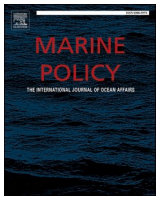
Marine Policy 187 (2026) 107063

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol



Economics of the Swedish small-scale Baltic fishery

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ARTICLE INFO

Keywords:
Small-scale fisheries
Baltic Sea
Herring
Diversification
Multiplier

ABSTRACT

Swedish small-scale fishing has undergone significant changes over time. There are examples of small-scale fishers who have diversified their activities by developing new sales channels or by processing a large part of their products themselves. However, this type of activity is significantly less well-documented than the fishing itself. In this paper, we examine how the catches of the Swedish small-scale Baltic fishery are used after landing, what economic values the sector generates, and what challenges the fishery sees to further develop its activities. The study is based on a survey of 379 small-scale commercial fishers along the Swedish Baltic Sea coast. We find that around 30 % of the fishers have income from sources other than fisheries or fisheries-related activities, and that approximately 70 % process at least part of their own catches. These activities also generate economic activity in other sectors, with regional multipliers ranging from 1.21 to 2.05. Regarding obstacles to company development, most small-scale fishers identify government management, including management of predator populations as well as the fishery itself, as the main obstacles rather than market access or the availability of labor and capital.

1. Introduction

Along the Swedish Baltic Sea coast, small-scale commercial fishing has a long tradition and plays an important role in maintaining cultural landscapes, active harbours, and regional food security [3]. However, the fishery has changed over time as it has had to adapt to the decline of commercially important fish stocks such as cod (*Gadus morhua*), European eel (*Anguilla anguilla*) and salmon (*Salmo salar*; [19]. The most recent species in focus is herring (*Clupea harengus*), as stocks along the Swedish coast have shown negative trends in both stock size and the size distribution of the fish over time [36]. Declining stocks and shifting distribution patterns have led to new regulations, reduced quotas, and fishing closures - which have all affected the conditions for conducting small-scale fishing.

The vulnerability of small-scale fisheries to external changes - both biological and others - is not unique to the Baltic Sea fisheries but similar features have been put forward from around the world [8]. In this paper, we apply a livelihood framework [2] with focus on diversification of household income when analyzing the economics of Swedish small-scale Baltic Sea fisheries. The livelihood framework focuses on the individual household's assets in the form of both physical, human, and social capital and how these interact with institutions such as fisheries management in order to determine the livelihood outcome. Fisheries is often one of many activities a household is engaged in, and diversification is an important strategy to gain a livelihood from both fishing and non-fishing activities [1]. Diversification enhances adaptive capacity and resilience to external shocks, and despite small-scale fisheries declining throughout Europe [24] the sector still employs approximately 60,000 fishers in the EU constituting over 50 % of total fishing workforce [33]. Thus, small-scale fisheries contribute significantly to local economies although the role is declining. Part of the sector's challenges may arise from management not being suited for artisanal fishing practices [2]. Examples from the Baltic Sea context are Lewin et al. [23] who point at Marine Spatial Planning not taking small-scale fisheries fully into account, and the growing population of grey seals (*Halichoerus grypus*) which is heavily debated due to interactions with fishing gears [34].

In this paper, we analyze the economics of the Swedish Baltic Sea small-scale fishery in three dimensions:

1. Diversification of income
2. Contribution to the regional economy
3. Small-scale fishers' views on issues constraining their future development

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https://doi.org/10.1016/j.marpol.2026.107063
Received 16 September 2025; Received in revised form 25 November 2025; Accepted 26 January 2026
Available online 30 January 2026

Diversifying fishing activities is a well-established way of reducing income variability in fisheries [20,21]. It is also a component in the Swedish action plan for developing the fishing sector [39] and financial support for diversification is available through the European Maritime, Fisheries, and Aquaculture Fund (EMFAF; [12]. Many Swedish fishers have already diversified their operations, for example by selling their products directly to final customers and/or process part of their products themselves [15]. However, diversification may take multiple forms. In this paper, we discuss three categories of diversification; Fishing for multiple species, development of fisheries-related activities within the company (e.g. processing) and activities outside the fishing industry.

Targeting multiple species is a traditional way of diversifying the fishing company following the natural seasons for different species. However, this strategy has become increasingly difficult over the years with stricter access regulations and declining fish stocks. In the Baltic, the cod fishery is prohibited [11], the fishery for European eel is heavily restricted [10], as is the fishery for salmon. Consequently, many fishers might need to look for other diversification options. With reduced quotas and increased diversification, the fisheries' contribution to regional economies is likely to change. The economic impact on different European fisheries regions has been estimated in, e.g., García-de-la-Fuente et al. [13] and Garza-Gil et al. [14] for different Spanish regions, Curtin and McCullough [6] for Ireland, and Hedetoft et al. [18] for Danish regions, but the impact on Swedish regions has not yet been analyzed. This paper contributes with an input-output analysis of the Swedish Baltic Sea small-scale fisheries' regional multipliers and its impact on the rest of the economy.

Turning to fishers' views on constraints affecting the future development of their companies, focus is on issues deemed important for small-scale fishers in the literature as well as in the specific Baltic Sea context. The latter includes the seal-fisheries interaction discussed above, fisheries regulations such as catch limits, gear restrictions, and access to fishing grounds. Following the livelihood framework, we further focus on how the fishers view issues on both human and physical capital as well as access to the market (see e.g. Prosperi et al. [28] for a discussion of business strategies among European small-scale fishers).

The paper contains the results from a survey conducted in 2024 and distributed to 379 Swedish small-scale fishers along the Baltic Sea coastline. Particular attention is given to the herring fisheries and the role it plays for the small-scale fishery. This is motivated by national discussions concerning reduced catches of coastal herring along the Swedish Baltic Sea coast. This has not only taken the form of a heated debate [35], but also governmental interventions in the form of closing areas to pelagic trawling [36].

2. The Swedish small-scale Baltic Sea fishery

The total landing volume for all species and all countries operating in the Baltic Sea is approximately 465 000 tons with a landing value of 163 million Euro. Landings primarily consist of herring and sprat (*Sprattus sprattus*). Sweden, together with Finland, is the second largest fishing nation after Poland in terms of both landed volume and value [33]. In 2022, the Swedish Baltic Sea fleet consisted of 651 vessels [30] of which a vast majority (585) was small-scale [33]. Notably, Swedish large-scale vessels primarily target herring and sprat using trawl, and the majority of catches are used for industrial purposes such as fish meal and fish oil. The small-scale fleet primarily uses passive gears such as gillnets to catch fish for human consumption. They target a broader range of species from herring to freshwater species such as perch (*Perca fluviatilis*) and pikeperch (*Sander lucioperca*). Smaller vessels are also used for trawling, e.g. for the valuable vendace (*Coregonus albula*) fishery in the Bothnian Bay. The fishing sectors' role at the national level is marginal from an economic point of view, and many fisheries-dependent communities have nearly disappeared [29]. According to the 2023 National Accounts [31], the "Fisheries and Aquaculture" sector accounted for approximately 0.01 % of Sweden's GDP. Still, the fishing sector is considered important and a plan for how to increase national landings for human consumption of herring and sprat has been developed [38].

Swedish commercial fishing in the Baltic Sea, including small-scale coastal fisheries, is regulated through a combination of European Union (EU), national, and regional rules. Under the Common Fisheries Policy (CFP), the EU determines Total Allowable Catches (TACs) and allocates national quotas for key species such as herring and salmon. These quotas are administrated at the national level by the Swedish Agency for Marine and Water Management, which also issues fishing licenses and special permits.

According to Swedish legislation (Fiskelag (1993:787) and Förordning om fisket, vattenbruket och fiskenäringen (1994:1716)), all professional fishers must hold a fishing license linked to a registered vessel in order to operate in the Baltic Sea. Certain species, fishing areas, and gear types - e.g. the coastal fishery for European eel - require special fishing permits, while most species are managed under general licensing rules. In addition, County Administrative Boards may adopt local regulations, including seasonal closures, gear restrictions, or protected areas, to conserve coastal fish stocks. Notably, herring is the only species where small- and large-scale fisheries interact. The latter is managed with Individual Transferable Quotas (ITQs), but the small-scale fishery is not. Fishing grounds for the small-scale and industrial fleets generally do not overlap, but the fleets utilize the same stocks. A share of the total national herring quota is allocated to the small-scale fishery where access is free for all licensed fishers [43]. Since 2025 trawling is prohibited within the Swedish territorial sea with the objective of evaluating the effects on herring stocks [36,37].

