment of Tuna supply chain. Preliminary result of this study identifies 15 risk events and 13 risk factors on fishing and trading operations and maps their interrelationships.

1. Introduction

Indonesian Government has a vision to set the oceans, the seas, the straits and the bays as the future of Indonesia civilization. In the next five years, Ministry of Marine Affairs and Fisheries (MMAF) of Indonesia plan "to achieve sovereign, independent and sustainable management of marine and fisheries resources for the people's prosperity". Strategic plan of MMAF is based on three pillars they are: sovereignty, sustainability and prosperity. One of MMAF target is to increase Gross Domestic Product for fisheries sector to 12% on 2019. However, there are many challenges for MMAF to achieve its target. Some of the problems are as follows: illegal, unreported and unregulated fishing, unresolved maritime territorial, lack of clear zoning regulations, low competitiveness and quality of fisheries products.

Therefore, MMAF is aiming to optimize marine resources management and improve fisheries competiveness and sustainability [1] [2] [3] [4].

Fish is not only important sources of food, many people also depend heavily on fisheries as source of their income. There are many stakeholders involved in Indonesian fisheries, from fishermen, traders, processing industries, distributors, retailers, to end of customers. To secure its competitiveness, Indonesian fisheries stakeholders (supply chain players) should be managed effectively. Furthermore, any undesire events which could make negative impact to competitiveness of Indonesian fisheries supply chain should be identified and managed properly. Therefore, supply chain risk management (SCRM) approach is required to support MMAF in accomplishing their goal. In general, SCRM consists of four steps, namely: risk identification, risk analysis, risk evaluation and risk treatment.

Tuna, shrimp and crab are top three Indonesia's capture fisheries products [1]. Tuna is considered as one of the world's popular fish which has a high economic value [5]. Majority of tuna species in international market are Skipjack tuna (Katsuwonus pelamis), Bigeye tuna (Thunnus obesus), Yellowfin tuna (Thunnus albacares), Albacore tuna (Thunnus alalunga), North Atlantic bluefin tuna (Thunnus thynnus), Pacific bluefin tuna (Thunnus thynnus orientalis) and Southern bluefin tuna (Thunnus maccoyii). Tuna is produced by approximately 70 countries. Positions of Indonesia, which is surrounded by Indian and Pasific Ocean, provides proper environment for tuna stock. Thus, it makes Indonesia as the largest tuna producing nations [6]. Most of Indonesia tuna catch is from Western Central Pacific Ocean and the rest is from Eastern Indian Ocean. In 2014, Indonesia has the biggest tuna landing for more than 600.000 metric tonnes (MT), then follows by Japan and Taiwan [7]. Skipjack and Yellow fin are two major species of tuna that mainly caught in Indonesia. Most of Tuna catch in Indonesia goes to further process domestically such as canneries or cured methods such as smoked, dried and salted. Small proportion of Tuna catch goes to domestic fresh markets and the smallest portion are exported to overseas canneries industries as loins [7]. As the largest tuna landing nation and the importance of Tuna in Indonesian fisheries, it is critical for MMAF to have a effective strategy to ensure sustainability and competitiveness of Indonesian tuna. For that reason, this research is aiming at developing strategy to manage potential risks in Indonesian Tuna supply chain. While, the focus of this paper is the first step of SCRM, that is to identify and provide a list of potential SC risks so it would guide MMAF in determining proper risk treatment strategies.

Study about Indonesian Tuna supply chain is not new but only few available, as can be seen in [8], [9], [10], and [11]. However, there is fewer number of research on managing risk of Indonesian Tuna supply chain [12] develops a model for managing risk in Tuna supply chain and use Bitung (Western Central Pacific Ocean) Indonesia as the case study. The model is developed using House of Risk (HOR) which is proposed by [13]. Since there are different interests from different supply chain players in Tuna SC, HOR is then modified to accomodate this issue. This paper uses case study of Tuna SC located in Eastern Indian Ocean, in order to give MMAF a more comprehensive view about Indonesian Tuna SC risks. Moreover, the structure of supply chain risk identification developed by [14] and combined with five why's analysis is adopted on this paper to identify Tuna SC risks and to map their interrelationships. To generate SC risks strategies, SC risk that has been identified is then analyzed futher by using HOR for multistakeholders proposed by [15].

