# INTRINSIC VULNERABILITY OF ARTISANAL FISHERIES RECORD FROM BANYUSANGKA FISH LANDING PORT, MADURA ISLAND

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**Abstrak**

Kegiatan perikanan saat ini berpotensi menyebabkan terjadinya kerentanan, salah satunya di Pelabuhan Banyusangka, Madura Jawa Timur. Kajian kerentanan yan dilakukan di Banyusangka ini bertujuan untuk melihat pengaruh dari tekanan penangkapan terhadap potensi kerentanan. Hasil kajian menunjukkan bahwa kerentanan ~~spesies~~ ikan berkisar antara 15-83 dengan risiko kerentanan tertinggi yaitu ikan cucut. Sementara kerentanan alat tangkap antara 36-57, yang tertinggi pada jenis alat tangkap trammel net. Untuk mengantisipasi terjadinya kerentanan, maka perlu pengawasan secara tetap pada setiap operasi penangkapan. Hal ini untuk memastikan ikan yang berpotensi rentan tinggi dapat terkendali penangkapanya.

Keywords: Kerentanan, Intrinsik, Banyusangka, Risiko, Manajemen

**Abstract**

Currently, fisheries activities have the potential to cause vulnerability, one of which is in Banyusangka Harbor, Madura, East Java. This vulnerability study conducted in Banyusangka aims to know the effect of fishing pressure on potential vulnerabilities. The results of the study showed that the vulnerability score of fish species ranged from 15-83 with the highest vulnerability risk os suceptability is *Sphuraena* sp. Meanwhile, the vulnerability of fishing gear score is between 36-57, where the highest risk of fishing gear is the trammel. To anticipate the occurrence of vulnerabilities, it is necessary to regularly monitor each fishing operation. This is to ensure that fish that are potentially highly vulnerable can be control of the fishing presure.

Keywords: Vulnerability , Banyusangka, Intrinsic, Risk, Management

## INTRODUCTION

Fisheries activities in Banyusangka, Madura are generally small scale fisheries that are a daily activity and simple technology of fishing. Fishers usually going to the fishing ground in one day, and return with the daily catch. The number of small scale fisheries is dominant in Banyusangka and reaches 90% of the total area. Practically, the daily fishing activities, the technology very simple, crew and personal 2-3 persons per boat, more adaptive to Banyusangka fisheries. However, small scale fisheries also have an impact on stock sustainability.

Risks to stock availability usually are evaluated from the conditions and level of stock vulnerability. Fish resources, even though they on a small scale, but if the fishing process had continuously, they cause a decrease in quality and quantity. Vulnerability indicators are usually used as a measurement to find out about this condition.

The catches of Banyusangka fishers are generally pelagic and demersal fish. The dominant types of fish are the group of mackerel (*Rastrelliger* sp.), layang (*Decapterus* sp.), *Euthynus*, and some reef fish. The increase in pressure may also increase the risk of individuals and families of fish and in long term to communities. The stock vulnerability often asses by

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productivity and susceptibility indicator, but intrinsic vulnerability close related to the performance of fishing gear and boat.

The intrinsic vulnerability has been carried out on small scale fisheries worldwide. The vulnerability potentially caused by climate change [9], population pressure [11], and due to fishing intensity [18], Vulnerability studies are an approach used to determine pressure on fishery activities as a poor data-based management approach [17]. Based on the explanations above, this research aims to know and asses the vulnerability level of fisheries activities and stock vulneraility that locate in Banyusangka.

## MATERIAL AND METHOD

The research location at the Banyusangka Fish Landing Port, Bangkalan Madura (Figure 1). The study was conducted for one month in May 2018 at that field to collect various data needed. Data collected relate to vulnerability studies are production data from fisheries, data on species of fish caught, data on the fishing ground, data on fishing gear used, fishing operations, and other fish biological data such as length and weight. The data collected is grouped according to analysis and descriptive explanation to know production patterns, potential vulnerabilities, risk and pressure estimates from the fishing gear used by fisherman.

