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Risk Analysis of the Impact of Pandemic COVID-19 on the Health and Economy of Fishery Households in Kedung Cowek Village, Bulak, Surabaya

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ABSTRACT

Since the COVID-19 pandemic hit Indonesia, many fishery households on Indonesia's coast have been affected. Therefore, an analysis of the impact of the COVID-19 pandemic was carried out on the health and economy of fisheries households in the coastal areas of Kenjeran Beach, especially in Kedung Cowek Village, Bulak, Surabaya. The Fault Tree Analysis (FTA) method is used to find the probability of decreasing fisheries household welfare and the Event Tree Analysis (ETA) to find the level of risk for each factor causing the decline in the welfare of fishery households. The analysis result shows that 21 factors cause household welfare in Kenjeran Beach to decline, grouped into two intermediate events: decreasing fisheries household income and decreasing fishery household health. The probability of fishery household welfare decreases by 0.0171212. Decreasing welfare of fisheries households has a risk that fisheries household income will not experience a decrease in income, and there is no spread of COVID-19, with a risk probability of 0.0052 and having a medium risk index level. Based on this, stakeholders in the income and health of fisheries households such as the government, analytical institutions, and households have a role in mitigating the impact of COVID-19.

Keywords: *COVID-19, event tree analysis, fault tree analysis, fishery household, mitigation recommendations*

1. INTRODUCTION

Recently, the world is being shocked by a virus that until now has not found a vaccine. Ebola, Influenza, A (H1N1), SARS, MERS, Zika virus, COVID-19 are also large-scale infectious diseases and have spread in almost all countries. There are 25.3 million confirmed cases of COVID-19 in the world [1].

The first time Indonesia confirmed the COVID-19 case on March 2, 2020, announcing that two Indonesians were positive for the coronavirus, namely a 31-year-old woman and a 64-year-old mother [2]. After that, the Indonesian Ministry of Health developed preparedness guidelines referring to the temporary guidelines of the World Health Organization (WHO). The Ministry of Health opens service contacts that can be accessed by the public. This service is used to communicate matters related to COVID-19. President Joko Widodo decided that regional isolation or lockdown was not a solution for Indonesia. The physical distancing policy or maintaining a safe distance was considered more effective [3].

COVID-19 is a threat to public health, including coastal areas. The population density in these coastal areas increases the risk of the spread of the COVID-19 pandemic due to physical contact and droplets [4]. Due to the implementation of physical distancing regulations, the local economy in the coastal area of Kenjeran Beach is hampered. Fishery households and fishing communities are also affected by COVID-19. There are 26,675 Fishery Households affected by COVID-19 because of the drop in fish prices and closed marketing for exports [5]. Fishers, processors, and sellers also face the risk of the spread and infection of COVID-19 and thus have to make difficult decisions; feed the family, or risk their health [6].

According to [7], a Fishery Household is a household that carries out fishery business activities (catching and or cultivating) to part or all of its products being sold. Thus the fishery household is a fishery economic unit (catching and or cultivation). The occupations which include fishery households are fishermen, fish cultivators, and fish traders.

2. METHODOLOGY

The research method begins by following the data by distributing questionnaires and interviews. The data used in this final project is data on community service activities "Compilation of Scientific Recommendations for Mitigation Policies for Coastal Communities in Facing" Department of Ocean Engineering, Faculty of Marine Technology ITS. This data is one factor that decreases the welfare of fishery households in terms of income and health. Data were obtained through surveys and interviews with the Fisheries Household of Kedung Cowek Village, Bulak, Surabaya, epidemic experts, and the COVID-19 handling task force.

3. RESULT AND DISCUSSION

3.1 Data Collecting

Data collecting is the first thing that is done in a study. The data used were interviews and questionnaires with fisheries households in Kedung Cowek village, Bulak, Surabaya. There are two factors in sampling, namely sampling based on profiles and sample areas [8]. A fishery household is a household that carries out fishery business activities (fishermen, fish traders) to part or all of the products being sold (Kementrian Kelautan dan Perikanan).

Regional sampling is a technique used by researchers when faced with a situation where the research population is well known in various regions. The target area is Kedung Cowek village, a village in the coastal area that serves fishers and fish traders as their main job. The thing that is being studied is the factors that cause fisheries' welfare to decline due to COVID-19. The following is data on fisheries households show in Table 1.