The rest of this paper is divided into four subchapters. The second subchapter is literature review of supply chain risk management and its related tools. Then, it is followed by proposed framework for identifying SC risks of Tuna. Next, preliminary case study findings is presented. Finally, conclusions and future works is elaborated in the last subchapter.

2. Literature Review

Supply Chain (SC) can be defined as the network of entities, which consist of suppliers, carriers, manufacturing sites, distribution centres, retailers, and customers, through which material flows [16]. While [17] propose that SC also not only comprise product and material flow but also the flow of services, finances, and information. Therefore, SC includes financial providers, market research firms, logistics providers, carriers and transport firms as part of SC partners besides suppliers, manufacturer, retailers, and customers.

Supply Chain Risk Management (SCRM) is "an inter-organizational collaborative endeavor utilizing quantitative and qualitative risk management methodologies to identify, evaluate, mitigate and monitor unexpected macro and micro level events or conditions, which might adversely impact any part of a supply chain" [18]. Managing supply chain (SC) risks are very important to be able to formulate suitable strategy to minimized or avoid these risks. If SC risks is not managed properly and promptly, it may leads to failures to the whole SC and usually involving financial losses and/or business discontinuity. On the other hand, when SC risks is managed properly, it would lead to a higher competitiveness of the SC. Risks in supply chain may arise from both internal and external SC environments. Internal SC is represented by SC network that consist of several players/actors that are: focal organization and its suppliers and customers including logistic providers. External SC is represented by external factors linked with SC network such as man made and natural disaster, economic and political stability, etc [19].

SCRM consists of four steps [20] [21] [22], they are: (1) risk identification: to determine potential SC risks and their sources, (2) risk assessment: to measure the magnitude of SC risks, (3) risk evaluation: to prioritize SC risks according to certain criteria and magnitude, and (4) risk mitigation: to formulate suitable action to deal with SC risks. Risk identification should provides most (if not all) of possible risks on the SC in order to enable correct mitigation strategy formulation [23] [24] According to [25], risk has several attributes namely: (1) source of risks, (2) consequences of risks, (3) time, (4) location, and (5) person/factor/activity that may involved. Furthermore, it is also crucial to understand interrelationships between risks to recognize their impact on the entire SC network.

[14] propose utilization of Knowledge Based System (KBS) to support SC risk identification which is called Supply Chain Risk Identification System (SCRIS). For identifying SC risks as well as their interrelationships, combination of hierarchical and causal structure is used. First, hierarchical structure represents risk attribute "time" (level 0), "location" (level 1) and "risk owner" (level 2). Risk attribute "time" divided according to five phases of SC operations (i.e. Plan, Source, Make, Deliver, and Return) [26]. Risk attribute "location" consist of manufacturing (focal) organization, its SC partners and SC external environment which is adopted from [19]. Every risk "time" stages at level 0 are connected to each risk "locations" at level 1. Risk "owner" (level 2) is located under each risk "location" (level 1) which represents two risk attributes (i.e. persons or factors) and consists of different members. Under risk "location" manufacturing organization, there are six generic functional areas/divisions namely: Operational, Technical, Organisational, Communication, Resource and Financial . While, there are three players (i.e. Suppliers, Customers, and Transportation carriers / logistics providers) under risk "location" SC partners, there are nine factors under risk "location" SC external environment, they are: Political-governmental, Macroeconomic, Socio-cultural, Competitor, Complementary product organisation, Other related organisations, Technology development, Nature and Accidents. Second, Causal structure represents risk attributes "risk sources" which are represented by risk factors and risk sub factors and "risk consequences" which are represented by risk events. This structure is located under and linked to level 2 of hierarchical structure. With this causal structure, interrelations between and within risk events, risk factors and risk sub factors can be depicted.