3. Method and definitions

Two methods are used in the paper. The first is a questionnaire sent to Swedish fishers in the Baltic Sea area, and the second is a regional input-output model used for analyzing the regional economic activity generated by the fishing industry.

3.1. Definitions

The regional analysis is performed based on the EU nomenclature of territorial units for statistics (NUTS) and using the NUTS2 regions which are developed for regional policies [9]. The Swedish Baltic Sea fishery takes place in seven different NUTS2 regions; Övre Norrland (Upper Norrland), Mellersta Norrland (Middle Norrland), Norra Mellansverige (North Middle Sweden), Östra Mellansverige (East Middle Sweden), Stockholm, Småland med öarna (Småland and the islands), and Sydsverige (South Sweden).

In this study, small-scale fisheries is defined as fishing carried out by licensed fishers with vessels less than 15 meters. Although a universally accepted definition of "small-scale fishing" is lacking, the term is generally employed to distinguish these activities from industrial and semi-industrial fisheries [13]. The EU definition of small-scale fishing includes vessels with a length of less than twelve meters and using passive gear. To better reflect the Swedish context, and to avoid excluding small-scale trawling for vendace, which is of particular importance in the Gulf of Bothnia, the northernmost part of the Baltic Sea, this study adopts a broader definition. This approach is consistent with the definition previously applied by the Swedish National Board of Fisheries [40] and is intended to include edge cases within the sector.

In Sweden, common gear types used in commercial marine fisheries include bottom trawls, pelagic trawls, purse seines, Danish seines, gillnets, hooks, pots/traps, and cages. These gears are generally classified as either passive or active. Passive gears—such as hooks, gillnets, and traps—remain stationary and rely on fish encountering them, whereas active gears—such as trawls and seines—are mobile and actively pursue fish within the water column [41].

3.2. Questionnaire

Data were collected using a questionnaire distributed to all fishers in Sweden who, in 2022, had registered a fishing vessel under 24 m[1] with home harbor in the Baltic Sea. The sampling frame was obtained with assistance from the Swedish Agency for Marine and Water Management, which maintains the official register of licensed fishers. In February 2024, the questionnaire was mailed in paper format to 379 identified fishers, accompanied by a cover letter containing a QR code linking to an online version of the survey. Participation was voluntary, and respondents were informed about the study's purpose, data confidentiality, and their right to withdraw at any time. Respondents could choose to complete the questionnaire digitally or return the paper version using the enclosed prepaid envelope. To improve the response rate, a reminder was sent six weeks after the initial mailing.

The questionnaire addressed the three topics analyzed (diversification, regional economy, obstacles for development). The unit of analysis in the questions was the fishing company as a whole, i.e. including both fisheries and other fishing related activities, and questions about the economic performance included not only fisheries but also the rest of the company. Consequently, the variables included differ from e.g. the STECF [32] report on fisheries economics for the EU. To facilitate accurate responses, the variables were selected based on information readily available from fishers' tax returns. The variables are revenues, labor costs, depreciation, interest, and "other costs". Since the management of the Baltic herring stocks is a major topic for discussion in the fishery, the respondents were asked to describe their activities in processing and sales separately for herring and for "other species", allowing a clearer assessment of the role of herring in small-scale fisheries.

3.3. Input-output analysis

The "Other costs" for various intermediate inputs can generate multiplier effects in the regional economy (NUTS2 regions). We estimate these multiplier effects using the Euregio model [42], a multiregional input-output-model which makes it possible to estimate the additional sales that the small-scale fishery generates in the sectors acting as its suppliers. Input-output analysis (see e.g. [25], whose approach we follow for both indirect and induced effects) estimates multiplier effects in a national or regional economy under the assumption that the economy in question is demand constrained, such that increased demand for intermediate inputs will generate increased sales for the fishery's suppliers and for the suppliers of those suppliers in turn. Using input-output analysis, indirect multiplier effects (through increased sales for suppliers) and induced multiplier effects (through increased income for the employees) can be estimated (see the Appendix for mathematical details) and the multiplier effects from an activity can also be divided by the activity's overall turnover to calculate its multipliers, the multiplier effects per Euro of spending.

It deserves to be noted, however, that this type of multiplier effect should not be seen as an end in itself. It is not necessarily a bad thing if a sector has small impacts on other firms in its vicinity. If suppliers outside the region are more efficient and can sell inputs more cheaply to the small-scale fisher, buying from those rather than from local suppliers improves the fisher's profitability and may be decisive for whether the fishing activity can continue at all. Integrating parts of the value chain within one's own firm will, almost by definition, reduce the multiplier effects outside the firm but can nonetheless be the best business strategy for that firm's survival.

In order to avoid placing an excessive workload on the fishers who responded to the survey, we did not ask for details on their "other costs" and instead assumed that these costs were distributed between different inputs in the same way as for Swedish fishing in general. The overall Swedish fishing sector includes large-scale fisheries that spend more on capital equipment and other manufactured goods than the small-scale fisheries do, so this is likely to overstate the importance of manufactured goods relative to e.g. fuel, and hence exaggerate the estimated multiplier effects somewhat. The regional multiplier effects are estimated for the entire NUTS2 region in which the fisher operates. Regional multiplier effects tend to become larger, the larger the studied region is, so including the entire NUTS2 region rather than only the municipality or the county in which the fisher is located leads to larger estimated multiplier effects than if only local effects were considered. We further assume that the "other costs" consist exclusively of purchases from suppliers within the region, although these suppliers may in turn purchase inputs from other parts of Sweden. This probably overestimates the importance for the regional economy further.

4. Response rate and background statistics

A total of 143 survey responses were received, representing a response rate of 38 %. Of these, a total of 25 survey responses were discarded because respondents indicated that they had not been active commercial fishers in 2022 (the year for which questions were asked). In addition, two of the respondents did not meet the criteria for small-scale fishing (because they each had at least one boat longer than 15 m) and were therefore excluded from the analysis to ensure that the sample accurately represented the population of interest.

Furthermore, the paper-based survey allowed respondents to skip questions, making partial responses common. For example, only 74 % of the survey respondents provided answers to questions regarding their fishing-related costs, which subsequently form the basis for the economic analysis.

The average age of the respondents is 67 years, and 95 % identify as male. Most respondents own only one fishing vessel (64 %), but 23 % own two, and about 13 % of respondents state that they own at least three vessels. Survey respondents mainly fish with passive gear (74 %), while 14 % fish with active gears and 12 % with a combination of both.

The representativeness of the sample was assessed by comparing the geographic characteristics of respondents with the corresponding characteristics of the full sampling frame obtained from the Swedish Agency for Marine and Water Management. This comparison indicated that the sample closely mirrored the population in terms of regional distribution. Furthermore, the demographic characteristics of respondents appear consistent with the findings reported by Björkvik et al. [3]. As shown in Fig. 1, most respondents reported that their primary fishing-related activities occurred in either Upper Norrland or Southern Sweden, with fewer active in other regions.

5. Diversification

As discussed in the introduction, fishing can be diversified by fishing for multiple species, by other fishing related activities, and by having income from activities outside the fishing sector. Regarding diversification outside the fishing sector, almost a third (32 %) of the respondents report combining their fishing-related activity with other sources of income. The most common sources of income are pensions and employment in forestry (Fig. 2).

For the diversification to other fishing-related activities, half of the respondents are engaged in processing and 44 % are engaged in fish trading/sales. Fewer are engaged in fishing tourism (3 % of respondents) or restaurant/café operations (9 %).

Notably, fishers' engagement in diversification is highly seasonal. Fishing itself is mainly carried out during the summer months, between May and September, as are other fishing-related activities. Employment outside fishing-related activities is mainly carried out between November and April, when little fishing takes place.

