The economic impact of marine plastics, including ghost fishing, on fishing boats in Phước Tinh and Loc An, Ba Ria Vung Tau Province, Viet Nam

Leander Raes, Aanchal Jain, Thong Nguyen Ba, Ruben Savels

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Contents

Acronyms 6
Table of Figures 7
Table of Tables 7
1. Introduction 8
2. Background: Viet Nam 12
2.1. Vietnamese fisheries 12
2.2. Viet Nam policies on ALDFG 16
3. Case study overview 17
3.1 Data collection 18
3.2 Cost-benefit analysis 20
4. Results 20
4.1 Cost-benefit analysis 20
4.1.1. Survey results ALDFG and marine plastics gillnet fisheries 21
4.1.2. Survey results policies on ALDFG in gillnet fisheries 25
4.2 Survey results of pots & traps fisheries 26
4.2.1. Survey results for ALDFG and marine plastics pots & traps fisheries 28
4.2.2. Survey results on policies on ALDFG in gillnet fisheries 31
4.3 Cost benefit analysis 32
4.3.1. Current costs and benefits 33
4.3.2. Costs of ghost fishing 35
4.3.3. Results of the cost-benefit analysis 36
4.3.4. Impact on biodiversity in Viet Nam 37
5. Final remarks 39
References 40
Annex 44

Acronyms

ALDFG	Abandoned, Lost or otherwise Discarded Fishing Gear
BAU	Business as usual
CBA	Cost Benefit Analysis
CR	Critical (conservation status per the IUCN Red List ™)
DRS	Deposit Refund Scheme
EN	Endangered (conservation status per the IUCN Red List ™)
EU	European Union
GDP	Gross Domestic Product
USD	United States Dollar
VND	Vietnamese Dong
VU	Vulnerable (conservation status per the IUCN Red List ™)

Table of Figures

Figure 1. Percentage total fish catch by different types of fish gear in Viet Nam. (Source: Elaboration from DFISH, 2020, and Research Institute for Marine Fisheries, 2007). 12
Figure 2. Vietnamese import statistics fishing gear/net materials (tonnes) period 2005-2019 categorized by commodity codes (HS codes, Table 2) (Source: UN, 2021). 14
Figure 3. Causes of losing gear, gillnet fisheries. 21
Figure 4. Frequency of losing gear due to each of the causes, gillnet fisheries. 22
Figure 5. Causes for discarding gear, gillnet fisheries. 22
Figure 6. Frequency of discarding gear due to each of the causes, gillnet fisheries. 23
Figure 7. Source of policy information received gillnet fisheries. 25
Figure 8. Measures used to prevent ALDFG (gillnet fisheries). 25
Figure 9. Effectiveness measures to prevent ALDFG according to respondents (gillnet fisheries). 26
Figure 10. Cause of losing gear traps/pots fisheries. 28
Figure 11. Probability of losing gear due to each of the causes, traps/pots fisheries. 28
Figure 12. Source of policy information received traps/pots fisheries. 31
Figure 13. Measures used to prevent ALDFG (pots/traps fisheries). 31
Figure 14. Effectiveness measures to prevent ALDFG according to respondents (pots/traps fisheries). 32
Figure 15. Comparison BAU and interventions. 37

Table of Tables

Table 1. Overview of boats, annual catch, and revenue for different types of fishing gear in 2019. .13
Table 2. HS-Commodity Codes related to fishing gear and netting materials. 13
Table 3. Survey sample overview. 19
Table 4. General data gillnet fishing boat (values/boat). 20
Table 5. Average impact gillnet fishing boats due to interactions with ALDFG (value/boat). 23
Table 6. Interaction gillnet boats with marine plastics (non-ALDFG) (value/boat). 24
Table 7. General data fishing boat that use pots/traps (value/boat). 26
Table 8. Average impact pots/traps fishing boats due to interactions with ALDFG (value/boat). 29
Table 9. Interaction pots/traps fishing boats with marine plastics (non-ALDFG) (value/boat). 30
Table 10. Average costs for a gillnet fishing boat in Viet Nam, 2019. 33
Table 11. Fishing revenue by catch type for gillnet fisheries in Viet Nam in 2019. 34
Table 12. Summary, literature review on ghost fishing impact at national and regional levels. 35
Table 13. Results of the cost-benefit analysis (VND/year). 36
Table 14. Turtle species global and Vietnamese Red List status and trends. 38

1. Introduction

Mismanagement of waste that causes plastics to end up in the ocean from both terrestrial and marine sources is a global problem. These 'marine plastics' are a threat to marine ecosystems on a worldwide level (NOAA Marine Debris Program, 2015; U.S. Fish and Wildlife Service, 2019).

One type of marine plastic pollution found in marine ecosystems that has caused great concern is the type of debris that originates from fishing activities (Macfadyen et al., 2009). Abandoned, lost or otherwise discarded fishing gear (ALDFG), also known as 'ghost gear', are considered one of the main sources of marine plastics coming from fisheries and from aquaculture (FAO, 2017; NOAA Marine Debris Program, 2015). Although no accurate global number on the amount of ALDFG exists, a rough estimate provided by Macfadyen et al. (2009) shows that it is likely less than 10% of marine debris by volume. ALDFG generates diverse impacts to marine organisms, the environment, and the fishing industry (Consoli et al., 2018; NOAA Marine Debris Program, 2015; Richardson et al., 2019a; Wilcox et al., 2016). The specific concern about ALDFG is that it passively "ghost fishes", which means it can continue to trap fish and crustaceans (target and non-target species), as well as ensnare and capture other species such as marine mammals, sea turtles, and seabirds (Edyvane and Penny, 2017; NOAA Marine Debris Program, 2015; Smolowitz, 1978).

There are several factors that can cause ALDFG: (i) Environmental conditions, such as storms, wave action, ice cover, or currents; (ii) Gear conflict, for example entanglement with other vessels, with active fishing gear, or with reefs and rocky bottoms; (iii) Gear condition due to old age, overuse, or the use of inferior material; and (iv) Improper disposal at sea caused by factors such as vandalism, the lack of waste disposal facilities, high costs for proper disposal, gear abandonment related to illegal fishing, or the use of illegal gear (FAO, 2016; Link et al., 2019; Macfadyen et al., 2009; NOAA Marine Debris Program, 2015; Wilcox et al., 2015).

There are a variety of studies that provide estimates on the amount of fishing gear lost in different fisheries. A global review by Richardson et al. (2019b) found annual gear loss estimates that ranged between zero to 79.8 percent. They estimated that around six percent of all fishing nets, nine percent of all traps, and 29 percent of all lines are lost globally each year. However, ghost fishing is mainly caused by passive gear such as gillnets, trammel nets, wreck nets, and traps, while longlines and trawls less likely to do so (Brown et al., 2005; NOAA Marine Debris Program, 2015) .

From all types of fishing gear, gillnets and pots have been the most documented ALDFG (NOAA Marine Debris Program, 2015). Both of these are used in temperate as well as in tropical waters (Huntington, 2016). Globally, gillnets are among the most common fishing gear used by the artisanal and small to large-scale commercial fleets for both demersal and pelagic fisheries (Gabriel et al., 2005; Standal et al., 2020). Gillnets are widely used because of their simplicity and low entrance cost to fisheries (Jentoft et al., 2017; Standal et al., 2020). According to Huntington (2016), even when buoyancy is lost, gillnets can continue to fish until the net breaks down. In addition, it is not easy for fish and other marine wildlife to see them, because they are made of light plastic materials. For traps and pots, as they normally contain bait, they will continue to attract marine animals when lost. Non-target animals can become trapped and die, forming new bait, creating a vicious circle called "cyclic

catching" (Huntington, 2016; Link et al., 2019), which can also occur with ghost nets, too (Havens et al., 2008). Moreover, the ropes of lost traps and pots can entangle larger marine animals (Huntington, 2016).
ALDFG can travel long distances via ocean currents and winds, before either sinking or accumulating along shorelines globally (Macfadyen et al., 2009), and may continue to ghost fish for a shorter or longer periods of time after having been lost (Sullivan et al., 2019; Tschernij and Larsson, 2003). Factors that contribute to the likelihood of ghost fishing are the rates at which gear is lost, the gear degradation rate, which depends on environmental factors such as water temperature, the catch efficiency of the fishing gear, the susceptibility of species to ghost fishing, the depth where the gear is lost, and the tidal and current conditions which will influence whether nets ball up faster or slower (Antonelis et al., 2011; Brown and Macfadyen, 2007; Erzini et al., 1997; Kaiser et al., 1996; Masompour et al., 2018). The rate at which ghost fishing continues varies widely. Estimates for gillnets range from several days (Stelfox et al., 2020) to years (Macfadyen et al., 2009), while also the fishing capacity of a net will decline over time (Pawson, 2003; Tschernij and Larsson, 2003). Similarly, for pots and traps, studies provide ranges from a few months to several years (Matsuoka et al., 2005; NOAA Marine Debris Program, 2015).

ALDFG can potentially create serious ecological and socioeconomic problems (Link et al., 2019). It harms marine life through the continued catch of target species and causes stock depletion. They capture species that are important for conservation and create hazards to vessels due to collision or prop entanglement (which is costly to remove) (Arthur et al., 2014; Havens et al., 2011; Macfadyen et al., 2009; Wilcox et al., 2015). Economic impact studies show the fisheries sector can be negatively affected by a variety of factors, including (i) direct costs, such as time spent disentangling vessels, the costs to replace lost gear, costs of buying new gear to comply with new regulations, or recovery costs; (ii) indirect costs due to decreased populations of species with commercial value, which can also lead to increased resource costs needed to capture decreasing target fishery populations, while there is also reduced multiplier effects from reduced fishing income; and (ii) social costs such as reduced employment in fishing communities, reduced recreational, tourism, and diving benefits, and safety risks for fishers and vessels (Al-Masroori et al., 2004; Brown et al., 2005; Koslow et al., 2000; Macfadyen et al., 2009; NOAA Marine Debris Program, 2015).

The economic impact of ALDFG is usually calculated the percentage of the catch in a region or of an individual species that has commercial value. Two examples of economic impacts attributed to ghost fishing are (i) a 1.5 percent loss of the catch of commercial monkfish in northern Spain (Sancho et al., 2003) and (ii) 20–30 percent loss of the Greenland halibut catch in Norway (Humborstad et al., 2003). For traps, two examples are (i) an estimated 4.5 percent loss in the Dungeness crab fishery in Washington state per year (Antonelis et al., 2011), and (ii) an estimated 3–13.5 percent of total catch value in the trap fishery in Kuwait (Brown and Macfadyen, 2007).

In addition to having socio-economic impacts, ALDFG can also have a broader impact on marine biodiversity and ecosystems. Ghost fishing poses a threat to marine wildlife such as turtles (Duncan et al., 2017), seabirds (Good et al., 2009), and whales (Stelfox et al., 2016). Marine fauna are particularly at risk through gear entanglement, or through the ingestion of fishing gear, such as nylon fragments or pieces of fishing floats (Gilardi et al., 2010; Laist, 1995). Both entanglement and ingestion can lead to injury and death through

exhaustion or suffocation (Gilardi et al., 2010; Wilcox et al., 2015). According to Wilcox et al. (2016), when compared to other consumer items that end up in the ocean, fishing gear poses the greatest threat to marine fauna. This limits the recovery of a number of marine species (Gall and Thompson, 2015; Reeves et al., 2013). A further impact is created by the damage ALDFG can cause to seafloor habitats by damaging benthic communities in vulnerable and significant coastal ecosystems such as seagrass beds and coral reefs (Gilman, 2015; Shester and Micheli, 2011; Valderrama Ballesteros et al., 2018).

Even when degraded, through exposure to ultra-violet radiation, wind, waves, seawater, and bacteria, fishing gear can continue to cause impacts (Grimaldo et al., 2020). Furthermore, when the plastics of the gear breaks down, it creates microplastics. The breakdown into microplastics can continue to impact the food web of an ecosystem (Chae and An, 2017; Min et al., 2020).

