

# Sustainable livelihoods frameworks in investigating household assets in Jakarta Bay, Indonesia

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**Abstract.** Jakarta Bay Ecosystem (JBE) consists of two areas: Jakarta Bay (mainland) and the Seribu Islands (islands). These ecosystems have experienced a series of drastic environmental shifts in recent decades. They both are heavily impacted by human activities with organic waste delivered directly to the rivers without special treatment, then transported into the bay. This study aims to describe and investigate the vulnerability of livelihoods by investigating household assets. This study performed the differences of main resource use in the two study areas. This study found differences in livelihood assets between the islands and the mainland. The asset pentagon of DFID livelihood framework enables the information about people's assets to be presented visually, thereby bringing to light the important interrelationships between various assets. Based on changes in or availability of assets, different shapes of the pentagon were obtained depending on the respective area's condition and community structure. The shape of the pentagon does not represent absolute or quantitative values, but rather gives a qualitative impression of the extend of different types of livelihood assets. The results reflect that, currently, different assets do not reach their full potential in the livelihood portfolios. Therefore, people's ability to adapt may be strengthened by using targeted strategies to reduce their vulnerability.

**Key Words:** fisheries dependence, household, Jakarta Bay, Seribu Islands.

**Introduction.** Jakarta Bay Ecosystem (JBE) consists of two coastal ecosystems: Jakarta Bay (Indonesia: Teluk Jakarta) and Seribu Islands (Indonesia: Kepulauan Seribu) (Williams et al 2000). The Jakarta Bay is located in the north of Jakarta City and the Seribu Islands is a group of small islands scattered in the Bay of Jakarta, which stretches from 5°42'58" to 6°1'45" south latitude and 106°37'30" to 106°50'53" east longitude. The Seribu Islands, located in the northern part of Jakarta Bay, also afford many marine fisheries areas and resources to support the market in Jakarta and surrounding areas.

In JBE, organic waste is delivered directly to the rivers without special treatment, which is then transported into the bay. It has become a wastewater disposal site for the Jakarta Metropolitan Area (JMA); domestic sewage, industrial and agricultural wastes are deposited in it. The major sources of the high load of human and industrial waste are the tributaries flowing into the JBE. There are 13 rivers flowing into Jakarta Bay; the biggest is the Ciliwung, and there are 12 additional tributaries, including the Angke, Bekasi, Cakung, Cidurian, Cikarang, Cimancuri, Ciranjang, Cisadane, Citarum, Karawang Krrukut and Sunter rivers (BPLHD 2003).

As a large coastal ecosystem with relatively different characteristics, Jakarta Bay and Seribu Islands have been undergoing environmental degradation since the last few decades due to anthropogenic factors, mainly from up-land. Vit (2012) reported that Jakarta Bay is a highly polluted water body. Due to human activities concentrated in Jakarta Bay, the spatial distributions of Pb and Cu in sediments were increased, especially in the west and central areas (Arifin 2004). This confirmed the results of Dahuri (2001), who listed tremendous expansion of coastal settlements, coastal aquaculture, and organic waste producing industries and coastal agriculture as the primary sources of organic pollution in Indonesia's coastal waters.

In this study, increased population, highly dependent on coastal resources, and several other factors are contributing to declining coastal resources in JBE. Due to these factors, the majority of the people that live in these coastal communities live below the poverty line with poor sanitation (Putri & Pearson 2014). This environmental crisis is likely to have major consequences for the livelihoods of those dependent on these resources. To study the livelihoods in both study areas, a framework about Sustainable Livelihood Approach (SLA) was described.

## Material and Method

**Description of the study sites.** The study was carried out from September 2012 to January 2013 and is used as a basis for ongoing research. The main geographical areas covered during the data collection by interview include 5 fishing communities in 5 different locations in Seribu Islands (Untung Jawa, Pramuka, Pari, Harapan, and Kelapa Island) and 10 coastal villages around Jakarta Bay (Kota Utara, Kalibaru, Kapuk Muara, Kamal Muara, Tanjung Priuk, Ancol, Pluit, Penjaringan, Cilincing, and Marunda) (Figure 1). Household samples were selected by the snow ball sampling method, with a total of 224 people interviewed using questionnaires to assess their perception, feeling, and behavior with regard to changes that have been taking place in Jakarta Bay and Seribu Islands, Indonesia.