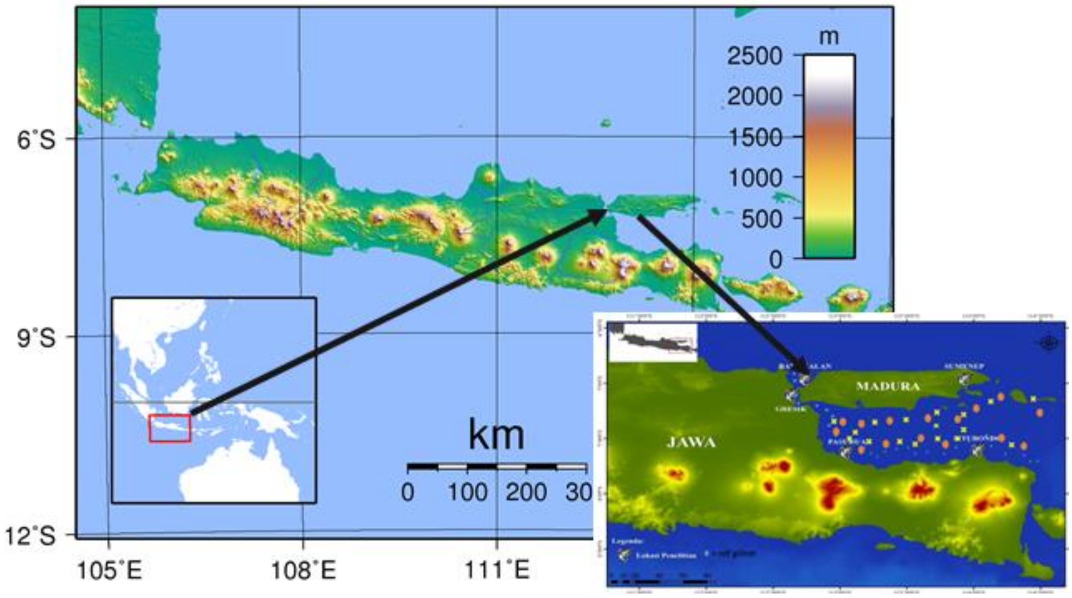



Figure 1. Fishing ground and sampling location in Banyusangka

Data analysis includes catch production trends by species, production by fishing gear, average landing size, fish conditions, reproduction patterns, fecundity, maturity size, vulnerability (intrinsic [5] and species vulnerability), tropic level of each type landed fish. The intrinsic vulnerability value is obtained using the formula [19]:

$$\mathrm{IV} = \frac{\text{Vulnerability species}-\text{i x APP}}{\text{Production total}}$$

The IV is an *intrinsic vulnerability* that obtained from the vulnerability value of fish species from Cheung [5] multiplied by the value (APP) or Annual Average Production or annual production in tons per year.