To reduce the impact of ALDFG, several policies and initiatives are gaining increased attention (FAO, 2016). Solutions focus on different aspects, from spatial zoning of fisheries which has the aim to avoid gear conflict, to interventions such as limiting the fishing time or having less gear on board, to reduce the fishing effort and the probability of generating ALDFG (NOAA Marine Debris Program, 2015). Another intervention is a specific form of gear modification which uses escape gaps and panels in nets and traps (Broadhurst and Millar, 2018; Vadziutsina and Riera, 2020). Banning specific gear has also been implemented. The European Union (EU) has implemented a ban on all deep-water gillnet fisheries at depths >600 m (Council Regulation (EC) No. 41/2006). Another way to reduce ghost fishing is by promoting the use of gear marking, which can reduce the chance of loss (Wilcox and Hardesty, 2016) and facilitate the recovery of fishing gear (NOAA Marine Debris Program, 2015). Another solution that is often proposed is to provide of disposal facilities that are affordable for fisherfolk, as well as incentives to encourage proper disposal (Cho, 2009; NOAA Marine Debris Program, 2015). Recently, an innovative solution is the development of biodegradable fishnets (FAO, 2016). Although the catch efficiency of biodegradable gillnets are often less than nylon gillnets and they are more expensive (Kim et al., 2014), biodegradable gillnets have great potential for reducing both ghost fishing and marine plastic pollution (Grimaldo et al., 2020).

According to Anderson and Alford (2014) removal of derelict traps is the only absolute solution, and has been happening in different parts of the world such as South Korea (Cho, 2011), and the USA (Sullivan et al., 2019), supported by sonar systems and the use of weather and ocean models to predicts where nets are likely to accumulate (NOAA Marine Debris Program, 2015; Pichel et al., 2012; Sullivan et al., 2019). An analysis on the economic effects of a pot removal program in Chesapeake Bay in the United States found that removing 34,408 derelict pots led to gains in gear efficiency and an additional 13,504 megatons in harvest valued at USD 21.3 million at the time of the study (Scheld et al., 2016). There will also be additional benefits such as a reduction in the loss of species such as marine mammals and birds, less impact on marine ecosystems, and a reduction in beach littering, which can lead to a reduction in negative impacts on beach tourism.

Picture 1: Fishing boats on the water in Viet Nam (Shutterstock).

In the following sections, this document broadly describes fisheries and fishnet use in Viet Nam, and presents results of data collection on fisheries and ghost fishing in two fishing ports in Viet Nam, and a cost-benefit of two potential interventions that can reduce the impact of ghost fishing in Vietnamese waters.

2. Background: Viet Nam

Viet Nam is a country in South East Asia. It has a population size of around 98 million (2020). In 2019 the GDP was valued at USD 262 billion, and in 2020 Viet Nam had a GDP of USD 271 billion with an economy based on services (41.6% of GDP and 35% of the total workforce), industry (34.5% of GDP and 28% of the total workforce), and agriculture (14% of GDP and 36% of the total workforce) (World Bank, 2020 data).

2.1. Vietnamese fisheries

The fishery sector contributed to between 4-5% of the GDP in 2019, with an estimated 65% being attributed to aquaculture (Hong et al., 2017). Capture fisheries contributed the rest, with a value of USD 4.1 billion[1] (VASEP, 2021). Fisheries are mainly net fisheries (gillnets, trawl nets, etc.), with a lower share going to hooks and lines, and pots and traps (Figure 1).

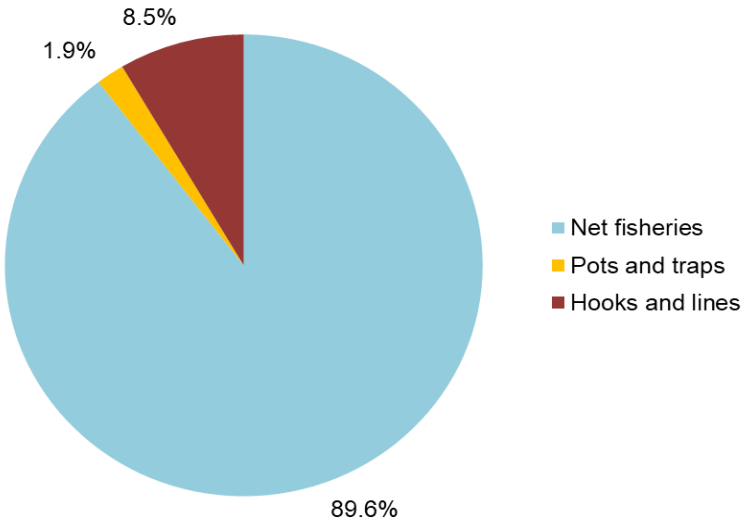


Figure 1. Percentage total fish catch by different types of fish gear in Viet Nam. (Source: Elaboration from DFISH, 2020, and Research Institute for Marine Fisheries, 2007).

[1] The rest of the data in this study will be presented in the currency of Viet Nam (VND or Vietnamese Dong). The exchange rate considered in this study is USD 1 = VND 22,415.1 (Source: https://currencies.zone/historic/us-dollar/vietnam-dong/december-2019).

In 2019, the fishing fleet of Viet Nam consisted of almost 100,000 fishing vessels, divided over different fleet segments, depending on whether they use predominantly nets, pots and traps, or hooks and lines (Table 1.)

In order to estimate the total use of fishnets, hooks and lines, and pots and traps used by the Vietnamese fishing fleet, import statistics can be used, as most materials are not produced in Viet Nam. Data on the import of fishing gear or fishing net materials was obtained through the UN Comtrade Database (UN, 2021).

Relevant information was collected based on the HS-commodity codes (Table 2). The HS commodity code 5608 provides the total estimate, the codes 560811, 560890 and (potentially) 560819 provide more detailed data.

Table 1. Overview of boats, annual catch, and revenue for different types of fishing gear in 2019.

	Vessels (number)	Annual catch (tonnes)	Fisheries value (billion VND[2])
Net fisheries	75,303	3,384,814	169,241
Pot and trap fisheries	2,924	71,776	3,589
Hook and line fisheries	18,382	321,104	16,055

Source: Elaboration from General Statistics Office, 2020; DFISH, 2020, Research Institute for Marine Fisheries, 2007.

Table 2. HS-Commodity Codes related to fishing gear and netting materials.

HS- Commodity Code	Explanation
5608	Twine, cordage or rope, knotted netting, made up fishing nets and other made-up nets, of textile materials
560811	Twine, cordage or rope, knotted netting, made up, of manmade textile materials
560819	Twine, cordage or rope, knotted netting, for other than fishing, of manmade textile materials
560890	Twine, cordage or rope, knotted netting, of other than man made textiles

[2] VND= Vietnamese Dong

The import of net materials and fishing gear in Viet Nam has increased over in the last 15 years. The total volume (in tonnes) has grown almost 4 times from 2005 to 2019 (Figure 2).

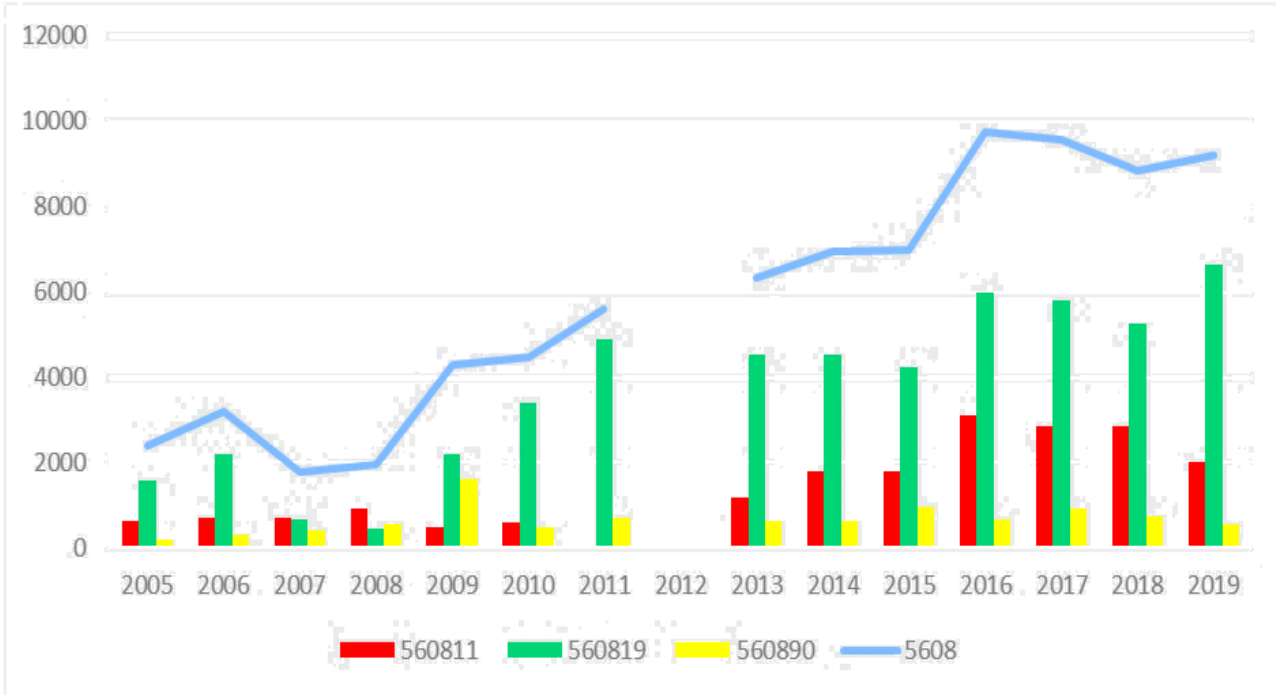


Figure 2. Vietnamese import statistics fishing gear/net materials (tonnes) period 2005-2019 categorized by commodity codes (HS codes, Table 2) (Source: UN, 2021).

In addition, a certain number of fishing nets are imported unofficially, specifically by crossing borders from China and Cambodia. There are no data available of this unofficial trade in fishing gear and fishing net materials.

Although the data are broad estimates, they provide a first indication of the use of fishing gear and the potential generation of marine plastics by the fishing industry, including ghost fishing gear. The increase in importation probably reflects an increase in marine plastics, including ALDFG, which can have a negative impact on the Vietnamese fisheries, marine biodiversity, and ecosystems in general.

Pictures 2 and 3: Repairing and cleaning of fishnets in Viet Nam (Shutterstock).

2.2. Viet Nam policies on ALDFG

As was presented previously, addressing ALDFG requires different solutions, such as marking fishing gear or the provision of appropriate disposal facilities. In Viet Nam action is undertaken both through programmes and projects, but also through policies. The country now has the National Action Plan "Marine Plastic Waste Management in the Fisheries Sector, Period 2020-2030" (Ministry of Agriculture and Rural Development, 2020). Key targets for the country are the aim to collect 50% of lost or discarded fishing gear by 2025, and 100% by 2030 (Decision No. 1746/QD-TTg, December, 2019). In order to achieve this, the action plan aims to "Develop and implement a program to collect lost and discarded fishing gear at sea in conservation areas, protected areas of aquatic resources and other marine areas".

Furthermore, Directive No. 33/CT-TTg (August, 2020) includes the goal to "implement measures to limit the use of Styrofoam buoys in the fisheries sector (to float fish cages) and develop and implement solutions to collect fishing gear such as nets, buoys lost, neglected or discarded at sea (ALDFG)" all of which can contribute to reducing the problem of ALDFG and other marine plastics coming from the fishery sector.

