Framework design of decision support system: Improving decision making in fishery supply chain for coastal communities

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Abstract. The focus of researchers in the field of decision making which related to designing a decision support system to assist in the decision-making process, so far is very limited to the fisheries sector, especially at the small and micro business scale. On the other hand, the SME-scale fisheries sector is a major driver of regional and country performance because it has a very significant multiplier effect on the economic development of the region. Specifically, for coastal areas, the main problem faced is the consistency of the results obtained, one of the main causes is a distorted supply chain. In this study, we are trying to design a conceptual framework for decision support systems in order to assist the decision-making process of fisheries business operators in coastal areas in the Kei Islands, Indonesia. With the main objective of expediting the supply chain of fisheries in this region. The design of the DSS that was built was adjusted to the needs of every fishery businessman in this region. So, in addition to web-based DSS framework design, we also conducted surveys on fisheries supply chain processes from capture fishermen and aquaculture farmers to adjust the conditions of needs and empirical problems to design DSS concepts that can help overcome supply chain problems in the fisheries sector in the region.

Keywords: decision support system, conceptual, supply chain, fisheries

1. Introduction
Effort in designing a decision support system (DSS), especially in business processes that have entered a high level of complexity where there are many factors that must be considered. DSS helps users to simplify and improve the performance of decision-making processes through information provided through computer programs that are designed [1-3]. The use of DSS has been very widespread in various fields including non-manufacture sectors such as agriculture [4-9], DSS utilization in the livestock sector [10-13], DSS utilization in the fisheries sector [14-19]. Even so the use of DSS is still limited to large periodic businesses and is still very limited to micro-scale businesses, specifically in the fisheries sector which is directly related to fishermen and aquaculture farmers. There are many factors that cause the attention of researchers so far not yet done a lot of research to produce DSS in the sector technically rely most on unpredicted sector such as agriculture and fisheries which makes the difficulty to formulate in an effective computer system is higher than other sector [20]. For this reason, it is necessary to use the precautionary
principle in preparing a DSS that is in accordance with user needs and is also capable of producing information in accordance with empirical conditions with simulation capabilities and an appropriate algorithm approach.

The fisheries sector in Indonesia should be one of the sectors that are the backbone of the economy of special regions in the coastal areas and islands such as in Maluku Province specifically in the Kei Islands. The money generated by each fishing village in the Kei Islands region is 150 to 200 million [21]. This condition is of course very worrying because until now the impact of the fisheries sector on the welfare of coastal communities in this region is still very low even the coastal communities who work as fishermen and aquaculture farmers are included in the marginal category. Technological factors [22], potential conflict factors [23], geographical location, infrastructure and transportation [25] become several factors that cause suboptimal contribution of the fisheries and marine sector for coastal communities in this region. In general, coastal communities in the Kei Islands are well aware of and understand the importance of the marine resources they have for their well-being, considering that the Kei Islands sea area has the highest level of biodiversity in the world and belongs to the coral triangle area [26], so the contribution of the fisheries sector should be the main driver for equity and improvement of economic and social welfare.

As mentioned by Tama et al. [26] regarding the importance of identify supply chain risk, based on preliminary research conducted by Hamid et al. [27] and Teniwut et al. [28] that, due to a combination of factors that exist both geographical, transportation, technology and human resource capabilities to infrastructure that has not been evenly distributed greatly affect the smooth supply chain flow in this region for the fisheries sector. For that reason, the recommendation produced by Teniwut et al. [28] is to create an information system whose purpose is to facilitate the supply chain flow within the Kei Islands region, starting from the location of fishing and cultivation, procurement of seeds for aquaculture, access to equipment, to harvesting activities, post production, distribution to sales. Thus, taking into account the geographical conditions and existing infrastructure and transportation, the purpose of this study is to design a good decision support system, in accordance with empirical conditions and beneficial for fisheries businesses in the Kei Islands in unravelling the distortion in the supply chain of fisheries to increase profitability of fishermen and aquaculture farmers in the region.

2. Material and method
To obtain and produce a good decision support system and in accordance with the needs of the users who are fishermen and aquaculture farmers, a field survey is carried out to obtain assistance related to smoothing the flow of fisheries supply chains in this region. The survey was conducted in 22 fishing villages spread across two administrative regions from January to July 2020, namely Tual City and Southeast Maluku Regency, which aimed to obtain information on empirical supply chain flow and then identify problems to be recommended for assistance through the proposed DSS. For the next stage, a DSS framework is developed. The flow of relationships between users, admin and output generated by DSS.

3. Result and discussion
Based on the results of the field survey that has been carried out, the problem is generalized and summarized into four main factors related to the local supply chain flow in the fisheries sector in this region as shown in Figure 1. The first factor is inconsistency in production, which is caused by the inconsistency of time in carrying out fisheries business activities, whether fishing or fishing costs. In addition, the season also influences the inconsistency of production both in quantity and quality. The second problem factor is, the selling price of products that tend to be incomplete, due
to too long supply chain flows that must be passed by fishermen and farmers so that the selling price margins are quite low. The third factor is profit that does not have a sufficiently good impact on welfare due to very low management ability. The next factor is the limited market demo. This is specifically due to geographical location, where for some villages in this region it was found that the results obtained did not sell as a result of being rotten and damaged on the way to the market.