Table 1. Data of Fisheries Household Respondents

Name	Age	Occupation	Service Time
Ilham	64	Fisherman	40
Hasan Solihin Roza	35	Fisherman	10
Musli	50	Fisherman	35
Hafidin	35	Fisherman	15
Irfan	35	Fisherman	15
Atahar	69	Fisherman	50
Somat	27	Fisherman	15
Hulaipi	40	Fisherman	20
Hasana	60	Dried fish seller	20
Fausia	40	Dried fish seller	10
Sumila	60	Dried fish seller	10
Aminah	29	Dried fish seller	4
Sudarmi	52	Dried fish seller	9
Dicky Ayoga Aditya	30	Clam seller	3
Nur Fadila	35	Grago fish seller	5

3.2 Risk Impact Analysis Using FTA and ETA

In this research, the analysis uses FTA and ETA in fishery households in terms of health and economic aspects to determine the factors that can cause fishery household welfare to decline and the risks.

3.3 Determining Fishery Household Failure Scenarios

In this study, the welfare of fisheries households is a system failure event, or it can be called the Top Event in the Fault Tree Analysis. In the preparation of the FTA using the Top Event FTA software.

3.4 Determining the Causes of Fishery Household Failure

Find out the components of failure and the causes of a system failure or what is called intermediate events and basic events, and it can be done by reviewing journals, reports, and news which will then be validated with related parties, namely fisheries households in Kedung Cowek village, Bulak, Surabaya. The following Table 2. shows intermediate and basic events in the FTA.

Table 2. Intermediate Event and Basic Event

Intermediate Event Level 1	*Intermediate Event Level* 2	*Basic Event*
fisheries households income decreased	decrease in fish prices	buyers from outside the area are reduced
		The customer activity is reduced
		Overload fish storage area
	decreased fisheries households activity	reduced export demand
		demand from outside the area is reduced
		People's purchasing ability has fallen
		the cost of living is high
	Oversupply of fish products	Demand for fish is decreasing
		People's

		purchasing ability has fallen
		Fish products cannot be moved/recycled (unsold)
Health & safety of fishery households Decreased	Infected while on-board	The vessels are not cleaned regularly
		No temperature checking
		The equipment is not cleaned regularly (fishing rods, nets, etc.)
		Do not use protective contact equipment (e.g., gloves).
	Infected while lowering fishing yields	Not keeping the distance at the fish market/port
		The equipment is not cleaned regularly (pallet trucks, boxes, etc.)
		Not use protective contact equipment (e.g., gloves).
	Infected during trading transactions (fish market)	Contact with infected people
		The fish market is not clean
		No temperature checking
		Not use protective contact equipment (e.g., gloves).

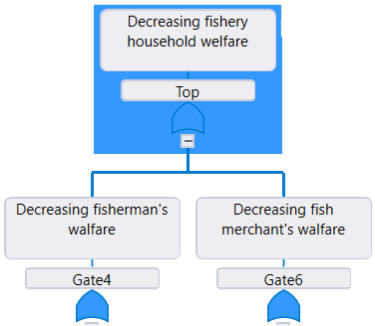

Figure 1. Declining Top Event of Fisheries Household Welfare

3.5 Diagrams and Probabilities for Each Failure Scenario

After determining the basic events and intermediate events, making a fault tree diagram is necessary to make it easier to understand. In Figure 1, the welfare of fishery households is the top event in the impact of the COVID-19 pandemic on the safety, health, and economy of fishery households in Kedung Cowek village, Bulak, Surabaya. There are two intermediate events from the following top event: decreasing fishery household income and decreasing fishery household health and safety. Table 3 bellow show the frequency index.

Table 3. *Frequency Index*

Category	Description	Quantitative
1 (very rarely)	The incidence occurs in the range 1% - 20% during the COVID-19 pandemic (March 2020-November 2020)	10^{-6}
2 (rarely)	The incidence occurs in the range 21% - 40% during the COVID-19 pandemic (March 2020-November 2020)	10^{-5}
3 (sometimes)	The incidence occurs in the range 41% - 60% during the COVID-19 pandemic (March 2020-November 2020)	10^{-4}
4 (often)	The incidence occurs in the range 60% - 80% during the COVID-19 pandemic (March 2020-November 2020)	10^{-3}
5 (very often)	The incidence occurred > 80% during the COVID-19 pandemic (March 2020-November 2020)	10^{-2}

By referring to the frequency index, which can be seen in Table 3, it can produce the basic event and top event probability, which can be seen in the Table 4 below.