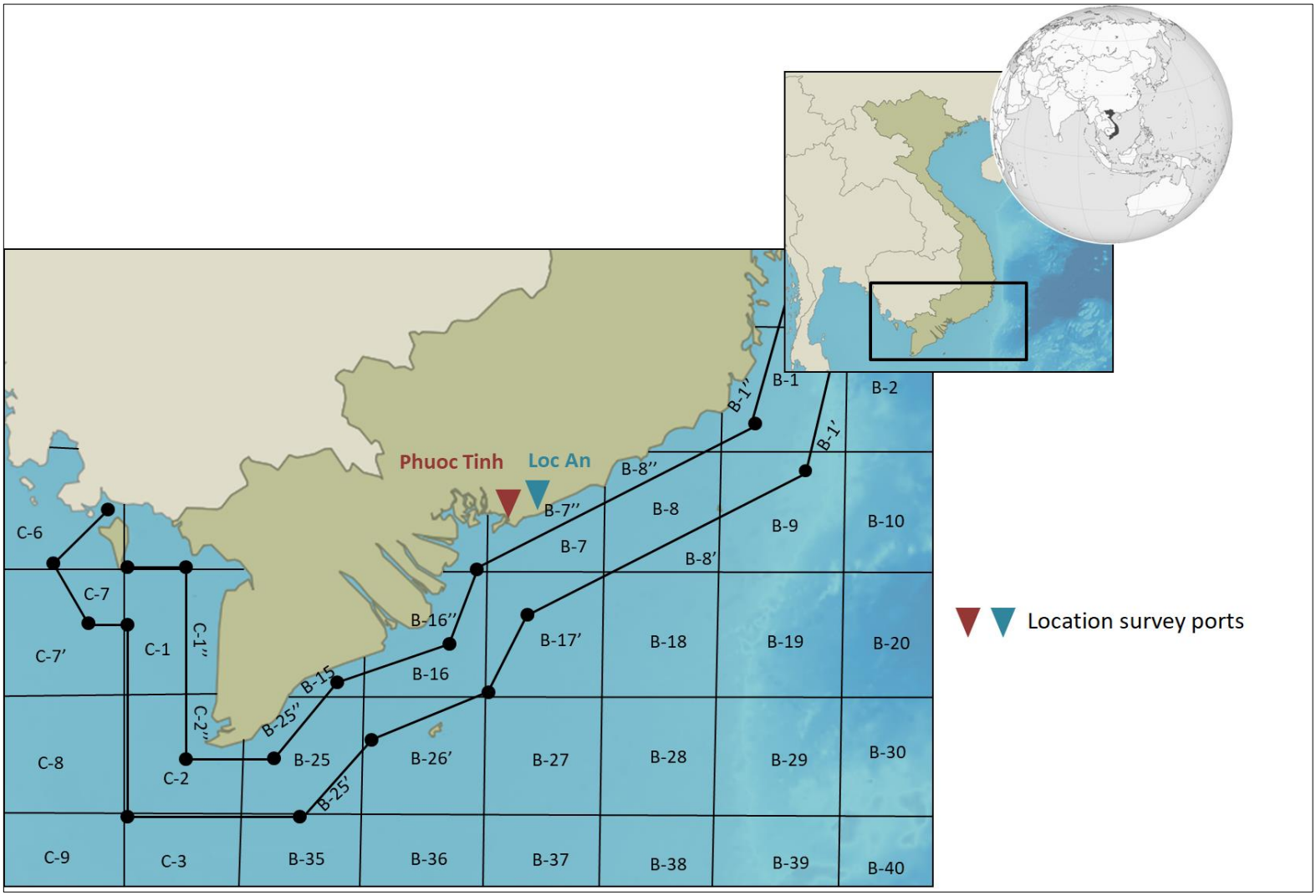
To understand more about ALDFG in Viet Nam and obtain more accurate data, a survey was carried out among fishers in two ports in Viet Nam. Some of the data collected where additionally used to estimate the costs and benefits of different policy options to reduce ALDFG.

Picture 4: Fishing boat and net in Viet Nam (Shutterstock)

3. Case study overview

The survey was carried out in fishing ports of Phước Tinh and Loc An. These are located in the Ba Ria Vung Tau province, in South Viet Nam (Map 1). The province has a fishing fleets consisting of trawlers, gillnets (demersal and pelagic fish species, cuttlefish), as well as pots and traps (mainly for crab and spotted Babylon snail). The survey focussed on bottom gillnet fishers in Phước Tinh, and among those who use mainly pots and traps in Loc An.

Picture 5: Pots, traps on a fishing vessel at Loc An landing site, Ba Ria Vung Tau province, Viet Nam (Son Nguyen Nhu)



Map 1: Location of ports in Viet Nam where survey was carried out

3.1 Data collection

A survey on general data related to fisheries, and specific questions on ALDFG was drafted following a survey developed by Savels et al. (2022) for a similar assessment in the Republic of Cyprus. In addition to the survey on ALDFG, a second survey was carried out focussing on the costs and benefits generated by fishing activities. Surveys were developed for both the bottom gillnet fisheries and for the pots and traps fisheries. The annex provides an overview of the two surveys used for boats that mainly depend on gillnets for fishing.

The surveys were carried out in July and August, 2021 by a team of five people. Fishers were randomly approached based on their availability to answer the different surveys, but no sampling techniques were used to identify respondents. The reference year used in the survey and the further assessment is 2020. Vessel owners, skippers or crew members were targeted for the surveys, with one interview per boat. In total 90 people were interviewed, with an equal amount of people interviewed for both types of fisheries (Table 3). The survey on costs and benefits was done with a subsample (30 people) of the 90 people surveyed on ALDFG.

Table 3. Survey sample overview.

Survey type	Sample size	Fishing ports/Landing sites
1. ALDFG and general data		
Bottom gillnet	45	Phước Tinh
Pot and trap	45	Loc An
2. Fishing boat costs and benefits		
Bottom gillnet	15*	Phước Tinh
Pot and trap	15*	Loc An

*subsample of those surveyed on ALDFG and general data on fisheries

Picture 6: Gillnet fisheries survey in Phước Tinh landing site, Ba Ria Vung Tau province, Viet Nam (Son Nguyen Nhu)

3.2 Cost-benefit analysis

Cost-benefit analysis is an analytical tool to study the economic advantages or disadvantages of a decision on investment by examining its costs and benefits (DG Regio, 2015). It is mainly applied to evaluate the economic efficiency of different options that achieve some predetermined policy or business objective (James and Predo 2015). In this study, the costs and benefits of a current fishing scenario (business as usual, or BAU) and the impact of ghost fishing are estimated. Additionally, the costs and benefits from three potential interventions to decrease the amount of ALDFG are estimated and compared. The aim is to understand the impact of implementing measures to reduce ghost fishing on the revenue generated by fishing. The cost benefit analysis (section 4.3) will focus on gillnet fisheries, as net fisheries are larger than pot and trap fisheries in Viet Nam.

For each scenario, all benefits and costs generated by an average fishing boat over a period of one year (reference year 2020) are estimated based on survey results, after which the net benefit for each scenario is calculated as follows:

$$\text{Net benefit}_i = \sum \text{Benefits}_i - \sum \text{Costs}_i$$

Where Benefits_i and Costs_i refer to the benefits and costs made in year i (2020). This is calculated for all four scenarios (BAU and the three intervention scenarios).

4. Results

The next two sections (4.1 and 4.2), present the survey results. Results are presented as average values of all the answers collected.

4.1 Cost-benefit analysis

Table 4 presents general data (average, minimum, and maximum values) on the surveyed fishing boats that used gillnets. Fishing is the most important source of revenue for all respondents, although with a variation in terms of annual catch and fishing revenue.

On average, a fishing boat takes 173 trips per year, although this ranges from 290 trips to only 15 trips per year among all respondents. The boats surveyed use on average 200 gillnets for fishing.

Table 4. General data gillnet fishing boat (values/boat).

	Average value	Minimum value	Maximum value
Vessel length (m)	13	7	18
Crew (number)	3	1	8
Annual catch (tonne)	28	7	64
Annual revenue (VND)	1,532,157,963	2,938,350	3,443,100,000
Income from fishing operation (%)	94	70	100

Picture 7: Gillnet fishing fleet at Phước Tinh landing site, Ba Ria Vung Tau province, Viet Nam (Son Nguyen Nhu)

4.1.1. Survey results ALDFG and marine plastics gillnet fisheries

Asking specifically about the loss[3] of fishing gear, 22 of the respondents stated that in 2020 they lost fishing gear in the sea. On average, eight pieces of gear were lost per fishing boat in 2020, or about four percent of the gear used annually on average per boat.

Figure 3 presents the different causes of losing gear that were provided by the respondents who had lost gear in 2020. Conflict with the seafloor was the cause mentioned by most respondents, followed by misplacement of gear. Weather was the cause of loss mentioned least.

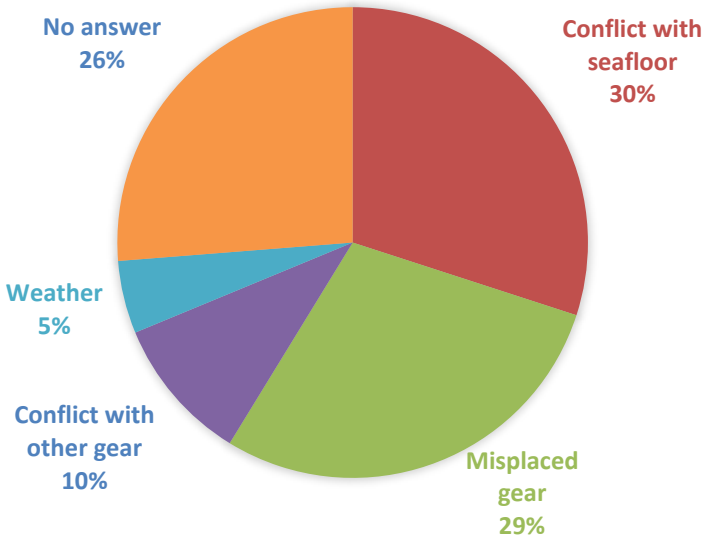


Figure 3. Causes of losing gear, gillnet fisheries.

[3] Respondents were asked about lost and discarded gear. The distinction between when a gear was abandoned, versus lost or discarded was not clear and so was not specifically included in the survey.

In addition to the different causes, the 22 respondents who lost gear were also asked to provide an estimate of the frequency in which a specific cause led to the loss of gear. Figure 4 shows that misplaced gear most often led to the loss of gear, while weather had the lowest probability of causing gear loss.

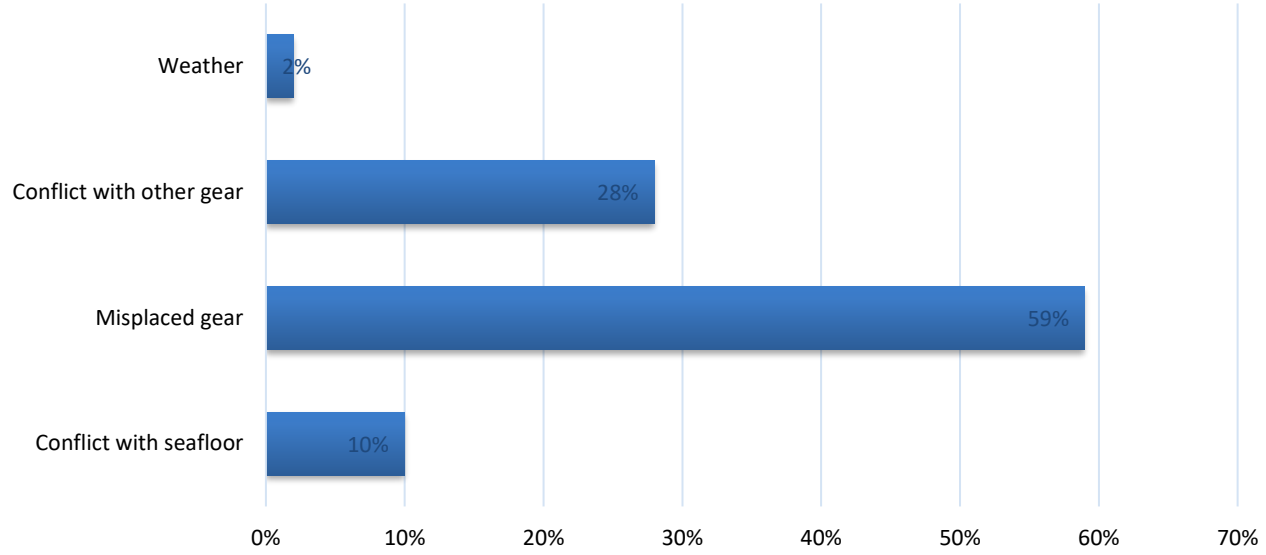


Figure 4. Frequency of losing gear due to each of the causes, gillnet fisheries.

Respondents were also asked about whether or not they discarded gillnets in the sea. Eight (18%) responded confirmed that in 2020 they had discarded gear, with an average of one discarded gear per boat, considering all respondents.

The main reason provided by the eight respondents that answered affirmatively to having discarded gear was that this was chosen as an alternative to disposing of gear onshore, followed by the fact that the gear was damaged (Figure 5). Both these reasons also have the highest frequency of causing gillnets to be discarded (Figure 6).