Turning to diversification across different species, it is clear that the

[1] Note that the 24-meter limit deviates from the limit of 15 m used for the empirical analysis.

Fig. 1. NUTS2 regions where the respondents' main activities were conducted in 2022. Number of respondents.

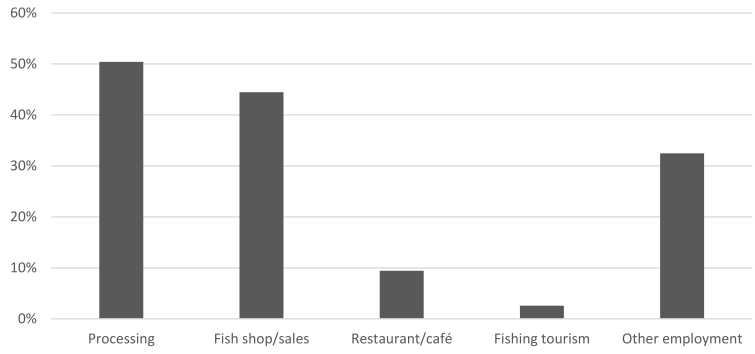

Fig. 2. Distribution of the respondents' other fishing-related activities.

fishery targets a wide range of species. As Fig. 3 shows, perch, followed by whitefish and salmon, are the species that the largest proportion of respondents reported fishing and/or processing. Note that this is not the same as these species being the most important since a species may be commonly caught but contribute only with a small share of total revenues. "Other species" in the figure include mackerel (*Scomber scombrus*), trout (*Salmo trutta*) and cod. It is worth noting that sprat, which is an important species for large-scale fisheries, is rarely caught by small-scale fishers, while many of the species caught in small-scale fisheries are not particularly important for large-scale fisheries.

What species are fished and/or processed varies across regions. Pike (*Esox lucius*), whitefish, and perch are fished in all the regions represented, while vendace is only fished by respondents who operate in Upper Norrland. On the other hand, it is mainly respondents who operate in the northern parts of the Baltic Sea proper who reported fishing and/or processing salmon and bream (*Abramis brama*). Eel and flatfish are frequently mentioned among fishers from South Sweden and Småland and the islands.

5.1. Diversification based on catches of herring

Fisheries and the diversification into other fishing-related activities follow the same seasonal pattern, and the fish species caught form the basis for activities such as processing and retail sales to final consumers. 36 % of the respondents had fished or processed herring in 2022. Together, they landed 169.8 tons of herring, corresponding to approximately 4 % of the total reported landing of herring on the Swedish Baltic coast in 2022 (i.e. including large-scale fishing; [30]. On average, each respondent who fished the species landed 4.7 tons of herring. The largest landings per respondent occurred in South Sweden with 29.8 tons, followed by North Middle Sweden with 7.0 tons.

Fig. 4 illustrates the proportion of respondents with herring catches who process their own herring or sell it to other parts of the value chain. 76 % of the fishers process at least part of their own catch, while 83 % sell at least a portion. Thus, many fishers both sell and process parts of their catches.

Among the 83 % who sell to other actors, the most common method is direct sales to private individuals at their own sales premises or through distance selling (69 %). Just over 25 % of respondents sold all or part of their catch directly to the processing industry for human consumption, and 14 % sold to wholesalers. A smaller proportion of respondents (6 %) stated that they sold part of the landed herring to the processing industry for the production of fishmeal or similar products. The open-ended responses indicate that a contributing reason for this is that there is limited local reception and processing capacity for fish for human consumption. However, this sales pattern differs depending on the region in which the fishing-related activity is conducted. For example, sales to restaurants have only been reported in Stockholm and in Småland and the islands.

76 % of respondents stated that they process some of the herring that they landed themselves. Of the respondents who process fish, the largest proportion (53 %) stated that they smoke the herring. 44 % of respondents stated that they skin and/or fillet, or can/preserve, the herring. From the open-ended answers, it appears that the decreasing size of the caught herring during recent years poses a problem during processing, as some fish may be so small that it becomes difficult to can or smoke it.

After the herring has been processed, 81 % of respondents who carrying out their own processing sell at least some of the fish directly to private individuals via distance selling or from their own shops. Furthermore, 25 % of the respondents who fish for herring and process it within the company serve it in their own restaurant/café.

5.2. Diversification based on catches of other species

90 % of the fishers also target species other than herring. Fig. 5 shows that for these species a somewhat lower share of the respondents use their catches for processing within their own company (69 % compared to 76 % for herring), while a somewhat larger share sell their catches to others (95 % compared to 83 %). However, it is still obvious from the high shares that many fishers both sell part of their catch and process part of it themselves.

53 % of fishers selling their catch to others sold directly to private individuals, 46 % to wholesalers, and 26 % to the processing industry for human consumption. A relatively small proportion of respondents (3 %) sold fish that was not used in their own operations to the processing industry for the production of, among other things, fishmeal, while 6 % of respondents sold the fish to grocery stores.

69 % of respondents stated that they used some of the fish caught in their own operations. The largest share of respondents who do this skin and/or fillet the fish. This is mainly done with fish such as perch, pike, pikeperch, and flatfish. Respondents who marked the option "other" mainly referred to preparing vendace roe. After the fish has been prepared, a majority of respondents (74 %) stated that they sell at least some of the catch directly to private individuals. Only 11 % of fishers who process their own catch use these species in their restaurants, which is a smaller proportion compared to those who use herring. In total, 7 % of all respondents serve other species in their own restaurants.

6. Contribution to the regional economy

In this section the fisheries' contribution to the regional economy is analyzed, both as employment opportunities within the sector and as a part of the local economy where fisheries affect also other sectors.

6.1. Employment

Respondents employed an average (mean) of four people per respondent in their fishing-related activities corresponding to an average of 1.2 full-time equivalents. This corresponds to approximately 0.3 full-time equivalents per employee and can be compared with fishing in Sweden as a whole, where each employee in 2021 worked on average the equivalent of 0.48 full-time equivalents [32], though it should be noted that this figure is for fishing only, while our estimate for small-scale operators also includes other fishing-related activities that the fisher engages in.

As Fig. 6 shows, both the average number of employees and the average number of full-time equivalents in the respondents' operations vary between regions. In Upper Norrland, the average number of employees was 7.3 per respondent and approximately 1.4 full-time equivalents. This suggests that a significant proportion of employees work part-time or in temporary positions. The average number of full-time equivalents working in the respondents' operations is highest for respondents operating in North Middle Sweden (2.5) and lowest for those operating in East Middle Sweden (0.4).

6.2. Revenues, costs, and value added

The average turnover in the companies was 100 thousand Euro.[2] The highest average turnover was observed in North Middle Sweden, where it amounted to 325 thousand Euro (Fig. 7). This result is partly driven by a single respondent who has been very successful diversifying and using their fish in a restaurant, but other respondents in this region also have high turnover. The lowest average turnovers are found among respondents in East Middle Sweden (27 thousand Euro).

Fig. 8 shows the average cost per respondent for each region, as well as the share that each cost item represents. Respondents operating in North Middle Sweden had the highest average costs (75 thousand Euro),

[2] All figures have been converted from SEK to Euros using the average exchange rate for the year 2022.1 SEK is approximately 0.09 Euro.