House of Risk (HOR) is an approach to manage SC risks by identifying risk event and its relationship with source of risk event (risk agents). By adopting Failure Mode and Effect Analysis (FMEA) and House of Quality (HOQ) framework, HOR prioritizes the most influential risk agents and the best preventive actions for those risk agents accordingly [13]. Tuna SC consists of multiple actors, namely: traditional and industrial fishermen, traders, traditional and modern processors, domestic and overseas distributors. Naturally, different actors have different interests and perspectives about risks that could happened in their supply chain. Thus, [12] suggest HOR for multistakeholders to accomodate this issue.

To ensure effectiveness of preventive action in reducing or eliminate risk events, root cause of risk events should be identified properly. One technique that have been utilized largely as root cause analysis tool is Five Why's analysis. This technique aims to discover and differentiate between the real root cause with the symptom by asking "why?" five times. Then, after the answer (risk agent) are obtained, a corrective solution are proposed accordingly [27].

3. Proposed Framework for Tuna Supply Chain Risk Identification

To develop framework for managing risk in Tuna supply chain, the potential SC risks are identified and mapped using the proposed framework which is elaborated in this section.

Firstly, supply chain of Tuna is defined. According to [15], Tuna supply chain operations consist of fishing, trading, processing and distribution. [8] presents similar supply network and suggests that fishermen, traders (middlemen), processors, distributors, retailers, end customers including transport firms are the main players/stakeholders of SC Tuna. Whereas, in this research, supporting players, such as government institution (MMAF), and local or international non government institutions are also taken into account.

Secondly, Tuna SC risks event are identified through literature review and interview with SC players including experts from government institutions. These risks are then organized using modified risk structure of [14]. Thus, this research also applies combination of hierarchical and causal risk structure but with some modification on risk attributes. On hierarchical structure, risk attribute "time" (level 0) is divided according to four operations of Tuna SC that are aligned with SCOR but do not include "plan" and "return", they are: (1) fishing and trading are considered as "source" operations, (2) processing is a "make" operation, and (3) distribution is a "deliver" operation. Risk attribute "location" (level 1) divided into internal and external environment of Tuna SC. In this research, internal Tuna SC is not divided into focal organization and its SC network partners, but it comprises all players ofTuna SC. Thus, risk "owner" (level 2) that located under internal Tuna SC consists of all Tuna SC players from fishermen to end customers including transportation firms. SC player at fishing, trading and processing operations are only one player each (e.q. fishing operations is conducted by fishermen). While, for deliver operations consists of four players, they are: distributors, transport firms (third party logistics), retailers, and end customers. External environment consist of similar factors as is in [14] with two modifications: (a) Addition of "Tuna International Trade Market" and "Government/MMAF", (b) "Complementary product organisation" is omitted. Next, for causal structure also use similar arrangement but only take into account risk events and risk agents/factors (risk sub factors are omitted) which is located under each SC players. To determine risk agents (factors) which is the origin source of risk events, the five why's analysis is adopted. By using this structure any risk agent/risk event that is occured at "Source" or Fishing which then iniates risk agent/risk event at later stage (e.q. at "Make" or Processing stage) can be mapped. Thus, interrelationships between risk events and risk agents within and between operations stages can also be depicted in this structure. As a result, the proposed Tuna Supply Chain Risk Identification (SCRI) structure can be seen in figure 1. After the risk events and risk agents are obtained and depicted in Tuna-SCRI, these risks are incorporated into modified House of Risk that take into account multistakeholder.

4. Preliminary Case Study Findings

4.1. Eastern Indian Ocean Tuna Supply Chain

Tuna supply chain and its potential risks for Eastern Indian Ocean is developed and identified based on literatures and interview with respondents who are SC players of Eastern Indian Ocean Tuna. They are several fishermen and middlemen at Sendang Biru Port - East Java, top management of a Tuna processor company at Pasuruan – East Java, a small size Tuna processor industry, experts from MMAF of East Java province and Trenggalek region, and Institute For Mariculture Reseach and Development Gondol – Bali. Figure 2 shows Tuna supply chain for Eastern Indian Ocean.

