

# Achieving Sustainability in Capture Fishing Industry Based on the Regional Characteristics

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**Abstract**— The prospect of the fishery sector becomes one of strategic economic activities, in which the government implements fisheries industrialization as a strategy to enhance added values of fishery production. The fishing industry is unique since it exploits fish as the main raw material naturally available and accessible by humans. Moreover, the capture fishing industry is relatively a high cost economy. This study was aimed at designing the regional-based institutional and network models of the fishing industry in order to achieve the sustainable fishing industry in Maluku province. The research employed Soft System Methodology to obtain an ideal model for the management of the sustainable capture fishing industry. Structure identification in designing the institutional model for a supply chain system of the sustainable fishing industry was carried out using the Interpretative Structural Modelling (ISM). Meanwhile, TOPSIS was involved in establishing a model for the fishing industry. This research is an integrative studies that conducted by using the relevant tools and performed convergence between tools. Therefore this study provides the real description of capture fishing industry condition in Maluku Province and construct an ideal model for the supply chain management of the sustainable capture fishing industry in Maluku province for the next 5-10 years as a novelty. The results show the institution that would be developed was a financial institution (cooperative) that would be managed and run by fishermen. The capture fishing industrial network in Maluku province was built by actualizing PPI Ambon as a main server in the route of PPI Masarette – PPI Eri – PPN Ambon. While Amahai would act as a main server for the route of PPN Tual – PPI Amahai and PPI East Tahme – PPI Amahai.

**Keywords**—Sustainability, the fishing industry, soft system Methodology, ISM, TOPSIS

## 1. Introduction

The prospect of the fishery sector is considered glowing and becomes one of strategic economic activities. Accordingly, the government implements fisheries industrialization as a strategy to enhance added values of fishery production. Moreover, in order to utilize marine and fisheries sectors in Maluku as a competitive advantage of Indonesian economy, the government has set a policy that allows Maluku as the National Fish Barn [1]. It means that Maluku as a greatest producer in Indonesia must be able to supply needs of community consumption and national industries and becomes the main exporter of Indonesia's fishery commodities [2]. In favor of that goal, the government also has issued a policy to set a national fishery logistic system as an appropriate mechanism in managing flows of marine and fishery products.

The capture fishing industry sector in Maluku is relied on its archipelago. The presence in the archipelago faces many latent problems comprising the low competitive advantages, oligopoly practices and or oligopsonies potentially harming fishermen and the low competitive power. One of underlying causes of that condition is the inefficient network of the capture fishing industry characterized by relatively high transportation costs. The inefficient network of the industries is resulted from the characterization of small islands and limitedness of infrastructures leading to occurrence of some other limitedness, including limitedness of natural resources, artificial resources and market as well as isolation. Indonesia's industries in general and the capture fishing sector in particular belong to the high cost economy. The high investment and operational costs of such industries above are

consequences of several factors including administration costs and technical factors. The abuse of authority in the process of approval is a real example of high cost consequences due to administration factors, whereas higher transportation costs are an example of ones due to technical factors. High transportation costs are an indicator of the inefficient industrial network [3]. In the relation of this problem, the government through The Regulation of Minister of Marine Affairs and Fisheries RI No. 5/ Permen-KP Concerning National Fishery Logistic System have launched national fisheries management and governance in terms of production and its distribution [4].

The process ranging from supply to distribution of marine and fishery products has a complex structure, involving many stakeholders including fishermen, small traders, wholesales, factories, exporters, the government and community as end consumers [5]. In addition, the fishing industry is unique since it exploits fish as the main raw material naturally available and accessible by humans [6]. Maluku province is characterized by its archipelago differing from other regions. This may increase the problematic situation and complexity in designing the supply chain management system of the capture fishing industry in Maluku province. [7] stated that the Soft Systems Methodology (SSM) is an approach to overcome the problems of unstructured and an action in the process of understanding the actual situation of the problem and take action to correct it. SSM is a framework solutions designed specifically for situations where the nature of the problem is difficult to define [8]. The essence is to build a model of the system through in-depth understanding and meaning appropriate problem situations faced phenomenon [9]. Use of the method Soft Systems Methodology (SSM) in the supply chain related research has been carried out by [10] and [11]. The second study researchers more to agricultural commodities. The SSM application research on fishery commodities has been done by [12], [13] and [14]. This study was aimed to obtain the regional-based institutional model and the industrial network model for the capture fishing industry using an approach of Soft System Methodology (SSM).

## 2. Literature Review

### 2.1. Capture Fishery Industry

[15] states that the fishing industry is an industry that uses the results of fishing as its main raw material, or industries that generate input factors, the industry that produces equipment, industrial output variables that support the capturing fish business. Fishing industry consists of three sub-systems, namely sub-systems industry upstream

industry, fishery business sub-systems and sub-systems downstream industries. Indonesian fishery industry conditions played by small businesses. Efforts innovative application does not provide a significant impact to boost fishery production volume. It is evident from the increase of fishing is only growing at about 12:58% [16]. Given the difficulties the provision of adequate infrastructure to create the industrialization of fisheries such as cold storage, the guarantee sought for businesses scale fisheries which are mostly SMEs, clear regulations related roadmap industrialization of fisheries laws and regulations to suppress illegal fishing.

### 2.2. Fishing Products Supply Chain

Conceptually, the supply chain of fisheries products is an economic system that distributes the benefits and risks of the actors involved in it. The linkage of the various processes must be able to create value-added fishery products, so that each participant chain to coordinate activities both in terms of quantity, location and the right time to satisfy customer needs [17]. Supply chain management will be able to run optimally when there is a synergy between all the components involved in every activity from upstream to downstream [18]. In principle, in the structure of SCM models should be able to accommodate two important decisions, namely from the side of producers and consumers [19]. From the producer side is how the product could be available and spread (spread) while on the consumer side is how the consumer can obtain a product with the quantity, location and time [20]. Decision strategies or supply chain design is a decision on the structure of a supply chain and processes to be run at each stage that includes the location, production, product design, and process optimization taking into account external factors such as politics, law, governance infrastructure, progress technology, etc. [21].

Fishery products has different characteristics compared to other products. These products have properties that use short lifespan and a high degree of vulnerability to weather, so it requires special handling in the packaging and distribution process, in order to maintain the quality of the product. Distribution process management fishery closely associated with the supply chain. Management the core of the supply chain is the integration, collaboration in the management of supply and demand with all parties involved in business processes [22]. [23] states that the distribution system of fisheries in Indonesia has several distinctive characteristics that must be considered in the development of the supply chain model, namely: (a) Has a long chain of distribution; (B) the processing unit is difficult to obtain raw

materials are continuously at a certain quality and standards; (C) Support the logistics of transport infrastructure is still lacking (d) Consumers are paying more but less producers enjoy advantages proportional; (E) Cost of goods distribution in Indonesia is higher than the average cost of distribution of commodities in the scope of the ASEAN countries.

### 2.3. Soft Systems Methodology (SSM)

[24] distinguishes the systems approach becomes hard system and soft system. Hard systems thinking with highly usable optimization paradigm in solving technical problems in a structured and purpose has been previously known. The soft System thinking by learning paradigm more appropriate to use in the problem-solving situations

that are not structured and involve the human and socio-cultural aspects. Approach to software systems can use the Soft Systems Methodology interpretive if problems faced are complex and messy or ill defined [25]. SSM's core is to build models of the systems associated with problem situations. These models are used as a medium for discussion in order to bring change in the actual situation. The discussion process allows participants to debate and ask each other such that a diversity of perspectives can be revealed.[26] in [27], "Systems Thinking, Creative holism for Manager", developed by [28], that the implementation of the SSM can be done within seven (7) stages. Each stage SSM as Fig 1. can be explained as follows:

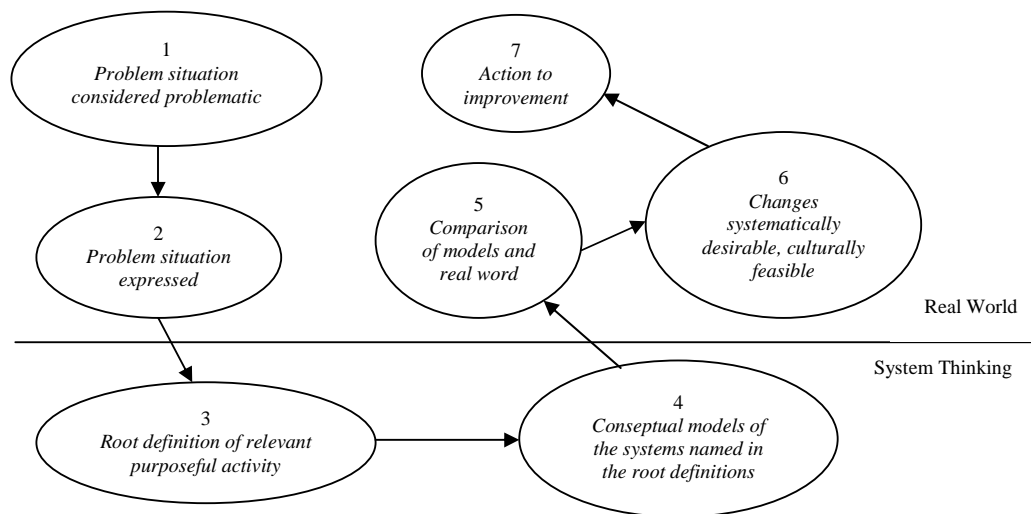


Fig 1. Stage of SSM

### 2.4. Interpretative Structural Modeling (ISM)

Model institutional structuring the supply chain is conducted by using Interpretative Structural Modeling (ISM), which was designed with the aim to illustrate the complexity of supply chains fishing industry. Preparation of the elements examined institutional structure refers to as 9 elements [29]. The ISM stages are as follows:

1. Preparation of sub-elements associated with the institutional structure in the industry supply chain sustainability of fisheries
2. Analysis of the contextual relationship between sub element to i and j.
3. Preparation of Structural Self Interaction Matrix (SSIM)
4. Establishment of Reachability Matrix for each element.

