Livelihood strategies of two small-scale fisher communities: adaptation strategies under different fishery resource at southern and northern coast of Java

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Abstract. Small-scale fishers are frequently exposed to a variety of hazards that threaten their livelihood. Different socio-cultural, natural resource, environment conditions potentially create unique vulnerability and livelihood strategies which may exist in different places. Therefore, an investigation in two different fishing communities was carried out to understand the similarities and different of livelihood strategy works in both places. The study was conducted in two small scale fisheries community in village Betahlawang (north of java) and Glagah (south of Java). This research aims to describe livelihood aspects and strategies of fisher communities in both locations under different fishery resource and their dependency on the fishery through systematic surveys. The study showed that both communities are highly dependent on natural capital which mainly the abundance of the fishery resources. Others factors affecting both communities’ sustainable livelihood are the uncertainty in catch, weather and policy, limited capital ownership, access, and knowledge and skills other than fishing. Although the two study sites share some capital similarities, the livelihood vulnerability and their strategy is different. Betahlawang fishers more vulnerable than Glagah fishers because Glagah fishers has more diverse livelihood alternatives.

1. Introduction
Fisheries is main livelihood resources for many coastal communities worldwide. The resources are not only important in terms of economy to provide job opportunities and main income sources, but also to guarantee food security. One of the communities in Indonesia who depend on the sea to live and to support their families are fishers. The official statistics of 2016 indicated that 2.387.591 (two million three hundred eighty-seven and five hundred ninety-one people) engaged in fisheries [1]. Small-scale fisheries play an important role in job creation. Fisheries business actors in Indonesia are dominated by small-scale fishers, which reach more than 75% of the total fisher [2]. The small-scale fishers generally use small vessels under 30 Gross Tonnage (GT). Small-scale fisheries according to Law Number 7 of 2016 are fisheries who catch fish to fulfill their daily needs, both those who do not use fishing vessels and those who use fishing vessels with vessel capacity of 10 gross tons (GT).
Nevertheless, fishers with boats under 30 GT typically catch for 1-3 days per fishing trip. There are also strata of positions in the fishing process in small-scale fisheries. Some fishers go on to become captains, engines, and crew members. Differences in positions have an impact on differences in income. The amount of money earned is determined by the number of catches made. However, due to fishing operations that use the capital system with the owner’s support, the total value's net income will be less than operating costs. The impact of this system also results in a strong relationship between the ship crew and the client (owner). As a result of this system, fishers are frequently trapped in poor conditions due to a period of low production or declining stock [3].

Fishers generally live on the side coast because they are close to the location of their fishing activities. According to Vatria [4] several factors that determine the level of resilience of fisher including 1) natural disasters; 2) fish dock/landing; 4) geographical conditions; 5) the role of the wife and family members; 6) diversification capability; 7) transfer payments; 8) social security; 9) norm. Fishers in Indonesia are spread on every coast in Indonesia, including the southern and northern coast of Java. This area is very fragile because of frequent high waves and storms sometimes which result in environmental degradation and subsequently affect the income of many community groups, including coastal fishers [5]. Moreover, recently the fishery resources are mostly fully or over-exploited in many parts of the world [6] stated that some small-scale fishers fishing grounds, especially in the Java Sea, have also reached over-exploitation. Nissa et al. [7] also added that the problem facing fishers at the northern coast of Java is high competition between the fishers and the tight catching area of fishing operations due to increasing numbers of fishers. The characteristics of small-scale fishers and the challenges they face may differ across regions in Indonesia. Small-scale fisheries are also diverse, both in terms of fishing gear used, species target, fishing grounds, and market orientation [8]. Moreover, according to Adger [9] that every community in different locations certainly faces different threats, therefore they have different adaptive strategies to maintain their livelihoods. As a result, research into the key characteristics of small-scale coastal fishers in different parts of Indonesia, such as fishers on the southern and northern coasts of Java and the challenges they face to maintain their livelihood is deemed critical. The following are the study's objectives: 1) describing the livelihood strategies of fisher communities in the southern and northern coast of Java 2) representing the fisher community livelihood under different fishery resource state and dependency on the fishery.