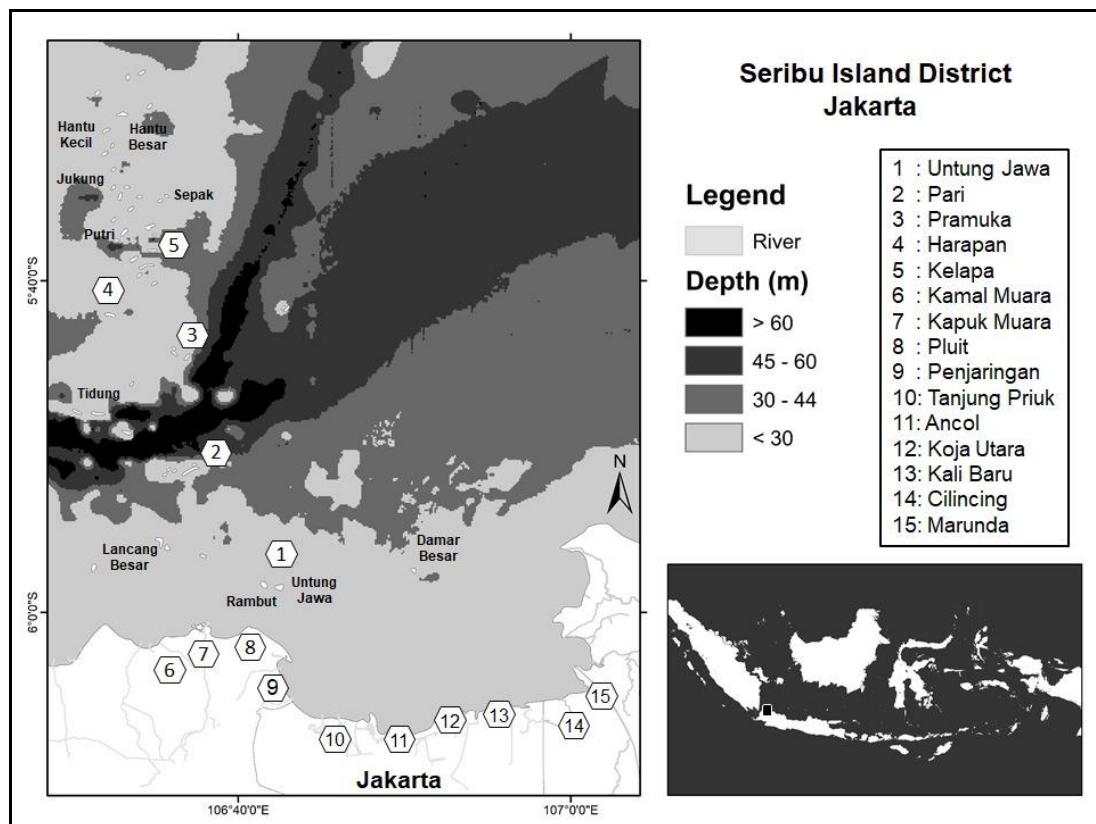


Figure 1. Research area.

**Data analysis.** The data analysis was divided in 2 parts: statistical analysis and descriptive analysis. Quantitative answers were obtained in the data collection method. To achieve the significant difference in both study sites, a non-parametric test for independent sample was used. A cross-tabulation was used to show the relationship between two or more categorical variables by SPSS (Statistical Package for Social Sciences) (Rovai et al 2013) IBM series 20. Chi-square ( $\chi^2$ ) test was employed for testing the hypotheses regarding statistical distribution on people perception of resources changes.

**Sustainable livelihoods approach.** The SLA in the coastal context was developed in the frame of the Sustainable Coastal Livelihoods (SCL) Project South Asia funded by the UK Government's Department for International Development's (DFID) Policy Research Program. Krantz (2001) reported that the adoption of a livelihood approach within DFID resulted from the publication of the 1999 UK Government White Paper on International Development.

Apart from DFID, there are other organizations using SLA. They include the International NGOs CARE, OXFAM, Save the Children, ITDG (Intermediate Technology Development Group), as well as bilateral organizations (DANIDA, SIDA) and multilateral organizations (UNDP, FAO, WFP, IFAD, World Bank).

DFID (1999) defined: "A livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now in the future, while not undermining the natural resources base".

The Sustainable Livelihoods Framework (SLF) is a way of looking at the complexity of people's lives and responding to it (Figure 2), used to understand and examine the livelihood of the poor (DFID 1999).