For this reason, the solution offered to be developed in the form of a DSS is to provide spatial data to help fishermen and aquaculture farmers to determine potential good fishing locations and close to village and market locations, thereby increasing the level of effectiveness and efficiency of production. In addition, there is also a local supplier and distribution station located close to the village location. Furthermore, to maximize profits, output is also provided in the form of calculating profit and production costs to distribution costs so that the user knows where to do business, where to sell efficiently, how to get the maximum profit.

Figure 1. Empirical condition and proposed solution in DSS
Table 1. Proposed DSS workflow

| The main objectives | System Outcome | User point of view | Data provided by admin |
|---------------------|----------------|--------------------|------------------------|
| 1. Produce information on fishing locations and/or seaweed farming locations that have good economic potential | 1. Fishermen and aquaculture farmers can increase profits better and first and foremost are consistent and sustainable | 1. User registration / login | 1. Spatial data: capture sites and cultivation sites that have been processed with ArcGIS with data mining and MCDM approaches |
| 2. Calculate the cost of production and distribution which is then compared with the revenue that should be obtained to get the optimal profit | 2. The ability of fishermen and traditional aquaculture farmers to use ITC will increase so that it will be easier to face the waters | 2. The user has information needed: capture fisheries or seaweed cultivation, continued | 2. Formulation of a feasibility study formula that is suitable for capture fisheries and aquaculture businesses |
|                     | 3. The user will be taken to a new page where the user will be asked to enter location data: The origin of the village and the location of fishing or cultivation desired by district (drop down by district), | 3. The user will be taken to a new page where they fill in the feasibility study data: operational costs (will be broken down into several items); variable costs and fixed costs (will also be broken down into several items), | 3. Formulation of formulas and distribution cost items that are appropriate to geographical conditions |
|                     | 4. Next, the user will be taken to the next place where they fill in the feasibility study data: the vehicle used (public, personal or rental), transportation costs, fuel (if using your own vehicle), the distance from the village to the point of sale, the number of fish / grass sea below, | 5. Next, the user will go to the next page where the user will fill in the distribution data: the vehicle used (public, person  or rental), transportation costs, fuel (if using your own vehicle), the distance from the village to the point of sale, the number of fish / grass sea below, | |
|                     | 6. Save all data, user continues to the next page to review data entry, continued | 6. Save all data, user continues to the next page to review data entry, continued | |
|                     | 7. Users will be taken to the bottom page and output is available where there are: | 7. Users will be taken to the bottom page and output is available where there are: | |
|                     | a. Fishing or cultivation locations (based on district and general) | a. Fishing or cultivation locations (based on district and general) | |
|                     | b. Minimum costs incurred and optimum revenue that must be generated to generate profits | b. Minimum costs incurred and optimum revenue that must be generated to generate profits | |
|                     | c. Efficient shipping costs so as to produce optimal profits | c. Efficient shipping costs so as to produce optimal profits | |
|                     | 8. Print documents or save as PDF | 8. Print documents or save as PDF | |
|                     | 9. Finish | 9. Finish | |
Figure 2. Framework of decision support system
Furthermore, in Figure 2 and Table 1 can be seen the stages of DSS and workflow of the decision support system that was built. Considering the average education level of fishermen and aquaculture farmers in this region is more than 45 years old with elementary education level, it is very important to make a DSS that is very user friendly by minimizing entry that must be done by the user so that the objectives of this DSS can be achieved and useful because the user is easily able to use this built DSS. The DSS that was built will be integrated with the internet so that it has high practicality, the resulting output is also obtained in PDF format to facilitate use on smartphones.

When compared to 4-5 years ago, the reach of internet networks in this region has improved, although more than a few villages in this region still do not have internet access, but it is fitting that web-based DSS becomes a necessity to be able to adapt to developments era. As a region with high biodiversity wealth, the contribution of community fisheries should have a high impact, to help achieve this, the web-based decision support system is expected to help improve the performance of fisheries supply chains in this region.

Both fishermen and aquaculture farmers in the Kei Islands have derived knowledge that is hereditary so it is in dire need of a touch of technology to improve their existing performance [22]. In general, coastal communities are very open with constructive input, so that the role of this web-based DSS can contribute to the reminder and optimization of the benefits of coastal communities. For this reason, this DSS-based development must be easily used [28]. Nevertheless, the results of research conducted by [27] found that fisheries businesses in this region tend to trust more information and knowledge that have been implemented by fellow fishermen or farmers, so that in the implementation and trial process will be targeted to fishermen and farmers who have experience so they will help provide information about the use of this DSS to their colleagues.

4. Conclusion
As an area with high marine resource wealth, fishermen and aquaculture in the Kei Islands should have a significant impact. In fact, until now fishermen and aquaculture farmers in this region belong to the middle to lower community groups. One reason is the low level of technology utilization. Other causes are specifically very related to the supply chain flow of fish in the region starting from the preparation process to start fishing and aquaculture activities, business locations, the results obtained, where to sell, post-production to the market. Thus, the web-based decision support system (DSS) that has been built that will provide information to assist small-scale fisheries businesses in the region in making decisions in a dual increase and optimization of profits derived from the fisheries sector.

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