## RESULT AND DISCUSSION

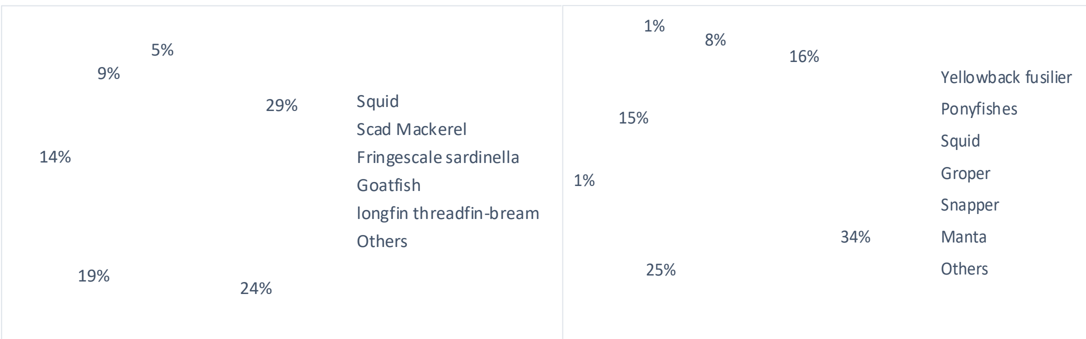
### Fish composition

The potential for fisheries activity by fisherman is in the Madura waters both in the North and Strait Madura and then landed on the Banyusangka fish landing port. Fishermen's catches species consist of small pelagic fish, large pelagic fish, and demersal fish. Some species of catches are grouper, mackerel, *Sphyraena*, Siganidae, snapper, anchovies, Nemipteridae, Scad mackerel fish, mackerel, Sardinella fish, anchovies, and other small fishes. The results recorded by species of fish landed in Banyusangka are as follows.

Table 1. Fish species landed by the fisherman in Banyusangka fish landing port

| No | Local name | Scientific name | No | Lerenceocal Name | Scientific name |
|---|---|---|---|---|---|
| 1 | Talang-Talang | *Chorinemus tala* | 18 | Selar Kuning | *Selaroides leptolepis* |
| 2 | Kurisi | *Nempiterus* | 19 | Parang parang | *Chirocentrus dorab* |
| 3 | Gulamah | *Johnius trachycephalus* | 20 | Kerapu | *Epinephalus* sp. |
| 4 | Barakuda | *Sphyraena* | 21 | Kapasan | *Geres puctatus* |
| 5 | Beloso | *Glossogobius Giuris* | 22 | Kakap Merah | *Lutjanus* sp. |
| 6 | Kuniran | *Upeneus moluccensis* | 23 | Kakap Putih | *Lates calcarifes* |
| 7 | Pepetek | *Leiognathus* sp. | 24 | Lentjam | *Lethrinus lentjam* |
| 8 | Tembang | *Sardinella* sp. | 25 | Pari | *Dasyatis* sp. |
| 9 | Kembung lelaki | *Rastrelliger kanagurta* | 26 | Kepe-Kepe | *Chaetodon octofasciatus* |
| 10 | Layang | *Decapterus* sp. | 27 | Baronang | *Siganus javus* |
| 11 | Layur | *Trichiurus* sp. | 28 | Cucut | *Rhizprionodon* sp. |
| 12 | Buntal | *Tetraodon* sp. | 29 | Ayam-ayam | *Abalistes stellaris* |
| 13 | Sebelah | *Psettodes erumei* | 30 | Belut Laut | *Gymnothorax* sp. |
| 14 | Tongkol | *Euthynus* | 31 | Tenggiri | *Scomberomorus* sp. |
| 15 | Raja Gantang | *Priachanthus tayenus* | 32 | Cumi-Cumi | *Loligo* sp. |
| 16 | Kuwe | *Caranx* sp. | 33 | Udang Kipas | *Thenus orientalis* |
| 17 | Kembung perempuan | *Rastrelliger brachisoma* | 34 | Sotong | *Sepia* |
| | | | 35 | Simping | *Pecten* sp. |

The species caught, are dominantly pelagic and demersal fish. The four dominant species are layang (*Decapterus* sp) and *squid*, Sardinella, and turtle. However, the composition of dominant species is less than 30% in Madura, which relatively has but not fully dominant. The catch composition is as shown in the following picture.




A B

Figure 2. Dominant fish catch composition that landed in Madura (A) and Banyusangka (B) landing base

**Fish Production**

Meanwhile, the total production of fish in Banyusangka is (most dominant 33.69%) pepetek, the second squid fish (24.6%), and the third Lutjanidae (15.76%), and snapper (15.42%). When we compare the total production in Madura and Banyusangka fish landing, squid is considered to be dominant in this region, which contributes to production total in Madura. The catches of dominant fish (yellowtail, pepetek, stingray, snapper, grouper and squid, and others as following T