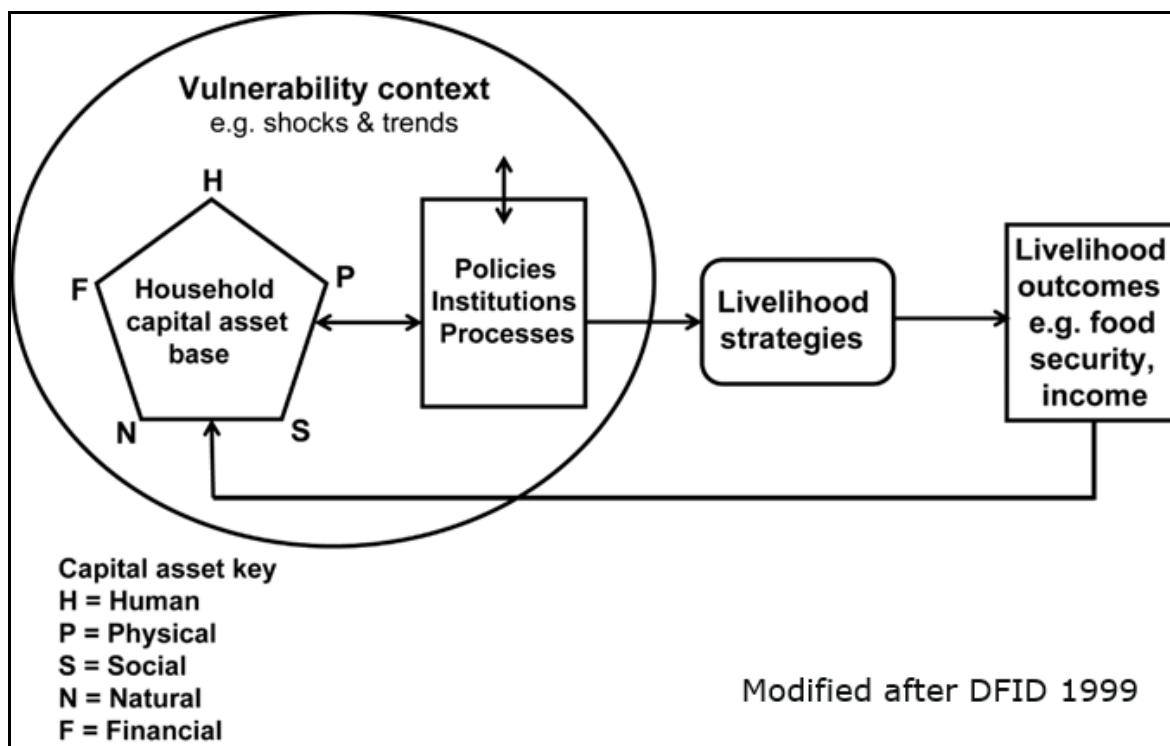


Figure 2. Sustainable livelihood frameworks.

The SLF is constructed based on 5 main categories of livelihood assets (human, social, physical, financial, and natural) (Carney 1998). In this study, comparison of livelihood assets between the islands and the mainland are based on the SLF with respect to the adaptive capacity of fishermen.

## Results and Discussion

**Household interviews.** In the Jakarta Bay Coastal Ecosystem (JBCE), the majority of people are immigrants from other parts of Java and other islands (82% on the mainland and 87% on the islands). They come from different ethnicities; the Javanese and Sundanese are the majority, while Makassarese, Buginese and Mandarese are minorities (Table 1).

Table 1  
People of different ethnicities living in the Jakarta Bay Ecosystem

		<i>Island</i>	<i>Mainland</i>	
	<i>N</i>	(%)	<i>N</i>	(%)
Native				
Jakarta surroundings (Tangerang, Bekasi, Bogor)	11	13	25	18
Immigrant				
Javanese	41	49		
Sundanese				
Makassarese			115	82
Buginese	32	38		
Mandarese				

**Human capital.** According to the respondents, both on the islands (63%) and the mainland (59%), the majority have received some training derived from the KKP collaborating with the Local Government as well as Non-Government Organization. To assess human capital in the study area, the types of training received by the respondents were categorized. Training on fishing technique was the most common type of training in the mainland, while foreign language in the islands (Figure 3).

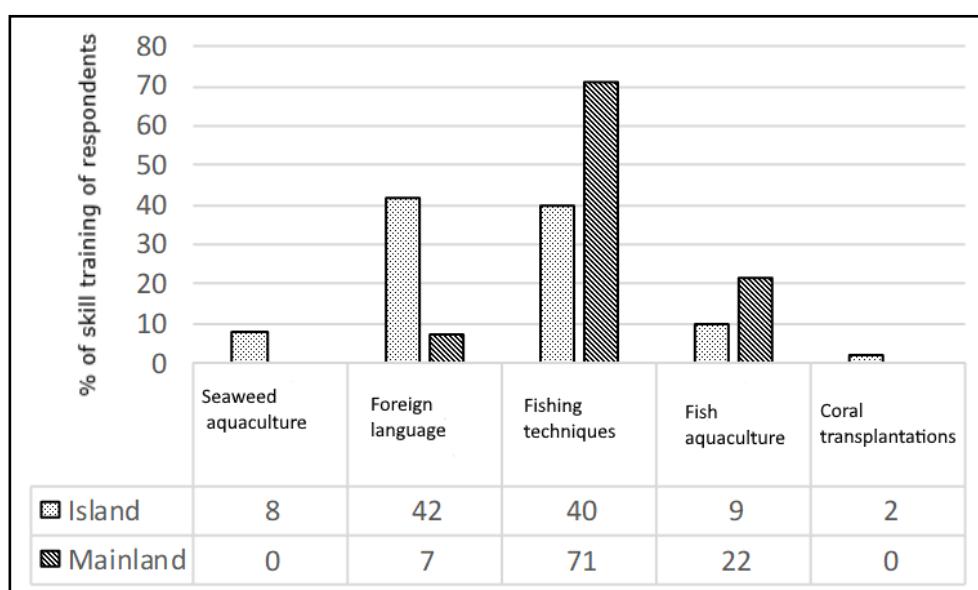


Figure 3. Different types of training received by the respondents.