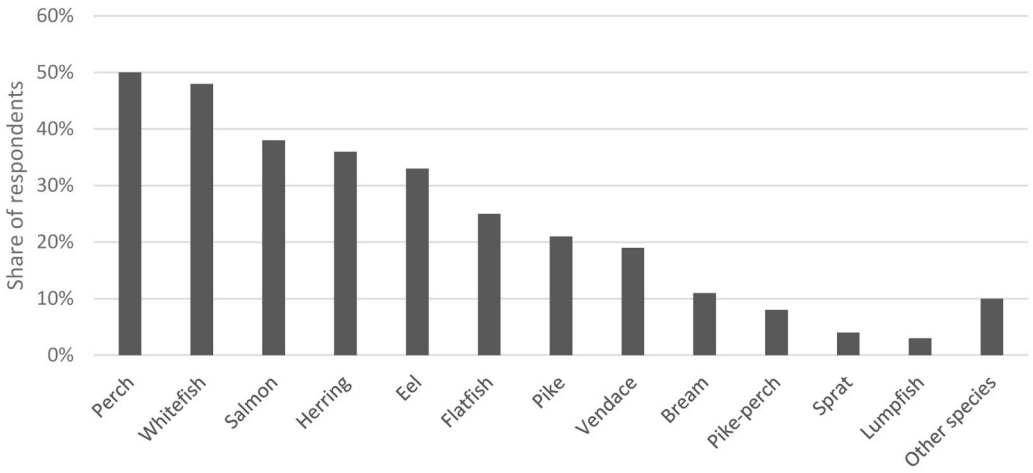

Fig. 3. Proportion of respondents engaged in fishing and/or processing various fish species[41]

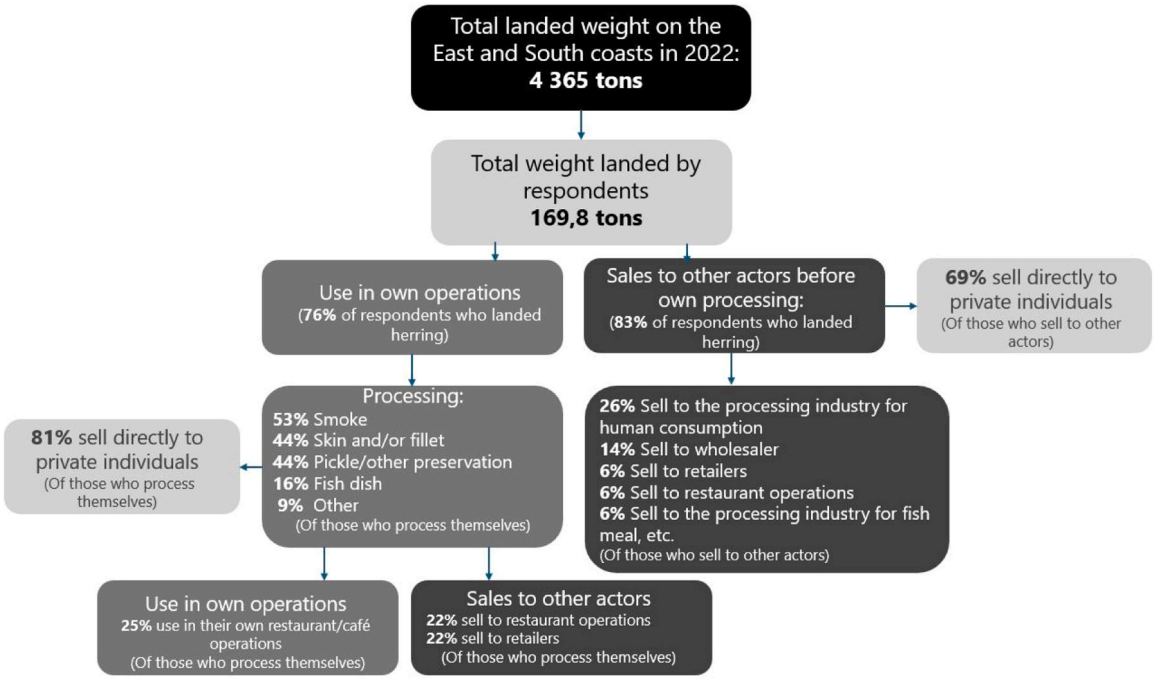

Fig. 4. Sales and further processing of herring. Since many respondents use their catches in multiple ways, the percentages usually do not sum to 100 %.

while the lowest average costs were noted for respondents in Stockholm (5 thousand Euro). The largest cost item in most regions was "Other costs", which refer to input goods such as raw materials and supplies that are necessary to produce the fish products.

To estimate the value added that respondents' fishing-related activities generated in 2022, these "Other costs" can be deducted from their total turnover. On average, respondents who answered these questions are estimated to have a value added of approximately 42.5 thousand Euro per respondent.

6.3. *Regional multipliers*

The regional multiplier effects are small, as shown in Fig. 9. This is largely due to the fact that small-scale fishers have low other costs, which is beneficial for their own competitiveness but at the same time means that they purchase relatively little from, and generate small effects for, their suppliers. The indirect and induced turnover effects that small-scale fishers generate in their own region vary from approximately 8 thousand Euro per fisher (for Stockholm where the other costs are lowest) to 68 thousand Euro per fisher (for Northern Central Sweden where they are highest). On average, the multiplier effect is approximately 23 thousand Euro in turnover per fisher compared to the average company turnover of 100 thousand Euro. The main regional economic effect thus comes from the fishing companies themselves and not from indirect or induced spillover effects.

The multiregional model used also allows us estimate indirect and induced turnover effects outside the fisher's own region, generated by suppliers' and employees' purchases of goods and services from the rest of Sweden. On average, these effects are 9 thousand Euro per fisher. These effects are also lowest for fishers in the Stockholm region (approximately 1 thousand Euro per fisher) and highest for fishers in North Central Sweden (approximately 25 thousand Euro). Respondents with operations in North Central Sweden were thus estimated to generate the largest indirect and induced turnover effects per fisher both in their own region and in Sweden as a whole.

If, instead of the *multiplier effect*, the total turnover effect that an

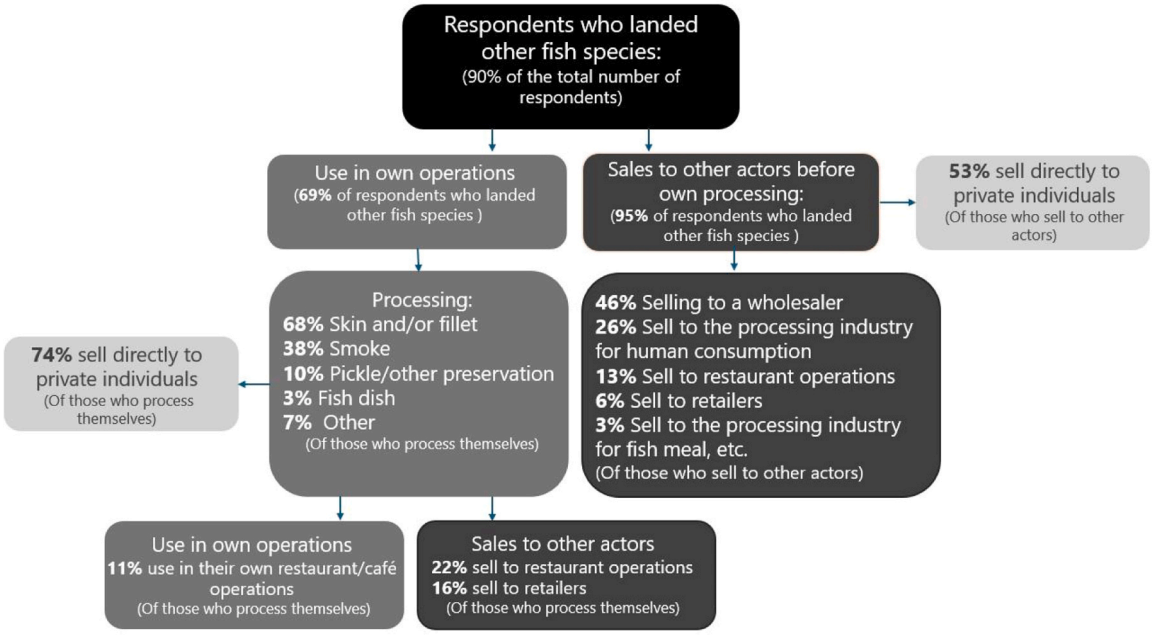

Fig. 5. Sale and further processing of fish species other than herring. Since many respondents use their catches in several different ways, the percentages usually do not sum to 100 %.