2. Research Method
This research was conducted through case study in the two fishing communities in two villages. The first case is the blue swimming crab fisher community at the Betahlawang Village, Demak Regency (north coast Java) to represent the fisher community with intensive fishery resource exploitation and dependency level; and the gillnet fisher community at Glagah Village, Kulon Progo Regency (southern coast of Java) representing the low exploitation level of fishery resources and dependency. This study was conducted in 2016 at the Glagah Village dan and 2017 at the Betahlawang Village. The livelihood approach in this study examines the livelihood assets and utilization both from the point of view of ownership and access, and vulnerabilities and livelihood strategies undertaken to survive or even develop their livelihoods. Data collected were both primary and secondary data. Primary data were collected based on the structured interviews using questionnaires (surveys). Forty (40) fishers of Betahlawang village and thirty-five (35) fishers from Glagah were chosen randomly as respondents. Secondary data were taken from various relevant documents such as village monograph data, fisher group organizations data, etc. The livelihood resources were identified through an analysis of pentagon assets, namely: natural capital, physical/infrastructure, and financial/economic capital, human resources and social capital.
3. Results and discussions

3.1. General Description of the Study Site

3.1.1. Villages descriptions

Betahlawang Village is in Bonang District, Demak Regency, Central Java. Betahlawang Village is bordered by the Java Sea in the north, Serangan Village in the south, while in the west it is bordered by Purworejo Village and in the east by Wedung District. [10]. The land in Betahlawang Village consists of 229.84 ha paddy field and 238.87 ha dry land. Dry land is used for yards (9.98 ha), ponds (196.02 ha) and others such as rivers, roads, etc. (32.87 ha). The irrigation model used by the rice fields of Betahlawang Village is a simple type of irrigation in all existing rice fields [10].

Glagah village is in Temon District, Kulon Progo Regency, Yogyakarta. Glagah Village size is 603.94 hectares (ha) which mostly used as paddy fields, secondary plants, chili, melon and watermelon farm. There are crown-lands ownership along the coast of Glagah beach under Paku Alam (Paku Alaman Ground) which can be used by the community for farming and other service sectors such as food stall and lodging. Besides ownerships and land use, area morphological conditions are also important in relation to patterns of behavior, adaptation, livelihoods, and local wisdom. Morphologically, the coast of Kulonprogo is classified as a sandy beach type originating from volcanic process activity (volcanic activity), fluvial (sedimentation of sand material carried by the Progo River, Serang River and Bogowonto River), and marine (tidal activity of sea water that occurs in the coastal area) [11]. Those type of soil is fertile and suitable for horticulture.

3.1.2. The Communities

The productive age of of Betahlawang villagers are 4,150 people [10]. The villagers’ occupation’s majority are fishers, followed by farmers, farm laborers, entrepreneurs, industrial workers, industrial workers, construction workers, traders, transport drivers and others as many as 1,407; 439; ;520; 67; 99; 81; 223; 59 and 1,754 people respectively. On the contrary, Glagah villagers mostly identify themselves as a farmer (1,073 people), and fishing is their secondary job. Fishing is not considered as the main job because of it is high risk, and the catch uncertainty. Other livelihoods Glagah villagers are civil servants (PNS), soldiers, private employees, entrepreneurs or traders, retirees, farm laborers and services.

3.2. Fishers’ characteristics in both villages represent fishers from northern and southern of Java

Generally, fishers of northern and southern Java are different. Northern Java waters has plain bathymetry compared to the southern Java waters that has high slope bathymetry. Because of those conditions, fisheries sector in northern Java has been existing longer than in Southern Java. As a results, the fishing boat, technology, and fishers’ skills are more advance in Northern Java rather than in Southern Java.

The similarities and difference of communities entitled to their jobs as a fisher is depicted in Table 1. The similarities in fishers’ detail between Betahlawang and Glagah village is that most of the fishers in the productive age for working and have fishing experience ranged from 0-20 years. Another similarity is the social class applied in both communities consist of boat owner and worker.

The fishing activity in Betahlawang is main job where the fishers all are locals and never have secondary education background. Unlike the fisher in Betahlawang, fishing is secondary job and is done not only by local fishers. Fishers in Glagah experience higher education level where 77% is graduate from junior high school and 48.5% from Senior high school. The level of education distinguishes the two fishers in these two locations. All of interviewed Betahlawang fishers only completed elementary school, whereas Glagah fishers were able to complete their education all the way through senior high school. This is because, after finishing school, the people of Java's northern coast will immediately learn to be fishers, so that they are already looking for work at sea at a young age. This habit is also passed down from their parents, who, on average, began fishing at a young age. Younger fishers are usually more dare than older fisher when it comes to venturing into more remote areas. Many young people choose to be fisher because they have a low education and believe that the pay for other jobs with such
an education is not as good as being a fisher. Meanwhile, the Glagah people, whose main source of income is farming, may influence their habits, including their views on education and job.