Table 2. Production of dominant fish that record in Banyusangka fish landing port

| Month | Production (Kg) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Selaroides | Leiognathus | Dasyatis | Grouper | Snapper | Squid | Others |
| January | 2511 | 17217 | 485 | 1974 | 338 | 6244 | 2766 |
| February | 2685 | 5409 | 245 | 3096 | 252 | 7074 | 3000 |
| March | 5636 | 5881 | 193 | 7639 | 158 | 3089 | 2842 |
| April | 4993 | 8824 | 187 | 8477 | 165 | 5326 | 2854 |
| May | 4914 | 8798 | 136 | 5194 | 128 | 4743 | 2430 |
| June | 3937 | 7600 | 115 | 3240 | 85 | 3710 | 1881 |
| July | 2529 | 6137 | 291 | 2165 | 121 | 3985 | 1308 |
| August | 2889 | 4263 | 253 | 2464 | 146 | 3093 | 1254 |
| September | 1937 | 4242 | 359 | 1124 | 107 | 4594 | 607 |
| October | 2246 | 3446 | 480 | 1194 | 151 | 6332 | 577 |
| November | 2267 | 3856 | 546 | 1284 | 160 | 5107 | 519 |
| December | 3086 | 9061 | 688 | 921 | 150 | 8563 | 512 |
| **Total** | **39630** | **84734** | **3978** | **38772** | **1961** | **61860** | **20550** |

Based on fisherman information, usually fishing intensity was influenced by seasonal climate such as dry and wet season. The season it is mean is the west (usually runny), and east seasons (usually and the direction of wind and currents. Besides the factors that influence fishermen's catches are the position of the dark moon and full moon. In general, the catch of fish in the dark moon higher than the full moon. This condition explains that the fish caught are generally known as positive phototaxis fish and tend to be attracted to light for feeding activity.

The fleet and boat of Banyusangka fishermen have various sizes, materials construct, and typical engines. According to data from the Banyusangka TPI in 2015, fishers using 29 units of purse seine vessels and 24 units of small payang alit. Other fishing gears that use and relatively few numbers are gillnet and nylon fishing gear. Recent year, fisheries production also depent on cilmate and environmental effect. The population and fishery must therefore be managed sustainably and if necessary accommodate environmental effects on population dynamics [11].

## Intrinsic Vulnerability

Intrinsic vulnerability is a biological indicator that closely related to the risk of fishing activity. The key parameters evaluate the type of fishing gear, fish caught, production value and the value of the biological vulnerability of each species. Vulnerability and production change generally in line with fishing pressures to fish and ecosystems. The other also influenced by the type of fishing gear that not only focuses on target also to retain and bycatch. The information below (Table 2) shown that any fishing gear catches more than one fish in each fishing operation.

Table 3. Local name, Scientific name and fishing gear, and that use by fisherman.

| Local Name | Scientific Name | PS | PA | GL | TRM | PCN | DG |
|---|---|---|---|---|---|---|---|
| Talang-Talang | *Chirocentrus dorab* | x | x | x | x | x | x |
| Kurisi | *Nemimoterus* | | x | x | x | x | x |
| Baracuda | *Sphyraena* sp. | x | x | x | x | x | x |
| Beloso | *Saurida tumbil* | | x | x | x | | x |
| Kuniran | *Upeneus* sp. | | x | x | x | x | x |
| Pepetek | *Leiognathus* sp. | x | x | x | | | x |
| Tembang | *Sardinella* sp. | x | x | x | | x | x |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Kembung | *Rastrelliger* sp. | x | x | x | x | x | x |
| Layang | *Decapterus* sp. | x | x | x | x | x | x |
| Selar Kuning | *Selaroides* sp. | x | x | x | x | x | x |
| Layur | *Trichiurus lepturus* | x | x | x | x | x | x |
| Buntal | *Tetraodon* sp. | x | x | x | x | | x |
| Sebelah | *Cynoglosus* sp. | | x | | | | x |
| Tongkol | *Euthynnus affiinis* | x | x | x | x | x | x |
| Raja Gantang | *Prichanthus hamrus* | | x | x | x | x | x |
| Kuwe | *Caranx* sp. | x | x | x | x | x | x |
| Kerapu | *Cromileptes* sp. | | x | x | x | x | x |
| Kapasan | *Geres puctatus* | x | x | x | x | | x |
| Kakap Merah | *Lutjanus* sp. | x | x | x | x | x | x |
| Kakap Putih | *Lates calcarifer* | x | x | x | x | x | x |
| Lencam | *Lethrinus lentjam* | x | x | x | x | x | x |
| Pari | *Dasyatis* sp. | | x | | x | x | x |
| Kepe Kepe | *Chaetodon* sp. | | x | x | x | | x |
| Baronang | *Siganus* sp. | x | x | x | x | x | x |
| Cucut | *Rhizoprinodon tipicus* | | x | | x | x | x |
| Belut Laut | *Petromyzontidae* | | x | | | x | x |