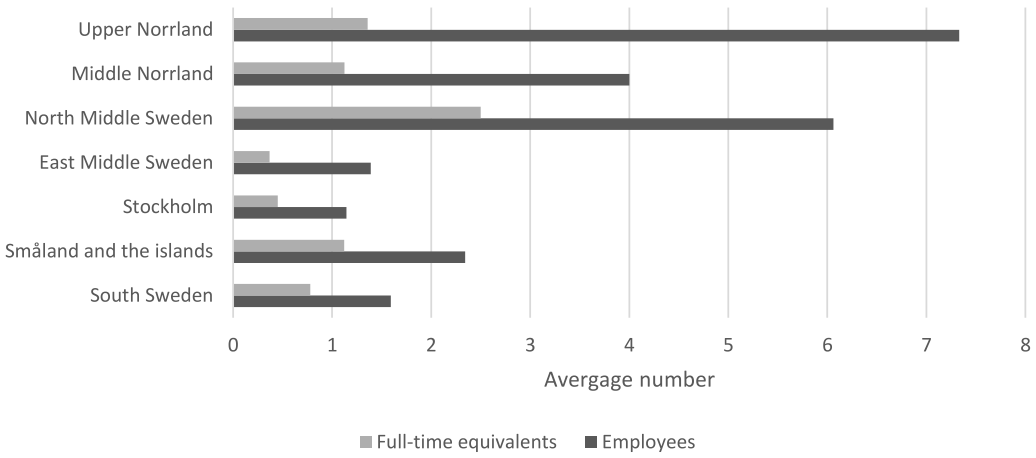

Fig. 6. Average number of employees and full-time equivalents by NUTS2 region.

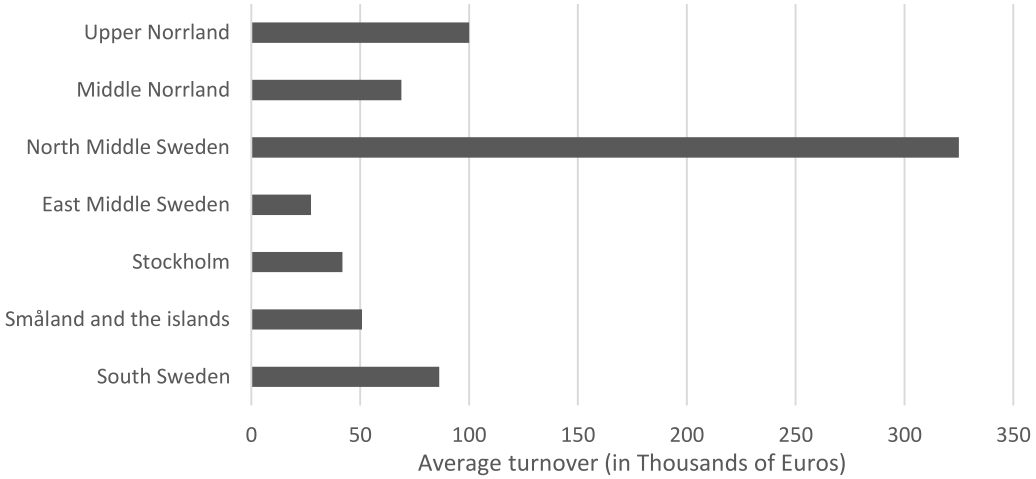

Fig. 7. Average turnover per respondent in 2022 by NUTS2 region.

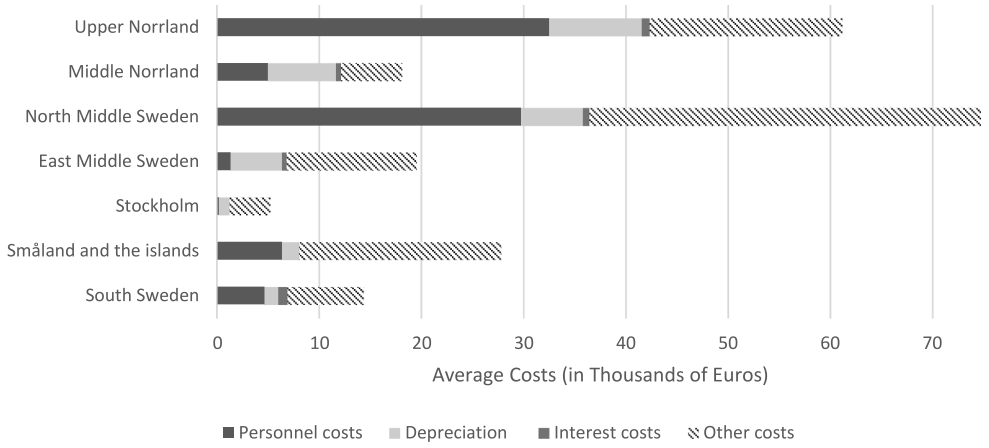

Fig. 8. Average cost per respondent for each NUTS2 region.

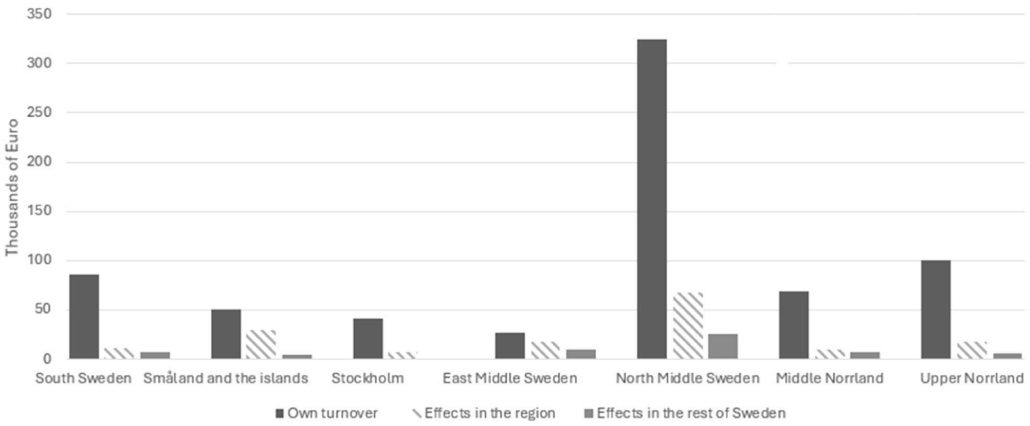

Fig. 9. The respondents' average direct turnover, as well as indirect and induced turnover effects in their own region and for Sweden as a whole.

average respondent generates, we study the *multiplier*, the turnover effect per Euro of own turnover, the picture is somewhat different (Fig. 10). The largest multiplier is found among fishers in East Middle Sweden who have a total multiplier of 2.05, followed by Småland and the islands who have a multiplier of 1.67. In these regions, the average own turnover per respondent is among the lowest. The smallest multiplier is found among fishers in South Sweden where the multiplier is 1.21. There, on the other hand, the average own turnover per respondent is one of the highest. There is thus no clear correlation between large turnover in the fishing company itself and large multipliers for the rest of the economy.

7. Threats to future development

Respondents were asked to evaluate the extent to which various obstacles might influence the development of their fishing-related activities over the next three years. This evaluation was conducted using a five-point Likert scale, where 1 represented "no impact" and 5 represented "very large impact". Fig. 11 displays these obstacles, ranked by the proportion of respondents who rated them as having a large or very large impact (scores of 4 or 5). It should be noted that these ratings reflect fishers' subjective perceptions rather than objectively measured effects on catch or income.

The seal and cormorant populations, which have increased in the Baltic in recent decades, are considered two major threats for development (94 and 84 % respectively). It is only among respondents whose main activities are in South Sweden that the seal population is considered to have little or no impact. For the cormorant population, respondents in South Sweden, Upper Norrland and North Middle Sweden consider it to have little or no impact.

Of the respondents who answered the question, 77 % and 67 %, respectively, believe that catch limits and gear restrictions have a large or very large impact on their future plans. Several respondents also mention bureaucracy and government actions as obstacles, which are included under "Other". "Other" also includes respondents mentioning growing populations of other predators such as heron or otter, marine wind parks, and competition from recreational fishing and large-scale trawling. Several respondents write that they feel that large-scale fishing is a contributing factor to the decline in coastal fishing as the large-scale trawlers deplete the sea of resources and that they benefit more from current management than small-scale fishing.

Obstacles that are not considered particularly significant, at least in relation to the other obstacles, are difficulty in reaching potential customers, lack of fishing waters, difficulty in obtaining loans for investments or lack of personnel with relevant education/experience. Instead, the main focus is on obstacles that are directly related to marine environmental management, including both the management of the fisheries themselves and the management of predators such as seals and cormorants.