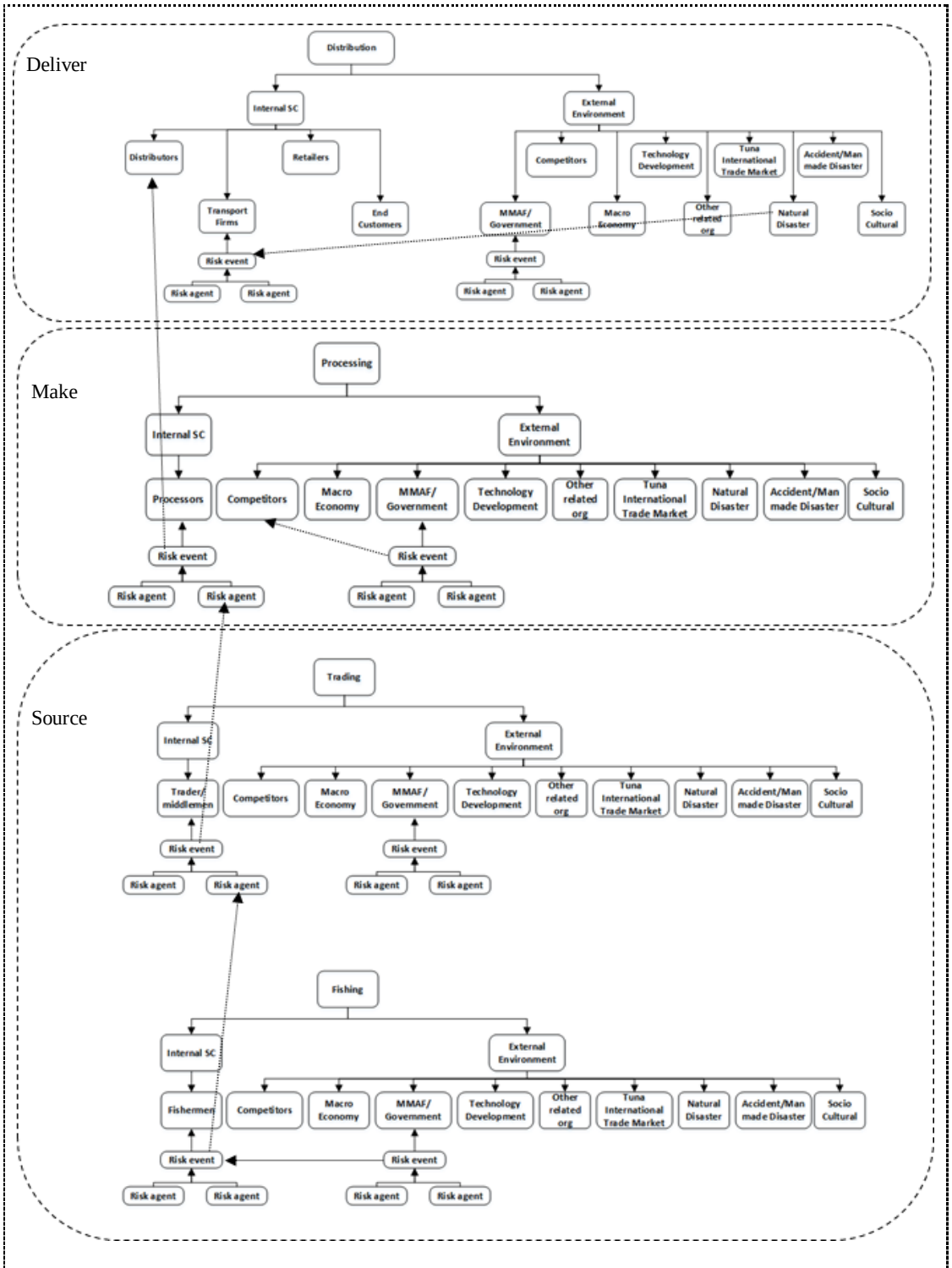

Figure 1. Tuna Supply Chain Risk Identification Framework

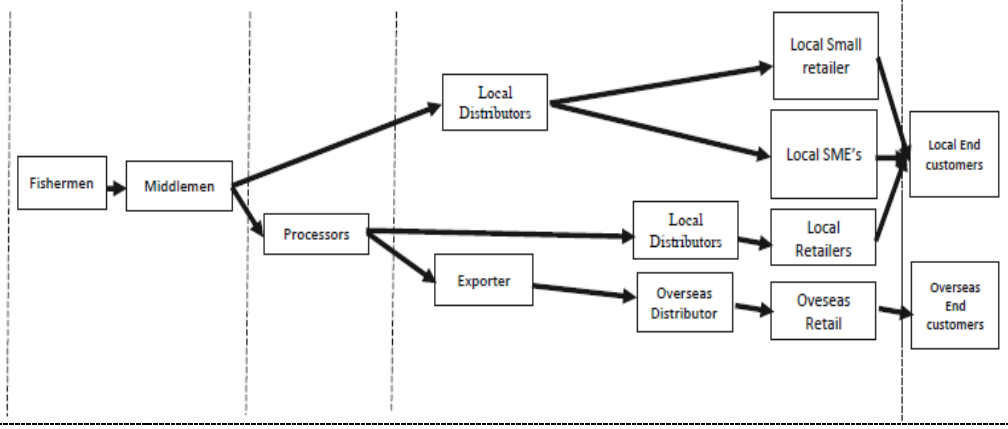

Figure 2. Eastern Indian Ocean Tuna SC

4.2. Supply Chain Risk Mapping of Eastern Indian Ocean Tuna

Potential risk events of SC Tuna are initially gathered from literature review and then validated by interviewing respondents. After risk events are identified, risk agents are obtained using five why's analysis. Then finally, risk events and risk agents are validated with the same respondents. All potential risk is then mapped on proposed framework of Tuna Supply Chain Risk Identification (Tuna-SCRI). A partial part of identified Tuna SC risks at Eastern Indian Ocean at Fishing and Trading operations (Source stage) can be seen on figure 3.

In general, most of SC risks that identified in figure 3 also is also occured on Tuna at Western Central Pacific Ocean. For example, improper fish quality due to lack of cold storage facilities during fishing. The same risk also applies on trading. In this case, due to unavailability of proper cold storage on the fishermen ships, they rely on ice block/pack vendor. Similarly, unpredictable weather in the last two years (2015 to 2016) also affect to lack of captured fish. Risk of unfair fish price is also occured. It could happened due to unregulated trading system in ports, lack of law enforcement of bidding scheme or declining price of world tuna.

Since 2015, Indonesian government/MMAF applies new regulations including war on illegal and unreported (IUU) fishing by foreign vessels in Indonesian waters and illegal transshipments (i.e. offloading of catch to foreign reefer vessels and processors at sea). Therefore, few SC risks listed on [12] are no longer applicable in this research (e.q. illegal transshipments)

One of interesting finding of this paper is when the price of tuna is too low (at trading operations), it could affects back to fishermen unwillingness to go fishing (at fishing operations). The reason for this, when the price of fish too low, fishermen could not get any revenue or even suffer a loss since they should provides funding around US$ 1500 each time they go fishing while usually spend 2 weeks in the offshore. This study also acknowledges the instution that responsible for regulating Tuna world price (located in Bangkok) as one of external environment.

5. Conclusion and future works

This paper shows development and application of framework for Tuna Supply Chain Risk Identification, which is then called as Tuna-SCRI, to identify and map supply chain risks of tuna. This framework is adopted from SCRIS by [14]. Some changing in the framework is conducted to consider particular characteristics of Tuna SC operations. Tuna-SCRI consists of three stages (i.e. Source, Make and Deliver), while on Source stages there are two operations that are: fishing and trading.