### 2.5. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS is one of multiple criteria decision making method that was first introduced by [30]. In TOPSIS method there is no limit on the number of attributes and alternatives used so that it can be used to solve a case that has a quantitative attributes more efficiently [31]. The measures used in TOPSIS method as follows:

1. Build normalized matrix decision
2. Building a normalized weighted matrix decision
3. Determine the ideal solution both positive and negative ideal solution
4. Calculated separation
5. Calculated relative closeness to the ideal solution
6. Rank the alternative.

### 3. Methodology

Results of situational analysis were used in SSM stages to obtain an ideal model for the supply chain management system of the sustainable capture fishing industry in Maluku province. Then, the structure identification is carried out to develop an

ideal model for the supply chain management system of the sustainable capture fishing industry using Interpretative Structural Model (ISM). The capture fishing industry model was constructed by multi-criteria analysis and TOPSIS. The research steps are shown in Fig 2.

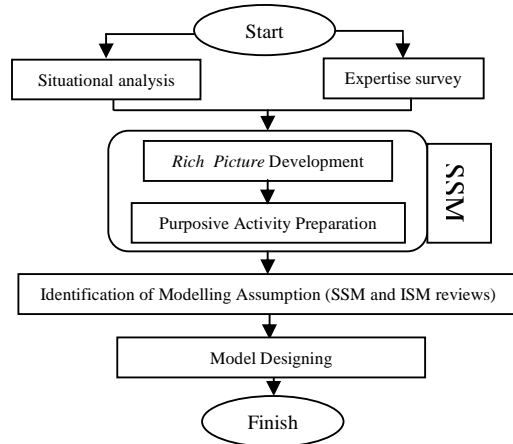


Fig 2. The research steps

### 3.1. Fishing Industry Situational Analysis

Fishery potential in Indonesia that can be utilized in Maluku Province is 26.3% which is spread on 3 Regional Water Management of the Republic of Indonesia (WPP), namely: WPP Banda Sea, Arafura Sea and WPP WPP Seram Sea and the Gulf of Tomini. Capture fisheries production in Maluku Province dominated from Ambon and Central Maluku. Fishing boat in Maluku province in Central Maluku dominated by the proportion reached 29.17%. Lowest number of fishing vessels in Ambon that proportion reached 4:11% of the total number of fishing vessels in Maluku province.

In 2010, the Maluku province is dominated by trolling fishing unit, which accounted for 13%. Fishing unit are commonly found in Southeast Maluku regency. Other fishing unit enough to dominate is an upright rod which are found also in Southeast Maluku regency. Based on the way or method of processing fish processing types can be grouped into 10 types, namely: fresh fish processing, canning, freezing, salting / drying, *pemindangan*, curing, fermenting, reduction, surimi, and other processing. Furthermore, the processing of fishery products business activities in the province of Maluku in general is still dominated by small and medium sized businesses with all its limitations, including: weak capitalization, and information technology, management and marketing, subsistence, and partially dispersed.

The process of distribution of fishery products made using sea transport. The role of fishing ports to be important in the fishing industry network of

Maluku province. There are 13 fishing ports are scattered in almost every district of the city. However, until now only six fishing ports that can be used, namely PPN Ambon and PPI Eri in Ambon, PPN Tual in the Dumar (Tual), PPI Massarette in Buru, PPI Amahai in Masohi (Central Maluku) and PPI Tamher East in East Seram District. Other ports largely being in the completion of development, so the future is expected to support the activities of marine fisheries in other regions. The ports, among others PPI Piru in West Seram regency, PPI Banda Island Banda (Central Maluku), PPI Kelvik on Taar (Southeast Maluku regency, PPI Dobo and PPI Kalar-Kalar in the Aru Islands, PPI Ukularang in Saumlaki (Maluku Tenggara Barat) and PPI Klishatu in Wetar (Southwest Maluku district).

A number of programs related to the industrialization of marine and fisheries is as follows:

- 1) The development of small and medium industries;
- 2) Program upgrading industrial technology; and
- 3) Program structuring of the industry.

### 3.2. Stage of Design Model Ideal Supply Chain Management Industry Fishing

Ideal model of supply chain management system built fishing industry through the SSM method. Data were obtained through interviews, questionnaires and focus group discussions). Furthermore, the data is processed and analyzed using a fish-bone diagram. This is as stated [32] that the fish-bone diagram can help the designer to focus on the fundamental causes of the most important, find opportunities for continuous improvement and provide critical guidance for designing sustainability.

### 3.3. Stage of Identification of assumptions and models design activities

Identification of structural modeling design is based on assumptions on the results of the study methodology soft system particularly stage 4 and stage 5 and the results of the analysis of the institutional structure of the supply chain using the ISM. Based on these assumptions built models needed in realizing a sustainable fishing industry in the province of Maluku.

#### 3.3.1. SSM Study

SSM studies in stage 5 produces a gap analysis between the ideal models are compared with the real world. And the next become inputs for the formulation of an improvement plan to achieve the desired ideal model on stage 6. At this stage will be identified improvement plans to focus on to do first. One of the ideal model to focus on next

proceed to the design stage of the system modeling. Selected ideal model adapted to the situation the conditions to support government policies related to the fisheries sector which exists today is the policy of the National Fish Logistics System with Maluku as the granary of national fish.

### 3.3.2 Analysis of Interpretative Structural Modeling (ISM)

In order to improve the performance of the supply chain it is necessary to identify relationships between variables in the supply chain [33] so it can know the behavior of the system as a whole. Therefore, identification of the behavior of the system is done by using ISM. [34] stated that the ISM is made in order to understand the behavior of the system in every element of the system. The identification results will be obtained of the key elements that can form the basis for building the institutional model of the supply chain.

## 3.4. Stage of Modeling activities to realize the Ideal Model of Sustainable Fishing Industry Supply Chain Management in Maluku Province

### 3.4.1 Network Model Fishing Industry

Modeling of industrial networking is done through three stages: (1) determination of the criteria of the fishing port status; (2) rank the center of fishing industry with an ideal value; (3) The formulation of the fishing industry network.

#### (a) Determination of criteria for fisheries port status

Analysis of the model parameters fishing industry in the archipelago was analyzed with Multi Criteria Analysis (MCA). The first MCA analysis conducted on four parameters: the fishing port facility services index (IPFP), an index of the capacity of fishing boats (IKAPI), self-reliance index (IK) and the capacity of industrial centers (KSI).

##### (1) Fishing port facilities services index

Fishing port facilities services index (IPFP) is a measure of the availability of infrastructure facilities at the center of fishing industry. Infrastructure measured include basic facilities, namely: docks, fish markets (TPI), fuel facilities, ice plants and supporting facilities such as cold storage. Formula to calculate the index is the fishing port facility services:

$$IPFP_i = \sum_{i=1}^5 I_{ij}$$

When :  $I_{ij} = X_{ij} \cdot B_j$  and  $B_j = n_j / n$

Where:

IPFP<sub>i</sub> = index fishing port facility services location i

I<sub>ij</sub> = value IPFP location infrastructure to ke- i-j

X<sub>ij</sub> = volume of infrastructure at the location j

B<sub>j</sub> = weight j infrastructure

N<sub>j</sub> = number of infrastructure j

N = the number of infrastructure

i = location

j = type of infrastructure

##### (2) Capacity index of fishing boats

Index fishing vessel capacity (IKAPI) is a measure of the capacity of vessels fishing in the fishing industry centers in the production process. Formula to calculate the index is the capacity of the fishing vessel:

$$IKAPI_i = \sum_{k=1}^3 J_{ik}$$

When :  $J_{ik} = Y_{ik} C_k$  as  $C_k = m_k / m$

Where:

IKAPI<sub>i</sub> = index capacity of vessels fishing in the location i

J<sub>ik</sub> = value IKAPI location of all first fishing vessel to k

Y<sub>ik</sub> = The number of fishing boats at the location i

C<sub>k</sub> = weighting means

M<sub>k</sub> = volume hatch fishing vessel types k

M = maximum volume of the hold fishing vessel observed

I = location

K = the type of fishing vessel

##### (3) Index independence

Independence Index (CI) is a measure of the size of the fishing industry to the center's ability to meet the needs of its own input factors. Factors analyzed input is fuel and ice. This value is measured by the proportion (%) of input factors, namely by the formula:

$$IK_i = \sum_{i=1}^2 IK_{i1}$$

When :  $IK_{i1} = I_1 / D_1$

Where:

IK<sub>i</sub> = degree of independence to the location i

IK<sub>i1</sub> = I intake level of independence at a location to i

I = the volume of supply intake factor I

D<sub>1</sub> = volume requirements intake factor I

I = location

L = type intake factor

##### (4) Capacity of industrial centers

Capacity of industrial centers (KSI) is the volume of fish produced from an industrial district. MSG is calculated with the following formula:

$$KSI_i = \sum_{o=1}^n X_{io}$$

where:

Lattice = capacity industrial centers to i

X<sub>o</sub> = volume of fish produced o

I = location to location

o = species of fish

*(b) Status industrial centers of fisheries*

Determination of the status of the center of fishing industry begins with the establishment of scores for all four of the above parameters. Score each parameter ranges from 0 to 1. The formula to calculate the score is:

$$Score_{ai} = \frac{ai - \min(a)}{Maks(a) - \min(a)}$$

when: A = the value of the index

*(c) Rank centers fishing industry with an ideal value.*

The yield on the stage 1.1.1 further analyzed using analysis of TOPSIS [35]. The measures used in TOPSIS method as follows:

*(1) Build normalized matrix decision.*

Element rij normalization decision result of matrix R by the method of Euclidean length of a vector is:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}$$

when:

rij = result of normalizing the decision matrix R

i = 1, 2, 3 ... m;

j = 1,2,3 ... n;

*(2) Build a normalized weighted matrix decision*

With a weight W = (w1, w2, ..., Wn), then the normalization of weight matrix V is:

$$V = \begin{bmatrix} w_{11}r_{11} & \dots & w_{1n}r_{1n} \\ \vdots & \vdots & \vdots \\ w_{m1}r_{m1} & \dots & w_{nm}r_{nm} \end{bmatrix}$$

*(3) Determine the ideal solution both positive and negative ideal solution*

The ideal solution is denoted by A + positive and negative ideal solution is denoted by A-, as follows:

Determining the solution idea (+) and (-)

$$\begin{aligned} A^+ &= \{(maxV_{ij})(minV_{ij}|j \in J)i = 1,2,3 \dots m\} \\ &= \{V_1^+, V_2^+ \dots V_m^+\}A^- \\ &= \{(maxV_{ij})(minV_{ij}|j \in J)i \\ &= 1,2,3 \dots m\} = \{V_1^-, V_2^- \dots V_m^-\} \end{aligned}$$

When:

Vij = matrix element V i<sup>th</sup> row and r<sup>th</sup> column j

i = {j = 1,2, 3, ..., n and j associated with benefit criteria}

j = {j = 1,2,3, ..., n and j associated with cost criteria}

*(4) Calculate separation*

The calculation of this separation is a measurement of the distance from one alternative to the positive ideal solution and negative ideal solution. The mathematical calculation is as follows:

Separation measure for positive solutions:

$$S_i^+ = \sqrt{\sum_{j=1}^n (V_{ij} - V_j^+)^2}, \text{ dengan } i = 1,2,3 \dots, n$$

When :

J = {j = 1,2,3, ..., n and j is a benefit criteria}

J' = {1,2,3, ..., n and j is the cost criteria}

Separation measure for the negative ideal solution

$$S_i^- = \sqrt{\sum_{j=1}^n (V_{ij} - V_j^-)^2}, \text{ dengan } i = 1,2,3 \dots, n$$

When:

J = {j = 1,2,3, ..., n and j is a benefit criteria}

J' = {1,2,3, ..., n and j is the cost criteria}

*(5) Calculate the relative closeness to the ideal solution*

Relative closeness of alternative A + to A- solutions represented by:

$$C_i = \frac{S_i^-}{S_i^- + S_i^+}, \text{ dengan } 0 < C_i < 1 \text{ 'an } i = 1,2,3, \dots m$$

*(6) Rank alternatives*

Alternatives can be ranked based on the sequence C<sub>i</sub> \*. Therefore, the best alternative is the one that is the shortest of the ideal solution and is the furthest to the negative ideal solution.

*(d) Formulation of the fishing industry network*

The formulation of the fishing industry network is done with optimization models through distance minimization analysis that aims to gain the most minimal distance through sweeping technique. This analysis is done by comparing the distance between the centers of the industry's most minimal. Further

alternatives formulated industrial networks.

#### *(e) Selection of the network model*

Selection of the network model by comparing the existing industrial networks (existing model) and the alternative network model fishing industry in the archipelago. Determination of the fishing industry network model was analyzed with minimization of travel time and transport costs variable output.

#### *3.4.2. Financial institutional model Fishermen*

The financial model is built following the seven stages fishermen SSM. At stages 1 and 2 will be known picture of the situation and the financial problems of fishermen. Stages 1 and 2 can be determined based on the identification assumption ISM analysis that has been done. Furthermore, based on this assumption then proceed to step 3 and 4 is to build root definition and conceptual models. The resulting model is an ideal model that is built on some activity or Purposeful Activity. In Stage 5 and 6 do gap analysis and action plan for improvement.

## **4. Discussion**

### **4.1 An Ideal Model for the Capture Fishing Industry Supply Chain Management**

**Stage 1 and 2 of SSM :** The Problematic situation and The Rich Picture supply chain management system of the capture fishing industry.

The supply chain of the capture fishing industry in Maluku province is influenced by physical, cultural, social, economic, institutional factors and the behaviour of supply chain actors. Present results from the situational analysis suggest that the sustainability of the capture fishing industry in Maluku province was in a position to be less sustainable and the market demand fulfilment was still performed by the system of order. A situation rich picture describing supply chain problems of the capture fishing industry in Maluku province is presented in Fig 3.

Refers to the rich picture above, we, along with stakeholders conducted analysis of causes and effects using fish-bone diagram [36], then supply chain root causes of the capture fishing industry in Maluku province were obtained and structured as following problems: (a) The low fishery product competitiveness; (b) Underdevelopment of the domestic market for fishery products and fish quality securement; (c) The limited access to capital for business development of the capture fishing industry; (d) The relatively low quality of most fishermen; (e) Illegal, Unregulated Fishing(IUU)activities; (f) Over fishing activities in coastal waters; (g) Lack of institutional capacity for

the regulatory and law enforcement; (h) The unreliable and partial data collection system of the capture fishing industry. Then, synthesis problems were performed to the eight issues mentioned to gain three transformation statements, i.e.: (a) There was no coordination among actors of the supply chain; (b) There was no institution that enabled fishermen to obtain the provision of production and distribution infrastructures of fishery products; (c) The supply chain did not have a sufficient access to markets that would connect consumer desires to the production system.

#### **Stage 3 :** Root definition/relevant system

The preparation of root definition was conducted as the basis for the conceptual model using the PQR formula that presented a case by doing P through or by Q to achieve R. The root definition was tested and refined by the CATWOE analysis tool (C = customers, A = actors, T = transformation, W = worldview, O = owners, E = environmental constraints) [37]. The root definition and CATWOE were sources of activity generation in a purposeful activity model for the supply chain management system of the sustainable capture fishing industry in Maluku province. This paper would only describe the root definition formulation of the first transformation statement, i.e.: There was no coordination among supply chain actors.

#### **Stage 4 :** Modelling the root definition/relevant system (a conceptual model)

A relevant system modelled into a conceptual model known as the purposeful human activity system that indicated activity linkages required to realize the transformation process [38]. Activities needing coordinating and managing was the consultation with the government representatives, quality control and assurance of fishery products, trading, logistics network, coordination and management. Refers to these activities, a model for supply chain management of the capture fishing industry in Maluku province was developed (Fig 4). The success of the model would be measured by 3E criteria (Efficacy, Efficiency, Effective), i.e.: the establishment of coordination among actors in the supply chain (efficacy), employing minimum resources and time (efficiency), supply chain performance achievement of the capture fishing industry in Maluku province (effective). Implementation of step 3 and 4 are described in Table 1.

#### **Stage 5 and 6 :** Comparing conceptual models to the real-world condition and the corrective actions

The process of comparing to the real world produced gaps requiring corrective actions. The

implementation of the fifth and sixth stages of SSM is shown in Appendix 1. Dialogue and debate are based visual material is allowed, it is more efficient than just the dialogue and debate [39]. Visual

material will increase the involvement of stakeholders because they are involved in taking action [40].