8. Discussion

A key finding in the study is that many of the small-scale fishers have diversified their activities and integrated fishing into activities that also encompasses other parts of the value chain. In addition to fishing, the most important fishing-related activities of the small-scale fishers are

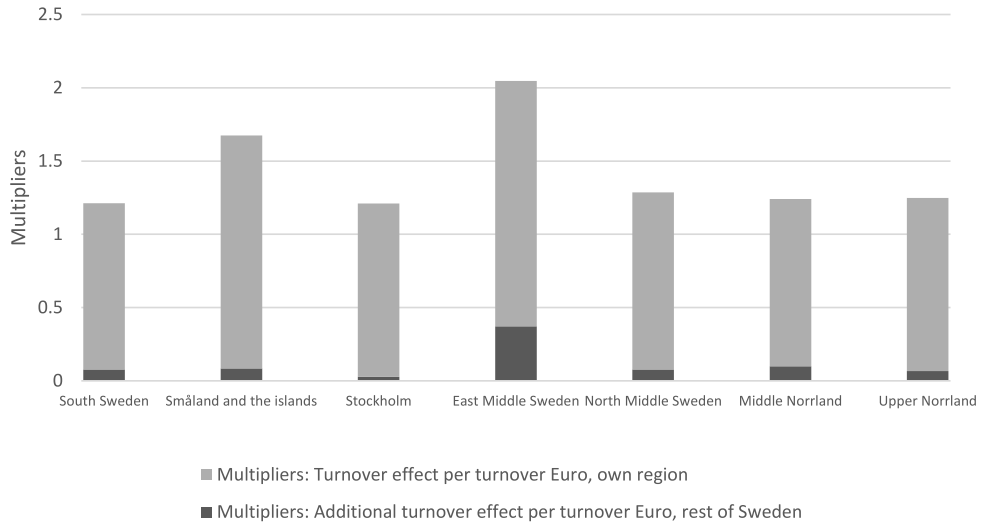

Fig. 10. Multipliers per NUTS2 region. Calculated by dividing the multiplier effects from Fig. 9 by the turnover in each region.

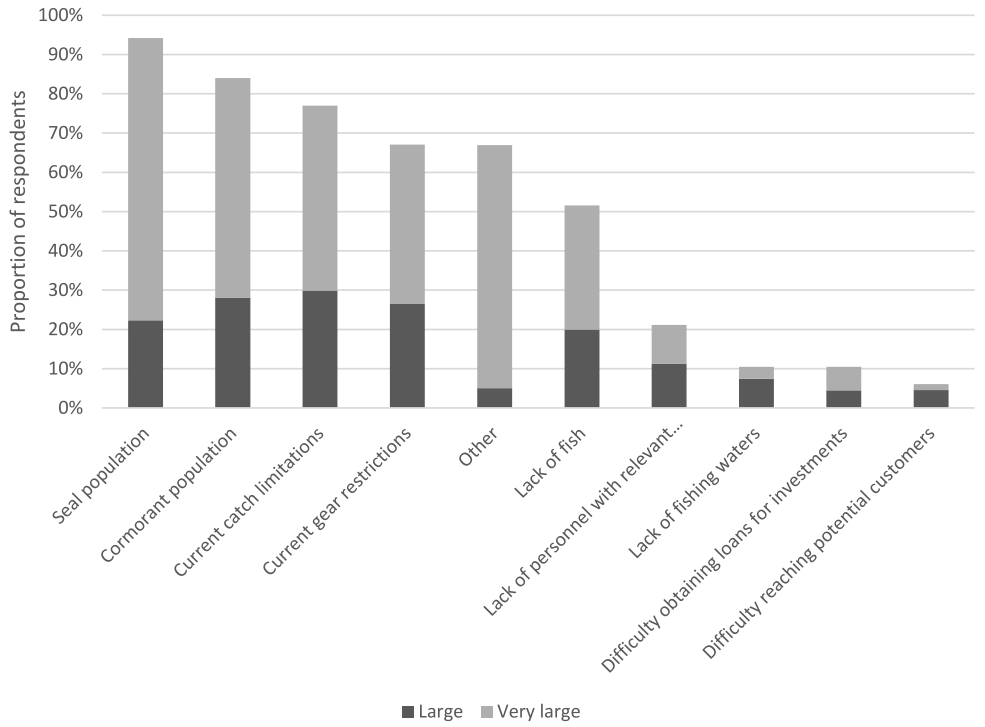

Fig. 11. Obstacles that respondents believe to have a large or very large impact on the development of their fishing-related activities within the next three years.

own fish processing and/or own fish sales directly to final consumers. Approximately one third of the fishers also have income from outside the fishing sector. While the survey data do not allow estimation of the precise share of income derived from fisheries, Nielsen et al. [26] show that Swedish small-scale fishers (operating in the Baltic Sea and other areas) generate 77 % of their earned income from fisheries, and 55 % of their total income (including e.g. pension). Allison and Ellis [2] argue that seasonal variations and the ability to switch to other activities are important for rural livelihoods, and our results indicate that diversification allows fishers to smoothen income streams over the year since at least some of the diversification is for non-fishing activities outside the fishing season. More stable income streams within the year align with the findings in Gokhale et al. [16] who show that Swedish fishers that diversify (including diversification within the household) have more stable incomes over the years. Dickey and och Theodossiou [7] find similar results for fisheries in Scotland.

Over 70 % of respondents who process fish in their own business report selling at least some of the processed fish directly to private consumers. This applies to both herring and other species. As Björkvik et al. [3] and Pita et al. [27] point out, direct sales can be an effective strategy for small-scale fishers as shortening supply chains may increase profits. Business models focused on local customers might not only generate economic value but also build social capital, which might contribute to the long-run economic sustainability [28]. Although the volume sold directly to private consumers might be small, the fact that many fishers process and sell fish shows that at least part of the Baltic Sea small-scale landings is processed within the fisher's own business. A short value chain means that a large part of the economic contribution of

small-scale fisheries to the local economy arises through the fishing company's own employment, turnover and value added.

The study shows that small-scale fishing generates relatively small indirect turnover effects in the regional economy, with the smallest multiplier estimated at 1.21. However, it is important to recognize that one reason for the limited spillover effects is that many small-scale fishers have successfully reduced their input costs. They have thereby been able to increase their own profitability, while simultaneously becoming less dependent on other companies. Small spillover effects should not necessarily be interpreted as something negative; rather, they reflect the ability of small-scale fishing companies adapting their operations. Notably, among fishers processing their own herring, about 25 % sell the product in their own restaurant or café. This is a very long value chain within the company, reaching all the way from catch to the dinner table.

Many respondents report experiencing “large” or “very large” obstacles to developing their business. Many of these obstacles fall directly or indirectly under the responsibility of the marine environmental authorities. For instance, a large majority (over 80 %) identify the seal and cormorant populations as major problems. These predators compete for the fish resource [17] and feed directly from the fishing gears [22]. Blomquist and Waldo [4] show that increased interactions with seals have historically caused small-scale fishers to exit the Baltic Sea cod fishery. Catch and gear restrictions, issues that also lie within the administration's mandate, are also indicated as major obstacles. In contrast, problems in reaching potential customers, as is put forward by e.g. Caldas et al. [5] for small-scale fisheries in developing countries, is not considered a major obstacle by Swedish small-scale fishers in the Baltic Sea. The survey also examines assets in the form of physical and human capital in the form of fishers’ views on difficulties in obtaining loans for investments and difficulties finding employees with relevant education or experience. Both these factors are ranked very low, indicating that they do not constitute major constraints for the sector.

Regarding obstacles and development opportunities, it is important to emphasize that the results reflect the industry's perspective. The survey provides insights into how fishers wish to develop their business and what obstacles they perceive. However, obstacles to development may exist for legitimate reasons; for example, catch and gear restrictions exist to protect ecosystems, which means that they may still be justified from a societal perspective even if they are perceived as constraints by the fishery. The findings from this study can nonetheless be useful to inform future management decisions that aim to facilitate well-functioning fisheries but also address other societal objectives.