Table 1. Characteristic fisher community at Northern and Southern Coast of Java

| Characteristic          | Betahlawang fishers (Northern Coast Java)                                                                 | Glagah fishers (Southern Coast Java)                                                                 |
|------------------------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Fishers’ detail        | Betahlawang (local fishers)                                                                             | Gelagah and Cilacap                                                                                   |
| 1. Origin              | 1-20 years                                                                                                | 1 -20 years                                                                                            |
| 2. Fishing experience  | Primary School (42,5%)                                                                                    | Primary School (100,0%)                                                                               |
| 3. Highest education   | Junior High School (0,0%)                                                                               | Junior High School (77,0%)                                                                             |
| 4. Fisher’s age range  | 20 – 40 years old                                                                                        | 20 – 30 years old                                                                                     |
| 5. Main Livelihood     | fisher                                                                                                   | farmer                                                                                                 |
| Information related to fishing |                                                                                                        |                                                                                                        |
| 1. Boat Capacity       | ± 3GT                                                                                                     | ≤2GT                                                                                                   |
| 2. Fishing vessel      | 24 HP                                                                                                     | gill net, dredge net, fishing hook, lobster net                                                       |
| 3. Fishing gear        | trap                                                                                                      |                                                                                                        |
| 4. Fish target         | blue swimming crabs                                                                                      | lobster, silver pomfret and snails                                                                      |
| 5. Long trip           | 7-8 hours/day                                                                                             | 8 hours/day                                                                                             |
| Social class           | boat owner and crew                                                                                      | boat owner and crew                                                                                    |
| Market for the catch   | sell to middlemen directly                                                                               | Sell in local fish auction                                                                             |

Fishing activities at Glagah Beach began in early 2000, with the presence of several Cilacap fishers. Prior to becoming a fisher, most Glagah people worked as farmers. It takes a long time and a lot of effort to change one's life to become a fisher [12].

For detail in fishing efforts in both communities, Glagah fishers use outboard motorboats with a 15 HP engine, and multi fishing gear such as gill nets, dredge nets, small longline, and lobster net are used for fishing. Meanwhile fishers in Betahlawang operate 3 GT and powered by a 24 HP engine and only use trap. The fishers catch blue swimming crab only because it is more profitable, rather than catch other fishes that has been declined. Besides the fishing gears, fishers in Betahlawang sold directly to the middleman rather than to fishing auctions, on the contrary, Glagah fishers sell their catch in fish auction.

3.3. Livelihood’s capital differences

Livelihood is defined as the availability of sufficient stock, food, and cash to meet basic needs. Security refers to ownership of and/or access to resources and all income-generating activities, including reserves and assets, to deal with risks, reduce pressure or disruption and meet all contingencies [13]. Livelihoods consist of capabilities, assets/capital (resources, supplies/stocks, and access) and all activities needed as a living strategy. This study particularly classified the livelihood assets into 5 capitals namely, natural capital (fish abundance, clean water source, land ownership), physical capital (the ownerships of house, boat and fishing gear, phone and internet, vehicles), financial capital (savings in money, jewelry, livestock, loan), human capital (skills, working family member, health insurance) and social capital (organizations and activity group in fishers’ social life).

Overall, fishers in Glagah have higher capital in all aspects rather than fishers in Betahlawang (Figure 1., with more detail in each capital in Table 2.). The significant differences are in natural and human capital. The Natural capital includes fish abundance, clean water source, land ownership. The difficulties in clean water source and no farming land ownerships makes Betahlawang fishers more vulnerable compared to Glagah fishers. Fishers in Betahwalang Village must pay for clean water source, and do not have farm. Glagah Village's fishers primarily use well water made access to clean water is very easy. This condition is very benefitable because fishers can use it to irrigate the agricultural land that 48.57% fishers own rice field, and 62.85% have farm. Another natural capital investigate is catch abundance. Both Betahlwang and Glagah fishers state that their catches have recently decreased. As many as 85%
of fishers in Betahwalang and 45.71% fishers in Glagah experiencing decreasing catch trough years. The use of environmentally unfriendly fishing gear, specifically arad (mini trawl), is the cause of the decline in catches for fishers in Betahlawang village. According to the respondent's testimony, arad was responsible for the trap's loss in the middle of the sea because it broke off and was dragged by arad while it was in operation. Meanwhile, the decline in Glagah fisher's catches was caused by unfavorable weather such as rainstorms at certain times, strong currents, and big waves, as well as changing fish seasons, which caused Glagah fishers to choose not going fishing.