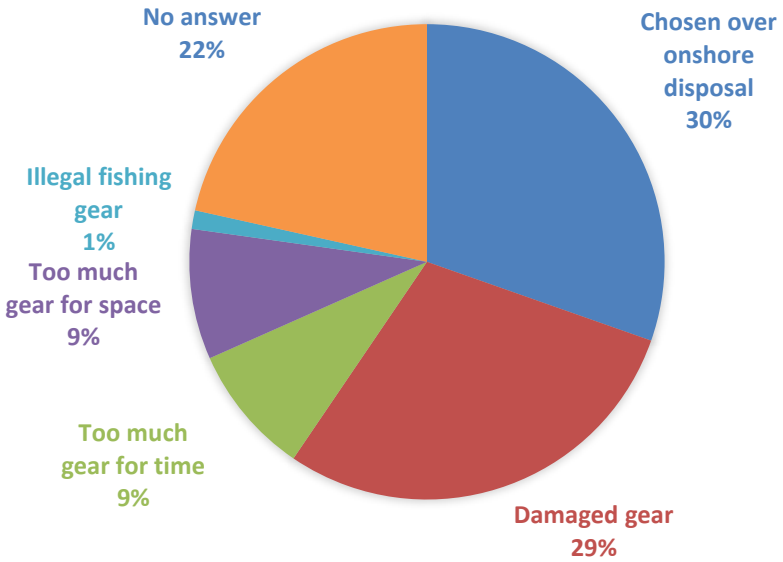


Figure 5. Causes for discarding gear, gillnet fisheries.

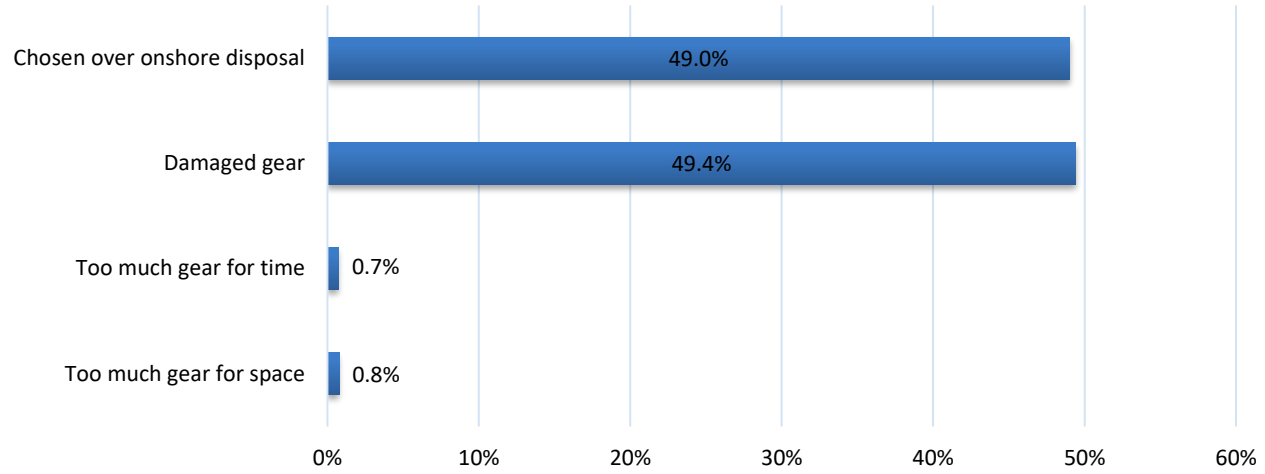


Figure 6. Frequency of discarding gear due to each of the causes, gillnet fisheries.

When asked about having had interactions, such as entanglement of the boat's propeller or own fishnets, with ALDFG while fishing, 21 respondents (47%) confirmed to have had such interactions in 2020. These interactions cause downtime and damages to fishing boats and gear, with an average cost, considering all respondents, of about 0.2% of the annual fishing revenue (Table 5).

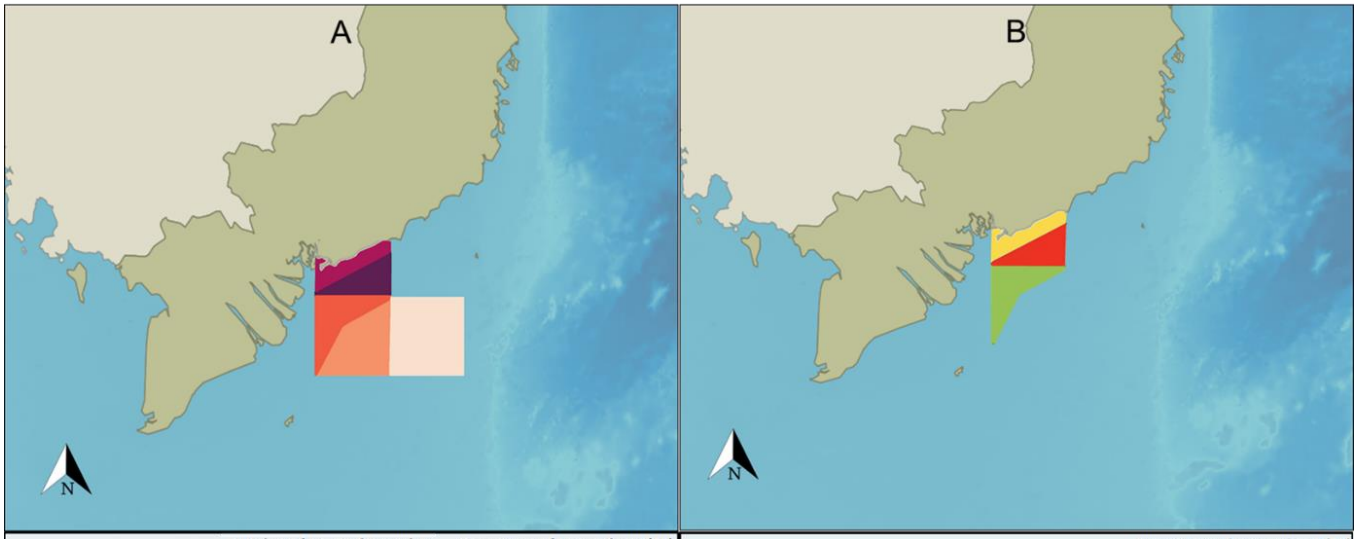
Table 5. Average impact gillnet fishing boats due to interactions with ALDFG (value/boat).

	Average value
Downtime due to interaction with ALDFG (minute/trip)	11
Cost downtime due to interaction with ALDFG (VND/year)[4]	2,429,633
Cost of damages due to interaction with ALDFG (VND/year)	1,277,778
Total cost downtime and damage due to ALDFG[a] (VND/year)	**3,707,411**

[a] does not include the impact on catch due to ghost fishing

Survey respondents were also asked to indicate the areas or fishing zones they use for fishing activities (Map 2A). In addition, 21 respondents provided the location where they encountered ALDFG (Map 2B). There is a clear overlap between the areas most used for fishing, and those where most encounters with ALDFG took place (B7 and B7'). Most encounters take place relatively close to the coast. This can be due to the fact that most fishing takes place there, but may also be due to other issues, such as depth of the sea or currents that may move ALDFG to other areas.

[4] This cost was calculated by estimating the total number of working days lost due to downtime over one year and multiplying with the daily minimum wage of VND 200,909.



Fishing zones	Number of respondents who fish in area	Percentage of respondents (45) who fish in area (%)
B7	29	64
B7''	25	56
B17	15	33
B17'	14	31
B18	5	11

Fishing zones	Number of respondents who interacted with ALDFG in area	Percentage of respondents (21) who interacted with ALDFG in area (%)
B7	13	62
B7''	8	38
B17	6	29

Map 2: Location gillnet fishing areas (A), and location encounters ALDFG (B)

ALDFG is not the only marine plastic pollution that impacts fishing boats. Other marine plastics can also have an impact by floating marine plastics getting caught in nets, which implies that time needs to be spent cleaning the fishing nets before and after use. All respondents confirmed to have interacted with marine plastics. On average respondents noted around two kilograms of plastics were encountered in the nets on each fishing trip, causing downtime and gear damage and costing on average around 0.36% of the fishing revenue (Table 6).

Table 6. Interaction gillnet boats with marine plastics (non-ALDFG) (value/boat).

	Average value
Volume of plastics in trip (kg)	2
Proportion of plastics in trip catch (%)	2.3
Down and clean-up time due to plastic (minute/trip)	19
Cost down and clean-up time (VND/year)	4,121,698
Cost of gear damage (VND)/year due to plastic	1,414,634
Total cost marine plastics (non-ALDFG) (VND/year)	**5,536,062**

4.1.2. Survey results policies on ALDFG in gillnet fisheries

Marine plastics and ghost fishing have an impact on the fishing sector through damage (as illustrated in the survey) and through broader impact on reduced catch. As such, a series of policies have been implemented or are being considered in Viet Nam. In the following section, the respondents' answers to a series of policy-related questions is presented. The main source of information are fisher associations, although the same percentage did not answer or indicated not to know the answer (Figure 7).

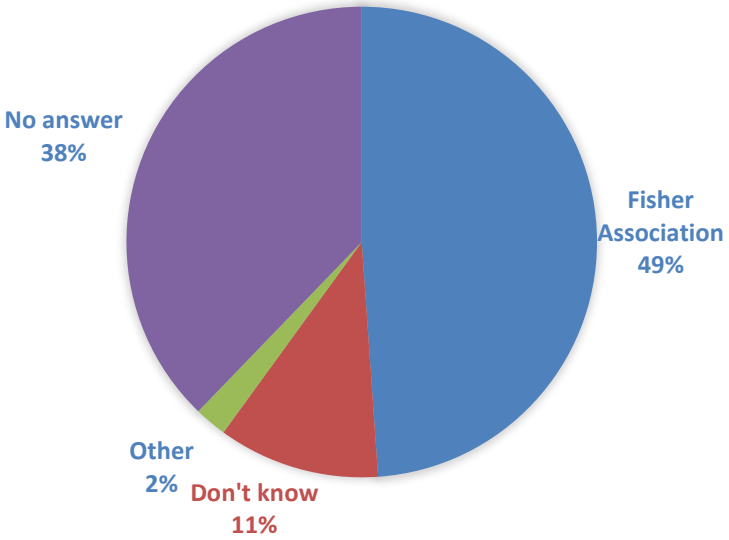


Figure 7. Source of policy information received gillnet fisheries.

Next, respondents were asked which measures to reduce ALDFG are being used according to them, based on a pre-developed list of potential instruments that can be used (Figure 8). All of the respondents indicated that gear marking or modification, economic incentives, and clean-up or recovery efforts are being used. A majority also indicated the use of technical transponders. These measures have the potential to reduce the loss of gear due to conflict with the seafloor or gear misplacement (see Figures 3 and 4). Some respondents also indicated the use of other policy instruments, while according to all respondents, four measures are not being used.

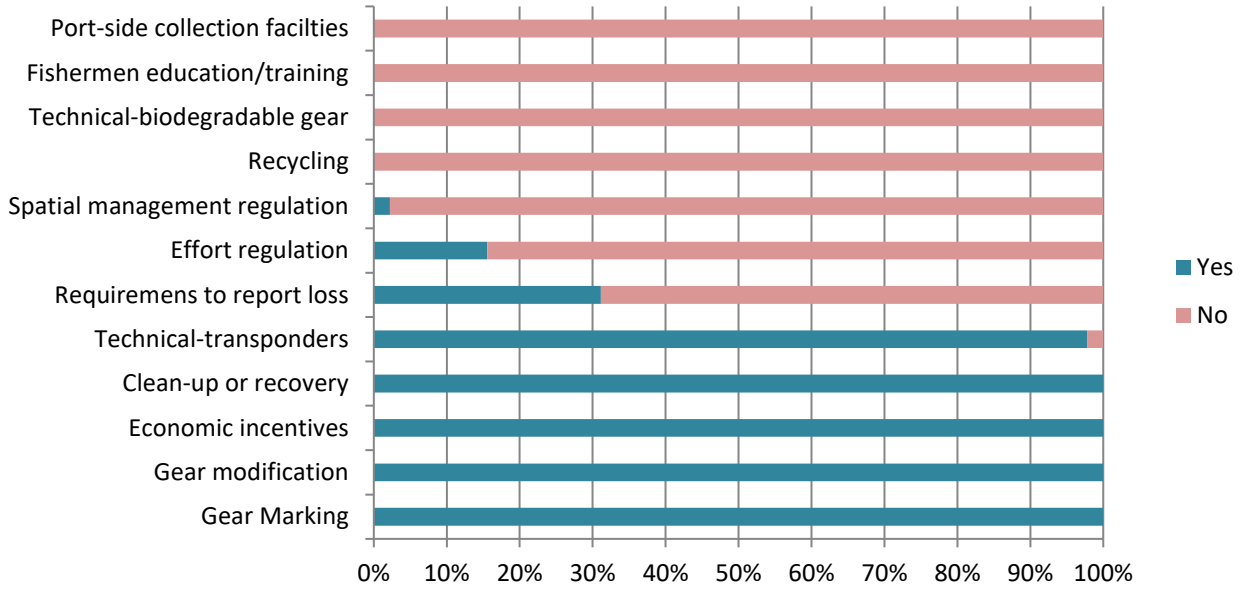


Figure 8. Measures used to prevent ALDFG (gillnet fisheries).