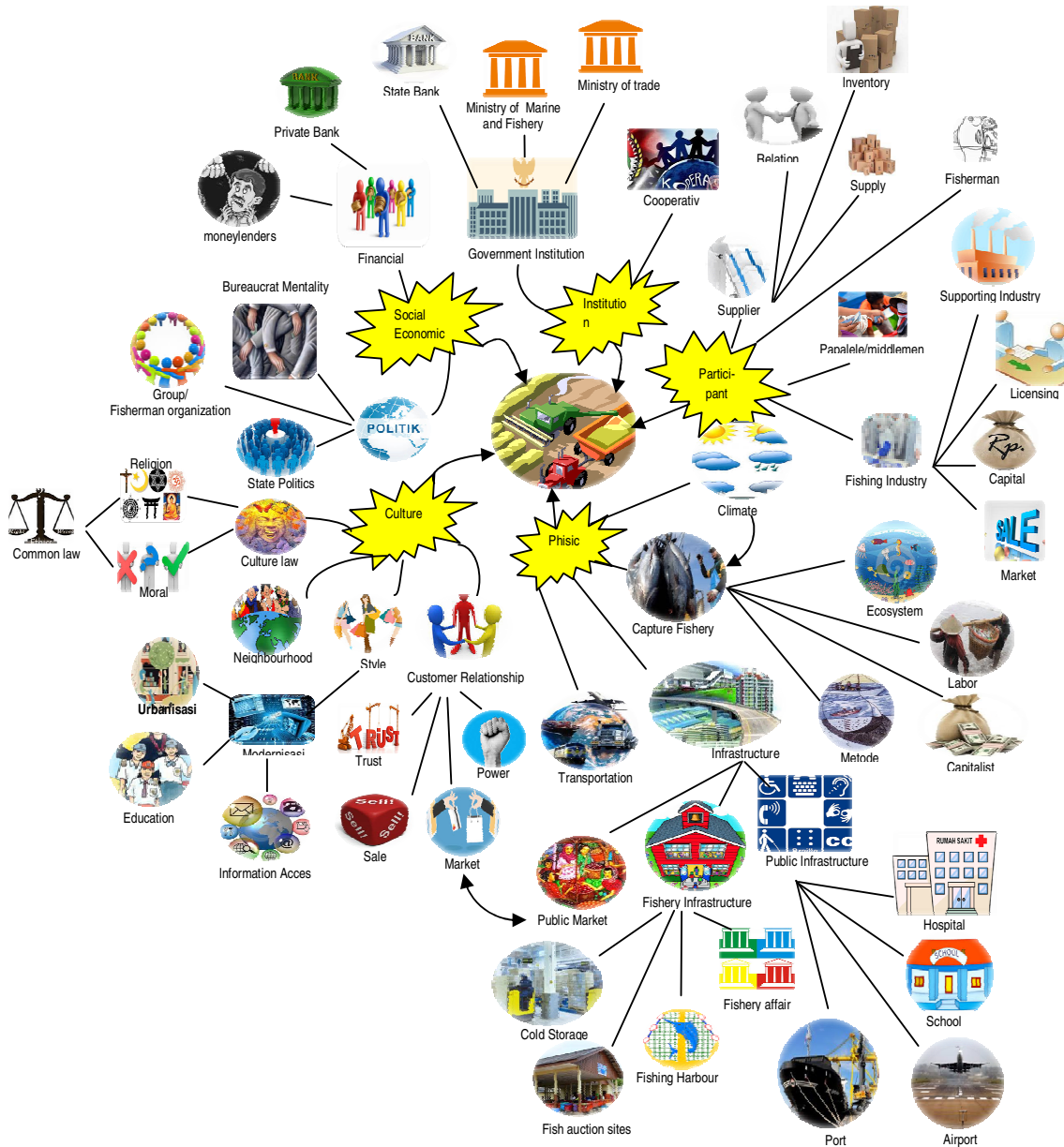


Fig 3. Rich picture of the capture fishing industry supply chain in Maluku province

**Stage 7 of SSM : Action Plans**

Formulation of action plans were recommended to be implemented by related parties. This study skipped the stage 7.

*4.1.2. Identification of design modelling assumptions*

*(a) Study Findings of Soft System Methodology*

- One sub-system models built in an ideal model for supply chain management of the capture fishing industry was the sub-system model for logistics network. The government policy on national fish logistics system and Maluku as the national fish barn



- In the implementation of phase 5 and 6, the activities of fishing distribution remained focused on the fishing port of Ambon and to date there were only six fishing ports operating.
- Access to the outside areas of the island could only be reached by marine transportation so that

the distribution process was only possible with boats.

- Improvements of distribution problems were conducted by developing the industrial network that matched condition and situation of Maluku areas by optimizing the function of existing fishing industry centres.

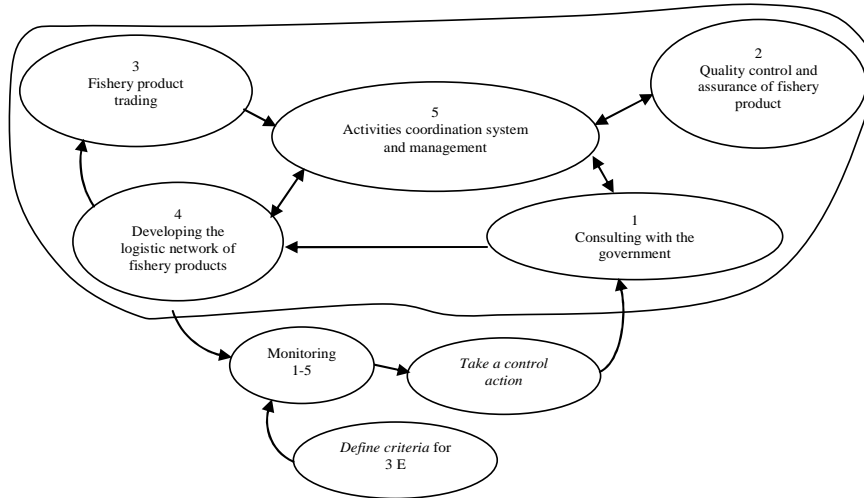


Fig 4. A model for coordination and supply chain management system of the capture fishing industry in Maluku province

Table 1. Implementation of the third and fourth stages SSM

Items	Descriptions
Root definition	A system in which fishery products in Maluku province was distributed (P) in a coordinated supply chain (Q) which yield a fair profit margin for all actors and there was a two-way information flow through the supply chain (R).
CATWOE Analysis	
Customers (C)	Supplier, fishermen and other supply chain actors who benefit directly from the system. While banks and the government institutions affecting the supply chain might benefit indirectly. Middlemen / <i>papalele</i> would immediately experience loss of profit. Distributors would experience a decrease in profit in short time, but would obtain net profit in the long term.
Actors (A)	All actors of the supply chain, including the final consumers
Transformation (T)	From not coordinated to coordinated.
Viewpoint (W)	Supply continuity of standard quality products at a fair profit sharing throughout the supply chain
Owners (O)	All the supply chain actors including the government institutions involved in the supply chain.
Environmental constraints (E)	The supply chain might change from individualist into a focused chain. There would be some rejection of the changes.
Purposeful Activities	
1	Consulting plans of coordination system with relevant the government institutions
2	Building fisheries Monitoring systems and quality assurance
3	Building a Trading System of fishery products
4	Building Logistic fishery systems
5	Designing activities and the implementation of coordination and management systems of the supply chain
Performance measure criteria	
Efficacy	The coordination establishment among actors in the supply chain
Efficiency	Employing minimum resources and time
Effective	Achieving an effective supply chain performance of the capture fishing industry in Maluku province

(a) Study Findings of the Supply Chain Institutional Structure Analysis

(1) The affected community sectors

The affected community sectors in supply chain activities of the capture fishing industry in Maluku

province consisted of 9 sub-elements. The sub-element of fishermen was a key element in the affected communities in the supply chain of the capture fishing industry in Maluku province (Fig 5).

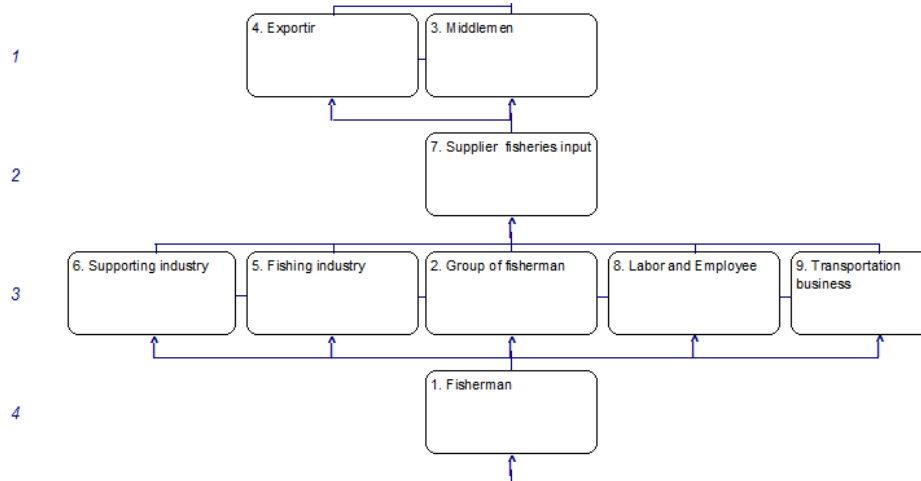


Fig 5. The hierarchical structure of the affected community sectors

Fishermen were a key element that would be able to affect or move sub-elements of other affected community sector elements including communities, businessmen / industries of raw material and component suppliers, businessmen / fishing industries, fishermen, workers and employees of companies, transportation entrepreneurs, providers of fishery infrastructures, exporters and traders.