Human capital represents skills, knowledge, ability for labor and good health (DFID 1999; Brocklesby & Fisher 2003). In this study, human capital can be described as the ability to cope with changes or better utilize existing potential (which can be increased by training and capacity building). Interestingly, the human assets owned by people on the islands were different from those on the mainland. The majority of the respondents on the islands mentioned knowledge of a foreign language as a skill, while on the mainland the most mentioned skill was knowing fishing techniques. Foreign language was mainly learned due to tourism development and the presence of foreigners coming to the islands for vacations. Islands are often ideal locations for resorts (Wong 1998), tourism (Miller 1993), and tourism-related economic development (Wilkinson 1989). The tourism development in Seribu Islands affects the human activity (Willoughby 1986). Thus, the majority of people on the islands adopted some skills related to tourism. On the other hand, on the mainland there were few signs of development besides fishing. Thus, local

people, who are working predominantly as fishermen, prefer to have more skills related to fishing.

As this study shows, the human capital of the islands is better developed than on the mainland. By increasing their capacity, people reduce their sensitivity to risks associated with the fishery in general or stemming from diminished resources, by going and joining trainings for gaining different skills, like seaweed aquaculture, foreign languages, fish aquaculture, coral transplantation, and others.

Table 2  
Physical capital of households on the islands and the mainland, where the islands have more physical capital

<i>Household items and facilities</i>	<i>Island (%)</i>	<i>Mainland (%)</i>
TV	95	74
Electricity	100	100
Electric fan	67	86
Air conditioner	43	0
Mobile phone	93	64
Refrigerator	90	37
DVD	29	13
Piped water	90	89
Lighting		
Light bulb	100	100
Transportation		
Bicycle	100	23
Motorcycle	25	63
Boat	18	10
Cooking		
Gas	90	63
Kerosene	31	28
Roof material		
Zinc board	42	53
Tile	58	47
Floor material		
Dirt/soil	6	0
Bamboo/palm	12	25
Plank wood	33	31
Cement	49	44
Wall material		
Bamboo/thatch	6	25
Wood	12	31
Stone block	49	44
Cement	49	44

**Social capital.** There were a number of social ties between communities on the islands and on the mainland. They depended on each in various aspects of life, especially for food supply. The dependence was also present in the health sector. Due to the inadequate number of health personnel on the islands, most islanders obtained health services on the mainland. This social relationship was confirmed by the statement the widow of a fisherman, who said that their livelihoods depend on the mainland market, that they catch fish and other marine resources and sell them to the people in the mainland, and that they buy food and other essentials from the market, which is a lifeline for them.

Moreover, the social relationship was observed in fishermen cooperatives and in an organization managed by the communities for saving money ("arisan"). Other relationships result in having fishing equipment without the issue of losing it.

In the SLF, social capital refers to the social resources which people draw in pursuit of their livelihood objectives. Following the definition by Kay (2006), social capital consists of the features of social organizations such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit. Based on observations during this study, membership and networking in trade matters are the most important social connections between the islands and mainland. In line with the definition of social capital, respondents perceived that having more networks means more possible help whenever needed.

The social capital among the people was enhanced by reciprocal generosity in the form of sharing to meet the daily needs (vegetables, fish) and helping each other. Especially on the islands, people were aware of the need for assistance by people on the mainland. Besides meeting daily needs, health, education, credit, and occupation are necessities that cannot be met entirely on the islands.

Due to the limited number of banks on the islands, people joined so-called "arisan" or cash-saving groups. As an illustration, people on Kelapa Island - the farthest island in this study - entrusted their money to others to be saved. Being recognized as a trustable individual made their life easier. It was common to seek sufficient help from relatives or neighbors, mostly without having to ask.

Moreover, people believe marriages can enhance social relationships. Therefore, many people have marital relations. By entering this relationship, they believe their social lives would be more secure. Moring (1996) argues that marriage can affect social change. In this study, there were indications for a notable religious endogamy. The custom of marrying within the local community, clan, or tribe was frequent, interestingly often crossing ethnical boundaries. As an example, among the people in Harapan Island, Muslim marriages occurred between the ethnicities of Mandarese-Javanese, Sundanese-Javanese, Buginese-Sundanese, Javanese-Betawi, Javanese-Javanese, and Mandarese-Buginese. This contributed to cultural integration. Therefore, it is not surprising that some people could speak the languages of other tribes. Le Guennec-Coppens (1989) reported that the social origin of migrants affects the local societies and influence in different roles. This can be used to justify the inter-ethnic relationships on the islands.

Grafton (2005) argues that social capital plays a crucial role in promoting trust, cooperation among fishermen, and may reduce the competition in fishing. According to the conditions in the JBE observed in this study, social capital was the most dynamic of all assets. It could be increased and developed by having good social relationships, and it could be lost if bad attitudes caused people to dislike each other and reduce trust.