Noted : PS = Purse seine; PA=paying alit; GL=Gillnet; TRM=Trammel net; PCN=Pancing; DG = Dogol. Symbol X= catcted by fleet.

While fishing operation (fishing process), the fishing intensity of each gear has differences catchability, where the purse seine gear has catchability about 60%. The payang alit about 100%, gillnet about 80%, trammel net dan line about 80%, and also dogol 100%. Overall purse seine has been pressure to the population until 12%, both payang alit dan dogol about 20%, gillnet dan trammel reach 17% and handline untill 15%. Based on this research, the shown handline has the lowest fishing intensity to all fishing gear operate by fishers.

Each fishing gear has a different target fish, but can be one species caught by any fishing gear. Although caught by many fishing gears, usually the target fish is only one species, and other species include as retain or bycatch. The catch data of each fleet for each species are list in the following table.

Table 4. Production in each fishing fleet in Banyusangka.

| Local name | Scientific name | PS | PA | GL | TRM | PCN | DG | IV |
|---|---|---|---|---|---|---|---|---|
| | | Production (kg/mth) | | | | | | |
| Talang-Talang | *Scomberoides tala* | 12 | 34 | 3 | 5 | 25 | 32 | 60 |
| Kurisi | *Nemimoterus* | | 2671 | 2351 | 3562 | 675 | 1134 | 50 |
| Barakuda | *Sphyraena sp* | 112 | 34 | 11 | 236 | 173 | 65 | 51 |
| Beloso | *Saurida tumbil* | | 364 | 45 | 67 | | 216 | 21 |
| Kuniran | *Upeneus sp* | | 7645 | 40 | 462 | 477 | 1786 | 27 |
| Pepetek | *Leiognathus sp* | 1897 | 45271 | 2145 | | | 35421 | 30 |
| Tembang | *Sardinella sp* | 1324 | 25481 | 4364 | | 12 | 645 | 51 |
| Kembung | *Rastrelliger sp* | 986 | 4658 | 59831 | 4563 | 54 | 364 | 45 |
| Layang | *Decapterus sp* | 73620 | 123478 | 8771 | 763 | 88 | 673 | 15 |
| Selar Kuning | *Selaroides sp* | 83 | 23 | 973 | 763 | 762 | 83 | 15 |
| Layur | *Trichiurus lepturus* | 135 | 42 | 736 | 42 | 245 | 17 | 51 |
| Buntal | *Tetraodon sp* | 3 | 43 | 12 | 48 | | 154 | 36 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sebelah | *Cynoglosus sp* | | 972 | | | | 687 | 43 |
| Tongkol | *Euthynnus affiinis* | 8631 | 9401 | 68301 | 98456 | 3107 | 8731 | 60 |
| Raja Gantang | *Prichanthus ham* | | 20781 | 1972 | 754 | 432 | 637 | 49 |
| Kuwe | *Caranx sp* | 234 | 543 | 178 | 105 | 2379 | 218 | 46 |
| Kerapu | *Cromileptes sp* | | 462 | 17 | 67 | 873 | 542 | 49 |
| Kapasan | *Geres puctatus* | 4 | 50 | 61 | 23 | | 64 | 54 |
| Kakap Merah | *Lutjanus sp* | 4553 | 8674 | 271 | 564 | 11435 | 13275 | 51 |
| Kakap Putih | *Lates calcarifer* | 4562 | 79651 | 34 | 7972 | 3990 | 6782 | 58 |
| Lencam | *Lethrinus lentjam* | 510 | 455 | 367 | 8661 | 352 | 662 | 53 |
| Pari | *Dasyatis sp* | | 1611 | | 675 | 564 | 1129 | 63 |
| Kepe Kepe | *Chaetodon sp* | | 688 | 1976 | 28 | | 16 | 30 |
| Baronang | *Siganus sp* | 79561 | 7961 | 691 | 867 | 5720 | 78950 | 60 |
| Cucut | *Rhizoprinodon sp* | | 564 | | 756 | 900 | 156 | 83 |
| Belut Laut | *Petromyzontidae* | | 670 | | | 125 | 650 | 55 |
| | Total | 176227 | 342227 | 153150 | 129439 | 32388 | 153089 | |
| | IV for fleet | 40.36 | 36.01 | 49.79 | 57.85 | 52.93 | 50.66 | |