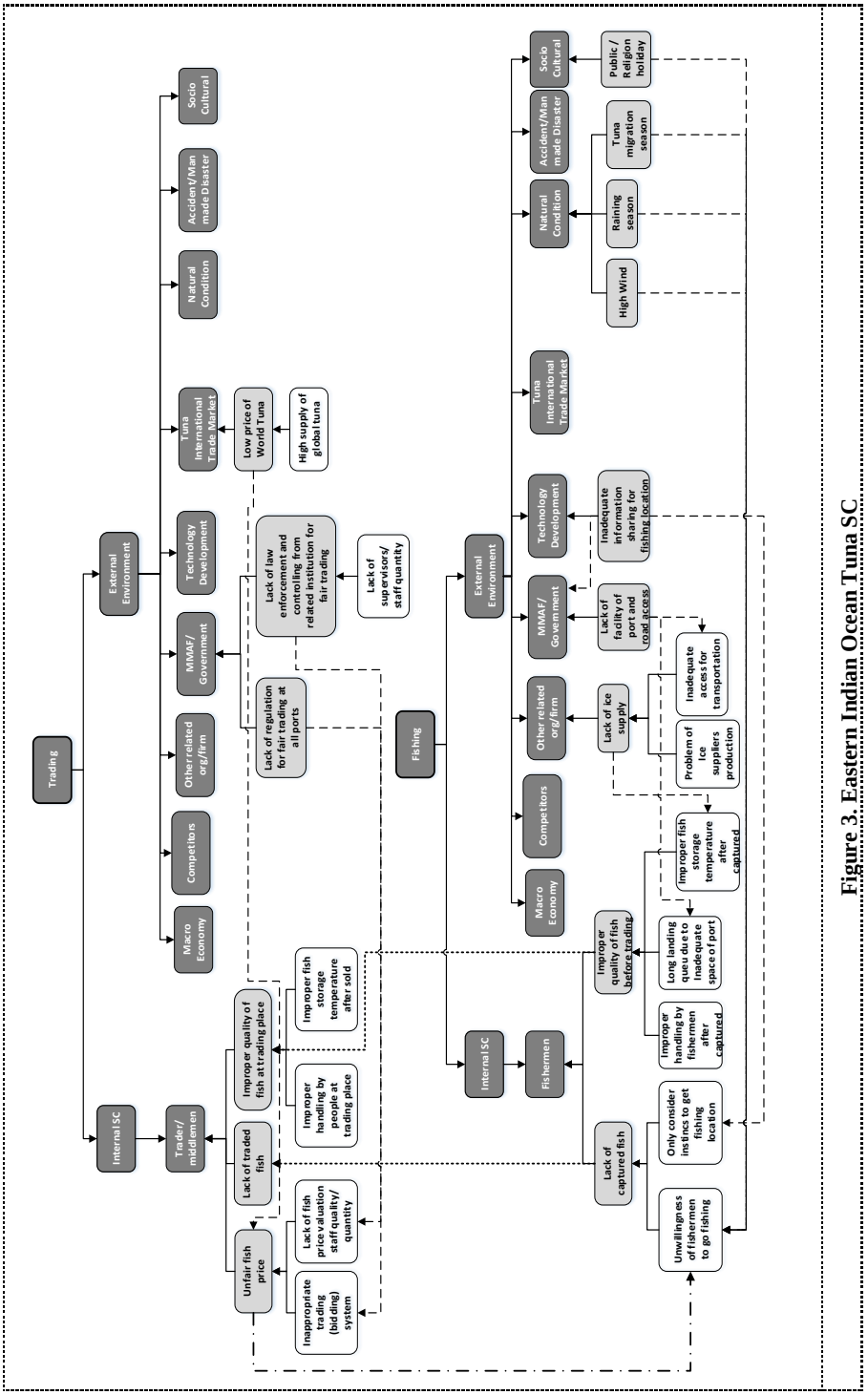

Figure 3. Eastern Indian Ocean Tuna SC

The next steps of this study are to identify and map SC risks events on Make and Deliver stages and then determine the risk agents. Modified House of Risk will be utilized to prioritize risk agents and determine the proper preventive actions by considering more than one SC stakeholders.

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