Figure 9 indicates whether respondents considered the measures to be very effective, quite effective or not effective. It seems that those measures that are being used according to the respondents, are those that are considered to be effective, whereas measures that are not being used, are in general not considered to be effective. Discarding gear versus the use of onshore facilities was mentioned as having a high frequency for discarding gear (see Figure 6 above). The fact that port-side facilities are not considered effective by most respondents could provide an opportunity, especially when aligned with other instruments, such as economic incentives, which are considered effective. Similarly, damaged gear is mentioned as a reason for discarding gear, providing opportunities for improved recycling, potentially with other instruments such as economic incentives.

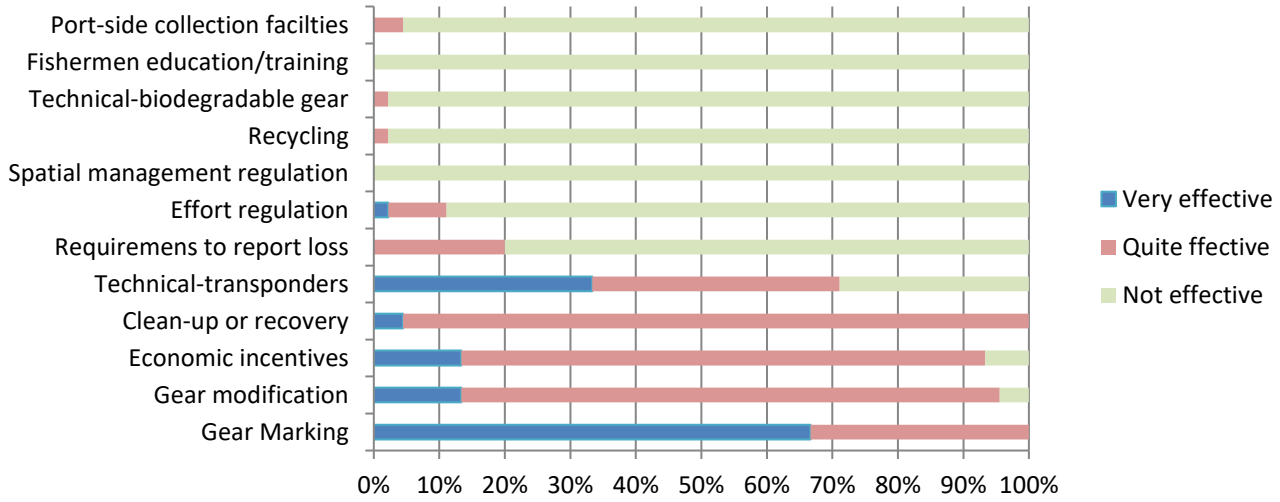


Figure 9. Effectiveness measures to prevent ALDFG according to respondents (gillnet fisheries).

4.2 Survey results of pots & traps fisheries

There were 45 respondents using pot and traps as main fishing gear who were interviewed in September and October 2021.
All respondents spent less than 10 years in fishing sector, and obtain their main income from fisheries, although with differences related to the size and value of the catch, the number of fishing trips taken and the duration of each trip (Table 7).

The boats surveyed use on average 793 pots and traps and take 190 fishing trips per year, with a range from three per year to a maximum of a reported 308 trips in one year.

Table 7. General data fishing boat that use pots/traps (value/boat).

	Average value	Minimum value	Maximum value
Vessel length (m)	13	7	19
Crew	5	2	13
Annual catch (tonne)	17	6	33.5
Average monthly catch (tonne)	1.4	0.50	2.80
Annual revenue (VND)	1,641,553,556	754,000,000	3,527,500,000
Income from fishing operation (%)	95	70	100

Picture 8: Crab trap fishing gear in Loc An landing site, Ba Ria Vung Tau province, Viet Nam (Son Nguyen Nhu)

4.2.1. Survey results for ALDFG and marine plastics pots & traps fisheries

All respondents confirmed that they lost gear during the reference year, with an average of 76 pots or traps lost per year per respondent (boat). Figure 10 presents the different causes given by the 45 respondents for losing gear. The rate of loss was around 9.6% per year.

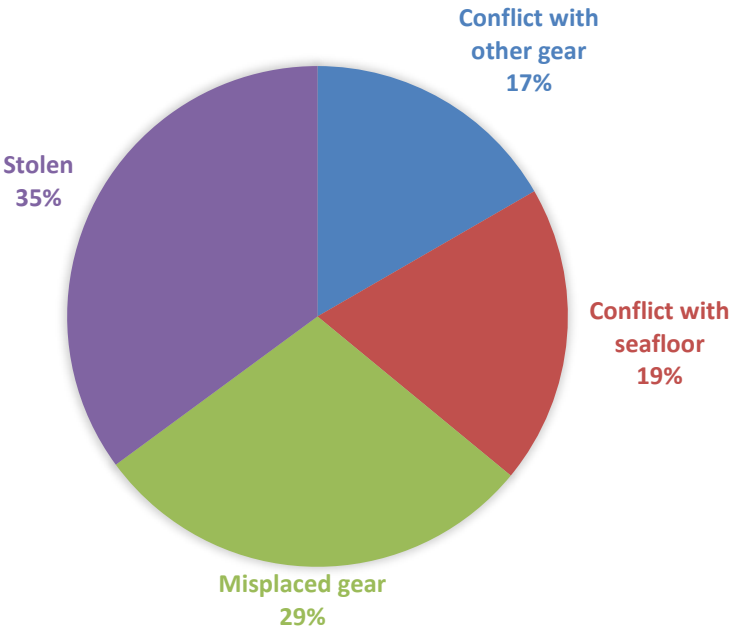


Figure 10. Cause of losing gear traps/pots fisheries.

Figure 11 provides the frequency with which a given cause has led to the loss of pots and traps. Stolen gear has the highest frequency of generating a loss, followed by conflict with other gear.

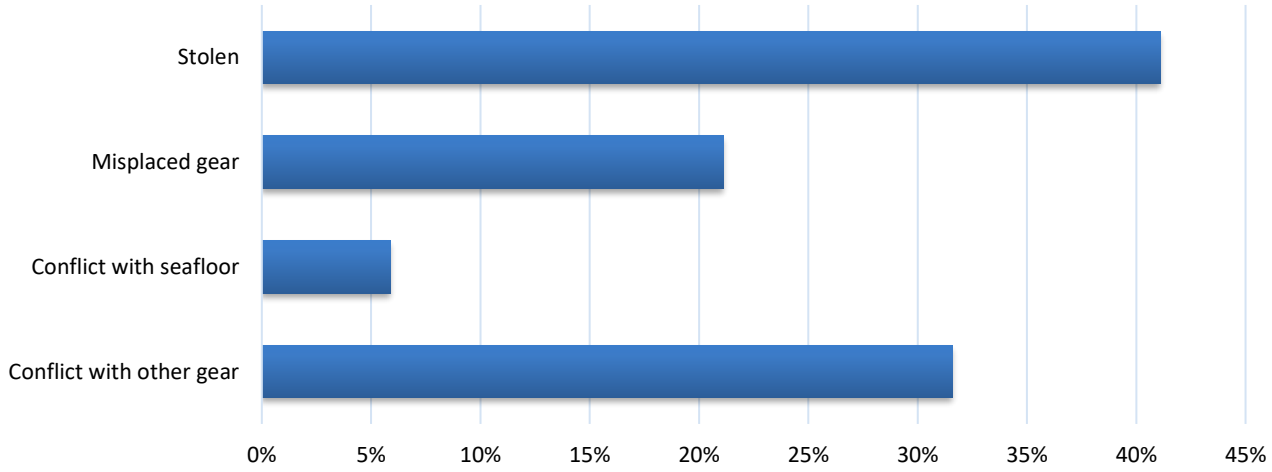


Figure 11. Probability of losing gear due to each of the causes, traps/pots fisheries.

No respondent stated to have discarded pots or traps, only lost.

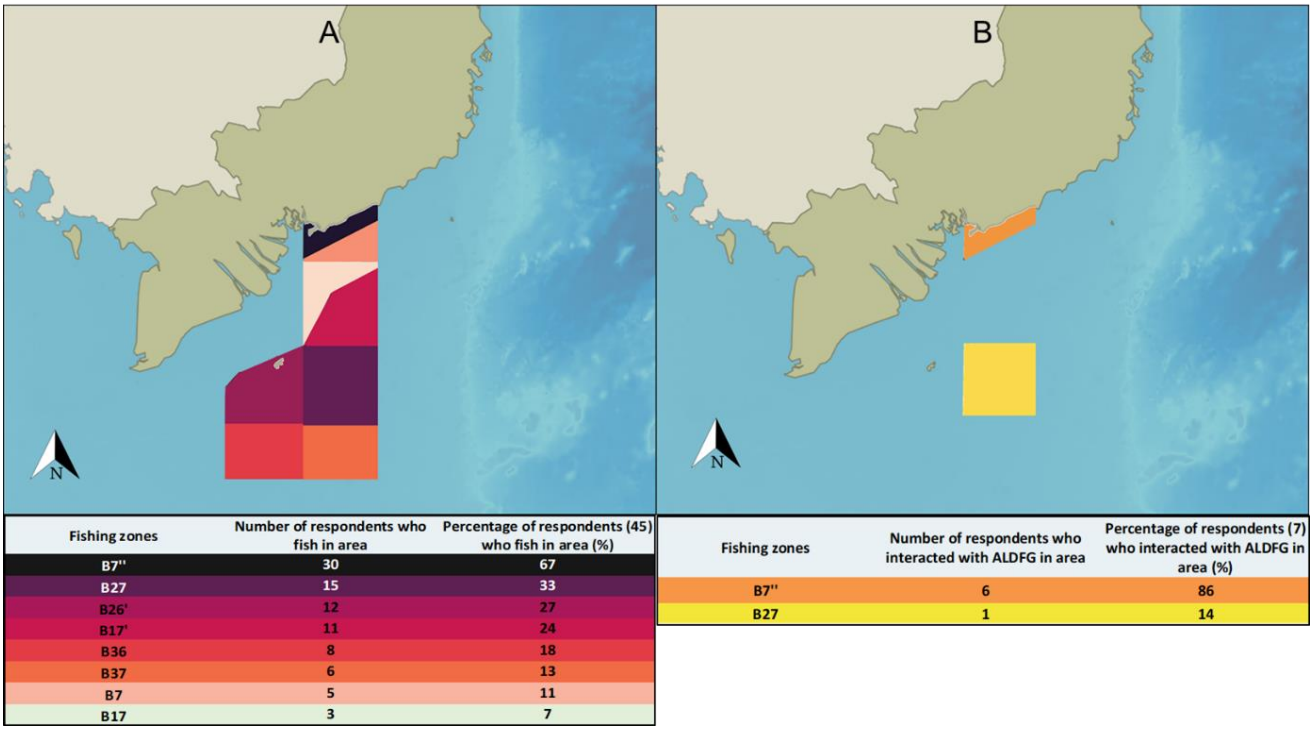
Although all respondents stated to have lost gear, only seven respondents confirmed interaction with ALDFG. Interaction with ALDFG causes downtime and damage, with an average impact of around 0.1% of the revenue for a pots/traps fishing boat in 2019 (Table 8).

Table 8. Average impact pots/traps fishing boats due to interactions with ALDFG (value/boat).

	Average value
Downtime due to interaction with ALDFG (minute/trip)	7
Cost downtime due to interaction with ALDFG (VND/year)	1,518,520
Cost of damages due to interaction with ALDFG (VND/year)	175,676
Total cost damage and interaction ALDFG (VND/year)[a]	**1,694,196**

[a] Does not include the revenue lost due to ghost fishing

Next, all survey respondents indicated their main fishing grounds (Map 3A). The seven of respondents that encountered ALDFG also provided the location where this happened (Map 3B). The areas where ALDFG were encountered overlap with the most used fishing grounds.