Keterangan = PS = Purse seine; PA=paying alit; GL=Gillnet; TRM=Trammel net; PCN=Pancing; DG = Dogol; IV (intrinsic vulnerability)

From the results above, it appears that the species vulnerability obtained from the study [4] ranged from 15-83. Populations with vulnerability values less than (<25) know as low vulnerability, 25-50 moderate vulnerability and 50-75 high vulnerability and> 75 very high vulnerability. Based on the criteria, the *Sphyraena fish* is a very vulnerable species. Barracuda, *Sardinella*, *Trichiurus*, red snapper, Lentjam, Geres, Sea eel, white snapper, gutters, *Scomberoides tala*, Siganus, and stingray are considered vulnerable. The species are of *Upeneus*, pepetek, kepe kepe, *Tetraodon*, *Cynoglosus*, *Rastrelliger*, *Caranx*, *Priachnthus*, grouper, and *Nemipterus* including as medium vulnerable. The other species are Selaroides, and Beloso recorded as low vulnerability. The grouping fish species according to vulnerability status are present in the following profile.

| Level | Score | Local name | Scientific name |
|---|---|---|---|
| VHV | 83 | Cucut | Rhizoprinodon tipicus |
| | 51 | Baracuda | *Sphyraena sp* |
| | 51 | Tembang | *Sardinella sp* |
| | 51 | Layur | *Trichiurus lepturus* |
| | 51 | Kakap Merah | *Lutjanus sp* |
| | 53 | Lencam | *Lethrinus lentjam* |
| | 54 | Kapasan | *Geres puctatus* |
| | 55 | Belut Laut | *Petromyzontidae* |
| | 58 | Kakap Putih | *Lates calcarifer* |
| | 60 | Talang-Talang | *Chirocentrus dorab* |
| | 60 | Tongkol | *Euthynnus affiinis* |
| | 60 | Baronang | *Siganus sp* |
| HV | 63 | Pari | *Dasyatis sp* |
| | 27 | Kuniran | *Upeneus sp* |
| | 30 | Pepetek | *Leiognathus sp* |
| | 30 | Kepe Kepe | *Chaetodon sp* |
| | 36 | Buntal | *Tetraodon sp* |
| | 43 | Sebelah | *Cynoglosus sp* |
| | 45 | Kembung | *Rastrelliger sp* |
| | 46 | Kuwe | *Caranx sp* |
| | 49 | Raja Gantang | *Prichanthus hamru* |
| | 49 | Kerapu | *Cromileptes sp* |
| MV | 50 | Kurisi | *Nemimoterus* |
| | 15 | Layang | *Decapterus sp* |
| | 15 | Selar Kuning | *Selaroides sp* |
| LV | 21 | Beloso | *Saurida tumbil* |

Figure 5. Profile of vulnerability level of fish species (LV=low vulnerable; MV=medium vulnerable; HV=high vulnerable; VHV=very high vulnerable.