Author statement

This manuscript is original, has not been published before and is not currently being considered for publication elsewhere. We confirm that the manuscript has been read and approved by all authors.

CRediT authorship contribution statement

Sara Andersson: Writing – original draft, Visualization, Investigation, Formal analysis, Data curation. **Staffan Waldo:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Jessica Lidberg:** Writing – original draft, Visualization, Investigation, Formal analysis, Data curation. **Jesper Stage:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Acknowledgements

Funding from the European Maritime- Fisheries and Aquaculture Fund, grant number 2023–1844, is greatly acknowledged.

Appendix[3]

If we have an economy with n different sectors, it will be the case for each sector i that its total revenue will consist of its sales of intermediate goods to each of the n different sectors in the economy together with its sales to what, in national accounting, is known as final demand; private consumption, public consumption, investment and net exports. The sum of all sectors’ sales revenue will be given by their sales of intermediate goods to each other plus GDP from the use side.

In the same way, for each sector i it will be the case that its total expenditure (if “expenditure” is taken to include profits retained within firms for future use) will be given by its purchases of intermediate goods from each of the n different sectors of the economy together with what, in national accounting, is defined as the value added, the sector’s factor costs for the factors used in production (labour, capital, and mixed income) as well as indirect taxes. The sum of all sectors’ expenditure will be given by their expenditure for intermediate goods from each other plus GDP from the income side.

For each sector its total expenditure will be equal to its total revenue, and GDP from the use side will be equal to GDP from the income side. If sector i’s sales to sector j are denoted as Z_{ij} and its sales to final demand as Y_i, we can write the sector’s total revenue X_i as

$$X_i = Z_{i1} + Z_{i2} + \cdots + Z_{in} + Y_i$$

In the same way, if we call the sector’s value added F_i, we can write its expenditure X_i as

$$X_i = Z_{1i} + Z_{2i} + \cdots + Z_{ni} + F_i$$

If we define the input output coefficient $a_{ij} = Z_{ij} / X_j$, the amount of sector i’s output needed to produce one unit of sector j’s output, we get $Z_{ij} = a_{ij}X_j$ and can write

$$X_i = Z_{i1} + Z_{i2} + \cdots + Z_{in} + Y_i = a_{i1}X_1 + a_{i2}X_2 + \cdots + a_{in}X_n + Y_i$$

The corresponding equations will apply to all sectors in the economy, so we will have an equation system

$$X_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n + Y_1$$

[3] The description in this Appendix closely mirrors that in Miller and Blair [25].

$$X_2 = a_{21}X_1 + a_{22}X_2 + \cdots + a_{2n}X_n + Y_2$$

…

$$X_3 = a_{n1}X_1 + a_{n2}X_2 + \cdots + a_{nn}X_n + Y_n$$

This can be written on matrix form as

$$\mathbf{X} = \mathbf{AX} + \mathbf{Y}$$

If we assume that all sectors use Leontief technology so that their input output coefficients a_{ij} are fixed, that each sector produces a homogeneous output or output mix, that each sector is demand constrained, and that the final demand **Y** is exogenous, this matrix equation will hold for any level of **Y**. We can then rewrite the equation as

$$\mathbf{X} - \mathbf{AX} = \mathbf{Y}$$

$$(\mathbf{I} - \mathbf{A})\mathbf{X} = \mathbf{Y}$$

$$\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{Y}$$

This equation will hold for any level of final demand, **Y**. If **Y** changes, **ΔY**, the overall effect on output in the economy will be given by

$$\Delta\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\Delta\mathbf{Y}$$

If **ΔY** is a small-scale fisher's sales in a specific region this equation shows the indirect multiplier effects **ΔX** that the fisher's business generates in the form of additional purchases of intermediate goods in the rest of the economy.

The fisher's business activities will also generate income for employees both within the fishing firm itself but also within its suppliers. This income will be spent on goods and services, some of which will be produced locally, and will generate additional effects on the local economy. It is therefore often of interest to also estimate the induced multiplier effects of an activity, including the effects on employee income and employee spending. Unlike the indirect effects, where there is widespread consensus on the approach outlined above, induced effects can be estimated in several ways which will lead to slightly different results. Here we follow the approach outlined in Miller and Blair [25], which is a straightforward extension of the indirect effects approach: the input output matrix is expanded slightly to also include payments to employees and private household consumption. The resulting, slightly larger, matrix is then used to estimate overall effects including the effects of increased household income and household spending. The additional assumption here is that households will spend additional income in the same way that they spend their current income.

Data availability

The authors do not have permission to share data.

References

[1] S. Aguilera, J. Cole, E. Finkbeiner, E. Le Cornu, N. BAn, M. Carr, J. Cinner, L. Crowder, S. Gelcich, C. Hicks, J. Kittinger, R. Martone, D. Malone, C. Pomeroy, R. Starr, S. Seram, R. Zuercher, K. Broad, Managing small-scale commercial fisheries for adaptive capacity: insights from dynamic social-ecological drivers of change in monterey bay, PLOS ONE (2015), https://doi.org/10.1371/journal.pone.0118992.

[2] E. Allison, F. Ellis, The livelihoods approach and management of small-scale fisheries, Mar. Policy 25 (2001) 377–388, https://doi.org/10.1016/j.marpol.2024.106423.

[3] E. Björkvik, W.J. Boonstra, J. Hentati-Sundberg, H. Österblom, Swedish small-scale fisheries in the Baltic Sea: Decline, diversity and development, in: J.J. Pascual-Fernández, C. Pita, M. Bavinck (Eds.), Small-scale fisheries in Europe: Status, resilience and governance, 23. ed, Springer International Publishing, 2020, pp. 559–579.

[4] J. Blomquist, S. Waldo, Seal interactions and exits from fisheries: insight from the Baltic Sea cod fishery (Online version), ICES J. Mar. Sci. (2021), https://doi.org/10.1093/icesjms/fsab173.

[5] J.P. Caldas, L. Jaramillo, A.F. Navia, Small-scale fisherfolk organizations: Do current condition facilitate their effective contribution to the value chain? Mar. Policy 171 (2025) 106423.

[6] R. Curtin, N. McCullough, The socioeconomic impact of the seafood sector at Ireland's main ports, Mar. Policy 152 (2023), https://doi.org/10.1016/j.marpol.2023.105627.

[7] H. Dickey, I. och Theodossiou, Who has two jobs and why? Evidence from rural coastal communities in west Scotland, Agric. Econ. 34 (2006) 291–301.

[8] A.C. Esteves Dias, D. Armitage, P. Kumar Nayak, et al., From vulnerability to viability: a situational analysis of small-scale fisheries in Asia and Africa, Mar. Policy 155 (2023) 105731, https://doi.org/10.1016/j.marpol.2023.105731.

[9] EU, Regulation (EC) no 1059/2003 of the European Parliament and of the council of 26 may 2003 on the establishment of a common classification of territorial units for statistics (NUTS), Off. J. Eur. Union L (2003) 154/1.

[10] EU, Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel, Off. J. Eur. Union. L 248 (2007) 17–23.

[11] EU, COMMISSION IMPLEMENTING REGULATION (EU) 2019/1248 of 22 July 2019 establishing measures to alleviate a serious threat to the conservation of the eastern Baltic cod (Gadus morhua) stock, Off. J. Eur. Union. L (2019), 195/2. 23.7.2019.

[12] EU, REGULATION (EU) 2021/1139 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 7 July 2021 establishing the European Maritime, Fisheries and Aquaculture Fund. Official Journal of the European Union L, 2021, p. 247/1, 13.7.2021.

[13] L. García-de-la-Fuente, E. Fernández-Vázquez, C. Ramos-Carvajal, A methodology for analyzing the impact of the artisanal fishing fleets on regional economies: an application for the case of Asturias (Spain), Mar. Policy 74 (2016) s. 165–176, https://doi.org/10.1016/j.marpol.2016.09.002.

[14] M.D. Garza-Gil, J.S. Regueiro, M.V. Lafuene, Using input-output methods to assess the effects of fishing and aquaculture on a regional economy: the case of Galicia, Spain (: s), Mar. Policy 85 (2017) 48–53, https://doi.org/10.1016/j.marpol.2017.08.003.