Fishing zones	Number of respondents who fish in area	Percentage of respondents (45) who fish in area (%)
B7''	30	67
B27	15	33
B26'	12	27
B17'	11	24
B36	8	18
B37	6	13
B7	5	11
B17	3	7

Fishing zones	Number of respondents who interacted with ALDFG in area	Percentage of respondents (7) who interacted with ALDFG in area (%)
B7''	6	86
B27	1	14

Map 3: Location pots/traps fishing areas (A), and location encounters ALDFG (B)

Picture 9: Pot and trap fishing boats in Loc An landing site, Ba Ria Vung Tau province, Viet Nam (Son Nguyen Nhu)

35 of the respondents confirmed interaction with other marine plastics (non-ALDFG), ten respondents didn't answer. Also, interaction with other types of marine plastics cause damage and downtime to pot/trap fishers, with an average cost of around 0.5% of the annual fishing revenue (Table 9).

Table 9. Interaction pots/traps fishing boats with marine plastics (non-ALDFG) (value/boat).

	Average value
Volume of plastics in trip (kg)	2
Proportion of plastics in trip catch (%)	3.8
Downtime and clean-up time due to plastics (minutes/trip)	38
Cost downtime and clean-up time (VND/year)	8,195,672
Cost of gear damage due to plastic (VND/year)	171,053
Total cost marine plastics (non-ALDFG) (VND/year)	**8,366,725**

4.2.2. Survey results on policies on ALDFG in gillnet fisheries

Similar to gillnet fisheries, fisher associations are the main, or even the only source of information on policies identified by the respondents (Figure 12). However, a majority of the respondents did not know the source, or did not answer the question.

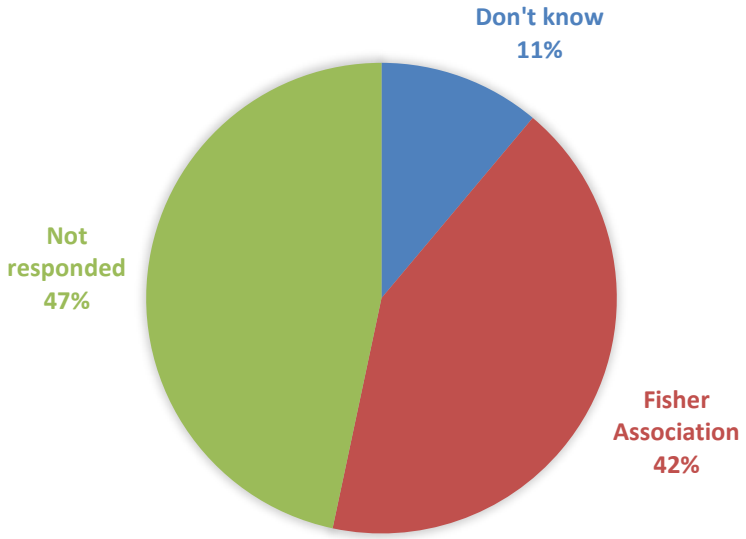


Figure 12. Source of policy information received traps/pots fisheries.

As in the survey on gillnet fisheries, respondents were asked which measures to reduce ALDFG are being used according to them (Figure 13). All respondents indicated the use of gear marking, clean-up or recovery efforts, as well as technical transponders. In addition, also the use of economic incentives is considered to be used by a majority. Some respondents also indicated the use of other policy instruments, while according to all respondents, four measures are not being used.

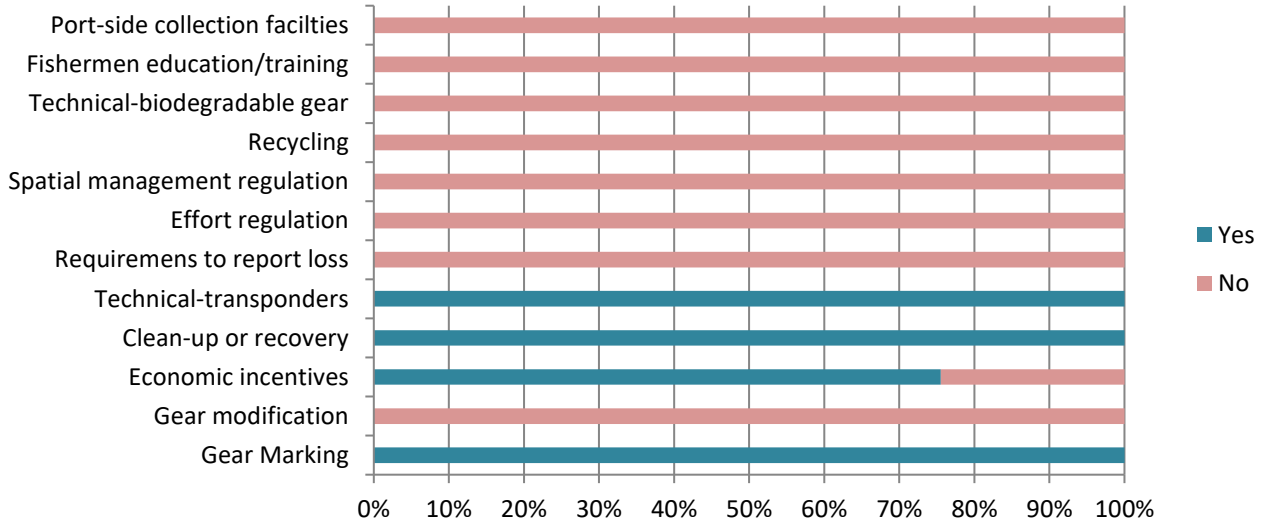


Figure 13. Measures used to prevent ALDFG (pots/traps fisheries).

Similar to what was observed for the gillnet fisheries, those measures that are known to be used to reduce ALDFG are considered to be very or quite effective by most respondents, whereas those measures that are not used, or at least not according to the respondents, are not considered to be effective tools to reduce ALDFG (Figure 14). Although conflict with other gear is provided as one of the main causes of losing gear (Figures 10 and 11), policies focusing on reducing gear conflict (spatial management regulation, effort regulations) are, according to the respondents, not used and not considered effective. This may create opportunities for education and training of fishers, although they will have to be convinced that education and training are effective policy options.

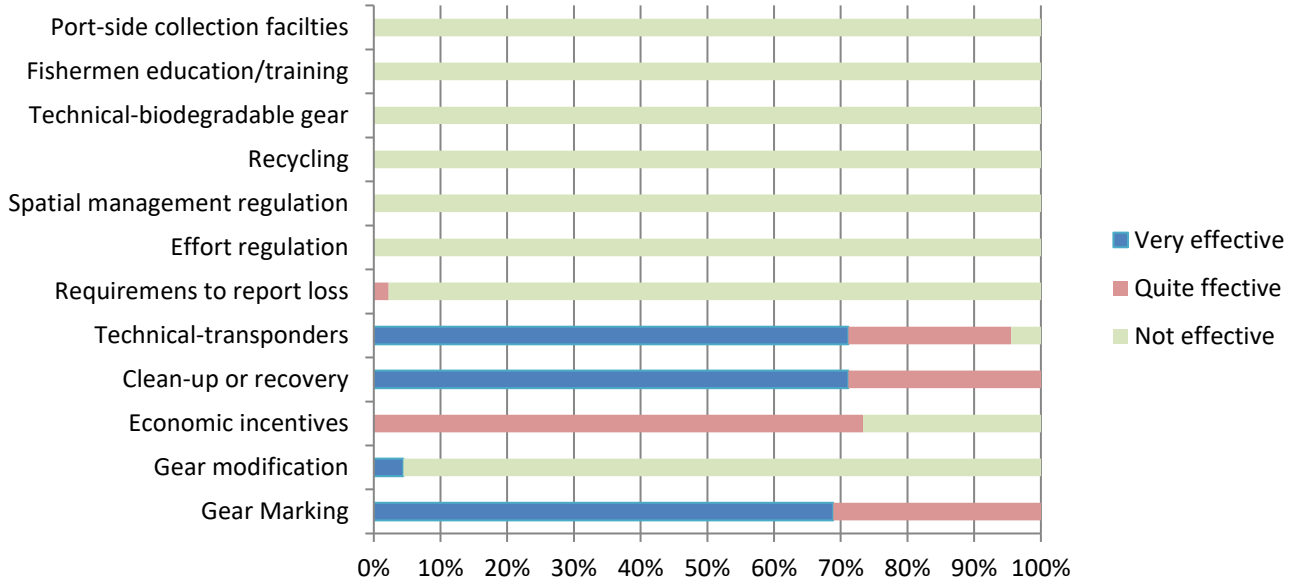


Figure 14. Effectiveness measures to prevent ALDFG according to respondents (pots/traps fisheries).

4.3 Cost benefit analysis

In order to provide some additional insights into the impact of ghost fishing and marine plastics on the revenues generated through fishing from the survey respondents, a cost benefit analysis is carried out focussing on the gillnet fisheries surveyed. The costs and benefits of this current scenario (a business as usual or BAU scenario), will be compared with the cost and benefits under three different intervention scenarios. These are interventions that aim to reduce the amount of ALDFG, either by decreasing the amount that could be lost or discarded, or by recovering lost gear. Following Savels et al. (2022), the interventions to be analysed are (i) gear marking and recovery; and (ii) a deposit refund scheme (DRS) for fishing gear, considering two different deposit values. Both gear marking and recovery, as economic incentives under a DRS are known by the fishers and considered to be very or quite effective in reducing ALDFG.

Marking gear and the recovery of ALDFG are curative measures, whereas a DRS is a preventative measure. DRS are extensively used for the collection, and recycling, of plastic and glass bottles (Watkins et al., 2019). Both systems could also be considered in combination, as gear recovery can also be used for ALDFG already present in the marine environment, or to recover gear that could still

be lost or discarded, despite the economic incentives included in the DRS.

The cost-benefit analysis was carried out using data gathered through the additional survey, focussing specifically on data related to the different types of costs the respondents incurred, as well as different types of revenue. This was complemented with data from literature on the impact of ghost-fishing on fishing revenue, and the costs of the different interventions.

In the current scenario (business as usual, or BAU), revenue is generated solely through fish catch, whereas the costs considered are: fixed costs (for example license renewal), operational costs (such as fuel or lubricants), costs related to the maintenance and repair of the engine and the vessel, investment costs (for example for a new engine), and the costs related to fishing gear (maintenance and repair and the replacement of old or abandoned, lost or discarded fishing gear). Other costs considered are those related to interactions with ALDFG and other marine plastics, to which the cost due to ghost fishing (value of lost revenue) is added.
In the scenario that considers the use of gear marking and the recovery of ALDFG, one additional revenue stream is considered: the benefit generated through the sale of recovered gear. A value of 10% of the original value of the gear was considered here, although the real value of recovered gear will depend on the context and how it enters the value chain of reuse or recycling. In addition, as gear is recovered and not left in the marine environment, the impact of ALDFG and the cost of ghost fishing is assumed to become zero. In the DRS scenarios additional costs are related to the deposit. Two scenarios are developed, one with a deposit value of 15% of the purchase price, and another one with 30%. Additional benefits are generated through the refunds of the deposits and a reduction in downtime and damage costs due to ALDFG, as well as a decrease in the costs due to ghost fishing.

To calculate the benefits, costs, total benefits, total costs, and total net benefits for the average vessel, the average of every cost and benefit was calculated based on the results of the second survey with gillnet fishers (Tables 10 and 11). The benefits and costs for an individual vessel can, however, differ significantly from this average.

4.3.1. Current costs and benefits

Table 10 presents the average costs considered, in addition to those related to impact and downtime due to ALDFG and other marine plastics presented previously (Tables 5 and 6). The number of gillnets used is 200 per boat on average with a lifetime of 1.2 years. Labour costs were not included, as crews consist of both hired and family labour. This thus implies that the net benefit considered is not complete profit.

Table 10. Average costs for a gillnet fishing boat in Viet Nam, 2019.

	Average value
Annual maintenance and repair costs (VND)	43,666,667
Annual fixed costs (VND)	38,000,000
Annual variable costs (VND)	30,127,933
Annual cost of purchasing new engine (VND)	219,633,333
Annual cost of purchasing new piece of fishing gear (VND)	139,333,333
Annual maintenance and repair cost of fishing gear (VND)	203,000,000

Fish landings are what generates the benefits (all of them under the BAU scenario). Demersal fish make up the largest part of the catch volume (57% of the total) and value (52%), followed by crustaceans in terms of volume (25%) and value (39%) (Table 11).