Further, the driving power-dependence mapping of affected community sector elements (Fig 6) shows that the sub-element 1 (fishermen) was in the sector IV. Sub-elements in the sector IV were elements with higher driving power towards other sub-elements but low dependence. Thus, it could be concluded that the fishermen sub-element was a key element in the supply chain of the sustainable capture fishing industry.

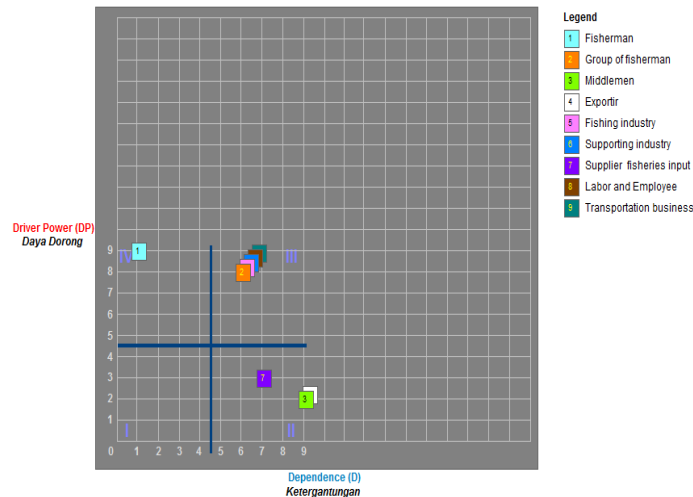


Fig 6. The driving power-dependence mapping of affected community sectors

Sub elements of fishermen groups (2), fishing industries (5), industries of raw material suppliers (6), labours and employees (8) belonged to the

sector III (linkage) seemingly unstable. Sector III was a sector in which the sub-element owned high driving power and also high dependence towards

other sub-elements. Thus, the careful study was needed in administering treatments and applying for management of sub-elements. The pattern of treatments/ management of sub-elements in this sector would create impact and feedback on other sub-elements. The success of these sub-elements would be a benchmark for the success of the other elements.

#### (2) Program Requirements

On the basis of SSM analysis, there were 15 sub-elements that constituted requirements in the supply chain of the fishing industry, i.e.: the certainty of price (1), handling technology of fishery qualities (2) production technologies (3)

Regulation (4) the availability of fishery production facilities and infrastructures (5) Cold storage Facilities (6), empowerment of fishermen communities (7), the availability of infrastructure (8), skilled human resources (9), infrastructures of public services administration (10), the availability of the fishery database (11), market information (12), fish resources management (13), access to capital (14) and the harmonious coordination (15). According to the some expert opinion, the hierarchical structure of sub-elements within the requirement elements was obtained as shown in Fig 7.

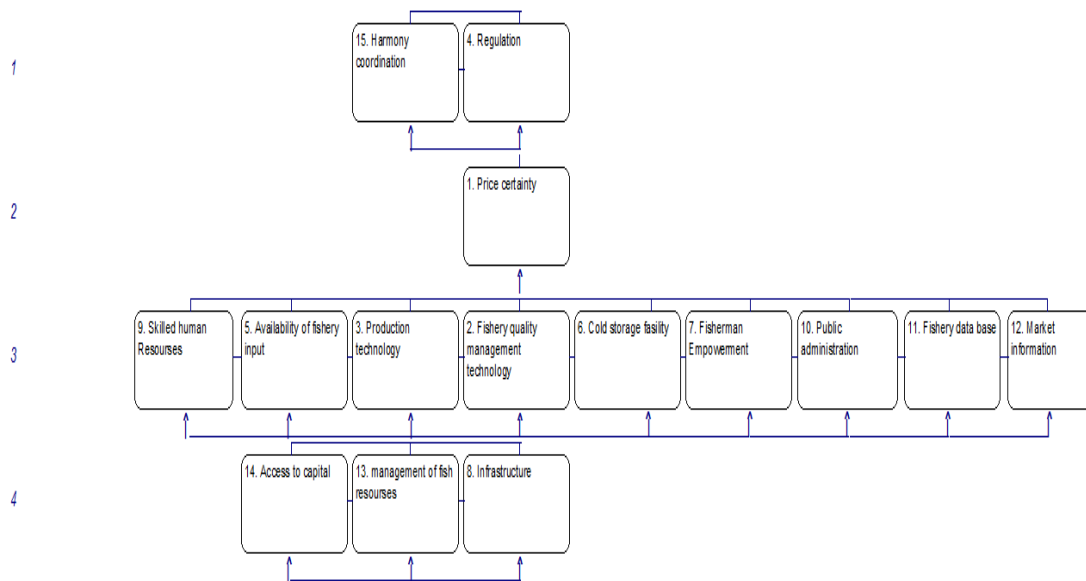


Fig 7. Hierarchical structure of sub-elements within the requirement elements

Fig 7 shows sub-elements of accesses to capital, management of fish resources and the availability of infrastructures were in the lowest level (level 4). As a result, these elements are key elements that should be the focus of need fulfilment of actors in an improvement of supply chain performance. On the driving power-dependence mapping, Sub-elements of accesses to capital, management of fish resources and the availability of infrastructures belonged in the sector 4 (Fig 8). The handling technologies of fishery qualities (2), production technology (3), the availability of fishery production facilities and infrastructures (5), empowerment of fishermen communities (7), cold storage facilities (6), skilled human resources (9), availability of fishery database (11) as well as market information (12) wherein the sector III (Fig 8). Thus, those sub-elements were ones that owned high level of driving power and dependence towards other elements in the sub-elements of the program

requirements. Mean while, sub-elements of price certainty (1), regulation (4) and the harmonious coordination among actors of the supply chain were in the sector II. These three sub-elements were sub-elements that owned high dependence towards others but low driving power.

#### (c) Constraints.

Results of the ISM analysis towards fourteen sub-elements in the constraint elements indicate that the climate / weather sub-element was in the lowest level. Therefore, the climate / weather sub-element was a major constraint that must be the focus of attention in improving supply chain performance. Hierarchical structure of constraint elements is shown in Fig 9. Driving power-dependence mapping of the constraint elements indicates there were six sub-elements in the sector III. Those included elements of climate / weather, limited access to funding and capital, unsecure continuity

of raw materials, low-skilled human resources, poor management of fisheries and limited

transportation and communication.

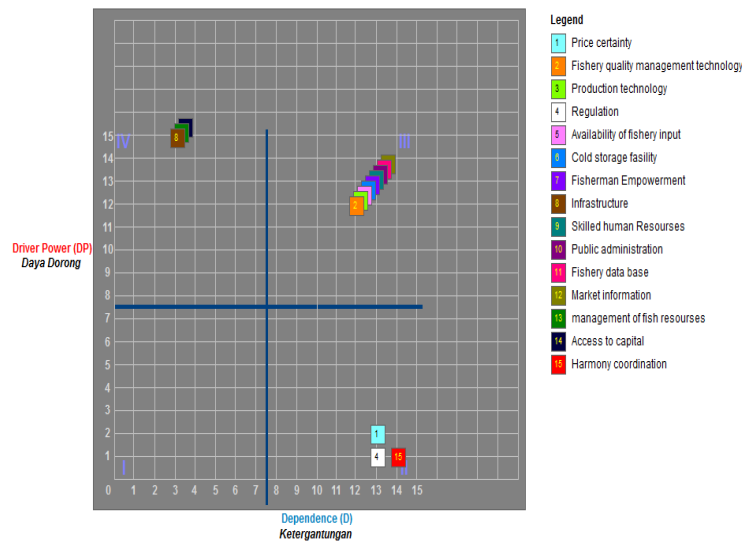


Fig 8. The driving power-dependence mapping of program requirements

This suggests that all six sub-elements possessed high driving power and low dependence towards other sub-elements. Results of the power driving-dependence mapping indicate there were no sub-elements in the sector III. There were six other sub-elements comprising unsupportive regulation (8), lack of coordination and commitment among stakeholders (4), weak socio-cultural institutions (1), the poor logistics network (2), unfocused commodities and fishing industries (7) and low fishery productivity in the sector II. Additionally, there was a sub-element, the low access to the availability of supporting facilities, over the dependence line with low driving power but high dependence. The sub-element of low catch productivity was right at the intersection of driving power-dependence lines. More details of driving power mapping results are presented in Fig 10.