Figure 1. Sustainable livelihood factors comparisons between Betahlawang Village and Glagah Village

The human capitals studied includes the number of working family members, skills, training or counseling attended and ownership of public health insurance. Most fishing families depend solely on their fathers for living. More working family members means more income for household needs of fishing families. Furthermore, skills outside of the field of fisheries can be capital for fishers to do other businesses when they are unable to go fishing. According to the data gathered, limited number of Betahlwang fishers have skills outside of fisheries. Betahlwang fishers’ skills is boat mechanic. Meanwhile, Glagah fishers are known to have many skills such as farming, trading, construction building, and mechanics. Nonetheless, Glagah fishers still developing themselves to be ore skillful trough fishing training. The skills and training are expected to help improve fisher's ability to improve their livelihood opportunity. The last measure is the ownership of health insurance. Health is important for livelihood because it enable fishers to get daily income. The number of Betahlwang and Glagah fishers who have health insurance is relatively small, which is unfortunate because high-risk fishing jobs must be planned for in terms of health insurance. Health insurance can also assist fisher's families in gaining better health.

Table 2. Livelihood capital sources of fisher of two location, Betahlawang village and Glagah village

| Kind of Capital                  | Betahlawang Fishers (n=40) | Glagah Fishers (n=35) |
|----------------------------------|----------------------------|-----------------------|
| Natural Capital                  |                            |                       |
| access to clean water source     | 100% company water         | 8.57% private well    |
| decrease in catch                | 85%                        | 45.71%                |
| land and farm ownership          | 0% have rice field,        | 48.57% have rice field,|
|                                  | 0% have farm               | 62.85% have farm      |
Physical Capital

| Item                         | Percentage |
|------------------------------|------------|
| owning vehicle               | 67%        |
| owning house building        | 60%        |
| owning mobile phone          | 72.5%      |
| connection internet          | 22.5%      |
| owning fishing gear          | 50%        |
| owning fishing vessel        | 50%        |

Financial Capital

| Item                         | Percentage |
|------------------------------|------------|
| owning some saving           | 70%        |
| owning some jewellery        | 55%        |
| owning some livestock        | 0%         |
| owning some loan             | 35%        |

Human Capital

| Item                                | Percentage |
|-------------------------------------|------------|
| number of working family members (1 person) | 72%        |
| owning skills outside the field of fishing | 25%        |
| attending training                  | 15%        |
| owning health insurance             | 55%        |

Social Capital

| Item                                | Percentage |
|-------------------------------------|------------|
| actively participate in fisher group | 40%        |
| actively participate in community work | 100%       |
| actively participate in religion activity | 47.5%      |
| actively participate in wife fisher social gathering | 65%        |
| obedience in local culture          | 100%       |

Source: [14], [15] with adjustment

3.4. Vulnerability and Livelihood strategy

Livelihood vulnerability is a condition when an individual or household experiences pressure and shocks to their livelihood sources, so that the sustainability of their livelihood and life is threatened [14]. Vulnerability context frames the external environment in people's social life. Community livelihoods and broader asset availability are fundamentally affected by critical trends as well as by shocks and seasonality [15]. The two-research locations, small-scale fishers face a variety of challenges to their livelihoods. They are generally confronted with the same constraints, both natural and socioeconomic. These difficulties and obstacles have an impact on their ability to earn a living. Fishers are vulnerable to uncertainty because their source of income is in the sea, with uncertain outcomes.
Table 3. Problems faced by fishers and their strategies to face them

| Community                  | Vulnerability sources                                                                 | Livelihood strategies                                                                 |
|---------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Glagah village, Kulon Progo, (Southern coast of Java) | 1. Natural exposure: weather is more unpredictable, lean season, Decreased catches (100%)<br>2. Physical exposure: The incomplete construction of breakwater creates strong currents eroding land. (20%), land use change.<br>3. Economic exposure: decreasing price of fish catches (26%)<br>4. Human exposure: increasing the number of fisher (63%) | 1. Multiple income pattern other occupations that are seasonal in nature such as farming, trading, mechanic, and tourism (83%)<br>2.-<br>3. Sell livestock, jewelry (77%), or get loan from the bank (45,7%)<br>4. Expanding fishing ground (11%) |
| Betahlawang village, Demak (Northern coast of Java) | 1. Natural exposure: weather is more unpredictable, lean season, Decreased catches, high wave (95%)<br>2. Physical exposure: trap net snagging or broken by arad net (60%)<br>3. Economic exposure: fluctuation of price product, expensive fuel prices, decreased income when lean season (60%)<br>4. Human exposure: there is no other skill except being fisher (75%)<br>5. Social exposure: Conflict with arad fishers (48%) | 1. Expanding fishing ground (92,5%), prolonging fishing time in different day to arad fishers like on Friday (70%) withdrawal money from own saving (95%)<br>2. Optimizing social capital, trust and networks: neighbors, relatives, and relationships to owe money to meet daily needs during the lean season (35%) negotiation.<br>3. Optimizing social capital, trust and networks: neighbors, relatives, and relationships to owe money to meet daily needs during the lean season (35%) negotiation.<br>4.-<br>5. Do nothing (69%), or sometimes just give an advice (30%) |

Source: [14], [15] with adjustment

The natural factor is the damage caused by overfishing that extends beyond the marine environment (Table 3). Both communities experiencing this uncertainty but has different strategies.