Table 4. Basic Event Probability

Code	*Basic Event*	Probability
A.1.1	buyers from outside the area are reduced	0.0003743
A.1.2	The costumer activity is reduced	0.0011412
A.1.3	Overload fish storage area	0.0036418
A.2.1	reduced export demand	0.0043620
A.2.2	demand from outside the area is reduced	0.0003169
A.2.3	People's purchasing ability has fallen	0.0003394
A.2.4	the cost of living is high	0.0027571

A.3.1	Demand for fish is decreasing	0.0004590
A.3.2	People's purchasing ability has fallen	0.0008988
A.3.3	Fish products cannot be moved/recycled (unsold)	0.0017856
B.1.1	The vessels are not cleaned regularly	0.0000469
B.1.2	No temperature checking	0.0001001
B.1.3	The equipment is not cleaned regularly (fishing rods, nets, etc.)	0.0000244
B.1.4	Not use the protective contact equipment (e.g., gloves).	0.0000861
B.2.1	Not keeping the distance at the fish market/port	0.0000184
B.2.2	The equipment is not cleaned regularly (pallet trucks, boxes, etc.)	0.0000244
B.2.3	Not use protective contact equipment (e.g., gloves).	0.0000184
B.3.1	Contact with infected people	0.0000810
B.3.2	Fish market is not clean	0.0003936
B.3.3	No temperature checking	0.0001657
B.3.4	Not use protective contact equipment (e.g., gloves).	0.0000861

3.6 Defining Initiating Event, Pivotal, Output

Initiating events in the Event Tree Analysis (ETA) reduces fishermen's household welfare. With the literature studies on what pivotal events are present in decline in fishery household welfare, the determination of these pivotal events is by conducting interviews and discussions with fishery households in Kedung Cowek Village. The following are pivotal events for decreasing the welfare of fishery households show on Table 5.

Table 5. *Pivotal Event*

No	*Pivotal Event*
1.	The cleanliness of vessels, equipment, and fish production equipment has been carried out regularly
2.	Social distancing when production and buying and selling activities have been carried out
3.	Health protocols for the spread of COVID-19 have been implemented
4.	The cost of living for the fishery households is efficient
5.	The process of storing and preserving fish runs smoothly
6.	The number of fish consumers has increased

After that, determine the output generated from the pivotal event obtained by the discussions with respondents. The following is the output of declining fishery household welfare:

1. Output A
   Fishery Household Income has almost no decrease in income or the spread of COVID-19 from fishing activities to trade.
2. Output B
   Fishery household income began to decrease, but there was no significant loss.
3. Output C
   Fishery household income decreased rapidly, causing significant losses, and the risk of debt began to increase.
4. Output D
   Fishery household income decreased significantly, causing significant losses and increasing debt.
5. Output E
   The incidence risk in the spread of the virus can lead to being infected with COVID-19 or becoming carriers of the virus which will be quarantined.
6. Output F
   The increased risk of the spread of the virus could increase the number of cases infected with COVID-19 and an increase in the number of cases of virus carriers who will be quarantined.
7. Output G
   The high risk of the spread of the virus can cause many cases of COVID-19 infection, a large number of deaths, and a large number of cases infected with COVID-19, resulting in a lockdown.

Figure 2 is an event tree diagram that has been created by including the events that have been obtained.

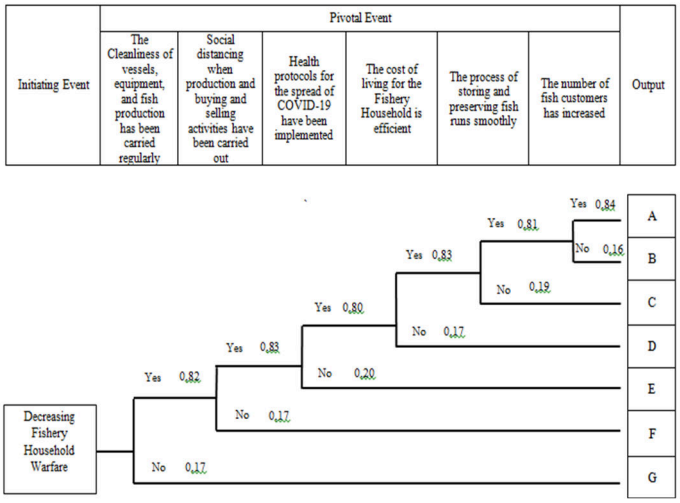

Figure 2. Event Tree Analysis

3.7 Probability from Initiating Event to Output

The input of initiating event opportunities from the previous Fault Tree Analysis (FTA) can be continued by looking for the probability of pivotal events. The probability of pivotal events is divided into two probabilities, namely implemented (Yes) and not implemented (No). From the re-

-sult of distributing the questionnaires, a recapitulation of the results of the pivotal event questionnaire was obtained, which can be seen in the Table 6 bellow.