Table 11. Fishing revenue by catch type for gillnet fisheries in Viet Nam in 2019.

	Average value
Demersal fish	
Landing volume (kg)	16,116
Landing value in (VND)	792,524,666
Small pelagic fish	
Landing volume (kg)	4,914
Landing value in (VND)	128,838,398
Crustaceans	
Landing volume (kg)	6,949
Landing value in (VND)	604,423,739
Molluscs	
Landing volume (kg)	154
Landing value in (VND)	11,846,603
Total	
Total landing volume (kg)	28,133
Total landing value (VND)	1,532,157,963

4.3.2. Costs of ghost fishing

In order to add an impact estimate of ghost fishing on revenue, a brief literature review was carried out. A series of studies from the region and globally were used to obtain an average estimate of the revenue losses in gillnet fisheries due to ghost fishing. In this study, this impact or cost is considered to be 2.3% of the catch value, based on the results of the studies presented in Table 12.

Table 12. Summary, literature review on ghost fishing impact at national and regional levels.

Fishing gear	Scale of study region	Country/ Region	Fish species	Impact on fish catch (%)	Source
Nets	Regional	EU	Total fish landings	1	Brown et al., 2007
Nets	Regional	Spain	Monkfish	1.46	Sancho, Puente, Bilbao, Gomez, and Arregi, 2003
Gillnets	Local	Japan	Red sea bream & filefish	5	Nakashima and Matsuoka (2004)
Gillnets	Local	Viet Nam	Cod fish	4.5	Tschernij and Larsson, 2003
Gillnets	Local	Spain	Sea monkfish	1.5	Santos et al., 2003
Gillnets	Local	Portugal	Hake fish	0.5	Erzini et al., 1997

4.3.3. Results of the cost-benefit analysis

The sum different costs and of the benefits are used to calculate the net benefit generated by the four scenarios considered (Table 13). Most benefits and costs remain the same, differences are due to new revenue streams (from the sale of recovered gear or from returned deposits), reduced costs due to a reduction in ghost fishing and the impact of ALDFG, or increased costs due to those related to gear recovery or the payment of deposits.

Table 13. Results of the cost-benefit analysis (VND/year).

	Business As Usual	Intervention A: Gear tracking and recovery	Intervention B.1: Deposit Refund Scheme (15%)	Intervention B.2: Deposit Refund Scheme (30%)
Fish landings	1,532,157,963	1,532,157,963	1,532,157,963	1,532,157,963
Recovered gear		648,030		
Deposit refunds			17,559,932	52,288,086
TOTAL BENEFITS	**1,532,157,963**	**1,532,805,993**	**1,549,717,895**	**1,584,446,049**
Fixed costs	38,000,000	38,000,000	38,000,000	38,000,000
Variable cost	30,127,933	30,127,933	30,127,933	30,127,933
Maintenance and repair costs	43,666,667	43,666,667	43,666,667	43,666,667
New engine cost	219,633,333	219,633,333	219,633,333	219,633,333
Fishing gear costs	342,333,333	342,333,333	339,347,165	339,347,165
ALDFG costs	3,707,411	0	1,482,964	1,482,964
Other plastic damage costs	1,414,634	1,414,634	1,414,634	1,414,634
Ghost fishing costs	35,239,633	0	14,095,853	14,095,853
ALDFG recovery costs		118,683,987		
Deposit costs			17,940,416	53,421,053
TOTAL COSTS	**714,122,944**	**792,445,253**	**705,708,966**	**741,189,602**
TOTAL NET BENEFITS	**818,035,019**	**740,360,739**	**844,008,929**	**843,256,447**

Figure 15 presents the overall costs, benefits and net benefits of the four scenarios considered in this study. All scenarios present a positive net benefit, without considering labour costs. The DRS scenario with a 15% deposit has the highest and the gear marking and recovery the lowest net benefit based on the estimates considered in this study. The higher net benefit of the DRS system is due to the estimated potential decrease in costs related to ghost fishing and ALDFG.

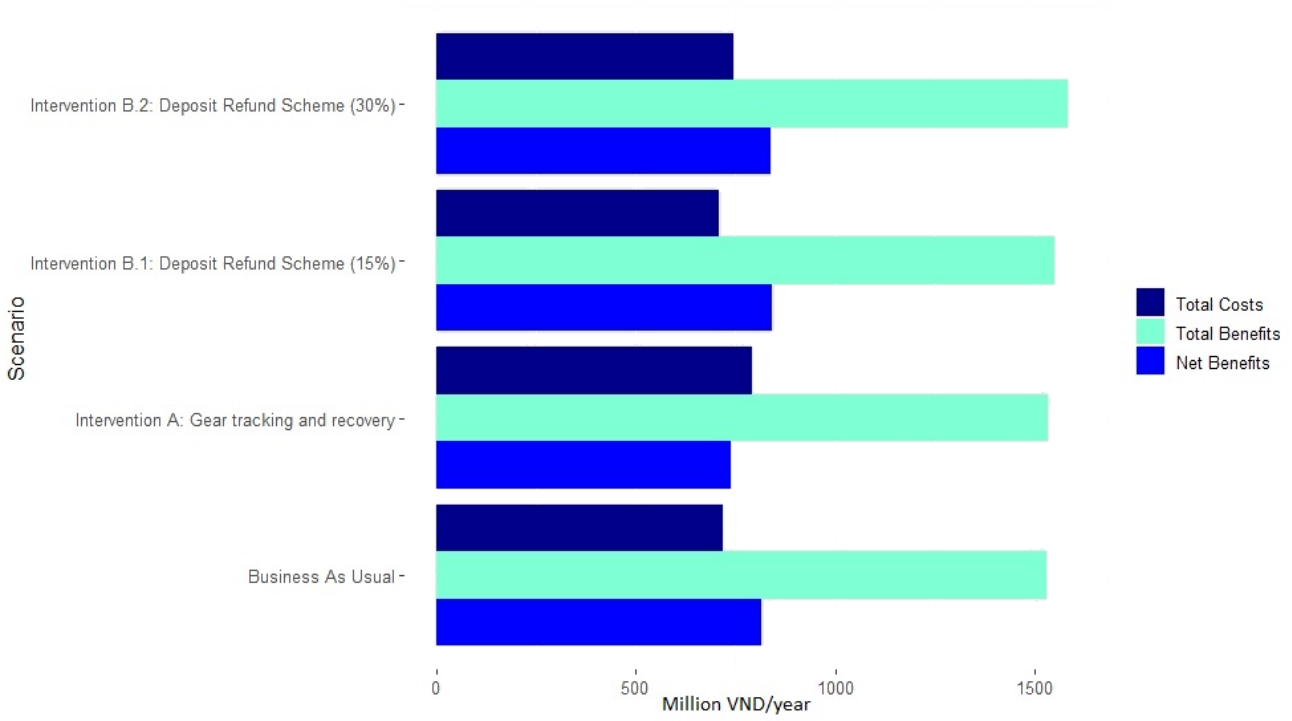


Figure 15. Comparison BAU and interventions.

4.3.4. Impact on biodiversity in Viet Nam

As was presented in the introduction, ALDFG does not only impact the fishing sector. Ghost nets can have a negative impact on marine environments in general, affecting not only fish stock and the economic revenue they generate, but marine biodiversity as a whole. In the previous CBA, only short-term financial gains from reducing ALDFG were evaluated, but a reduction in ghost fishing (and marine plastics in general) can have larger economic benefits (e.g. reduced impact on the tourism sector through cleaner beaches) and can benefit marine animals such as turtles. Just as an illustration, this section presents the current conservation status of marine turtle species found in Viet Nam. Reducing ghost fishing is one of the many measures that have the potential to improve the status of these turtle species.

There are four marine turtle species that have nesting grounds in Viet Nam, which are the green turtle (*Chelonia mydas*), the hawksbill turtle (*Eretmochelys imbricata*), the Olive Ridley turtle (*Lepidochelys olivacea*) and the leatherback turtle (*Dermochelys coriacea*) (Hamann, Cuong, Hong, Thuoc, & Thu Hien, 2006). In many areas where a large number of

nesting turtles used to be found like the central coastal provinces such as Such as Quảng Trị, Quang Nam, Quảng Ngãi, Phú Yên, Khanh Hoa, Ninh Thuan, Binh Thuan and Ba Ria Vung Tau, there are rarely any sightings of turtles nesting nowadays, except in Ninh Thuan, Binh Thuan and Ba Ria – Vung Tau. Currently the only regularly found nesting turtles are green turtles. Nesting Leatherback turtles have also been found, but very irregularly. Nesting hawksbill turtles and Olive Ridley turtles have disappeared from all surveyed locations for the last 10 years (Cuong and Hien, 2021).

Table 14. Turtle species global and Vietnamese Red List status and trends.

Scientific name	Common name	Global Red list status	Current population trend	Viet Nam Red list status	Trend in nesting in Viet Nam[a]
Cheloniidae family					
Caretta caretta	Loggerhead turtle	VU[b]	Decreasing	CR[c]	Declining
Chelonia mydas	Green turtle	EN[d]	Decreasing	EN	Increasing in number of protected areas
Eretmochelys imbricata	Hawksbill turtle	CR	Decreasing	EN	Declining, no sightings
Lepidochelys olivacea	Olive Ridley	VU	Decreasing	EN	Declining, no Sightings
Dermochelyidae Family					
Dermochelys coriacea	Leatherback turtle	VU	Decreasing	CR	Declining, only 2 turtles sighted

[a] Comparison 2020 and 2010
[b] VU: Vulnerable
[c] CR: Critical
[d] EN: Endangered
Sources: IUCN Red List (2021) and Cuong and Hien (2021)

Pictures 10 and 11: Mother turtle heading back to the ocean after laying her eggs (IUCN Viet Nam/Hahn Candy) and Green turtle in Viet Nam (IUCN Viet Nam/Nguyen Hai Van).

5. Final remarks

The survey results showed that fishing gear is lost or discarded among gillnet and pots/traps fishers that participated in the survey. Furthermore, results illustrated an overlap between areas more used for fishing (both gillnets and pots/traps) and interactions with ALDFG. Although this causes an impact on fishing boats, with an estimated average cost of 0.56% of the revenue for gillnet fisheries and 0.6% for pots and traps (not considering the impact on lost revenue due to ghost fishing), according to the respondents, only few policies are in use to address the issue. In addition, most policies that are not used according to the respondents, are not considered to be effective. Increasing the understanding among fishers on how ALDFG affect their businesses as well as the marine environment may be a first step, together with a combined implementation of a series of regulatory and economic instruments, such as those presented in the CBA. Some policy options, such as recycling of fishing nets or the use of biodegradable fishnets depend on improving the development of markets for recycled materials and technological innovation to make these options more attractive.

The CBA showed that, with the data estimates used, gear marking and recovery, as well as a DRS can be profitable solutions. In the scenarios considered, the DRS is even more profitable than the current situation, reflecting the potential positive impact of reducing the impact of ALDFG on fisheries, as well as reduced losses due to ghost fishing. Although these costs could eventually become zero in a scenario where ALDFG are recovered, this intervention does have higher costs. This could be offset by improving the market for recycled fishing gear, which also has potential for additional benefits in a DRS.

This analysis is limited in scope and therefore does not include all relevant aspects. Although this small survey provides some evidence on ALDFG and estimates provided some insights into the costs and benefits related to several interventions, more data are needed to have a bigger understanding of the issue for the whole of Viet Nam. Better data on the occurrence and location of ALDFG will improve and inform policies, whereas more data on the costs and benefits Vietnamese fisheries face will facilitate assuring that interventions can also provide benefits, especially for small scale fisheries for whom fishing is the main or only source of income. The interventions do include further costs, for example for those who aim to implement them, and may have more complicated effects on the behaviour of fishers. This, however, was not assessed in this study. Finally, the data collection focussed on a very small number of fishers. This group may not be representative for the fishing sector in Viet Nam. A broader survey, including the use of sampling techniques, is needed to do an assessment of impact of ghost fishing and instruments to reduce it that is representative for the whole country. This case study is a step in this direction.