In Glagah, fishers’ experiences and geographic conditions help them to have more sustainable livelihood during low-catch season. Glagah fishers’ settlement near from tourist attractions and vast farming land. It devised them to have more livelihood source such as from farming, selling, and providing other services in tourism sectors near the beach when the catch is unpredictable. During holiday, income from service in tourism sectors exceeding the income from fishing. A slightly different situation exists in Betahlawang, where fishers prioritize fishing over tourism. This is because beach tourism in Betahlawang is not as popular as tourism on Glagah Beach. Betahlawang fishers do not have favorable assets, consequently their livelihood strategy option is limited. The 92.5% fishers keep fishing during low-catch season by increase their fishing efforts by works longer hours and further distance, which results in capital loss.

Borrowing money is another strategy during hard time. Usually, fishers owe money from their relatives. Similar practice occurs in Tegal coast (northern coast of Java), where social capital play important role in gaining trust and networks to get loan. Stronger social capital could activate other livelihood capital so that fishers could survive [7]. During the hard-time, Betahlawang fisher households borrowed money from family or relatives before going to sea for fishing, which they would repay when
they returned home with their catch from the sea. This social capital strategy doesn’t occur in Glagah, where fishers prefer to take out bank loans than owing money from relatives.

Social conflict is part of our social life, and therefore it is not surprising if small-scale fishers in the research site are also experiencing social conflicts. In fact, almost all Indonesian fisher, as well as those in Southeast Asia in general, have faced social conflicts ([18], [19], [20]). The social problem that occurs in the fishing community is the existence of social conflicts between fishers. Social conflicts that occur are often caused by fighting over the catch. Blue swimming crab fishers of Betahlawang who admits that he often has conflicts with arad fishers. Meanwhile, local Glagah fishers who sometimes also have conflicts with andon fishers. The process of building a port and airport in Kulon Progo at that time certainly affected the fishers's livelihood too. Most of them support the construction of ports, but some refuse because they are detrimental to small fisher who find it increasingly difficult to find a fishing ground near the coast that is in accordance with the capacity of their ships and boat engines. Likewise, the airport construction process which resulted in a lot of land conversion has an impact on fishers whom their main job is farmers.

In accordance with the theoretical framework on the sociology of livelihood [21], namely: 1) in any condition and situation, every individual or household always tries to maintain its livelihood status and as far as possible continue its existence across generations through various survival strategies by manipulating resources. Accessible and accessible livelihoods; 2) Each individual or household builds a survival mechanism through a group or community according to its socio-cultural and eco-geographic context; 3) The existence of infrastructure strength (institutional/social institution) and superstructure strength (value system) as well as social structure (social relationship pattern) that shape the livelihood strategy of each individual/household is different; 4) To some extent, livelihood strategies developed by households/individuals will affect the dynamics of the social life of the community or vice versa, the dynamics of the social life of the community will determine the livelihood strategies that are built.

4. Conclusion and Implication to Management

Based on previous description, some conclusions are:

1. The study showed the differences in the livelihood asset, access, vulnerability, and strategies of the fisher communities in the different geographical settings.
2. The livelihoods of small-scale fisher, as discussed in the two-case studies, are highly dependent on natural capital, mainly the availability or the abundance of the fish resources.
3. Limited capital ownership, access and skills haunt fishers’ livelihood sustainability.
4. Although the two study sites share some similarities, there were clearly differences on the issue of livelihood vulnerability and strategies. Betahlawang fisher tend to have various vulnerabilities compared to Glagah. Also, Glagah fisher tend to have more diverse livelihood alternatives than Betahlawang. The availability of various livelihood resources and the ability to diversify work are the characteristics of Glagah.

Thus, our suggestion that may implicate to the management are:

1. Fisheries management need to consider wisely human-environment relation, particularly the livelihood sustainability issues.
2. Strengthening the livelihood resources through human development programs is needed for the coastal community.
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