**Financial capital.** In general, the majority of fishermen, both on the islands and the mainland, depend on fishing as their main source of income (Figure 4). Fishermen tended to save their income every day to fulfill their daily needs. However, as the fish stock is decreasing, most fishermen had two or more sources of income to increase their financial standing. These additional sources of income are grouped here into fish-related and non-fishing activities. Fish-related activities consisted of ornamental fish farming, selling fish, collecting fish as intermediaries, and fish processing. Non-fishing activities consisted of marketing, boat rentals, house rentals, ferry transport, and some other tourism-related activities.

According to DFID (1999), there are two main sources of financial capital: available financial stocks (savings, credit) and regular inflows of money (pensions, other transfers, and remittances). According to the respondents, both on the islands and the mainland, the financial capital is a highly fluctuating and uncertain asset for developing their livelihoods. Fishing is a high-risk occupation (Poggie & Gersuni 1972), as it is seasonal (Crawford 1980; Esporlas 1982) and subjected to cyclical fluctuations in stock size (Allison & Ellis 2001) and highly unpredictable occurrence of stocks.

As a result, the fishermen cannot guarantee how much money they can earn in a day. Under this condition, they aim to save any extra income to build sufficient reserves. But, in reality, the amount of money accumulated is barely sufficient to cover their daily needs. An example was given by one fisherman in Kamal Muara. During the dry season, he was not able to go fishing regularly. This situation caused him to fish harder, going

outside the common fishing ground. Normally, he would earn up to IDR 70000 (5 USD) a day, but in the dry season, that figure would be halved. Sometimes, he did not even make any money from fishing, and only caught enough fish to eat. Therefore, those who did not have sufficient financial support would try to have an alternative livelihood activity, such as boat rental.

On the other hand, the effort of fishermen to fish harder can affect the financial assets they have. By aiming to catch more fish, fishermen in the JBE try to move to other fishing grounds, which means they need more money to buy fuel. This may lead to the condition described by De Camargo (2001), who states that the use of motors can be detrimental in both the dry and wet seasons on economic grounds. In these cases, the fishermen used more fuel, but did not catch enough fish to cover their cost.

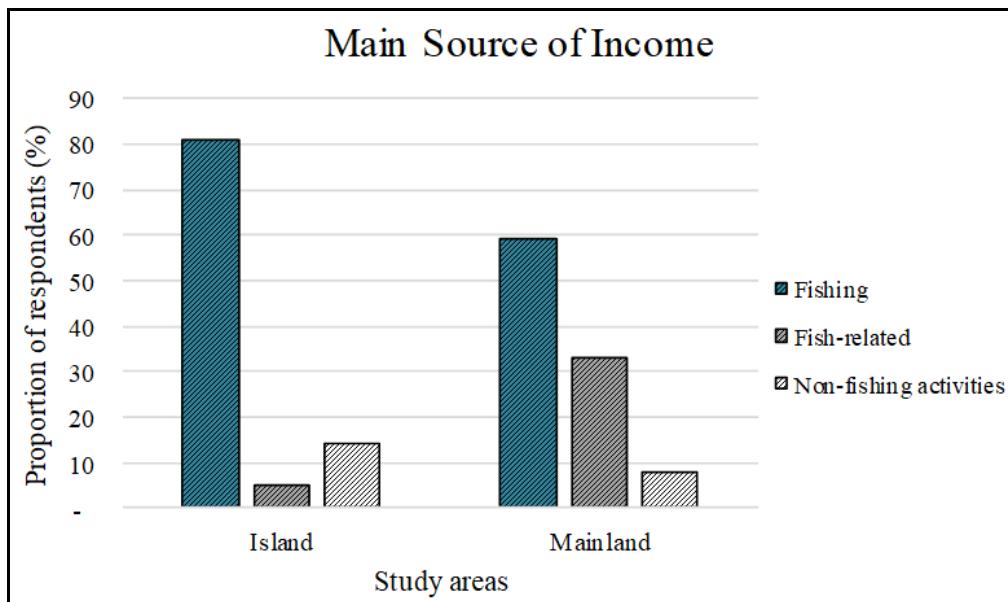


Figure 4. Main sources of income of respondents on the islands and mainland.

**Physical capital.** The physical assets of the islands and mainland are described in Table 2. According to DFID (1999), the livelihood assets consist of human, social, physical, financial and natural assets. The livelihood assets are part of a framework describing the complexity of people's livelihood. According to Chambers & Conway (1992), the meaning of livelihood is the gaining of living, including livelihood capabilities, tangible assets and intangible assets. A livelihood can be sustained when it is able to cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resources at its base (Scoones 1998).

According to the DFID (1999), physical capital comprises the basic infrastructure (consisting of changes to the physical environment that help people to meet their basic needs and to be more productive) and producer goods (the tools and equipment that people use to function more productively) needed to support livelihoods. In this study, the most important type of physical capital owned by the fishermen was their fishing equipment: boats, nets, hooks, and other fishing gear. For those engaged in non-fishing activities as an alternative job, the availability of equipment related to tourism (snorkeling, diving) and other support (house rental) are determining factors of feasibility among their physical capital.