[15] M.B. Gillette, V. Vesterberg, Dead in the water? Sustainability and direct seafood sales in Sweden, J. Rural Stud. 89 (2022) 248–256, https://doi.org/10.1016/j.jrurstud.2021.12.004.

[16] S. Gokhale, J. Blomquist, M. Lindegren, A. Richter, S. Waldo, The role of non-fishing and partner incomes in managing fishers' economic risk, Mar. Resour. Econ. 39 (4) (2024), https://doi.org/10.1086/731762.

[17] S. Hansson, U. Bergstrom, E. Bonsdorff, T. Harkonen, N. Jepsen, L. Kautsky, K. Lundstrom, S.-G. Lunneryd, M. Ovegård, J. Salmi, D. Sendek, M. Vetemaa, Competition for the fish – fish extraction from the Baltic Sea by humans, aquatic mammals and birds, ICES (Int. Counc. Explor. Sea) J. Mar. Sci. 75 (3) (2018) 999–1008, https://doi.org/10.1093/icesjms/fsx207.

[18] A. Hedetoft, J. Lindahl, J. Lindahl, *Oplæg til Fiskerikommissionen* [The importance of the fishery for the regional economy. Report to the Fisheries commission]. Center for Regional and Tourism Research, Fisk. Reg. økonomiske betydning (2023).

[19] Helcom. (2023). State of the Baltic Sea 2023. Third HELCOM holistic assessment 2016-2021. Baltic Sea Environment Proceedings n°194.

[20] D. Holland, C. Speir, J. Agar, S. Crosson, G. DePiper, G. Kasperski, A. Kitts, L. Perruso, Impact of catch shares on diversification of fishers' income and risk, Proc. Natl. Acad. Sci. 114 (35) (2017) 9302–9307, https://doi.org/10.1073/pnas.1702382114.
[21] S. Kasperski, D. Holland, Income diversification and risk for fishermen, Proc. Natl. Acad. Sci. 110 (6) (2013) 2076–2081, https://doi.org/10.1073/pnas.1212278110.
[22] S. Königson, S.-G. Lunneryd, F. Sundqvist, H. Stridh, Grey seal predation in cod gillnet fisheries in the central Baltic Sea, J. Northwest Atl. Fish. Sci. 42 (2009) 41–47, https://doi.org/10.2960/J.v42.m654.
[23] W.-C. Lewin, F. Barz, M.S. Weltersbach, H. Strehlow, Trends in a European coastal fishery with a special focus on small-scale fishers - Implications for fisheries policies and management, Mar. Policy 155 (2023) 105680.
[24] J. Lloret, I. Cowx, H. Cabral, M. Castro, T. Font, J. Goncalves, A. Gordoa, E. Hoefnagel, S. Matic-Skoko, E. Mikkelsen, B. Morales-Nin, D. Moutopoulos, M. Muñoz, M. Neves dos Santos, P. Pintassilgo, C. Pita, K. Stergiou, V. Ünal, P. Veiga, K. Erzini, Small-scale coastal fisheries in European Seas are not what they were: ecological, social and economic changes, Mar. Policy 97 (2018) 176–186, https://doi.org/10.1016/j.marpol.2016.11.007.
[25] R.R. Miller, P.D. Blair. Input-Output Analysis: Foundations and Extensions, 3rd ed., Cambridge University Press, Cambridge, 2022.
[26] M. Nielsen, F. Asche, O. Bergesen, J. Blomquist, E. Henriksen, A. Hoff, R. Nielsen, J. Viðarsson, S. Waldo, The Myth of the Poor Fisher: Evidence from the Nordic countries, Mar. Policy 93 (2018) 186–194.
[27] C. Pita, J.J. Pascual-Fernández, M. Bavinck, Small-scale fisheries in, Eur. Chall. Oppor. Mare 23 S. (2020) 581–600.
[28] P. Prosperi, J. Kriwan, D. Maye, E. Tsakalou, G. Vlachos, F. Bartolini, D. Vergamini, G. Brunori, Adaptive business arrangements and the creation of social capital: towards small-scale fisheries resilience in different European geographical areas, Sociol. Rural. 62 (2021) 44–67, https://doi.org/10.1111/soru.12362.
[29] P. Salmi, S. Linke, N. Siegrist, K. Svels, A new hope for small-scale fisheries through local action groups? Comparing Finnish and Swedish experiences, Marit. Stud. 21 (3) (2022) 309–323.
[30] Statistics Sweden. (2023). Det yrkesmässiga fisket i havet 2022..
[31] Statistics Sweden. (2025). GDP: production approach (ESA2010), by industrial classification SNI 2007. Year 1980 - 2023. (Retriewed: 2025-11-06).
[32] STECF, in: R. Prellezo, E. Sabatella, J. Virtanen, M. Tardy Martorell, J. Guillen (Eds.), The 2023 Annual Economic Report on the EU Fishing Fleet (STECF 23-07) Annex, Publications Office ofthe European Union, Luxembourg, 2023, 2023, doi: 10.2760/423534, JRC135182. Scientific, Technical and Economic Committee for Fisheries.
[33] STECF, in: R. Prellezo, E.C. Sabatella, J. Virtanen, M. Tardy Martorell, J. Guillen (Eds.), The 2024 Annual Economic Report on the EU Fishing Fleet (STECF-24-03 & STECF-24-07), Publications Office of the European Union, Luxembourg, 2024. ⟨https://data.europa.eu/doi/10.2760/5037826⟩, 2024. Joint Research Centre, Scientific Technical and Economic Committee for Fisheries (STECF).
[34] K. Svels, P. Salmi, N. Coelho, V. Eriksson, S. Königson, E. Lehtonen, S.-G. Lunneryd, P. Suuronen, M. Vetemaa, Å. Waldo, Struggling towards co-existence of the Baltic Sea coastal fisheries and the grey seal, 24_1, Marit. Stud. (2025), https://doi.org/10.1007/s40152-024-00393-x.
[35] Svensk Fisknäring, Het debatt om strömmingen i Östersjön. ("Heated debate on the herring in the Baltic Sea"), Swedish 4 (2022) (2022) 8–10. ⟨https://issuu.com/billes/docs/svensk_fiskn_ring_nr_4_2022/8?utm_source=newsletter&utm_medium=email&utm_campaign=branschnyheter_fraan_svensk_fisknaering_november&utm_term=2022-11-07⟩ (Available at).
[36] Swedish Agency for Marine and Water Management. (2024). *Uppdrag att på prov genomföra fiskeriförvaltningsåtgärder som motsvarar en utflyttning av trålgränsen*.
[37] Swedish Agency for Marine and Water Management. 2025. *Havs- och vattenmyndighetens föreskrifter om förbud mot trålfiske efter pelagiska arter i del av centrala Östersjön innanför territorialhavets gräns*. HVMFS 2025:2. Havs- och vattenmyndighetens författningssamling.
[38] Swedish Board of Agriculture (2024). *Handlingsplan för mer mat av pelagisk fisk*. Jordbruksverkets rapport 2024:9.
[39] Swedish Board of Agriculture & Swedish Agency for Marine and Water Management. (2021). *Handlingsplan för utveckling av svenskt yrkesfiske 2021-2026*.
[40] Swedish National Board of Fisheries. (2010). *Småskaligt kustfiske [Small-scale coastal fishing]*. Report on behalf of the Ministry of Agriculture. Göteborg.
[41] The Swedish Rural Network. (2022). Aktuellt för fisk och fiske 2022. (landsbygdsnatverket.se). (Retriewed: 2024-09-17).
[42] Thissen, M., Lankhuizen, M., van Oort, F., Los, B. & Diodato, D. (2018). EUREGIO: The construction of a global IO database with regional detail for Europe for 2000–2010. *Tinbergen Institute Discussion Paper* 2018-084.
[43] S. Waldo, K. Berndt, C. Hammarlund, M. Lindegren, A. Nilsson, A. Persson, Swedish coastal herring fisheries in the wake of an ITQ system, Mar. Policy 38 (2013) 321–324.