Table 6. Probability of Pivotal Event

Pivotal Event	Probability (Yes)	Probability (No)
The cleanliness of vessels, equipment, and fish production equipment has been carried out regularly	0.82	0.18
Social distancing when production and buying and selling activities have been carried out	0.83	0.17
Health protocols for the spread of COVID-19 have been implemented	0.80	0.20
The cost of living for the fishery households is efficient	0.83	0.17
The process of storing and preserving fish runs smoothly	0.81	0.19
The number of fish consumers has increased	0.84	0.16

After that, a probability is obtained from the seven outputs that have been determined above with the following explanation:

1. Output A
   Fishery Household Income has almost not decreased in income or the spread of COVID-19 from fishing activities to trade. Output probability A is obtained by: 0.0171212 x 0.82 x 0.83 x 0.80 x 0.83 x 0.81 x 0.84 = 0.0052.
2. Output B
   Fishery household income began to decline but there was no big loss. Output probability B is obtained by: 0.0171212 x 0.82 x 0.83 x 0.80 x 0.81 x 0.16 = 0.0010.
3. Output C
   Fishery household income decreased rapidly, causing large losses and the risk of debt began to increase. Output probability C is obtained by: 0.0171212 x 0.82 x 0.83 x 0.80 x 0.83 x 0.19 = 0.0015.
4. Output D
   Fishery household income decreased significantly, causing large losses and increasing debt. Output probability D is obtained by: 0.0171212 x 0.82 x 0.83 x 0.80 x 0.17 = 0.0016.
5. Output E
   The incidence risk in the spread of the virus can lead to being infected with COVID-19 or becoming carriers of the virus which will be quarantined. Output probability E is obtained by: 0.0171212 x 0.82 x 0.83 x 0.20 = 0.0023.
6. Output F
   The increased risk of the spread of the virus could increase the number of cases infected with COVID-19 and an increase in the number of cases of virus carriers who will be quarantined. Output probability F is obtained by: 0.0171212 x 0.82 x 0.17 = 0.0024.
7. Output G
   The high risk of spreading the virus, which can cause a large number of cases of COVID-19 infection, a large number of deaths, and a large number of cases of COVID-19 infection, will result in lockdowns in coastal areas. Output probability G is obtained by: 0.0171212 x 0.19 = 0.0031.

By categorizing the risk from each output into a risk matrix. With the frequency index and severity index that are included in the risk matrix, it can be obtained that the level of risk categories in fishery household welfare decreases. The following is a table of severity index and the results of the ETA output to the risk matrix show in Table 7 dan Table 8 bellow.

Table 7. *Severity Index*

SI	Impact on the income of fishery households	Rating	Impact on Safety and Health
1	Decreased income but no loss	Very low	Few infected cases or few isolated cases
2	Increasing decrease in income, increasing losses	Low	Few infected cases or many isolated cases
3	Significant decrease in income, beginning to go into debt	High	Few deaths or many infected cases
4	Debt has increased significantly	Very high	Many deaths occurred

Table 8. ETA Output Results to the Risk Matrix

Low :
Medium :
High :

		Severity			
		1	2	3	4
Frequency	5				
	4	**A B C D**	**E**	**F**	**G**
	3				
	2				
	1				

3.8 Determining Mitigation Based on Analysis

In the face of the COVID-19 pandemic, fishery households need prevention strategies appropriate to the work environment. From the results of the analysis above, stakeholders in the income and health of fishery households such as the government, academics (universities/institutions), and fishery households have roles in improving the welfare of fishery households and preventing the spread of COVID-19. 19.

The role of government in mitigating the impact of COVID-19:

1. Reopen the export of fish trade and ensure supply chain access.
2. Provide financial and loan support to fishery households and local fisheries organizations to increase social and economic resilience.
3. Maintain and increase health care services and supplies.

The role of academics (universities/institutions) in mitigating the impact of COVID-19:

1. Provide support in the form of promotion of domestic seafood products and online sales
2. Conduct training in fishery product processing such as making crackers, nuggets, shredded, etc.
3. Hold training or open discussions for coastal household health in dealing with the impact of COVID-19.

The role of fishery households in mitigating the impact of COVID-19:

1. Increase access to sales in accordance with pandemic situations such as online sales, direct sales, and especially domestically.
2. Follow health protocols when carrying out activities such as wearing self-protection tools (masks, face masks, gloves), cleaning the work environment (boats/vessels/markets/auctions), and social distancing.

4. CONCLUSIONS

This section will discuss the results of the research to answer the problem formulation. It can be concluded that:

1. From the analysis results, there are 21 causative factors (can be seen in Table 4.) and the opportunities for decreasing fisheries household welfare.
2. The results of the FTA analysis with decreasing household welfare as the Top Event have a probability of 0.0171212 (can be seen in Table 5.)
3. Then the fisheries household welfare decreases have a risk: Fishery household income does not decrease in income, and there is no spread of COVID-19 when carrying out fishing activities to trade with a risk probability of 0.0052 and has a medium risk index level.
4. In mitigating the COVID-19 pandemic, each stakeholder in the income and health of fisheries households such as the government, academics (universities/institutions), and fisheries households have roles in mitigating the impact of COVID-19.

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