As Jakarta, a major city characterized by strong capitalization and transportation infrastructure development (Cervero & Susantono 1999), is close by, the physical assets on the mainland should be better. Interestingly, this study found the contrary. The physical assets on the islands were better compared with the mainland. Table 2 shows that the household items and facilities on the islands were more advanced compared to the mainland. This was due to the islands having a strong influence from the tourism sector.

Based on the observations in this study, it was found that many people were competing to move or have access to the islands due to the money being available there. For investors, this condition is an opportunity for business. With the support of the government and investors, the infrastructure on the islands has developed considerably in recent years. On the other hand, the mainland people were struggling more to survive. The rapid development on the islands had an influence on the natural assets of the islands themselves. The construction of artificial islands for tourism projects will have a direct impact on marine habitats.

There are several studies that underline the importance of biodiversity in marine sediments. Snelgrove et al (1999) reported that the highest part of species diversity in marine ecosystems consists of invertebrates (infauna and epifauna) which are found in sediments. These marine sediments are important in ecosystem processes (Snelgrove 1997). They also can influence global carbon dioxide dynamics (Snelgrove et al 1999) and, hence, global warming. Additionally, shallow marine habitats have a strong relationship with fish richness (Gratwicke & Speight 2005; Baum et al 2016). Therefore, even though the infrastructure development in the islands increases, it has indirect effects in reducing target species, thus affecting the natural asset base.

**Natural capital.** By definition, natural capital comprises the natural resource stocks from which resource flow and services useful for livelihoods are derived (DFID 1999). Natural capital and services include, and are derived from land, forests, marine resources, water, air quality, erosion protection, waste assimilation, storm protection, biodiversity degree and rate of change. The resources owned and used jointly by a community of resource users are referred to as 'common property' (Schlager & Ostrom 1992).

In this study, natural capital was mainly comprised of fisheries resources. According to Tables 3 and 4, there are 10 fish species playing a role as important natural resources in the JBE. Due to fishing being the dominant activity, these resources are very important for the livelihoods of coastal communities depending on fisheries. By using these resources, the communities should be able to manage their livelihoods. Pomeroy & Carlos (1997) reported that communities would be able to produce resource management strategies for the natural assets under certain conditions.

According to the respondents, people in the JBE were aware that the fisheries resources are declining. However, the coastal communities still depended on the fishery sector. By these changes in stock, people have different strategies to manage resources as a necessity to boost their income. On the islands, redbelly yellowtail fusilier (*Caesio cuning*), as the economically most important resource, cannot be caught in large amounts due to the prohibition of "muroami" fishing gear. Presently, cultured grouper has a very high economic value, which makes it a very important cultured species to improve the economic standard of the island inhabitants. This aspect was further clarified by one of the fishermen on Harapan Island, who said that in the beginning, he was not interested in aquaculture, because it is difficult and needs patience until he could make money. However, since he knew it has a high economic potential and fish collectors ask for live reef fish, he tried to do aquaculture around the island. Now he is supplying his customers on the mainland for their restaurants.

The most important species mentioned by the interviewed households differed between islands (Table 3) and mainland communities (Table 4).

On the mainland, alternative earnings are from value-added fish products. Addition of value to *Rastrelliger kanagurta* (Indian mackerel) and other species (*Sellaroides leptolepis*, *Sardinella lemuru*, *Sardinella* sp., and *Perna viridis*) is achieved through processing (Figure 5). These fishery resources are processed into salted and smoked fish, and the manufacture of crackers improve the market value, thereby increasing the economic benefits for the fishermen.

Table 3

Economically important species (in terms of consumption and trade) and their ranks according to the household survey on the islands (n=84); multiple answers were possible

No	Local name	Latin name	English name	Rank (mean±SE)	Spread (households mentioning this resource)	Relative importance (% of all households)
1	Ekor kuning	<i>Caesio cuning</i>	Redbelly yellowtail fusilier	1.29±0.081	75	89.3
2	Tongkol	<i>Euthynnus affinis</i>	Mackerel tuna	1.91±0.07	66	78.6
3	Banyar	<i>Rastrelliger kanagurta</i>	Indian mackerel	1.95±0.07	58	69.0
4	Kerapu	<i>Epinephelus</i> sp./ <i>Plectropomus</i> sp.	Grouper	2.06±0.11	32	38.1
5	Selar kuning	<i>Selaroides leptolepis</i>	Yellowtail scad	2.33±0.06	51	60.7
6	Baronang tompel	<i>Siganus guttatus</i>	Rabbit fish	2.69±0.08	48	57.1
7	Tembang	Clupeidae: <i>Sardinella albella</i> , <i>Sardinella brachysoma</i> , <i>Sardinella fimbriata</i>	Fringe scale sardine	2.74±0.06	38	45.2
8	Lemuru	<i>Sardinella lemuru</i> , ( <i>Amblygaster leiogaster</i> )	Bali sardinella	2.8±0.06	49	58.3
9	Tenggiri	<i>Acanthocybium solandri</i>	Narrow-barred Spanish mackerel	2.95±0.03	38	45.2
10	Kerang hijau	<i>Perna viridis</i>	Green mussel	3	7	8.3