On the basis of ISM analysis of actor, requirement and constraint elements, fishermen were a key element in the supply chain of capture fishing industry in Maluku province. Fishermen had high driving power but low dependence towards other sub-elements. On requirement elements, SSM analysis results indicate that accesses to capital, management of fish resources and the availability of infrastructures are the focus that must be met. The ISM analysis of constraint elements shows that the main constraint in the supply chain was the climate / weather. In addition, the other obstacle that should be the focus of improvement is the limited access to funding and capital. This is in line with the research of [20] arguing that the weakness

of small-scale fisheries was limitedness of capital and low education levels.

Thus, the improvement of fishing industry supply chain would focus on the institutional establishment of fishermen and meeting the needs of fishermen in terms of access to capital able to overcome the fishermen's constraints in terms of access to capital.

### 4.3. Modelling the Capture Fishing Industry Sustainable Supply Chain Management

#### 4.3.1. The Regional-Based Network Model for the Capture Fishing Industry

The analysis results show that the PPI Amahai was defined as the Main Service Provider 1 and PPN Ambon as the main service provider 2. This was because both had the highest total scores compared to four other ports on TOPSIS analysis (Table 2 and Table 3). According to the infrastructures, the number of fishing vessels, supplies of input factors and the number of fish landed, it was known that Maluku was the best and the most complete industry centre with the highest number of fish production compared to 4 centres in four other islands.

Some of the assumptions were considered to calculate the travel time and transportation costs of each scenario. Optimization models were carried out by spacing minimization analysis based on statuses of industry centres as contained in Table 4.

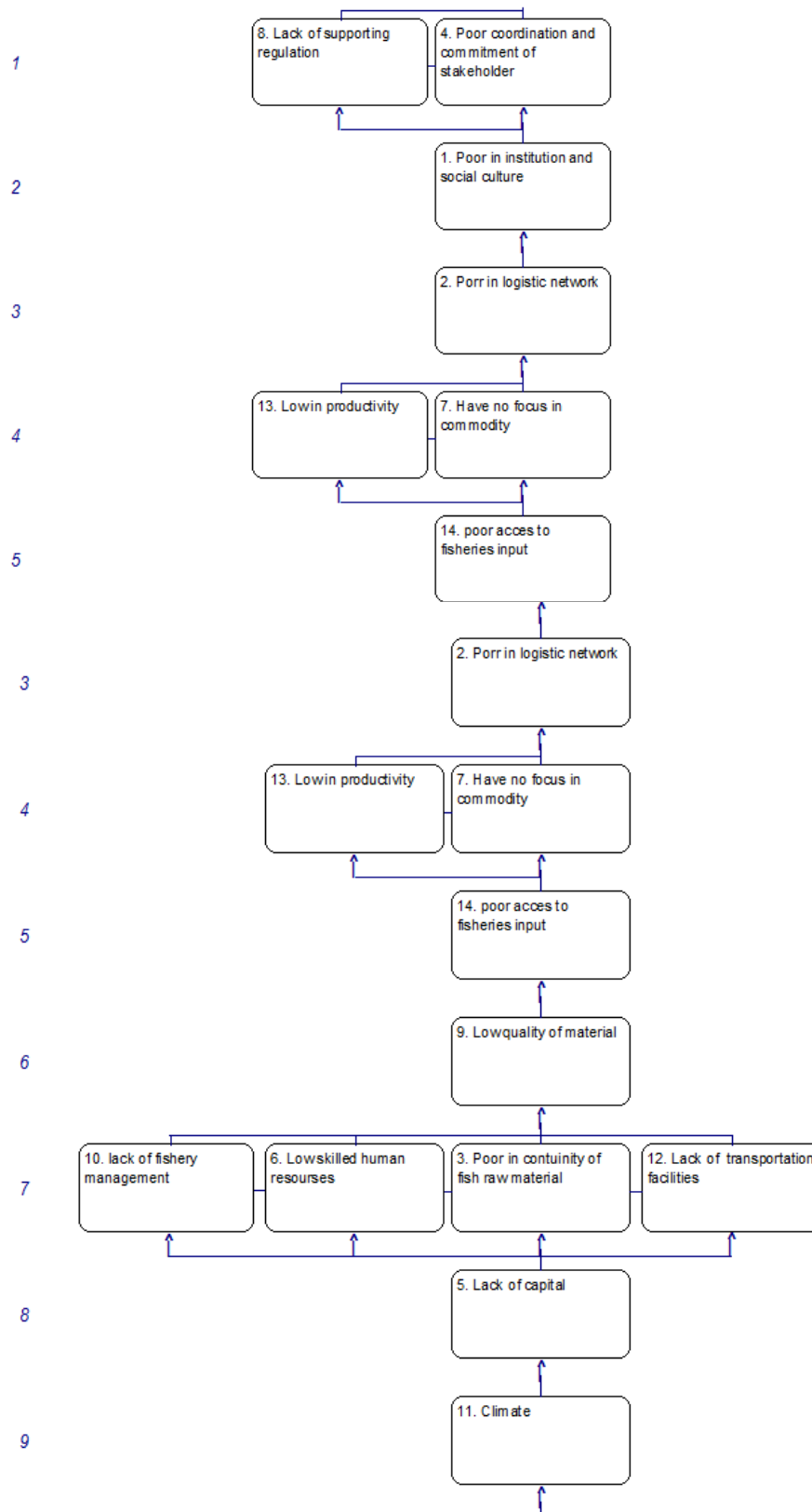


Fig 9. Hierarchical structures of constraint elements

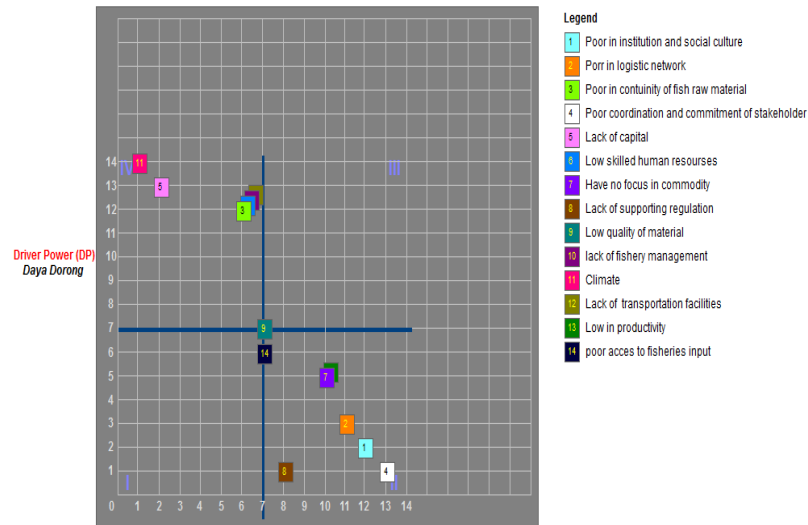


Fig 10 Mapping of driving power-dependence constraints

Table 2 IPFP, IKAPI, IK and KSI values of capture fishery industry centres in Maluku Province

Port	IPFP	IKAPI	IK	KSI	Total
PPN Ambon	1.0	0.1	1.0	1.0	3.1
PPI Eri	0.4	0.1	0.4	0.7	1.6
PPN Tual	0.2	0.1	0.5	0.1	1.0
PPI Massarette	0.0	0.0	0.3	0.0	0.3
PPI Amahai	0.5	1.0	0.9	0.5	2.9
PPI Tamher Timur	0.1	0.0	0.0	0.5	0.6

Descriptions :

IPFP : The Index of Port Facility Services; IKAPI : The Index of Fishing Ship Capacity; IK: The Index of Independency, KSI : Capacity of the Industry Centre

Table 3 Ranks and statutes of industry centres status of the capture fishing industry in Maluku province

Ranks	Industry Centers	Random Utility Values	Values of IPFP and IKAPI	Statuses
1	PPI Amahai	0.69823	1 <sup>st</sup> Highest	Main Service Provider 1
2	PPN Ambon	0.54123	2 <sup>nd</sup> Highest	Main Service Provider 2
3	PPI Eri	0.37872	Positive	Server/Spoke Services Provider
4	PPN Tual	0.06705	Positive	Server/Spoke Services Provider
5	PPI TahmeTimur	0.04123	Positive	Server/Spoke Services Provider
6	PPI Masarette	0.01094	0.0	Client

Tabel 4 Distances between Clients and servers

Origin (Client)	Destination (Server)		
	PPI Eri	PPN Tual	PPI Tamher Timur
PPI Masarette	151 Km	725 Km	287 Km

PPI Eri, PPN Ambon and PPI Tamher Timur were centres of the capture fishing industry receiving positive scores on IPFP and IKAPI parameters as they ranked 3rd, 4th and 5th respectively in the TOPSIS analysis. The results of the above analysis concluded that the centres of the capture fishing industry of the three fishing ports had a status as

the service providers (servers/spokes). Low IKAPI and KSI values of these industry centres had demonstrated the small capacity of fishing vessels and fish landed. A zero value on the IK parameter suggests the input factors supplies of these industry centres depended on supplies from PPI Amahai and PPN Ambon.