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Annex

MARPLASTICCs Viet Nam – Marine plastics and ALDFG survey

General information and ALDFG Gillnet fisheries: Phước Tỉnh fishing port

Part A: Administrative information

1. Name of the interviewer
2. Date of the interview
3. License type fishing vessel
4. Type of vessel:
    - Engine capacity - Horsepower (CV): …
    - Length (m): …
6. Number of crew members:
    - … crew members

Part B: Effort

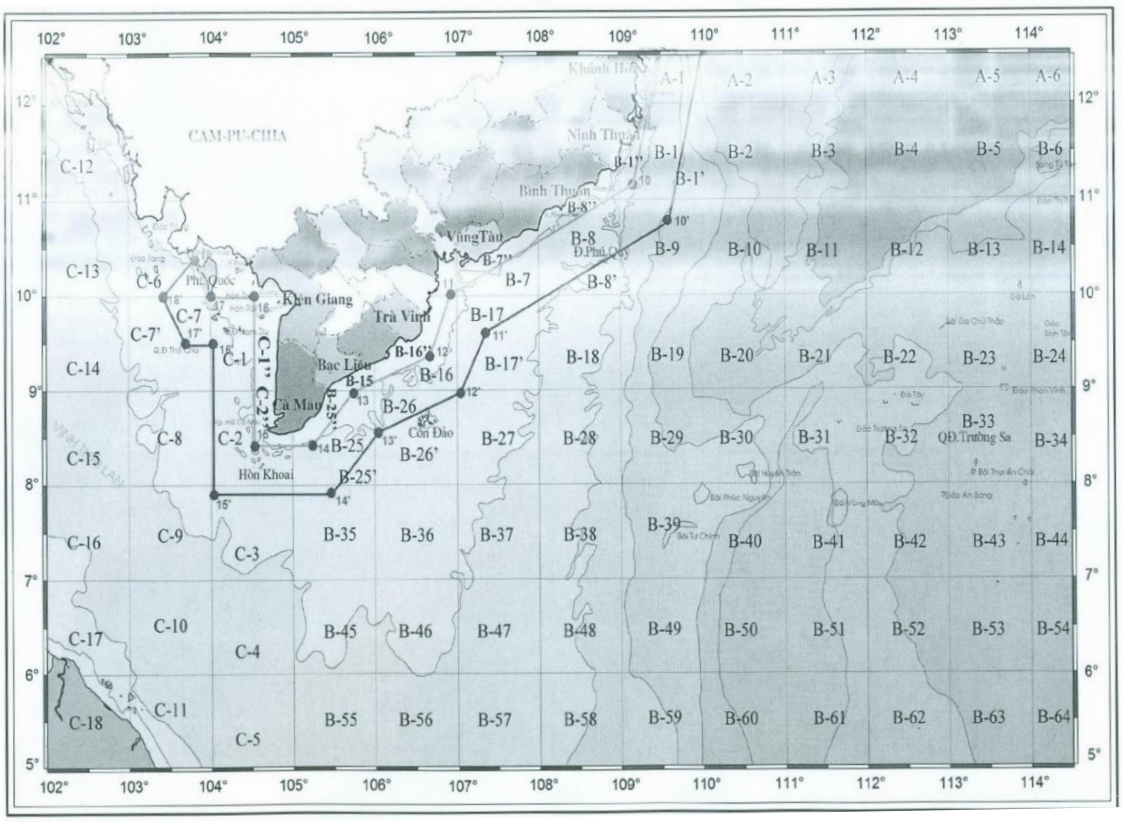
7. In 2019, how many fishing trips did you perform?
    a. …
8. In 2019, what was the average duration of a fishing trip in hours?
    a. …
9. In 2019, how many gillnets did you use in 2019?
    a. Gillnets: …
    b. Average length gillnet:….
    c. Average age gillnets:….
10. In 2019 what was your:
    a. Annual catch … (kg/tons)
    b. Average monthly catch … (kg/tons)
    c. Annual value of catch

Part C: Marine plastics

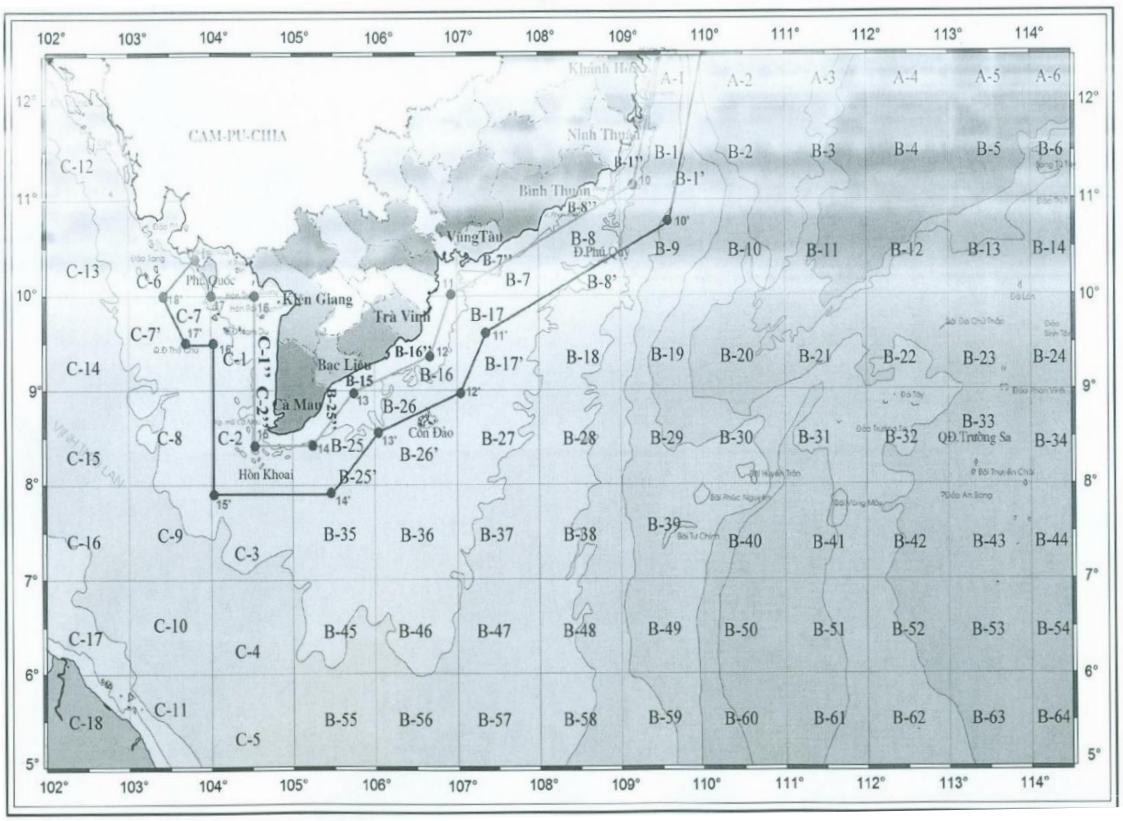
11. In 2019, what was the duration and cost of interaction with marine plastic?
    a. Do you know much Kg or % catch is plastic on average on each fishing trip?
        i. …(Kg or %)
    b. How much downtime and clean-up time to clean fishnets from marine plastic (minutes per fishing trip)
        i. …
    c. Cost of gear and other damage due to marine plastic (VND per year)
        i. …

Part D: Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG)

12. In 2019, where were the fishing grounds you used located?
    a. Cross boxes where fishing grounds are located



13. In 2019, did you encounter abandoned, lost or otherwise discarded fishing gear at sea?
    - Yes
    - No
    - Don't know
14. In 2019, where did you encounter abandoned, lost or discarded fishing gear?
    a. Cross boxes where ALDFG were encountered



15. In 2019, did you interact with ALDFG at sea?
    - Yes
    - No
    - Don't know
16. In 2019, what was the duration and cost of interaction with ALDFG?
    a. How much downtime and clean-up time due to interaction with ALDFG (minutes per fishing trip)
        i. …
    b. Cost of gear and other damage due to interaction with ALDFG (euros per year)
        i. …
17. In 2019, did you lose fishing gear yourself?
    - Yes
    - No
    - Don't know
18. In 2019, how many gear (gillnets) were lost?
    - Gillnets: …
19. In 2019, what were the causes of losing fishing gear, by proportion of occurrence?
    a. Conflict with other gear 0 - 100
    b. Conflict with seafloor 0 - 100
    c. Misplaced gear 0 - 100
    d. Weather 0 - 100
    e. Other (fill in) 0 – 100
20. In 2019, what were the causes of abandoning or discarding fishing gear, by proportion of occurrence?
    a. Illegal fishing or gear 0 - 100
    b. Too much gear for time 0 - 100
    c. Too much gear for space 0 - 100
    d. Chosen over onshore disposal 0 - 100
    e. Damaged gear 0 – 100
21. In 2019, did you abandon or discard fishing gear yourself?
    - Yes
    - No
    - Don't know

22. In 2019, how many gear (gillnets) were abandoned or discarded?
    a. Abandoned
        - Gillnets: …
    - Discarded
        - Gillnets: …
23. In 2019, what were the causes of losing fishing gear, by proportion of occurrence?
    a. Time or space constraints 0 - 100
    b. Chosen over onshore disposal 0 - 100
    c. Damaged gear 0 - 100
    d. Illegal fishing or gear 0 - 100
    e. Other (fill in) 0 – 100
24. In 2019, where did you abandon, lose or discard fishing gear yourself?
    a. Heat map of a Google Earth image around the port or shelter chosen in question 3
    b. See next page 3

Part E: Policies and management

25. Where do you get your information on fishery policies and regulations?
    - Government website
    - Fishers' organization
    - NGOs
    - Other
26. Do you know any policies or regulations in place concerning ALDFG?
    - Yes
    - No
    - Don't know
27. Which of the following measures to reduce ALDFG are being used? (yes, no, don't know)
    a. Gear marking to indicate ownership
    b. Gear modification to reduce loss
    c. Technical – transponders
    d. Technical – biodegradable gear
    e. Requirements to report loss
    f. Effort regulation (e.g. soak times)
    g. Spatial management regulation
    h. Fishermen education/training
    i. Port-side collection facilities
    j. Economic incentives (e.g. payment for old gear)
    k. Clean-up or recovery
    l. Recycling
28. How effective do you think the following measures could potentially be, or are, in preventing ALDFG? (very effective, quite effective, not effective)
    a. Gear marking to indicate ownership
    b. Gear modification to reduce loss
    c. Technical – transponders
    d. Technical – biodegradable gear
    e. Requirements to report loss
    f. Effort regulation (e.g. soak times)
    g. Spatial management regulation
    h. Fishermen education/training
    i. Port-side collection facilities
    j. Economic incentives (e.g. payment for old gear)
    k. Clean-up or recovery
    l. Recycling

Part F: Demographic

29. What is your year of birth?

a. …

30. Indicate the proportion of total household income from fishing
    a. 0 – 100
31. Are you member of a fishers' organization and/or cooperative?
    - Fisher's organization
    - Cooperative
    - Don't know

<u>Cost and benefits gillnet fisheries</u>: Phước Tỉnh fishing port

Part A: Administrative information

Part B: Costs and benefits

5. Yearly maintenance and repair costs to vessel, engines and machinery
    - …
6. Yearly fixed costs (insurance, legal, license renewal, …)
    - …
7. Yearly variable costs (fuel, lubricants, bait, …)
    - …
8. Yearly average costs of purchasing new engine(s), machinery and equipment
    - …
9. Average costs of a new piece of fishing gear
    - Gillnets …
10. How many fishing gear are owned per type
    - Gillnets …
11. Average lifetime of a piece of fishing gear (including maintenance and repair) in years
    - Gillnets …years
12. Yearly maintenance and repair costs of fishing gear
    - Average per gillnet …
    - Total annual repair costs ….

13. In 2019, what were the total quantities of fish landed by group of species (in kilograms)
    - Demersal …
    - Large pelagic …
    - Small pelagic …
    - Crustaceans …
    - Mollusks …
14. In 2019, what were the total earnings of fish landed by group of species (in Dong)
    - Demersal …
    - Large pelagic …
    - Small pelagic …
    - Crustaceans …
    - Mollusks …
15. In 2019, what were the destinations of landings by percentage
    - Self-consumption 0 – 100
    - Restaurants 0 – 100
    - Fishmonger 0 – 100
    - Auction 0 – 100
    - Processing industry 0 – 100
    - Final consumer 0 – 100
    - Other 0 – 100
16. In 2019, what was the total value of monetary subsidies you received
    - Investment subsidy
    - Operational subsidy

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