Table 4

Economically important species (in term of consumption and trade) and their ranks according to the household survey on the mainland (n=140); multiple answer were possible

No	Local name	Latin name	English name	Rank (mean±SE)	Spread (households mentioning this resource)	Relative importance (% of all households)
1	Banyar	<i>Rastrelliger kanagurta</i>	Indian mackerel	1.41±0.05	118	84.3
2	Lemuru	<i>Sardinella lemuru</i> , ( <i>Amblygaster leiogaster</i> )	Bali sardinella	1.68±0.05	102	72.9
3	Kerang hijau	<i>Perna viridis</i>	Green mussel	1.75±0.06	85	60.7
4	Tembang	Clupeidae: <i>Sardinella albella</i> , <i>Sardinella brachysoma</i> , <i>Sardinella fimbriata</i>	Fringe scale sardine	1.87±0.07	94	67.1
5	Selar kuning	<i>Selaroides leptolepis</i>	Yellowtail scad	1.97±0.02	94	67.1
6	Tenggiri	<i>Acanthocybium solandri</i>	Narrow-barred Spanish mackerel	2.6±0.05	91	65.0
7	Tongkol	<i>Euthynnus affinis</i>	Mackerel tuna	2.82±0.04	88	62.9
8	Kerapu	<i>Epinephelus</i> sp./ <i>Plectropomus</i> sp.	Grouper	2.85±0.1	13	9.3
9	Baronang tompel	<i>Siganus guttatus</i>	Rabbit fish	2.94±0.04	36	25.7
10	Ekor kuning	<i>Caesio cuning</i>	Redbelly yellowtail fusilier	2.98±0.02	53	37.9



Figure 5. Fish processing activities (upper left); salted fish (upper right); fisherman family during fish processing activities (left down); smoked fish (right down).

**Comparison of livelihood assets between the islands and the mainland.** As described above, this study found differences in livelihood assets between the islands and the mainland. The asset pentagon of DFID livelihood framework (Figure 6) enables the information about people's assets to be presented visually, thereby highlighting the important interrelationships between the various assets.

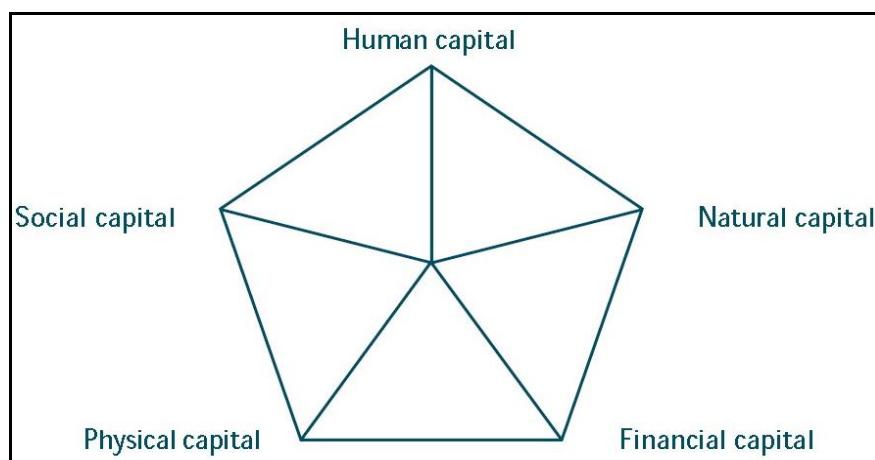


Figure 6. The assets pentagon of the DFID sustainability livelihood framework (DFID 1999).

There were differences in the available livelihood assets between the islands and the mainland. Quantitative data from BPS (2010a, 2010b) and the KKP (2010) were obtained to qualitatively assess trends in the different assets (before and after intervention), which affect the communities. Based on previous literature review and observations during this study, qualitative changes occurred in the islands and mainland (Table 5). Policy intervention was found, and it might have caused the development in the islands, such as the infrastructure and the artificial islands building.

Table 5  
Different livelihood assets with changes in each after policy interventions in the islands and the mainland

<i>Livelihoods assets (islands)</i>	<i>Past</i>	<i>Current study</i>
Human	L	Increase
Social	H	Increase
Financial	L	Increase
Physical	L	Increase
Natural	H	Decrease
<i>Livelihoods assets (mainland)</i>	<i>Past</i>	<i>Current study</i>
Human	L	No changes
Social	H	Increase
Financial	L	Increase
Physical	L	Increase
Natural	H	Decrease

Note: L - low; H - high.

Based on the changes in the availability of assets, different shapes of the pentagon were obtained depending on the respective area's condition and community structure (Figure 7). The shape of the pentagon does not represent absolute or quantitative values, but rather gives a qualitative impression of the extent of different types of livelihood assets. The results reflect that, currently, different assets do not reach their full potential in the livelihood portfolios. Therefore, the people's ability to adapt may be strengthened by using targeted strategies to reduce their vulnerabilities.