Refers to statuses of fishing ports, industrial network scenarios were organized. Formulation of alternative models was performed by creating network development scenarios of the capture fishing industry formed on statuses of each fishing port. The alternative networks for the capture fishing industry were generated by the formulation

of alternative models and analysis of the travel time and transport costs of output variable.

On the basis of distances between the client and the three servers (PPI Eri, PPN Tual and Tamher Timur PPI), one PPI server with the shortest distance was selected. The shortest distance between the client and the server is that between PPI Massarette and PPI Eri. Therefore, the catch in PPI Massarette is immediately transported to PPI Eri as a server for the purpose of collection. Then, an analysis of the shortest distance from each server to the main server was conducted. The distances between each server to the main server is presented in Table 5.

Table 5 The distances between each server and the main server.

Origin ( <i>Server</i> )	Destination ( <i>main server</i> )	
	PPI Ambon	PPN Amahai
PPI Eri	16 Km	159 Km
PPN Tual	605 Km	566 Km
PPN Tamher Timur	184 Km	127 Km

Results of the distance analysis between each server and the main server indicates that the shortest distance was 16 Km from PPI Eri to PPN Ambon. Therefore, henceforth fish in PPI Masarette would be collected in PPI Eri and then transferred to PPN Ambon. PPN Tual and PPN Tamher Timur act as servers for the supplies of fish in the vicinity, because of the closer distance rather than that to PPN Ambon, before the fishery products are transported to the PPN Amahai. Results of the distance minimization analysis above indicates that the chosen models were already obtained, i.e.: PPN Ambon had a status as the main service provider (main server) interacting directly with one server (PPI Eri) which is the server that interacted directly with one client, PPI Masarette, while The PPN Tual and Tamher Timur have statuses as servers serving the catch in the vicinity before transferred to PPN Amahai. Thus, the main server PPI Tamher Timur, serves PPN Tual and PPI Amahai. The costs and travel time calculation was performed towards results of the distance analysis. Routes, volumes, travel times and transportation costs of alternative networks are shown in Table 6.

Table 6 Routes, volumes, travel times and transportation costs of alternative networks

No	Route	Volume (Tons)	Travel Time (hours)	Transportation Cost (Million Rupiahs)
1.	PPI Masarette –PPI Eri – PPN Ambon	29 337.6	7 781 637	50 851 840.000
2.	PPN Tual – PPI Amahai	4 168.6	13 783	8005573333
3.	PPI Tamher Timur – PPI Amahai	18 913.6	1 736	5269680.000
	Total	52869.8	93.336	641 270 93.333

Table 6 shows that the route of PPI Masarette - PPI Eri - PPN Ambon would transport as much 29 337.6 tons with 7781637 hours travel time and 50 851 840 000,- IDR cost. On the route of PPN Tual - PPI Amahai, the volume of fish that would be gathered around the main server of PPI Amahai was as much as 4 168.6 tons for 1 3783 hours and 8 005 573 333,- IDR cost.

For the route of PPI Tamher Timur - PPI Amahai, fish might be transported as much as 18 913 6 tons with the 1736 hour travel time of transportation and 5 269 680 000,- IDR cost. The average transportation cost required by this network model is 1 3593 IDR/ton/hour. The average transportation cost of the capture fishing industry in Maluku province is shown in Table 7.

Table 7 shows that the alternative network models provide the total time 24.36% shorter than the existing models. Apparently, in terms of total transportation costs and the average costs alternative model transportation were, respectively, 48.78% and 7.49% cheaper than the existing models,. Thus, there is a demand for an improvement of the industrial network towards

those existing industrial networks. The network improvement could be initiated by reviewing facilities, capacity and capability of the existing fishing industry centres.

Table 7 The average transportation costs of the capture fishing industry network in Maluku province

Model	Total travel Time (hours)	Total cost transportation (Million Rupiahs)	Average transportation cost (Rupiahs/tones/ hours)
Existing	123 399	125 198 320	13 593
Alternative	93 336	641 270 93	12995

The results show that in the network model for fishing industries in Maluku province, PPN Ambon and PPI Amahai would act as the main server. PPN Tual, PPI Eri and PPI Tamher Timur act as servers whereas PPI Masarette would take a role as Clients. PPN Ambon would act as the main server on the route of PPI Masarette - PPI Eri - PPN Ambon. The PPI Amahai would play a role as the main server to

route a PPN Tual - PPI Amahai and PPI Tamher Timur - PPI Amahai.

4.3.2. *The Institutional Model for the supply chain of the capture fishing industry.*

Based on the ISM analysis, it could be formulated the root definition as follows: "A fishermen financial institution which is able to meet the needs of fishermen in terms of access to capital with easy procedures and responsive to the socio-cultural conditions of fishermen and is managed and operated by fishermen (P) established through the support of community and the government (Q) to evolve the existing fishery businesses (R)".

CATWOE Analysis

Customers (C)	Fishermen
Actors (A)	All supply chain actors
Transformation (T)	Financial institution providers that can be accessed easily and responsive to fishermen
Worldview (W)	The fact that fishermen have an access to capital through the established financial institutions
Owner (O)	All supply chain actors including the governmental institutions involved in the system
Environmental constraints (E)	Support of willingness and good faith from communities and provincial and regencial the governments, non-the governmental organizations, NGO

The core of the thinking system was the conceptual model generation as an intellectual means that was used to discuss real-world situations considered problematic [2]. The conceptual model for the establishment of the fishermen cooperative could be carried out with the following activities: (1) submission; (2) Educating fishermen about the cooperative and how to manage it; (3) Establishing the fishery cooperative; (4) Collaborating with relevant businesses; (5) Monitoring and evaluating the cooperative. A conceptual model for the development of the fishermen cooperative is presented in Fig 11.

The success of this conceptual model could be measured by 3E criteria (Efficacy, Efficiency, and Effective as follow:

- Efficacy The availability of the fishermen cooperative managed and operated by fishermen and responsive to them
- Efficiency Employing human resources of local fishermen
- Effective An effective management and operational of the cooperative business in favor of fishermen running the capture fishing business

The next step is comparing the conceptual model to that in the real. [41] described the comparison of the conceptual model to that in the real world (Table 8) made by answering questions whether it existed in the real world, how it could be, and by what criteria it could be assessed.

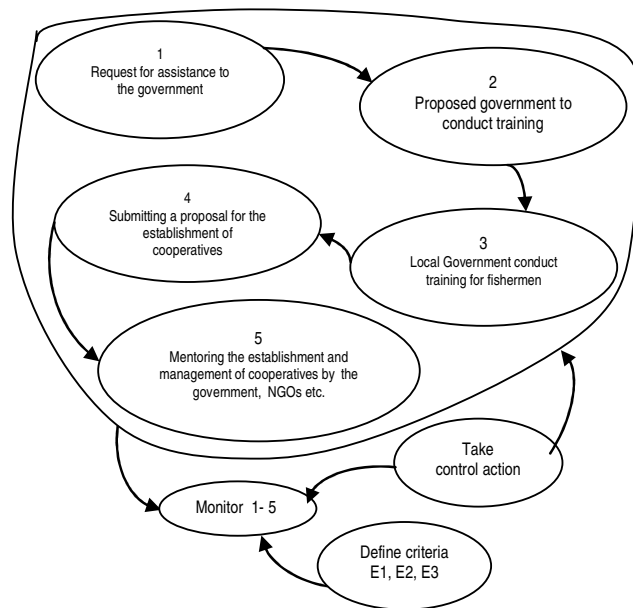


Fig 11. The conceptual model for establishment of the local fishermen cooperative



Table 8. The comparison of the conceptual model to that in the real world

Activities	Real World	How	Who	Good/ Bad	Alternatives
Assistance request to the government	Not available	Discussing with community public figures and groups	Fishermen and influential public figures	Not going well	The government would step in
The submission of training proposal for cooperative establishment, business plan and the management	Not available	Normally, the financial proposal is submitted through the government staffs by fishermen associations/ groups	The government, fishermen associations/ groups	Already proposed but the responses were not yet received	The chairmen of groups and their deputies directly hand over the proposal
Local the government held training for fishermen	Already available	NGO-based program training	Fishermen, headmen, NGO	The training results could not be implemented	Training is held based on demands and by involving influential public figures
Submitting the cooperative establishment proposal	Not available	Normally, the financial proposal is submitted through the government staffs by fisher associations/ groups	The government, fisher associations/ groups	Already proposed but the responses were not yet received	The chairmen of groups and their deputies directly handed over the proposal
Establishment and management assistance by the government, NGO etc	Already available	Assistance of community empowerment programs by involving public figures	The government, NGO	The expected programs did not persistently run	Assistance programs are sustainable and held based on demands and by involving influential public figures

Refers to the stage 5 of SSM, desired changes were formulated systematically without breaking cultural norms, comprising the significant changes able to meet needs and desires of stakeholders [42] as described in Table 9. Dialog and arguments relied

on the allowed visual materials were more efficient rather than merely dialog and arguments only [39]. As stakeholders take a part in taking actions visual materials would increase their involvement [40].