The type of fleet that has caused a high level of an intrinsic vulnerability is trammel net, line (hook), and dogol. And then the fleet with medium vulnerability impact to fisheries are payang alit, purse seine and gillnet: the fishing fleet vulnerability and its profile showed medium to high vulnerability as figure below. Fishing has been the main cause of collapse of fisheries for pelagic, demersal species [3].

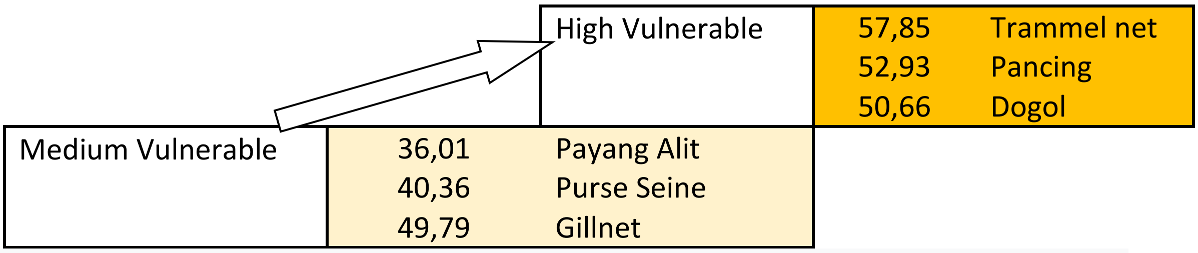



Figure 6. Fishing gear vulnerability level (value indicates score)

Based on the profile obtained above, its seen that overall risky devices that can cause increased vulnerability are trammel net, line, and dogol. For this reason, it is necessary to monitor periodically fishing activities by fishers from the fleet used. Such as monitoring can be carried out during the capture operation, or from the actual catch.

The level of susceptibility of fish in Banyusangka evaluated by species vulnerability [6] as well as the intrinsic vulnerability of the fishing process. Species vulnerability indicates that certain species can experience pressure due to capture. The lowest species susceptibility of demersal fish species is *Saurida tumbil*. The moderate vulnerability of small pelagic groups layang (scad) and selar. High vulnerability is more dominant demersal fish species, which shows that the target of catching many of the demersal fish species [15]. Species vulnerability can be at risk and cause economic vulnerability to society [14], so it needs to monitor properly. Besides, environmental conditions such as temperature and salinity (Betts et al. 2014) or capture patterns [15] also trigger vulnerability.

Fishing in the weakest phase of reproduction, the vulnerability of pelagic fish tends to be greater than reef fish species [17]. Intrinsic vulnerability is part of the fishing process carried out by fishermen [8] in the fisheries business system. Changes in temperature and environmental quality on a macro level also spurred the vulnerability of fish stocks [10]. Payang attention to vulnerability because it can be triggered to hight vulnerable, it is necessary to have a planned management mechanism [16].

Fishing gear vulnerability is classified as medium, namely paying, purse seine and gillnet fishing gear with a range of 36-49. While the high is the trammel net, dogol fishing rods up to 50.6-57.8. The condition of vulnerability at this level classifies as a risk to the sustainability of the fisheries business. High risk of vulnerability can also mean high intensity and sometimes leads to high production potential and fishermen's income [1] . Efforts to ensure the sustainability of the stock mitigation efforts against the use of fishing gear that is at risk of causing the vulnerability [7].

Pressure, vulnerability is more dominant when fishermen's income is low, and economic conditions are not good [13] as well as fisheries business instability. The risk of control decrease will be the trigger of risk to the ecosystem [2]. If the fishery experiences high vulnerability, it will require resilience and adaptation capacity which is also high [12] to ensure the level of sustainability of population stock.

## CONCLUSION

The species that list as high vulnerability species is *Rhizoprionodin typicus* that know as demersal fish. The intrinsic vulnerability dominated cause by active gear like dogol and trammel net. To avoid the increase of vulnerability needed a monitoring program of the fishing gear and fishing operation process.

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