This study was not able to fully explore the living conditions and livelihoods of the entire communities due to the limitations in terms of duration and limited number of respondents. If more information is available, the living conditions and livelihoods can be assessed through adequate indicators for each of the 5 types of livelihood assets. The length of each axis represents the extent of each respective type of asset. For a quantitative assessment, indicators need to be defined for each type of asset that can then be measured. These indicators can be developed in a participatory manner together with the communities to identify parameters that are relevant to both the local communities and to managers (Glaser et al 2010).

Sustainability thresholds can then be defined based on socio-economic or biological criteria based on literature values or joint deliberations of stakeholders, like attendance of elementary school by all youth, a minimum wage level, or a maximum sustainable amount of fished biomass (Glaser et al 2010). As no quantitative measures were defined for the different assets in this study, it can only provide an abstract overview of the livelihood aspects in both study areas.

According to statements from people on the islands, an ideal condition would be if they were able to earn minimum wages, if house ownership in the community would be 100%, if there was enough food not to starve, and if 100% of the community members were able to have an education. If further defined, these aspects could be used as indicators for the different types of assets, with a definition of respective sustainability thresholds. In this study, people were observed to readily accept some changes in order to be able to continue or improve their lives. Increasing one asset will influence others; for example, by increasing human capital, there are potential knock-on effects increasing social and financial capital (through support by government and investors), which again can increase the physical assets (through infrastructure development).

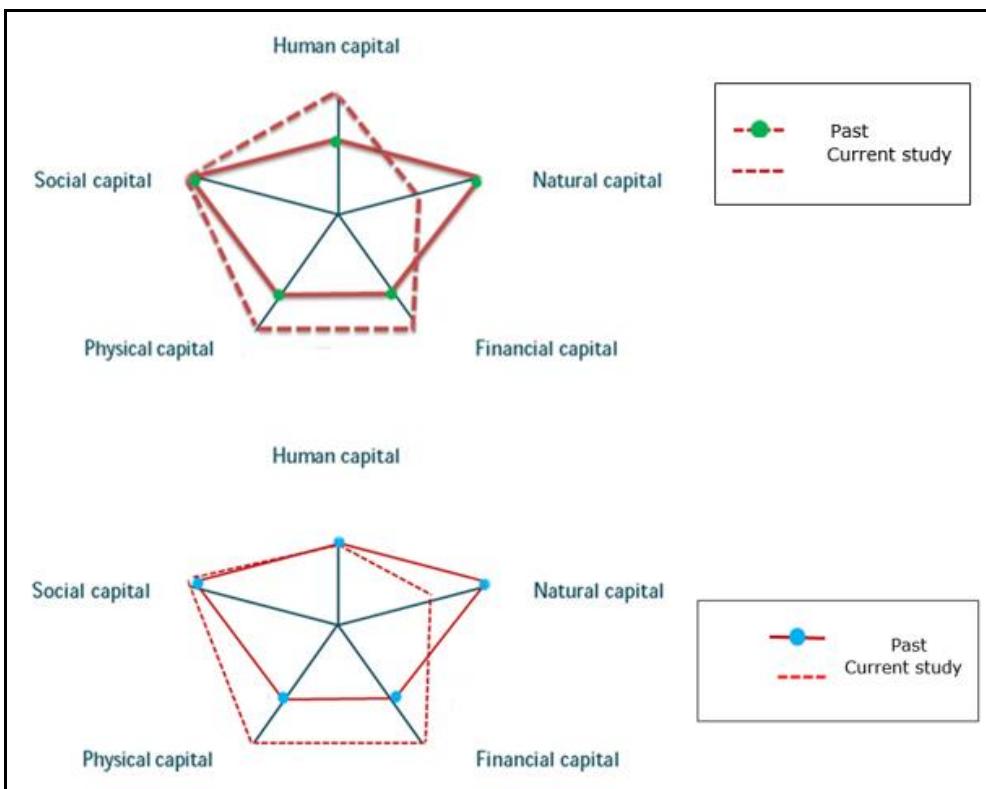


Figure 7. Relative extent of the 5 different types of livelihood assets on the islands (above figure), and mainland (below figure) before intervention and at the time of the current study.

On the mainland, people were not observed to easily accept change, and opportunities for changes in livelihood strategies were limited. Comparing both study areas, the communities on the mainland appear more vulnerable than those on the islands.

**Conclusions.** In both the islands and the mainland, overexploitation of resources and pollution are the two most important factors perceived as the cause of declining fishery resources. With respect to the adaptive capacity of the fishermen in both study areas, the island communities have higher human, financial, and capital assets. This is because the fishermen acquired different types of knowledge, skills and more alternative sources of livelihood, relying less on marine resources, compared to the mainland, where the majority of respondents only engaged in fish-related activities. With low livelihood assets, a sole dependence on fishery resources and a lack of alternative livelihoods, communities in the mainland can be more vulnerable to decreases in fishery resources.

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