Table 9 Formulating changes

How	Desired?	Feasible?	Possible actions?
Assistance request to the government	Yes	Yes	Taking an approach to public figures and fishermen groups and determining who would express expectations of the assistance.
The training proposal of cooperative importance, ways to establish a cooperative as well as ways to manage it	Yes	Yes	Deciding desired training topics, setting a time, and determining who would be a person in charge.
Local the government held training for fishermen	Yes	Yes	Deciding the location and the type of training and the participants.
Submitting cooperative establishment proposal	Yes	Yes	Preparing the proposal for aid assistance and determining who would submit it and when.
Cooperative establishment and management assistance from the government, NGO etc	Yes	Yes	Proposing assistance request to the government/ NGO/ banking institutional consultants

The action plans in implementing changes and improvement in problems mentioned was conducted as a strategy to answer problems in the

supply chain of the capture fishing industry in Maluku province. The construction of action plans was recommended to be implemented for the

related parties in accordance with the results of Focus Group Discussion. This study skipped the step 7 of SSM.

[43] claimed that the institution functioned as the rules in a social group and highly influenced by economic, social and politic factors. They could be formal rules or in forms of informal ethic codes mutually agreed. Thus, is it hoped that the established fishermen' institution could improve performance of the supply chain of the capture fishing industry since such financial institution that would be built adopts the prevailing socio-cultural values in community.

On the basis of SSM analysis, it is suggested that there was problematic situation faced by fishermen. To date, fishermen are accustomed to the system run by rural institutions and figure out benefits of the rural financial institution controlling. Nevertheless, some of them once gained bad experience with the financial institutions such as the KUD (village unit cooperative). Therefore, the financial institution that would be developed is the village financial institution such as the cooperative that would be managed and run by fishermen themselves. In order to succeed the financial institution mentioned above, there are several essential stages to do.

In the first stage, kinds of educational activities regarding the model for a village financial institution and how to run it properly are delivered to the fishermen. The training could be presented by the fishermen associations/ groups supported by related parties such as state banks and others operating nationally, universities or NGO. Once the village financial institution is established, in order to maintain and enhance its performance it would be necessary to collaborate with business people including public banks or private banks, BUMN (Indonesian state owned enterprises), and other proprietorships. The primary output expected from this activity is the large number of fishermen whose knowledge and understanding about the village financial institution and the way to run it are increased. It is also expected that fishermen would be prepared for running and managing their own financial institution.

The training that would be conducted is as follows:

- The advantages and disadvantages of being members of the village financial institution
- The rights and obligations of financial institution members
- The reward and punishment system applied for members
- The management of the financial institution business

- The development of an appropriate information system

Apparently, the input givers are mostly fishermen groups having representatives at the village level, able to coordinate the process, having resources and good relationship with the research institutes, universities and the ministry of cooperatives.

The second stage is the stage for the purpose of gathering support from community and important organizations. The support for the concept of local financial institution establishment is expected from the village institutions and village leaders (traditional leaders or influential people in villages), community outside villages and village neighbourhood and the government representatives in villages. Fishermen are required to arrange consultation with village representatives from the government and the ministry of cooperatives and small enterprises at the village level. Besides, it is essential to engage relationship with relevant businesses working with different trading or able to conducting trading with fishermen in villages. In this case, the proper group to coordinate this activity is the fisher associations/ groups. All the inputs and opinions and suggestions collected are considered in developing the proposed village financial institution. The outcome from this activity would come to a conclusion on sustainability of the local village financial institution development and encouragement at the village level.

The third level is developing the local financial institution based on provisions set by the government. Those provisions include the government policy to promote small businesses to work together constructing cooperative business structures. Formally, each financial institution including cooperatives should be legally recognized by the government representatives at local levels. Therefore, the proposal accompanied with a dissertation of a clear business plan providing the full support (finance and members) for establishing a village financial institution is required. Consequently, the training for developing a village financial institution and matters related to the business plan and the formal documentation are necessary to formerly undergo. This could be received from the government representatives in regencies or provincial levels. For the appropriateness of the proposed cooperative, a close cooperation with other businesses is critical, particularly with the village traders and fishery product supplier, banks and other financial institutions as well as traders and fishery product supplier in higher regional levels.

## 5. Conclusions and Suggestions

The situational analysis using statistical data shows that the capture fishing industries in Indonesia mostly are located in Ambon city. The sustainability of the capture fishing industry in Maluku province was categorized into the less sustainable level (43.91) with the good and excellent levels of fishing industry performance in scopes of fishermen and companies. This was because companies had already focused on one commodity and run the system of order in the process of marketing that enabled them to prepare the better production planning. One ideal model for the supply chain management system of the capture fishing industry was the system of coordination and supply chain activity management. The institutional structure analysis using ISM shows that the affected key element of community sectors was the fishermen; while the main need that must be met was capital; and the main obstacle faced was the limitedness of access to funding and capital. According to the present results, the institutional model focused to establish was a local fisher cooperative as a fishermen financial institution able to meet needs of them in terms of capital access with an easy procedure and responsive to the condition of fishermen' socio-culture and managed and operated by fishermen evolved by community and the government support for developing fish farming. The institutional model for fishing industries built was based on 6 fishing ports operating in 3 routes of (1) PPI Massarett – PPI Eri – PPN Ambon; (2) PPN Tual – PPI Amahai and (3) PPI Tamher Timur – PPI Amahai. The network model constructed provided the total time 24.36% shorter compared with those already existed and 48.78% cheaper in terms of total transportation costs and 7.49% compared with network models presenting today.

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**Appendix 1.**Implementation of the fifth and sixth stages of SSM

Sub Systems	Current activities	Gaps	Action Plans
Coordination and management	There was no coordination between the fishermen and the supply chain or among actors in the supply chain	<ul style="list-style-type: none"> <li>• Lack of communication</li> <li>• Individual marketing</li> <li>• No coordination</li> <li>• No cooperation among supply chain actors</li> </ul>	<ul style="list-style-type: none"> <li>• Actors had not a strong bargaining position during all negotiations and when coordinating supply chain but the process of fair trade and sustainable trade could be performed</li> </ul>
Trade in fishery product	<ul style="list-style-type: none"> <li>• The trade was not coordinated in a supply chain</li> <li>• Almost 80% of trade were executed traditionally and limitedly in Maluku</li> <li>• Most of tuna fishermen, particularly, had been cooperating with companies</li> </ul>	<ul style="list-style-type: none"> <li>• Performed individually</li> <li>• Fishermen did not have the bargaining power</li> <li>• The absence of market information</li> </ul>	<ul style="list-style-type: none"> <li>• The trade process would be more efficient and provided higher profits once it was carried out in groups in a good collaboration between sellers and buyers</li> <li>• Each actor should be able to access market information</li> </ul>
Quality control and assurance of fishery products	<ul style="list-style-type: none"> <li>• Most fishermen did not understand about qualities and do not have adequate facilities for storing or handling fishery products.</li> <li>• Catching was carried out by traditional methods</li> <li>• Depending on the climate or season</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of facilities to control and maintain product qualities</li> <li>• Limitedness or very lack of the ice supply</li> <li>• Lack of practical management</li> <li>• Lack of knowledge about post-harvest handling</li> <li>• Did not have quality standards, qualities were set by buyers</li> </ul>	<ul style="list-style-type: none"> <li>• Training for fishermen on how to handle the catch and how to perform quality-based grouping by approaching to fishermen groups and involving public figures or community leaders or trusted people.</li> </ul>
Distribution and dispatch of fishery products	<ul style="list-style-type: none"> <li>• Distribution process was only possible with sea transportation.</li> </ul>	<ul style="list-style-type: none"> <li>• Modern transportation was still limited</li> <li>• No efficient logistics network</li> </ul>	<ul style="list-style-type: none"> <li>• Collaboration among actors would optimize the distribution system</li> <li>• Building the port-based fishery logistics network</li> </ul>
Consultation with the government staffs	<ul style="list-style-type: none"> <li>• Theoretically, fishermen are able to discuss their problems with PPL</li> <li>• Some PPL did not carry out their duties</li> </ul>	<ul style="list-style-type: none"> <li>• Consultation of fishermen was performed by volunteers from non-the government institutions/ organizations and also by headmen who actively sought the latest information about the process of fishery product marketing</li> </ul>	<ul style="list-style-type: none"> <li>• PPL and other the government institutions need to be more involved in the provision of training or in a well-organized system</li> <li>• Incorporating the supply chain issue into one focus of annual programs</li> </ul>